UNDP/GEF Yellow Sea Project

Second Yellow Sea Regional Science Conference

Towards a Science-Driven Ecosystem Approach to Management

24th to 26th February 2010
Xiamen, China

Organised by:

GEF

UNDP/GEF Yellow Sea Project
"Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem"

Contents

CONFERENCE PROGRAMME

DAY 1 – 24TH FEBRUARY 2010

08:30 - 09:00	**REGISTRATION**
	OPENING CEREMONY
09:00 – 09:05	Welcome address from conference host *(Dr. Haiqing Li, State Oceanographic Administration)*
09:05 - 09:10	Opening and congratulatory address from the government of China *(Dr. Zhanghai Zhang, State Oceanographic Administration)*
09:10 - 09:15	Opening remark from the government of Republic of Korea *(Dr. Sinjae Yoo, Korean Oceanic Research & Development Institute)*
09:15 – 09:20	Opening remark from the government of Democratic People's Republic of Korea (*Dr. Gangho Ma, State Hydrometeorological Administration*)
09:20 – 09:25	Welcome speech of local government *(Representative from Local Government Agency, China)*
09:25 – 09:30	YSLME Project Manager's address *(Mr. Yihang Jiang, UNDP/GEF Yellow Sea Project)*
09:30 – 10:00	Group photo
	KEYNOTE SPEECHES *CHAIRPERSON - Dr. Sinjae Yoo*
10:00 - 10:30	Impacts of global change on marine ecosystem *(Dr. Jilan Su, Second Institute of Oceanography, China)*
10:30 - 11:00	Overview of the achievements of the YSLME Project with special reference to the ecosystem-based approach *(Mr. Yihang Jiang, UNDP/GEF Yellow Sea Project)*
11:00 - 11:25	**Coffee Break**
	SESSION 1: ECOSYSTEM DRIVERS AND IMPACTS *CHAIRPERSON - Dr. Mingyuan Zhu*
11:25 - 11: 50	Recent warming in the Yellow and East China Sea during the boreal winter *(Dr. Sang Wook Yeh, KORDI, ROK)*
11:50 - 12:15	Satellite observation of 10 years eutrophication of Yellow Sea *(Dr. Joji Ishizaka, Nagoya University, Japan)*

12:15 - 12:40	Marine biodiversity response to climate change: cases in China *(Dr. Quan Wen, NMEMC, China)*
12:40 - 13:40	**Lunch**
	SESSION 1: ECOSYSTEM DRIVERS AND IMPACTS (CONT'D) *CHAIRPERSON - Dr. Chang Ik Zhang*
13:40 - 14:05	Recent warm climate change is good for Yellow Sea ecosystem *(Dr. Sangbok Hahn, Hahnguk Academy of Hydrographic Nature, ROK)*
14:05 - 14:30	Estimating primary production of the Yellow Sea *(Dr. Sinjae Yoo, KORDI, ROK)*
14:30 - 14:55	Assessing the impacts of N:P:Si ratio change on the Yellow Sea ecosystem *(Dr. Zongling Wang, FIO, China)*
14:55 - 15:20	Protection and management of ecosystem in Korean West Bay *(Dr. Song Chun Jong, SHMA, DPRK)*
15:20 - 15:45	Monitoring and assessment of atmospheric loads in the Yellow Sea *(Dr. Ziwei Yao, NMEMC, China)*
15:45 - 16:05	**Coffee Break**
	SESSION 1: ECOSYSTEM DRIVERS AND IMPACTS (CONT'D) *CHAIRPERSON - Mr. Sadayosi Tobai*
16:05 - 16:30	Coastal and estuarine habitat loss and gain – repercussions for economic and ecological goods and services *(Dr. Mike Elliott, Hull University, UK)*
16:30 - 16:55	Recent status of fisheries resources and ecosystem caused by overfishing in the Yellow Sea *(Dr. Jae-Bong Lee, NFRDI, ROK)*
16:55 - 17:20	Benthic indicators of eutrophication in the Yellow Sea *(Dr. Xuelei Zhang, FIO, China)*
17:20 - 17:45	Changes in sociocultural condition and tidal flat in R. Korea *(Dr. Joon Kim, Jeonnam Research Institute, ROK)*
17:45 - 18:15	Discussion - Led by Session Chairpersons
18:30 - 20:00	**Cocktail reception hosted by YSLME Project Management Office**

DAY 2 – 25TH FEBRUARY 2010

SESSION 2: MECHANISMS OF ECOSYSTEM CHANGE
CHAIRPERSON - Dr. Jilan Su

09:00 - 09:25	A changing ecosystem: the Yellow Sea *(Dr. Song Sun, IOCAS, China)*
09:25 - 09:50	The grazing pressure of dominant copepods on phytoplankton and microbial food web in Gyeonggi Bay, the Yellow Sea *(Dr. Joong Ki Choi, Inha University, ROK)*
09:50 - 10:15	An integrated ecosystem-based approach for assessing and forecasting impacts of fisheries *(Dr. Chang Ik Zhang, Pukyoung National University, ROK)*
10:15 - 10:40	A study of physical environment impacts on anchovy population dynamics in the Yellow Sea by individual-based model *(Dr. Yuheng Wang, OUC, China)*
10:40 - 11:00	**Coffee Break**
11:00 - 11:25	Model study on impacts of wave-mixing to vertical distribution and time-variation of phytoplankton in South Yellow Sea *(Dr. Xuehai Liu, FIO,China)*
11:25 - 11:50	Summer upwelling in the Yellow Sea: The dynamics and ecological implications *(Dr. Xingang Lü, FIO, China)*
11:50 - 12:15	Quantitative monitoring trial of Giant Jellyfish, *Nemopilema nomurai,* in Yellow Sea *(Dr. Kyounghoon Lee, NFRDI, ROK)*
12:15 - 12:45	Discussion - Led by Session Chairperson
12:45 - 13:45	**Lunch**

SESSION 3: SCIENCE-BASED MANAGEMENT
CHAIRPERSON -Dr. Song Sun

13:45 - 14:10	Effectiveness of fishing boat buyback programs on Korean Yellow Sea stock status *(Dr. Seong-Kwae Park, Pukyoung National University, ROK)*
14:10 - 14:35	Fishery resources, fishery, and future prospect for the Yellow Sea ecosystem *(Dr. Xiujuan Shan, YSFRI, China)*
14:35 - 15:00	Development of integrated multi-trophic aquaculture in Sanggou Bay *(Dr. Jianguang Fang, YSFRI, China)*

15:00 - 15:25 Super-intensive shrimp culture using no-water exchange
(Dr. In-Kwon Jang, WSMRC, ROK)

15:25 - 15:45 **Coffee Break**

15:45 - 16:10 Assessment on phytoplankton quantity in the coastal area by using remote sensing data
(Dr. Songgun Ri, SHMA, DPRK)

16:10 - 16:35 Status and trend of coastal recreational waters in Qingdao
(Dr. Juying Wang, NMEMC, China)

16:35 - 17:00 Monitoring and estimation of land-based nutrient loads in the Yellow Sea region: Methodology and case study
(Dr. Zhifeng Zhang, NMEMC, China)

17:00: 18:00 **Poster Session**

DAY 3 – 26TH FEBRUARY 2010

SESSION 3: SCIENCE-BASED MANAGEMENT (CONT'D)
CHAIRPERSON -Dr. Sang Bok Hahn

09:00 - 09:25 Improving biodiversity conservation in Ganghwa tidal mud flat, Korea
(Dr. Gyung Soo Park, Anyang University, ROK)

09:25 - 09:50 Landscape changes during 1970-2007 in Yancheng Biosphere Reserve, Jiangsu Province, China: Implications for biodiversity conservation
(Dr. Ping Zuo, Nanjing University, China)

09:50 - 10:15 Degradation pathway of pyrene in *Novosphingobium pentaromativorans* US6-1: Potential for bioremediation of PAHs contaminated environment
(Dr. Yuanrong Luo, KORDI, ROK)

10:15 - 10: 40 Assessment of eutrophication status in Toyama Bay based on the "Procedures for assessment of eutrophication status including evaluation of land based sources of nutrients for the NOWPAP region"
(Mr. Genki Terauchi, NOWPAP-CEARAC, Japan)

10:40 - 11:00 **Coffee Break**

11:00 - 11:25 Estimating the benefits of improving environmental quality in the Ganghwa tidal flat
(Mr. Isao Endo, UNDP/GEF Yellow Sea Project)

11: 25 - 11:50 Cost-benefit analysis of integrated multi-trophic aquaculture
(Dr. Mingyuan Zhu, FIO, China)

11:50 - 12:15	Stakeholder capacity and participation in ecosystem recovery of Masan Bay *(Dr. Chan-Won Lee, Kyungnam University, ROK)*
12:15 - 12:45	Discussion - Led by Session Chairpersons
12:45 - 13:45	**Lunch**
	SESSION 4: GOVERNANCE AND CO-OPERATION *CHAIRPERSON* - Dr. Quan Wen
13:45 - 14:10	Institutionalizing current efforts through YSLME Commission *(Dr. Suh-Yong Chung, Korea University, ROK)*
14:10 - 14:35	Legal improvements in fisheries saw under the context of YSLME *(Dr. Ming Yu, OUC, China)*
14:35 - 15:00	Requirements for widening partnership for ecosystem-based management of the Yellow Sea - With special focus on the roles and needs of the NGOs *(Mr. Sadayosi Tobai, WWF Japan, Japan)*
15:00 - 15:25	One step at a time: Overcoming challenges to conservation in the Yellow Sea *(Mr. Nial Moores, Birds Korea, ROK)*
15:25 - 15:45	**Coffee Break**
15:45 - 16:45	**SESSION 5: SUMMARY & DISCUSSION** *Dr. Sinjae Yoo and Dr. Mingyuan Zhu, Co-Chairpersons, Conference Organising Committee*
16:45 - 17:45	**Poster Session**

ABSTRACTS

Project manager's welcome speech at the second Regional Science Conference of the UNDP/GEF Yellow Sea Project: *Yihang Jiang*

Distinguished Colleagues and Friends,
Ladies and Gentlemen,

On behalf of the UNDP/GEF Yellow Sea Project, it is a great pleasure for me to welcome all of you to attend the 2nd Regional Science Conference of the Project. First of all, I would like to express our sincere appreciation to the Government of China for hosting this important conference in the beautiful city, Xiamen. I would like also to thank Governments of China and R. Korea to provide financial support to the Conference to ensure the successful organization of the event.

As some of you may remember, the first Regional Science Conference was organized in Hangzhou, China, 14-16 August 2007, when we just finalized the Transboundary Diagnostic Analysis (TDA). During the 1st Conference, there are a lot of scientific findings were presented.

Since the last Conference, there have been many activities implemented within and outside the framework of the YSLME project:

- Regional co-operative cruises have been carried out, which provided useful data and information for better understanding of marine environment in the Yellow Sea;

- Joint fishery stock assessment cruises were also organized to provide critically important information on status and changes of fishery resources in the Yellow Sea;

- The Strategic Action Programme (SAP), and the National Strategic Action Plan (NSAP) have been prepared, and the official endorsement ceremony was organized in Xi'an, November 2009. The governments of China and R. Korea endorsed the SAP, and an official supporting letter was received from DPRK. The SAP provided for first time in the GEF International Water portfolio a science-driven and ecosystem-based approach;

- For better implementation of the SAP, more than 20 demonstration projects have been implemented. Most of them provided not only the management experiences but also many new scientific findings were presented. I am looking forward to listen to the successful stories of the demonstration activities during this conference;

- Closer co-operation and co-ordination with the members of the Yellow Sea Partnership are one of the key issues for the successful implementation of the project. Wider participation with involvement of all stakeholders will provide a stronger framework to protect marine environment in the Yellow Sea.

