The effects of bioturbation by the Japanese mud shrimp *Upogebia major* on macrobenthic community structure

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Key Words : *Bioturbation, Community structure, Macrobenthos,* Upogebia major, Ruditapes philippinarum

Abstract

Bioturbation is a particle transport mechanism wherein animals directly or indirectly affect sediment matrices. Bioturbation by the macrobenthos has particularly large effects in sedimentary environments. Ghost shrimps (Callianassidae) and lugworms (Arenicolidae) are considered destabilizers because they make sediments more unstable by feeding at depth and transporting wastes to the sediment surface. Mud shrimps (Upogebiidae), however, may function as stabilizers because their mucous secretion glues sediment particles together as they excavate very deep burrows, transferring sediments from depth to the surface. The mud shrimp *Upogebia major* dominates locally on the Arao tidal flat in Kumamoto Prefecture, Japan. We aimed to determine the impacts of bioturbation by this mud shrimp on other benthic animals (e.g., the Japanese littleneck clam *Ruditapes philippinarum*). We set two transect lines seaward from the shore and quantitatively collected benthic animals on each line at 100- or 200-m intervals (20 sites) after washing sediment samples through a 1-mm-mesh sieve. We simultaneously collected environmental data (elevation above/below sea level, sediment hardness, and silt–clay content) at each sampling point to explore their effects on macrobenthic community structure. *U. major* was dominant in upper shore sites, and *R. philippinarum* in lower sites on both lines. Multi-dimensional scaling (MDS) ordination identified two groups of sites clustered at 55% similarity. One group comprised upper shore, and the second comprised lower shore sites. Three species made the greatest contributions to the dissimilarity between groups (37.5% collectively): Asian mussel *Arcuatula senhousia* (15.0%), *R. philippinarum* (13.3%), and *U. major* (9.2%). The Asian mussel was abundant at the lower sites. An analysis to identify the subset of environmental variables most strongly rank correlated with community dissimilarities (BIOENV) was performed. Elevation and sediment hardness were the environmental factors most closely correlated with community composition (BIOENV correlation 0.679). Thus, (1) the distribution of *U. major* was likely restricted by elevation, and (2) species composition was affected by the presence/absence of *U. major* bioturbation.