UNDP/GEF/YS/RSP.4/8
Date: 2 November 2007
English only

Fourth Meeting of the Regional Scientific and Technical Panel for the UNDP/GEF Yellow Sea Project
Guangzhou, China, 26-28 November 2007

Progress of SAP Development

This Document describes the progress made during 2007 in developing the Strategic Action Programme (SAP) and the National Strategic Action Plans (NSAPs) for the Yellow Sea. The Document summarises activities that were conducted to prepare the SAP/NSAPs, highlighting major outputs from those activities. Relevant meeting reports as well as other key references are attached to this Document.

To prepare the SAP/NSAPs, the Project organised three brain storming meetings in 2007:

1. Consultation Meeting - (Jinghong, Xishuangbanna, Yunnan, China, 6-8 February 2007) prepared the "Conceptual Procedure" which describes the objective and central theme of the Project's SAP, the procedure and mechanism of preparing the SAP, and the timelines and responsible parties to prepare the SAP.

2. First *Ad-hoc* Working Group Meeting - (Hongchun, ROK, 10-12 April 2007) identified "Regional Targets" also known as Ecosystem Quality Objectives, which is "the ecological state that is aimed for by the year 2020" (Document UNDP/GEF/YS/AWG.2/2, Annex 2).

3. Second *Ad-hoc* Working Group Meeting - (Hangzhou, China, 18-20 August 2007) identified "Management Actions" which aim to achieve the regional targets.

A draft structure of the SAP which included some preliminary ideas on the Regional Targets and Management Actions was presented to the First *Ad-hoc* Meeting. The Second *Ad-hoc* Meeting prepared guidelines for demonstration activities and for two components of feasibility studies (i.e. cost-benefit analysis [CBA], political and social acceptance analysis [PSA]). The second Meeting also established an SAP drafting group consisting of five members: three natural scientists, one social scientist, and the Project Manager.

The RWG meetings organised after the above three preparatory meetings, reviewed and finalised the Regional Targets and Management Actions. The RWG meetings of natural science components assessed the technical feasibility of the proposed actions, while the RWG-I Component prepared implementation plans for the CBA and PSA. The RWG-I also prepared guidelines for preparing NSAPs and for conducting CBA of Management Actions.

In summary, the Project produced the following outputs in 2007 to develop SAP and NSAPs:

- Conceptual Procedure* finalised;
- Regional Targets* identified;
- Management Actions* identified;
- SAP Structure* drafted;
- Guidelines for demonstration activities prepared;
- SAP Drafting Group established;
- Call for Proposals for Demonstration Activities prepared;
- Technical Feasibility Study of Proposed Management Actions conducted;
- Implementation Plans of the CBA and PSA prepared;
- Guidelines for NSAPs development prepared; and
- Guidelines for CBA prepared.

For reference, the key outputs with an asterisk (*) above as well as the two *Ad-hoc* Meeting reports are attached as Annexes to this Document.

It is suggested that: (i) three sessions of the SAP Drafting Group are scheduled 2008 (January, March, and May); (ii) a Special PSC Meeting will be convened in April 2008 to review the final draft of the SAP; (iii) the expected time for obtaining endorsement of the SAP from the governments of China and ROK would be middle of 2008.

DRAFT STRUCTURE OF SAP

List of Abbreviations

Acknowledgement

1. ENVIRONMENTAL CHALLENGES IN THE YELLOW SEA: ENVIRONMENT STATUS

- Statement from the Project Document to find what was the knowledge when the project document prepared;
- Environment status according to the national reports and regional synthesis on the improved knowledge of the environment problems and causes;
- There should be an attempt to link the environmental problems to the Carrying Capacity of Ecosystem to provide a basis for SAP.

2. FINDINGS OF THE TDA: PROBLEMS, PRIORITIES, CAUSES AND POSSIBLE SOLUTIONS

Problems for Actions. With General information provided in the section 1, this section will provide specific information on the Problem, Priorities, Causes and possible solution.

The relevant parts of TDA should be summarised here with clear indication of WHICH AGENCIES need to take WHAT actions. This is scientific and environmental bases for the SAP.

3. EXISTING REGIONAL AND NATIONAL POLICIES AND LEGAL FRAMEWORK: GAPS FOR PROTECTION OF MARINE ENVIRONMENT AND SUSTAINABLE USE OF MARINE AND COASTAL ENVIRONMENT

Before identifying actions to address the problems, we need to find out why current governance system would not appropriately solve the problem. in another words, there is a need to identify the gaps in legislative, institutional and participatory approaches.

3.1 National Analysis

3.1.1 Governance analysis of China: legal, institutional and stakeholders analyses

Concise summary of the governance analysis from China will provide information on the governance status in China, with aims at to identify better management actions to improve it.

Avoiding copying the text from the report, the summary should have (i) proposed ideal management actions regarding governance issues; (ii) analysis of existing governance; (iii) gaps; e.g. enforcement and/or implementation; and (iv) recommendations.

3.1.2 Governance analysis of R. Korea: legal, institutional and stakeholders analyses

Concise summary of the governance analysis from ROK will provide information on the governance status in China, with aims at to identify better management actions to improve it.

Avoiding copying the text from the report, the summary should have (i) proposed ideal management actions regarding governance issues; (ii) analysis of existing governance; (iii) gaps; e.g. enforcement and/or implementation; and (iv) recommendations.

3.2 Regional Analysis

The same consideration should be given at regional level, but emphasis should focus on regional governance, focusing on a review of international and regional conventions, what is the (i) better governance in the Yellow Sea, and (ii) what are the gaps; and (iii) recommendations for regional governance.

Particular attention should be given to regional co-operation mechanisms, e.g fishery agreement, some non-legal binding approaches, or some relevant international conventions.

4. Environmental and Scientific Basis for the Management Strategies: Carrying Capacity of Ecosystem

This section is to establish scientific and environmental justifications to provide sound basis for the management action, and to establish the concept of the Ecosystem-based Approach to be taken in this SAP.

4.1 Carrying Capacity of Ecosystem

4.1.1 Definition of the Carrying Capacity of Ecosystem used in YSLME

The definition of the Carrying Capacity of the Ecosystem to be used in this document should be clearly provided here. It should clearly note that (i) the CCE of this project has slight different definition with others; (ii) why CCE is needed for management action; and (iii) how the CCE should be considered in preparing the SAP.

4.1.2 Ecosystem services

With reference to MA definition, this section will provide specific definition of the following services with special reference to the situation in the Yellow Sea. The management actions will focus on the recovery, maintaining and improvement of these services.

Relevant elements from the Concept Paper of SAP consultation should be included here with some more scientific explanations.

- *Provisioning services*
- *Supporting/regulating services* (Note the difference with MA's)
- *Cultural services*

4.2 Regional Ecosystem Quality Objectives (regional targets)

This is one of key parts of the SAP to provide the regional targets for the management actions. This section is very much reliant on the discussion and agreement of the ad-hoc working group.

Would it be possible to have more collective targets, instead of targets according to the project component?

5. MANAGEMENT STRATEGIES: INTERVENTIONS AND ACTIONS TOWARDS 2020

This is the section to provide management actions according to the regional targets established in the section 4.

Does the SAP need to provide both Strategies (overall plan) and Actions (process to achieve the target)?

5.1 Protection of Coastal and Marine Environment in the Yellow Sea

This section mainly contributes to the Supporting/Regulating services of the Ecosystem. It should cover Pollution, Biodiversity and Ecosystem components.

5.1.1 Identified areas requiring management actions: through the Causal Chain Analysis

As the causal chain analysis was done according to the project components, logically, the management actions should also be prepared in each component. However, as the CCE will be the linkage for ecosystem-based approach, there should be linkage between the management actions, not just between action and problem in each component.

Question: What kind of linkage should be established according to the CCE?

5.1.2 Management actions to remove the stresses: Management options and associated costs

This is the place to identify the management actions together with estimated costs, which may covers following elements.

The second meeting of the ad-hoc working group discussed this issue.

- *Harmonisation of legislation*
- *Institutional reforms*

- *Technical actions*

Question: how to group the actions is still a question that will affect the identification of management actions. For instance, the harmonisation of legislation and institutional reform will not need to follow the project components. But the technical actions may have specific actions to address specific problems.

5.1.3 Contributions to the ecosystem services: Scales of actions meeting the regional targets

How the identified actions should address to the regional targets for the management action?

5.1.4 Indicators of management actions (Process indicator, stress reduction indicator and environmental status indicator)

The indicators include the Process Indicator, Stress Remove Indicator and the Environment Status Indicator, as define by GEF. For each management action, there is a need to identify the success indicators that indicate how much success the implementation of the management actions can get, against the regional targets identified.

The meetings of the RWGs should also discuss this issue.

5.2 Sustainable Use of Coastal and Marine Resources in the Yellow Sea

This section mainly contributes to the Provisioning Services of the Ecosystem. It should cover mainly the Fishery component and partially Biodiversity. Ecosystem component has also roles in the provisioning service, in particular the productivities.

5.2.1 Identified areas requiring management actions: through the Causal Chain Analysis

Same as the section 5.1.1.

5.2.2 Management actions to remove the stresses: Management options and associated costs

- *Harmonisation of legislation*
- *Institutional reforms*
- *Technical actions*

Same as the section 5.1.2.

5.2.3 Contributions to the ecosystem services: Scales of actions meeting the regional targets

Same as the section 5.1.3.

5.2.4 Indicators of management actions (Process indicator, stress reduction indicator and environmental status indicator)

Same as the section 5.1.4

5.3 Upgrading National Capacity in Protection of Marine Environment

This is mainly the tasks of the Investment component. The "national capacity" does not mean the capacity within a country only, but also mean the capacity to participate in regional and international activities, which provide benefits to assist in addressing the protection of marine environment and sustainable use of coastal and marine resources.

5.3.1 Enhancement of Regional Co-operation mechanism

- *Data and information exchange and sharing*
- *Regional research and monitoring programme*
- *Regional agreement in co-operating efforts in marine environmental protection and sustainable uses of coastal and marine resources*

5.3.2 Enhancement of National Co-ordination

- *Preparation of National SAP*
- *National co-ordinating mechanism in dealing with marine environment*

5.3.3 Upgrading capacities of National Institutions

- *Capacities in Marine Environment management: Central and local Governments*
- *Involvement of all stakeholders, including NGOs and local communities*
- *Mechanism to exchange research and monitoring programmes and outcomes*

6. COST AND BENEFITS ANALYSIS OF THE MANAGEMENT ACTIONS: ECONOMIC INCENTIVES

This section will help the understanding of all stakeholders, in particular the national and local governments on the incentives created by the management actions. It is important to give clear and concise information in the section. It should not be too long, but enough for understanding of non economist.

- **Environmental Valuation (as 6.1)**
  - Economic value of goods & services
  - Negative externalities
  - Valuation techniques

- **Cost-benefit analysis (CBA) of management actions (as 6.2)**
  - Benefits and costs of actions
  - With-or-without action scenarios
  - CBA procedure

- **Case studies (as 6.3)**

6.1 Regional guidelines: Brief introduction

Based on the regional guidelines for environmental valuation, a summary of relevant parts of the guidelines should be prepared here, covering following elements, for instance.

Question: What depth of technical detail should be provided remains the question. Concise and informative are the requests, but they do not always go together.

There is a need to have contributions from the Investment group, in particular the economists involved in the project.

- *Basic environment economics: theoretical part*
- *Practical valuation:*
- *Case studies*

6.2 Costs and benefits analysis for management actions

How should the cost benefits should be done? To what level of details the analysis should go for the management actions?

The management actions should be grouped together where possible, and the impacts of the management actions should be estimated (the regional targets). With the impacts, it is anticipated the cost and benefit analysis could be carried out.

Question: Is there a need to have meeting of economists in this regards?

7. FINANCIAL MECHANISM FOR IMPLEMENTATION OF SAP:

Financial mechanism is an important element for GEF to consider for the next phase: Implementation of SAP. GEF will cover incremental costs to address the transboundary problems, and the national governments are responsible to address the environmental problems in the countries.

7.1 Existing Financing Mechanisms at National Level

There is a need to identify the existing financial mechanism in the participating countries to support the relevant action in protection of marine environment and sustainable use of coastal and marine resources.

At this stage, we do not have detailed information on the existing mechanism the participating countries deal with marine environmental issues.

7.2 Appraisal of Financial Requirements for the Implementation of YSLME SAP

In order to find appropriate financial mechanisms to support implementation of YSLME SAP, there is a need to have appraisal of financial requirements. From

costed actions identified in the Section 5, it would be possible to come up with idea, covering:

(i) Requirements from the governments of the participating countries;
(ii) Requirements from GEF to cover the incremental costs in a short period, e.g. 5 years;
(iii) Requirements for a long-term perspectives

7.3 Concept and Proposed Actions in Financing SAP

Concept should cover the issues of:

(i) Requirements
(ii) Responsibilities
(iii) Financial sustainability
(iv) Review and monitoring

7.4 Development of Financing Mechanism

Financing mechanism is largely an implementing mechanism, which would cover:

(i) national funding and mechanism for national problems;
(ii) regional funding and mechanism for transboundary problems;
(iii) establishment and management of regional funding; and
(iv) fund raising if necessary

8. REFERENCES

9. ANNEXES

UNDP/GEF PROJECT ENTITLED "REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM"

UNDP/GEF/YS/AWG.1/1
Date: 28 March 2007
English only

First Meeting of the Strategic Action Programme Ad-hoc Working Group for the UNDP/GEF Yellow Sea Project
Hongchun, ROK, 10-12 April 2007

Conceptual Procedure for SAP Preparation

Conceptual Procedure for SAP Preparation

Having completed the Transboundary Diagnostic Analysis (TDA), the UNDP/GEF Yellow Sea Project will develop a regional Strategic Action Programme (SAP) and the National Strategic Action Plans from 2007 through 2008. The SAP is a document that identifies policy, legal and institutional reforms, and environmental inventions to address transboundary environmental issues in the Yellow Sea. The SAP describes actions to solve major problems that the TDA identifies through its causal chain analysis.

For the SAP of the Yellow Sea Project, it is proposed to use the central theme of "Carrying Capacity of Ecosystem (CCE)" to link all Project Components—Biodiversity, Ecosystem, Fisheries, Investment, and Pollution The goal of the SAP for the Yellow Sea Project is to prepare management interventions to maintain and/or improve the Carrying Capacity of the Yellow Sea Ecosystem in order to ensure the continued provision of ecosystem services. These interventions will address environmental problems identified by the causal chain analysis of TDA. As the environmental problems are closely interlinked and interacted each others, the interventions will tackle them in a comprehensive manner, but not individually, as this will not achieve the primary objective, that of maintaining/improving the CCE.

As an initial step in the development of a Yellow Sea SAP, the Project convened an SAP Consultation Meeting (Jinghong, China, 6-8 February 2007). The Meeting of regional experts from relevant fields discussed in detail a process and a framework for preparing the SAP, as well as formulating a set of guidelines for subsequent work.

This Paper was prepared for the discussion at the consultation meeting, and revised based on the comments and recommendations of the Meeting. The document will be circulated for the Project Steering Committee (PSC) to review and approve. This document will outline the basic structure for the preparation of the SAP, specifically:

- Objectives of SAP for the Yellow Sea Project;
- Carrying Capacity of Ecosystem: Central Theme of the SAP;
- Ecosystem Services of the Yellow Sea;
- Framework of SAP Preparation;
- Procedure for SAP Preparation;
- SAP preparation mechanism; and
- SAP Preparation Schedule.

1. Objectives of SAP for the Yellow Sea Project

The SAP for the Yellow Sea Project aims to prepare management actions to maintain and/or improve the Carrying Capacity of Ecosystem in the Yellow Sea to ensure continued provision of Ecosystem Services; as a result, the Project would achieve the following objectives comprehensively:

- Protection of marine and coastal environments in the Yellow Sea;
- Sustainable use of marine and coastal resources in the Yellow Sea; and
- Upgrading national capacity in protection of marine environment.

For the definitions of the Carrying Capacity of Ecosystem as well as the Ecosystem Services, see Sections 2 and 3, respectively.

2. Carrying Capacity of Ecosystem: Central Theme of the SAP

The TDA, conducted in 2005-2006, identified five major environmental problems in the Yellow Sea:

- Marine environment pollution;
- Marine and coastal habitat modification;
- Change in ecosystem structures and functions;
- Unsustainable fisheries; and
- Unsustainable mariculture practices.

These problems adversely affect the "Carrying Capacity of Ecosystem" in the Yellow Sea (Figure 1). We define "Carrying Capacity of Ecosystem" as the ability to sustain the provisioning, regulating/supporting and cultural services in the Yellow Sea (adapted from Olsen et al. 2006). We use the maintenance of CCE as a management concept to identify management actions in the Yellow Sea based on the causes described in the causal chain analysis prepared during the TDA process.

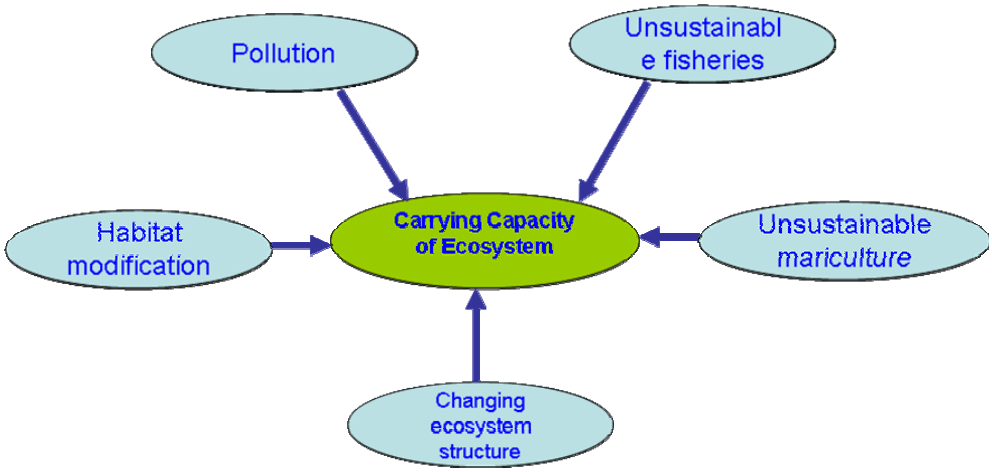


Figure 1. Central theme of the SAP for the Yellow Sea Project

The problems are often linked. For example, unsustainable mariculture practices might result in pollution problems (through eutrophication and localised benthic enrichment) and changes in ecosystem structure (as a result of habitat modification due to increased sedimentation rates caused by changes in water movement). As a consequence of these changes, fisheries yields will be impacted. Habitat modification through e.g., pollutants or land reclamation might change the ecosystem structure by adversely affecting primary production, spawning sites, nursing grounds, and/or nitrogen absorption capacity by the ecosystem. All those negative impacts of the environmental problems could eventually diminish the ability of the Yellow Sea ecosystem to provide its services.

Based on past experiences in managing marine environment and sustainable use of coastal and marine resources, it is very difficult, if not impossible, to manage the marine environment according to the Project Components individually, i.e., Biodiversity, Ecosystem, Fisheries, and Pollution. Addressing all the impacts from these Components will be critical for the success of management actions. For instance, protection of coastal wetlands will not simply imply the protection of the habitats for migratory birds. It would not work if the management actions only focus on wetlands themselves because the impacts from pollution, fishing activities, changes in productivity, and development contribute to the degradation and/or modification of coastal wetlands.

Therefore, it is critical to identify an appropriate linkage between the Project Components, which can provide effective central concept for preparing the SAP. We propose Carrying Capacity of the Ecosystem to be used as the central linkage in the management structure. Previously, the Regional Working Group (RWG) for Pollution Component discussed the issue of regional targets for pollution management, and indicated that the level to control nutrients in the marine environment will depend on the requirements of productivity in the Yellow Sea ecosystem. Therefore, it would be reasonable to use Carrying Capacity of Ecosystem as a linkage between the Ecosystem Component and the Pollution Component.

3. Ecosystem Services of the Yellow Sea

For the purposes of the Yellow Sea Project's SAP development, the services that the Yellow Sea ecosystem provides, hereinafter called "Ecosystem Services," mainly consist of the following (Figure 2):

- Provisioning services;
- Supporting/regulating services; and
- Cultural services.

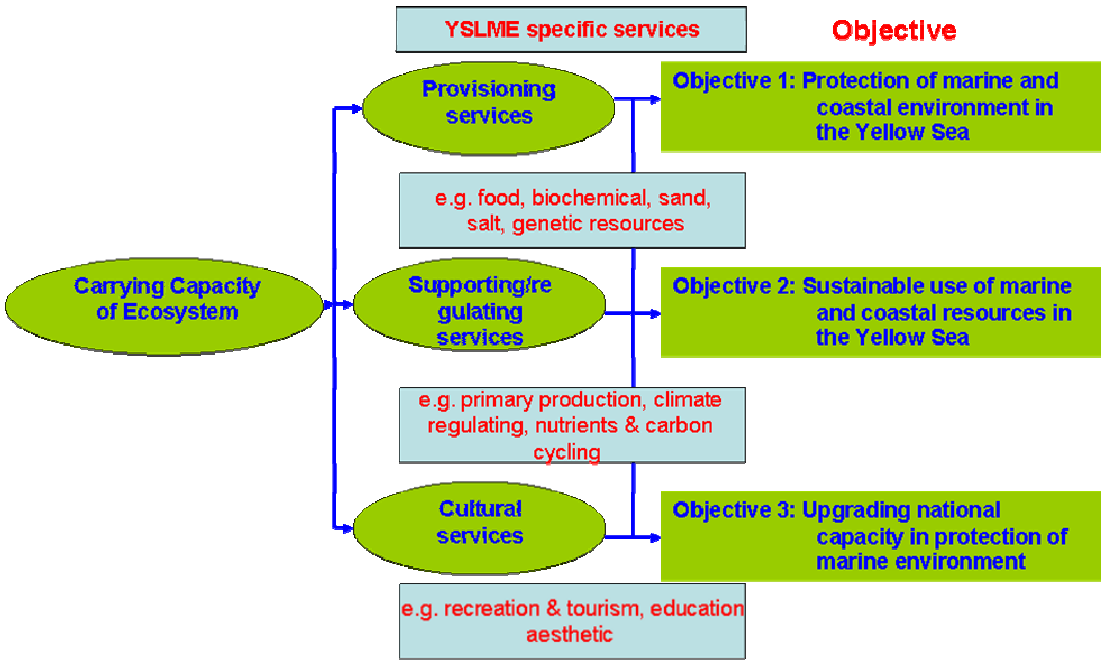


Figure 2. Ecosystem services provided by the Yellow Sea

Provisioning services are the products obtained from ecosystems. Those services in the Yellow Sea include food, biochemical, sand, salt, and genetic resources. Supporting and regulating services in the Yellow Sea are those that are necessary for providing the two categories of services—provisioning and cultural services—including *inter alia* primary production, climate regulation, and nutrient and carbon cycling. Cultural services are the ones that people obtain from ecosystems through spiritual enrichment, cognitive development, and recreational and aesthetic experiences. The Yellow Sea provides opportunities for tourism and education. The classification of Ecosystem Services is adapted from the Millennium Ecosystem Assessment (2003).

To address the environmental problems in the Yellow Sea, it is important to act comprehensively, not individually due to the interlinkages between the environmental problems as well as the Project Components as illustrated above in the previous section.

As a result of the intervention, the SAP is expected to contribute to the objectives described in Section 1: protection of and sustainable use of marine and coastal resources in the Yellow Sea, and upgraded national capacity in protecting the marine environment.

4. Framework of SAP Preparation

There are four main parts to the SAP development (Figure 3):

(1) Identification of the central linkage of protection and/or improvement of the Carrying Capacity of Ecosystem in the Yellow Sea through securing and/or improving its ability to provide Ecosystem Services;
(2) Identification and prioritisation of environmental problems in the Yellow Sea;
(3) Application of Causal Chain Analysis; and
(4) Creation, prioritisation, and implementation of management interventions.

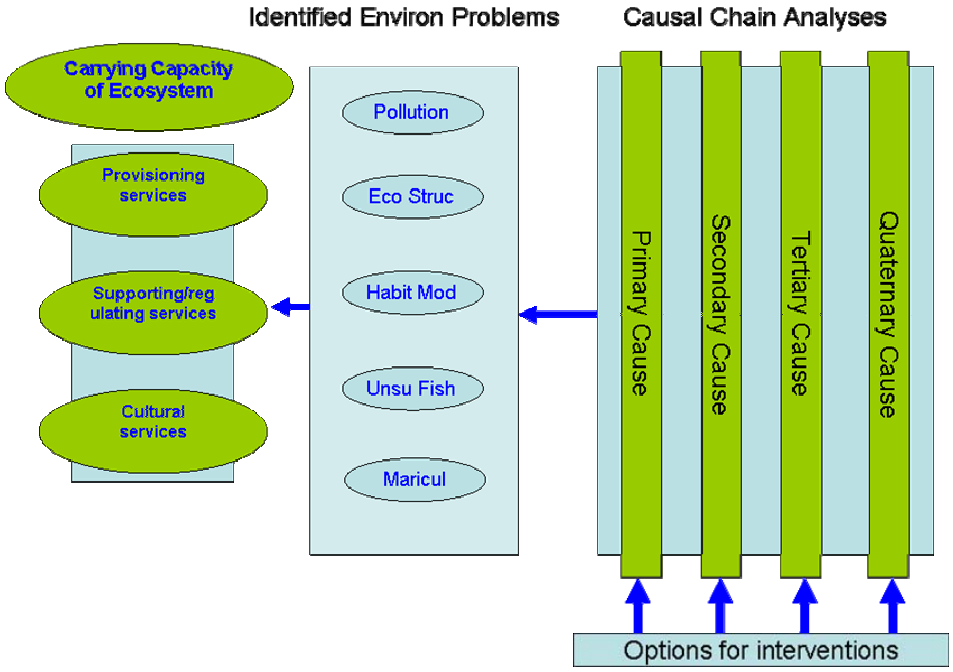


Figure 3. Four main parts of the SAP development

These result in the SAP identifying options for intervention i.e. harmonisations of the policies and legislations, institutional reforms, and environmental investments. The SAP should also prioritise conservation activities or interventions to protect and improve the Carrying Capacity of Ecosystem in the Yellow Sea.

Note that the TDA process has already completed part 2 and provided the causal chain analysis for part 3. Having conducted the Causal Chain Analysis, the TDA as well as other national and regional studies identified environmental problems in order of priority. Those priority problems are, as mentioned above, marine environment pollution, marine and coastal habitats modification, changes in ecosystem structures and functions, unsustainable fisheries, and unsustainable mariculture. The TDA then assessed the causes of the

problems hierarchically "from the immediate to the proximal causes as high a level of hierarchy as possible, extending up to the policy level wherever feasible" (TDA 2006, p. 4).

The impacts of the management interventions may take time to take effect and there may be a need to review and adjust the levels of those interventions, based on the required outcomes. It is therefore suggested that the duration of SAP should be until 2020.

5. Procedure for SAP Preparation

In order to identify the appropriate levels of management interventions (Part 4 of the SAP Framework) it is necessary to:

(1) Identify the procedure to determine the regional Ecosystem Quality Objectives (EcoQOs)

Given the central linkage of CCE and the need to set the extent of management interventions, the next important step for the SAP preparation is to identify the regional EcoQOs. Note that EcoQOs are referred to as "regional targets" for management in some documents. This document uses EcoQOs and regional targets interchangeably.

Early on in the SAP development, there is a need to work out a procedure to identify the EcoQOs for the SAP.

Figure 4 shows the nitrogen enrichment problem as an example (for details of this example, see Box 1). In this example, the regional target for nitrogen concentration is established so that the level allows the Yellow Sea ecosystem to continue to provide its supporting and regulating services. However, it is necessary to have a clear understanding of how interlinking problems in the Yellow Sea will affect the level at which the EcoQOs are set.

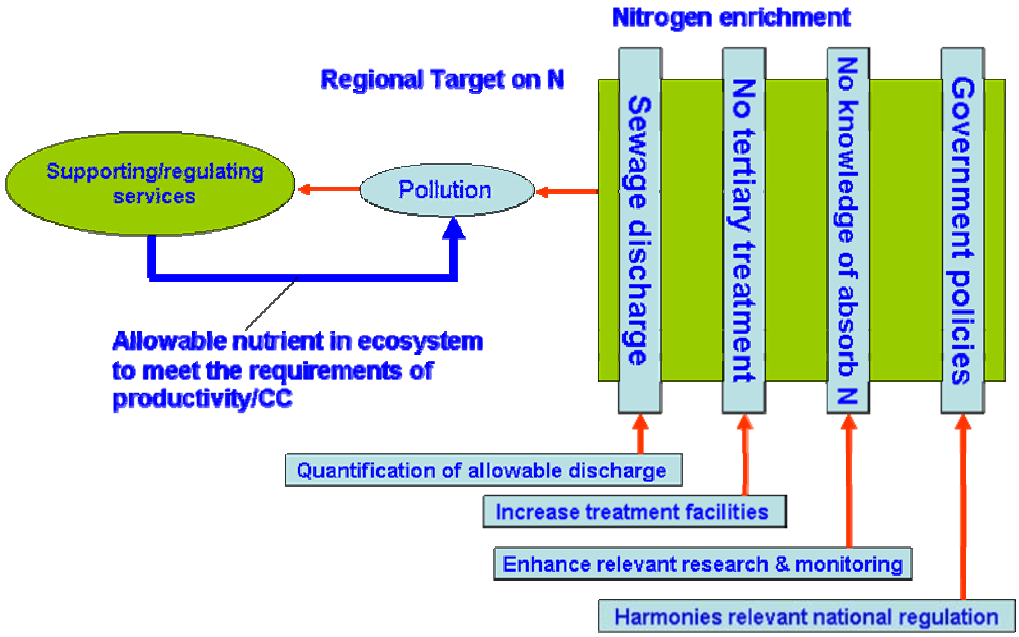


Figure 4. EcoQO identification process

Box 1. SAP Process Illustrated with an Example of a Pollution Problem

The SAP will list a set of management interventions according to priority in order to address major environmental problems identified by the TDA. For example, suppose that there are four hierarchically-organised causes of a pollution problem—nitrogen enrichment—as shown in Table 1.

Table 1. Causes of pollution problem – Nitrogen enrichment

Level of causes	Causes
Primary cause	Sewage discharge
Secondary cause	No tertiary treatment
Tertiary cause	No knowledge of Nitrogen absorption capacity by ecosystem
Root cause	Inadequate government policies

Suppose also that the sewage discharge, the primary cause, contributes to the pollution problems in the Yellow Sea, adversely affecting its supporting and regulating services. To mitigate those problems, the SAP would establish Ecosystem Quality Objectives (EcoQOs) on the nitrogen level in the concerned ecosystem so that it could provide the necessary supporting and regulating services. Subsequently, the SAP would create possible options for intervention to lessen the nitrogen enrichment. Table 2 shows examples of such options.

Table 2. Possible options for intervention

Causes	Interventions
Sewage discharge	Quantification of allowable discharge
No tertiary treatment	Increase treatment facilities
No knowledge of nitrogen absorption	Enhancement of relevant research and monitoring activities
Inadequate government policies	Harmonisation of relevant national regulations

Table 3 shows potential EcoQOs according to the three categories of the Ecosystem Services that the Yellow Sea ecosystem provides.

Table 3. Possible EcoQOs for Ecosystem Services in the Yellow Sea

Ecosystem Services	EcoQOs
Provisioning services	Maximum sustainable fisheries yield (MSY), sustainable production of mariculture, genetic resources
Supporting/regulating services	Allowable pollutant levels, productivity (diagnoses of changes), maintaining marine and coastal habitats
Cultural services	Sustained recreation and tourism

The SAP should define each EcoQC as specifically as possible to be used as the regional target.

There are three possible steps to identify the EcoQOs: (i) retrospective approach, (ii) theoretical approach, and (iii) comparative analysis approach. Each approach, shown in Table 4, contains a series of tasks to identify the EcoQOs.

Table 4. Methodologies for EcoQOs identification

Methodology	Task
Retrospective approach	Review historical data
	Check historical trends
	Identify current situation
	Review current political situation
	Identify critical habitats
Theoretical approach	Modelling
	Best Management Practices
	Maximum sustainable fisheries yield (MSY)
Comparative analysis approach	Comparative analysis with other LME's, international projects
	Consideration of different requirements between central and local govt.

(2) Identify the mechanisms to determine the EcoQOs

Having identified a methodology to determine the EcoQOs, it is also important to find an appropriate mechanism to discuss and agree on the EcoQOs. Currently, the Project is structured according to the "Components." This structure was useful and effective for the TDA process. However, as we are facing the issue of cross components, the current project structure may not be as effective as for the TDA process. So now we need to agree on EcoQOs based on the central linkage of "Carrying Capacity of Ecosystem" that incorporates the cross component issues. It might be necessary to modify both the roles of the RWGs and the way RWG meetings are organised. For further discussion on this issue, see Section 6 "SAP Preparation Mechanism" in this document.

(3) Calculate the Carrying Capacity of Ecosystem

There is a need to identify how the Carrying Capacity of Ecosystem should be calculated. Currently most Carrying Capacity models use primary productivity as the central theme, however we need to consider how to quantitatively describe the provisioning, supporting/regulating, and cultural services that the Yellow Sea provides.

(4) Identify management interventions

With clearly defined regional targets for management, the necessary management interventions need to be identified based on the Causal Chain Analysis, and on geographic, social, and political conditions. Management actions should include harmonisation of legislation, institutional reforms, financial sustainability, human resource development, and regional co-operation. Technical interventions should also be considered to address specific problems identified in the TDA.

(5) Perform feasibility studies on the various options of management interventions

Studies will be conducted to test the feasibility of possible management interventions from the perspective of:

- Technical feasibility;
- Cost-benefit analysis; and
- Political and social acceptance.

The feasibility studies would then prioritise the interventions. Demonstration projects would be implemented to show the effectiveness of the proposed management actions before they are adopted on a widespread basis.

(6) Identify regional and national mechanisms to implement the management interventions

The mechanism to implement the agreed management actions will be very critical in ensuring success of the SAP. The SAP should:

- Clearly define the period of management actions;
- Clearly define regional targets for management;
- Describe management interventions to address the identified environmental problems and associated causes; and
- Clearly define feasibilities and benefits of the management interventions.

(7) Endorse the SAP

The SAP will describe a mechanism for SAP endorsement, specifying not only how and when the draft SAP should be presented for the participating governments to review and endorse, but also who should be involved in that endorsement process. An explicit consultation process with the government entities as well as other relevant stakeholders should be established in the SAP.

Figure 5 summarises the above procedure as well as other relevant work for preparing the SAP. Other preparatory work includes the following:

- Cost-benefit analysis;
- Regional governance analysis;
- Analysis on relationship between local and national governments; and
- Critical habitat verification.