Distinguished Colleagues and Friends,
Ladies and Gentlemen,

With clear instructions from the Project Steering Committee, and active participation of the governments in the region, the Project is engaged in the preparation for the 2nd phase:

- The draft Project Document has been prepared in consultation with all the members of the project;

- The draft Project Information Form has also been prepared. This document will be submitted to the GEF Council for consideration and approval;

- Negotiation with participating governments, GEF Secretariat, UNDP/GEF, UNOPS, and other relevant organizations and NGOs have been, or will be carried out in this regard. I am pleased to inform you that at this moment, we have received positive responses.

During the last five years of the project, we have gained many experiences and lessons. It is the intention of the project that we need to summarize our understandings in the Yellow Sea, including scientific, environmental and governance issues. This Regional Scientific Conference will provide good opportunity to get useful information.

I would like to take this opportunity to express our sincere gratitude to all the governments of the Yellow Seas countries, all the experts involved in the project implementation, and all the organizations who contributed to the project. Without your generous support and active participation, it would not be possible for the project to achieve its goals

Finally, I wish the conference every success, and hope all of you have a nice stay in Xiamen.

Thank you for your attention.

KEYNOTE SPEECHES

Impacts of global change on marine ecosystem: *Jilan Su*

Second Institute of Oceanography, China

The term “global change” has evolved since it became popular in the 1970s. From first referring to change in international social, economic and political systems, it has come to mean global environmental change, covering systemic and cumulative changes. These Global-scale changes could impact the marine ecosystem as well as human health. The main changes include greenhouse gas emissions that have caused global warming and resulted in melting of permafrost and icecaps, sea level rise and ocean acidification; excessive nutrient loading caused eutrophication and resulted in harmful algal blooms, hypoxia and jellyfish blooms; overfishing causing decline of living marine resources and may result in malnutrition; etc. It is necessary to understand the relationship between ecosystem status, socio-economic conditions and human health and we may consider changing from “environmental standards approach” to a “human health based approach”.

Overview of the achievements of the YSLME Project with special reference to the ecosystem-based approach: *Yihang Jiang*

UNDP/GEF Yellow Sea Project

The presentation summarises the achievements of science-driven and ecosystem-based approaches during the current phase of the project. Justifications of the science-driven and ecosystem-based approaches are provided to highlight the major considerations of the YSLME project on the preparation of the Transboundary Diagnostic Analysis (TDA) and the Strategic Action Programme (SAP).

The brief history and process of the science-driven and ecosystem-based approaches are prepared to provide information on the progress of the regional project in developing the major project outcomes. This process includes the initial consultation and outcomes; the design of the project implementation; and final results of the implementation.

The presentation also provides some examples on the science-driven and ecosystem-based approaches, including: management actions on the fishery-mariculture-pollution control; assessment tools for management of pollution discharge on a defined area; and demonstration projects on the combined management efforts in biodiversity conservation-public awareness-economic valuation.

SESSION 1: ECOSYSTEM DRIVERS AND IMPACTS

Recent warming in the Yellow and East China Sea during the boreal winter: *Sang Wook Yeh*

KORDI, ROK

We examine characteristics in the variability of sea surface temperature (SST) in the Yellow/East China Sea during the boreal winter (December-January-February) for the period of 1950-2008 in observations. It is found that the mean SST in the Yellow Sea/East China Sea gradually increased during recent decades. A warming trend of a basin scale SST is significant in most regions in the Yellow/East Sea, which is well explained by the variability of the first empirical orthogonal function SST mode. We suggest one candidate mechanism that the North Pacific Oscillation (NPO)-like sea level pressure play an important role to warm the Yellow/East China Sea. Anomalous anticyclonic circulation, which is the southern lobe of NPO-like sea level pressure over the North Pacific, causes a weakening of northerly winds over the Yellow/East China Sea. This contributes to warm SST in the Yellow/East China Sea through the latent heat flux and sensible heat flux into the ocean.

Satellite observation of 10 years eutrophication of Yellow Sea: *Joji Ishizaka*

Nagoya University, Japan

Yellow Sea and East China Sea is influenced by various human activities. Eutrophication is one of the most typical changes of shallow enclosed coastal seas. Water quality of Changjiang River has been known to be deteriorating because of the increased nutrients, specifically the reported loadings of dissolved inorganic nitrogen. Even in the middle of the East China Sea, increased dissolved inorganic nitrogen has been reported. In the last 50 years, dissolved nitrogen has increased with decreases in salinity and this can be explained by the increase of the river discharge amount during summer, and may be related to the increase of precipitation as well as the melting of glaciers in the western China. Specific dissolved nitrogen amount for same salinity indicated the increase of the nutrient concentration in Changjiang River discharge. Time series of satellite ocean colour for last 10 years indicates that the interannual variation of summer satellite chlorophyll in the East China Sea corresponded well to the interannual variation of Changjiang River discharge amount, and both did not show significant increase. However, satellite chlorophyll in the middle of Yellow Sea indicates significant increases for both spring and summer. This may indicate the possible results of eutrophication in the Yellow Sea.

Marine biodiversity response to climate change: cases in China: *Quan Wen*

NMEMC, China

The impacts of global climate change on the marine ecosystems are of concern. In spite of the natural disasters, the responses of marine species, habitats and ecosystems to the climate change have been also observed in China. The temperature in the seas of China has been rising and the coral reef, mangrove, shellfish and algal ecosystems and the distributions of some species including fishes and mammals have certain changes. The central government of China has issued the National Strategy to Response Climate Change in China, which involves the strategy for coastal zones to adapt to climate change and reduce vulnerability of coastal ecosystems. For those purposes some practices have been carried out and the capacity building and scientific research are called for.

Recent warm climate change is good for Yellow Sea ecosystem: *Sangbok Hahn*

Hahnguk Academy of Hydrographic Nature, ROK

Warming trend of SST (Sea Surface Temperature) and sea level rise are two major roles for recent climate change in the Yellow Sea region. The warming trend is twice effective in winter than in summer, and annual range of SST variation is decreasing.

By 2100, winter SST may warm up 4 degree C. in general (5 degree C. in northern part and 3 degree C. in southern part), and summer SST may warm up 2 degree C. As a result, some part of temperate zone at present, will be changed to a subtropical zone by 2100, accordingly ecosystem should be changed to adapt this milder environment.

The sea level may rise approximately 70cm due to global warming by 2100 in this region, indicating wider sea area than at present.

Estimating primary production of the Yellow Sea: *Sinjae Yoo*
Jisoo Park, Yu-Hwan Ahn, and Joji Ishizaka

KORDI, ROK

Despite some efforts to get better estimation of the primary production of the Yellow Sea, there is still uncertainty in the estimates. Extreme range of the environmental factors through seasons makes the estimation difficult. High turbidity caused by strong tidal mixing in the coastal waters makes its light environment very complicated. Diffuse attenuation coefficient easily surpasses 2.0 m^{-1} in the turbid zone while it is less than 0.10 m^{-1} in the central region when the water column is stratified. In winter, the water column gets totally mixed vertically in the central region, while in summer the depth of thermocline can be as shallow as some 10 m. The high variability in environmental characteristics makes estimation of the fundamental variables extremely difficult: chlorophyll-a and photosynthetic parameters. YSLME project commissioned a working group of scientists to develop better regional chlorophyll-a algorithms for the Yellow Sea. The working group developed regional algorithms based on in-situ bio-optical observations. Here we compare the estimates of primary production from combinations of different chlorophyll-a and photosynthetic algorithms. The resultant estimates of the annual primary production of the Yellow Sea range from 96.5 to 610.2 $gC\ m^{-2}\ yr^{-1}$. We analyze the sources of such large discrepancies and discuss how to reduce the uncertainty.

Assessing the impacts of N:P:Si ratio change on the Yellow Sea ecosystem: *Zongling Wang*

FIO, China

To investigate the impacts of nutrient concentrations and N:P:Si ratios on the ecosystem of the Yellow Sea, current status and long-term variation of nutrients in Yellow Sea were collected and analyzed. The results showed the nutrient concentrations and N:P:Si ratios revealed great annual fluctuations during the last 10 years and no clear pattern were observed in the whole region. Yet in the coastal region, significant increase of DIN level and N/P ratio were observed such as Jiaozhou Bay and Sanggou Bay, and many pelagic ecosystem changes has been strongly related to the changes of the inorganic nutrient.

Mesocosm and laboratory experiments aim to study the N:P:Si ratios on the phytoplankton community structure and interspecific competition were conducted, and the results showed that the absolute concentrations and N/P ratios seemed to work together. In the mesocosm experiment, the peak values of Chl-a were relatively higher in the high level nutrient and/or balanced N:P:Si ratio treatments. No significant impact of N:P:Si ratios were found on the phytoplankton species composition and dominance.

In the laboratory experiment between *S. costatum* and *P. dentatum*, N:P ratios may not be the major influencing factor for the growth of the two target algae. And the algal cell density was mainly influenced by the absolute concentrations of the potential limiting nutrient. *S. costatum* is more competitive in nutrient-rich environment while *P. dentatum* is the winner in nutrient-poor environment during an interspecific competition. The experimental results are consistent with the field environmental survey results during the *S. costatum* red tide events.

In the laboratory experiment between *P. dentatum* and *A. tamarense*, the results showed that different N/P supply ratios had no significant effect on population growth process of the two species during unispecific cultures, but had effect on the final cell density; and different N/P ratios had effect on the interspecific competition process of the two species during bispecific cultures, but had no effect on the final competition results. The initial cell densities of competitional species had significant effect on the interspecific competition results during bispecific culture, when the ratios of inoculated *P. dentatum* cell density to *A. tamarense* cell density were 2000:100 and 2000:200, *P. dentatum* finally dominated, but when the ratio was 4000:400, *A. tamarense* finally dominated.

Protection and management of ecosystem in Korean West Bay: *Song Chun Jong*

SHMA, DPRK

Introduction

As the Korean West Bay has high nutrient contents and there exists a distinguished ecological environment condition, it is rich in various natural resources. When fresh water flows into sea through the West Sea Barrage, the downstream area can be come eutrophic from land-derived contaminants.

Environment Issues

The Korean West Bay and its coast are polluted from domestic sewages in urban, industry, agriculture and ship/harbour wastes. The seasonal change is noticable with the good water quality in winter and spring, but in summer and autumn it is low. The deterioration of water quality in the Korean West Bay caused reduction or destruction in area of mariculture farms.

Policy and Management

To further enhance the beauty and to clean the coasts through improving management of the coasts and territorial waters is a consistent policy of the government for their management.

Community participation

The major bodies to participate in management of Korean West Bay are the Ministry of Land and Environment Protection, Ministry of City Management, Ministry of Land and Marine Transportation, Ministry of Electricity, Ministry of Agriculture, Ministry of Health, Ministry of Fishery, State Hydrometeorological Administration, State Academy of Science.

Pollution Prevention Plan of Korean West Bay

The current measures for purification and treatment of sewage and wastes in the bay, are to rebuild and expand sewage treatment plants in Pyongyang city, Nampo city and Songrim city of North Hwanghae Province and in the future, rebuild and establish new plants in the area around Pyongyang city and major cities of South Pyongan Province and North Hwanghae Province.

The purified sewage can be used for irrigation, plant watering and biological fertilizer and solid wastes for the production of methane.

Challenges and Opportunity

The YSLME project will be opportunity for capacity building of DPR Korea to protect ecosystem of the Korean West Sea and the Yellow Sea.

