



HOKKAIDO UNIVERSITY

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学 位 論 文 内 容 の 要 旨

博士（環境科学）

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学 位 論 文 題 名

Multidimensional assessment of structural dynamics in native fish assemblages in
lentic habitats and identification of potential conservation areas

（止水域における在来魚類群集構造動態の多面的解析および潜在的保全地域の特定）

Global biodiversity in freshwater ecosystems is declining rapidly, with freshwater fish species facing extinction at concerning rates. Despite substantial investments in conservation efforts, these have largely not met their goals. A potential cause for this shortfall is the overemphasis on taxonomic changes in fish species, overlooking their evolutionary histories and ecological functions. This dissertation examines the spatial and temporal diversity patterns of freshwater fish in Japan, using a multifaceted approach combining taxonomic, phylogenetic, and functional diversity metrics. Specifically, this study analyzes native fish assemblages in 39 lakes across the Japanese archipelago and 28 oxbow lakes along the Ishikari River in Hokkaido. Additionally, this research proposes a computational framework for a cumulative diversity index that integrates multifaceted diversity measures into a concise metric for easier application by conservationists. Temporal multifaceted diversity analysis indicates a nationwide continuation of native fish species loss, especially among endemic species, leading to increased homogenization of fish compositions. Such native loss and homogenization in three perspectives, i.e., taxonomic, phylogenetic, and functional, are all expected to be continued in the future if the endangered species remain unprotected. Meanwhile, although the native fish in the Ishikari oxbow lakes have maintained their richness over the studied decade, this study revealed a significant loss of native functions as well as the phylogenetic and functional redundancy due to severe competition with invasive species. Moreover, national spatial multifaceted diversity analysis reveals a correlation between fish assemblage cumulative diversity and lake location, with the northernmost (Hokkaido) and southernmost (Kyushu) islands exhibiting low native fish richness but high uniqueness, marking them as high-priority conservation areas. Regionally, in the Ishikari River basin, the upper oxbow lakes host a greater richness and lesser impact from non-native expansion, thereby have greater potential as fish shelters. Additionally, this research shows that spatial patterns primarily influenced by dispersal constraints are hard to shift along the time, while that spatial patterns mainly shaped by ecological competition are alterable. To summarize, this study deepened the understanding of the structural dynamic processes of native fish communities inhabiting the lentic habitats in Japan from taxonomic, phylogenetic and functional perspectives. Also, this study validates the applicability of the proposed cumulative diversity index and evaluation framework in pinpointing potential native fish conservation areas.