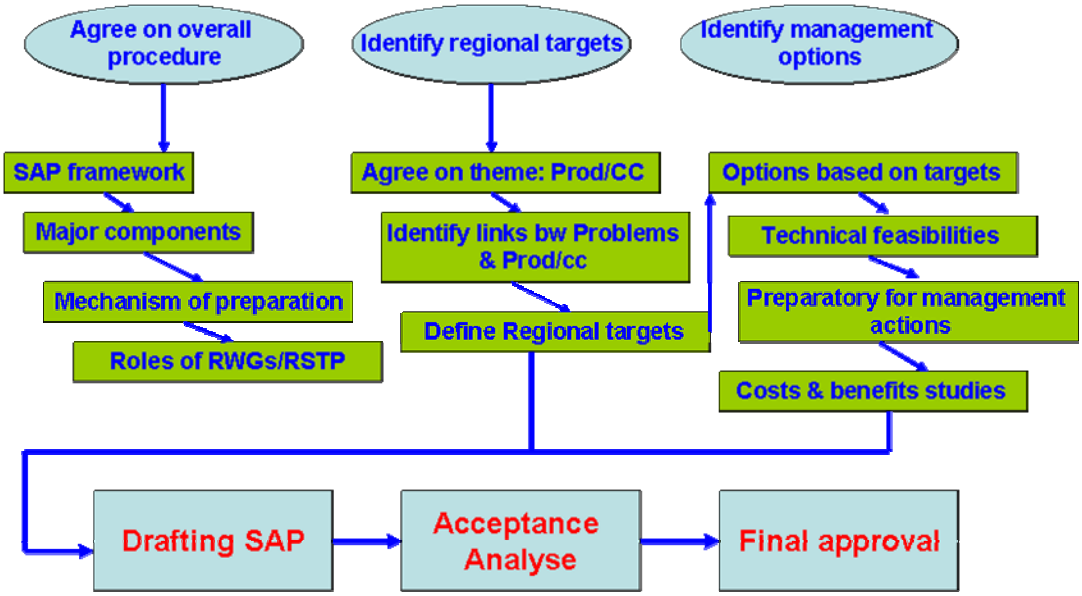


Figure 5. SAP preparation process

6. SAP Preparation Mechanism

An Ad-hoc Working Group that is responsible for the SAP preparation will be established under the Regional Scientific and Technical Panel (RSTP). According to the Terms of Reference (TOR), the RSTP has a role to "prepare scientifically and environmentally sound TDA and SAP." The Ad-hoc Working Group will consist of 11 members with expertise in both natural science and social science. Table 5 shows the expertise required for the Group activities with the number of experts.

Table 5. Personnel composition of Ad-hoc Working Group

Expert	Number of experts
Natural scientists:	
Biodiversity	2
Ecosystem	2
Fisheries	2
Pollution	2
Economist	1
Legal expert	1
Project Manager	1
Total	11

The Ad-hoc Working Group will be guided by the Project Manager from the Project Management Office (PMO).

The first Ad-hoc Working Group meeting will be organised in the first half of April, 2007. The objective of this meeting is to identify the EcoQOs. The participants will use the retrospective approach as described in Section 5 (Table 4) in this document, reviewing historical data and trends, identifying the current situation of the Yellow Sea ecosystem, and reviewing the current political situation. The participants will also discuss whether alternative and/or supplementary approaches, i.e., the theoretical approach and the comparative analysis approach, are necessary for the EcoQO identification.

Prior to the first meeting, the Project will contract experts who may also be members of the Ad-hoc Group to provide the first Ad-hoc Working Group meeting with information to identify the EcoQOs. The contracted work, requiring approximately five person-days, should be carried out in March, 2007. A possible TOR for the work might include the following:

- Review historical data and trends of the Yellow Sea ecosystem;
- Identify the current situation of the Yellow Sea ecosystem;
- Review the current political situation in the countries bordering the Yellow Sea;
- Present the results of the above analyses which should include various options for EcoQOs for each variable (as highlighted by the HAB example in the SAP consultation meeting where an experts suggested that a 30% cut in N concentration in seawater would virtually eliminate HAB events, whereas a 50% cut in N concentration would restore the original diatom/dinoflagellate ratio) to the first Ad-hoc Working Group meeting; and
- Conduct further analysis, if necessary, and provide the Ad-hoc Working Group with the results based on the comments and suggestions provided during the first meeting.

The second Ad-hoc Working Group meeting will be organised in August, 2007. The objective of this second meeting is to:

- Review additional data and information collected after the first meeting;
- Finalise and agree on the EcoQOs;
- Discuss and agree on how to calculate the Carrying Capacity of Ecosystem; and

- Identify management actions to achieve the EcoQOs.

Participants in the second meeting will be determined after the first meeting according to needs. Inviting those who have expertise in local governments and NGOs—both are important stakeholders—might be necessary to incorporate their views and opinions in the SAP development.

It is preferable to organise several Regional Working Groups (RWG) meetings at the same time, which are currently scheduled separately, for the effective and efficient preparation of the SAP. The RWG meetings might be organised in conjunction with the Ad-hoc Working Group. The necessity as well as the timing of the RWG meetings will be considered after the first Ad-hoc Working Group meeting.

An SAP drafting group will consist of three/four members. The specific number of members will be decided through consultation at the Ad-hoc Working Group meetings. The drafting team might be drawn from within the Ad-hoc Working Group.

7. SAP Preparation Schedule

Task	Deadline	Responsibility
Finalise the Concept Paper	February, 2007	PMO
Contract with experts for basic data preparation (e.g., historical data review)	March, 2007	Regional experts/PMO
Start other relevant preparatory work (e.g., cost-benefit analysis, regional governance analysis, critical habitat verification)	March – July, 2007	Consultants/PMO
First Ad-hoc Working Group meeting	April, 2007	Ad-hoc Working Group/PMO
Second Ad-hoc Working Group meeting	August, 2007	Ad-hoc Working Group/PMO
Feasibility studies (technical, socio-economic, political)	August – December, 2007	Consultants/PMO
Start drafting Regional SAP	December, 2007 – Middle of 2008	SAP Drafting Group
Final Regional SAP	Middle of 2008	SAP Drafting Group
Endorse Regional SAP/National Yellow Sea Action Plans (NYSAP)	End of 2008	RSTP/PSC

References

Millennium Ecosystem Assessment. (2003). Ecosystems and human well-being: A framework for assessment. Washington, DC: Island Press.

UNDP/GEF Project "Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem." (2006). Transboundary Diagnostic Analysis.

Appendix

Productivity Module "focuses on oceanic variability and its effect on the production of phytoplankton and zooplankton that are at the base of the ocean food chain; it is concerned with the carrying capacity of ecosystems and their ability to sustain fishery and other living resources" (Olsen, et al., 2006).

Source: Olsen, S.B., J.G. Sutinen, Juda, L., Hennessey, T.M., & Grigalunas, T.A., 2006. A Handbook on Governance and Socioeconomics of Large Marine Ecosystems. Univ. of Rhodes Island, 94 p.

UNDP/GEF PROJECT ENTITLED "REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM"

UNDP/GEF/YS/AWG.1/3
Date: 12 April 2007
English only

First Meeting of the Strategic Action Programme *Ad-hoc* Working Group for the UNDP/GEF Yellow Sea Project
Hongchun, Republic of Korea, 10-12 April 2007

Meeting Report

TABLE OF CONTENTS

ANNEXES

1 OPENING OF THE MEETING

1.1 Welcome addresses

1.1.1 On behalf of the UNDP/GEF Yellow Sea project, Mr. Yihang JIANG, Project Manager, opened the meeting and welcomed the participants to the first meeting of the Strategic Action Programme (SAP) Ad-hoc Working Group. He informed the meeting that the *ad hoc* Working Group was established within the Regional Scientific and Technical Panel (RSTP) for preparation of SAP. Mr. Jiang briefly stated that the objective of this meeting is to define "Ecosystem Quality Objectives (EcoQOs)" or "regional targets" for future environmental management actions. Mr. Jiang then explained the documents prepared for the meeting, consisting of "working documents" and "information documents".

1.2 Introduction of members

1.2.1 Members and other participants were invited to introduce themselves and gave a brief introduction on their background and roles in the Project. The list of participants is attached to this report as Annex I.

1.2.2 The list of documents and the meeting agenda are attached to this report as Annex II and Annex III, respectively.

1.2.3 Mr. Jiang served as Chairperson of the meeting, while Project Management Office (PMO) served as Secretariat.

2 BRIEF INTRODUCTION OF THE BACKGROUND AND THE DOCUMENT, "CONCEPTUAL PROCEDURE FOR SAP PREPARATION"

2.1 The Chairperson introduced the background of the meeting, explaining the procedure for the SAP preparation (Document UNDP/GEF/YS/AWG.1/1). He explained the basic components of SAP consisting of identified environmental problems, regional targets, management actions to achieve the targets; also, he clarified the difference between regional targets and management actions. Mr. Jiang then explained the SAP process specifically, citing food, nutrients, habitats, and primary production as examples.

2.2 Asked for clarification on the definition of the "optimal conditions" and that of the "regional targets," the meeting discussed and **agreed to use the term, "reference conditions," to specify ideal environmental conditions in the Yellow Sea as a reference for the regional targets which are the feasible conditions for the management actions may be expected to achieve.**

3 EXPECTED OUTPUTS FROM THE 1ST AD-HOC WORKING GROUP MEETING

3.1 The Chairperson explained expected outputs from the meeting, emphasising that the meeting should identify and agree on the regional targets for environmental management actions in the Yellow Sea. The participants are expected to set the regional targets by reviewing historical data and trends, identifying the current situation of the Yellow Sea ecosystem, and reviewing the current political situation.

3.2 Mr. Jiang also mentioned that in addition to the retrospective approach (i.e., reviewing historical data and trends), the participants are also expected to discuss

whether alternative and/or supplementary approaches (i.e., the theoretical approach and the comparative analysis approach) are necessary for the identification of regional targets.

3.3 Additionally, the meeting is expected to review and provide comments on the First Yellow Sea Regional Science Conference to be organised 14th to 16th August, 2007, Hangzhou, China. The meeting will review a draft programme for the Conference, prepared by the Co-Chairpersons of the Organising Committee for the Conference.

4 PRESENTATION BY REGIONAL EXPERTS ON PRELIMINARY REGIONAL TARGETS WITH RESPECT TO THE PROJECT'S OBJECTIVES (BIODIVERSITY, ECOSYSTEM, FISHERIES, AND POLLUTION)

4.1 The meeting reviewed the conceptual procedure for preparation of the SAP, and reiterated that the carrying capacity of ecosystem will serve as the central linkage for SAP to identify integrated management actions to address environmental problems in the Yellow Sea. It was well understood by all participants that the management actions to be included in the SAP should aim at improving the ecosystem service functions in the Yellow Sea:

- Provisioning service
- Supporting & regulation services; and
- Cultural service

4.2 Eight regional experts presented preliminary regional targets with respect to the Project's objectives of Biodiversity, Ecosystem, Fisheries, and Pollution, with special reference to the ecosystem services identified. The expert reports are attached to this report as Annex IV.

4.3 To identify the current situation of the biodiversity in the Yellow Sea, Ms. Young Shil KANG reviewed the historical data mainly on habitats, exotic species, indigenous species, and vulnerable species. Based on those data and trends, Ms. Kang proposed the following four items as regional targets: the diversity of species, the number of vulnerable species, the number of exotic species, and the area of reclamation. Ms. Kang further specified the issues to address regarding Biodiversity, including tidal flat reclamation, ballast water, and introduced species to aquaculture.

4.4 Mr. Xuelei Zhang suggested there were four major concerns for biodiversity; habitat, species, and genetics and management. Habitats were lost as part of coastal reclamation and converted for aquaculture and salt pans or degraded due to environmental change. Species diversity was at risk through the loss of vulnerable species, introduced species from ballasted water and aquaculture and loss of endemic species. Genetic diversity is threatened from species loss and gene flow. Management needed to be strengthened and new regulations enforced. To preserve vulnerable and endemic species, conserve local biodiversity, maintain critical habitats and preserve genetic resources we need to; construct a well linked network of conservation areas, minimize new reclamation, minimize introduction of alien species, build a gene pool library and partially recover some converted habitats.

4.5 Mr. Sinjae YOO presented the results of his preliminary consideration about the regional targets with respect to Ecosystem. Mr. Yoo explained potential indices, including nutrients, diatom/dinoflagellate ratio, species diversity, abundance and biomass of phytoplankton, and HAB. Having reviewed the historical data and trends

of those possible indices, Mr. Yoo found that there are long-term changes established in nutrients (N↑, P↓, Si↓, N:P↑) and in macrobenthos (biomass and abundance ↑); meanwhile, there are no such changes established in the diatom/dinoflagellate ratio, the phytoplankton biomass and productivity, and the zooplankton biomass. Mr. Yoo then emphasised the need to establish a coherent picture from nutrients, phytoplankton community and primary productivity to zooplankton community and biomass and eventually to fish community and productivity.

4.6 Having reviewed the historical data and trends as well as the environmental problems, Mr. Mingyuan ZHU suggested the following two regional targets for management actions with respect to Ecosystem: (i) to reduce the change of biomass and abundance of plankton and benthos, and (ii) to reduce HAB events. To achieve those regional targets, Mr. Zhu then suggested possible management actions: to reduce the eutrophication, to strengthen monitoring by harmonising survey methods and by introducing new technologies and monitoring approaches, to improve assessment of eutrophication as well as carrying capacity.

4.7 Mr. Xianshi JIN reviewed historical data and identified overexploitation, over-capacity of fishing fleets, ineffectiveness in fisheries management and climate change as the major problems. Maximum sustainable yield (MSY) or rather a level set at less than MSY, as the MSY of the ecosystem was likely to be less than the sum of the MSY of individual species. He also suggested that the yield from a capture fishery should be less than that the growth of the fish stock to conserve the spawning stock. He warned that care was needed to avoid seriously affecting the Yellow Sea fishermen's livelihoods. According to the China State Council, by 2010 the number of motorized fishing boats and the marine fisheries catch in China will be cut by 10% and 15%, respectively. Moreover, mariculture development will be controlled and techniques improved to reduce environmental impact. By 2020 the number of motorized fishing boats and marine fisheries catch in China will be reduced by 1/3, and harvesting levels will meet the "surplus yield", implying that the stock levels are sufficient for reproduction to maintain healthy fisheries resources. Meanwhile billions of fry will be released into the sea for enhancement and sustainable mariculture will be reached.

4.8 Mr. Jang-Uk LEE also reviewed historical data, and found there was heavy exploitation of fish stocks in the Yellow Sea, both the fishing effort and catch per unit effort (CPUE) had increased since the 1980's and there appeared to be little scientific basis for fisheries management actions. He also noted that China and Republic of Korea (ROK) had differences in growth and reproductive parameters for individual species. Acceptable Biological Catch (ABC) models were suggested as a method of estimating sustainable yields. When ABC estimates of catch were compared with actual catch data from the period 1998-2004 a 25% reduction in catch was required to achieve this ABC. For mariculture there was an increase in both production and cultured area. However, there was a decrease in production per unit area and no expectation of increase in production with further increases in area.

4.9 Having employed three methodologies (retrospective, theoretical, comparative analysis approaches), Mr. Quan WEN proposed several indices as potential regional targets with respect to Pollution. Those indices included the international treaties and conventions such as the Stockholm Convention and the MARPOL Convention; the function-based environmental standard approach; and the maximum residue limits (MRLs) for pollutants in foodstuffs. Mr. Wen further suggested management actions to achieve those regional targets based on the Transboundary Diagnostic Analysis (TDA). Those actions include the following:

- Control of pollutants discharge from land-based sources;
- Management on ocean and coastal engineering;
- Control of pollution from sea-based sources; and
- Management on ocean dumping.

4.10 Mr. Dong Beom YANG presented his preliminary analysis of the historical data and trends in terms of Pollution, reviewing the information about nutrients, heavy metals, POPs, and HAB. Mr. Yang then proposed several options as management actions as follows.

Nutrients

- Tertiary treatment
- Management through TMDL approach (control by total maximum daily loads)
- Establishment of monitoring network for atmospheric input of nutrients (control the emission of N if necessary)

HAB

- Reduction of the nutrients level
- Management of coastal bottom sediments to avoid growth-stimulating substances (dredging if necessary)
- Control of ballast water against invasive species

5 BRAINSTORMING SESSION: IDENTIFICATION OF REGIONAL TARGETS

Initial consideration on regional targets with "enrichment of nitrite" and "decline in fisheries" as examples

5.1 Having taken the regional environmental problems of "*enrichment of nitrite*" and "decline in fisheries stocks" as examples, the participants brainstormed the reference conditions as well as the regional targets.

5.2 Mr. Wen mentioned that according to the national policy, China has a plan to reduce the total nutrient loading from point sources by 10 % every 5 years.

5.3 Mr. Yang stated that although there is an equivalent national policy in ROK, Ministry of Environment has a regulation to reduce nutrient at point sources. The regulation, though it does not specify a numerical target for the nutrient discharge to the marine environment.

5.4 The Chairperson suggested having a sessional meeting with Mr. Wen and Mr. Yang to prepare both the reference conditions and the regional targets. The meeting agreed on the Chairperson's suggestion and to review the outputs from the sessional meeting.

5.5 After the discussion, the sessional working group on Pollution presented the following:

- It is difficult at this moment to suggest the optimal levels of nutrient concentration and control of nutrient load, as well as the reference year. It is necessary to recheck the historical data carefully before suggesting the reference conditions and the regional targets. The Pollution working group would like to suggest those at the 2nd Ad-hoc Working Group meeting.

- Possible management actions might be to (i) develop a strategy for monitoring pollutants, including those from atmosphere, ground water, and resuspension; (ii) consider pollution loading; and (ii) control N emissions from industries to the atmosphere.

5.6 The meeting thanked the efforts of the sessional working group to prepare the suggestions. After further discussing this matter, the meeting **agreed to use the "historical reference year" as the reference conditions** (the Pollution working group will define the specific reference year by the 2nd Ad-hoc Working Group meeting), **and the "control of total loading to meet the reference year" as the regional targets.**

5.7 Referring to the presentations made by Mr. Jin and Mr. Lee, the meeting discussed and **agreed on setting "Maximum Sustainable Fisheries Yield (MSY)" and "Allowable Biological Catch (ABC)" as the reference conditions for Fisheries.** The meeting also **agreed to set the regional targets as the "25-30% reduction by 2020 in catch and fishing effort with respect to the average level of 1998-2004."**

Consideration of regional targets of other identified regional priority problems

5.8 Following the successful identification of the reference conditions and regional targets for Pollution and Fisheries, the Chairperson invited the participants to consider how to proceed with other issues such as those relevant to Biodiversity and Ecosystem. The meeting then decided to organise sessional meetings according to the Project's Components, i.e., Biodiversity, Ecosystem, Fisheries, and Pollution; have those meetings to prepare suggestions for the plenary session; and convene sesssional meetings again, if necessary, when specific issues are raised, that require technical considerations by a small group(s) of experts.

5.9 The sessional working group on Biodiversity, followed by that on Ecosystem, presented discussion results, suggesting possible reference conditions and regional targets.

5.10 The participants raised various questions and issues relevant to the suggested reference conditions and regional targets, such as the clarification on the definition of the "reference conditions," the legal status of the regional targets, the availability of the data and information about genetic diversity, and the inclusion of species that are engaged and not endangered. The participants agreed to use current populations/distributions of endangered and endemic species as a reference conditions for Biodiversity. Improvements on the current conditions were agreed as the regional targets. Concerns were raised regarding the classification of endangered species and data availability and list of endangered species. Current area of habitats was accepted as reference condition and after some discussion on the current position of both countries governments on coastal habitats it was agreed that the maintenance of the current area of habitats (except approved projects) according to standards and regulations of 2007 would be the regional target.

5.11 Regarding Ecosystem, a diatom dominated community as the basis for a healthy ecosystem was proposed as the reference condition. The participants suggested that phytoplankton communities were always diatom dominated so this was not specific enough. However, more recent data, that included picoplankton, suggested diatoms formed approximately 20% of the community. A reference year of 1980's was

agreed. It was agreed that the plankton communities cannot be influenced through management actions within the Ecosystem component, and only by the relevant management actions to control the N: P: Si ratio and by the fisheries management actions to control the abundance of planktivorous fish. Therefore, provision of better scientific understanding of the role of nutrient control on plankton communities for adaptive management was proposed as the regional target through monitoring and assessment. It was accepted that as zooplankton was directly controlled by phytoplankton community structure then only a single category of plankton was needed. High species diversity in the benthic community (1992 – reference year) was proposed as the reference condition for benthic abundance/biomass and diversity. Benthic diversity is very susceptible to changes in nutrient/pollution concentrations in the sediment reflecting the historical record and as such appropriate monitoring is warranted.

5.12 After clarifying the questions and issues raised and discussing further the suggestions proposed by the sessional working groups, the meeting **agreed on the reference conditions and regional targets for Biodiversity and Ecosystem.**

5.13 The meeting revisited the Fisheries and Pollution issues to refine the relevant reference conditions and management targets.

5.14 The reference conditions for fisheries remained as MSY/ABC while Ecosystem Based Fisheries Management (EBFM) was included to reflect the ecosystem concerns of fisheries management. Regional targets for 2020 were set according to the provisional estimated ABC calculated by Dr Lee Jang-Uk, which estimated a 25% reduction in catch and fishing effort were needed to reach the ABC for the Yellow Sea and the 30% reduction in fishing vessels agreed by China. Mariculture reference conditions were slightly changed to optimal growth and survival of culture organism and insignificant environmental impact. After some discussion, the regional targets were changed to sustainable practices, polyculture and optimisation of the cultured species and their distribution. Improvement in culture techniques was also added as one of the regional targets.

5.15 For Pollution the international guidelines or directives of Codex/Stockholm Convention/MARPOL were adopted, where appropriate, as both the reference conditions and regional targets for respective pollutants. A historical reference of circa 1990 was used a reference condition for nitrogen enrichment as this coincided with both an ideal diatom-based community and low frequency of HABs. Control of total loading of nutrients to meet the reference point was accepted as the regional target. The silicate concentration was considered ideal in the 1980's in accordance with the diatom-based community existing at the time; a regional target of an improvement in the freshwater seasonal fluxes was set. Marine litter was introduced as a new problem identified in the TDA, a historical reference condition of 1960's was accepted after some discussion on an era when synthetic/plastic/nylon waste was negligible. A regional target of reduced standing stock of litter was proposed. For contaminants that affected the cultural and tourism services a "Blue Flag" system was adopted as the reference condition and reduction of pollutants to nationally acceptable levels for bathing beaches was accepted as the regional targets.

5.16 After having an extensive discussion, the meeting **agreed on the relevant reference conditions and management targets on Fisheries and Pollutions. Annex V summarises the agreed reference conditions and regional targets with respect to all the Project's objectives with respect to Biodiversity, Ecosystem, Fisheries, and Pollution.**

6 DISCUSSION ON THE NEEDS OF ALTERNATIVE AND/OR SUPPLEMENTARY APPROACHES (THE THEORETICAL AND COMPARATIVE ANALYSIS APPROACHES) FOR THE REGIONAL TARGETS IDENTIFICATION

6.1 Following the successful identification of the regional targets based on the historical data review and analysis, the Chairperson mentioned that it might not be necessary for this meeting to introduce alternative and/or supplementary approaches (i.e., the theoretical approach and the comparative analysis approach). **The meeting agreed with the Chairperson and agreed to consider the use of the alternative and/or supplementary approaches, if necessary, to refine the regional targets along with the identification of management actions**.

7 DISCUSSION ON NECESSARY EXPERTISE AND WORK FOR AND DURING THE 2ND AD-HOC WORKING GROUP MEETING SCHEDULED TENTATIVELY FOR AUGUST, 2007

7.1 The suggested management actions should result in the reaching of the regional targets that agreed during this meeting. These actions would address any level of the causes identified in the causal chain analysis during the TDA process, with most emphasis on the root causes. The need to diversify the participants at the second SAP Ad-hoc Working Group meeting was discussed. The inclusion of more socio-economists, policy experts, and both national and local government was raised. Finally **it was agreed that the PMO will make a checklist for the preparation of the 2nd *ad hoc* Working Group meeting to identified necessary management actions.** This list will be circulated to the participants for comments. The draft will be revised based on those received comments and returned to participants for a final check.

8 OTHER BUSINESS

Law and policy consideration for SAP regional targets

8.1 The Chairperson invited Mr. Xiangmin XU to present the preliminary considerations about regional target identification from the perspective of law and policy.

8.2 Mr. Xu summarised the review result of existing data and information, including not only the root causes of environmental problems in the Yellow Sea, that were identified in the TDA; but also the recommendations suggested in the national governance analysis reports for China and ROK. Mr. Xu then proposed seven policy targets with sets of possible management actions. The suggested policy targets consist of:

- Regional co-operation established;
- Comprehensive legal framework established;
- Capacity in environmental decision-making enhanced;
- Education and research activities on the Yellow Sea strengthened;
- Public awareness about the environmental problems raised;
- Transparency in decision-making secured and improved; and
- Cultural value or services of the Yellow Sea secured.

8.3 The meeting thanked Mr. Xu for his presentation that was comprehensive and informative. The meeting expressed its willingness to consider during the SAP preparation the proposed suggestions and actions, including the establishment of the "Yellow Sea Commission" to strengthen the regional co-operation.

Regional Science Conference

8.4 As the Chairperson of the Organising Committee, Mr. Yoo chaired the session to discuss the First Yellow Sea Regional Science Conference. Mr. Yoo, Co-Chairperson of the Conference, introduced its background briefly, mentioning not only the objective of the Conference but also the relationship between the Conference and the other Project's activities, particularly the SAP development and the Ad-hoc Working Group meeting. Mr. Yoo then invited the participants to consider a draft programme of the Conference.

8.5 The meeting reviewed the draft programme and suggested speech topics and speakers. Presented papers will consist of "invited papers" and "contributed papers." The meeting **agreed to invite 19 speakers to present the invited papers and 10 speakers to present the contributed papers.** The call for abstracts will be advertised for the contributed papers. A poster session might be organised, depending on the number of abstracts submitted. The meeting noted that **the Organising Committee will review the abstracts and select the contributed papers.** The agreed programme is attached to this report as Annex VI. An agreed workplan for the Conference preparation is as follows.

Task	Responsibility	Deadline
Start inviting contributed papers	Committee/PMO	April, 2007
Finalise the topics and speakers for invited papers	Committee	30th April, 2007
Evaluate/select contributed papers	Committee	30th Jun, 2007
Organise the Conference	Committee/PMO	14th-16th August, 2007

9 DATE AND PLACE FOR THE 2ND AD-HOC WORKING GROUP MEETING

9.1 The Chairperson informed the meeting that **tentative dates and venue for the 2nd SAP Ad-hoc Working Group meeting are 7th – 9th August, 2007 in China. The meeting agreed with this original plan** and acknowledged that the detailed venue will be decided after the discussion between the National Project Co-ordinator for China and the PMO.

10 ADOPTION OF THE MEETING REPORT

10.1 The Chairperson invited the meeting to consider how to prepare and adopt the meeting report. The participants suggested for the Secretariat, to prepare a draft report, and circulate it after the meeting to the participants to review. The meeting agreed with this suggestion: **The PMO will send the draft report after the meeting to the participants for their review.** With comments from the participants given, the report will be amended and adopted by the meeting.

11 CLOSURE OF THE MEETING

11.1 The Chairperson thanked all the participants for their hard work, applauding the meeting produced a number of substantial outputs, including the regional targets for management actions.

11.2 The meeting closed at 15:30 hours on 12th April 2007.

Annex I

List of Participants

Surname in alphabetical order

PARTICIPANTS OF THE MEETING

Mr. JIN Xianshi
Fishery Biologist
Director of Fishable Resources & Ecosystem Management Division
Yellow Sea Fisheries Research Institute
106 Nanjing Road
Qingdao, Shandong, 266071
China
Tel: 86-532-584-9430/583-6344
Fax: 86-532-581-1514
Email: jin@ysfri.ac.cn

Ms. KANG Young Shil
Chief, Fisheries Resources and Marine Environment Team
West Sea Fisheries Research Institute (NFRDI)
707, Eulwang-dong, Jung-gu
Incheon, 400-420
Republic of Korea
Tel : 82-32-745-0550
Fax : 82-32-745-0549
E-mail : yskang@nfrdi.re.kr

Mr. KWON Sukjae
Senior Researcher
Policy Research Department
Korea Ocean Research and Development Institute
1270 Sa-dong, Sangnok
Ansan City, Gyeonggi Province, 426-744
Republic of Korea
Tel: 82-31-400-6502
Fax: 82-31-400-6505
Email: sjkwon@kordi.re.kr

Mr. LEE Jang-Uk
President of Korean Fisheries Society
Professor, Pukyong National University
#599-1 Daeyeon 3-Dong, Namgu,
Busan, 608-737
Republic of Korea
Tel. 82-51-343-3898
Fax: 82-51-622-3306
E-mail: julee0922@korea.com

Mr. WEN Quan
Chief Scientist
SOA Key Lab of Coastal Ecosystem and Environment Research
National Marine Environmental Monitoring Center
42 Linghe Street
Dalian, Liaoning 116023
China
Tel: 86-411-8478-2522
Fax: 86-411-8478-2522
Email: gwen@nmemc.gov.cn

Mr. XU Xiangmin
Dean
Law School of Ocean University of China
No. 23 Hong Kong Dong Road,
Qingdao, Shandong Province, 266071
China
Tel. 86-532-8590-1857
Fax. 86-532-8590-1851
Email: xuxiangmin58@hotmail.com

Mr. YANG Dong Beom
Principal Research Scientist
Korean Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-6157
Fax: 82-31-408-4493

Mr. YOO Sinjae
Senior Research Scientist
Marine Living Resources Research Division
Korean Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-6221

Email: dbyang@kordi.re.kr

Fax: 82-31-408-5934
Email: sjyoo@kordi.re.kr

Mr. ZHANG Xuelei
First Institute of Oceanography
6 Xianxialing Road Hi-Tech Industrial Park
Qingdao, Shandong 266001
China
Tel: 86-532-8896-7476
Fax: 86-532-8896-7548
Email: zhangxl@fio.org.cn

Mr. ZHU Mingyuan
Professor
First Institute of Oceanography, SOA
6 Xianxialing Road Hi-Tech Industrial Park
Qingdao, Shandong 266001
China
Tel: 86-532-8896-7548
Fax: 86-532-8896-7447
Mobile: 86-136-0898-3422
Email: myzhu@public.qd.sd.cn

PROJECT MANAGEMENT OFFICE (PMO)

Mr. Yihang JIANG
Project Manager
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-7825
Fax: 82-31-400-7826
email: yihang@yslme.org

Mr. Isao ENDO
Environmental Economics Officer
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-7793
Fax: 82-31-400-7826
Email: isao@yslme.org

Mr. Mark WALTON
Environmental Specialist
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-7832
Fax: 82-31-400-7826
Email: mark@yslme.org

Mr. Sungjun PARK
Finance & Administrative Officer
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-7828
Fax: 82-31-400-7826
Email: sungjun@yslme.org

Mr. Kap-Sung SONG
Driver
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-7826
Fax: 82-31-400-7826
email: kapsung@yslme.org

OBSERVER

Mr. HUH Hyung-Tack
Sr. Scientist Emeritus, KORDI
Fellow, Korean Academy Of Science & Technology
Chairman, IOC/WESTPAC
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-6201
Fax: 82-31-408-5934
Email: hthuh@kordi.re.kr

Mr. Suh-Yong CHUNG
Professor
/Member of International Committee
College of Law
Myongji University
50-3 Namgajwadong, Seodaemongu,
Seoul, 120-728
Republic of Korea
Tel: 82-2-300-0818
Fax: 82-2-300-0804
Email: mahlerchung@yahoo.com

Mr. TOBAI Sadayosi
Yellow Sea Ecoregion Planning Programme
Ecoregion Coordinator
WWF Japan
Nihonseimei Akabanebashi Bldg., 6Fl.
3-1-14 Shiba Minto-ku
Tokyo, 105-0014
Japan
Tel: 81-3-3769-1783
Fax: 81-3-3769-1717
Email: tobai@wwf.or.jp

Annex II

List of Documents

Working Documents

UNDP/GEF/YS/AWG.1/1	Conceptual Procedure for SAP Preparation
UNDP/GEF/YS/AWG.1/2	Report on Preliminary Regional Targets with Respect to the Project's Objectives of:
	Biodiversity – China (1/2a-prc), R. Korea (1/2a-rok)
	Ecosystem – China (1/2b-prc), R. Korea (1/2b-rok)
	Fisheries – China (1/2c-prc), R. Korea (1/2c-rok)
	Pollution – China (1/2d-prc), R. Korea (1/2d-rok)
UNDP/GEF/YS/AWG.1/3	Report of the Meeting *(to be prepared at the meeting)*
UNDP/GEF/YS/AWG.1/4	Draft Structure of SAP for the Yellow Sea
UNDP/GEF/YS/AWG.1/5	Provisional Agenda

Information Documents

UNDP/GEF/YS/AWG.1/inf.1 ver.1	Provisional List of Documents
UNDP/GEF/YS/AWG.1/inf.2 ver.1	Provisional List of Participants

Annex III

Agenda

1. Opening of the meeting

2. Brief introduction of the background and the Document, “Conceptual Procedure for SAP Preparation”

3. Expected outputs from the 1st Ad-hoc Working Group Meeting

4. Presentation by regional experts on preliminary regional targets with respect to the Project’s objectives (Biodiversity, Ecosystem, Fisheries, and Pollution)

5. Brainstorming session: Identification of regional targets

6. Discussion on the needs of alternative and/or supplementary approaches (the theoretical and comparative analysis approaches) for the regional targets identification

7. Discussion on necessary expertise and work for and during the 2nd Ad-hoc Working Group Meeting scheduled tentatively for August, 2007

8. Other business

9. Date and place for the 2nd Ad-hoc Working Group Meeting

10. Adoption of the meeting report

11. Closure of the meeting

Annex IV

Report on Preliminary Regional Targets with Respect to the Project's Objectives of:

Biodiversity – China, R. Korea

Ecosystem – China, R. Korea

Fisheries – China, R. Korea

Pollution – China, R. Korea

Biodiversity – China

Report

On Preliminary Regional Targets

With Respect to the Project's Objectives

Of Biodiversity

by

ZHANG Xuelei
First Institute of Oceanography

Preliminary Identification of EcoQOs for Regional SAP in the YSLME: Biodiversity

Xuelei Zhang

(First Institute of Oceanography, SOA, CHINA)

1. Trends and Status

The major issues of biodiversity, identified by the working group of biodiversity, include the issues of habitat, species, genetics and management. Among these issues, habitat degradation ranks top and is identified in TDA as one of the major five problems affecting carrying capacity of the Yellow Sea.

There are two sources of habitat degradation: loss and conversion, of which conversion is regarded more significant. Environmental change due to pollution and reduced freshwater discharge degrade some habitats. Salt pans and inappropriate aquaculture may also convert critical coastal habitats. Such conversion of habitat has been expanded at large scale and more or less stabilized now in coastal areas with shallow waters and wide tidal flats. Habitats loss mainly occurs as a result of coastal reclamation, which has widely happened from the north to the south, with a smaller but still significant development now due to requirement from the coastal urbanization and industrialization.

There are more than thirty vulnerable species, either endangered or declined seriously. These species are critical to sustain the provisioning and cultural services of the YSLME. Apart from the species that are major components in fisheries (capture or culture), there is limited information on the status or trends of vulnerable species.

It is estimated that about 200 marine species have been introduced, of which around thirty species now successfully inhabit either in aquaculture systems or in the wild. As economic globalization develops and marine transportation increases, risk of introducing alien species from ship ballast water will continue to grow. With the increasing market

demand, more species might also be introduced for aquaculture.

There are not many species identified as endemic, but most of them are at less favored status if not endangered. This is mainly because their habitats are located in coastal waters where impacts from anthropogenic activities are easily to reach.

Genetic diversity is an important issue; nonetheless lack of information makes it difficult to assess the status and trend. From the available information, however, it could be inferred that, decline of wild populations, isolation or motivation of gene flows through practice of artificial breeding/culture, are posing critical threatens to genetic diversity.

Biodiversity management is also facing problems. The existing regulations needs to be strengthened, and implementation requires facilitation. A typical case is that there are some existing reserves/protected areas at different governmental levels and under different governance sectors, but there is little communication between these reserves and they are largely isolated rather than joined as a network, even though the existing conserved area is so small compared to the proposed area to protect (Fig. 1). Furthermore, some of these reserves are not properly operated due to lack of public involvement.