Monitoring and assessment of atmospheric loads in the Yellow Sea: *Ziwei Yao*
Zhen Wang

NMEMC, China

Atmospheric deposition networks in the north Yellow Sea were designed to monitor and assess the atmospheric loads of nutrients (nitrite, nitrate, phosphate and ammonium), heavy metals (Cu, Pb, Zn, Cd and Fe) and 15 polycyclic aromatic hydrocarbons (PAHs) in the atmosphere of the north Yellow Sea. In the present study three stations were selected: Xiaomai Island, Laohutan and Zhangzi Island. The sampling duration was from October 2008 to September 2009. Samples were collected every two weeks, and precipitation samples were collected only when it rained. The results of the present study provide an important overview of contaminant concentrations and deposition fluxes in the north Yellow Sea. Higher concentrations and deposition fluxes of nutrients, trace metals and PAHs were observed compared with the other areas of the world and the composition of atmospheric pollutants has its own characteristics. For nutrient, nitrate and ammonium salt were two main components, wet deposition of nitrate played an important role on the input of nutrients into the Yellow Sea, seasonal variation in nutrient deposition fluxes was not obvious and ratios of N/P measured were much higher than the appropriate N/P ratio for the production of phytoplankton. For heavy metals, local spatial trends were observed, but these trends vary by element, deposition fluxes of some metals (Cu, Zn, Fe and Pb) in urban areas are elevated with respect to the regional background, and higher atmospheric concentration and deposition fluxes of Cd were noted at Zhangzi Island than the sites near the urban/industrial areas. For PAHs, atmospheric ΣPAHs deposition fluxes increased with proximity to urban areas, PAH concentrations and deposition fluxes varied spatially across the sites with the highest occurring at the most heavily urban and industrial locations and PAH profiles were similar at the three sites, however, the primary sources were not the same.

Coastal and estuarine habitat loss and gain – repercussions for economic and ecological goods and services: *Mike Elliott*

Hull University, UK

Wetlands and estuarine, coastal and marine areas have many uses and users, each with the potential to degrade the system. They are the sites of temporary and permanent habitat loss, especially by land claim (reclamation) which may reduce the ability of an area to accommodate natural or anthropogenic hazards such as sea-level rise and storm-surges. Unless these types of habitat loss are reversed then the ecosystem structure and functioning are impaired and the ecological carrying capacity will be reduced. The areas also fulfill an economic role such as the production of food, sequestration of carbon, nutrient cycling, providing recreation, absorbing flooding, etc. Hence their degradation ultimately affects human and ecological health and societal wealth generation. Thus we require habitat recreation, restoration and management to balance the maintenance of ecological goods and services and the protection of biodiversity while at the same time delivering economic goods and services - hence fulfilling '*The Ecosystem Approach*' *sensu stricto*. All of this can be regarded as delivering *ecological carrying capacity*, for example the ability to support birds, fishes and marine mammals, while at the same time maximizing the societal needs to support the *socio-economic carrying capacity* such as the ability of an area to maintain its ports, fisheries and tourism. Hence we can define the carrying capacity of a system to receive all human activities and so need to quantify these different carrying capacities and restore or recreate the carrying capacity by management actions. The paper gives examples of these concepts and discusses a management framework which includes the habitat needs for the main organisms, the conservation goals and management indicators and objectives. This includes examples of getting 'triple wins': benefits for the ecology, public safety and economy. This indicates that any successful and sustainable management of these areas has to fulfill *the 7 tenets*: that actions have to be *environmentally/ecologically sustainable, economically viable, technologically feasible, socially desirable/tolerable, legally permissible, administratively achievable and politically expedient*.

Recent status of fisheries resources and ecosystem caused by overfishing in the Yellow Sea: *Jae-Bong Lee*

NFRDI, ROK

The Yellow Sea is bounded by the Korean Peninsula, China, Bohai and East China seas, has a seafloor that largely consists of sandy and mud, and has an average depth of about 40 m. Many fished species migrate seasonally for wintering, spawning and feeding. Wintering often occurs in the deeper waters of the southern Yellow Sea (YS) and northern East China Sea (ECS), with migrations to coastal areas for spring to fall spawning and feeding. Approximately 450 fish and large invertebrate species are found here, of which about 50 are commercially important and targeted by Korean fisheries. There were significant increases in fishing efforts (number of vessel, gross ton, horse power) of coastal and offshore fisheries in Korean waters. Especially, the increase in the horse power was remarkable. The major reason of this increase was the facts that the horse power of drift net increased more than 3 times and that of the towing nets increased 7 times during recent period. Dominant commercial fisheries groups changed greatly from 1954 to 2008. The annual mean catch has decreased from 1,042 thousand mt to 908 thousand mt in the Yellow/East China Sea (YES) between the periods of 1997-2002 and 2003-2008. The annual catch of Korean commercial fisheries in the YS ranges from 182 thousand mt in 1998 to 117 thosand mt in 2005 and the fishery production by species group has been changed in the YS. In the YS, finfish has declined from 58% to 36% between the recent two periods and main target species were Pacific anchovy, blue crab, hairtail, common squid and small yellow croaker, which were exploited by multiple fishing gears. Pacific anchovy, blue crab and common squid became dominant species in recent years, while small yellow croaker and hairtail used to be two most important species in this region in 1980s-1990s in the YES. These changes caused the gradual transition from animals at higher trophic level such as, piscivorous demersal fish to animals at lower trophic level as, planktivorous small pelagic fish and crustacean in the catches during the period. In the Yellow Sea ecosystem, squids and small pelagic fishes as well as demersal fishes have increased until mid 1980s, but they decreased after mid 1980s. The trophic level in the Yellow Sea ecosystem has decreased slowly showing 3 times inflection points. Several commercially valuable species, such as small yellow croaker and hairtail, and some other species are considered to be heavily exploited, and can not be sustainable under the current management system, which is not sufficient to maintain those important stocks and their habitat sustainable. The necessity and importance of the ecosystem-based holitic approach for fisheries assessment and management were stressed by illustrating case studies of the anchored gillnet and stownet fisheries for blue crab, yellow croaker, hairtail and Pacific anchovy in the YES.

Benthic indicators of eutrophication in the Yellow Sea: *Xuelei Zhang*

FIO, China

The Yellow Sea provides valuable services to the neighbouring countries; hence the health of the sea is critical to the surrounding human welfare. However, the Yellow Sea is a semi-enclosed shallow shelf sea and is vulnerable to pressures from social-economic development in the neighbouring countries. This study presents an analysis of some indicators for long term environmental changes in the sea. The results showed that composition of sediment in terms of total organic carbon, total nitrogen and total phosphorus all presented an overall increasing trend over the last century. The molar ratios C/N, C/P and N/P also presented significant increases since sixty years ago, which apparently were associated with beginning of the modern socio-economic development in the surrounding countries after the end of the World War II. The seasonal averages of biomass and abundance of macrobenthic organisms also increased significantly over the last decades, which indicated greater food availability owing increased organic supplies from the water column as a result of increased production. These results indicate that the Yellow Sea has received more nutrient inputs from the neighbouring lands, which stimulated the Sea's production toward a higher trophic state through bottom-up effects.

Changes in sociocultural condition and tidal flat in R. Korea: *Joon Kim*

Jeonnam Research Institute, ROK

Tidal flat is the place where a number of creatures inhabit, and it is important for fisherman to make a living. Human being is the final beneficiary of resources in the tidal flat. A variety of species, including human, live in and around the tidal flat, and that creates biological and cultural diversity. However, the tidal flat is disappearing due to the "land-oriented" view. This view does concern not sea or tidal flat, but expanding land and building companies. This view threatens tidal flat and promotes only development. As tidal flat is disappearing, fishermen are changing their jobs and becoming farmers. Some people are leaving their hometown. Therefore, the whole communities are disappearing.

1. Tidal flat is not the only place for fishery. Fishermen collect laver, brown sea weed, short-necked clam, hard clam, ark shells, and oyster in tidal flat. Collecting sea weed, octopus, short-necked clam, etc., with weeding hoe or a rake is called as "fisheries without gear." These are done in the tidal zone such as mud flat, sand flat, and on some rocky areas, so it can be classified as tidal zone fisheries.
2. The tidal flat has been the center of economic activities for the fishermen who are small-scale and family-run operators. However, the fishery policy has stressed the increase in scale of fishing, ignoring the fact that the public fishing ground is based on the collective ownership Therefore, it is important to view the fishing ground as the essential space of lives of the fishermen, not as the object to exploit.
3. Where would be the most primordial place to obtain protein-rich foods? The answer is the tidal flat. The foods that the tidal flat provides are more nutritious than commercial supplements.
4. The fishermen who thrive on the seas and mudflats tend to be those who do not own farmland or special skills to support themselves. They work as day laborers in nearby farming villages or even leave their hometown for cities to look for jobs. The Saemangeum project has been a major cause of tension among fishermen. There are conflicts between fishermen in Saemangeum and Buan, even whole the nation. Now the fishermen themselves, once like-minded neighbors, are showing signs of chasm and tension. The conflict among fishermen is multi-layered and combined with a variety of factors, such as the controversy on compensation at the early stage of the project, the tension during the process of protests against the project, and the disagreement on the radioactive waste dump. Their income has also dropped drastically to less than one tenth of what they had earned in the past.
5. Living as fishermen is becoming tough. Income has increased compared to what it was ten years ago. However, the younger generation wants to move out to the cities. The motivation behind this is the limited environment for education and the cultural desire. Furthermore, their products have to compete with those from China, North Korea, and other countries. The worsening conditions have made it necessary to develop the more aggressive industries, including sightseeing, leisure business, experience package, rather than the fishery itself. Government is now running the program to facilitate this trend of experience-oriented sightseeing that is designed to increase the income of the sea people communities. The best known is the fishing village visitation program in the southwestern regions. This is done in tidal flat.

SESSION 2: MECHANISMS OF ECOSYSTEM CHANGE

A changing ecosystem: the Yellow Sea: *Song Sun*

IOCAS, China

The Yellow Sea Ecosystem is changing continuously; it seems in the phase of regime shift. Many notable ecological events have happened in the recent years: the giant jelly fish bloom, the starfish bloom, the salp bloom and the green algae bloom, one by one, what happened? What caused these ecological events? Is it because the human activities or because the climate change? Based on the cruise data analysis and from the point of the ecosystem dynamics, these questions are discussed. The ecosystem structure, functional groups and the physical and biological coupling model are also discussed.

The grazing pressure of dominant copepods on phytoplankton and microbial food web in Gyeonggi Bay, the Yellow Sea: *Joong Ki Choi*

Ji Ho Seo, Eun Ju Seong and Eun Jin Yang

Inha University, ROK

To investigate the grazing pressure of copepod zooplankton on phytoplankton in the coastal waters of the Yellow Sea, we carried out in situ grazing experiment with *Acartia hongi*, *Paracalanus indicus* and *Calanus sinicus*, the three dominant species of Gyeonggi Bay, using the gut fluorescence method. Averaged annual grazing pressure on phytoplankton by *Acartia hongi* female population was 3.9% of the Chlorophyll *a* concentration. Averaged grazing pressure of these three copepods on phytoplankton was 8.76% of total chlorophyll *a* concentration in Gyeonggi Bay. Over 50% of primary production of phytoplankton passed through the microbial food web including bacteria and nano- and microzooplankton. In the ingestion experiment of *Acartia hongi* on planktonic ciliates and phytoplankton, clearance rate of *A. hongi* on planktonic ciliates was higher than on phytoplankton. Selective feeding of *A. hongi* was preferentially preying on planktonic ciliates. The rest of phytoplankton is uptaken by small fish larvae and benthos and released to DOM and POM. In the food web of offshore waters in the Yellow Sea, microbial food web might play an important role in the energy flow from phytoplankton to zooplankton.

