

and presently cultivates 26 500 ha of the scallop, *Patinopecten yessoensis*, 10 000 ha of the arkshell, *Scapharca broughtonii*, 660 ha of the sea cucumber, *Apostichopus japonicus*, and 100 ha of the abalone *Haliotis discus hannai*. The company has been in existence for more than ten years. The total harvest in 2005 reached 28 000 tonnes, valued at more than US\$60 million (US\$18 million in net profit). To improve ecological conditions and the sustainability of the operation, the company is now thinking of developing seaweed cultivation and the construction of artificial reefs in more offshore environments. To date, about 13 300 ha have been optimized in this way.

Besides the development of demonstration activities and applied research to clearly show farmers and regulators the benefits of IMTA, basic research on IMTA has also been performed by some institutions of China, for example, the environmental requirements for the growth of seaweeds and shellfish to maximise the nutrient recycling efficiency to the culture conditions (depths, relative position with respect to the fish cages in relation to the prevailing currents, distance from the cages and culture density).

To avoid spatial competition and serious environmental impacts in inshore region, developing the IMTA in offshore areas, such as suspending culture of fish, shellfish and kelp, sea ranching of sea cucumber, sea urchin, abalone, seaweeds and scallop is a trend for mariculture industry in China.

Seasonal retention and release of phosphorus in Shinkawa-Kasugagawa Estuary, the western Japan

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Estimation of mass balance of biophilic elements, such as nitrogen or phosphorus, is very important to understand the dynamics of these materials in coastal ecosystems. Phosphorus plays as one of the most effective material for the growth of primary producer or the eutrophication including occurrence of noxious red tides in the coastal sea. Phosphorus, discharged from a river, is varied in quality and quantity in estuary ecosystem, and then flow out to the coastal sea. We carried out 10-

12 hours surveys during a high-low tidal cycle in May, August and November in 2006. Our objective is to estimate the phosphorus balance in Shinkawa-Kasugagawa estuary and to demonstrate the function of intertidal zone to coastal environment.

Hourly seawater samplings were conducted at boundary site between intertidal and subtidal area to estimate the abundance of phosphorus which flowed into or flowed out from intertidal zone. Collection of river water and measurement of flow rate of the river were also carried out to estimate the abundance of discharged phosphorus from the river. As a result, 40.9 kg of phosphorus (dissolved inorganic phosphorus+particle phosphorus) were discharged into intertidal zone from Shinkawa-Kasugagawa River, and 23.6 kg of phosphorus flowed out from intertidal zone to the sea in May. In August, 33.7 kg of phosphorus were discharged from the river and 12.4 kg of phosphorus flowed out to the sea. Therefore, 17.3 kg (42%) and 21.3 kg (63%) of discharged phosphorus from the river could be considered to trap in intertidal zone in May and August, respectively. On the contrary in November, only 2.6 kg of phosphorus were discharged from the river and 42.8 kg of phosphorus flowed out to the sea, showing 40.2 kg of phosphorus were released from intertidal zone.

Our results indicate that considerable phosphorus discharged from the river are trapped in intertidal zone during spring to summer, when various estuarine organisms are active, and are released drastically to the sea during autumn to winter.

Adaptive cooperative management of tidal flat by citizens - governments - researchers in the Yamaguchi Bay

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In the Yamaguchi Bay, which is located at the mouth of the Fushino River, fishery resources have been decreased quickly. The local government established a "committee of

developing a healthy river basin” in 2002, and selected the basin of the Fishino River as a model field. In 2003, the natural environmental restoration law has been established. Based on this law, a “council of the river mouse and tidal flat restoration in the Fishino River” has been launched in 2004. The members of the council were consisted of thirty individuals and citizen groups, eighteen local and national governmental organizations, and nine researchers. There are a lot of living organisms which should be conserved in the bay, which include short-necked clam, eel grass, houseshoe crab, waterfowls, etc. Among them, short-necked clam and eel grass were in the most serious situation. In the past, there were 700 ha eel grass bed in this area, which decreased down to 32 ha in 2002. The council members have planted young plant of eel grass, and the eel grass bed has increased to 153 ha in 2005. Our researches of finding the suitable habitat for eel grass would have helped the activity.

About short-necked clam, the situation was more complicated. Fishery catch of short-necked clam was 653 ton in 1975, which is sharply down to zero ton in 1991. Although there are a lot of possible reasons for this problem: 1. High mud content on the bottom sediment, 2. Low nutrient in the water, 3. Toxic substances in the water, 4. Over fishing, 5. Predation, etc., we could not reach a concrete conclusion about the cause. The council needed to start from possible countermeasures together with monitoring and researches. Since the clearest change of the environment was rise of mud content, the local government conducted sand covering works at first. The council members also conducted tidal flat cultivation at the place where the sand became hard. Low nutrient, toxic substances and predation were left unknown. We conducted researches to know the effects of these unchecked factors. Our research revealed that predation had a huge influence on short-necked clam biomass, and protecting by nets is essential in this bay. We also showed the appropriate location of spawning based on current simulations. Recently the council has set up protecting nets at some places in the bay based on our proposal. We will continue this cooperative activity until we



successfully restore this area in the near future.

Creation of SATO-UMI as a policy in Japan

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Circumstance of the Environmental Coastal Seas in Japan: In Japan, Effluent Standards of nitrogen and phosphorus are applied in the enclosed coastal seas. In particularly regional area (for example: Seto Inland Sea), Total Pollutant Load Control System of COD_{Mn}, nitrogen and phosphorus is added. As a result, remarkable pollution was improved, but the functional depression of material circulation, deterioration of the ecosystem including marine resources and citizen's unconcern for water environment were advanced. Therefore the Government of Japan promotes the verification of technologies for improvement of the water environment in enclosed coastal seas, pushes forward establishment of action plan to achieve the water environment quality that should be target in future indicated by the DO in the bottom layer and transparency. And recently the restoration of enclosed coastal seas by the creation of SATO-UMI is added.

The Creation of SATO-UMI as a National Policy: The creation of SATO-UMI as a national policy had its inception when it was designated as the environmental policy which should be started during the next one or two years in BECOMING A LEADING ENVIRONMENTAL NATION STRATEGY IN THE 21st CENTURY (MOE, June 2007). This strategy plans the creation of seas which are full of the natural blessings that various fishery products inhabit by integrating promotion of conservation and restoration of shallow area, water pollution control, and sustainable resources management.

Therefore, MOE has started supporting the advanced activities for the environmental conservation and evaluating the effects of them since 2008, and the know-how of these activities are going to be edited as a manual which serves as a reference when a new activity is started.

View point at Creation of SATO-UMI: MOE tidied up the concept of SATO-UMI as follows in cooperation with some experts in 2007.

- SATO-UMI is the coastal sea where human coexist with nature tied to living and the