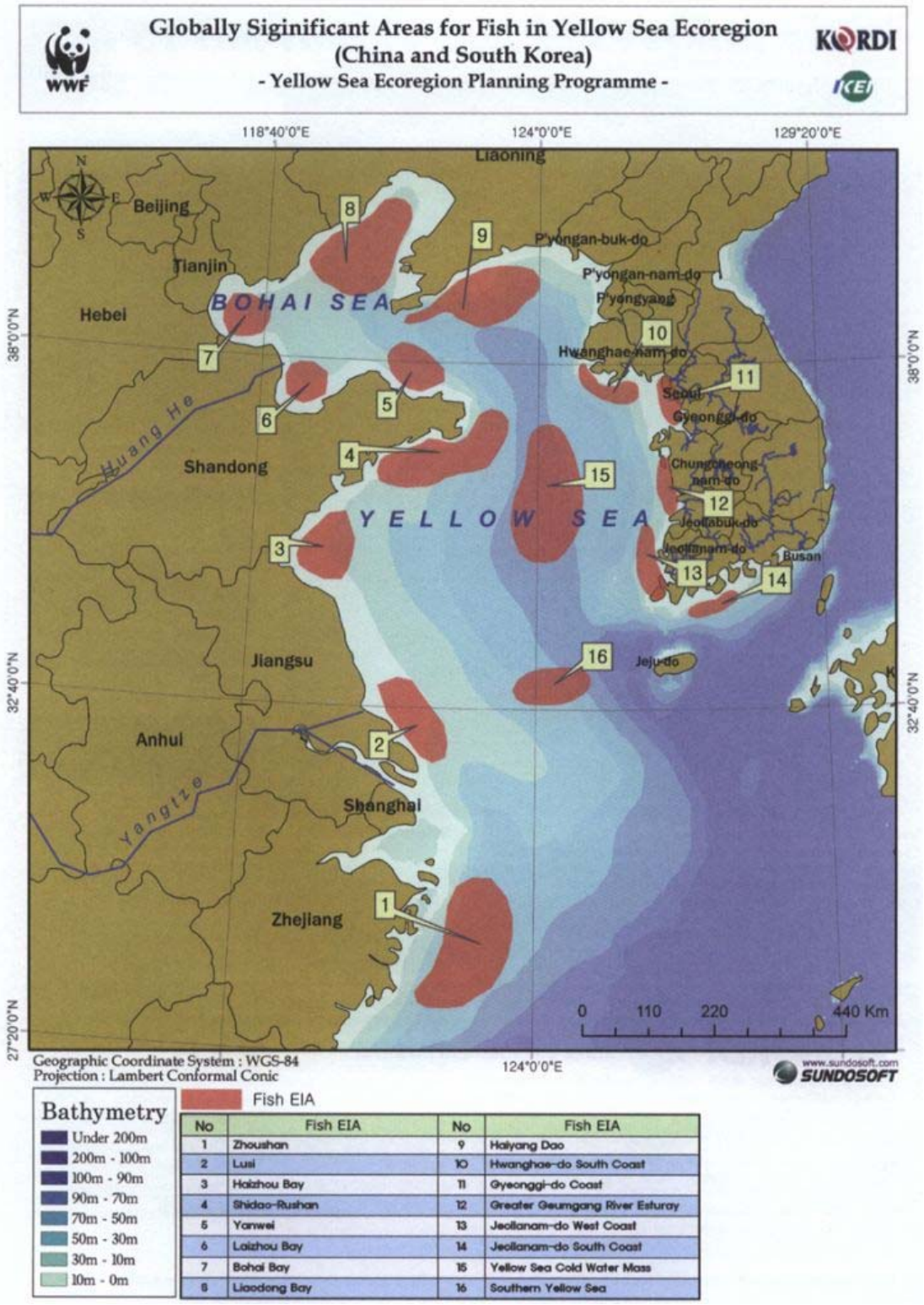


Figure 1. Important habitats with potential to conserve (WWF, Yellow Sea Ecoregion Planning Programme, 2006).

2. Suggested Options of EcoQOs

The suggested overall EcoQO is to minimize, stop or even reverse the trend of biodiversity degradation, so that the YSLME sustain its ability to provide provisioning, supporting and cultural services. Specific options are listed in the following table:

Ecosystem Services	EcoQO
Provisioning services	Build a well linked network of conservation, in order ● To protect the most vulnerable species.
	Build a gene pool library, in order ● To conserve the most valuable and endangered genetic resources.
Supporting	Strictly minimize new reclamation in order ● To maintain critical habitats of biotic resources.
	Partially recover some converted habitats, in order ● To maintain critical habitats of biotic resources.
	Build a well linked network of conservation, in order ● To protect the most vulnerable species; ● To protect the endemic species; and ● To maintain critical habitats of biotic resources.
	Minimize introduction of alien species in order ● To conserve local biodiversity.
Cultural services	Build a well linked network of conservation, in order ● To protect the most vulnerable species; ● To protect the endemic species; ● To maintain critical genuine habitats; and ● To attract public awareness and involvement.

Biodiversity– Republic Of Korea

Report
On Preliminary Regional Targets
With Respect to the Project's Objectives
Of Biodiversity

By

Kang, Young Shil
West Sea Fisheries Research Institute, NFRDI, MOMAF

Report

On Preliminary Regional Targets with Respect to the Project's Objectives of Biodiversity

Prepared by Kang, Young Shil

April , 2007

PROJECT TITLE: Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem
CONTRACT No.: SAP-7-ECOQO-1220-kang
OFFICE: West Sea Fisheries Research Institute, NFRDI, MOMAF, Korea
CONTRACTOR: Young-Shil KANG
PROJECT PERIOD: 13 March, 2007 – 30 April, 2007

TABLE OF CONTENTS

I. Introduction

The goal of this report is to give some ideas for making the regional Ecosystem Quality Objectives in Biodiversity Component. It is written according to the Conceptual procedure for Strategic Action Program (SAP), and consists of three parts, Inroduction, Trends and the Current Situation of Biodiversity in the Yellow Sea and Suggestion of Regional Target.

The data and information collected were analyzed and summarized to figure out trends and the current situation of biodiversity. Based on the trends and current situation, regional targets are suggested in here.

II. Trends and the current situations of biodiversity in the Yellow Sea

Biodiversity issues focused on five important categories, such as habitat status, species introduced for aquaculture, exotic species, endemic species and vulnerable species. It is very difficult to define an endemic species because there is no long-term historical data of each species. Thus, the species recorded in the Yellow Sea and the other Seas is referred as a general species (cosmopolitan species). The data and information of major marine organism groups are analyzed.

Habitat Status

Habitat is covered by three parts, estuaries, bays and tidal flats in the Yellow Sea. Habitat loss in the YS is mainly due to the reclamation of tidal flat and construction. The tidal flat of west coast of Korea is occupied more than 80% of all tidal flats around Korean peninsula. However, it has been dramatically developed after the first reclamation in the Gangwha Island about 800 years ago. Since the 1970s, tidal flat reclamation were accelerated and spread across the entire tidal flats. Approximately 30% of the total tidal flats were lost by reclamation in Korea. From the late 1980's, the government shifted its wetland policy from development to conservation. A new Wetland Conservation Act and related laws/regulation have been enacted.

Species introduced for aquaculture

A total of 11 species are introduced to Korea as aquaculture species. It is consist of seven species of fishes, three species shellfish and one species of shrimp. Of these eleven species, five are exotic (non-indigenous) with three species of finfish, one species of shellfish and one species of shrimp. The other seven species are indigenous in Korean and were reported from Korean waters. Among them, only two species of fishes and one species of shrimp are currently cultured on commercial scales.

General species (Cosmopolitan species)

It is defined as the species reported in the Korean waters and the other area. Seaweed was identified to 199 species (28 Chlorophyta, 50 Phaeophyta and 121 Rhodophyta). Seaweed flora tends to become tropical with time because of global warming.

A total of 587 phytoplankton species (11 Cyanobacteria, 5 Cryptophyta, 153 Dinophyta, 383 Heterokontophyta, 7 Haptophyta, 6 Euglenophyta, 22 Chlorophyta) were listed up in the west coast of Korea. The major occurring specie was diatoms in the 1930s and dinoflagellates, crysophytes and diatoms in the 1960s. Diatoms were the major occurring species, followed by dinoflagellates and flagellates during 1980's to 2000's.

Zooplankton was identified to 18 taxonomical groups and larvae. Of these groups, copepods were the most diversity in species composition, followed by chaetognaths and mysids. 101 species of copepods were recorded in the west sea of Korea. On the other hand, 34 species of jellyfish were listed up even though the research has been stared since the early 2000s. *Aurelia aurita* and *Nemopilema nomurai* are common species.

A total 206 molluscan species were listed. They were included to two major groups, such as gastropod species (top shells and whelks etc., 182 spp.) and cephalopod species (squids and cuttlefishes etc., 24 spp.). 20 echinoderm species were identified. Of these, bat seastar, *Asterias pectinifera* and a few brittle star, Myophiurida species predominated in the coastal area. Decapod species were identified to 148 species (94 species of crab and 54 species of shrimp. There are problems in identification for echinoderms and decapods because of very limited expert pool. However, in recent, species diversity of decapods tends to increase due to increasing of taxonomic efforts.

A total 101 fish species were identified as a general species with regarding their specific habitat and stocks.

Exotic species

So far, the exotic species has been recorded one species of echinodermats, seven species of fishes and two species benthos in the Yellow Sea. *Asterias ammurensis* is an exotic echinoderm species regarded transferred from Japan. The seven exotic fish species are introduced through aquaculture farming and resources enhancement. Although it is difficult to define the exotic benthos, Polychaete and bivalve species, the potential exotic species are suggested in here. *Perinere* sp. is being imported from China, so there is possibility that this species is different from the species produced in the Korean coastal area of Yellow Sea. *Mytilus edulis* could be considered as potential exotic species. Because no data about when, where and how this species could be

installed in the Korean coastal are of Yellow Sea.

Endemic species

In zooplankton, some copepods (zooplankton), *Acartia hongi* and *Acartia bifilosa*, are recently recorded as a new species in the Korean coast of Yellow Sea. However, there is no information whether they are exotic species or not. However, *A. hongi* is a possible endemic species because its record is limited to Yellow Sea, so far.

A total 15 polychaetes species were reported as endemic species living near coastal area in the Yellow Sea, Korea.

Vulnerable species

A total 28 fish species were suggested as the vulnerable species, of which commercially landings decreased or largely fluctuated, or the stock sizes would be small to get damage easily by the changes of habitat environments, threatened and/or protected species. The vulnerable fish species were mainly affected by overexploit and habitat deterioration.

Birds have recently become vulnerable in the Yellow Sea ecosystem due to not only loss and deterioration of habitat but also disturbance by human activities. A total vulnerable bird species is 19.

In benthos (Polychaetes and bivalves), three species were considered as a vulnerable species by experts even though there are no vulnerable species on the lists of IUCN and Korean vulnerable species. They are *Perinereis aibuhitensis* (Polychaeta), and *Meretrix lusoria* and *M. petechialis* (Bivalve).

Over 30 species of marine mammals historically appeared in the Yellow Sea according to the marine mammal field guide book, FAO. However, a total of 9 species of marine mammals are recently listed in the Yellow Sea.

III. Suggestion of Region Target

Based on the trends and current situation of biodiversity in the Yellow Sea, the regional target is suggested in here.

A. Change in representative biodiversity index

Biodiversity indices are essential to figure out species composition, abundance and dominant in the ecosystem. It is very useful to diagnose the trends and current situation of biodiversity and to make policy for biodiversity conservation.

B. Loss of habitat

Habitat loss is very important issue to keep biodiversity. Because it directly affects the species composition and abundance etc.

Ecosystem - China

Report

On Preliminary Regional Targets

With Respect to the Project's Objectives

Of Ecosystem

by

Mingyuan ZHU and Ruixiang LI
First Institute of Oceanography

Preliminary Regional Targets with respect to the Ecosystem Component

Mingyuan ZHU and Ruixiang LI

March 27, 2007

I Historical data and trends

In the ecosystem component, main concern focuses on the phytoplankton, zooplankton and benthos at lower trophic level and environmental problem of red tide (HAB).

1. Phytoplankton

1.1 Species composition

In the Yellow Sea there are about 500 phytoplankton species (including variant types). This umber is more than that in Bohai Sea and lee than that in east China Sea.

Table 1 Composition of phytoplankton in Yellow Sea.

Phylum	**No. genus**	**No. species**
Bacillariophyta	71	418
Pyrrophyta	13	65
Chrysophyta	1	2
Chlorophyta	2	2
Cyanophyta	1	1
Euglenophyta	1	1
Chromophyto	2	2
total	91	491

But, the species number in the sample from 4 seasonal cruises of a research project are often only 200. Though there were only 63 species in samples from cruises during 1998-2000, it could not be referred to there is a decrease trend in Yellow Sea. In samples from one cruise in spring of 2006, there were 110 species.

Table 2 Number of phytoplankton species identified in Yellow Sea in different years

Season	Spring			Summer		Autumn		Winter		Total		
Year	1984	1998	2005	1984	1998	1984	1998	1984	1998	1959	1984	1998
Diatoms	78	22	99	89	44	85	42	109	42	168	160	55
Dinoflagellates	17	8	16	15	8	28	7	11	5	32	36	8

There is a seasonal pattern for the succession of dominant species of phytoplankton：
The dominant species in spring include *Bacteriastrum hyalinum*， *Chaetoceros densus*，*Ch. castracanei*，*Nitzschia paradoxa*，*and Ch.tortissimus*
In summer, *Chaetoceros affinis*、*Ch.s compressus*，*Ch. pseudocurvisetus*，*Ceratium* spp*, Eucampia zoodiacus, Streptothece thamesis*
in autumn, *Chaetoceros pseudocurvisetus*，*Eucampia zoodiacus, Ch. affinis*、*Ch. compressus*，*Rhizosolenia alata f. gracillima*，*Nitzschia paradoxa*，*Nitzschia pungens*
in winter, *Nitzschia pungens*，*Bacteriastrum hyalinum*，*Thalassionema nitzschioides*，*Ch.debilis*，*Ch.castracanei Ch.s compressus Ch. densus*，
There is no clear change of this pattern from historical data.

1.2 Seasonal variation of phytoplankton abundance

There are two peaks in seasonal variation pattern of phytoplankton in Yellow Sea. The high peak is in winter or early spring. The second peak in summer. The abundance after the high peak is lowest in late spring (Fig. 1).

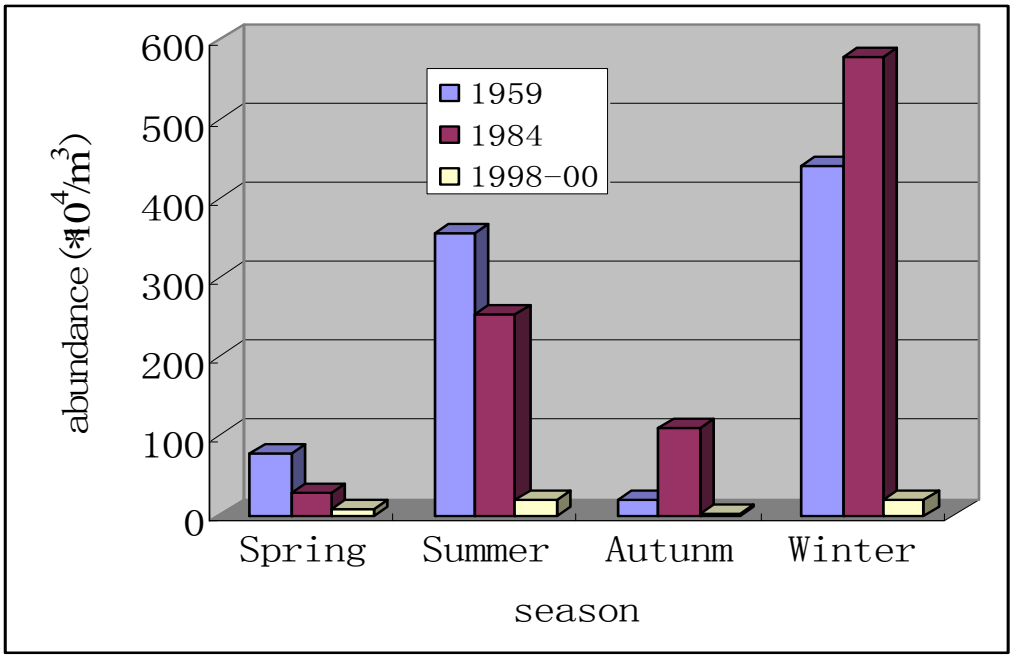


Fig. 1 The seasonal and interannual variation of phytoplankton abundance

Since 2001, the abundance of phytoplankton in spring became much higher than that in earlier years. It may attribute to the acceleration of eutrophication process and global warming.

Table 3. The cell abundance of phytoplankton in Yellow Sea ($\times 10^4$ cells/m^3)

Year	Spring	Summer	Autunm	Winter	Mean	Data source
1959	77.29	354.90	20.40	441.53	223.53	[1]
1984-1985	27.6	254.0	109.4	577	242	[9, 11]
1998-2000	7.96	20.17	2.24	18.24	12.94	[18, 19, 25]
2000			9.54			FIO
2001	777.06					FIO
March 2005	1334.3					FIO
May 2005	2.59					FIO
April 2006	2027.66					FIO

1.3 The horizontal distribution of phytoplankton abundance

There is a clear patchiness distribution of phytoplankton. The location of high value areas are coastal water of Liaoning Province in North Yellow Sea, coastal water near Qingdao City and Dasha Fishing Ground in the north of Changjiang River Estuary. But the distribution pattern also varies with seasons.

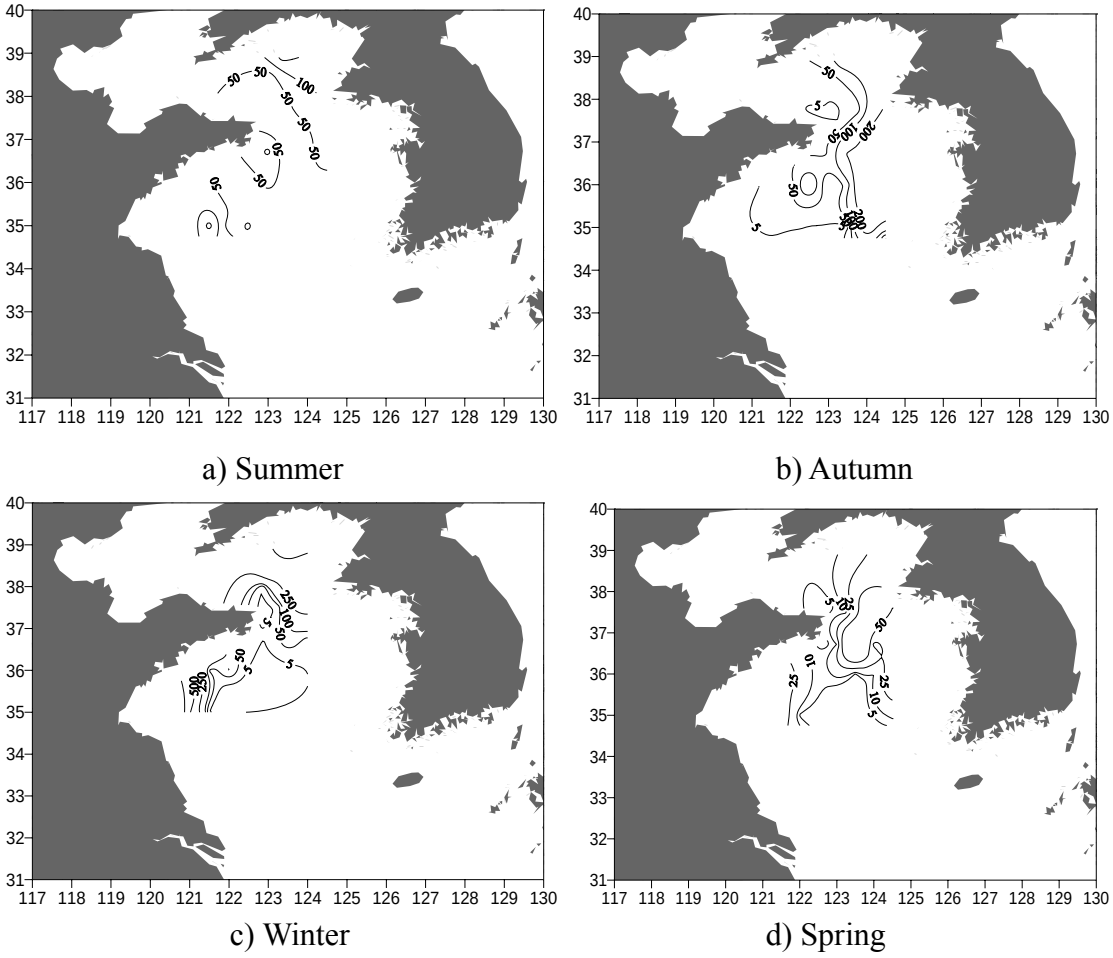
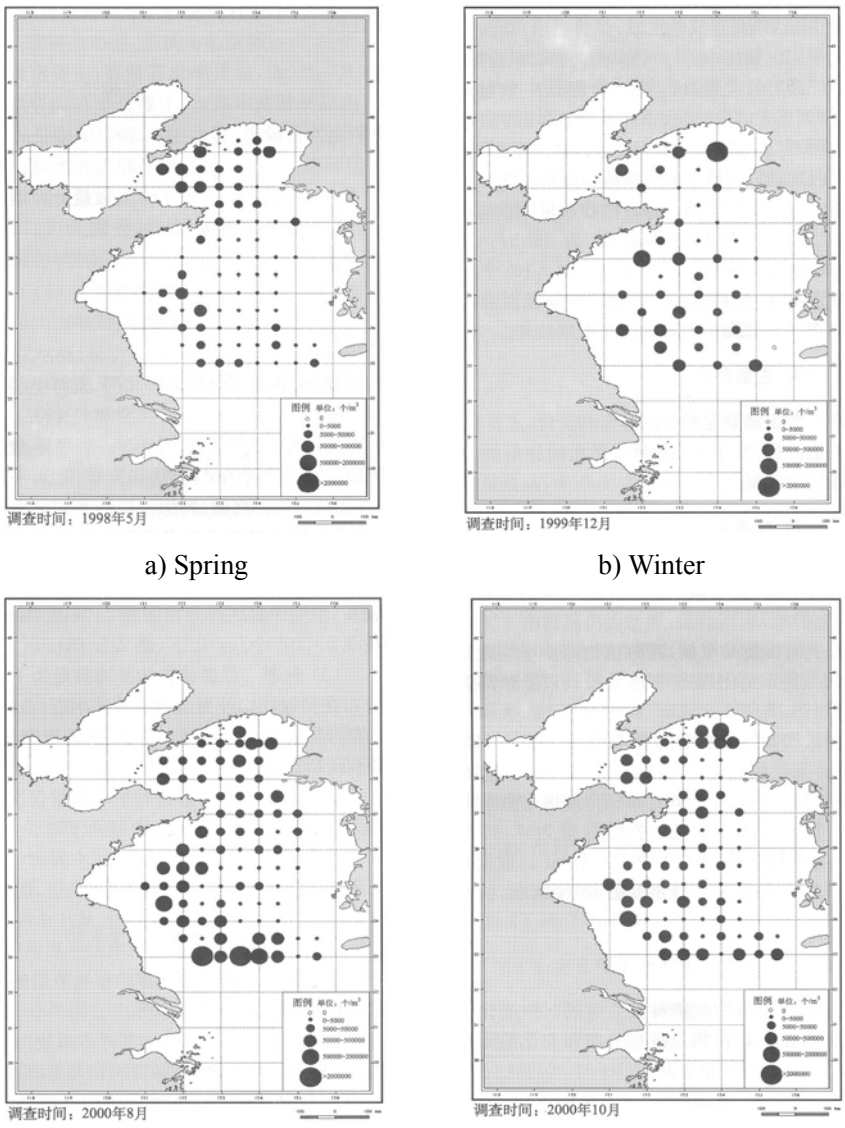


Figure 2 Distribution of Phytoplankton in Yellow Sea in 1984 (10^4cell/m^3)

In 1984, the high value in summer was in coastal water of Liaoning Province (Fig. 2a). That in autumn was in middle of Yellow Sea (Fig. 2b). In winter, there were two high value area, one was in North Yellow Sea, the other from coastal water of Qingdao to the north of Jiangsu coastal water (Fig. 2c). It was quite even in spring (Fig. 2 d).



a) Spring b) Winter

c) Summer d) Autumn

Figure 3. The distribution of phytoplankton in Yellow Sea in 1998~2000 (cell/m^3)[30]

The phytoplankton abundance in Yellow Sea during 1998~2000 (Fig. 3) was much lower than that in 1959 and 1984. In spring, the high value area was in east of Bohai Strait, in summer, high value area was in southern Yellow Sea. The most abundant area situated in coastal water of Liangyungang City and south of Shidao City and low value area in middle of Yellow Sea. In autumn, high value area was in Estuary of Yalu River in North Yellow Sea and Bohai Strait. In winter, the abundance was high in deep water area in middle of Yellow Sea.

In 2005, there was a big difference between the phytoplankton abundance in early spring (March) and late spring (May).The distribution pattern showed that the abundance in North Yellow Sea was higher than that in South Yellow Sea and that in coastal water was higher than in offshore water (Fig4, Fig. 5).

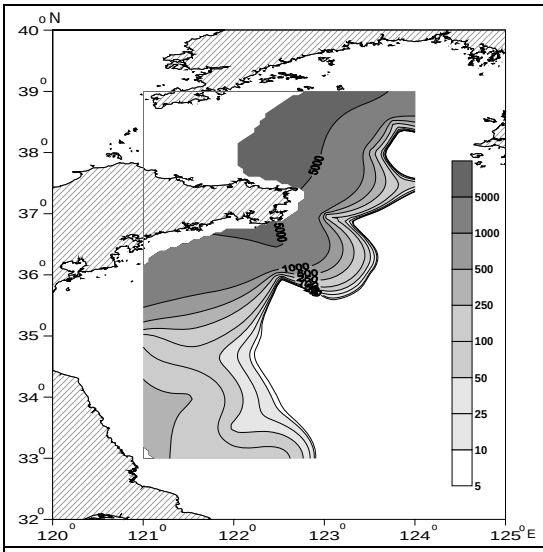


Figure 4. Phytoplankton abundance in Yellow Sea in March 2005 (10^4cell/m^3).

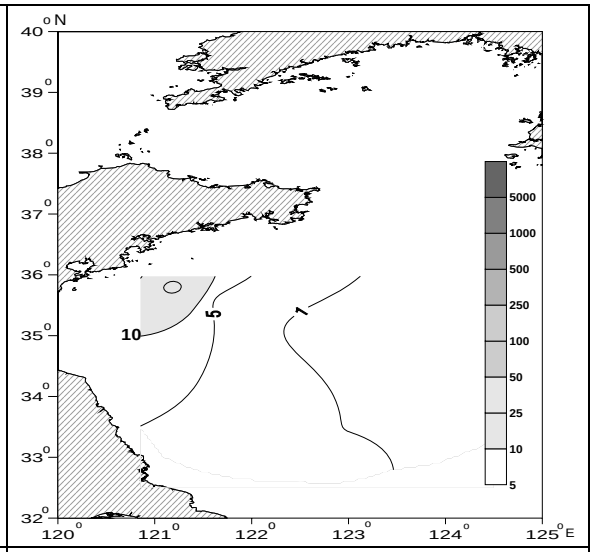


Figure 5. Phytoplankton abundance in Yellow Sea in May 2005 (10^4cell/m^3).

In April, 2006, the abundance of phytoplankton ranged 3.04-26308.33×10^4 cells/m^3 for the whole survey area (Fig. 6). The high value was close to level of red tide. In both east of Bohai Strait and Haizhou Bay, the abundance was over 2×10^8 cells/m^3. In east of Bohai Strait , the dominant species was *Skeletonema costatum* and in East of Haizhou Bay, *Eucampia zoodiacus.*

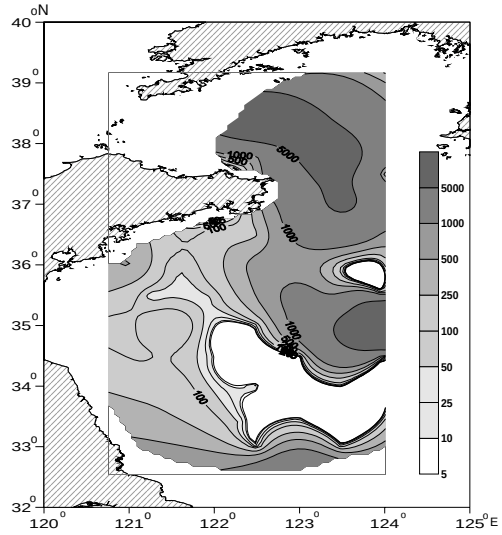


Figure 6. Phytoplankton abundance in Yellow Sea in April 2006 (10^4cell/m^3).

2. Chlorophyll a (chl-a) and primary productivity

2.1 Chl-a

During 1998-2000, the mean content of chl-a in the water column of Yellow Sea was 0.57 mg/m^3 within a range of 0.03-5.74 mg/m^3 (Fig. 7). The chl-a level was highest in spring and lowest in autumn, but the difference of 0.66mg/m^3 to 0.44 mg/m^3 was not very big.

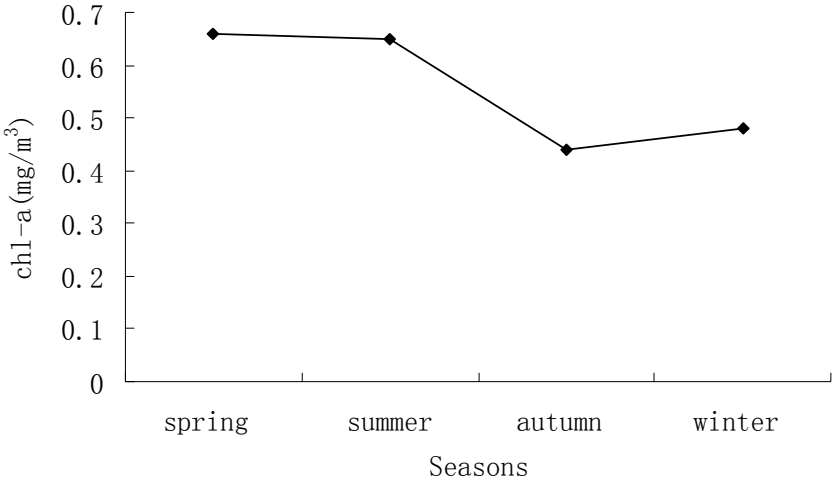


Figure 7　The seasonal chl-a in the Yellow Sea in 1998~2000.

The high value area of chl-a in summer and autumn was located in south part of southern Yellow Sea and east of Bohai Strait of North Yellow Sea. In winter and spring, it was in North West and North part of North Yellow Sea and East of Jiazhou Bay and Haizhou Bay. It was coincided with the results of 1984~1985.

2.2 Primary productivity

The annual average primary productivity in Yellow Sea was 490 $mgC \cdot m^{-2} \cdot d^{-1}$. during 1998-2000. Primary productivity was higher in spring and summer and lower in winter (Fig. 8). The assimilation number was 3.45 $mgC \cdot mgchl\text{-}a \cdot h^{-1}$, which was a little lower than that of 3.7$mgC \cdot mgchl\text{-}a \cdot h^{-1}$, mean value for world ocean This results is consistent with the previous study.

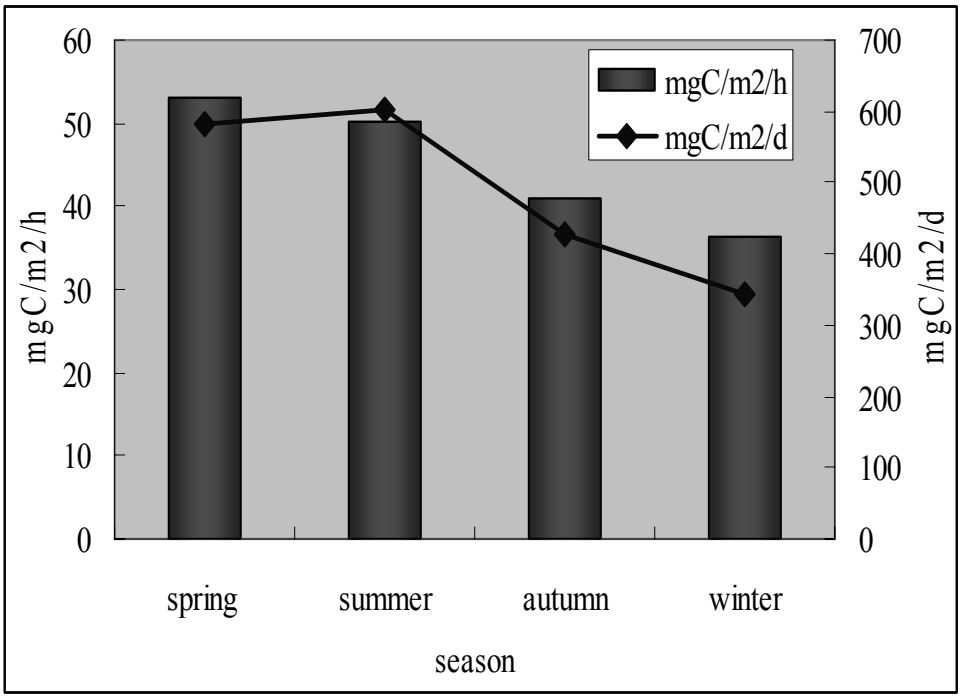


Figure 8 The seasonal variation of primary productivity in Yellow Sea in 1998~2000.

Compared with adjacent waters, primary productivity in Yellow Sea was higher than that in Bohai Sea and lower than that in East China Sea in 1984 -1985(Table 4).

Table 4 The comparison of primary productivity in Yellow Sea and its adjacent waters

($mgC \cdot m^{-2} \cdot d^{-1}$)

Region	spring	summer	autumn	winter	mean
Bohai Sea	309	468	305	151	308
Yellow Sea	625	596	369	111	425
North East China Sea	1248	1000	403	103	689

3. Zooplankton

3.1 Species compositions

There are 256 zooplankton species recorded, which belong to eleven groups and 123 genera (Table 5). Among the 11 groups, species number and biomass of Copepoda are the highest, and it plays important role in food web.

Table 5 The species composition of zooplankton in Yellow Sea

Group	**No. genus**	**No. species**
Hydromedusa	49	65
Ctenophora	4	4
Cladocers	3	4
Copepoda	30	98
Mysidacea	18	30
Euphausiacea	2	14
Sergestinae	2	8
Amphipoda	1	1
Chaetognatha	1	11
Tunicata	14	21
Gastropoda	1	1
Total	123	256

From 1950's to 1990's, the species compositions of zooplankton had been changed (Table 6). The species number of zooplankton in the Yellow Sea was 88 in 1958-59, 133 in 1980's and only 50 in 1998-2000.