An integrated ecosystem-based approach for assessing and forecasting impacts of fisheries: *Chang Ik Zhang*

Pukyoung National University, ROK

A pragmatic ecosystem-based approach has been developed for assessing and forecasting fisheries resources, which evaluates four management objectives: maintaining sustainability, biodiversity, habitat quality, and socio-economic benefits. A number of indicators and their reference points were developed to assess the status of species, fisheries and ecosystems. This approach is to forecast impacts of fishing activities (e.g. TAC) and/or climate changes on fish and fisheries of an ecosystem. This approach was applied to the Korean large purse seine fishery, which is one of Korea's major fisheries, accounting for more than 20% of total catch of the Korean coastal and offshore fisheries. The ecosystem structure and risk indices were forecasted by altering management options such as allocated TAC of chub mackerel. When we changed the TAC from 160,000mt to 120,000mt, the species risk index decreased from 0.30 to 0.23. It was found that this approach has potential as a tool for forecasting risk indices of objectives, species and fisheries. However, it is still far from practical applications due to lack of knowledge for assessing risks of a number of indicators, and thus further research especially on indicators and reference points is required.

Keywords: Ecosystem risk assessment, Forecast, Total allowable catch, Large purse seine, Chub mackerel

A study of physical environment impacts on anchovy population dynamics in the Yellow Sea by individual-based model: *Yuheng Wang*

Hao WEI, Liang ZHAO, J. Kishi

OUC, China

Due to over-fishing, the biomass of anchovy (*Engraulis japonicus*) in the Yellow Sea declined sharply since the late 1990s. The early life history, which is heavily influenced by physical environment, is important to anchovy recruitment. To study the relationship between physical environment and anchovy recruitment, an individual-based model (IBM) of anchovy was built, coupled with hydrodynamic model POM and lower trophic level ecosystem model NEMURO. Seasonal variation of 3D averaged residual current, water temperature, salinity, turbulent diffusion were simulated by POM using climate forcing to drive transport of phytoplankton, zooplankton, eggs and larval fish. Life history and growth of an individual anchovy were considered when it moved between overwintering, spawning and feeding grounds. Survival fitness theory related to temperature and food was used to describe the swimming action of anchovy. Swimming speed related to the fork length while the swim direction is determined by the gradients of fitness. The annual cycle of phytoplankton biomass, small zooplankton, large zooplankton and predate zooplankton were reproduced by NEMURO. The growth, reproduction and migration of anchovy were simulated. Numerical experiments were deployed forcing by interannual variation of spring monsoon, Yellow Sea Warm Current (YSWC) and water temperature. The results show that the time and distribution of spring bloom will change with wind speed, thus affect the match/mismatch relationship of anchovy larvae and food (zooplanktons) and influence the recruitment of anchovy. Stronger YSWC induced by stronger winter monsoon will cause a northward movement of anchovy wintering ground. Higher water temperature not only affects the migration of anchovy but also changes its population structure. So East Asia monsoon is the major reason for anchovy population dynamics in the Yellow Sea besides over-fishing.

Model study on impacts of wave-mixing to vertical distribution and time-variation of phytoplankton in South Yellow Sea: *Xuehai Liu*

FIO,China

Coupling biogeochemical-physical processes a 3-D plankton ecosystem model was established for South Yellow Sea (SYS) which contains complete main physical forcing (wind stress, boundary water exchange, surface thermal flux, wave-mixing, combined tides, and runoff). Biological processes involve basic interactions between four components: phytoplankton, herbivorous zooplankton, nutrients and detritus.

The model reproduced realistic hydrodynamic processes. The simulated vertical distributions of temperature agree with observations more than without inclusion of wave-mixing. This indicates wave-mixing plays important roles in forming physical patterns in SYS. The mixing makes vertical diffusion coefficients increase with 10^{-3}~10^{-1} m^2/s in upper layers. It mixes coastal waters more uniform vertically, enlarges thickness of mixed layers near surface, and increases thermocline strength in deep areas.

The spatial and temporal structures of ecological components by modelling are consistent with surveyed data. The Chl-a growth is mainly limited to light in coastal areas where transparency is low and mixing is strong, but in a considerable offshore portion, phosphate is a crucial limiting factor where the thermocline prevents transportation of nutrients vertically. In central areas, a critical bloom happens in spring and a slight one in fall both in surface layers. Nevertheless in summer the maximal density of Chl-a is presented in a subsurface layer. In coastal areas the density is high from May to September and stratification is unobvious. Near Changjiang River a significant bloom appears in May and strong mixing processes preclude phytoplankton's accumulation. In central and east areas the stratification of phytoplankton is obvious. From May the subsurface layer where the biomass is highest deepens gradually until September when the layer's top is deep to 30m.

Above features are related to wave-mixing which brings nutrients up to euphotic-zone and takes phytoplankton downwards. It is further revealed by modelling biological processes under conditions with and without wave-mixing respectively. Wave-mixing delays and strengthens the spring bloom.

Summer upwelling in the Yellow Sea: the dynamics and ecological implications:

Xingang Lü
Fangli Qiao

FIO, China

Upwelling systems are one of the most important types of the Large Marine Ecosystem (LME) in the world, and accounts for a large fraction of global fisheries production. In many coastal waters, wind-driven upwelling has been identified as a key dynamical contributor for the nutrient supply for marine ecosystems. In the Yellow Sea (YS) LME, however, it remains unclear whether there is systematic upwelling in summer. In this study, we try to answer this question, and investigate with focus on the dynamical mechanism of the upwelling by using a three-dimensional, prognostic, wave-tide-circulation coupled numerical model. Numerical modelling suggests that systematic upwelling belts are present around the Yellow Sea Cold Water Mass as a frontal-scale vertical circulation. Tidal Mixing Front (TMF) over sloping topography is determined to be the key mechanism inducing the upwelling. Considerable baroclinic gradient across the TMF makes the frontal zone the spot where the most active vertical circulation occurs; a density-driven secondary circulation is triggered with a distinct upwelling branch occurring mainly on the mixed side of the front. As shown by both satellite data and numerical modelling, the summertime SST field in the YS is featured by the stable existence of several site-selective surface cold patches (SCPs), most of which scatter in the waters off convex coastlines. In these waters, tidal current as well as the tidal mixing are particularly strong, resulting in upwelling so strong to reach the sea surface and give rise to the SCPs. The TMF-induced upwelling was probably associated with the nutrient enrichment events, such as the green tides and jellyfish blooms, in the Yellow Sea in recent years. The proposed upwelling dynamics are different from those in most eastern boundary upwelling regimes in the world, and provide an alternative to understand the physical-biogeochemical processes in the Yellow Sea LME.

Quantitative monitoring trial of giant jellyfish, *Nemopilema nomurai*, in Yellow Sea:

Kyounghoon Lee
Soo-Jeong Jang, Won-Deuk Yoon, Chang-Doo Park, Seong-Wook Park

NFRDI, ROK

Nemopilema nomurai jellyfish, which are presumed to be developing in the East China Sea, has recently migrated into the Yellow Sea during the last few years. National Fisheries Research & Development Institute (NFRDI) has estimated its biomass using bottom trawl fishing gear and sighting survey during the last 5 years. These methods are effective to investigate density of *Nomurai* jellyfish and their distribution near the sea bottom or on the surface, but they have difficulty in investigating the vertical distribution of jellyfishes. However, hydroacoustic methods can be utilized extensively and effectively to solve such problem in short period of time.

This research was conducted to verify the vertical distribution of giant jellyfish between an optical stereo camera system attached on the towed sledge and echo counting method with scientific echosounder system (EK500 system, Simrad co., Norway) with 3 frequencies in R/V Tamgu 8^{th} (282G/T).

Acoustical and optical techniques were used to understand the distribution and density of giant jellyfish. A camera system was towed at 3 knots and recorded jellyfish from 7 m mean depth to sea level while the range of the acoustic system was from 8 m depth to bottom surface.

This preliminary result showed in 0.11322 (inds/m^3) by the optical method and 0.00657 (inds/m^3) by the acoustical method, however, with considering their vertical distribution in around 98% in the depth range from 10-35m, the density estimated by echo counting from acoustical method was relatively 2.4 times higher than that of the optical method.

Keywords: Giant jellyfish, *Nemopilema nomurai*, Sighting method, Acoustical and Optical method, Yellow Sea

SESSION 3: SCIENCE-BASED MANAGEMENT

Effectiveness of fishing boat buyback programs on Korean Yellow Sea stock status:

Seong-Kwae Park

Pukyoung National University, ROK

The stock assessment results suggest that (i) red fish *Doederleinia berycoides*), monkfish (*Lophius sp.)*, anchovy (*Engraulis japonicus*), sea bass (*Collichthys sp*.), yellow tail *Seriola quinqueradiata*), pen shell (*Atrina pectinata*), and Spanish mackerel (*Scomberomorus niphonius*) are not in overexploitation/overcapacity, (ii) hair tail (*Trichiurus lepturus*) and skate ray are in overexploitation but in non-overcapacity, and (iii) yellow croaker (*Larimichthys polyactis*) and flounders are in non-overexploitation but in overcapacity. However, considering stock fluctuations and assessment uncertainties, the average optimal fishing effort over the last three years (2005-2007) on E_{NSY} and $2/3E_{MSY}$ criteria was evaluated at 73.4 – 90.2. This result suggests that the current level of total fishing capacity in the Yellow Sea be reduced by 9.8 – 26.6%, which is in line with YSLME management targets for reducing fishing effort in the Yellow Sea as a whole by 25-30%.

The survey of fishing boat buyback program effectiveness on resource restoration showed that 70% of the respondents replied that the programs have significant effect on resource recovery. This indicates that fishermen recognize the buyback programs as useful policy instruments in restoring fishery resources. Where the government implements the buyback programs in parallel with TAC (total allowable catch) schemes, 70% of the respondents replied that implementing the two policies at the same time would be more effective on resource restoration than the buyback programs alone. It appeared that the fish species on which the buyback programs have the largest positive effect are in order of bottom fish (63.3%), middle-layer fish (30%) and pelagic fish (3.3%). Some respondents (3.4%) replied that there is the same effect on all fish species.

In addition, it is known that fisheries resource management problems are compounded by land-based pollution and climate change. Korean government has begun to much actively manage land-based pollution through the intergovernmental cooperative mechanism. In order to respond to climate change, the government declared low carbon/green growth strategy as a new national policy toward six decades ahead. In particular, dealing with land-based pollution problems in the Yellow Sea is much more important than other seas in Korean peninsular since most of large industrial complexes and metropolitan cities are located in the east coast of China and in the west coast of Korea

Following such national initiative, the central and provincial governments should be able to develop integrated green policy package including buyback, resource enhancement, off-fisheries income promotion, fuel subsidy reorientation and self (or co)-management programs. Also, the package program should be supported by a new R&D system that is focused on enhancing and maintaining the Yellow Sea's environment and ecosystem. This will require far closer cooperative work among South/North Korea, China, and related international bodies.

