Assembly rule and its spatial-scale dependency of benthic macrofaunal communities at the broadest tidal flat (Arao tidal flat) of Ariake sea, Japan

*Yamada Katsumasa[1], Kitaguchi Kouyou[2], Henmi Yasuhisa[1]

1. Kumamoto University, CWMD, Aitsu Marine Station, 2. Kumamoto University, Graduate School of Science and Technology

Recently, the synchronous decline in both coastal biodiversity and fishery resources (e.g., clam catches) has been remarkable in Japan. Although a few theoretical studies rogued direct or indirect relationships between the decline of coastal biodiversity and fishery resources, the concrete ecological process between coastal biodiversity (e.g., number of species and species composition) and fisheries resource management is still vague.
In this study, assembly rule and its spatial-scale dependency of benthic macrofaunal communities were evaluated at the broadest tidal flat (Arao tidal flat) of Ariake sea, Japan. Furthermore, contribution and/or attribution coastal biodiversity (assembly rule) to clam catch (the process by which the assembly rules lead to clam catch) are discussed based on the relationship of the spatial distribution pattern between assembly rule and the clam catches.
Benthic macrofauna was collected semi-quantitatively at random selected ca. 300 sites of Arao tidal flat (1600 ha) in the spring and summer of 2018-2020, and individuals were sorted and counted. From the obtained species and number of individuals, we evaluated the spatial variation pattern of the assembly rules (nestdness, turnover, differences, etc.) of the benthic communities in the tidal flat ecosystem and its spatial dependence. Furthermore, functional diversity (FRic) was calculated based on the various traits and functions in each species, and its spatial dependence was also evaluated.
Spatial dependence was not detected in the assembly rule of the benthic communities, i.e., species replacement (turnover) occurred frequently in every spatial scale. On the other hand, nested community structure (nestedness) was fragmentally shown at the local scale (i.e., narrow area). The relationship between the spatial pattern of the assembly rule and the abundance of the clam (fisheries catch) suggested that forming the nested community structure may contribute to the abundance of the clam (fisheries catch). The spatial distribution of functional diversity (FRic) showed partly as spatial autocorrelation, but the spatial pattern was explained as random distribution.
The clam catch is higher in the southern part of Arao tidal flat than in the northern part. In the south, sandbar pools are formed commonly, and nestedness by shellfish and polychaete species were shown. On the other hand, in the northern part of the Arao tidal flat where the clam catch is low, species replacement (turnover) may occur due to species interactions (i.e., competition and exclusion) by niche construction species (biological disturbance; niche construction; keystone species), such as mud shrimp. The decline in both tidal flat ecosystems (biodiversity and resources) may be due to the synergistic effects of both the abiotic environment and biotic interactions.

Keywords: Tidal flat ecosystem, Assembly role, macrofauna, spatial scale