Table 6. Zooplankton species numbers in the Yellow Sea in different years

Group	**1950's**	**1980's**	**1990's**
Hydromedusa	29	39	—
Ctenophora	3	2	—
Cladocers	4	3	—
Copepoda	28	69	27
Mysidacea	6	6	5
Euphausiacea	3	2	3
Sergestinae	2	4	2
Amphipoda	1	1	5
Chaetognatha	8	3	4
Tunicata	4	—	—
Decapoda	—	—	4
Gastropoda	—	1	
Total	88	133	50

The species composition of zooplankton in the Yellow Sea was simpler compared to that in the East China Sea, but was more complex than that in the Bohai Sea. The species composition and distributions reflects the water masses and currents in the Yellow Sea. The warm-temperature-zone neritic species are associated with the coastal currents. The low-temperature and high-salinity species exist in the Yellow Sea Cold Water Mass in the central Yellow Sea. Warm-water and tropical species are transported by the Yellow Sea Warm Current. *Euphausia pacifica* and *Themisto gracilipes* are indicative species to the Yellow Sea Cold Water Mass. *Sagitta enflata, Acrocalanus gibber* and *Eucalanus attenuatus* are indicative species to the Yellow Sea Warm Current. There is no clear change trend of dominant species composition from historical data.

3.2 Seasonal variation of zooplankton biomass

Seasonal variation of zooplankton biomass shows a double peak type. In general, the peaks occur in spring and autumn. But there is a winter peak in 1984-85. The seasonal variation of zooplankton biomass in Yellow Sea is shown in Fig. 9. In 1958-59, zooplankton biomass is highest in spring and lowest in summer. However, zooplankton biomass is highest in winter of 1984-85. The average zooplankton biomass is highest in 1958-59, being 115 mg/m^3. Zooplankton biomass decreased to 65.95 in 1984-85 and is only 42.45 in 1998-2000. Zooplankton biomass in 1984-85 and 1998-2000 was only 57% and 37% of the average biomass in 1958-1959. From the results of these 3 surveys, there was clearly a decreasing trend for the zooplankton biomass in the Yellow Sea. However, the results from a joint survey conducted by Marine Science and Technology Institute, Inha University of Korea and Institute of Oceanology, Chinese Academy of Sciences showed that Zooplankton biomass in

spring and summer were 280.5 mg/m^3 and 216.7 mg/m^3 respectively in Yellow Sea in 1992, which is much higher than previous results. The reason of this difference needs further studies.

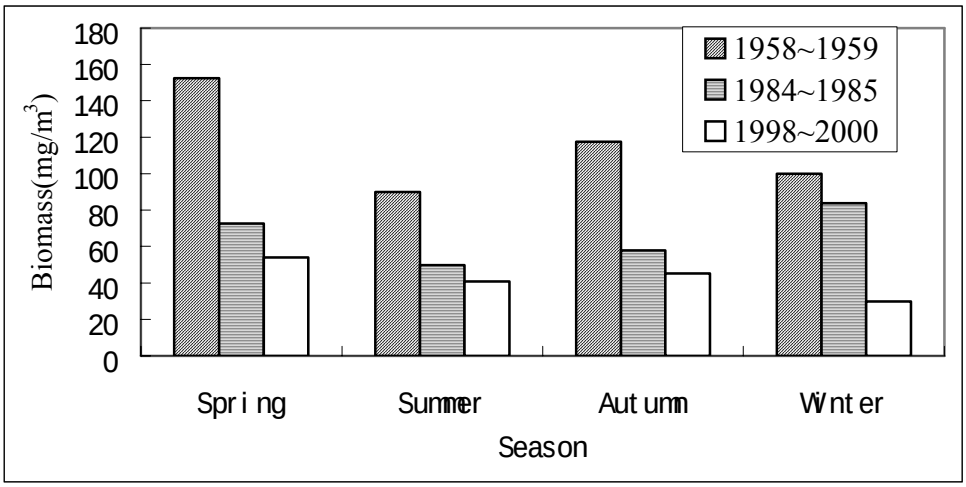


Figure 9. Seasonal variation of zooplankton in different years in Yellow Sea.

3.4 Spatial distribution of zooplankton biomass

In the Yellow Sea, spatial distribution of zooplankton biomass had a downward trend from south to north (Table 7). Zooplankton biomass was higher in the south area than in the middle area and in the middle area than in the north.

Table 7 Biomass of zooplankton (mg/m^3) in Yellow Sea

Region	**Year**	**Spring**	**Summer**	**Autumn**	**Winter**	**Mean**
North (north to 37°N)	1958~1959	117	50	110	103	95
	1998~2000	12.9	50.1	16.8	30.0	28.8
Middle (34°~37°N)	1998~2000	14.3	45.4	33.7	24.4	31.7
South (south to 34°N)	1998~2000	134.7	27.1	84.9	35.1	74.3
(south to 37°N)	1958~1959	185	125	61	75	112
	1992	280.5		216.7		

4. Macrobenthos

4.1 Species composition

One thousand and sixty-nine species from fourteen phyla (excluding macroalgae) have been recorded as benthos in the Yellow Sea, among which most species (412) are molluscs, less species (339) are polychaetes, 197 are crustaceans, 49 are echinoderms and the rest 72 species belong to the phyla Coelenterata, Platyhelminthes, Nematinea, Nematoda, Sipuncula, Brachiopoda, Hemichordata and Chordota (Table 8). The number of identified species ranged from 200 to 400 during year round benthic sampling, and the number of benthic species was higher in Spring and Summer than that in Autumn and Winter (Table 9). Polychaetes were most dominant in terms of density, whereas mollusks and crustaceans weighed out in terms of biomass.

Table 8. The species grouping of benthos in the Yellow Sea[1~20, 22].

Group	Polychaetes	Molluscs	Crustaceans	Echinoderms	Others	Total
Species	339	412	197	49	72	1069

Table 9. Seasonal species numbers of benthos in the Yellow Sea during 1998~2000[22~24].

Season	Polychaetes	Molluscs	Crustaceans	Echinoderms	Others	Total
Spring	125	47	52	13	10	247
Summer	103	46	41	9	7	206
Autumn	88	19	54	9	11	181
Winter	92	30	34	13	9	178
Total	194	86	90	21	23	414

4.2 Biomass composition and its seasonal variation

The average biomass of macrobenthos was 37.17g/m^2 in the Yellow Sea during 1998~2000, of which echinoderms and polychaetes biomass was higher (>10g/m^2) and biomass of each other groups was below 5 g/m^2 (Table 10). The order of seasonal average biomass of macrobenthos was spring 50.75 g/m^2 >autumn 35.35g/m^2 >summer 32.64g/m^2 >winter 29.94 g/m^2.

Table 10. The biomass (g/m^2) of benthos in Yellow Sea [17, 21-24]

Year/season		Polychaetes	Mollus	Crustacean	Echinoder	Others	Total
1998~00	spring	11.07	8.54	3.81	18.99	8.6	50.75
	summer	10.49	3.19	6.50	6.41	6.07	32.64
	autumn	10.75	1.78	2.56	11.56	8.69	35.35
	winter	7.89	3.69	1.56	9.48	7.33	29.94
	mean	10.05	4.30	3.61	11.61	7.67	37.17
1992	spring	3.33	6.85	1.5	12.59	4.93	29.2
	autumn	4.33	4.44	1.6	3.42	1.46	15.25
1984~85	mean	5.79	5.64	<1	3.63		<16.1

4.3 Density composition and its seasonal variation

The average density of macrobenthos was 250 ind./m^2 in the Yellow Sea during 1998~2000, of which polychaetes (143 ind./m^2) accounting for 57% of the total density while crustaceans (44 ind./m^2) and molluscs (38 ind./m^2) ranked the next and echinoderms density (13 ind./m^2) was the lowest (Table 11). The density was highest in spring for the whole benthos (359 ind./m^2) and for the different groups except for molluscs and others that peaked in winter. Comparing with the data from the year of 1984~85 and 1992, the polychaete density and total density of macrobenthos has both increased by more than 20%.

Table 11. The density (ind./m^2) of benthos in Yellow Sea [17, 21-24]

Year/season		Polychaetes	Molluscs	Crustaceans	Echinoderms	Others	Total
1998~00	spring	202	57	70	24	5	359
	summer	108	16	55	5	2	186
	autumn	130	7	13	11	3	165
	winter	131	72	37	11	38	290
	mean	143	38	44	13	12	250
1992	spring	94	73	55	28	5	254
	autumn	67	32	42	16	20	177
1984~85	mean	90	31	64	15		200

4.4 Comparison with adjacent seas

The number of benthos species in the Yellow Sea is higher than the adjacent Bohai Sea, but lower than the East China Seas (Table 12). Polychaetes form the most dominant group in terms of species number, making 50% of the total number of benthic species in the Yellow Sea. Of the Yellow Sea benthic species, 104 species also inhabit Bohai Sea, 209 also inhabit the East China Sea, and 128 species (e.g. *Ophelia acuminata*, *Thyasira tokunagai*, *Raetellops pulchella*, *Natita janthostomoides*, *Eudorella pacifica*, and *Ophiura sarsii*, etc.) do not occur in China coastal waters other than Yellow Sea.

The benthos biomass in Yellow Sea averages 37.17 g/m^2, higher than the adjacent Bohai Sea and East China Sea (Table 12). Echinoderms is the groups with highest biomass in the benthos and biomass of the echinoderm *Ophiura sarsii* affects total benthos biomass, which is distinct from the two adjacent seas.

The benthos density averages 250ind/m^2 in the Yellow Sea and it is at intermediate level between the adjacent Bohai Sea and East China Sea. In the macrobenthos of Yellow Sea, polychaete density makes the largest proportion (52%), higher than its contribution in the Bohai Sea and East China Sea.

Both the biomass and density of macrobenthos tends to increase considerably in the Yellow Sea, but the biomass of major groups (polychaetes, crustaceans and echinoderms) increased by larger extents such that the average individual weight tends to increase in these groups and thus the benthos as a whole.

Table 12. Species number, biomass and density of benthos in the Yellow Sea and adjacent seas.

	Yellow Sea	**Bohai Sea**	**East China Sea**
Species number	414	119	855
Biomass (g/m^2)	37.09	15.88	20.84
Density (ind./m^2)	250	177	280

5. Information on red tide (HABs)

5.1 HAB frequency

Fig. 10 shows the HAB events in Yellow Sea over the period 1980-2006. As will be readily seen, occurrence of HAB events is gradually increasing. During 2000-2005 the HAB events accounted for about 50% of total records. Although there were only two HAB events in 2006, this does not suggest that the environmental quality of Yellow Sea is being improved. The last six years of records indicate that a little more HAB events in the west of middle Yellow Sea than in the north and south of Yellow Sea (Table 5.1).

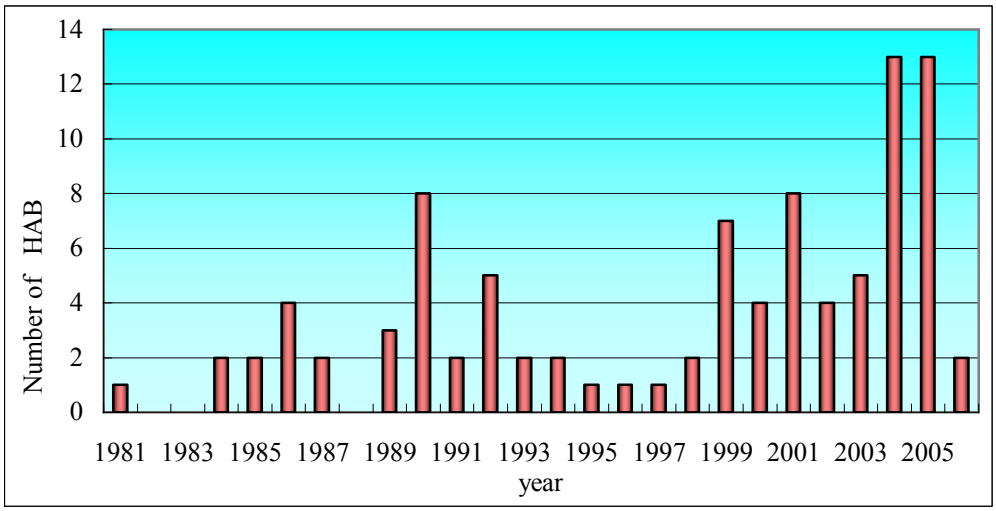


Figure 10 The events of HABs in Yellow Sea since 1981.

Table 13 HAB events in the coastal waters of Yellow Sea during 2001-2006.

Year	Liaoning coast	Shandong coast	Jiangsu coast	Total
2001	2	2	4	8
2002	0	2	2	4
2003	3	2	0	5
2004	5	5	2	13
2005	4	5	4	13
2006	0	1	1	2

5.2 The hot spots of HAB events

HAB events occurr more frequently in waters of high eutrophication and poor water exchange such as estuaries, semi-enclosed bays, sheltered harbours and mariculture area, etc. HAB events are less frequent in the middle of Yellow Sea (Table 14).

Table 14 The regions of HABs occurrence in Yellow Sea.

Waters	**City**	**Province**
Donggang	Dandong	Liaoning
Yalujiang Estuary		Liaoning
Dalian Bay	Dalian city	Liaoning
Zhangzidao	Dalian city	Liaoning
Sishili Bay	Yantai city	Shandong
Rushan Bay	Yantai city	Shandong
Jiaozhou Bay	Qingdao city	Shandong
Rizhao costal water	Rizhao city	Shandong
Haizhou Bay	Lianyunguang	Jiangsu
North of Changjiang Estuary	Rudong,	Jiangsu

5.3 HAB event species

Although more than 30 HAB species have been suggested in Yellow Sea, only 17 species did formed HABs in Yellow Sea (Table 15). *Noctiluca scintillans*, a dinoflagellate, is one with highest frequency of HAB connection, accounting for 50% of HAB events in Yellow Sea. *Skeletonema costatum* ranks next making 20%~30% of HAB records. In general HAB species occur regionally, but HABs of *Noctiluca scintillans* and *Skeletonema costatum* are recorded in the whole Yellow Sea. *Alexandrium catenetum* and *Heterosiama akashiwa* only occurred in seawaters adjacent to Dalian. Many HABs of *Gymnodinium sanguinieus* were only recorded in Sishili Bay, Yantai. A *Gymnodinium catenatum* red tide took palce in Lianyungang. *Mesodinium rubrum* red tide out broke more in Qingdao and sometimes in Dalian. The first HAB of *Phaeocystis globosa* was found in the coastal water of Yantai in 2004. In 2005 the first HAB of *Chattonella marina* was recorded in the coastal water of Jiaonan (Qingdao). Furthermore, diarrhetic shellfish poison (DSP) has been detected in shellfishes from Weihai, Qingdao and Lianyungang, but we are not clear about the causal algae species. Great importance must be paid on this issue.

Table 15 The species caused HABs in Yellow Sea

Group	Species
Dinoflagellates:	*Noctiluca scintillans*
	Gymnodinium sanguinieus
	Alexandrium catenella
	Gymnodinium catenatum
	Gonyaulax polygramme
	Gonyaulax spinifera
	Ceratium furca
Diatoms:	*Skeletonema costatum*
	Eucampia zoodiacus
	Leptocilindrus danicus
	Thalasiosira sp.
	Chaetoceros affinis
	Cheatoceros socialis
Raphidophytes	*Chattonella marina*
	Heterosiama akashiwa
Prymnesiophyceae	*Phaeocistis globosa*
Protozea:	*Mesodinium rubrum*

II. Environmental problems

During transboudary diagnostic analysis of Yellow Sea LME projects, 4 environmental issues in ecosystem components were identified (Table16).

Table 16

Types and Nature of Environmental Problems Relating to the Ecosystem Component

Environmental Issue	Nature of Issue	Priority
Change in biomass or abundance	Environmental Problem	3
Change in species composition	Environmental Problem	2
Increased frequency of harmful algal blooms (HABs)	Environmental Problem	1
Loss of benthic habitat in coastal areas	Environmental Problem	Referred to RWG-B

Under the heading "*change in biomass or abundance*" the RWG-E has first listed "*Increase in zooplankton > 330μm zooplankton in the Korean area of the Yellow Sea*" and "*Decrease in zooplankton > 505μm and phytoplankton > 77μm in the Chinese area of the Yellow Sea*".

The concern here is that these changes, although incoherent, are evidence of changes in the composition of both phytoplankton and zooplankton communities in the Yellow Sea. The consequences of such changes in community composition are changes in the food web and threats to the food supplies for living marine resources at higher trophic levels. The decreases in phytoplankton >77μm in the Chinese area of the Yellow Sea could also result in a reduced capacity for carbon fixation in the region and a change in carbon fluxes over a large area. Similarly, such reductions could also result in reduced production of dimethyl sulphide that plays a significant role in cloud formation, thus having an influence on both regional and global climatic conditions. Under the same category the RWG-E has also defined a "*Shift in peak in seasonal pattern of zooplankton biomass abundance in the Korean area of the Yellow Sea*". This reflects similar evidence of zooplanktonic community changes that could have an adverse effect on the food supplies for higher trophic level organisms. It must be remembered that phytoplankton and zooplankton constitute the foundation for the entire marine food web that ultimately provides the basis for the sustenance of all marine species, including commercial wildfish and other exploited species. Changes in primary and secondary production, both in terms of the rates of production and species diversity, will inevitably have consequences at higher levels in the marine organism community but contemporary knowledge of food web dynamics does not allow for reliable prediction of the consequences at higher trophic levels.

Under the heading "*Change in species composition*" the RWG-E has listed "*Change in dominant groups of zooplankton (Korea)*", "*Changed ratio of diatoms to dinoflagellates (China)*", "*Jellyfish blooms*" and "*Change in benthic species composition and dominant species*". The first two of these issues are of concern because they reflect changes in food web dynamics that can affect organisms at higher trophic levels. The change in phytoplankton species from diatoms to dinoflagellates could either be a corresponding response to changes in predation or, more likely, a response to an abundance of dissolved nitrogen and phosphorus accompanied by dissolved silicate impoverishment. The concern here is that the majority of toxic algae and those that cause adverse effects on other marine organisms are in the dinoflagellate class of phytoplankton. Thus, it is likely that the shift from diatoms to flagellates is a response to much reduced silicate concentrations in relation to the other nutrients. This has occurred elsewhere, in the eastern North Sea for example, and has occasionally given rise to a preponderance of foaming algae that caused aesthetic problems for beach users. There has been a significant increase in the abundance of jellyfish within the Yellow Sea in recent years. Jellyfish cause interference with fishing activities, the clogging of sea water intakes and pose threats of stinging to sea bathers. The increased presence of jellyfish is also a reflection of changes in primary and secondary productivity in the system and alterations to the food web of the Yellow Sea. The change in benthic species composition and the dominant benthos in parts of the Yellow Sea signify a reduction in benthic biodiversity. Such changes will be a response both to changes in the food web dynamics and the composition of bottom sediments. The concern here is that such changes will reduce the availability of both benthic and demersal fishing resources in the Yellow Sea but currently there exist insufficient data to quantify such losses.

Under the heading of the *increased frequency of harmful algal blooms*, the RWG-E has noted that there has been a significant increase in the annual incidence of intense algal blooms (see

Figure 8[1]). Such blooms can cause increased mortality of mariculture stocks, kills of wild fish thereby reducing fishery yields, and increased risks to seafood consumers through the incorporation of natural toxins into exploited marine organisms.

III. Preliminary consideration for Regional EcoQO's Target

There are 4 environmental issues in TDA.

1. Change in biomass or abundance

The trend in phytoplankton and benthos is not very clear. There is a trend of decrease in zooplankton biomass, but for Korea, the trend is increase. Furthermore, the technology to regulate zooplankton biomass is not available. It is very difficult to set a EcoQO for biomass or abundance. However, suggestion is to strengthen monitoring activities and to improve assessment of the biomass or abundance status, especially regional joint efforts.

2. Change in species composition

This is a similar problem to change of biomass or abundance.

3. Increased frequency of harmful algal blooms (HABs)

This problem is referred as Priority 1 in ecosystem component. But, knowledge on the ecology and oceanography of HAB in Yellow Sea is not enough to prevent and control HAB. If the eutrophication in Yellow Sea could be reduced, then HAB events will be reduced. Eutrophication will be concerned by Pollution Component.

4. Loss of benthic habitat in coastal areas

This issue will be considered by biodiversity component

Ecosystem – Republic Of Korea

Report

On Preliminary Regional Targets

With Respect to the Project's Objectives

Of Ecosystem

by

YOO Sinjae
Korean Ocean Research and Development Institute

Preliminary Analysis for Identification of the Ecosystem Quality Objectives of the Carrying Capacity in the Yellow Sea: Ecosystem change

Sinjae Yoo
KORDI
Ansan Sa-dong 1270, South Korea
sjyoo@kordi.re.kr

1. Introduction

The purpose of this analysis is to identify targets for intervention to sustain ecosystem services under deteriorating ecosystem quality during the past decades. Such targets are preferably of quantitative nature so that costs and benefits of intervention can be optimized.

Possible approaches would be 1) to select potential indices that indicate ecosystem changes/trends, 2) to check whether good time series data for each index are available, 3) if yes, to check whether any discernable trend can be established, 4) to ask what that trend means, and 5) to set a reference value for selected indices.

The nature of the analysis at this preliminary stage is unavoidably exploratory. Here I will examine potential indices of ecosystem changes for their validity and consistency. I will also suggest directions for further analysis.

2. Requirements for indices

As candidates for EQ targets in ecosystem, some indicators of the structure and function of ecosystem are reviewed based on TDA as well as the national reports from China and Korea. For these indices to be useful there are certain requirements. First of all, there should be more than one data set ranging decades' period. Preferably, a time series will be the best data, but even two data sets can be used. Second, the data should be comparable in terms of spatial coverage, taxonomic representation, sampling methods, temporal variability, etc. Third, there should be inherent consistency within datasets. If the data show very high fluctuation that cannot be explained, the data can not be used to detect trends.

3. Potential indices

A. Nutrients

Lin et al. (2005) provide valuable data of T, S, nutrients (N, P, Si) and DO for the periods of 1976-2000. Periodic surveys were made seasonally every year on a monitoring line located at 36°N, 120.5-124.5°E. Their data clearly show an increase in DIN, decrease in DIP, and Silicates. As a result, the N:P ratio has steadily increased. They attributed this to the decrease in the freshwater input from the Yellow River. They tried to match the trends with lower trophic as well as higher trophic components. They resorted to the second hand data from literature. They argued that the trend in the N:P ratio was accompanied by decreases in chlorophyll, primary production, phytoplankton abundance, diatom abundance, and relative proportion of diatom. However, at least part of this observation is not consistent with other observation. Son et al. (2005) show that chlorophyll might have increased from 1979 to 2000 from satellite data. Kang et al. (2007) argued using Korean side data that *Calanus sinicus* increased from 1980s to 1990s but chlorophyll did not show much change. They attributed the change to the decrease of Japanese anchovy, a major predator of *Calanus*. Thus a further analysis is required to assemble a coherent picture of the subsequent changes in the ecosystem structure. Although nutrients have clear meaning and implication for both ecosystem productivity and functioning, setting N, P, Si, or N:P, N:Si as management targets has problems in practicability. If this decreases of phosphorus and silicates are caused by decrease in freshwater input as Lin et al. (2005) infers, whether the freshwater input to the Yellow Sea basin is manageable is not clear.

B. Diatom/dinoflagellate ratio

In relation with N:P ratio change, one of the important property of the ecosystem is change in the phytoplankton community. Particularly, diatoms and dinoflagellates are important as dominant phytoplankton groups linking primary production to grazing chain. Given the long-term change in the nutrients, it is worthwhile to ask what kind of changes happened in the lower trophic components to begin with. Chinese report show the species number of phytoplankton surveyed in 1984, 1998, and 2005 (spring only for 2005). Although the exact nature of the data is not clearly specified, the overall distribution of each year's surveys seems comparable. Original data from the report include the species number of diatoms and dinoflagellates. Since these two groups

represent more than 98% of the net phytoplankton, the change of these two groups can be a very effective indicator of structural change in the phytoplankton community of the Yellow Sea. Identification and counting of phytoplankton species are simple and robust methodology, so that as long as the areal coverage is similar among different years, the data can be used as an indicator for ecosystem change. Temporal variability is a problem particularly in spring and fall when the seasonal changes in the community structure are rapid so the variability is compounded by temporal, spatial, and interannual variation. Understandably, Table 1.2 of the Chinese report shows quite variable number of species for diatoms and dinoflagellates. Using a ratio of diatoms/(diatoms+dinoflagellates) rather than species number of each group can remove compounded variability. Figure 1. shows the change in the ratio among 1984, 1998, and 2005 sampling periods.

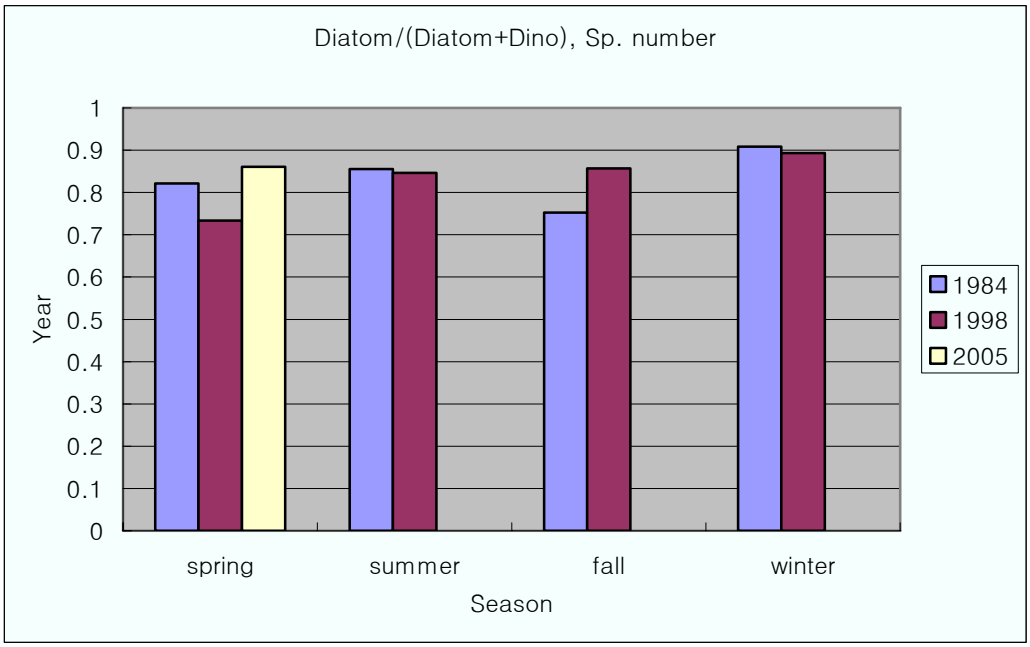


Figure 1. Ratio of diatoms/(diatoms+dinoflagellates) species number from Chinese surveys. Redrawn using the data from the Chinese report.

While the species number of each group varied by five folds, the ratio of diatom species number to the total species number remains rather constant, between 0.73~0.90. Also there seems no particular trend in the ratio between 1984 and 1998. Unfortunately, Korean report does not include diatoms/dinoflagellates data covering at least a decade's interval. The data of Lin et al. (2005) show a decrease in the diatom/dinoflagellates ratio but do not show actual increase in the dinoflagellates abundance. Their data only indicated a decrease in the diatom abundance. Therefore, the consequences of

decreasing N:P ratio are not clear yet. Further rigorous analyses are necessary.

C. Species diversity (phytoplankton, zooplankton, benthos)

There are no time series of species diversity from the reports by China or Korea.

D. Abundance/biomass of phytoplankton

Although Chinese report includes cell abundance data ranging from 1959 to 2006, the data do show an incredible fluctuation within a season. For example, spring abundance of phytoplankton cells was 77.29 x 10^4 cells m^{-3} in 1959, then decreased to 7.96 x 10^4 cells m^{-3} in 1998-2000 but increased to 2027.6 x 10^4 cells m^{-3} in 2006, about 254 fold increases. The data also indicate summer and winter abundance were much higher than spring and autumn. This pattern is contradictory to what we know about the general pattern from temperate seas where seasonal stratification is a driving factor (Sverdrup, 1953; Longhurst, 1998) or from the pattern observed by satellites. Some of the inconsistency can be explained by sampling methods. The abundance data were collected from net samples with 77 μm mesh size. With this mesh size, only larger cells are collected and net samples have very high errors. Korea report does not include long enough time series for the analysis.

E. Primary productivity

Chinese data of primary productivity cover 1998-2000, while Korean data cover 1992, 1996, 1997. The temporal coverage is too short even if spatial variation and other comparison issues are resolved. Son et al. (2005) compared CZCS (1979) and SeaWiFS (2002) data and found the average chlorophyll concentration increased by 15-60% in the offshore deep waters. Bimonthly in-situ measurements from 61 stations in the western coast of Korea from 1978 and 2002 were compared with the trends found in satellite data. The results show that there were increasing trends in temperature and zooplankton biomass, and decreasing trends in salinity and Secchi depth. However, according to Lin et al. (2005), primary productivity decreased from 1980s to 1990s. Their conclusion was based on values from literature and inconsistent with their own data of steady increase in nitrogen. Further scrutiny is necessay.

F. Abundance/biomass of zooplankton

Chinese data show the zooplankton biomass decreased consistently from 1950s to 1980s and 1998~2000 periods. The pattern is consistent throughout all seasons. However, Korean data ranging from 1965 to 2000 with bimonthly sampling show quite different

yet consistent pattern of increase after late 1980's. The contradiction is significant and it cannot be explained solely by sampling differences. Although the patterns are interesting and may have important information, they do not represent basin-wise consistent trend at a glance. Zooplankton abundance increased in the fraction > 330 μm (Korea), but decreased in the fraction > 505 μm (China). At face values, this means the fraction between 330 μm and 505 μm increased while larger fraction decreased. If the data are comparable and reliable, this indicates a change in the structure of zooplankton community. Further analysis is necessary to check this possibility.

G. Abundance/biomass of benthos

Chinese benthos data cover about 15 years' range. The biomass seems to increase sfrom less than 16 g m^{-2} (1984~1985), to 22.2 g m^{-2} (1992), and 37 g m^{-2} (1998~2000). Although direct comparison may be difficult, but at least the differences among the periods are greater than seasonal variation. Density data show similar pattern of increases from 200 ind. m^{-2} (1984-1985), to 215 ind. m^{-2} (1992), and to 250 ind. m^{-2} (1998~2000). Korean data include only 1992 survey and do not provide information of temporal change.

H. HAB

There is no evidence that HABs are increasing in both Chinese and Korean coasts. My arguments rested on the facts that the criteria of a HAB event in both Korea and China are based on the phytoplankton density regardless of harmfulness. For example, NFRDI adopt the criterion of cell density 1,000 cells ml^{-1} for HAB. Except for the small *Cochlodinium* blooms in 1998 and 2000, and *Chatonella* blooms in 2006, all the bloom incidents reported from Korea were by harmless diatoms. And in fact, no economic or social damage even from the *Cochlodinium* and *Chatonella* blooms has been reported from the Korean coast of the Yellow Sea. Thus the data at best indicate a trend of eutrophication in near-shore region at least in Korea. The increasing trend of the algal blooms may also reflect increasing monitoring during the late 90's not only in Korea but also in China. There seems even a slight decrease in the frequency of algal blooms after 1998 in Korea (Figure 2). Therefore, there is no ground that HAB is a standing transboundary issue in the Yellow Sea.

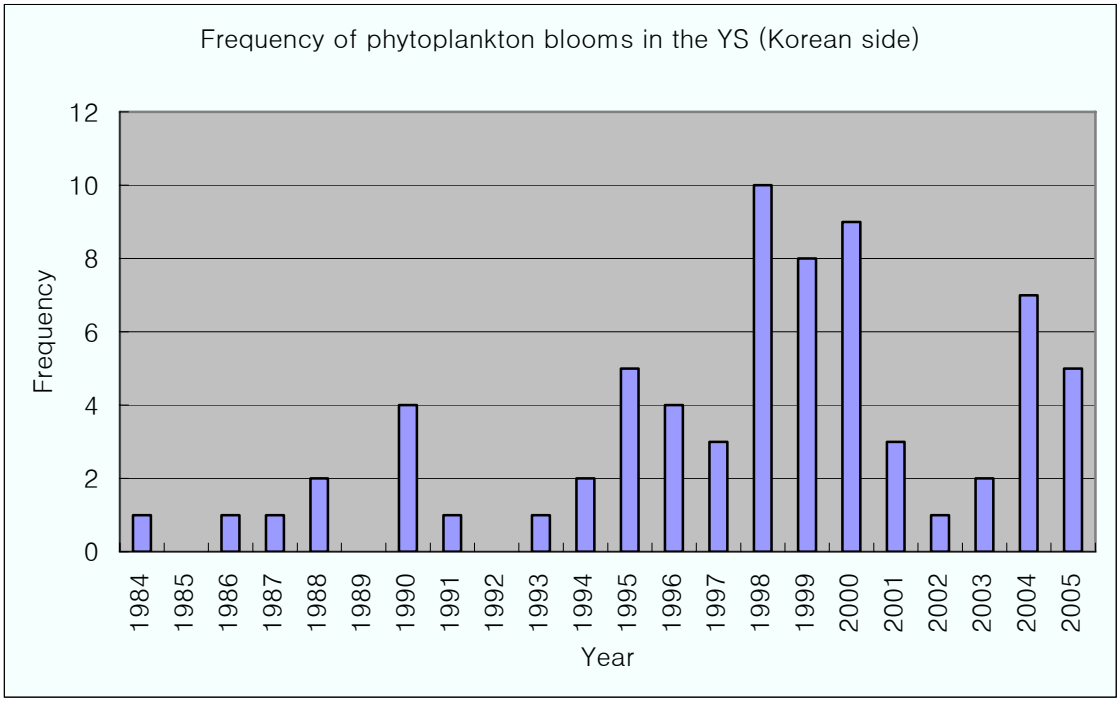


Figure 2. The trend in the purported HAB incidences from Korean side of the Yellow Sea. Here, identification of HABs was based on cell density (1,000 cells ml^{-1}).

I. Jellyfish

Although recent jellyfish blooms in the Yellow Sea are well known and even mentioned in the TDA, no description is given either in the Chinese or Korean reports. Some hypothesize that recent global surge of jellyfish blooms might be related to change in the phytoplankton community (Parsons and Lalli, 2002). However, the causes of jellyfish blooms are not clear yet and using this as quantitative measure of environmental quality by itself is not feasible at the moment.

4. Conclusions

As I have shown it is difficult to establish meaningful trends in the ecosystem change from the national reports. The collected data are mostly not good enough in spatial and temporal coverage to indicate consistent changes beyond possible spatial and temporal variance or noises. Among the indices examined, only the two groups of properties seem established to show meaningful trends: Nutrients and the biomass/abundance of macrobenthos. Nutrients data by Lin et al. (2005) show consistent trends. Nitrate increased but phosphates and silicates decreased. As a result, N:P ratio increased. However, the subsequent changes accompanying the nutrient changes are not clear yet.

Conflicting data are reported by different authors. The change in the phytoplankton community, represented by diatom/dinoflagellates, is not clear. One source argues the diatom abundance decreased, while other data indicate no significant change in the diatom/dinoflagellate ratio. Regarding phytoplankton biomass and productivity, data are again conflicting. Some show an increase, but some show a decrease. Regarding zooplankton biomass, we are in a similar situation. Chinese data indicate a steady decrease while Korean data show an increase.

Where do we go from here? First all, the inconsistency in information about ecosystem changes have to be resolved and we have to establish a coherent picture from nutrients, phytoplankton community and primary productivity to zooplankton community and biomass and eventually to fish community and productivity. Therefore, the next step would be further data mining with specific questions mentioned above. Once we establish the ecosystem changes in the past decades beyond reasonable doubts, we would understand the forcing and mechanisms involved. This understanding will help us to differentiate the human-induced local change from global change in the Yellow Sea ecosystem.

References

Kang, J.-H., Kim, W.-S., Jeong H.J., Shin, K., Chang, M. 2007. Why did the copepod Calanus sinicus increase during the 1990s in the Yellow Sea? Marine Environmental Research 63, 82-90.