Fishery resources, fishery, and future prospect for the Yellow Sea ecosystem: *Xiujuan Shan*
Xianshi Jin

YSFRI, China

With the development of industry and growth of human population, the increasing food demand is putting great pressure on fishery resources and coastal environments in the Yellow Sea ecosystem. Efforts are being made to protect the coastal habitats, to restore the populations of aquatic organisms and to create new fishing opportunities. In recent years, stock enhancement and closed season/areas measures have been recognized for their potential of increasing and sustaining coastal fisheries. In order to better evaluate the effects of stock enhancement on the restoration of fisheries resource, olive flounder (*Paralichthys olivaceus*) was regarded as the target fish for stock enhancement in Taozi Bay China, combined with the bottom survey before/after releasing olive flounder. The releasing olive flounder included three groups: 50-70mm, 70-80mm and 80-100mm. The results showed most of the 43 recaptured olive flounder belonged to larger size group with tagged body length 80-100mm. The recapture rate was 0.4%. Weight of recaptured tagged olive flounder gradually increased with time from release except when seawater temperature was less then 5ºC during January and February. In addition, the initial mortality during the recovery period following tagging of the bigger size group (80-100mm) was 4.6%, and tag missing rate was 3.2%, and relatively lower than that in the other groups. The tagged olive flounder mainly found distributed within Taozi Bay, and had the same migratory habit as wild olive flounder. A trawl survey to estimate the density of tagged flounder suggested that the survival rate was 10.4%, and it had positive effect on the restoration of natural olive flounder resource. So the stock enhancement of appropriate species was suggested as helpful in protecting and restoring natural resource in the Yellow Sea ecosystem.

Key words: the Yellow Sea ecosystem, Taozi Bay, Stock enhancement, Olive flounder

Development of integrated multi-trophic aquaculture in Sanggou Bay: *Jianguang Fang*

YSFRI, China

The monoculture of any organism can have adverse affects on the ecosystem, and generally the higher up the food chain the greater the impact with the unsustainable monoculture of carnivorous fish resulting in the release of excessive nutrients and organic material. However Integrated Multi-trophic Aquaculture (IMTA) systems use the co-culture of species from different trophic levels so that waste products of one species are absorbed by another so maintaining the ecosystem in equilibrium. Sanggou Bay is located in the east of the Shandong Peninsula, China. Since late 1990's IMTA has been well developed in the bay with an annual production of 2,100 ton of scallop *Chlamys farreri* in fresh weight, 110,000 ton of oysters *Crassostrea gigas* in fresh weight, 80,000 ton of kelp *Laminaria japonica* in dry weight, 1500 tone of abalone, and about 100 ton of finfish. Sanggou Bay is well known as the one of most famous IMTA areas in the world.

Three kinds of IMTA approaches have been implemented in the bay. The first type is suspension IMTA of fish, seaweed *Laminaria japonica* and shellfish oyster/scallop. The second kind is the longline culture of seaweed, abalone and sea cucumber. The third is the sea ranching of seaweed, shellfish (abalone, scallop, clams) and sea cucumber and sea urchin.

Among the three kind of IMTA, the suspension IMTA of fish, seaweed *Laminaria japonica* and shellfish oyster/scallop is the major method developed in the bay. The IMTA of abalone *Haliotis discus hannai*, kelp *L. japonica* and sea cucumber Apos*tichopus japonica* has also well been developed in last 5 years. The large scale sea ranching of sea urchin, abalone, sea cucumber and clams is another kind of IMTA that mainly developed in south cape of the bay. Such sea ranching is usually practiced by releasing the hatchery produced juveniles of scallop, abalone, and sea cucumber onto the natural seabed where is enriched in the seaweed based on the estimation of carrying capacity of the sea ranching site.

Funded by YSLME project, the evaluation of the ecosystem service function and value of monoculture and IMTA has been finished. The results showed that IMTA of longline culture of seaweed, abalone and sea cucumber was the best combination with the higher economic value or environmental benefit than others.

Super-intensive shrimp culture using no-water exchange: *In-Kwon Jang Jong-Sheek Kim, Seo-Hyeong Chul, Bong-Rae Kim, Young-Rok Cho*

WSMRC, ROK

Shrimp culture is one of the most important aquaculture activities along the Yellow Sea coast of Korea and northern China. In 2004, 1,179 and about 150,000 metric tons of farmed shrimp were produced in Korean and Chinese coast, respectively. Most shrimp farms in these areas are semi-intensive in earthen ponds using conventional flow-through water exchange method. This method discharges huge amounts of waste water, causing coastal eutrophication and introduces viral pathogens via water-exchange into the farms, resulting in mass mortalities of farmed shrimp. These issues force the shrimp farming industry to seek out more sustainable management practices. The objectives of this study are to demonstrate shrimp culture practices to enhance production as well as to reduce negative environmental effects in the Yellow Sea.

To develop a super-intensive shrimp culture technology under limited or no water exchange, commercial-scale greenhouse enclosed shrimp production system (two tanks of 300 m^2 each) was constructed and stocked with Pacific white shrimp, *L. vannamei* juveniles (408 ind/m^2 in density). The shrimp was cultured for 152 days under no water exchange condition. Production of shrimp was 5.47 kg/m^2 (about 20 times higher than traditional pond method), survival rate was 88.3% and FCR was 1.22 (about 40-50% lower than traditional method). The production and FCR of this study are about 20 times higher and 40-50% lower than traditional pond culture method, respectively. The results showed that the super-intensive indoor shrimp culture using no water exchange can enhance production, improve feeding efficiency, minimize viral introduction and greatly reduce the amount of coastal pollution caused by water discharge.

Assessment on phytoplankton quantity in the coastal area by using remote sensing data:

Songgun Ri

SHMA, DPRK

Introduction

Phytoplankton is a primary index of some ecosystem problems and a basic means of assessing the primary production of marine ecosystem. In this paper is focused on quantitative assessment of phytoplankton by analyzing the relation between phytoplankton quantity and remote sensing data.

Summary

In the marine remote sensing survey, water colour is used to measure the concentration of phytoplankton chlorophyll-a. The concentration value of phytoplankton chlorophyll-a on sea surface is very similar to the observation one in situ.

NDVI is closely related to the growth of phytoplankton. NDVI is for surveying the growth of vegetable by remote sensing and is very effective to find out vegetable existence and growth status, assess its quantity, define temporal and spatial distribute.

The experiments we had made show that the relationship between NDVI from NOAA/AVHRR and phytoplankton chlorophyll-a is an exponential one.

This paper suggested one estimated model for phytoplankton quantity at the coast under the restrict condition that we can receive only from polar orbit satellite NOAA for marine remote sensing. We can approximately estimate phytoplankton quantity in the coastal water area of the Yellow Sea by satellite NOAA and however enhance the estimated precision by using finer and more precise remote sensing data from marine satellites and MODIS data.

Status and trend of coastal recreational waters in Qingdao: *Juying Wang*

NMEMC, China

Lying on the south coast of the Shandong Peninsula, Qingdao is a city of picturesque red-tiled roofs nestled between green hills and blue sea. Every year, more than 30 million domestic and overseas tourists are attracted by the mild climate, bathing beach, and Mount Laoshan. The total tourism revenue exceeded 40 billion RMB. Coastal recreational waters are valuable resource for development of the local economy.

The primary problem of water quality in coastal recreational waters is fecal contamination. Fecal pollution in recreational waters can lead to health risk due to the presence of infectious microorganisms. Microbial indicator bacteria, for example fecal coliform and *Enterococci,* are generally used for assessing water quality. In this study, 95% compliance level and geometric mean values of fecal coliforms are chosen to assess water quality. 95th values of annual fecal coliform cells in coastal recreational waters in Qingdao were shown in Fig.1. The results demonstrated that the water quality tended to become "Good" from poor since 2002 to now.

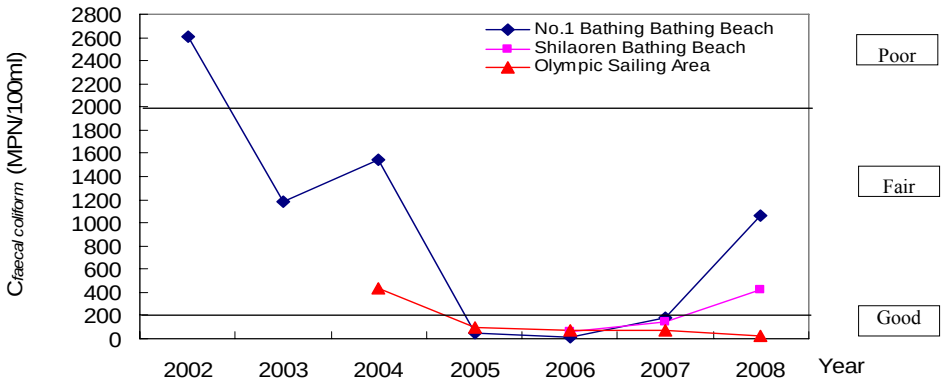

Fig.1: 95th value of annual fecal coliform cells in target areas

There are many factors that have impact on recreational water quality. Rainfall, hydrodynamic condition (including tide and current), sewage discharge, sunlight, swimmers are recognized as the most important factors. Fig.2 showed the positive correlation relationship between the rainfall and bacterial cells. It was shown that the cells of fecal indicator bacteria remained at high level even at 4 to 7 hours after heavy rainfall. It was observed that the water quality generally restored to its previous status after 3 days of rainfall.

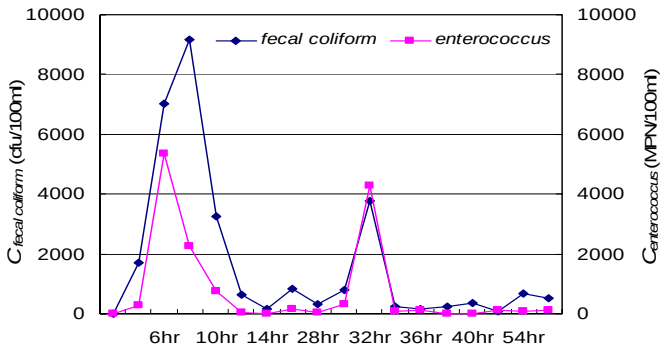

Fig.2: Variation of indicator after rainfall

Combining with the management action taken by local government, the causes of water quality change were analyzed. Based on the analysis of spatial and temporal variation of fecal indicator bacteria, a preliminary study on water quality forecasting model was conducted. The warning system of water quality could help improve the accuracy of beach closure decisions.

In our study, we also identified the gaps in existing monitoring system and management action on the basis of analyzing collected data and information, and put forward recommendations on monitoring programme and management of recreational waters.

Monitoring and estimation of land-based nutrient loads in the Yellow Sea region: Methodology and case study: *Zhifeng Zhang*
Lijun Wang, Jingli Mu, Yuewen Jiang

NMEMC, China

Land-based nutrient loads are the major source of nutrients for coastal ecosystems of Yellow Sea, either from natural background discharge or from human activity-related discharges. Systematic monitoring and research has been done to establish methodology for estimation of total loading of nutrients from different sources, choosing Yalu River watershed and estuary as the demonstration area. Point sources such as municipal sewage collection-and-discharging systems, industrial wastewater collection-and-discharging systems were seasonally monitored; TN and TP concentrations of water samples from Yalu River were also seasonally monitored, but the flux of the river was monitored monthly. Nutrient load calculation methods were separately established for different categories of point sources, according to their different discharging characteristics. Experimental models, such as ArcGIS-based Universal Soil Loss Equation (USLE), were employed to evaluate the contribution of non-point sources to the total loadings of Yalu River. Historical data were used to complete monthly, seasonally and annually variations of nutrient loads in Yalu River watershed. It was calculated that the annual loads of TN and TP to Yalu River estuary were 37,670 tons and 3,370 tons, respectively, in which Yalu River contributed more than 95% of nutrients, originating from non-point sources and industrial and municipal wastewaters. The applicability of the methodology for nutrient loads estimation was also discussed.

