Yellow Sea Large Marine Ecosystem Project

Activity Title:	Strategic Action Programme (SAP) Demonstration Activities on Reducing Nutrient Loads from Riverine, Atmospheric and Mariculture Inputs into the Northern Yellow Sea
Lead Organisations:	National Marine Environmental Monitoring Center (NMEMC), Liaoning Ocean and Fisheries Science Research Institute (LOFSRI)

Pollution in the northern Yellow Sea

The northern part of the Yellow Sea around Liaoning Province, China, experiences pollution from various sources - atmospheric, sea-based (mariculture farms), and point and non-point sources. There are areas designated as "hot spots" of nutrient inputs such as the Yalu River and its estuary. Annual loads of inorganic nitrogen and active phosphate from the Yalu River into the Yellow Sea are estimated at 4,415 tonnes and 367 tonnes respectively. Land- and sea-based nutrient discharges are also responsible for the heavily polluted estuary, such as from direct discharge outlets from the cities and wastewater discharge from mariculture. As a result of the serious pollution through nutrient input, harmful algal blooms have occurred more often in the past few years.

Precipitation sampler in Dalian.

Large cities and industries in the region contribute to atmospheric inputs of pollutants such as PAHs (polycyclic aromatic hydrocarbons). In Qingduizi Bay, there is a large area dedicated to mariculture and land reclamation. The Yingna, Huli, and Diyin Rivers flow into the bay, bringing silt and sand into the bay.

The 3 SAP demonstration activities will demonstrate the effectiveness of the management action "control total loading from point sources." The activities will model pollution load and manage pollution input from atmospheric, sea, and land-based sources, and demonstrate the possible actions that will contribute to achieving the target identified in the SAP - "reduce total loading of nutrients from 2006 levels."

Achievements

Atmospheric deposition

Rainwater samples are collected from monitoring stations in Zhangzi Island, Laohutan, and Xiaomai Island. Zhangzi Island, being further from land, has shown less deposition than the other 2 places. It was observed that metals had highest concentration in Laohutan due to the existence of various industries. Meanwhile, Hg and total PAHs were highest in Xiaomai Island which is close to Qingdao where there is a large oil refinery.

There are enough data to determine the sources of PAHs, and it is also fairly easy to determine the sources of metal deposition. However, the nutrients sources are more difficult to pinpoint, since the sources and compounds vary quite a bit. Furthermore, wind from land and sea can affect the trends and deposition amounts.

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Scientists will determine the ratio of atmospheric deposition vs. the total pollutants discharged to the sea, and also to identify the sources of the pollutants.

Sea-based sources of nutrient input

The activity is monitoring the amount of sewage from the Huli and Yingna Rivers, as well as modelling the nutrient inputs from mariculture farms. Information is being obtained from 9 monitoring stations in the bay, 3 stations outside the bay, and from mariculture farmers.

Outdoor jellyfish (*Rhopilema esculentum)* pond.

NO_3 and NH_4 concentration in Qingduizi bayhead area was higher near land, while NO_2 concentration did not differ much area- or season-wise. Indoor ponds are growing juvenile sea cucumber, while outdoor ponds raise jellyfish from juveniles until maturity. In the ponds, plankton is used as feed, but artificial feeds are also added for higher production; thus, there might be high nutrient outflow from the ponds during water exchange.

Extensive efforts have been carried out to determine the coefficient of pollution discharge for sea cucumber and crab. With the coefficient of pollution discharge, it is expected that the overall pollution discharge of mariculture could be estimated, and necessary management actions could be designed to reduce the pollutants from the mariculture ponds.

A bacteria known as the “EM strain” is being tested as “nutrient absorbers” and ability to exist symbiotically in the mariculture ponds with the mariculture products.

Land-based nutrient inputs

In the Yalu River, the main sources of nutrient input are from agriculture and sewage and other point sources. Historical data, monthly data of ddo obtained from Dandong local government, and data from 3 surveys will be analysed together, and collaboration with the other 2 activities will attempt to model the total nutrient load from atmosphere, land, and sea. Furthermore, the point and non-point sources will be identified to aid in management and policy development.

Initial model development revealed that different models are required for different situations, e.g. distinguishing water flow volume vs. nutrient load. Information from remote sensing and data from other similar projects will be used to determine loads from non-point sources and water flow amount, respectively.

One of 14 direct discharge outlets along the Yalu River.

Management of Pollution

Results from the 3 demonstration activities will be available at the end of 2009. They will be combined to serve as a model and/or test case in other areas to determine total nutrient loads from all sources, and to manage the inputs. Transfer of the results to Liaoning Province environmental policy makers has started and will continue through science-policy fora organised by the researchers and YSLME Project. There is strong collaboration between scientists and provincial government policy makers that serves as a foundation and catalyst for SAP implementation.

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