Lin, C., Ning, X., Su, J., Lin, Y., Xu, B. 2005. Environmental changes and the responses of the ecosystems of the Yellow Sea during 1976-2000. Journal of Marine Systems 55, 223-234.

Longhurst, A. R. 1998, Ecological Geography of the Sea, 398 pp., Elsevier, New York. Lukas, R., and E. Lindstrom.

Parsons, T.R., Lalli, C.M. 2002. Jellyfish population explosions: Revisiting a hypothesis of possible causes. La mer 40, 111-121.

Son, S., Campbell, J.W., Dowell, M, and Yoo, S., 2005. Decadal variability in the Yellow and East China Seas as revealed by satellite ocean color data (1979–2003). Indian Journal of Marine Sciences, 34, 418-429.

Sverdrup, H. U. 1953. On conditions for the vernal blooming of phytoplankton. J. Cons. Perm. Int. Explor. Mer., 18, 287-295.

Fisheries – China

Report

On Preliminary Regional Targets

With Respect to the Project's Objectives

Of Fisheries

by

Xianshi JIN
Yellow Sea Fisheries Research Institute

Strategic Action Programme for Fisheries of Yellow Sea LME Project

1. Introduction

This mission is to prepare preliminary Ecosystem Quality Objectives (EcoQOs) for management actions of the Strategic Action Programme (SAP) with respect to the Project's Fisheries objectives, analyzing the data and information collected through the Project's data collection and regional syntheses contracts and other available data:

(1) Review historical data and trends of the Yellow Sea ecosystem collected through the national data and information collection and the regional syntheses;
(2) Identify the current situation of the Yellow Sea ecosystem;
(3) Based on the review, present the results of the above analyses to the 1st Ad-hoc Working Group meeting (tentatively scheduled from 10 to 12 April 2007), which should include various options for EcoQOs for each variable (as highlighted by the HAB example in the SAP consultation meeting where an expert suggested that a 30% cut in nutrients concentration in seawater would virtually eliminate HAB events, whereas a 50% cut in N concentration would restore the original diatom/dinoflagellate ratio);
(4) Based on the comments and suggestions provided during the 1st Ad-hoc Working Group Meeting, conduct further analysis, if necessary, and provide the Ad-hoc Working Group, at its second meeting, with the additional results;
(5) Provide draft report to PMO no less than 2 weeks before the 1st Ad-hoc Working Group Meeting; and
(6) Expected outputs include a list of optional EcoQOs with respect to "Fisheries" in the Yellow Sea.

2. Trends and the current situation of fisheries in the Yellow Sea LME

The China and Korea national and regional data and information provided the basic information and analysis of fisheries to the Yellow Sea Large Marine Ecosystem (LME) (Jin et al., 2006, Lee, 2006; West Sea Fisheries Research Institute, 2006). By reviewing the historical data and information, the working group for fisheries component has indicated the first issue was that

overexploitation of target species through over-capacity of fishing fleets and ineffectiveness in fisheries management and climate changes caused changes in dominant species in landings resulting in decline of many traditional commercially-important species and increased landing of low value species.

In the 1950's, the economically important species in the Yellow Sea were the Small Yellow Croaker (*Larimichthys polyactis*), Largehead Hairtail (*Trichiurus lepturus*) and Fleshy Prawn (*Fenneropenaeus chinensis*) *etc*. With the increase in fishing effort, the abundance of these species has declined. In the early 1970s, the main target of the pelagic fisheries was Pacific herring (*Clupea pallasi*) with the peak catch of 180,000 tonnes in 1972 from China. The catch has decreased continuously since then and overfishing of this species has undoubtedly contributed to the decline in this fishery with climatic change also playing a role. In the 1980's, the stocks of some other pelagic fish like half-fin anchovy (*Setipinna taty*), Japanese anchovy (*Engraulis japonicus*), chub mackerel (*Scomber japonicus*) and Spanish mackerel (*Scomberomorus niphonius*) appeared to have increased to some extent (Fig. 1).

Annual landings of anchovy increased due to the increased abundance of this species and the expanded fishing effort (Jin, 1996, Jin et al., 2006). Since the mid-1980's, Japanese anchovy became the most abundant pelagic species in the Yellow Sea (Jin, 1996b). According to a series acoustic survey carried out by R/V "Bei Dou" from the Yellow Sea Fisheries Research Institute, the biomass of Japanese anchovy in the Yellow Sea varied annually from 2.5 to 4.3 million tons. The annual landing of anchovy increased from 20,000 tons in 1989 to 640,000 tons in 1996, and more than 1 million tons in 1997 and 1998, becoming the largest landing of any single species fishery in China. Meanwhile, the catch in Korea ranged from 20,000 tons to 30,000 tons during 1986~1992, and after that the mean catch was increased gradually to 46,000 tons during 2000~2004, also accounted for the largest proportion of total landings from the Yellow Sea (West Sea Fisheries Research Institute, 2006). These catches were far above a half million tons of maximum sustainable yield (MSY) estimated by Iversen et al (1993) , and recent acoustic surveys indicated a fall in biomass of Japanese anchovy to about 0.2-0.3 million tons (Fig. 2, Jin, 2003; Zhao *et al*. 2003).

Although there is evidence of changes in catch species in the Yellow Sea LME, the overall yield from capture fisheries in the region as a whole appears to be

fairly constant in recent years (Fig. 3).

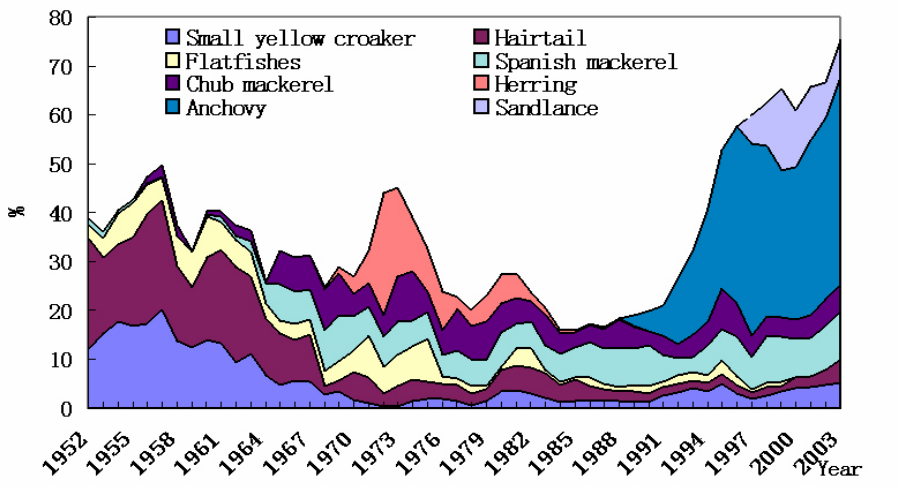


Fig. 1. Landings composition from coastal areas of China around Yellow and Bohai Seas (Jin, 2003, Jin *et al*. 2006)

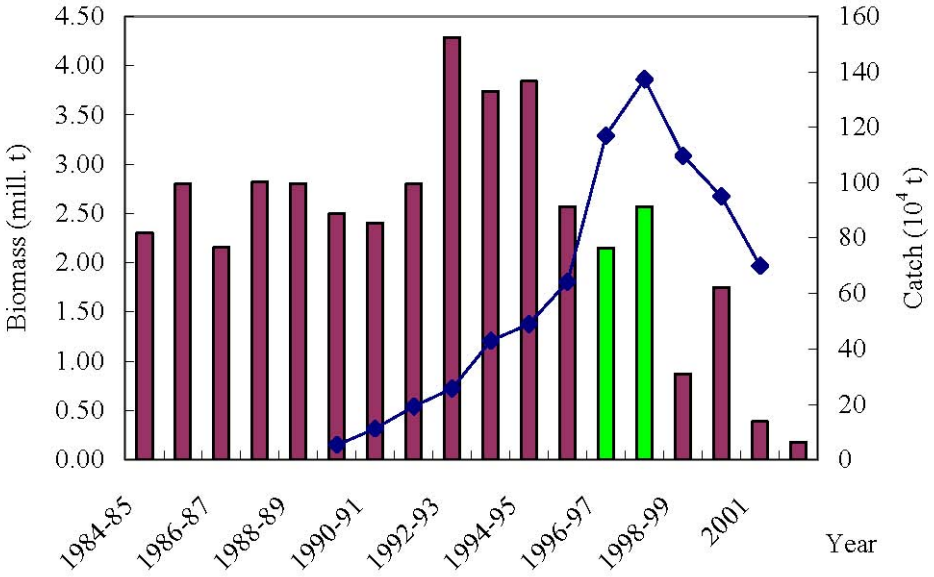


Fig. 2. Annual Japanese anchovy biomass (bars) and landings (line) from China (Jin, 2003; Zhao *et al*. 2003)

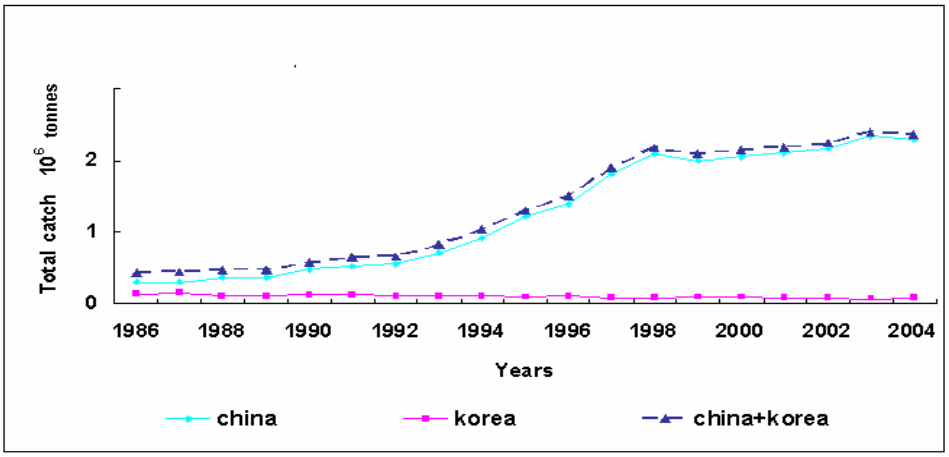


Fig. 3. Temporal Trend for the Catch from the Yellow Sea of 10 Commercially-Important Species, 1986-2004 (Anno, 2006)

For the mariculture, the important issue is the unsustainable maricultural practices by rapid expansion of mariculture and over-intensive mariculture in coastal zones. The growth in culturing of aquatic organisms for food production in the region is reflected in the scale of combined mariculture and inland aquaculture in China and Korea as an increasing and largest proportion in global production as shown in Fig. 4.

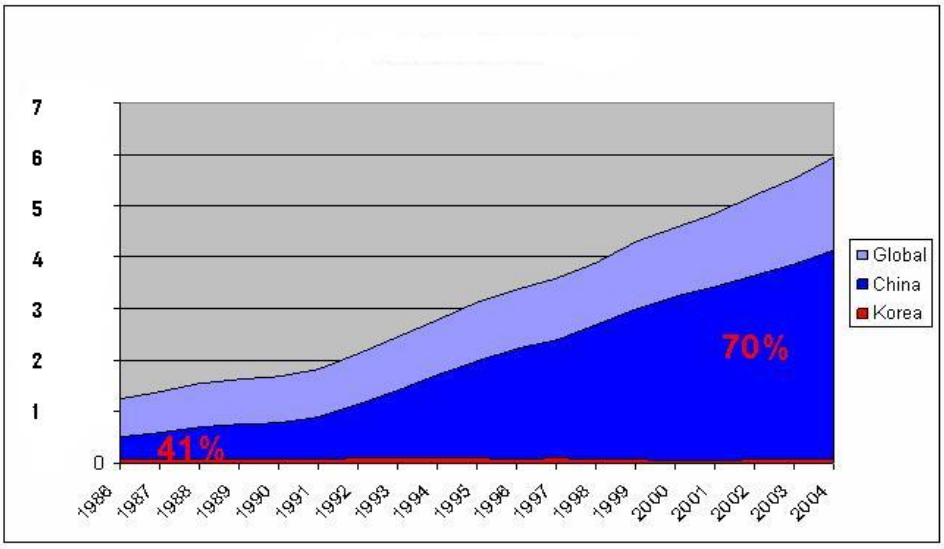


Fig. 4. Growth of Combined Mariculture and Aquaculture Production in China and Korea in Comparison with Global (Millions of tonnes) (Anno. 2006)

Over the period 1995 to 1997, maricultural production around the Yellow Sea LME increased rapidly from 400 thousand tonnes/year to just less than 4 million tonnes/per year. Subsequently there has been continued, but less spectacular, growth to over 6 million tonnes in 2004. The gross annual Yellow Sea mariculture production for the years 1995 to 2004 and the annual breakdown among finfish, crustaceans, molluscs and seaweeds is shown in Table 1 (Anno., 2006; Lee, 2006). As seen from the table, the shellfish represent the dominant proportion (75% in average) of the total production and also contributed the most growth of mariculture, although the production of others has continuously increased.

The total maricultural area in the Yellow Sea by the two countries showed a continuous increase from 359,000 ha in 1986 to 760,000 ha in 2004. Both the total production of shellfish and the associated farmed area for shellfish production have increased gradually, although the production per unit area reveals a decreasing trend from 14.1 MT/ha in 2000 to 10.5 MT/ha in 2004. For seaweed, annual production per area also showed a downward trend from 22.0 MT/ha in 2000 to 17.1 MT/ha in 2004. This suggests that production per unit area could not be expected to increase even if farmed area in this region was expanded in the future(Lee, 2006).

Table 1. Yellow Sea Mariculture Production 1995 to 2004 (tonnes) (Lee, 2006)

Species	Year									
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Finfish	975	33,942	37,931	49,364	51,759	70,752	98,755	155,310	135,725	159,041
Crustacea	7,443	38,618	57,000	61,178	72,997	85,403	110,426	131,293	135,202	151,340
Shellfish	199,128	2,019,783	3,032,230	3,037,281	3,547,837	3,845,123	4,171,174	4,495,842	4,610,421	4,807,310
Seaweeds	193,469	788,494	803,037	817,778	885,521	914,710	900,857	964,693	1,001,017	1,077,019
Other	858	1,213	2,717	5,001	9,156	15,170	17,339	34,467	92,452	51,923
Total	**401,872**	**2,882,050**	**3,932,915**	**3,970,601**	**4,567,270**	**4,931,158**	**5,298,550**	**5,781,804**	**5,974,817**	**6,246,633**

The fisheries problems by causal chain analysis from regional fisheries working group of the project has been indicated as shown in Table 2.

Table 2. Causal Chain Analysis – Fisheries Problems

Issue/Concern	Fundamental Problem/ Driver	Primary Cause(s)	Secondary Cause(s)	Tertiary Cause(s)	Quaternary Cause(s)	Root Cause(s)
Decline in landings of many traditional commercially-important species and increased landings of low value species (including changes in dominant species)	**Unsustainable natural resource exploitation practices**	Overexploitation of target fish species	Over-capacity of fishing fleets	Lack of alternative livelihood Unchecked increase in demand for capture fish as the result of changing lifestyle	Deficiencies in management and control of fisheries activities	Lack of comprehensive and effective system of fisheries stock management
					Insufficient monitoring and enforcement	Lack of compliance assurance procedures
			Deficiencies in fisheries stock management	Weak scientific-based knowledge of ecosystem processes	Insufficient support for, and guidance of, education and research	Poor recognition of the limits to sustainable natural resource exploitation
		Climatic change				**See Ecosystem causal chain**
Unsustainable maricultural practices	**Unsustainable development of coastal zone**	Over-intensive mariculture	Unguided/unchecked increased in demand for seafood as the result of changing lifestyle	Lack of scientific and technical guidelines for maricultural practices	Inadequate controls and regulations for maricultural development	Coastal development undertaken with limited comprehensive and coherent legislation that provides adequate environmental protection
		Limited and variable natural food supply	Variation of environmental conditions (*e.g.*, primary productivity) combined with overintensive maricultural activities	Insufficient knowledge of carrying capacity	Limited application of science to regulation of maricultural activities	Deficiencies in the application of science to environmental protection and coastal zone development
		Over-exploitation of natural habitats	Inappropriate management plan based on zoning of mariculture areas	Insufficient strategies for preparing and approving coastal zone development plans based on the maintenance of ecosystem services	Inadequacies in the control and regulation of developmental activities in coastal areas	Lack of comprehensive and coherent framework for coastal and marine resource development
		Environmental consequences of releases of nutrients, bacterial, viral and faecal matter and food residues from mariculture	Overfeeding, inadequate effluent treatment, poor quality of feed	Insufficient application of environmental friendly techniques and considerations of carrying capacity	Inadequacies in the control and regulation of developmental activities in coastal areas	Lack of comprehensive and coherent framework for coastal and marine resource development
		Potential impacts on human health	Chemical and pharmaceutical residues in farmed organisms	Inappropriate use of chemicals in mariculture and frequent algal blooms	Insufficient application of environmental friendly techniques and environmental changes	Lack of coordination between public health sector, government agencies and the private sector
			Effects of natural toxins generated by harmful algal blooms (HABs)	Eutrophication		**See Pollution causal chain**

3. Suggestion of Preliminary Ecosystem Quality Objectives for Fisheries

From the Conceptual Procedure for SAP Preparation (YSLME. 2007), it is proposed to use the central theme of "**Carrying Capacity of Ecosystem** (CCE)" to link all Project Components—Biodiversity, Ecosystem, Fisheries, Investment, and Pollution.

The goal of the SAP for the Yellow Sea Project is to prepare management interventions to maintain and/or improve the Carrying Capacity of the Yellow Sea Ecosystem in order to ensure the continued provision of ecosystem services.

The objectives are:

- protection of marine and coastal environments in the Yellow Sea;
- Sustainable use of marine and coastal resources in the Yellow Sea; and
- Upgrading national capacity in protection of marine environment.

The 1982 Convention specifies one technical reference point, MSY as the highest point of the harvesting for fisheries consideration. At the current situation, to reach the MSY and even below MSY level need to cut the fishing effort and yield, but should carefully plan in order to avoid seriously influencing the fishermen's life along the coastal waters of the Yellow Sea Large Marine Ecosystem.

Therefore, the Ecosystem Quality Objectives for Fisheries is regarded as MSY as a reference point for management. The yield of capture fisheries should be less than that the growth of population. Based on the current situation of overexploitation of the wild stocks and over-fishing capacity in the Yellow Sea, China State Council has issued "Compendium of Conservation Action Plan of Aquatic Living Resources of China" in Feb., 2006. The conservation action of aquatic living resources was brought into national general deployment in related to the resource and environment. One of three action plans related to this project is protection of fisheries resources and enhancement.

By 2010, over capacity of fishing effort and fishing intensity will be reduced. Concerning the marine fisheries, the number of motorized fishing boats and marine catch in China will be cut by 10% and 15%, respectively. The fishing efficiency and economic benefit will be increased and the over-fishing will be relaxed.

The development of mariculture will continue with more rational overall arrangement and improved methods, as a result of increasing production and quality.

By 2020, the number of motorized fishing boats and marine catch in China will be reduced by 1/3, and a harvesting level will meets the “surplus yield”, implying that the stock levels are kept adequately high for reproduction to have the fisheries resources in a healthy condition. Meanwhile billions of fry will be released into the sea for enhancement. Sustainable mariculture will be reached.

Reference:

1）Anno. 2006. Transboundary diagnostic analysis. Document of UNDP/GEF PROJECT “REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM”.

2）Iversen, S.A., D. Zhu, A. Johannessen and Toresen, R. 1993. Stock size, distribution and biology of anchovy in the Yellow Sea and East China Sea. *Fish. Res*., 16: 147-163.

3）Jin, X. 1996. Variations in Fish Community Structure and Ecology of Major Species in the Yellow/Bohai Sea. University of Bergen Publishing. Norway. ISBN 82-7744-025-1.

4）Jin, Xianshi, Hamre, Johannes, Zhao, Xianyong, and Li, Fuguo. 2001. Study on the quota management of anchovy (*Engraulis japonicus*) in the Yellow Sea. Journal of Fisheries Science of China, 8(3):27-30

5）Jin，X. 2003. Fishery biodiversity and community structure in the Yellow and Bohai Seas. *American Fisheries Society Symposium*. 38: 643-650.

6）Jin, Xianshi, Jianguang Fang, Jun Wang, Naihao Ye, Xianyong Zhao and Jihong Zhang. 2006. Report of Data and information collection from China. Document of UNDP/GEF Project Entitled “REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM”

7）Lee, Jang-uk. 2006. Report on fisheries component’s regional data and information sythesis. Document of UNDP/GEF Project Entitled “REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM”.

8） West Sea Fisheries Research Institute, 2006. 2006. Report of Data and information collection from Korea. Document of UNDP/GEF Project Entitled “REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM”

9） YSLME. 2007. Conceptual Procedure for SAP Preparation. UNDP/GEF/YS/SAP.1/2 rev3.

10） Zhao, X., Hamre, J., Li, F., Jin, X. & Tang, Q. (2003). Recruitment, sustainable yield and possible ecological consequences of the sharp decline of the anchovy (*Engraulis japonicus*) stock in the Yellow Sea in the 1990s. *Fisheries Oceanography* 12 (4-5), 495-501

Fisheries – Republic Of Korea

Report

On Preliminary Regional Targets

With Respect to the Project's Objectives

Of Fisheries

by

LEE Jang-Uk
Pukyong National University

Report

On

Regional Targets for Management

In Fisheries Component's Data and Information

Lee, Jang-Uk

Korean Fisheries Society

March 2007

Contents

1. Introduction

In accordance with the statement of the Conceptual procedure for Strategic Action Programme (SAP) for the Yellow Sea Project, this paper provides a preliminary guideline to identify methodologies for the regional Ecosystem Quality Objectives (EcoQOs) in the fisheries component. The methodologies for EcoQOs contain three major parts including 1) retrospective approach, 2) theoretical approach and 3) comparative analysis approach.

Having completed the regional data and information synthesis of fisheries component of UNDP/GEF Yellow Sea project (the 3rd regional working group meeting for the fisheries component of YSLME held in Weihai, China, October 25-28, 2006), tasks of approaches in this paper were based on the regional fisheries data and information synthesis. The fisheries component consists of five parts such as description of fisheries, biological/ecological data, bottom trawl survey and socio-economics. These data and information are summarized, provided for the Ad-hoc Working Group Meeting, together with additional information if available.

2. Methods

The basic goal of this chapter is to create a long-term database using both national fisheries data, mainly fishery-dependent and auxiliary data submitted from China and Korea in the Yellow Sea. Then, this database can be used for evaluation of commercially and/or economically important trans-boundary stocks. Furthermore, the combined data and information will be very useful for the ecosystem-based fisheries management in this region (Pauly et al., 2000).

Fishery-independent information, especially both biological and ecological data on the some commercial species studied from respective national institutes is compared to figure out scientific data/information gaps and/or discrepancies. It is quite clear that if different values on population parameters of the same species in a habitat would be used for stock assessment, the results could cause significant bias and also advise wrong recommendation to decision-makers (Gulland, 1983).

2.1 Description of fisheries

The main idea is to evaluate the historical trends in both quantitative fluctuations and relative abundance (ex, CPUE: catch per unit of effort) from landing and fishing effort exerted to catch marine animals moving or distributing in between the two nations in the Yellow Sea.

ⅰ) Quantitative analysis in landings (or catches)
- Comparison of long-term fluctuations of total annual landings
- Temporal variations of commercially important species

ⅱ) Fishing effort analysis
- Type of fishing gear operating and amount of fishing effort (boats, tonnage and Kilowatt-horse power etc.)
- Long-term trends on fishing effort

ⅲ) Estimation of relative abundance by species
- Catch per unit of effort (CPUE) for boat, tonnage and Kilowatt (KW)
- CPUE from synthesis data between the two nations

ⅳ) Experimental survey data
- Seasonal biomass trend for each species
- Early life history analysis

2.2 Biological and ecological studies

Population characteristic estimates for commercial fish species (or more species if available) studied between China and Korea are compared to find out whether or not there are any significant differences in scientific findings between the same species in the Yellow Sea ecosystem.

Available data and information were used to estimate fisheries reproduction potential as ecosystem indicators (Gislason et al., 2000).

ⅰ) Growth pattern: growth equation, size at capture, maximum age, Length-weight relationship

ⅱ) Reproduction biology: fecundity, spawning time, size at spawning, sex ratio, life span etc.

ⅲ) Migration patterns: spawning, nursery and wintering migration routes

2.3 Status of mariculture

Both capture fisheries and mariculture in the Yellow Sea and its adjacent area has developed remarkably in recent years. Therefore, the general features to understand the current aspects in this region are described on the basis of data and information collected from the two countries.

ⅰ) Historical production trends by cultured animals and by habitats
- Fishes, shrimp, shellfish and seaweeds etc.

ⅱ) Culturing area trends for species groups
- Fishes, shrimp, shellfish and seaweeds etc

ⅲ) Interaction between marine farmed production and farmed area

- Relationship between production and area, and production per unit area

2.4 Socio-economic data and policy

The YSLME project should be focused on socio-economic benefits as they are related to resource sustainability options (Elsevier science, 2003). In this section, however, some data and information currently available from the two countries are only tabulated because of lack of data and information to analyze.

The long-term data and information are included in the tables:

ⅰ) Number of fishing vessels and fishermen involved in fisheries

ⅱ) Fisheries incomes and consumption per capita

ⅲ) Fisheries export and import trends

Fisheries policies, on the other hand, will be reported with summary of main important fisheries management laws and regulations of the two nations.

3. Retrospective approach

3.1 Review of historical data on fisheries and its trends

Fisheries data and information were collected from both China (Yellow Sea Fisheries Research Institute, YSFRI of CAS, 2006) and Korea (West Sea Fisheries Research Institute, WSFRI of NFRDI, 2006), following four major sectors: fisheries data, mariculture data, socio-economic data and legislation information.

Table 1 summarized as a retrospective archives on historical fisheries data for each section.

3.1.1 Description of fisheries

Most of marine living resources in the Yellow Sea including the west coast of Korea and the East China Sea have their own migration patterns seasonally for spawning, hibernating, and feeding. In this region, there are over 300 fish species, 41 crustaceans and 20 cephalopods.

Warm-temperate animals are more dominant than warm-water species among the fisheries resources. Migratory fish species mainly consist of both the warm-temperate and warm-water animals, showing a wide range of migration and distribution. Main target species in the Yellow Sea covering the northern part of the East China Sea are listed in Table 2 together with common name and scientific name.

3.1.1.1 Landings (or catches)

The historical trend of total landings combined from Chinese and Korean

fisheries data, and those of each nation for the 10 commercial species in the Yellow Sea from 1986 to 2004 are given in Table 3 and in Figs. 1 and 2. The total landing has shown a rapid increasing trend every year from about 425,000 MT in 1986 to 1.9 million MT in 1997. It remained at a level of 2.08 million MT during 1998–2002, and then increased to 2.40 million MT in 2003 and 2.36 million MT in 2004, maintaining a slow upward trend. The annual landings in this region are very much dependent on China's figures, with an average value of 92.6% of the total during the study period (Fig. 1).

Trends of 10 commercially important species are summarized below:

Small yellow croaker (*Larimichthys polyactis*)**:** Yearly catch of this species was increased from 16,000 MT in 1986 to about 85,000 MT in 1994. Since 1995, the catch level varied between about 100,000 MT and 110,000 MT until 1998. The catch showed a trend of increase from 146,000 MT in 1999 to 193,000 MT in 2004 as a whole (Table 3). The total annual catch of China accounted for 92.4% per annum (Fig. 2).

Spanish mackerel (*Scomberomorus niphonius*)**:** This species was caught at 56,700 MT in 1986 and increased to 178,500 MT in 1997. The catch was 292,000 MT in 1998 which was the highest level through the whole period. It showed a slightly downward trend, recorded at about 275,000 MT in 2004 (Table 3). The Chinese catch of this species has a proportion of 99.4% of the total per year (Fig. 2).

Anchovy (*Engraulis japonicus*)**:** In 1997, its catch reached nearly at 1.04 million MT, which is about 37 times as compared to the 1986 catch. Afterwards, the species catch remained at a level of 1.02 and 1.10 million MT till 2003, but the catches in 1999, 2000 and 2004 were less than 1.0 million MT, respectively (Table 3). The catch proportion of China averaged at 93.4% during the period (Fig. 2).

Chub mackerel (*Scomber japonicus*)**:** The catch peaked at 171,000 MT in 1995, indicating a continuously increase trend from 43,000 MT in 1986 even though the 1991 catch was decreased to about 40,000 MT. From 1996, it showed a slight decrease with a fluctuation between 133,000 MT and 161,000 MT (Table 3). The Chinese proportion of this species was 96.2% on average through the whole period (Fig. 2).

Largehead hairtail (*Trichiurus lepturus*)**:** The steady upward trend was maintained until 1995, reaching at 226,000 MT. In 1996 and 1997, there was a little decrease in the catches. The annual catch showed a slowly increasing

trend with a level of 222,000 MT and 240,000 MT from 1999 to 2003. The 2004 catch peaked at 312,500 MT (Table 3). The catch proportion was 86.2% from China and 13.8% from Korea (Fig, 2).

Pacific herring (*Clupea pallasii*)**:** This fish is not a target species of both nations (Fig. 2). The catch peaked at 3,360 MT in 1987 and at 4,600 MT in 1991. Then it decreased significantly to less than 600 MT until 2004 (Table 3). During 1986–1990, the annual catch was mainly from China with over 99.5 % of the total, but in 1991 about 76% of the total was from Korea.

Sandlance (*Ammodytes personatus*)**:** This species was not utilized until 2002 by China. In 2003, however, the catch was 197,000 MT and 177,000 MT in 2004. Korean catch was recorded sporadically but not at a commercial level (Table 3, Fig. 2).

Acetes (*Acetes chinensis*) and (*A. japonicus*)**:** The catch trend showed an increase from 82,000 MT in 1986 to 304,000 MT in 1998, with a decrease to 79,000 MT in 1992. Since 1999, it decreased 244,000 MT in 2003, but increased to 299,000 MT in 2004 (Table 3). The catch portion was 93.2% from China and 6.8% from Korea on the average during the period (Fig. 2).

Fleshy prawn (*Fenneropenaeus chinensis*)**:** Yearly total catch varied between 10,000 MT and 18,500 MT during 1986–1992, showed a decreasing trend as a while. From 1993 till 2004, it remained at less than 10,000 MT (Table 3, Fig. 2).

Squids (*Todarodes pacificus*), *Loligo* spp. etc**:** The annual catch has shown a steady decrease from 52,600 MT in 1986 to 25,000 MT in1994. From 1995, its catch showed a slight increase until 2000, peaking at 76,400 MT through the whole period. Then, it decreased again at a level of 33,000–38,000 MT in 2003 and 2004 (Table 3, Fig. 2).

3.1.1.2 Catch composition by commercial species

10 species compositions of total catch for China and Korea in the Yellow Sea are given in Tables 4 and 5.

China: Percentage composition of 10 species in this region increased from about 20% in the 1980s to 37% in 1995. In the 2000s, it occupied over 40% every year (Table 4). Main target species in the yearly catch composition were largehead hairtail, acetes and Spanish mackerel with a proportion of total catch ranging from 3.0%–6.0%. Anchovy showed a higher portion between species compositions in the years of 1994–1997 and 2001–2004 with a value of more than 13.0% and 17.0%, respectively. Small yellow croaker as commercially valuable species has a low proportion every year with a trend of increase.

Korea: The 10 species percentage compositions every year remained between 28% and 36% (Table 5). Largehead hairtail showed the highest percentage portion during the first half of the 1980s, with values of 10.0−12.0% and then decreased significantly. Anchovy had a gradually increasing trend until 2003, showing the highest percentage of 25%. Acetes occupied a higher portion during the first half of the 1990s, with values of 4.0−6.0% (Table 5).

3.1.1.3 Fishing effort

Total powered and non-powered vessel effort: Total boats from China and Korea showed an increasing trend for 7 years from about 100,000 vessels in 1986 to 153,000 vessels in 1992, and then it remained constant at 140,000−150,000 vessels until 2004. This trend mainly followed Chinese fishing effort, while Korean effort remained unchanged at about 30,000 vessels throughout the whole period (Table 6, Fig. 3). In contrary to this, gross tonnage showed a slow increasing trend according to Chinese yearly number of vessels, but Korean vessels showed no fluctuation across the years (Fig. 3).

Powered vessel effort: The trend showed an increasing pattern from 72,500 vessels in 1986 to 140,000 in 2000, then a bit of a downward trend to 2004 (Fig. 4). Gross tonnage of powered vessels showed the same picture with that of the total effort, which implies that total effort was entirely depended upon by powered vessels (Table 6, Fig. 4).

Non-powered vessel effort: Both number of vessels and gross tonnage from China and Korea have shown a continuous decreasing trend from year to year (Fig. 5). In 2004, the numbers of boats were about 10,000 vessels and gross tonnage was about 15,000 tons (Table 6).

KW of powered effort: Total Kilowatt has kept up a steady increasing trend from 1.9 million KW in 1986 to 7.1 million KW in 2002 and then leveled off at this value in 2003 and 2004 (Fig. 6). It should be pointed out that KW from Korea showed much higher values than that of China from 2001 up to 2004.

3.1.1.4 Tonnage per vessel and KW (kilowatt) per vessel

Total powered plus non-powered vessels: Tons per vessels from powered and non-powered vessels data combined from the two nations' data showed nearly unchanged values, 8.3−9.5 tons/vessels during 1986−1996 (Fig. 7). From 1997, its value jumped to about 10.0 tons/vessels and remained at this level until 2004. Chinese values each year were much higher than those of Korean values. This figure indicated that tonnage per vessels from China had

an increasing trend but Korea data remained nearly unchanged level during the study period (Table 6).

Powered vessels vs. non-powered vessels: Each year's tons/vessels value showed a parallel level at a value of 10.0 to 11.5 tons/vessels, but non-powered vessels decreased as a whole (Fig. 8).

KW per boats: The combined KW/boats values from the two nations showed a trend of increase slowly every year (Fig. 9). Chinese figure has kept an upward trend although the values during 1998–2000 were lower than the previous year, and also the 2004 value decreased. Korea's value was unchanged throughout the entire period (Fig. 9).

3.1.1.5 Catch per unit of effort trends

Data combined from China and Korea: The CPUE values for total number of powered and non-powered vessels, and the total gross tonnages and KW of powered vessels are shown in Tables 7, 8, 9 and Figs. 10, 11, 12. These data sets can be used for quantitative evaluations based on synthetic models (Schaefer, 1954; Fox, 1970) after sophisticated data handling.

The CPUEs of total boats including both fishing efforts from total number of powered and non-powered vessels were significantly increased from 3.9 MT in 1986 to 17.2 MT in 2004 (Table 7 and Fig. 10). The CPUE from total gross tonnage also has kept the same trend with that of total number of boats (Table 8 and Fig. 11). When fishing efforts of powered vessels were taken as a unit effort, the CPUE for number of boats, the CPUE trends for tonnage and CPUE for KW are given in Fig. 12 and Table 9. Those three CPUEs showed the same patterns with an upward trend from 1992 to 1998. Recent values from 2001 to 2004 remained nearly unchanged.

Data from China: The values of CPUE from total catch for 10 fish species (Table 3) and total number of vessel, tonnage and KW of China (Table 6) are given in Table 10 and its long term trends in Fig. 13. The CPUEs from the three unit efforts have shown a significant upward trend: the CPUE of total number of boats increased from 3.95 MT in 1986 and 3.64 MT in 1987 to 22.18 MT in 2003 and 22.13 MT in 2004, for the value from tonnage, 0.38 MT in 1986 to 1.83 MT in 2003 and 1.63 MT in 2004, and for the value from KW, 0.24 MT in 1986 to 0.76 MT in 2003 and 0.73 MT in 2004 (Table 10).