Improving biodiversity conservation in Ganghwa Tidal Mud Flat, Korea: *Gyung Soo Park*

Anyang University, ROK

Ganghwa Southern Tidal Flat (GSTF) is located in the delta area of Han River estuary and the largest mud flat in RO Korea. The habitat was designated as demonstration site for YSLME biodiversity activities to improve management planning and implementation. Benthic biodiversity and pollution status/loadings were estimated to identify the environmental issues to be managed. As a result we identified nutrient/organic pollution, marine litter and development plans for construction of two tidal power plants in the habitat as the most critical issues threatening the habitat conservation. We reviewed existing environmental laws and regulations, coastal zoning, current management plans and pollution control in the region. Based on the above review we proposed new management plans for the better management in the area. Major plans include re-zoning of coastal use, possible amendment of current laws and regulations, establishment of Han River Basin Working Group to reduce the pollution loadings through Han River, and increase of public awareness and education. We presented the plans to a range of stakeholders including local and provincial government, NGO's, scientists and the general public at various meetings and revised them according to feedback.

For the implementation of management plans we propose top-down and bottom-up (community based) approaches simultaneously. We identified key organizations, departments, ministries for implementation mechanisms. Bottom up approaches from local to central government are more efficient to implement management plans in terms of the time and possibility of success. Public awareness and education are essential under current conditions. Gradual increase of public awareness, education and training for the local people can improve the understanding on the importance of ecological roles and services of the GSTF. This can provide support for the designation of the tidal flat as national marine protected area (MPA). This presentation deals with a series of surveys and activities to produce a more efficient and practical management plan and implementation mechanism to conserve the critical sites for biodiversity conservation in the Yellow Sea. We hope this demonstration could be used a model case for the coastal habitat management planning in the region. Supported by YSLME biodiversity project.

Landscape changes during 1970-2007 in Yancheng Biosphere Reserve, Jiangsu Province, China: Implications for biodiversity conservation: *Ping Zuo*

Nanjing University, China

The Yancheng Biosphere Reserve (YBR) is located in the middle-east part of Chinese coast facing the Yellow Sea. It is the largest tidal flat nature reserve in China stretching for more than 900 km along the coast of Jiangsu Province and an area of 45.33×10^4 ha. It is recognized as one of the most important Marine Protected Areas in China since 1983 with the major aim of protecting an endangered bird species, the red-crowned crane (*Grus japonensis*) and other rare species, and their habitats.

The paper analyzes the landscape changes in the core area of YBR based on the topographic data of 1970, remote sensing data of 1987, 1992, 1997, 2002 and 2007 to acquire the landscape and land use changes in temporal and spatial scales. Results show that there is an obvious degradation trend of original wetlands shifting to other land uses for different objectives during 1970-2007 periods because of important events: ① Plantation of alien species; ② Original wetlands losses while with artificial wetlands increase; ③ The buffer zone and experimental zone of YBR have been under serious threat from industrial and agricultural waste, and extensive economic development in the coastal zone which has resulted in the loss of biodiversity and habitat. The after-effects of the landscape changes was reflected by the number of red-crowned cranes living in YBR as one of the most important winter migrating species in YBR.

Therefore, wise use of wetlands needs wise planning that is friendly to biodiversity conservation and ecosystem protection. Any human-induced activities in the Reserve should be evaluated prior to implementation in order to minimize the pressure to whole ecosystem. In addition, there are many problems happening in the buffer zone and experimental zone which should be controlled through introduction of strict measures to restore the whole coastal ecosystem.

Keywords: Landscape change; Biodiversity conservation; Red-crown cranes; Yancheng Biosphere Reserve

Degradation pathway of pyrene in *Novosphingobium pentaromativorans* US6-1: Potential for bioremediation of PAHs contaminated environment: *Yuanrong Luo Kaekyoung Kwon, Sangjin Kim*

KORDI, ROK

Polycyclic aromatic hydrocarbons (PAHs) are a class of toxic environmental pollutants consisting of two or more fused benzene rings. Anthropogenic inputs of PAHs from oil spills, ship traffic, urban runoff, wastewater and industrial discharge, as well as atmospheric fallout of vehicle exhaust and industrial stack emissions, have caused significant accumulation of PAHs in the marine environment. *Novosphingobium pentaromativorans* US6-1 was isolated from sediment of Ulsan Bay and has broad substrates that can degrade PAHs of two to five rings, including pyrene. Genomic and proteomic approaches were utilized to investigate pyrene degradation pathway in *N. pentaromativorans* US6-1. Genome sequence analyses identified genes involved in the pyrene degradation pathway that we have proposed for this bacterium. Total proteins were separated by one- and two-dimensional gel electrophoresis after pyrene exposure, and then identified by liquid chromatography/tandem mass spectrometry (LC-MS/MS). Based on genome and proteome analysis, we proposed a pyrene degradation pathway in *N. pentaromativorans* US6-1. Degradation of pyrene in *N. pentaromativorans* US6-1 proceeds via multiple metabolic routes initiated by mono-(C-1,2 and C-4,5) and dioxygenation (C-4,5) reactions, further degradation via either *o*-phthalate pathway or salicylate pathway, both pathways subsequently entered tricarboxylic acid (TCA) cycle and were mineralized to CO_2. Results in this study establish a basis for the understanding of metabolisms of microbial degradation of high molecular weight PAHs, which is necessary in order to design efficient and predictable bioremediation procedures.

Assessment of eutrophication status in Toyama Bay based on the "Procedures for assessment of eutrophication status including evaluation of land based sources of nutrients for the NOWPAP region": *Genki Terauchi*
Ryo Tsujimoto, Joji Ishizaka

NOWPAP-CEARAC, Japan

Degradation of water quality possibly caused by eutrhophication has been reported in Toyama Bay, Japan, a semi-enclosed bay located in the center of the Honshu Island of Japan. Salinity is often low at coastal area of the bay due to influence of fresh water from rivers, and discharge from 5 major rivers greatly contributes to supplies of nutrients into the bay. In 1970s, when Japan was in a period of rapid economic growth, large amount of nutrients were transported from rivers to coastal area of the bay and occurrence of diatom red tides were frequently reported in spring to summer. Water quality, measured by Chemical Oxygen Demand (COD), recovered in 1980s; however it degraded again in 1997. Toyama prefectural government reported that possible cause of this degradation was due to increase of phytoplankton in summer.

A holistic assessment, based on the "Procedures for assessment of eutrophication status including evaluation of land based sources of nutrients for the NOWPAP region" developed by NOWPAP CEARAC in 2009, was conducted to understand the mechanism of eutrophication in the bay. High status and increase trend of nutrients were observed eastern part of inner bay and it possibly lead to the increase COD. Although phosphate in coastal area of the bay decreased reflecting measures to reduce phosphate from industrial effluent water, nitrogen rather increased in coastal area of the bay. We concluded that increase of total nitrogen to the bay is one of the main causes of the recent degradation of water quality in the bay. We believe that the same methodology can be applied to other areas including Yellow Sea and it may enable assessment of eutrophication in regional scale.

Estimating the benefits of improving environmental quality in the Ganghwa tidal flat:

Isao Endo
Mark Walton, Sunyoung Chae

UNDP/GEF Yellow Sea Project

The tidal flat of the Ganghwa Island, located on the west coast of Republic of Korea, provides habitats for various creatures, including the last remaining populations of black-faced spoonbill, one of the endangered species. This area is losing its biodiversity due to anthropogenic activities such as organic pollution, reclamation, and overfishing. To reduce the negative impact of these activities, a recently-implemented demonstration project "To improve management in critical habitats" has introduced a new management plan. The plan proposes management actions, including the introduction of total maximum daily load to improve the surface water quality in the habitats. This study examines the benefit of improving the environment (e.g., water quality improvement) as planned, estimating the change in economic value of non-market recreational opportunities that the tidal flat provides. On-site and face-to-face questionnaire surveys targeting visitors to the Dongmak Beach and the Ganghwa Tidal Flat Center have been conducted; as a result, total 400 samples have been collected. A combined model of travel cost and contingent behaviour estimates demand schedules for the recreational opportunities with the following different levels of environmental quality: (i) actual current environmental quality, (ii) hypothetical future degraded environmental quality without management, and (iii) hypothetical future improved environmental quality with management. Economic benefits of improving the environmental quality are calculated based on the estimated model. Early results indicate that improving the tidal flat management with the introduction of the proposed plan would generate economic benefits. The results would provide managers and decision-makers with valuable information on investing in the tidal flat conservation.

Cost-benefit analysis of integrated multi-trophic aquaculture: *Mingyuan Zhu*
Wei Zhen

FIO, China

Integrated multi-trophic aquaculture (or polyculture) is an approach to mitigate ecological effects of mariculture and its benefits are prompting increased interest among researchers and commercial growers worldwide.

In this paper we use Cost-Benefit Analysis (CBA) and Emergy method to compare different culture modes of Sanggou bay. In CBA method, we propose a new index----Relative Coefficient (RC) in order to balance the benefit and efficiency. As an integrated index, RC is an important attempt of decision-making standard in CBA. Furthermore, we develop Emergy analysis framework of mariculture ecosystem, and present energy flow process of different culture modes.

The result of CBA shows that the descending order of Net Present Value (NPV), Benefit to Cost Ratio (BCR) and Relative Coefficient (RC) follows as: polyculture of kelp and scallop, monoculture of kelp and monoculture of scallop. And polyculture of kelp and scallop is the most sustainable culture mode in the three modes from both economic and environmental aspects. It shows from Emergy approach that the index of sustainability (ESI) of monoculture ecosystem of kelp, monoculture ecosystem of scallop, and polyculture ecosystem of kelp and scallop are respectively 0.019, 0.0187 and 0.0196. In these three culture mode, polyculture ecosystem of kelp and scallop has the largest ESI, so it is the most sustainable.

Stakeholder capacity and participation in ecosystem recovery of Masan Bay: *Chan-Won Lee*

Kyungnam University, ROK

A variety of coast usage has caused damage to the fisheries and recreation. A large amount of sewage has been discharged through short streams into the Masan Bay without proper treatment in the period of 1970~80, which led to closure of recreational beaches and had a prohibition of shellfish harvesting in 1979. The first large-scale red tide outbreak (1981) was observed in the Masan-Jinhae Bay. The Masan Bay was designated as one of Special Management Area. A large sewage treatment plant was constructed, started its operation in 1994 and upgraded until 2007. Sediment dredging was applied to the bay as a decontamination process from 1990 to 1994. The amended Marine Pollution Prevention Act in 1999 has provided the legal framework for the watershed-based approach to be applied to the marine environment management in Korea. However, laws are just words unless there is political will and funds available to implement and enforce them. A huge gap in ecosystem recovery for fishable water remains. The Korean government has been planning to introduce a total pollution load management (TPLM) system into the coastal environment management regime of the Masan Bay. TPLM has been initiated since 2005 to assess total pollution load and carrying capacity, and allocated reduction load to each city (Masan City, Jinhae City, and Changwon City). Based on the newly formulated mechanisms, central government, local government, three cities, the navy, academies, business sectors and NGOs established a Community Advisory Council. They had 14 meetings together from 2006 to 2009. A close collaboration of stakeholders in this effort is recovering and preserving the bay ecosystem. Major action plans of TPLM include the regulation of polluted runoff by formulation of natural streams and repair works of sewer lines, increase of removal efficiency in wastewater treatment plant, and control of coastal development. Members of Community Advisory Council have experienced that encouraging participation and collaboration was a platform for building capacity, resolving conflicts among them and implementing TPLM in Masan Bay. There should be institutional mechanism applicable on a local base in making decision such as reclamation in coastal seas. Good governance is generally characterized as referring to openness, participation, accountability, predictability, and transparency giving stakeholders the capacity to participate in the decision that affect their lives. There are still conflicts to be resolved in Masan Bay with reclamation pressure even though we learned that stakeholders' voluntary participation is key success factor in achieving ecosystem recovery. The main effects of governance on ecosystem recovery occur through stakeholders' collaboration and maturity.

