



## Environmental DNA metabarcoding reveals a decline of fish diversity from 2019 to 2023 in Dongshan Bay, China

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### ABSTRACT

The ecosystem of Dongshan Bay (DSB) is significantly impacted by aquaculture activities. However, due to a lack of effective tools for monitoring and assessing fish diversity, information on the spatial and temporal changes in fish communities within the bay remains limited. To better understand how human activities influence the bay ecosystem, it is essential to clarify the patterns of community changes under disturbance. This study integrated environmental DNA (eDNA) metabarcoding with fish traits to analyze the spatiotemporal patterns of fish communities responses to anthropogenic disturbances and to assess the stability of fish communities, thereby addressing the gaps in traditional monitoring methods regarding the multidimensional analysis of fish communities in DSB. We demonstrated a match between taxonomic diversity and functional diversity. Over time, anthropogenic disturbances contributed to a significant decline in both taxonomic and functional diversity, particularly in aquaculture areas. Dissolved nitrogen salts played a significant role in the changes in taxonomic diversity in aquaculture areas, leading to increased homogenization of fish functional traits and intensifying resource competition. This competition for limited resources further contributed to the decline of high-trophic level species in fish communities assembly. The reduced species richness in aquaculture areas led to lower functional redundancy, weakening the communities to buffer anthropogenic disturbances, ultimately making the communities more unstable and sensitive to external disturbances. Overall, the patterns of communities changes observed under disturbance were primarily driven by shifts in species richness and variations of trophic level in communities assembly. This study demonstrated the feasibility of utilizing eDNA technology to reveal multidimensional fish diversity changes, offering new insights into understanding communities stability. The findings provided scientific evidence for the conservation of fish diversity in DSB and offer important theoretical support for the sustainable management of fisheries resources and the protection of coastal ecosystem.

### 1. Introduction

The bay is a highly productive area that plays a key role in maintaining biodiversity and ecological balance (Kennish, 2002). The relatively enclosed environment and abundant food resources are conducive to the spawning of fish, as well as the growth and survival of larvae and juveniles, providing crucial habitats and breeding grounds for fish (Able, 2005). However, aquaculture activities may lead to changes in the

taxonomic structure of wild fish communities and result in functional impoverishment, thereby affecting the biological composition and ecosystem services of aquatic communities. Therefore, long-term temporal assessments are crucial for gaining a deeper understanding of the impacts of aquaculture on fish communities (Parra et al., 2018).

Monitoring these impacts presents challenges, as traditional methods often struggle to capture the full extent of biodiversity changes. Traditional monitoring methods, such as bottom trawling, are invasive, time-

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