Data from Korea: Based on the data on total catch in Table 3 and fishing efforts in Table 6, the calculated CPUE from Korea generally has kept a decreasing trend (Fig. 14): the value from total number of boats recorded from 3.87 MT in

1986 and 4.19 MT in 1987 to 1.82 MT in 2003 and 2.22 MT in 2004, for the value of tonnage ranged from 0.76 MT in 1986 and 0.83 MT in 1987 to 0.46 MT in 2003 and 0.57 MT in 2004, and for the value of KW decreased to 0.02 MT in 2004 from 0.20 MT in 1986 (Table 11).

3.1.2 Biological and ecological data

3.1.2.1 Growth parameters

Growth patterns, length-weight relationship and spawning seasons for the 10 commercial species estimated from both nations' research institutes are briefed in Table 12. The growth figures of small yellow croaker (*Larimichthys polyactis*) from the two nations differed tremendously, especially its life span of which estimate from China was 23 yr and 10 yr from Korea. Based on the growth equations, calculated lengths at age are given in Table 13.

These two different figures may seriously cause inaccurate estimations of such population parameters as instantaneous natural mortality rate (M) and total mortality (Z) as well as in analytical stock assessments including VPA (virtual population analysis or cohort analysis) (Pope, 1972).

Asymptotic length of Spanish mackerel (*Scomberomous niphonius*) showed a large difference between the two nations' estimates, 71 ㎝ from China and 123.3 ㎝ from Korea. This phenomenon will also give a serious bias when performing stock evaluation study for this species, especially for analytical stock assessment (Beverton and Holt, 1957).

Other species are also available with information gaps (Table 13).

3.1.2.2 Reproduction and spawning characteristics

Reproductive and spawning biology for 10 species studied from the two national reports are compared in Table 14. Fecundity of the same species from the two institutes showed a wide range of values but not much different. The minimum sizes at maturity for both small yellow croaker and Spanish mackerel differed from the two nations. That of yellow croaker was 13.5 ㎝ from China and 19.1 ㎝ from Korea. Spanish mackerel was 34/42 ㎝ from China and 78 ㎝ from Korea. These figures will give different recruitment patterns to the stocks (Ricker 1948).

3.1.2.3 Season migration and movement of commercial species

General patterns of migration routes and distribution for the 10 commercial fish species are presented in the national reports of China (YSFRI, 2006) and Korea (WSFRI, 2006). For more detailed information related to movements of

these species, it will be of help to have data on statistical area by seasonally rectangular distribution, *that is*, 0.5 x 0.5 square miles. Tagging is known as very useful tools to estimate migration route and range of distribution.

Available information on migration from both nations is small yellow croaker (*Larimichthys polyactis*), Spanish mackerel (*Scomberomorus niphonius*), anchovy (*Engraulis japonicus*), chub mackerel (*Scomber japonicus*), largehead hairtail (*Trichiurus lepturus*) and rear data for other species such as Pacific herring (*Clupea pallasii*) from China, and fleshy prawn (*Fenneropenaeus chinensis*) and Pacific squid (*Todarodes pacificus*) from Korea, respectively.

3.1.3 Bottom trawl survey

Available data and information on results of bottom trawl survey are only from every month of June 2000-2004 from China and spring and winter, 2003-2005 from Korea. The reports represent very few scientific findings including mainly species composition, seasonal density distribution of species and seasonal number of fish larvae and eggs by ichthyoplankton survey etc. Therefore, the survey data may not make any contribution to fisheries resources analysis and management intervention so far.

3.1.4 Status and trends of mariculture

3.1.4.1 Farmed production trends

Yearly farmed production figures from China and Korea are given in Table15 and the trends in Figs. 15 and 16. The production jumped to about 17.5 million MT in 1996 from 2.1million MT in 1995. Then, it showed a continuous trend of increase year after year, reaching at over 33.0 million MT in 2004 (Table 15, Fig. 15). This upward trend resulted from China's production, accounting for an average of 96.4% of the total during the whole period. Korea contributed a proportion of 3.6% between the two nations. By species groups, finfish, crustacean, shellfish and seaweed have revealed the same pattern as in the total production (Fig. 16). Proportion of species groups between two nations was: 99.7% from China and 0.3% from Korea for finfish, 99.8% and 0.2% for crustacean, 96.5% and 3.5% for shellfish and 68.1% from China and 31.9% from Korea for seaweed (Table 15). By species groups figure combined from the two nations' data, finfish has the highest portion with a value of 55.8% on average, followed by shellfish 33.2%, seaweed 6.9%, crustacean 3.5% and others 0.6%.

Percentage composition for species groups for China and Korea differed

considerably (Table 16). In China, finfish showed the highest proportion with a decreasing trend from year to year. Shellfish consisted more than 30% of the total. In Korea, seaweed accounted for about 60% per year on average throughout the study period, and followed by shellfish with more than 30% every year.

Marine farmed production trend: Total production pooled from the two nations in the Yellow Sea and the nation's whole figures during 1995–2004 are presented in Table 17 and Fig. 17 for each species.

Seawater farmed production indicted a swift year to year increase from 1.23 million MT in 1986 to 14.1 million MT in 2004. This was attributed mainly to increase of shellfish from China, an average of 75% of the total. Freshwater production maintained the highest portion with a slightly increasing trend.

The proportions of the farmed production in the Yellow Sea to those of total seawater and total aquatic farmed production by species groups showed that high proportions of the Yellow Sea were from both shellfish and seaweed with values between 40% and 50% of the seawater and freshwater totals, respectively (Table 17). The proportion of the Yellow Sea to the seawater remained constant, having an estimate of 45% through the years from 1997 to 2004, and the proportion from freshwater was about 35% every year (Fig. 17). In the Yellow Sea, the total production showed a trend of increase from 400,000 MT in 1986 to 6.25 million MT in 2004.

Major farmed species: Yearly production of economically important cultured species from China and Korea are given in Table 18. In the finfish species group, the major species in China were sea bass (*Lateolabrax latus*), flounder (*Paralichthys olivaceus*), black sea bream (*Acanthopagru sschlegelii*), and red drum (*Sciaenops ocellatus*). In Korea, flounder (*Paralichthys olivaceus*) was the dominant species showing an increasing trend in the yearly production. In crustaceans, *Fenneropenaeus chinensis* was a common species in both nations. For the shellfish species groups, *Crassostrea gigas* showed much higher production than other species in both nations. This species' production rate in China has kept an increase year after year at a level of 3.75 million MT in 2004, but in Korea less than about 240,000 MT in 2004 as a peak production. The yearly production of this species from China was about 15 times that of Korea. *Cyclina sinensis* from China showed a high level of production at 2.8 million TM in 2004, keeping a steady upward trend. In seaweed, China's dominant species of *Laminaria japonica* produced more than 800,000 MT in the years of 2002–

2004. In Korea, *Undaria pinnatifida* and *Porphyra* spp were the main cultured species with a decrease to about 200,000 MT in recent years (Table 18).

3.1.4.2 Aquaculture area

Total aquaculture area: Aquaculture area used every year in China and Korea increased significantly from 461,500 ha in 1995 to 1,106,000 ha in 2004 (Table 19 and Fig. 18). The area in China rapidly climbed at a level of 1.05 million ha in 2004 from 416,000 ha in 1986 which was nearly doubled. Korea increased from 46,000 ha in 1995 to 56,000 ha in 2004. By species groups, shellfish area from both countries occupied more than 65% every year, followed by crustacean area, seaweed and finfish areas. The aquaculture area from China was about 95% of the total figure. Fig. 19 gives a trend of aquaculture area of species groups for 10 years. In China, finfish area showed a downward trend from 1995 to 1999 and then it increased again from 2000 onward. The three species of crustacean, shellfish and seaweed kept an increasing trend. Korea's trends showed nearly unchanged patterns all the four species groups. The area of collective farms was available only from Korea, keeping an increasing trend in recent years (Fig. 19).

Marine farmed species area: The areas of marine farmed species based on the data combined from China and Korea for 10 years are presented in Table 20. The total area has indicated a trend of increase from 359,000 ha in 1995 to 760,000 ha in 2004 (Fig. 20). Percentage portion of species groups to the total was: shellfish area 60.5%, crustacean 22.0%, seaweed 8.4% and finfish 3.5% on an average throughout the whole period.

Interaction between marine farmed production and farmed area: Total production per area increased from 7.2 MT/ha in 1996 to 10.4 Mt/ha in 2000 and it decreased to 8.2 MT/ha in 2004 (Table 21, Fig. 21). For shellfish, its production/area peaked at 14.7 MT/ha in 1997 and revealed a decreasing trend from 14.1 MT/ha in 2000 to 10.5 MT/ha in 2004 (Table 22, Fig. 22). Annual production per area of seaweed showed a nearly constant value of 21 MT/ha during 1996–1999. Its value decreased from 22.0 MT/ha in 2000 to 17.1 MT/ha in 2004 (Table 23, Fig. 23). This might suggest that production per unit area could not be expected to increase even if farmed area in this region would expand in future.

3.1.5 Socio-economics

3.1.5.1 Vessels by fishery

The total number of vessels and gross tonnage including powered and non-powered vessels by offshore and coastal fishery as well as distant waters fishery are tabulated for each nation during 2000−2004 (Table 24).

Total number of vessels: China showed a trend of steady decrease from about 294,100 boats in 2000 to 241,300 boats in 2004. This was caused by decrease of powered vessels throughout the period and the proportion of powered vessels took over 91.0% every year. The number of non-powered vessels stayed in between 20,400 and 24,300 vessels.

Korea has maintained a much lower number of vessels in both total powered and non-powered boats than those of China. The numbers have remained between about 91,600 and 95,900 vessels with a slowly decreasing trend, but showed the proportion of more than 92.0% by powered vessels (Table 24).

Gross tonnage: China's gross tonnage decreased from 5.42 million tons in 2000 to 5.10−5.16 million tons in 2001−2002, but increased to 5.66 million tons in 2003 and 5.60 million tons in 2004. The trend was also similar with the powered vessels (Table 24). Korea showed a trend of continuous decrease from 923,000 tons in 2000 to 725,000 tons in 2004. This was totally depended on the trend of powered vessels.

Vessel composition by fishery: Coastal vessels of both nations every year took the proportion of over 99.0% of the total. There are about 2,000 distant waters vessels in China and about 500 boats in Korea in recent years (Table 24).

3.1.5.2 Fisheries income

Both nations' fisheries incomes generally kept an upward trend and the 2004 incomes were higher than in other years (Table 25).

3.1.5.3 Exports and imports of fishery products

China's exports increased from 1,534,000 MT in 2000 to 2,421,000 MT in 2004, but Korea showed a trend of decrease (Table 26). Imports of China slowly decreased, but increased in 2004, and Korea showed a year after year increasing trend.

3.1.5.4 Economic importance of fisheries (GDP contribution)

Two countries maintained a steady increase in GDP but in the fisheries sector, China increased and Korea decreased instead (Table 27). Fisheries contribution to GDP in China was much higher than that of Korea.

3.1.5.5 Fishery consumption per capita

Per capita consumption of fishery in Korea was about 3.2-4.8 times higher than that of China for certain years (Table 28).

3.2 Identification of current situation

3.2.1 China

The current situation in data and information mentioned through the national report of China are described below:

ⅰ) No available data on catch statistics by area and species.

ⅱ) Lack of English-written publications and information.

ⅲ) Most mariculture data and information are based on the provincial level. So, it would be useful to access the data easily if they could be managed under an independent government level

ⅳ) No detailed data on habitat as mariculture methods.

ⅴ) No available statistical data on mariculture licenses by habitat so far.

3.2.2 Korea

ⅰ) No available data on catch statistics by area and species

ⅱ) Little data available on area of collective farms during 1995-2000 but available data from 2001 to 2004.

ⅲ) Data on area for culture method of shellfish only available in 2004.

ⅳ) The number of farm area from legally permitted farms does not include illegal farms (when added, about 10% increase in total area).

3.2.3 Lack of data and information from two nations

It was pointed out that the following types of data and information are essential to understand the current status of commercially exploited stocks in the Yellow Sea as well as to carry out future research works.

ⅰ) A need for basic statistics and effort data by different fishing methods for standardization of fishing effort that should be used for quantitative assessment to understand current exploitation level of marine resources.

- Recording on logbook for landings or catches with information on amount of dumping and/or discards at sea.

ⅱ) Estimations of relative abundance index (ex. CPUE, density etc.) from fishery independent research.

ⅲ) Distribution area and range of commercial species that migrate or cross the boundary between two nations for TDA analysis.

- Statistical area distribution by rectangular method (0.5x0.5 miles) for each species
- Establishment of long-term database available for retrieval use

iv) Size composition data or if possible age-length key data for cohort analysis

v) Submission of all data from both nations according to agreed data formats, especially for mariculture data.

vi) Research works of joint cruises from China and Korea in the Yellow Sea.

3.3 Review of current political situation

3.3.1 Major laws and regulations related to fisheries

3.3.1.1 China

Fishery act: This Act was promulgated, enforced in 1986 as a legal provision. Based on the Act, the central and provincial governments have issued various laws and regulations consisting of more than 500 documents. On December 1, 2000, a revised Chinese Fishery Act went into effect, imposing strong punishment for illegal fishing and establishing a legal foundation for a quota management system.

There were about 30,000 fisheries inspectors and 1,500 enforcement vessels including marine enforcement vessels in 2003.

Marine Environmental Protection Act: The Act went into effect in April 2000 for protection and improvement of environment, marine resources, pollution damage, ecological balance, human health, and sustainable development in economic and society. The chapter of marine ecological protection is highly related to fishery resources.

Breeding and Protection Act of Fishery Resources: In 1957, a draft Act was promulgated as a regulation and first trial to identify fishery resources for protection. In 1979, this Act was issued in which 26 marine fishes, 7 shrimps and crabs, 14 mollusks, 6 algae and 10 mammals were listed as protected species. More detailed protection rules went into forces by each province.

Conservation regulation of living resources in the Bohai Sea: On May 1, 2004, this law went into effect to protect, enhance and rationally use living marine resources, as well as to protect the ecological environment in the Bohai Sea. In 1991, it was replaced with the regulation of fisheries resources breeding and conservation, which set down the minimum landing size, minimum mesh size and closing season for each fishing gear.

Regulation on administration/management of aquatic seedling production: In December, 1996, the regulation was issued, and amended and reissued on December 8, 2000. The main aspects are: ⅰ) regulation on the examination and approval of native and excellent breeds, ⅱ) standard on the examination and approval of native and excellent breeds, ⅲ) brief introduction of species approved by the examination and approval committee of the nation, ⅳ) regulation on checking and accepting of the breeding factory, ⅴ) regulation on the administration of producing procedure and regulation on the administration of the project of breeding factory construction.

Fishing effort control: In 1981, identification of fishery problems and overcapacity; In 1983, measures to stop increased catches, and strict control over increase of fishing boats; In 1987, control effort limiting aggregate horsepower by fishing zone; In 1997, fishing permits reissued in all coastal provinces and cities; In 1999, new fishery structural adjustment guidelines for strict control of fishing effort and catch reduction.

Measures designed to reduce effort include: ⅰ) stop on permission to build new fishing vessels except for distant fishing purposes, ⅱ) comprehensive clear up of illegal boats, ⅲ) prohibition on the introduction of foreign boats to fish in the Chinese EEZ, ⅳ) gradual establishment of a mandated vessel retirement system and, ⅴ) strict prohibition for non-fishing laborers to take jobs in marine fisheries.

Currently three official documents are required for engaging in fishing activities along the Chinese coast: ⅰ) fishing vessel inspection document, ⅱ) fishing vessel registration document and, ⅲ) fishing permit.

A fishing ban in the Yellow Sea, Bohai Sea and East China Sea has been implemented for 2–3 months in summer since 1995 and similar measures along the continental shelf of the South China Sea are used.

Output control: The government on the basis of the catch level in 1999 as the maximum production imposed a zero growth policy in total marine catches. This policy continued in the year 2000 and thereafter.

3.3.1.2 Korea

Off-shore, coastal fishery structure control: The main contents of off-shore and coastal fishery structure reorganization policy are as follows: ⅰ) reorganizing type of off-shore and coastal fishery, ⅱ) control of off-shore and coastal fishing waters, ⅲ) maintenance of continual usable fishing intensity, ⅳ) maintenance of proper vessel number, ⅴ) building of fishery management

system scientifically and, ⅵ) development and diffusion of fishing implements and systematic support to fishermen.

Rebuilding of fishery resources: A newly management system has been taking by government to enhance commercially important fish resources with participation of fishermen since February 2001. At present, there are a total of 122 nationwide self-management fishery communities along the coastal area.

Output control: In 1999, the total allowable catch (TAC) system was started with some commercial species such as chub mackerel, horse mackerel, sardine in the west sea of Korea, Now, it has expanded to 10 species around Korean waters.

Revision of fisheries sub-ordinate laws: Details of the preservation ordinance of fisheries resources (Presidential decree 18095, on August 27, 2000) include: ⅰ) limit the use of double gillnet in Ulleung Island and Dokdo island waters in the East Sea of Korea, ⅱ) standards of net-knot size in coastal fishery and inland waters, ⅲ) capturing and picking Chinese mitten crab and lenok during the forbidden period and, ⅳ) TAC resources management through systematic selling and reporting.

Other revisions are: enforcement of ordinance of fisheries law – Presidential decree No. 18121, on November 4, 2003, and Rule of fisheries license and declaration – Marine Affairs and Fisheries (MOMAF) decree No. 247, on May 29, 2003.

3.3.2 Major laws and regulations related to mariculture

3.3.2.1 China

Firstly, current legislation and regulations are: standards for aquaculture production, the code for aquaculture operations, quality standards for fish products, environmental standards for fisheries including water quality standards and standards for rearing techniques.

Secondly, aquaculture system and technologies should be developed in accordance with accepted ecological standards.

Thirdly, a licensing system for the discharge of sewage drain into fishery environments should be implemented where sewage could only be released after approval by the fishery environment-monitoring department. Financial charges would be collected from the sources of discharging sewage and be used as a management fee to assist in: production management, technical renovation, treatment of wastes and drainage waters, and cleaning of pollution

to protect or recover fishery environments.

3.3.2.1 Korea

Status of raising fishery-cultivating law: Enforcement ordinance of raising fishery-cultivating law (Presidential decree No. 18052) was promulgated on July 15, 2003, where the minister of MOMAF and provincial governors can decide the methods and contents of basic investigation for Raising Fisheries Development Plan.

The rule of raising fishery-cultivating law (MOMAF decree No. 251, on July 15, 2003) was enacted to decide methods and procedures of fishery developing areas.

3.4 Identification of critical habitats

Critical elements causing natural environment changes in the Yellow Sea, based on the national reports as well as the data and information in this report, are summarized.

3.4.1 Regional issues

3.4.1.1 China

i) Over-exploitation of target species and climate change has caused a shifting in dominant species with the food-web shifting downwards.

ii) Insufficient monitoring and lack of scientific-based knowledge on status of stocks.

iii) Insufficient management and control of fisheries activities

iv) Intensive use of natural coastal habitats and ecosystems for mariculture, exceeding the carrying capacity and causing environmental degradation, disease outbreaks and reduced growth rates.

v) Poor regional coordination, communication and collaboration between fishermen and government.

vi) Insufficient information and environmental impact assessments for ecosystem-based management.

3.4.1.2 Korea

i) Local production of farmed animals and seaweeds is not included in total farmed figure when they are sold directly. It is estimated that such production comprises an additional 10-30% to the total, depending upon the species.

ii) Data on aquaculture area only include licensed farms until 1997, but from

1998 the annual aquaculture areas include all from the licensed, permitted and notified farms.

iii) Data on area of culture method include only licensed farms before 1998 and during the period 1998-2004 the data on culture method include all from licensed, permitted or notified farms.

3.4.2 Major issues from regional data and information

3.4.2.1 Fisheries

Heavy exploitation of capture fisheries: Most of the commercial fisheries resources seem to be heavily exploited due to intense Chinese fishing activities, showing a significant increase in catch since the late 1990s despite of a zero growth policy in marine total catch referenced to the 1999 catch level. It is anticipated, therefore, that sustainable yield can not be achieved in the future at the current level of catch from capture fisheries in this region. It is not possible, however, to arrive at any conclusions on the status of commercial important stocks on the basis of the currently available data. Such information is required to perform fish stock assessments by the two nations' institutes for a reasonable level of managements to be achieved.

Fishing effort: The total registered number of powered fishing vessels has been kept on a somewhat constant level since the 1990s, but trends in gross tonnages and KW (kilowatt) showed increases during the study period. This implies that the fishing power and/or fishing efficiency have significantly improved taking into account recent catch levels. It is assumed, on the other hand, that fishing pressures on marine living resources have increased since the1980s.

Catch per unit of effort (CPUE): CPUE values as a relative abundance index were calculated for 10 commercial species using fishing effort information including the total number of vessels, gross tonnages and KW. It is clear that the estimated values do not reflect the real abundances of each fish stock. The fishing effort data used for calculating the CPUE values was not the actual fishing efforts, but the total number of registered boats, tonnages and KW. The relative abundance index obtained from the total catch and fishing effort could not be used for quantitative assessments. This makes it difficult to understand how the aquatic population reacts to a given level of fishing effort. In fact, the long-term CPUE trends from China showed a continuously increasing figure, but the CPUE of Korea decreased every year. Accordingly, it identifies the

important data requirements for stock evaluation that can provide reliable CPUE values for fish stocks and enable the formulation of rational fisheries management advice on the basis of synthetic models.

3.4.2.2 Biological and ecological data

Growth parameters: The comparison of the biological aspects of commercial species, based on the two nations' research, reveals that the estimated growth figures showed considerable differences: for small yellow croaker, longevity (or maximum age) were disparate, being 23 years for China and 10 years for Korea, and for Spanish mackerel, asymptotic lengths were 71 ㎝ for China and 123.3 ㎝ for Korea. Some differences also existed in the growth parameters of other species. This situation causes discrepancies in such population characteristics as instantaneous natural mortality (M) and instantaneous total mortality (Z) as well as in analytical stock assessments including VPA (virtual population analysis) and yield-per-recruit study. It is recommended that a study group or working group be established to perform a cooperative research effort to improve the age estimation techniques used by the two nations' institutes.

Reproduction and spawning characteristics: The fecundity of commercial species showed a wide range of values, but did not result in markedly different outcomes for the same species from the two nations. However, the minimum sizes at maturity of small yellow croaker and Spanish mackerel have large differences between the two nations. These will result in the prediction of differing recruitment pattern in the same stocks. There is no information on recruitment patterns, so a study is needed for developing an index of recruitment for commercially important fish species.

Migration and distribution of commercial species: General patterns of migration routes and distributions of commercial species are described using only the data from the two nations' institutes. More detailed descriptions would require data on statistical fishing locations by season and rectangular sea blocks distribution (e.g., 0.5x0.5 square miles). It is well known, in general, that tagging experiments will be of help in understanding actual migration routes and ranges in the seasonal distributions of marine animals.

Bottom trawls survey: Research cruise surveys were conducted every June in the years 2000-2004 in China and spring and winter in the years 2003-2005 in Korea. The data and information from these research activities are very limited and cannot be well correlated with syntheses because of spatial-temporal differences among the various surveys. It is recommended that research

investigations based on joint cruises between the two national institutes be used in the future.

3.4.2.3 Mariculture

Aquaculture farmed production: Farmed aquaculture production showed a continuously increasing trend and reached 33 million MT in 2004. This resulted mainly from Chinese production that accounted for 96.4% of the total during the period 1995-2004. Based on these figures, there was a substantial change in the production of China between 1995 and 1996, from about 1.1 million MT in 1995 to 16.6 million MT in 1996 (by about 16 times compared to the previous year). This period explains a turning point in Chinese aquaculture farmed production.

Marine farmed production: Seawater farmed production in the Yellow Sea maintained an increasing trend similar to that of aquaculture production, recording a production of 6.2 million MT in 2004. Significant increases in production from 402,000 MT in 1995 to 2.9 million MT in 1996 (i.e., by a factor of 7) occurred mainly as a result of increased Chinese mariculture. This rapid growth in mariculture warrants explanation.

Aquaculture area: The total aquaculture area in the Yellow Sea used by the two countries increased significantly from 462,000 ha in 1986 to 1.1 million ha in 2004, with China accounting for approximately 95% of the total increase. In terms of the marine farmed area, the total area showed a continuous increase from 359,000 ha in 1986 to 760,000 ha in 2004. This would appear to imply that there has been significantly increased impact on marine environments as a result of the growth in mariculture facilities in the coastal areas of the region.

Interaction between marine farmed production and marine farmed area: In the Yellow Sea, yearly production depended heavily on the shellfish production, which accounted for an average of 75% of the total during the entire period. Both the total production of shellfish and the associated farmed area for shellfish production have increased gradually, although the production per unit area reveals a decreasing trend from 14.1 MT/ha in 2000 to 10.5 MT/ha in 2004. For seaweed, annual production per area also showed a downward trend from 22.0 MT/ha in 2000 to 17.1 MT/ha in 2004. This suggests that production per unit area could not be expected to increase even if farmed area in this region was expanded in the future.

3.4.2.4 Socio-economics

Some data and information related to the fisheries socio-economic aspects of fisheries made available by the two nations are contained in this report. However, only general descriptions have been provided without the detailed analyses required for long-term data interpretation. There is a need, on the one hand, to collect long-term data on fisheries economics. On the other hand, there is a need to include expertise on economic data analysis in future studies.

3.4.3 Establishing a regional fisheries database

It is recommended that a database be established, not only for historical fisheries data and information but also for future cooperative research studies in the Yellow Sea between the two nation's institutes, which can be expanded to include other nations in this area. Such a database would be of great assistance to scientific activities for collecting and retrieving research data and for monitoring the status of fisheries resources.

4. Theoretical approach

4.1 Modeling

Most of aquatic animals in the Yellow Sea have utilized at commercial level and some of important fisheries resources have shown a continuous downward trend in annual total catch (see section 3.1 in this report). Once natural resources is to be exploited from external causes it is necessary to be managed by appropriate measures, so that the animals should be kept at proper level for future uses from protecting over-fishing and/or overexploitation.

4.1.1 Estimation of population size

Many kinds of theoretical models for estimating population size (or biomass) have been developed according to available fisheries data and information. Some useful models that have been used mainly by researchers are only introduced below.

Direct methods: Trawl survey by using research vessels/chartered vessels
Ichthyoplankton survey
Hydroacoustic survey

Indirect methods: Cohort analysis −Gulland (1965)
Pope (1972)
Deriso et al. (1985)
Zhang and Sullivan (1988)
Catch per unit of effort −Leslie and Davis (1939)
DeLury (1947)

Pertesen' tagging method
Capture and release

4.1.2 Population dynamics

In general, two types of methods are being used for stock assessments and management purposes in order to evaluate impacts by fishing efforts forced into fisheries resources, that is, synthetic models called surplus production models or global models, and analytical models called structural models. In addition, reproduction models obtained from stock size-recruit relation offers very important information for recruitment and/or growth over-fishing.

Synthetic models: Schaefer (1954, 1957)
Pella and Tomlison (969)
Fox (1970)
Schnute (1977)
Csirke and Caddy (1983)

Analytical models: Thompson and Bell (1934)
Beverton and Holt (1957)'s yield per recruit

Reproduction models: Ricker (1954)
Beverton and Holt (1957)

4.1.3 Ecosystem-based management

Fisheries management based on ecosystem components has been simulated since late 1970s. Most representative models are (Zhang et al., 2002):

Andersen and Ursin (1977)
DYNUMES and PROBUB models (Laevastu and Favorite, 1978a, 1978b; Laevastu and Larkins 1981)
Ecopath (Polovina, 1984)
Ecopath Ⅱ (Christensen and Pauly, 1992)
Ecosim (Walters et al., 1997)

4.2 Best management practices

Utmost purposes of fisheries management are to maximize the resources, to maintain rational conservation and sustainable uses. To achieve this goal, several measures have been imposed through government-based controls. The management measures are summarized below:

Technical measures: Size limit in taking
Prohibition during spawning seasons
Prohibit of fishing in spawning/nursery seasons

Input control: License and permit system for fishing activity

Allocation of individual fishing activity

Control of number of fishing vessels and gear

Illegal fishing with or without licenses

Output control: Total allowable catch (TAC) －Total catch quota system

Individual fishing quota system

Individual quota (IQ)

Individual transferable quota (ITQ)

Fisherman-oriented management from government-led control:

Voluntary fisherman's participation for fisheries management

Sharing responsibilities on illegal fishing and conservation

Cooperation between fishermen and government from conflicts

Joint users of resources as managers

4.3 Maximum sustainable fisheries yield (MSY)

Even though Larkin (1977) pointed out that there are some unreasonable validities in adapting surplus production models as management reference point, the models are still survival, widely used in stock assessment sector. On the other hand, its estimated value is based on TAC management system to calculate biological acceptable catch (ABC) together with biological reference points. The ABC estimation methods of TAC-based management differ according to tier of data available for demersal and pelagic resources, respectively (Zhang et. al., 2000).

(1) The ABC models for demersal resources are detailed following:

Tier 1 Information available: Reliable estimates of B, F, B_{MSY}, f_{MSY}, $F_{x\%}$ and M

1.1 Stock state: $B/B_{MSY} > 1$

$F_{ABC} \leq$ low value out of f_{MSY} or $F_{35\%}$

1.2 Stock state: $\alpha < B/B_{MSY} \leq 1$

$F_{ABC} \leq$ low value out of either $f_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$ or $f_{35\%}$

1.3 Stock state: $B/B_{MSY} < \alpha$: $F_{ABC} = 0$

Tier 2 Information available: Current B, $B_{x\%}$, $F_{x\%}$, M

2.1 Stock state: $B/B_{35\%} > 1$

$F_{ABC} \leq F_{35\%}$

2.2 Stock state: $\alpha < B/B_{35\%} \leq 1$

$F_{ABC} \leq F_{35\%} \times \alpha < B/B_{35\%} \leq 1$

2.3 Stock state: $B/B_{35\%} \leq \alpha$: $F_{ABC} = 0$

Tier 3 Information available: Current B, $F_{0.1}$, M

$F_{ABC} \leq F_{0.1}$

Tier 4 Information available: Time-series catch (Y) and effort (or CPUE) data

4.1 Stock state: $CPUE/CPUE_{MSY} > 1$

$ABC \leq MSY$

4.2 Stock state: $\alpha < CPUE/CPUE_{MSY} \leq 1$

$ABC \leq MSY \times (CPUE/CPUE_{MSY} - \alpha)/(1- \alpha)$

4.3 Stock state: $CPUE/CPUE_{MSY} \leq \alpha$; ABC = 0

Tier 5 Information available: Reliable catch history (Y)

$ABC \leq 0.75 \times YAM$ (average catch over an appropriate time period)

---

① Determination of ABC in tiers 1 – 3:

$ABC = (BF_{ABC} / M + F_{ABC}) \times (1 - e^{-(M+F_{ABC})})$

Where B: biomass, M: instantaneous coefficient of natural mortality,

F_{ABC}: instantaneous coefficient of fishing mortality determined by the data available and stock status

② In tiers 1, 2 and 4, $\alpha = 0.05$.

(2) The ABC models for pelagic resources are described following:

Tier 1 Information available: Reliable estimates of annual B and F, B_{MSY}, f_{MSY}, $F_{x\%}$, M and environmental factor

1.1 Stock state: $B/ B_{MSY} > 1$

$F_{ABC} \leq$ low value out of f_{MSY} or $F_{30\%}$

1.2 Stock state: $\alpha < B/ B_{MSY} \leq 1$

$F_{ABC} \leq$ low value out of either $f_{MSY} \times (B/ B_{MSY} - \alpha)/(1- \alpha)$ or $f_{30\%}$

1.3 Stock state: $B/ B_{MSY} < \alpha$: $F_{ABC} = 0$

Tier 2 Information available: Current B at age, $B_{x\%}$, $F_{x\%}$, M and environmental factor

2.1 Stock state: $B/B_{30\%} > 1$

$F_{ABC} \leq F_{30\%}$

2.2 Stock state: $\alpha < B/ B_{30\%} \leq 1$

$F_{ABC} \leq F_{30\%} \times \alpha < B/ B_{30\%} \leq 1$

2.3 Stock state: $B/B_{30\%} \leq \alpha$: $F_{ABC} = 0$

Tier 3 Information available: Current B, $F_{0.1}$, M

$F_{ABC} \leq F_{0.1}$

Tier 4 Information available: Time-series catch (Y) and effort (or CPUE) data

4.1 Stock state: $CPUE/CPUE_{MSY} > 1$

ABC ≤ MSY

4.2 Stock state: $\alpha < CPUE/CPUE_{MSY} \leq 1$

ABC ≤ MSY X $(CPUE/CPUE_{MSY} - \alpha)/(1- \alpha)$

4.3 Stock state: $CPUE/CPUE_{MSY} \leq \alpha$; ABC = 0

Tier 5 Information available: Reliable catch history (Y)

ABC ≤ 0.75 X YAM (average catch over an appropriate time period)

---

① Determination of ABC in tiers1 – 3:

$$ABC = ABC_r + \sum_{i=r+1}^{t\lambda} (B_i F_{ABC}/M + F_{ABC}) X (1 - e^{-(M+F_{ABC})})$$

$$ABC_r = (R F_r/M + F_r) X (1 - e^{-(M+F_r)}), R = f (SB, E_i)$$

Where B_i: biomass at age iI, M: instantaneous coefficient of natural mortality, F_r: instantaneous coefficient of fishing mortality determined by the data available and stock status, r: recruit age, $t\lambda$: maximum fishing age.

② Without data of environmental factor in tiers 1-3, the equation for demersal stocks would be applied to determine ABC.

③ In tiers 1, 2 and 4, α = 0.05.

5. Comparative analysis approach

5.1 Comparative analysis with other LME's international projects

It is known that there are about 63 Large Marine Ecosystems (LME) of the world (www.edc.uri.edu/lme). In this report, the LMEs with a semi-enclosed sea were selected for comparative purposes in terms of brief description, states of fisheries, socio-economic conditions and governance. If necessary, some important LMEs are also described.

Eastern Bering Sea LME

Description: This LME is characterized by its Sub-Arctic climate. The growing impacts of pollution, overexploitation and environmental changes on sustained biomass yield are under investigation.

Fish and fisheries: Catches of all major species groups decrease recent, but supporting the world's largest pollock fishery. Other commercially valuable species include halibut, herring, capelin, Pacific cod and plaice etc. There is evidence of overexploitation, excessive by-catch and destructive fishing practices. There is strong evidence of effective ecosystem-based management planning for this LME and the management regime annually updates fishing

quotas based on biomass estimates.

Socio-economic conditions: Native Americans in this region depend on its resources for their subsistence in food, Alaska natives benefit from individual fishing quota or IFQs, and community development quotas (CDQs).

Governance: The North Pacific Fishery Management Council manages with the goal of maintaining stable yields by shifting harvest allocation species.

Gulf of Mexico LME

Description: The LME characterized by its tropic climate and bordered by USA, Cuba and Mexico. The growing impacts of pollution, overexploitation, and environmental changes on sustained biomass yields are under investigation for the LME. Intensive fishing is the primary force driving the LME with climate as the secondary driving force.

Fish and fisheries: Main target species from fishing are mackerel, shrimp, blue crab. Red grouper is the most important commercial species of reef fish off the west Florida coast. Red snapper is apparently the most over fished species in the Gulf of Mexico. The management of king mackerel has been successful in increasing the biomass

Socio-economic conditions: Major assets are fisheries, tourism, agriculture, oil and infrastructure, trade and shipping. Commercial fishing is an important component of the LME's economy.

