sediments for constructing an artificial tidal flat.
The purpose of this study was to evaluate the environmental conditions of the constructed tidal flat over two years after it was built. We monitored the biological characteristics (restoration of macrobenthos and growth of bivalve) and physico-chemical parameters (oxidation-reduction potential, acid volatile sulphide, loss on ignition, water content, total organic carbon, total nitrogen, chlorophyll a, and particle size) for five types of constructed tidal flats and a natural tidal flat. At the same tidal situation, the physico-chemical parameters were almost similar among the five constructed and natural tidal flats. However, the biomass and macrobenthic population in the constructed flats was higher compared to the natural one. Moreover, it was observed that the results for the young short-necked clam indicated remarkably larger growth in the artificial tidal flat relative to that obtained in the natural one. From this result, it was supported that the muddy solidified sea bottom sediments were very effective for the excellent growth of the young clams. These observations may be considered to be attributable to the minerals which were supplied from the solidified sea bottom sediments. These solidified materials would give the good ecological conditions to benthic animals. The muddy dredged sediments generated by the HBS could provide useful materials for enhancing the productivity of the tidal coast in order to create new environment.
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Isotopic evidence of seasonal variation in feeding niche of river and brackish gastropods

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Dynamics of organism's feeding niche in response to environmental changes is of fundamental importance for understanding determinants of community structures and diversity. Feeding niche can be examined by stable isotope analysis. At a downstream bank of Yura River, Kyoto, Japan, feeding habit of three common gastropods and their possible food were studied using ^{13}Carbon and ^{15}Nitrogen stable isotopes. Anadromous gastropod *Clithon retropictus* depended mostly on benthic microalgae and marine POM as source of nutrition. It utilized about 65% benthic microalgae in spring and slightly decreased to 62% in summer while marine POM in its diet increased from 25% in spring to 30% in summer. Marine water enters Yura estuary and intrudes midstream from spring to summer, making oceanic phytoplankton available as part of the diet of *C. retropictus*. *Cipangopaludina japonica* and *Semisulcospira libertina* which are both freshwater gastropods change diet from spring to summer. In spring, *C. japonica* consumed about 67% from organic matter of the sediment but shifts its diet to river POM (68%) in summer. A wider food spectrum is consumed by *S. libertina* in spring; about 27% river POM, 25% sediment POM, 24% estuary POM and 16% microalgae. In summer, it shifts its diet to mostly river POM (71%).
To understand the dynamics of feeding niches of the three river gastropods, we measured and analyzed stable Carbon isotope trends of the five possible food items in the study site. Stable isotope ^{13}C of microalgae had enriched greatly from spring to summer, from -25% to -17% which indicated the presence of marine-origin epiphyton. The same trend was observed in sediment POM which increased from -26% to -22%. River POM showed the opposite trend, ^{13}C decreased from -24% to -27% from spring to summer which indicated more influence of terrestrial-origin materials in the river freshwater during summer. Marine and estuarine POM showed relatively constant ^{13}C values in the two seasons (-22% and -24% respectively).
C. retropictus utilized marine POM aside from benthic microalgae. Although marine-origin materials are more available in summer due to marine water intrusion, *C. japonica* and *S. libertina* still selected terrestrial-origin materials either from river POM or sediment POM. Shift, expansion and overlapping of feeding niches were thought to be responses to food availability, competition and water dynamics in the estuary. River discharge and movement of marine water into the river may play an important role in the temporal change of feeding niches of the gastropod populations. This has implication on the diversity and management of river and estuary systems.

Evaluation of restoration effect in the coastal unused reclaimed area by promoting sea water exchange in Ago Bay, Mie Prefecture, Japan

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Ago Bay is located in Ise-Shima National Park, Mie prefecture, Central Japan. This bay is famous for cradle of the pearl culture and it has been continued for more than 100 years. However, harmful algal blooms and infectious diseases make the pearl oyster culture for whole year difficult. Furthermore, sediment eutrophication and frequent occurrence of oxygen-deficient water has caused the deterioration of benthic ecosystem and decrease of biological productivity in recent years. It is considered that one of the major causes of these phenomena is stagnation of the material circulation by reclamation of shallow coastal area including a tidal flat, sea glass and sea weed beds. The reclaimed coastal areas were made clear by the multi-spectrum aerial picture analysis. In detail, more than 50 years ago approximately 70% of tidal flats and shallow area were reclaimed for constructing rice fields in Ago Bay. But now these reclaimed areas are given up cultivation and changing the unused wetland. Therefore, for environmental restoration of Ago Bay, it is necessary to enhance the biological productivity and natural purification capacity which these areas provided, and to recover a smooth material circulation around the shallow area. Then in this study, attempts were made to enhance the biological productivity, by promoting water exchange between unused reclaimed area and outer sea using pumps, pipeline system was set up in an experimental reclaimed wetland. Improvements were evaluated by monitoring sediment quality, benthic abundance and species diversity every season.

1) Present state in unused reclaimed area

The total reclaimed areas are about 185 ha, however almost of these areas were given up cultivation and changed hypertrophic unused wetland in Ago Bay. Such areas add up to about 153 ha. The sediment of unused wetlands are too muddy and contain high organic matter, because the dykes which were constructing for reclamation, lead to accumulation of the nutrient and organic matter run off from the land. In these wetlands, the abundance and diversity of benthos are quite poor.

2) Seasonal changes of the sediment quality, abundance and species diversity of benthos in experimental field by promoting the water exchange

The sediment samples from experimental field with promoting water exchange and natural tidal flat in front of the reclaimed areas were measured for COD, TOC, TN, IL, AVS, particle size, chl.a and benthic abundance and species were counted every season for 2 years. Now these monitoring are continuing. Before water exchange, sediment was hypertrophic and anaerobic state. *Capitella sp.* and *Chironomidae* were dominant species, because wetland was brackish. And more both wet weight and diversity were quite small. After water exchange, the macrobenthos were changed from brackish to sea water. The diversity and wet weight were gradually increased and after two years they became same level of the natural tidal flat in front of the reclaimed area. The COD and AVS in sediment were decreased too. These results indicate that the sediment statuses in wetland were gradually changed to the aerobic condition by promoting the decomposition of the hypertrophic sediment under the water exchange. Continuous water exchange would provide enhancement of the biological productivity. This method would lead to wise use of the coastal environment and enhance the biological productivity around the unused reclaimed areas.

Restoration of Elgrass (*Zostera marina* L.) bed by filling up a borrow pit with natural sediment

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The objective of this study is to evaluate restoration technology of eelgrass (*Zostera marina* L.) bed by filling up borrow pit by the coast of Iwakuni, the Seto Inland Sea, Japan. We constructed eelgrass habitat at the edge of a