SESSION 4: GOVERNANCE AND CO-OPERATION

Institutionalizing current efforts through YSLME Commission: *Suh-Yong Chung*

Korea University, ROK

After its successful implementation of planned activities of the UNDP/GEF YS LME Project during the 1st phase, participating governments and other stakeholders are about to start the 2nd phase of the YS LME Project. As its ultimate goal is to establish an effective management mechanism of the Yellow Sea region through which serious marine environmental stresses can be addressed, it is highly expected that the YS LME Commission will play a central role in coordinating necessary activities in the region.

In fact, the idea of the YS LME Commission was introduced by the Strategic Action Plan of the 1st phase of the YS LME Project. According to the SAP, which proposed management actions required in the region until 2020 and was recently endorsed by ROK and China, YS LME Commission is soft and cooperative nature of institution. In order to implement the proposed activities effectively, the YS LME Commission will have a supreme decision making body, sub-commissions (or working groups) and a permanent secretariat.

As the YS LME Project is in the middle of preparing for launching the 2nd phase which will last for five years, it is critical to make feasible plans on how to launch the YS LME Commission and how to develop its institutional and governance structure in more detail. One of the options may be to form a Task Force which will address the issues on the creation of the YS LME Commission according to the guidelines to be developed by the participating governments and other stakeholders. This will ultimately guarantee the legitimacy and effectiveness of the YS LME Commission.

Legal improvements in fisheries law under the context of YSLME: *Ming Yu*

OUC, China

Fisheries laws have been developed in China for more than 50 years, consisting of more than 500 laws, regulations, department rules, local government rules and standards. However, compared with relevant international conventions and guidelines, there are still many shortcomings existed.

Using the platform established by the YSLME Commission, actions can be taken to improve the legal arrangement for fisheries management under the context of YSLME. The actions may include: 1) finding out the shortcomings of domestic laws which influence the implementation of fisheries management; 2) comparing domestic laws of China, ROK and DPRK to reveal the advantages and disadvantages of each country's legal arrangements; 3) establish regional guidelines or model laws to cover the gap between national laws and international guidelines (FAO Code of Conduct for Responsible Fisheries) and to address the advanced legal system and regulations and management experiences in each country's domestic laws; 4) carrying out demonstration activities to test the guidelines or model laws and make revisions accordingly.

Requirements for widening partnership for ecosystem-based management of the Yellow Sea - With special focus on the roles and needs of the NGOs: *Sadayosi Tobai*

WWF Japan, Japan

During the 1st phase of the UNDP/GEF Yellow Sea Large Marne Ecosystem Project (YSLME) between 2005 and 2009, a number of international environmental NGOs and research institutes have participated in the planning process of the Trans-boundary Diagnostic Analysis (TDA) and the Strategic Action Plan (SAP). A larger number of NGOs in China and Korea also participated in taking actions for conservation of the ecosystem notably through conducting projects that were supported by two small grant schemes: one by the YSLME project, a government-lead project and another by the Yellow Sea Ecoregion Support Project, a NGO-initiated project. In addition, the YSLME project made an intentional effort from the beginning of the project to encourage participation of NGOs in the YSLME project by organizing various regional as well as national workshops and the Yellow Sea Partnership meetings, whose membership consists of environmental NGOs in China, Korea and beyond is one such good example.

Reviewing roles played and contributions made by these NGOs for environmental conservation for the past five years should give useful insights into practical roles and needs of the NGOs in future. In turn, these insights will be valuable lessons learnt and they should be actively reflected in developing and widening partnerships for implementation of the ecosystem-based management with NGO community.

Results of the review show that the NGOs had the following roles and achievements: 1) raising awareness of local government and local communities including school students about the importance of local habitats and species that are of regional significance, 2) assisting local communities to develop sustainable use plans such as tourism, 3) assisting local communities in restoring and enhancing local cultural activities and traditional fishing method, 4) conducting scientific surveys to generate data on threats to habitats and species, 5) organising scientists to conduct inter-disciplinary assessment of critical habitats and species, 6) assessing management effectiveness of current MPAs.

Based on the results of this review, when the YSLME regional and national SAPs will be implemented, NGOs can be expected to play the following roles: 1) linking the regional and national SAPs with local governments and communities, 2) linking relevant scientists with local governments and local communities, 3) raising awareness and building capacity of local governments and local communities.

It is expected that some part of the SAPs, especially management actions for habitats conservation will need to involve local government and local communities. These three roles will be required elements of introducing and implementing ecosystem-based management in the field and NGOs are based placed to play such roles.

However, NGOs will need adequate support in the following area in order to play the expected roles effectively: 1) financial support such as small grants for coordination with local government and local communities, 2) regular opportunities to exchange experiences and lessons learnt such as a regional forum, 3) a formal recognition of their roles and contributions to the SAP implementation such as a formal participation in the governance mechanism of the Yellow Sea Commission.

One step at a time: Overcoming challenges to conservation in the Yellow Sea: *Nial Moores*

Birds Korea, ROK

In addition to their importance for fisheries and a broad range of ecosystem services, the inter-tidal, marine and island habitats of the South Korean part of the Yellow Sea regularly support at least 30 bird species of global Special Conservation Concern. In line with existing obligations (including under the Millennium Development Goals, Ramsar, and the Convention on Biological Diversity [CBD]) the conservation of such species ought to be a national and regional priority, yet most remain threatened by human activities in the short-term (through reclamation and infrastructure development), mid-term (e.g. through the proposed development of tidal power plants) and long-term (through human-induced climate change and e.g. unsustainable fisheries practices). Major information gaps remain and conservation capacity and political opportunity are also limited. With 2010 the United Nations' International Year of Biodiversity [IYB], the conservation NGO Birds Korea is developing a Blueprint for the conservation of the Avian Biodiversity of the South Korean Yellow Sea that aims to close key information gaps; to identify populations in decline; to strengthen linkages between existing initiatives; and to promote positive conservation approaches. The Blueprint is based on field research (including the Saemangeum Shorebird Monitoring Program, counts of seabirds at sea, and survey of island-breeding species) and literature review (both science and policy). Analysis will identify population trends in selected species, and key sites will be examined to highlight the failure or success of existing conservation approaches. Potential costs and benefits of development decisions and existing conservation initiatives will also be introduced through case studies (e.g. on the Critically Endangered Spoon-billed Sandpiper). The Blueprint will be published in Korean and English in both hard copy and online in the run-up to the CBD Tenth Conference of the Parties (October 2010), and supported by educational materials and public meetings, timed to benefit from other IYB-related activities.

POSTER PRESENTATIONS

Polychlorinated biphenyls, organochlorine pesticides, and polycyclic aromatic hydrocarbons concentration in the water column and sediments of Yellow Sea: *Jae-hyun Bang*

KORDI, ROK

Polychlorinated biphenyl (PCBs), polycyclic aromatic hydrocarbons (PAHs), and organic chlorobiphenyl pesticides (OCPs) in seawater and sediments which were collected from Yellow sea in 2008 were determined for the current status and the spatial trends of those pollutants. The mean concentrations of total PCBs and PAHs and OCPs in seawater were 52.4 ng/L, 447.07 ng/L and 30.96 ng/L, respectively. Total PCBs in seawater of winter was 3 times higher than that of summer. Total OCPs concentrations were less than 52.64 ng/L and there was no significant difference between summer and winter. In the surface sediments, the mean concentration of total PCBs and PAHs and OCPs were 101.33 ng/L, 135.68 ng/L and 36.32 ng/L, respectively. Relatively high concentrations of these were found at central area of Yellow sea. This may be influenced by a geomorphological characteristics and/or the current movement of the Yellow sea. Our data provide a basic data for interpretation of PCBs, PAHs, OCPs in the Yellow sea which was characterized by a semi-closed sea between Korea and China.

Marine diatom-derived aldehydes induce deleterious effect on the reproduction of *Calanus sinicus*: *Jie Li*

Qingdao Technological University

Diatoms are ubiquitously present in marine and freshwater habitats, and are regarded as a good food source for copepods and important for fisheries. However, recent evidence has shown that certain diatom diets can seriously impair the reproduction of copepods. One possibility might be toxic secondary metabolites that induced females to produce low-quality eggs or preventing eggs from hatching. To date, whether common diatom species in Yellow Sea have chemical defences against dominant copepods was not well understood. In this paper, 2 diatoms: *Skeletonema costatum* (SC), *Chaetoceros muelleri* (CM) and 2 non-diatom diets: *Prorocentrum micans*(PM), *Scrippsiella trochoidea* (ST) were tested during the course of 15d experiment, examining the effects of these algae on the reproduction on the copepod *Calanus sinicus*, a target species in the project of China GLOBEC (Global Ocean Ecosystem Dynamics) and dominant constituent of mesozooplankton communities in Yellow Sea. HS-SPME (Headspace solid-phase microextraction) / GS-MS (gas chromatography–mass spectrometry) was developed for the analysis of aldehydes produced by phytoplankton. The results showed that, compared with PM and ST, diatoms SC and CM induced inhibitory effects on female survival, egg production and egg hatching for *Calanus sinicus*. By the analysis of aldehydes, there were 6 kinds of aldehydes (trans-2-hexenal, heptaldehyde, trans-2-heptenal, trans-2,4-heptadienal, trans-2-decenal and trans-2,4-decadienal) detected in SC, and 5 kinds detected in CM, whereas only 2 kinds of aldehydes (trans-2-hexenal and trans-2-heptenal) were found in PM and ST. Furthermore, the total content of aldehydes in SC (982.08 10^{-3}μg /g) and CM(397.86 10^{-3}μg /g) were significantly higher than those in PM (28.90 10^{-3}μg /g) and ST (82.84 10^{-3}μg /g). Both egg production and hatching success were negatively correlated with the total content of aldehydes. Therefore, the evidences indicated that aldehydes produced by diatoms caused potential negative effect on the reproduction of *Calanus sinicus*.

Key words: diatom, *Calanus sinicus,* aldehydes, Yellow Sea

Monitoring and assessing sea-based sources of nutrients: *Guiying Liu*
Ai Li, Nianbin Wang

Liaoning Province Ocean and Fishery Bureau, China

To investigate pollution from mariculture sites and total nutrient load from mariculture farms, and how to reduce nutrient loads, sea-based sources of nutrients were monitored and assessed in Qingduizi Bay. With the coefficient of pollution discharge, the overall pollution discharge of mariculture was measured and estimated. The results showed that the contribution of sea-based discharge of nutrients to total loads is about 2.30%. In addition, the nutrients in sediments were measured and estimated in Qingduizi Bay. The spatial and temporal distribution of nutrients in sediment was estimated. The levels of nutrients in the sediment were compared in the interstitial water and the overlying water. The results showed the significantly larger flux SiO_3^{2-}, NH_4^+ and NO_3^- was observed in the sediment-water interface of Qingduizi Bay, which suggested the nutrients were released by the sediment. NH_4^+ and NO_3^- diffusion across sediment–water interface was the dominant process of DIN exchange. So assessment of yearly fluxes of nutrient in Qingduizi Bay was a clear complementary way of estimating the source of nutrients. According to the result of the experiment, we made some suggestions for finding an effective or optimal culture model that will not only yield high quality aquatic products, but also provide ecological and socio-economic benefits.