Governance: Marine resources experts from Mexico, Cuba and USA have developed a project for the LME. The result will be a Trans-boundary Diagnosis Analysis and Strategic Acton Programme. There is no current institutional arrangement for cooperation between the three countries.

East China Sea LME

Description: This LME is a vast, semi-enclosed LME bordered by China, South Korea and Japan. The LME is influenced by the warm Tsushima Current and the Kuroshio Current. It is a productive LME with shallow coastal waters that provide spawning and nursery grounds for many pelagic species. Intensive fishing is the primary force driving the LME with climate as the secondary driving force.

Fish and fisheries: The LME is intensively exploited for fisheries and algae. Due to an overexploitation, significant changes in fisheries biomass have occurred in the past few years. The key species are hairtail, large yellow croaker, small yellow croaker, filefish, mackerel and shrimp etc. Heavy fishing mortality has resulted in a shift from an older to faster growing smaller such as shrimp

and cephalopods. There are changes occurring in catch composition and ecological diversity.

Socio-economic conditions: The LME region is an important economic area that is experiencing rapid economic development. Mariculture is a growing economic activity in the region.

Governance: An important governance initiative will be to take measures to recover depleted fisheries resources and improve ecological and environmental conditions. Reducing fishing efforts are strongly required from the current high levels including number of fishing vessels.

Sea of Japan/East Sea LME

Description: This LME is a semi-enclosed sea with entering the Tsushima Current, a small branch of the warm Kuroshio Current. Climate is the primary force driving the LME, with intensive fishing as the secondary driving force.

Fish and fisheries: The Japanese sardine is an abundant pelagic fish consisting more than 70% of the total catch. Others are scad, mackerel, yellowtail, common squid and anchovy etc.

Socio-economic conditions: This LME coastal region is highly developed with commercial ports and fishery harbors. It is very reliant on the sea for its supply of fish, seaweed and other marine resources.

Governance: The five nations sharing the governance of the LME are Russia, China, South Korea, North Korea and Japan. There are conflicts arising from name of the sea (Sea of Japan and called the East Sea by South Korea). In terms of environmental protection, bilateral agreements have been concluded between China, South Korea, Japan and Russia.

Sea of Okhotsk LME

Description: The LME is a semi-enclosed sea at the edge of Russia and Northern Japan. There are marked differences in climate, hydro-graphy and biology. Climate is the primary force driving the LME with the intensive fishing as the secondary driving force.

Fish and fisheries: Commercial important species are walleye Pollock, flounder, herring Pacific salmon cod and capelin. Walleye Pollock abundance appears to depend on climatic or oceanographic factors. Over fishing affects most of the major fish stocks. Nowadays stocks of Pacific salmon stocks are at low levels.

Socio-economic conditions: Fisheries in the region and fish processing provide an economic basis for the lucrative Sakhalin fishing industry.

Overexploitation is depleting some of the fish stocks. The Kamchatka peninsula is also rich in deposits of gold, silver, copper and coal.

Governance: The LME comes under the government of Russia. The issue of who has sovereignty over the Kuril Islands involves Japan.

Arabian Sea LME

Brief description: The LME is characterized by its tropical climate. There is interchange of surface waters in the Indian Ocean between the Arabian Sea LME and Somalia Current and the Bay of Bengal LME.

Fish and fisheries: This LME is one of only 6 LMEs identified in which trends are not decreasing and for which a precautionary approach to management might lead to sustainability. There is a high catch percentage for coastal region and for pelagic fishes.

Socio-economic conditions: A high catch are from artisanal fisheries. Most important export is prawn. Overexploitation of prawn, sardines, mackerels and promfrets has been caused by the introduction of large fishing vessels that fish illegally near the coast.

Governance: The countries of Somalia, Oman, Iran, Iraq, Kuwait, India and Pakistan, share in the governance of the LME. There is urgency in the need for a long-term management plan. The multiplicity of national boundaries and EEZ make governance complex. The coastal nations of the region need to develop a regional framework that would encompass jurisdictional issues.

5.2 Consideration of different requirements between central and local governments

There have been arguments and requirements between central and local governments. Core things that need to take considerations are listed below:

i) Multi-species fisheries management
ii) Multi-gear fisheries management
iii) Trans-boundary fishing between large and local areas (between nations)
- Migratory species
iv) Trans-boundary fishing between local areas (or between provinces)
v) Illegal and ghost fishing, especially at spawning and nursery seasons.
vi) Conflicts between fishing vessels.
vii) Demolish and reclamations of coastal areas.

REFERENCES

Andersen, K. P. and E. Ursin. 1977. A multi-species extension to the Beverton and Holt theory of fishing with accounts of phosphorus circulation and primary production. Medd. Danm. Fisk.-og Havunders, N. S., 7:319-435.

Beverton, R. J. H. and S. J. Holt. 1957. On the dynamics of exploited fish population. Fishery investigation. Series II. Marine Fisheries. Great Britain Ministry of Agriculture. Fisheries and Food, 19, 533p.

Christensen, V. and D. Pauly. 1992. ECOPATH II, a software for balancing steady ecosystem models and calculating network characteristics. Ecol. Modeling, 61: 169-185.

Csirke, J. and J. F. Caddy. 1983. Production modeling using mortality estimates. Can. J. Fish. Aquat. Sci. 40: 43-51 (with errata in Can. J. Fish. Aquat. Sci.. 40: 255-256).

DeLury, D. B. 1947. On the estimation of biological population. Biometrics, 3: 145-167.

Deriso, R. B., T. J. Quinn and P. R. Neal. 1985.Catch-age analysis with auxiliary information. Can. J. Fish. Aquat. Sci. 42: 818-824.

Elsevier science. 2003. Large marine ecosystem of the world - Trends in the exploitation, protection and research, LME 48-Yellow Sea, edited by Hempel, G. and K. Sherman, 423p.

Fox, W. W. Jr. 1970. An experimental surplus yield model for optimizing exploited fish populations. Trans. Amer. Fish. Soc., 90: 80-88.

Gislason, K., M. Sinclair and K. Sainsbury. 2000. Symposium overview: Incorporating ecosystem objectives within fisheries management. ICES Journal of Marine Science, 57: 468-475.

Gulland, J. A. 1965. Estimation of mortality rate. Annex to arctic fisheries workshop group report. International Council for the Exploitation of the Sea, C. M. 1965/3, Copenhagen.

Gulland, J.A. 1983. Stock assessment: Why? FAO, FIRM/C 759, Rome, Italy.

Laevastu, T. and F. Favorite, 1978a, Numerical evaluation of marine ecosystems, Part I. Deterministic Bulk Biomasss Model (BBM). Northwest & Alaska Fish.Cen, Seattle, Wash., Pro. Rep.

Laevastu, T. and F. Favorite, 1978b. Numerical evaluation of marine ecosystems, Part II. Dynamical Numirical Marine Ecoststem Model (DYNUMES III) for evaluation of fishery resources. Northwest & Alaska Fish.Cen, Seattle, Wash., Pro. Rep.

Laevastu, T. and H. A. Larkins. 1981. Marine fish Ecosystem Fishing News Books, Oxford.

Larkin, P. A.1977. An epitaph for the concept of maximum sustainable yield. Trans. Am. Fish. Soc., 106(1): 1-11.

Leslie, P. H. and D. H. S. Davis. 1939. An attempt to determine the absolute number of rats on a given area. J. Anim. Ecol., 8: 94-113.

Pauly, D., V. Christensen and C. Walters. 2000. Ecopath, ecosim and ecospace as tools for evaluating ecosystem impact of fisheries. ICES Journal of Marine Science, 57: 697-706.

Pellar, J.J. and P.K. Tomlinson. 1968. A generalized stock production model. Inter. Am. Trop. Tuna comm. Bull. 13: 419-496.

Polovina, J. J. 1984. Model of a coral reef ecosystem, I. The ECOPATH model and its application to French Shoals. Coral Reefs, 3(1): 1-11.

Pope, J. C. 1972. An investigation of the accuracy of virtual population analysis using cohort analysis. Int. Comm. Northwest Atl. Fish. Res. Bull., 9: 65-74.

Ricker, W. E. 1948. Production and utilization of fish population. Ecol. Monogr., 16:379-391.

Ricker, W. E. 1954. Stock and recruitment. J. Fish. Bd. Can., 11: 559-623.

Schaefer, R. B. 1954. Some aspects of the dynamics of populations important to management of commercial marine fisheries. Inter. Am. Trop. Tuna Comm. Bull., 1: 25-56.

Schaefer. R. B. 1957. A study of the dynamics of the fishery for yellowfin tuna in the eastern tropical Pacific Ocean. Inter. Am. Trop. Tuna Comm. Bull., 2:245-285.

Schnute, J. 1977. Improved estimates from the Schaefer production model: theoretical considerations. J. Fish. Res. Bd. Can., 34:583-603.

Thompson, W. F. and W.H. Bell. 1934. Biological statistics of the Pacific halibut dynamics. J. Amer. Stat. Assoc. 64: 111-130.

Walters, C., V. Christensen and D. Pauly.1997. Structuring dynamics models of exploited ecosystems from trophic mass-balance assessments. Review in Fish Biology and Fisheries, 7: 139-172.

West Sea Fisheries Research Institute (WSFRI). 2006. Reducing environmental stress in the YSLME: Data/information collection – fisheries component, 96p.

Yellow Sea Fisheries Research Institute (YSFRI). 2006. Report of data and information collection from China, National report of China, 56p.

Zhang, C. I., J. B. Lee, S. Kim and J. H. Oh, 2002. Climate regime shift and their impacts on marine ecosystem and fisheries resources in the Korean waters. Oceanography, 47: 171-190.

Zhang, C.I., J.. B. Lee and C.I. Baik. 2000. A study on the stock assessment methods incorporating ocean environment factors. J. Korean Soc. Fish. Res., 3: 16-28 (in Korean)

Zhang, C. I. and P. J. Sullivan.1988. Biomass-based cohort analysis that incorporates growth. Tran. Amer. Fish. Soc., 117(2):180-189.

Pollution – China

Report

On Preliminary Regional Targets

With Respect to the Project's Objectives

Of Pollution

by

WEN Quan
National Marine Environmental Monitoring Center

Proposed EcoQOs for Pollution Management Actions of SAP for YSLME Project

WEN Quan
SOA Key Laboratory of Coastal Ecosystem and Environmental Research
National Marine Environmental Monitoring Center of China

1. Reviewing historical data and trends

1.1 Pollution issues identified in TDA Report

The Regional Working Group on Pollution first established the nature and priorities among the environmental concerns within its sphere of reference. These issues, their nature and their relative priorities are shown in Table 1(YSLME TDA Report).

Table 1.Types and Nature of Environmental Problems Relating to Pollution

Environmental Issue	Nature of Issue	Priority of Issue [1]
1. Eutrophication	Category of Environmental Problems	**1**
Nitrogen (N) enrichment	Immediate Cause	1/1
Phosphorus (P) enrichment	Immediate Cause	Low
Silicate (Si) depletion	Immediate Cause	1/2
Changed Si:N:P ratios	Immediate Cause	1/2
Oxygen depletion	Consequence	N/A
Phytoplankton blooms including red tides	Consequence	N/A
2. Contaminants and their Effects	Category of Environmental Problems	**2**
Faecal contamination	Environmental Problem	2/1
Heavy metal contamination	Environmental Problem	2/5
POPs[2] contamination	Environmental Problem	2/4
PAH[3] contamination	Environmental Problem	2/2
Marine litter	Environmental Problem	2/3
3. Increased risks to human health	Category of Environmental Problems	**3**
- through seafood contamination	Environmental Problem	3/2
- through exposures to contaminated water	Environmental Problem	3/1

1.2 Historical trends

Temporal trends in dissolved nitrogen, phosphate and silicate in the Yellow Sea are depicted in Figure 1. This figure shows a trend of increasing dissolved inorganic nitrogen (DIN) and

[1] "1" signifies the highest priority; "1/1" signifies the highest priority in category 1; N/A = not applicable

[2] Persistent Organic Pollutants as defined by the Stockholm Convention 2001

[3] Polyaromatic hydrocarbons

corresponding declines in the concentrations of phosphate and silicate in the Yellow Sea resulting in an increasing N/P ratio and reduced silicate that would be consonant with conditions under which blooms of dinoflagellates would be expected to become more frequent.

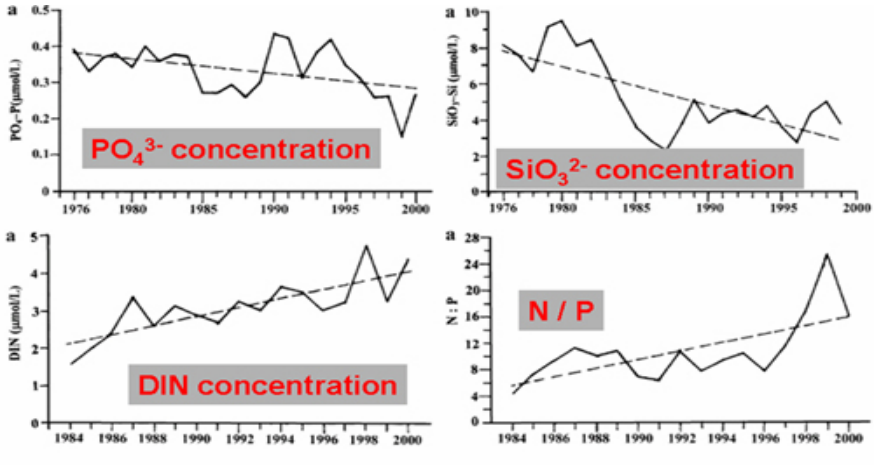


Figure 1. Temporal Trends in Annual Mean Nutrient Concentrations and N/P Ratio in the Yellow Sea

Based on the Bulletins of Marine Environmental Quality in China (2001-2005), it can be seen that the environmental quality in Yellow Sea on China side shows a trend of deterioration, showing in Figure 2.

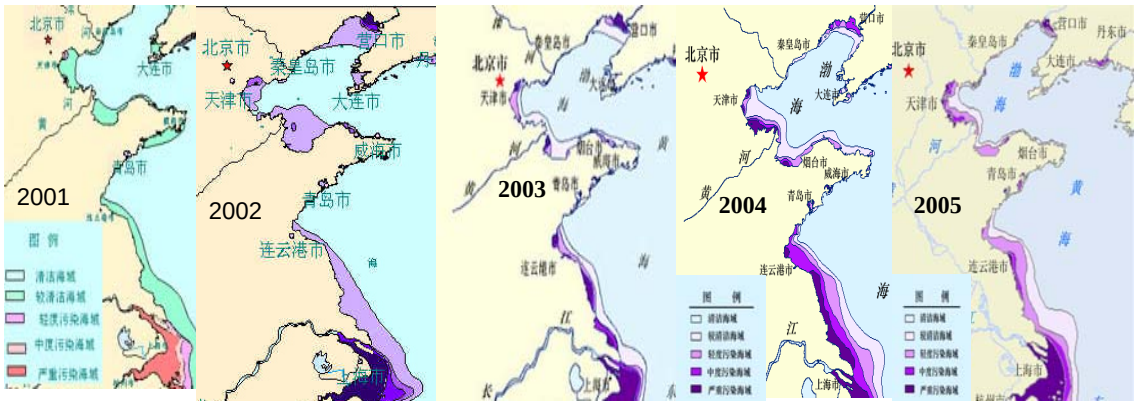


Figure 2 Environmental status and trends in Yellow Sea (2001-2005)

Dissolved Oxygen (DO) is an important indicator for ecosystem quality. The contents of DO in seawater in southern Yellow Sea fluctuated in last decades. The average content of dissolved oxygen (DO) was about 6.75mg/Land fluctuated from 5.8mg/L to 7.75 mg/L in the Southern Yellow Sea (see Figure 3), which shows that the ecosystem in southern Yellow Sea has not been stable.

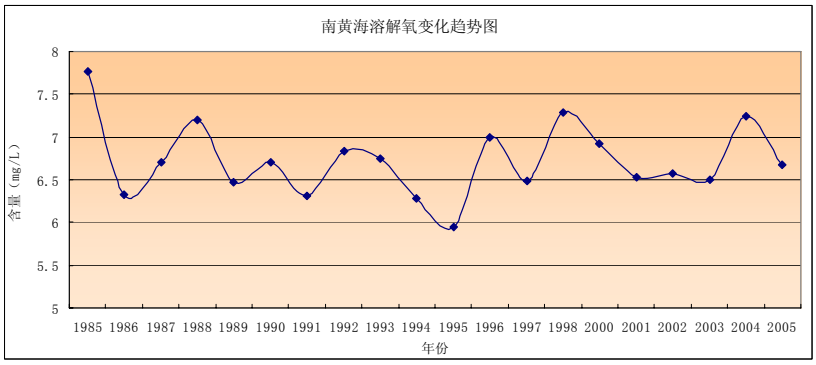


Figure 3 The trends of average DO contents in southern Yellow Sea

Figure 4 and Figure 5 show that the contents of P and N in seawater of southern Yellow Sea has the same trends of fluctuation.

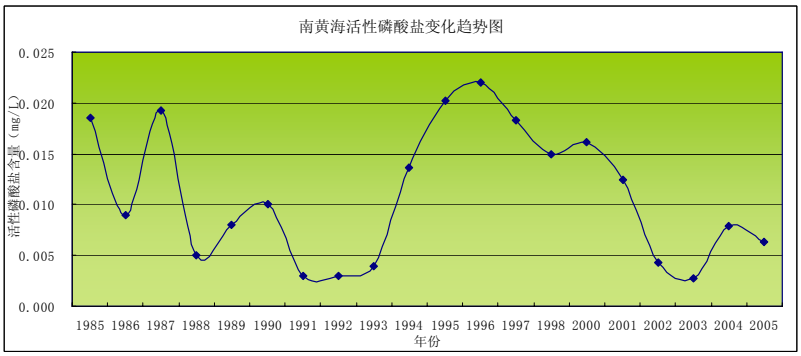


Figure 4 Trends of PO4-P in seawater of southern Yellow Sea

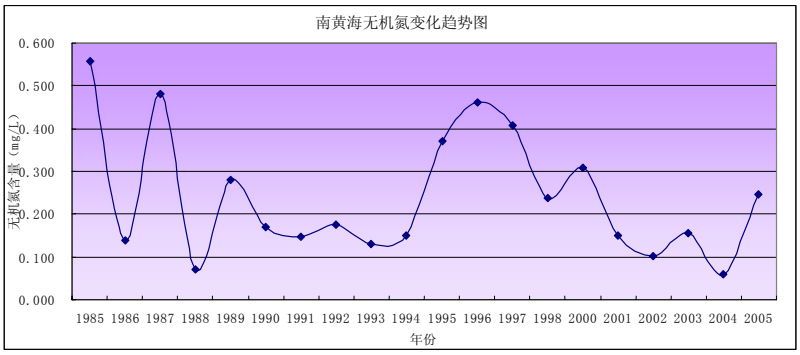


Figure 5 Trends of DIN in southern Yellow Sea

The RWG-E has noted that there has been a significant increase in the annual incidence of intense algal blooms (see Figure 6[4], YSLME TDA Report). Such blooms can cause increased mortality of mariculture stocks, kills of wild fish thereby reducing fishery yields, and increased risks to seafood consumers through the incorporation of natural toxins into exploited marine organisms. Compared with the temporal trends in annual mean nutrient and

[4] This figure depicts intense algal blooms defined as exceeding a minimum cell density (cells/cm^3) or causing discoloration of water (*i.e.*, red tides). The Korean data may partially reflect increased monitoring since 1995.

concentrations and N/P ratio in the Yellow Sea the ecosystem quality objectives for N, P and Si could be determined, after discussing with RWG-E.

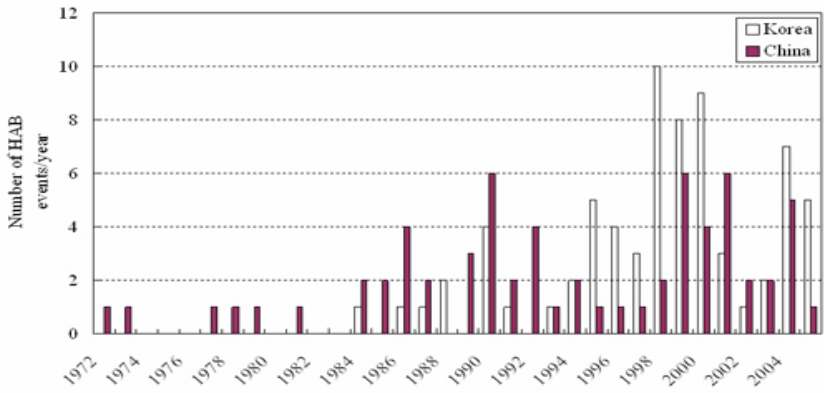


Figure 6. Frequency of Intense Algal Blooms

The target proposed from Ecosystem Group of China for control of red-tides in Yellow Sea is that the occurrence of red tides in Yellow Sea is kept at the level in the end of ？？s, i.e. ？？ times per year, less than ？？ of the highest.

2. Identifying the current situation

Based on the Bulletin of Marine Environmental Quality in China 2006, the environmental quality in Yellow Sea is still deteriorating. The heavy pollution area, 9000km2, is increasing more than that in 2005, showing in Figure 7.

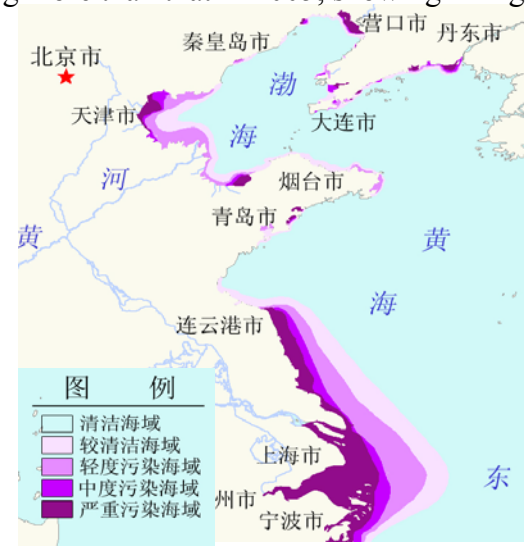


Figure 7. Status of environmental quality in Yellow Sea of 2006

The heavy pollution area is located in coastal waters in Jiangsu Province and the major pollutants are DIN, PO4-P and Oil.

The mussel watch program in China gives the trends of pollutants in bivalves in

marine environment. The assessment results and trends in coastal waters of Yellow Sea show in Table 2.

Table 2. Trends of pollutant contents in bivalves

in coastal waters of Yellow Sea (1997～2006)

Coastal Area	Oil	THg	Cd	Pb	As	DDT	PCBs
Water near Dalian	↘	↗	+	+	↗	+	
Water near Yantai	⇔	↘	⇔	-	↘	↘	+
Water near Qingdao	↘	+	↘	↘	↘	↗	+
Water in north Jiangsu	⇔	+	↘	↘	↘	⇔	+
Water near Nantong	⇔	+	↘	↘	↘	↘	⇔
Changjiang Estuary	↘	+	↘	↗	+	⇔	⇔

↗ significantly increasing; ↗ increasing; + slightly increasing; ⇔ no change; - slightly decreasing; ↘ decreasing; ↘ significantly decreasing; no enough data

The atmospheric monitoring results show increasing trends of pollutants of atmospheric deposit (Table 3)

Table 3 Atmospheric deposit trends of pollutants in area of Yellow Sea

Areas	Fluxes of atmospheric deposit				Contents of pollutant in aerosol			
	TSP*	Cu	Pb	Cd	TSP*	Cu	Pb	Cd
near Dalian	-	⇔	+	⇔	-	+	+	-
near Qingdao	⇔	↗	↗	↘	⇔	↗	+	↘
Changjiang Estuary	-	↗	↗	↗	-	↗	↗	↗
All seas	⇔	↗	↗	↗	⇔	↗	↗	⇔

↗ significantly increasing; ↗ increasing; + slightly increasing; ⇔ no change; - slightly decreasing; ↘ significantly decreasing

* TSP: Total suspended particles in atmosphere.

3. Proposed EcoQOs

3.1 Methodologies

The methodologies for EcoQOs identification on pollution component of YSLME are listed in Table 4 (revised from SAP Concept Report).

Table 4. Methodologies for EcoQOs identification on pollution component

Methodology	Task
Retrospective approach	Review historical data
	Check historical trends
	Identify current situation
	Review current political situation
	Identify critical habitats
Theoretical approach	Best Management Practices(BMP)
Comparative analysis approach	Comparative analysis with other LME's, international projects
	Consideration of different requirements between central and local govt.

3.2 Identifying Environmental Targets in RWG-P Meeting

There was extensive discussion on the proposed procedure to identify the management issues, the regional "targets" (Table 5) for the Pollution Component, and associated activities necessary for developing the SAP, during the 3rd RWG-P Meeting.

Table 5 Proposed Regional "Targets"

	Problem	Direction (next 10-15 yrs)	"Target"	Actions for RWG-P (if no target)
Eutrophication				
	Nitrogen enrichment	reduce		get primary production values from RWG-E; joint meeting with RWG-E members
	Phosphorus enrichment	no change		
	Silicate depletion		try to adjust freshwater fluxes	
	Changed Si:N:P ratios	refer to above		
	Oxygen depletion	refer to above		
	Phytoplankton blooms including red tides	refer to above		
Contamination and Effects (Pollution)				
	Faecal contamination	reduce	incidents of exposure reduced to nationally accepted level	
	Heavy metal contamination	reduce or no action	codex alimentaris - for all foodstuffs	
	PCBs, pesticides, dioxins, furans contamination	reduce	Stockholm Convention	
	PAH contamination	reduce	codex alimentaris - for all foodstuffs	
	Marine litter	reduce	as minimal as possible	
	TBT	control release from dredging activities; survey sediment erosion areas	[2pg/l - need to be checked]	
	petroleum hydrocarbons	reduce	MARPOL Convention - need to be checked	
Increased risks to human health				
	through seafood contamination	reduce	codex alimentaris - for all foodstuffs	
	through exposures to contaminated water	reduce	incidents of exposure reduced to nationally accepted level	
	shaded targets require further checking of the internationally accepted standards			

3.3 Identifying environmental Targets from BMP

In China, marine environmental management has been developed from marine pollution monitoring and assessment to pollution management. And right now the novel technologies are adopted and the management approach changes from environmental standards approach to medically-based approach, even to the ecosystem-based approach. Recently the management depends upon the environmental planning and the environmental quality standards in marine function zones, which is called as the function-based environmental standard approach.

Different function zones have different environmental quality requirements according to the national marine environmental quality standards (e.g. seawater quality standards, marine organism quality standards, marine sediment quality standards, etc.). This can be used for the zonation of environmental targets, when the function has been defined for the zones. The function zones are divided in general as follows:

----zone for utilization and conservation of fishery resources
----zone for port and transportation
----zone for tourism
----zone for seawater utilization
----zone for MPAs
----zone for marine and coastal engineering
----zone for development of energy
----zone for development of minerals
----zone for specific utilization (scientific research, etc)
----reserved zones

Seawater Quality Standard(1997) involves the major pollutants as: floating materials, suspended substances, coliform, pathogen, DO, COD, BOD, inorg-N , non-ion-NH3, inorg-P, Hg, Cd, Pb, Cr, As, Cu, Zn, Sn, Ni, cyanide, sulfide, oil, phenol, 666, DDT, etc. And 4 grades are classified as:

- 1st grade----fishery, natural reserves, endangered animals MPAs
- 2nd grade----mariculture, bathing waters, waters related to human health and food production
- 3rd grade----general industry, tourism waters
- 4th grade----port and ocean exploration

Marine Sediment Quality Standard (2002) involves the major pollutants as: wastes, coliform, pathogens, Hg, Cd, Pb, Zn, Cu, Cr, As, org-C, sulfide, oil, 666, DDT, PCBs, etc. And 3 grades are classified as:

- 1st grade----fishery, natural reserves, MPAs for endangered widelifes, mariculture, waters related to human health and food, etc.
- 2nd grade----general industry, coastal tourism
- 3rd grade----port and ocean exploration with special purposes

Marine Organism Quality Standard(2001) involves the major pollutants as: sensory,

coliform, PSP, Hg, Cd, Pb, Cr, As, Cu, Zn, Oil, 666, DDT, etc. And 3 grades are classified except for PSP (only one grade) as:

- 1st grade----fishery, mariculture, natural reserves, MPAs, waters related to human health
- 2nd grade----general industry, coastal tourism
- 3rd grade----port and exploration activities

3.4 Comparative analysis approach

For marine organism quality, the international, regional and national criteria and standards are considered and compared. The maximum residue limits (MRLs) for major pollutants in seafoods are listed in Table 6.

Table 6 MRLs in seafoods

Chemicals	Values of MRL in seafoods		
	FAO/WHO (codex alimentarius) (mg/kg)	EU(mg/kg)	China (mg/kg)
Cd(mg/kg)	1.0 (Fish meat)	0.1 (Fish) 0.5 (crustacean)	≤1.0 (mollusc) ≤0.5 (crustacean) ≤0.1 (Fish)
Hg(mg/kg)	1.0 (Fish)	1.0 (Fish)	≤1.0 (shellfish and fishes) ≤0.5 (other seafood)
Pb(mg/kg)	0.2(fish) 1.0 (meat)	0.5 (crustacean) 0.4 (fish) 1.0 (bivalves)	41.0 (mollusc) ≤0.5 (other seafood)
^{131}I			4.7X102Bq/kg(fish/shrimp)
^{137}Cs			8X102Bq/kg(fish/shrimp)
^{147}Pm			2.4X104Bq/kg(fish/shrimp)
^{210}Po			1.5X10Bq/kg(fish/shrimp)
^{223}Ra			2.1X10Bq/kg fish/shrimp)
^{226}Ra			3.8X10Bq/kg(fish/shrimp)
^{239}Pu			10Bq/kg(fish/shrimp)
^{3}H			6.5X105Bq/kg(fish/shrimp)
^{89}Sr			2.9X103Bq/kg(fish/shrimp)
^{90}Sr			2.9X102Bq/kg(fish/shrimp
PCB138			0.5 (marine fishes, shellfishes, shrimps and algae(edible parts))
PCB153			0.5 (marine fishes, shellfishes, shrimps and algae(edible parts))
PCBs	2 (Fish meat)	2 (Fish meat)	0.2 (scallop/prawn/fresh kelp/ Wakame-*Undaria pinnatifida* /nori) 2 (fish meat)
Cu(mg/kg)			≤50(all seafoods)
Se(mg/kg)			≤1.0 (fish)
F(mg/kg)			≤2.0 (freshwater fish)
Cr(mg/kg)			≤2.0 (fishes and shellfishes)
BHC(mg/kg)			≤2 (all seafoods)
DDT(mg/kg)			≤1(all seafoods)
As(mg/kg)			40.5(freshwater fish)
inorg-As(mg/kg)			≤1.0(shellfishes/crustacean/other seafoods) ≤0.5 (marine fishes)
Dioxins	4pg WHO-PCDD/F-TEQ/ g (fish meat and	4pg WHO-PCDD/F-TEQ/g (fish meat and	

	seafoods)	seafoods)	
Azinphos-methyl			
Heptachlor	0.2 (fish meat)		
Lindane	0.1 (fish meat)		
METHOMYL	0.02 (fish meat)		
Aldrin	0.3 (fishes)	0.2 (fishes)	
Chlordane	0.5 (fish meat)		
DDT	5 (fish meat)		
Dieldrin	0.2 (fish meat)		
Endrin	0.01 (fish meat)		
Hexachlorobenzene		0.01	
Mirex	0.1 (fishes)		
Toxaphene	0.1 (fishes)	0.1 (fish meat)	

4. Proposed management options related to proposed EcoQOs

4.1 Further research on the causal-chain analysis and the root causes

With clearly defined regional targets for management, the necessary management interventions need to be identified based on the Causal Chain Analysis, and on geographic, social, and political conditions. Management actions should include harmonisation of legislation, institutional reforms, financial sustainability, human resource development, and regional co-operation. Technical interventions should also be considered to address specific problems identified in the TDA.

Perform feasibility studies on the various options of management interventions
Studies will be conducted to test the feasibility of possible management interventions from the perspective of:

- Technical feasibility;
- Cost-benefit analysis; and
- Political and social acceptance.

4.2 Major management actions proposed based on TDA

4.2.1 Control of pollutants discharge from land-based sources

The management options may be concerned of the total-quantity-control of pollutant discharge, the ratio of wastewater treatment, the treatment of wastesolids and marine litter, the control of non-point pollution sources, the recover of wetlands, etc.

4.2.2 Management on ocean and coastal engineering

The management actions may be concerned of the implementation of EIA regulation, the control of reclamation in critical habitats and valuable areas, the discharge of pollutants from engineering and installation, the control of pollution from mariculture activities, etc.

4.2.3 Control of pollution from sea-based sources

The management actions may be concerned of the environment management in seaport, the control of pollution from ships, the contingency plan for oil spillage, etc.

4.2.4 Management on ocean dumping

The emphasis should be put on the dumping site zonation, the monitoring and evaluation, the reasonable utilization of carrying capacity for dredged materials, the promotion of new technologies for reuse of waste solids, etc.

4.2.5 Environmental engineering measures

The activities related to environmental engineering are concerned of the mitigation of pollution in critical areas, the restoration of the important habitats, the recovery of important functions, especially Dalian Bay and Jiaozhou Bay, ect.

4.2.6 Capacity building

It is emphasized on the marine environmental monitoring capacity for Yellow Sea. Based on the current monitoring system and capacity, the integrated marine environmental monitoring system should be built in the manner of network-distributed, 3-dimensioned base, which is composed of satellite, vessel, databuoy, land-based stations, underwater stations and other monitoring technics. The building of information system for Yellow Sea is also needed to provide a platform for publics and for early warning and prediction/forecasting.

4.2.7 Scientific research

The scientific research on environmental protection in Yellow Sea should be enhanced in fields of the marine environmental protection tools, the monitoring, assessment and prediction, the technologies for ecosystem restoration, the ecosystem-based approaches, the biodiversity conservation and management, etc.

4.2.8 Publicity

The public awareness and participation should be promoted in different manners of the activities and actions. The new approaches for promoting public awareness should be developed.

