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Understanding seasonal migration of Shishamo smelt in coastal regions using environmental DNA

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1. Introduction

Migratory animals have unique life history strategies and can link heterogeneous ecosystems across spaces. Thorough understanding of migration ecology of these organisms is essential for both species conservation and ecosystem management, although monitoring migration at fine spatiotemporal scales, especially in open marine systems, often requires huge costs and efforts. Shishamo smelt (*Spirinchus lanceolatus*) is an endemic migratory species to the Pacific coast of Hokkaido and characterized by anadromous migration between seawater and freshwater. While the seawater migration corresponds to the growth phase, habitat use of *S. lanceolatus* in this phase is almost unknown. Over the last decade, scientists developed environmental DNA (eDNA) techniques that enabled us to carry out large-scale surveys with a relatively small amount of effort and to trace species distribution and habitat changes. Here, I conducted an eDNA survey in coastal regions for understanding the seawater migration of *S. lanceolatus*.

2. Materials & Methods

Seawater samplings were carried out 14 times in seven sites along the Pacific coast of Hokkaido from March to August 2019, then I examined 1) seasonal changes of eDNA concentrations and 2) environmental factors driving the seawater migration of *S. lanceolatus* using generalized linear mixed models (GLMMs). Extracted eDNA was quantified by real-time PCR with specific primers and probe for *S. lanceolatus* DNA. Four environmental factors (seawater temperature, salinity, chlorophyll-a concentration and tidal height) were collected and used as explanatory variables in GLMMs.

3. Results & Discussion

Spatiotemporal eDNA concentrations along a coastline represented seasonal variation, suggesting that this species shifts its habitat moving out from nearshore between spring and summer. I also found a significantly negative correlation between eDNA concentration and seawater temperature based on the statistical analyses with GLMM. The latter result indicates that *S. lanceolatus* changes their habitat in summer presumably due to the increased seawater temperature in nearshore areas.

4. Conclusion & Future direction

This study revealed seasonal habitat changes and a trigger for the migration in the growth phase of *S. lanceolatus*. Given that this endemic species has quite limited distribution and migrates depending on seawater temperature, the results also indicate that habitat loss of this species in the growth phase is of realistic risk if the current trend of global warming continues. For the long-term conservation of *S. lanceolatus* and other migratory species, thorough understanding of migration ecologies and detailed evaluations for potential impacts of climate change on them are urgently required.