Population dynamics of *Calanus sinicus* in the Yellow Sea Cold Water Mass: an indicator for the impacts of climate change on the ecosystem of the Yellow Sea: *Xinming Pu*
Ping Liu, Zongling Wang

FIO, China

Calanus sinicus is the dominant planktonic copepod in the Yellow Sea and East China Sea. In summer, *C. sinicus* in the Yellow Sea Cold Water Mass (YSCWM) are in a state of diapause. The diapause was attributed to the adaptation of this species to the low temperature and low food availability in the YSCBW. With the climate change, the YSCWM fluctuated significantly in the past 50 years. So what is the relationship between YSCWM oscillation and population dynamics of *C. sinicus*?
Historical data from 1958-59 on *C. sinicus* and YSCWM were collected and analyzed. In the central part of the southern Yellow Sea (where depth is more than 50m), abundance of *C. sinicus* was highest in summer and lowest in winter. This seasonal pattern is just contrary to that in the shallow coastal waters. The YSCWM is a good shelter for *C. sinicus* to survive in hot summer. However, with a warming trend in the past 50 years in the Yellow Sea, the yearly average abundance of *C. sinicus* increased from 43.37 ind.m^{-3} in 1959 to 73.28 ind. m^{-3} in 2006-07. Did this increase indicate *C. sinicus* benefited from warming?

A theoretical model was proposed to interpret the relationship between YSCWM and *C.sinicus*. In cold years, the strong thermocline obstructs the nutrient supply from depth to surface and results in lower phytoplankton biomass. *C. sinicus* is forced into diapause in this habitat of low temperature and low food availability. In warmer years of YSCWM, however, thermocline is relatively weaker and nutrients can support a higher phytoplankton biomass. *C. sinicus* is more active in vertical migration, feeding, moulting, and spawning and thus has a higher production rate. The success of *C. sinicus* reflects its diverse life history strategies and high adaptation ability to the changing environments of the Yellow Sea. This result is also helpful for us to forecast the population dynamics of *C. sinicus* when climate will change in the future.

Improve stakeholder training in a critical habitat of seagrass beds: *Yamin Wang*

Shandong University at Weihai

The seagrass is a unique group of flowering plants that exist fully submersed in the sea and the taxa, regarded as seagrasses, include 60 species, It develops extensive beds at the interface between the water column and sediment in tidal or subtidal environments. It was considered one of the most important ecosystem engineers and its metabolism affects carbon and nutrient dynamics and oxygen concentration in coastal areas.

Seagrasses are threatened by coastal development and growing human population, as well as climate change. One comprehensive global assessment of 215 studies published in 2009 found that seagrasses have been disappearing at a rate of 110 km^2 yr^{-1} since 1980 and that 29% of the known areal extent has disappeared since seagrass areas were initially recorded in 1879. Human impacts on seagrasses are mainly in three ways: eutrophication, sedimentation and contamination. In the Yellow Sea eco-region, seagrass beds are one of the most important components, distributed along the coastal area of Shandong Province. While across this region, the seagrasses are mostly found in the coastal areas of Yantai and Weihai city and dominated by 4 species of marine eelgrasses or *Zostera*.

We initiated activities to increase public awareness on sustainable utilization and conservation of seagrass bed in our demonstration site, Weihai, thorough providing a series of stakeholder training with specific objectives; To spread the information of the ecological and economical significance of seagrasses to different stakeholders; To enhance the cooperation between governments, NGO, research institute in seagrass bed conservation; and as a demonstration to derive the successful experience or lessons for replication activities in the future.

We also hosted “China seagrass bed recovery and conservation workshop” to consult about future China seagrass conservation and habitat activities

Distribution pattern of photosynthetic picoplankton and heterotrophic bacteria in South Yellow Sea in summer and winter in 2008: *Zongjun Xu*

FIO, China

The environmental regulation of picoplankton distribution in South Yellow Sea was examined in winter and summer of 2008. The average abundance of *Synechococcus* spp. and heterotrophic bacteria was lower in winter (6 and 479×10^3 cells/cm^3, respectively) than in summer (52 and 1214×10^3 cells/cm^3, respectively), but the seasonal pattern was opposite for pico-eukaryotic phytoplankton (2.65 and 1.90 cells/cm^3 in winter and summer, respectively). *Prochlorococcus* spp. were only detected in the summer cruise. The average abundance of *Prochlorococcus* spp. were 40×10^3 cells/cm^3. *Synechococcus* spp., pico-eukaryotes, and bacteria were most abundant in the nutrient-rich coastal zone and sea area near the Yangtze River estuary. From coastal waters to the open sea, the distribution of photosynthetic pico-plankton changes obviously, along with the changes of environmental factors. Horizontal distribution feature is that the coastal waters have a large abundance, and in the open sea the abundance is much smaller. The vertical distribution of photosynthetic pico-eukaryotes can be divided into three categories: many in surface and reducing rapidly, a certain number in surface and gradually decreasing down, intermediate type. Finally, the reason why the distribution characteristics of photosynthetic pico-plankton in south yellow sea are so different appears to be due to two factors: Yellow Sea Cold Water Mass and Yangtze River diluted water.

The effect of warm water discharged from power plant to the marine ecosystem in East China Sea: *Ying Yang*

East China Sea Environmental Monitoring Center, China

The circulating cooling water of the fossil fuel/nuclear power plant is the largest source of thermal discharge in industries. This paper describes the large quantity of residual heat contained in thermal discharge, which may induce thermal pollution in the physical and chemical properties of water, as well as the marine ecosystem.

Three power plants in East China Sea were selected to describe the effect of warm water discharge to the ecosystem. From the monitoring results, we observed that discharges caused different effects in different locations. The dominant species are different between the periods before and after the power plants were running, and clear changes in the phytoplankton, zooplankton and benthic community are reported. In the Tianwan nuclear station warm water discharges into the sea area, the maximum phytoplankton density was found in the zone in which temperature rises about 4℃. In the Yueqing and Kemen power plants warm water discharge sea area, fish eggs and larval densities were higher than in other regions, in contrast the number and density of benthic species decreased.

The results suggested that warm water discharge sea areas were not suitable for sea-water aquiculture，the function of the sea are must be adjusted. It is proposed that revision of the temperature clause of water quality standard is needed in order to strengthen effective management of the warm water discharged.

Ecotoxicological approaches on the coastal ecosystem management: *Sung Jin Yoon*

KORIME, ROK

Ecotoxicological test process referred to the standard methods established by USEPA, international organizations and European methods applied to assess the toxicity of effluents and receiving water to freshwater and marine organisms. Six standard methods for marine ecotoxicological tests were established using marine decomposer, primary producers and consumers (such as bioluminescent bacteria, diatom, seaweed, rotifer, benthic copepod, benthic amphipods, and fish), which were selected among the domestic species generally found in the Korean coastal area. Bioassays for ecotoxicological approaches to assess the toxicity of toxic materials, which include major ocean dumping materials such as chemicals, domestic waste and dye, leather, and livestock waste in the Yellow Sea of Korea, have been tried using various test species and methods.

For example, ecotoxicological toxic tests using the nauplius of the harpacticoid copepod *Tigriopus japonicus*, which is widely distributed in coastal water of Korea and plays important role in marine trophic structure as a first consumer, were conducted using ecological assessment of the marine dumping pollutants. There was significant concentration-response relationship in mortality of *T. japonicus* nauplius using elutriates of ocean dumping materials (industrial waste sludge and chemicals). These results suggest that the ecotoxicological study of various toxicants (included marine dumping pollutants) must be conducted before release of potential harmful waste in the natural environment as part of an ecological risk assessment.

Based on the above experimental result, ecotoxocological approaches are suggested as a good tool for coastal ecosystem management for the screening of wastes dumped in the oceans and to protect the ecosystem from various contaminants introduced from the land to coastal areas.

Seagrass bed, the coastal oasis of Yellow Sea: *Xuelei Zhang*

FIO, China

Seagrass bed is a type of critical habitat in the sea, just like oasis in the desert. In an effort to identify representative coastal wetlands in the west bank of Yellow Sea, seagrass bed was ranked top on the list. Nonetheless, seagrass bed was largely overlooked for a long time in the region. According to the limited information available, seagrasses in this region experienced considerable declines, both in terms of distribution (>90% lost) and biomass (>50% lost). Studies have shown seagrass beds host diverse marine life and provide valuable ecosystem services to the human society, our latest study confirmed this with findings on one healthy seagrass bed that provided nursery for many valuable species (sea cucumber, crab, conch and finfish, etc.). The value was also recognized with local culture associated with seagrass thatched folk houses that use naturally shed seagrass collected from the shore as a roofing material. The major threats to seagrass beds in the region are believed be the result of a lack of awareness, heavy pressure from human exploitation activities and environmental changes. Recent social-economic development and climate change has brought many challenges to the human life, yet also presents opportunities for restoring coastal wetlands such as the seagrass beds. Since the beginning of the new millennium, researchers have been calling for public awareness of, and actions to protect/rehabilitate the seagrass beds in the region. As the first seagrass bed in this region established as a protected area, and thanks to efforts of projects both international and national, management and public awareness of the seagrass beds are being improved, and there is movement towards the proper development and restoration of these coastal oases of the Yellow Sea.

Hemocyte parameters of the Pacific oyster *Crassostrea gigas* a year after the Hebei Spirit oil spill off the west coast of Korea: *Kwang-Sik Choi*

Faculty of Marine Biomedical Science, Jeju National University

In marine bivalves, hemocytes support various physiological functions, including immune defense, nutrient transport, shell repair, and homeostatic maintenance. Although the effects of marine contaminants on the immunological functions of bivalves have been extensively investigated, the impacts of oil spills are not well understood. Therefore, we investigated hemocyte parameters in the Pacific oyster *Crassostrea gigas* 13 months after the Hebei Spirit oil spill (December 2007) off the west coast of Korea. The parameters studied included hemocyte concentration and mortality, relative proportion of hemocyte populations, and immunological functions such as phagocytosis and oxidative activity using flow cytometry. These immune-related parameters in oysters damaged by the oil spill were also compared to control oysters that were collected from an area unaffected by the spill. The flow cytometry study indicated that granulocyte population, phagocytic capacity, and reactive oxygen species production in oysters exposed to crude oil 13 months prior were depressed compared to the unexposed control oysters. Our data suggest that immunocompetence in oysters affected by the oil spill had not fully recovered 1 year after the accident, although more detailed studies on the physiology and disease resistance should be performed.

Comparative study on annual gametogenesis and reproductive effort of Pacific oyster (*Crassostrea gigas*) exposed to Hebei spirit oil spill on the western coast of Korea:

Kwang-Sik Choi

Faculty of Marine Biomedical Science, Jeju National University

The present study reports on the impacts of the Hebei spirit oil spill (December 2007) on gonad development and reproductive effort of Pacific oyster, *Crassostera gigas* in the spilled area. Condition index (CI), digestive tubule atrophy and gonad development of *C. gigas* were analyzed monthly over a year from the heavily exposed area and a control site. Shell growth and overall physiological condition of oysters from the spilled area were much slower and poorer during the spring of 2008, a few months after the accident. Oysters from the control site were sexually mature and ready for spawning in late June and spawning occurred during June and late July. In contrast, the oil-exposed oysters from the damaged area matured in July and spawned in August, suggesting retarded gonad maturation due to the stress from oil spill. In July 2008, GSI (gonad-somatic index, a ratio of egg mass to total tissue dry weight) of oysters from the control site ranged 40-55%, while the damaged oysters exhibited low level of GSI ranging 30-40%. Proximate composition analysis revealed that protein, lipid and carbohydrate levels in oysters from control site was 1.5-2.0 times higher than those of oysters from the damaged area in spring to mid summer. In contrast, protein, carbohydrate and lipid levels of oysters from the damaged area were significantly higher than the levels of oysters from the control site in late summer to fall, indicating that a certain level of physiological recovery occurred in the oil-damaged oysters in the spilled area. Our study suggested that the Herbei spirit oil spill did exerted a certain level of stress on oyster physiology at the early phase of the accident. Consequently, oysters in the spilled area exhibited retarded gonad maturation and accumulation of the storage materials and reduced egg production in spring spawning period, although such impacts become diminished by the fall of 2008.

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