References

1. Bulletin of Marine Environmental Quality in China 2001, SOA
2. Bulletin of Marine Environmental Quality in China 2002, SOA
3. Bulletin of Marine Environmental Quality in China 2003, SOA
4. Bulletin of Marine Environmental Quality in China 2004, SOA
5. Bulletin of Marine Environmental Quality in China 2005, SOA
6. Bulletin of Marine Environmental Quality in China 2006, SOA
7. UNDP/GEF YSLME TDA Report, 2006, PMO
8. Meeting Report for 3rd RWG-P for YSLME Project, PMO
9. Ocean future and human health—practical management and policy issues in coastal marine ecosystem, M.H.Depledge, Plymouth Marine Laboratory, EAS Congress 2006, Haikou City, Hainan Province, China

Annex 1. National Marine Environmental Quality Standards

—Seawater Quality Standard (GB3097-1997)

Code	Items	1st class	2nd class	3rd class	4th class
1	Float materials	No oil film and other floating materials on the sea			No significant oil film and other floating materials on the sea
2	Color, smell	No abnormal			No detested
3	Suspended substances	increment≤10	increment≤100		increment≤150
4	coliform≤(ind/L)	10000 Water for mariculture of shellfish≤700			—
5	Fecal coliform≤(ind/L)	2000, Water for mariculture of shellfish≤140			—
6	pathogen	No pathogen in water for edible shellfish culture			
7	Temperature(℃)	Less than1℃ in summer by anthropogenic activities at local level, 2℃ for other seasons		Less than4℃ in summer by anthropogenic activities	
8	pH	7.8～8.5 Meanwhile not changed over 0.2pH in normal fluctuation		6.8～8.8Meanwhile not changed over 0.5pH in normal fluctuation	
9	DO(>)	6	5	4	3
10	COD≤	2	3	4	5
11	BOD5≤	1	3	4	5
12	Inorg-N≤	0.20	0.30	0.40	0.50
13	Non-ionic N≤	0.020			
14	PO4-P≤	0.015	0.030		0.045
15	Hg≤	0.00005	0.0002		0.0005
16	Cd≤	0.001	0.005	0.010	
17	Pb≤	0.001	0.005	0.010	0.050
18	Cr(VI) ≤	0.005	0.010	0.020	0.050
19	tCr≤	0.05	0.10	0.20	0.50
20	As≤	0.020	0.030	0.050	
21	Cu≤	0.005	0.010	0.050	
22	Zn≤	0.020	0.050	0.10	0.50
23	Se≤	0.010	0.020		0.050

24	Ni≤	0.005	0.010	0.020	0.050
25	Cyanide≤	0.005		0.10	0.20
26	Sulphide≤	0.02	0.05	0.10	0.25
27	Volatile phenol≤	0.005		0.010	0.050
28	Oil≤	0.05		0.30	0.50
29	**C**hlordane≤	0.001	0.002	0.003	0.005
30	DDT≤	0.00005	0.0001		
	etc				

Annex 2. National Marine Environmental Quality Standards

—Sediment Quality Standard

Code	Items	1st class	2nd class	3rd class
1	Wastes and other solids	No industrial and domestic wastes, no macro-plant debris		No significant industrial and domestic wastes, no macro-plant debris
2	Color, smell, structure	No abnormal, in natural structure		
3	Coliform(ind/g-wetweight)≤	200[1)]		
4	Fecal coliform (ind/g-wetweight)≤	40[2)]		
5	pathogen	No pathogen in sediment for shellfish cutlture		
6	Hg（$\times10^{-6}$） ≤	0.20	0.50	1.00
7	Cd（$\times10^{-6}$） ≤	0.50	1.50	5.00
8	Pb（$\times10^{-6}$） ≤	60.0	130.0	250.0
9	Zn（$\times10^{-6}$） ≤	150.0	350.0	600.0
10	Cu（$\times10^{-6}$） ≤	35.0	100.0	200.0
11	Cr（$\times10^{-6}$） ≤	80.0	150.0	270.0
12	As（$\times10^{-6}$） ≤	20.0	65.0	93.0
13	Organic C（$\times10^{-2}$） ≤	2.0	3.0	4.0
14	Sulphide（$\times10^{-6}$） ≤	300.0	500.0	600.0
15	Oil（$\times10^{-6}$） ≤	500.0	1000.0	1500.0
16	**C**hlordane（$\times10^{-6}$） ≤	0.50	1.00	1.50
17	DDT（$\times10^{-6}$） ≤	0.02	0.05	0.10
18	PCBs（$\times10^{-6}$） ≤	0.02	0.20	0.60

1）the values for items except for coliform, fecal coliform and pathogen are countered in dry weight.

2）coliform for sediment of edible shellfish culture is less than 14 ind/g-wetweight.

3）fecal coliform for sediment of edible shellfish culture is less than 3 ind/g-wetweight.

Annex3. National Marine Environmental Quality Standards

—Organism Quality Standard (GB18421—2001)

Marine Shellfish Quality Standards (fresh weight, mg/kg)

Code	Item	1st class	2nd class	3rd class
1	Sensory requirements	Shellfishes in normal growth and activities, without abnormal oil and smell.		Shellfish survival and without significant abnormal smell.
2	Fecal coliform(ind//kg)	3000	5000	—
3	PSP ≤	0.8		
4	tHg ≤	0.05	0.10	0.30
5	Cd ≤	0.2	2.0	5.0
6	Pb ≤	0.1	2.0	6.0
7	Cr ≤	0.5	2.0	6.0
8	As ≤	1.0	5.0	8.0
9	Cu ≤	10	25	50(100 for oyster)
10	Zn ≤	20	50	100(500 for oyster)
11	Oil ≤	15	50	80
12	**C**hlordane ≤	0.02	0.15	0.50
13	DDT ≤	0.01	0.10	0.50
	Note: --Countering in fresh weight without shell; --**C**hlordane involves four isomers(α-, β-, γ-, σ-666); --DDT contains four isomers(ρρ'-DDE, oρ'-DDT, ρρ'-DDD, ρρ'-DDT).			

Pollution – Republic Of Korea

Report

On Preliminary Regional Targets

With Respect to the Project's Objectives

Of Pollution

by

YANG Dong Beom
Korean Ocean Research and Development Institute

Preliminary EcoQOs for management actions of the SAP
1st Ad-hoc Working Group meeting (10-12 April 2007)

Pollution

- Dong Beom YANG (Korea)

Historical data and trends

The overall trend was that the rapid spread of marine pollution was controlled to a certain extent.

1) Nutrients

Nutrients and organic compounds seemed to be the major components of pollutants in the coastal waters of Korea and China. The variation of nitrate concentration in coastal waters of Korea over 1982 to 2004 period showed a decreasing pattern with a maximum value of about 60ug/L in recent years. According to the regional synthesis report the concentrations of inorganic nitrogen in coastal waters of China decreased year after year.

Relatively high concentrations of inorganic nitrogen were found in some coastal waters.

The variation of phosphate concentration in coastal waters of Korea did not show the clear decreasing tendency over 1982 to 2004 periods. The maximum concentration of phosphates was over 50ug/L in recent years.

According to the Chinese monitoring data of the Yellow Sea in the past years, the concentrations of phosphate in the coastal waters decreased year after year. The maximum concentration of reactive phosphate in the Yellow Sea was about 0.024mg/L, found in 1995. The minimum concentration of active phosphate in the Yellow Sea was about 0.003 mg/L, found in 1996 and 2003.

Atmospheric input (dry and wet deposition) of nutrients to the Yellow Sea cannot be quantified with existing data.

---

2) Heavy metals

There are not enough data on heavy metals.

The monitoring results of marine sediment in China indicated that the marine sediment quality in the coastal areas of China was at good condition in 2005, and the potential ecological risk of integrated sediment pollution was low. The statistical analysis of the historical data of 1997 and 1990 collected in China showed that the concentration of Hg in the shellfishes increased, the concentrations of Cd in the shellfishes reduced and the concentrations of Pb and As in the shellfishes reduced significantly in the Yellow Sea.

According to the Korean national report The average concentration of Cr and Cu in the fish muscle tissues

are relatively higher than those of other metals and the order of average concentration of metals is Zn>Cr>Cu>Ni>Hg>Pb>Cd. The concentration of heavy metals fish were not contaminated compared to the other coastal areas and other regions of the world. The heavy metal concentration in fish tissue from the Yellow Sea is relatively low and below the criteria set by Europe and Korea.

Heavy metals are heterogeneously distributed and there is a need for more data along some coasts.

---

3) POPs

There is a need for more data along some coasts, and there are not enough data on POPs. It is not clear what are the origins and pathways of theses pollutants.

In the coastal waters of Korea, more than 1 ppm of PAH was determined in Incheon area followed by Lake Shihwa. Phenolic compounds are the next highest, with the highest concentrations in Lake Shihwa and Mokpo. TBTs are prevalent in all provincial waters, but PCBs are determined only in some areas. The total PCBs concentrations in the sediments collected from the southeastern part of the Yellow Sea in 2000 ranged from 0.17ng/g to 1.37ng/g. Except Endrin, all the other POPs are measurable in Yellow Sea biota. Along the Korean coast, most of the determined POPs are highest in Incheon province. PAHs concentrations are rather uniform in all provinces. DDTs, CHLs, HCHs, HCB are present in all provinces. Dioxins and Furans are detected only in some provinces. Most of the Yellow Sea fish samples had very low concentrations of total PCBs and chlorinated pesticides.

Persistent organic pollutants (POPs) in the fishes, shellfishes and algae collected from the Chinese coasts mainly include organochlorine pesticides, PCBs, PAHs and DDT. The statistical analysis of the historical data of 1997 and 1990 collected in China showed the decrease of PCBs and DDTs concentrations in the organisms of the Yellow Sea

---

4) HAB

According to the regional synthesis report there is an increase in eutrophication in the Yellow Sea. There appears to be four “"hot spots”" of eutrophication –- Bohai Sea, Yalu River, Yangtze River and Han River. HABs are becoming more frequent and widespread, with causative species shift from diatoms to dinoflagellates, and negative impacts of food poisoning in humans and fish mortality. High nutrients levels cause increase in biomass, resulting in HAB and increased fish mortality, which also result in an overall decrease in biodiversity.

In coastal waters of Korea, the red tides became widespread encompassing entire coast since 1990s. The bloom has been occurred from May to October with the peak of June to August. . Diatoms were major phytoplankton species responsible for the blooms until 1980s. Recently dinoflagellates (Prorocentrum micans and Heterosigma akashiwo in recent coastal waters. The occurrence of HABs in coastal waters of China has been increased all the time, with a sharp increase after 2000. . It was found that the magnitude, frequency, and geographic extent of these occurrences have increased significantly over the last several decades.

Various options for EcoQOs for each variable

1) Nutrients
   option 1 - tertiary treatment
   option 2 - management through TMDL approach
   (control by total maximum daily loads)
   option 3 - establish monitoring network for atmospheric input of nutrients
   (control the emission of N if necessary)

2) Heavy metals
   - needs more data

3) POPs
   - needs more data
   (distribution, input and pathways uncertain)

4) HAB
   option 1 - reduce the nutrients level
   option 2 - management of coastal bottom sediments to avoid growth-stimulating substances
   (dredging if necessary)
   option 3 - control ballast water against invasive species

Annex V

SAP Reference Conditions and Regional Targets for Management Actions

SERVICES	Component	Problems identified in CCA	Reference Conditions (Ideal Management target)	Regional target (2020)	Comments
Supporting/regulating	Pollution	Contaminants and their effects (1)	Codex / Stockholm Convention / MARPOL	Codex / Stockholm Convention / MARPOL	
Supporting/regulating	Pollution	Nitrogen enrichment and eutrophication	Historical reference year of around 1990's in the coastal waters	Control of total loading to meet reference point	China will reduce total loading from point sources 10% every 5 years
Supporting/regulating	Pollution	Silicon depletion	Silicate concentration (1980's)	Improve FW seasonal fluxes	
Supporting/regulating	Pollution	Marine Litter	(1960's?)	Reduced standing stock of litter	Increae public awareness Periodic clean ups
Cultural	Pollution	Contaminants and their effects (2)	Blue flag standards	Reduced to nationally acceptable levels	
Provisioning	Fisheries	Decline in landings of many commercially-important species	MSY / ABC/ EBFM	25-30% reduction in catch and fishing effort (2004)	
Provisioning	Fisheries	Unsustainable maricultural practices	Optimal growth and survival of culture organism / Insignificant environmental impact	Sustainable/Polyculture/optimization of the distribution and the cultured spp Improvement culture techniques.	
Provisioning	Ecosystem	Changes in abundance/biomass and species diversity of plankton	Diatom dominated community (1980's) that will drive a healthy ecosystem	Provision of better scientific understanding for Adaptive Management	monitoring/assessment/prediction
Supporting/regulating	Ecosystem	Change in abundance/biomass and species diversity of benthic community	High species diversity in benthos (1992)	Provision of better scientific understanding for Adaptive Management	monitoring/assessment/prediction
Supporting/regulating	Ecosystem	Increased frequency of HABs	Historical reference year of 1990's	< 5 events on each coast	HAB inlcudes high biomass algal bloom
Provisioning	Ecosystem	Loss of benthic habitat in coastal areas.	(covered by biodiversity)		
Provisioning	Biodiversity	Changes in abundance and diversity of endemic and endangered spp.	Current populations/distributions of endangered and endemic spp.	Maintain and improve current populations/distributions and genetic diversity of endangered and endemic spp.	Reduce human impact , reduce bycatch of endangered spp
Provisioning	Biodiversity	Habitat loss and degradation (1)	Maintain current habitat area of tidal flats (excluding current approved projects)	Maintain current habitats according to standards and regulations of 2007	According to Chinese and Korean functional zoning plans
Supporting/regulating	Biodiversity	Habitat loss and degradation (2)			
Cultural	Biodiversity	Habitat loss and degradation (3)			

Annex VI

Programme for First Yellow Sea Regional Science Conference

GEF

UNDP/GEF PROJECT ENTITLED "REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM"

First Yellow Sea Regional Science Conference

Ecosystem Carrying Capacity of the Yellow Sea: Scientific Approaches for Marine Environment Management

Hangzhou, China, 14th-16th August 2007

PROVISIONAL PROGRAMME

Call for Abstracts

The Conference Organising Committee is now looking for speakers to present papers during the First Yellow Sea Regional Science Conference. For more details on the Conference, please see the website at: http://www.yslme.org/. If interested, please submit a one-page abstract in MS Word format (maximum 300 words), describing topics and contents of the paper with contact information (e.g., Author's name, title and organisation). The abstract submission format is available at: http://www.yslme.org/.

Approximately 10 speakers will be invited to present their papers at the Conference, in addition to other existing 19 speakers who are already invited already. Contributions from young scientists are welcomed. Funds are available, though they are limited, to cover the costs of travel and/or accommodation for the invited speakers. For those participants not selected give a presentation, a poster session may be organised if required..

The abstract should be submitted to the UNDP/GEF Yellow Sea Project by email: info@yslme.org. Please title the email "Regional Science Conference: Abstracts for Contributing Paper Presentation." The deadline for the abstract submission is **15th June, 2007**.

DAY 1 – 14TH AUGUST 2007		
09:00 – 09:30	**Opening of the Regional Science Conference**	
	Welcome address of the Government of China	
	Opening remark of the Government of Republic of Korea	
	Welcome Speech of Local Government	
	YSLME Project Manager's Address	
	Group Photo	
09:30 – 10:50	**Keynote Speeches**	
9:30 – 10:00	Scientific Implication of Carrying Capacity of Ecosystem in the Management	Shinjae Yoo, ROK
10:00 – 10:30	Physical Environment Supporting Carrying Capacity of Ecosystem in the Yellow Sea	Fangli Qiao, PRC
10:30 – 10:50	Lessons learned from Benguela LME	TBD
10:50 – 18:00	**Session 1: Yellow Sea Ecosystem's Provisioning Services**	
10:50 – 11:15	Variations of Commercially Important Fishery Resources in the Yellow Sea	Xianshi Jin, PRC
11:15 – 11:40	Status and management issues of fisheries in the Yellow Sea	Jang-Uk Lee, ROK
11:40 – 12:05	Disease control and prevention in mariculture	Soogil Park, ROK
12:05 – 12:30	Case Study of Sustainable Mariculture in Sanggou Bay	Jianguang Fang, ROK
12:30 – 14:00	Lunch	
14:00 – 14:25	Contributed paper (20 mins.)	
14:25 – 14:50	Contributed paper (20 mins.)	
14:50 – 15:15	Contributed paper (20 mins.)	
15:15 – 15:35	Coffee Break	
15:35 – 16:00	Contributed paper (20 mins.)	
16:00 – 16:25	Contributed paper (20 mins.)	
16:25 – 16:50	Contributed paper (20 mins.)	
16:50 – 18:00	Session Discussion	
DAY 2 – 15TH AUGUST 2007		
09:00 – 16:00	**Session 2: Supporting & Regulating Services of Ecosystem in the Yellow Sea**	
09:00 – 09:25	Variation of community structure at lower trophic levels in the Yellow Sea	Mingyuan Zhu, PRC
09:25 – 09:50	Jellyfish Bloom in the Northwest Pacific: Current Status and Environmental Impacts	Shin-ichi Uye, JPN
09:50 – 10:15	Regional Status of Nutrient Inputs and Distribution in the Yellow Sea	Quan Wen, PRC
10:15 – 10:35	Coffee Break	
10:35 – 11:00	Implications of eutrophication for the Yellow Sea	Hak-kyun Kim, ROK
11:00 – 11:25	Trends of Productivity in the Yellow Sea and Its Implication to Carrying Capacity of Ecosystem	Daeseok Kang, ROK
11:25 – 11:50	Contributed paper (20 mins.)	
11:50 – 12:15	Contributed paper (20 mins.)	
12:30 – 14:00	Lunch	
14:00 – 14:25	Contributed paper (20 mins.)	
14:25 – 14:50	Contributed paper (20 mins.)	
14:50 – 15:40	Session Discussion	

15:40 – 16:00	Coffee Break	
16:00 – 18:00	**Session 3: Cultural Service of Ecosystem in the Yellow Sea**	
16:00 – 16:25	Critical Coastal habitats in the Yellow Sea and Its Contributions to the Ecosystem	Sadayosi Tobai, JPN
16:25 – 16:50	Ecosystem and Education: Educational opportunities of coastal habitats	TBD
16:50 – 17:15	Integration of eco-tourism and nature conservancy	Sung-Gui Kim, ROK
17:15 – 18:00	Session Discussion	
DAY 3 – 16TH AUGUST 2007		
09:00 – 11:00	**Session 4: Good Management**	
09:00 – 09:25	Governance analysis for the LMEs	TBD
09:25 – 09:50	Regional Governance of the Yellow Sea: Analysis and Recommendations	Suh-Yong Chung, ROK
09:50 – 10:15	Cost and Benefit Analysis of Management Actions (mariculture as an example)	Jingmei Li, PRC
10:15 – 10:35	Coffee Break	
10:35 – 11:00	Economic analysis of coastal development: How to incorporate negative externality into management decisions	Sukjae Kwon, ROK
11:00 – 11:30	Session Discussion	
11:30 – 12:30	**Session 5: Summary**	
12:30 – 14:00	Lunch	
14:00 – 18:00	**Session 6: Field Trip**	
14:00 – 18:00	Field Trip	

UNDP/GEF PROJECT ENTITLED "REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM"

UNDP/GEF/YS/AWG.2/3
Date: 20 August 2007
English only

Second Meeting of the Strategic Action Programme Ad-hoc Working Group For the UNDP/GEF Yellow Sea Project
Hangzhou, China, 18-20 August 2007

Meeting Report

TABLE OF CONTENTS

ANNEXES

1 OPENING OF THE MEETING

1.1 Welcome addresses

1.1.1 On behalf of the UNDP/GEF Yellow Sea project, Mr. Yihang JIANG, Project Manager and Chairperson of the Ad-hoc Working Group, opened the meeting and welcomed the participants to the second meeting of the Strategic Action Programme (SAP) Ad-hoc Working Group. He briefly introduced the background of this second meeting, explaining the results of the first SAP Ad-hoc meeting which was organised in Hongchun, Republic of Korea, 10-12 April 2007. Mr. Jiang then stated that the second meeting focuses mainly on identifying the environmental management actions to meet regional targets that were agreed during the first Ad-hoc meeting.

1.1.2 On behalf of the delegation from China, Mr. Fengkui LIANG welcomed the participants to Hangzhou. Mr. Liang pointed out the importance of this meeting. He emphasised that the fruitful discussion during the meeting would be crucial for a successful preparation of the SAP. Mr. Liang hoped that all the participants would try to do their best to produce significant outputs in this meeting.

1.1.3 On behalf of the delegation from Republic of Korea (ROK), Ms. Young Shil KANG joined Mr. Liang to reemphasise the importance of the meeting. Ms. Kang mentioned that the tasks for this meeting are not easy; therefore, she hoped, the participating members should make their efforts to contribute to the meeting.

1.2 Introduction of members

1.2.1 Members and other participants were invited to introduce themselves, and they gave a brief introduction on their background and roles in the Project. The list of participants is attached to this report as Annex I.

1.2.2 The list of documents and the meeting agenda are attached to this report as Annex II and Annex III, respectively.

2 REVIEW OF OUTCOMES FROM THE 1ST AD-HOC WORKING GROUP MEETING ON THE REGIONAL TARGETS

2.1 The Chairperson introduced the background of the meeting, explaining the “SAP Reference Conditions and Regional Targets for Management Actions by 2020” (Document UNDP/GEF/YS/AWG.1/3).

2.2 There was an opinion from the participants that the new findings and recommendations that were presented in the Regional Science Conference (RSC; Hangzhou, China, 14-16 August 2007) should be incorporated into the consideration of management actions to be discussed in this Ad-hoc Working Group meeting.

2.3 The Meeting agreed on this suggestion and decided to include the results of the RSC as much as possible in the management actions.

3 EXPECTED OUTPUTS FROM THE 2ND AD-HOC WORKING GROUP MEETING

3.1 The Chairperson explained expected outputs from this meeting. Mr. Jiang stated that the meeting should discuss and agree on the following five major issues:

- Management actions;
- Demonstration activities and sites;
- Feasibility studies;
- Regional SAP drafting group; and
- National Strategic Action Plans.

3.2 Mr. Jiang mentioned that the meeting is expected to prepare the management actions to meet agreed regional targets, the guidelines to choose appropriate demonstration projects and their sites, and the guidelines to conduct feasibility studies of the proposed management actions. Mr. Jiang also mentioned that the meeting is expected to form a drafting group of the regional SAP and give guidance on how to prepare national SAPs in line with the regional SAP.

3.3 The participants took note of the expected outputs, explained by the Chairperson, to be produced in this meeting.

4 INTRODUCTION OF DOCUMENT, "GUIDELINES FOR PREPARING MANAGEMENT ACTIONS FOR SAP"

4.1 The Chairperson introduced this agenda item, referring to Document UNDP/GEF/YS/AWG.2/2. Mr. Jiang stated that the participants are expected to propose all possible necessary management actions to meet the regional targets. He explained the four components that form management actions: (i) ideal management actions, (ii) analysis of planned and on-going management actions, (iii) feasible management actions by 2020, and (iv) potential demonstration activities. Each component consists of three subcomponents: technical, institutional, and legislative actions.

4.2 The participants noted all the requirements introduced by the Chairperson to prepare the management actions.

5 PRESENTATION BY REGIONAL EXPERTS ON PRELIMINARY MANAGEMENT ACTIONS WITH RESPECT TO THE PROJECT'S OBJECTIVES (BIODIVERSITY, ECOSYSTEM, FISHERIES, POLLUTION, AND SOCIO-ECONOMY)

5.1 The Chairperson invited Mr. Jang-Uk LEE and Mr. Sadayosi TOBAI to present their preliminary management actions.

5.2 Mr. Lee explained his ideas on Fisheries management. For example, Mr. Lee proposed to increase "biomass with a reduction of catch by 30-40% or reducing fishing effort by more than 25% taking into account the 2004 catch and fishing effort" as a technical action to the regional target of "25-30% reduction in catch and fishing effort (2004)." Mr. Lee thought there is a need to prepare, as an institutional action, a plan on how to co-ordinate relevant organisations to implement the technical action. He thought that a legislative action should be taken to legalise the management action.

5.3 Mr. Tobai addressed a wide range of issues, including supporting/regulation and cultural services. Mr. Tobai proposed, for example, the following as feasible management actions to address the regional target of "loss of benthic habitat in coastal areas:"

- To develop a trans-boundary plan for representative network of Marine Protected Areas (MPAs);
- To designate new MPAs to fill gaps in representation;
- To improve capacity of MPA management offices through regional information exchange and cooperation;
- To develop a coordination mechanism across national government agencies and at a transboundary level;
- To develop stakeholder participation mechanisms in MPA management nationally; and
- To showcase well-managed MPAs by designating demonstration MPA sites.

5.4 Having thanked the efforts made by Mr. Lee and Mr. Tobai, the Chairperson mentioned that their ideas serve as good examples to check the logic of the framework for preparing management actions. Mr. Jiang then invited the participants to consider whether this framework is rational, functional, and appropriate for discussing management action in this meeting.

5.5 Having agreed the framework in general, the participants expressed difficulty to separate actions into the three subcomponents because some actions might be categorized into several subcomponents. Given that concern, **the meeting discussed and agreed to add one column, "General Action," to overarch and guide relevant technical, institutional, and legislative actions.** Each proposed technical, institutional, or legislative action should be relevant to a specific general action.

5.6 The meeting also agreed to keep using three subcomponents—technical, institutional, and legislative—because those categories would help the participants examine the actions from various angles.

5.7 With a clear understanding of the framework shared among the participants, the Chairperson suggested to form four sessional working groups according to Biodiversity, Ecosystem, Fisheries, and Pollution. He also suggested forming another group with social scientists, which prepares a procedure of feasibility studies, i.e., the cost-benefit analysis and the political and social acceptability analysis, according to the draft guidelines prepared by PMO.

5.8 **The meeting accepted the Chairperson's suggestion and agreed to form sessional working groups to prepare management actions.** The groups were requested to present the result of the discussion to the plenary session.

6 BRAINSTORMING SESSION: IDENTIFICATION OF MANAGEMENT ACTIONS

6.1 The Chairperson invited the representatives of the small groups to provide the results of their discussion. Mr. Xianshi JIN, Ms. Young Shil KANG, Mr. Sinjae YOO, and Mr. Quan WEN presented their ideas on management actions for Fisheries, Biodiversity, Ecosystem, and Pollution, respectively. After the presentations, the participants provide their comments on each component. Major comments are summarised below.

Fisheries

6.2 About the Fisheries component, Mr. Dong-Oh CHO mentioned that incentive programme, in addition to command-and-control programme, should be included as management actions.

6.3 The Chairperson asked Mr. Cho to provide the Fisheries group with specific incentive activities.

6.4 Having discussed about incentive-based actions, the Fisheries group, Mr. Cho, and Mr. Sang-Go LEE who is familiar with those economic tools agreed not to include the incentive programme as the management actions because the programme is not feasible.

Biodiversity

6.5 Regarding the Biodiversity component's presentation made by Ms. Kang, Mr. Tobai added that the following three points were considered to develop management actions: to conserve species population, to protect habitats, and to increase the effectiveness of existing MPA management.

6.6 Having noticed that China's on-going conservation activities were not included in the Biodiversity's analysis of the planned and on-going management actions, Mr. Jin suggested considering the information provided in the RSC by Mr. Yamin Wang.

6.7 Mr. Mark WALTON mentioned that management actions addressing invasive species should be considered in the Biodiversity component.

6.8 Mr. Jin stated that the concept of MPA is not clearly defined; in other words, MPA might be defined differently depending on country. It is necessary to clarify what MPA means in developing management actions.

Ecosystem

6.9 A comment was made to revise the wording of the regional target of the Ecosystem component to emphasise the management aspect of actions rather than the scientific-work aspect. The comment was accepted, and the target was reworded accordingly, i.e., "provide relevant information to understand and predict ecosystem status."

Pollution

6.10 Following Mr. Wen's presentation on the Pollution component, Mr. Dong Beom YANG added that nutrient inputs from groundwater account for approximately 20-30% of the total nutrient inputs in the Yellow Sea; therefore, he expressed his willingness to include management actions that address the nutrient inputs attributing to groundwater.

6.11 Mr. Sang-Go LEE suggested market-based input reduction programme, such as eco-labelling programme, as a management actions to reduce pollution.

6.12 Mr. Yoo mentioned Si fertilization would be too costly as Si is a macro nutrient and dredging to remove polluted sediments may cause other ecosystem problems; therefore, they are not appropriate as management actions.

6.13 Accepting Mr. Yoo's opinion, the Pollution group decided to delete the both items from management actions. Dr. Wen also mentioned that the pollution component would like to work closely with the Ecosystem component to co-ordinate activities and seek synergy between both components' management actions.

6.14 Mr. Suh-Yong Chung offered to review, with Ms. Ming YU, the institutional and legislative actions of each component from the perspectives of legislation and political science.

6.15 The meeting appreciated Mr. Chung's offer and asked the legal experts to review relevant parts of the management actions prepared by the four natural science components.

6.16 The final version of the agreed management actions is attached as Annex IV to this report.

7 CONSIDERATION ON DEMONSTRATION PROJECTS (E.G., IDENTIFICATION OF RELEVANT MANAGEMENT ACTIONS TO BE DEMONSTRATED, DEMONSTRATION SITES, AND IMPLEMENTATION MECHANISM)

7.1 The Chairperson invited the participants to discuss how to determine demonstration projects and sites. He emphasised that the meeting should focus on the criteria and procedure to select appropriate demonstration activities to show the usefulness and effectiveness of management actions to be included in the SAP.

7.2 The participants proposed possible criteria to choose demonstration projects, mentioning that sites should be decided after the projects are specified.

7.3 The Chairperson suggested organising a small group to discuss the selection criteria on demonstration activities and sites. The meeting agreed on the Chairperson's suggestion. The small group was required to provide discussion results to the plenary session.

7.4 On behalf of the group, Mr. Walton reported the results of the expert group. He introduced eight criteria in order of importance for selecting demonstration projects and four criteria for selecting demonstration sites. Mr. Walton also explained the timing of implementing demonstration projects as well as the procedure of the project and site selections.

7.5 After comments and questions were raised and duly answered, **the meeting agreed on, as guidelines, the criteria and procedure of project and site selection and the timing of implementing selected demonstration projects. The final version of the guidelines for determining demonstration projects and sites is attached as Annex V to this report.** All the comments raised from the participants during the meeting were reflected in this document.

7.6 **The meeting also agreed that the PMO prepare a proposal format.** The advertisement for proposal submission will be made on the Project website with the format.

7.7 As invited by the Chairperson, Mr. Jianguang FANG presented his proposal on the demonstration project for sustainable mariculture, as an example. Mr. Fang proposed to conduct a project in Sanggou Bay, China to demonstrate how the

polyculture and the Integrated Multi Trophic Aquaculture (IMTA) would contribute to producing ecological as well as economic benefits.

7.8 The meeting expressed its gratitude to Mr. Fang for his presentation, and felt that his proposal should be duly considered by the next RWG Fisheries Meeting to identify appropriate projects and sites to demonstrate sustainable mariculture activities.

8 INTRODUCTION OF DOCUMENT "DRAFT GUIDELINE FOR FEASIBILITY STUDY," AND DISCUSSION ON FEASIBILITY STUDIES (E.G., REQUIREMENTS FOR FEASIBILITY STUDIES: NECESSARY EXPERTISE, PERSONNEL, AND WORKPLAN)

8.1 The Chairperson explained the Document UNDP/GEF/YS/AWG.2/4 to introduce the guidelines for feasibility studies. He mentioned that three kinds of feasibility studies—technical, economical, and political and social acceptance analyses—should be conducted to show the applicability, effectiveness, efficiency, and appropriateness of the proposed management actions.

8.2 Mr. Chung presented the results of the sessional group organised to prepare procedures for the cost-benefit analysis (CBA) and the political and social acceptance analysis. He informed the meeting that the sessional group agreed on the target, scale, and methods of the CBA study. Mr. Chung also described that the group thought it was important for economists to work closely with natural scientists to incorporate relevant scientific knowledge. About the political and social acceptance analysis, Mr. Chung explained a methodology to be employed, which includes the public hearings and the summary and analysis of the collected opinions from the hearings. Mr. Chung mentioned that the group agreed to propose that the two feasibility studies should be completed before the submission of the draft SAP to the governments for their considerations.

8.3 Mr. Jiang commented that the CBA is important not only for securing the endorsement on the SAP from the governments, but also for informing the public of the effectiveness and efficiency of the management actions. Mr. Jiang thought that it might be necessary to conduct the CBA in two stages. First, the CBA focuses on selected targets in a relatively small scale; second, the CBA analyses other targets, in a more complete manner, that would be implemented in the implementation of SAP.

8.4 Having thanked the work of Mr. Chung and his group, **the meeting agreed with the proposed guidelines for the feasibility studies. The final version of the guidelines, with all comments from the participants incorporated, is attached to this report as Annex VI.**

9 CONSIDERATION AND AGREEMENT ON THE ESTABLISHMENT AND WORKPLAN OF A DRAFTING GROUP FOR PREPARING SAP

9.1 Having referred to Document UNDP/GEF/YS/AWG.2/7, the Chairperson explained the idea of forming a drafting group to draft the regional SAP. The Chairperson then invited the participants to provide their thoughts on the tasks of the drafting group, the necessary expertise, and the number of group members.

9.2 After some clarifications on the Chairperson's presentation were made, **the meeting discussed and agreed that the drafting group should consist of five members**

with three natural scientists, one social scientist, and the Project Manager. The meeting agreed to invite the following experts to the drafting group: Mr. Chung, Mr. Jin, Mr. Wen, and Mr. Yoo. Those nominated four experts expressed their willingness to join the drafting group, and will try their best to contribute to the successful preparation of SAP.

9.3 The meeting agreed the **tentative dates for the regional SAP Drafting Group meetings are December 2007, February 2008, and May 2008. The special Project Steering Committee (PSC) meeting will be organised in April 2008 to review the draft regional SAP.** The third meeting of the regional SAP Drafting Group should prepare the final SAP, incorporating all the comments from the PSC. The locations of the meetings will be agreed by the drafting group.

10 PREPARATION OF THE NATIONAL YELLOW SEA ACTION PLANS

10.1 Mr. Isao ENDO explained the preparation of National Strategic Action Plans (NSAPs), describing the objectives of developing the NSAPs, the issues to be addressed in NSAPs, and the formulation of NSAP drafting groups. Mr. Endo also explained that drafting of the NSAP should be co-ordinated by NPCs of the relevant efforts. He mentioned that ideally, the final version of NSAPs should be prepared by May 2008 so that both the regional and national SAPs can be submitted at the same time to the governments for their review.

10.2 The participants presented opinions about various issues, including the deadline for NSAPs preparation and the structure of the report. After exchanging views and comments, **the meeting agreed to prepare the final draft of the NSAPs by June 2008** when the Project aims at securing the endorsement of the regional SAP by the governments.

10.3 The meeting also discussed the necessity of the guidelines for NSAP preparation and **agreed that the PMO should prepare the guidelines by the end of year 2007**, consulting with the NPCs and the members of the SAP Ad-hoc Working Group.

11 OTHER BUSINESS

11.1 The Chairperson invited the members to raise any other issues that needed to be considered at this meeting. There was no other issue raised by the participants of the meeting.

12 ADOPTION OF THE MEETING REPORT

12.1 The Chairperson mentioned that in accordance with precedent, a draft report of this meeting will be prepared by the Secretariat after the meeting and circulated to all the participants for their review. The final version of the report will then be prepared by the Secretariat with all the comments from the participants incorporated.

12.2 The meeting agreed with the Chairperson's suggestion and decided that the participants should review the draft report carefully and provide their comments to the Secretariat.

12.3 All the comments from the participants are incorporated in this meeting report already.

13 CLOSURE OF THE MEETING

13.1 The Chairperson thanked all the participants for their hard work to produce a number of significant outputs, including the management actions for the SAP regional targets, the guidelines for demonstration projects and sites selection, the guidelines for feasibility studies, and the formulation of the regional SAP drafting group.

13.2 Mr. Liang stated that this meeting was conduced successfully and efficiently. He believed that the participants strengthened the co-operative spirit and the friendship between the two participating countries. Mr. Liang hoped to see the delegation from ROK and other relevant organisations again to facilitate the SAP development and implementation.

13.3 Ms. Kang thanked the participants, especially the delegation from China and the Project Manager, for their dedication and contribution to the successful implementation of this meeting. As a result, Ms. Kang thought that the meeting produced more results than expected. She believed that those good results would form a solid foundation for the preparation and endorsement of not only the regional SAP but also the NYSAPs.

13.4 The meeting closed at 10:10 hours on 20th August 2007.

Annex I

List of Participants

Surname in alphabetical order

PARTICIPANTS OF THE MEETING

Mr. Dong-Oh CHO
Research Fellow
Coastal & Ocean Policy Research Division
Korea Maritime Institute (KMI)
1027-4, Bangbae 3-dong, Seocho-gu
Seoul, 137-851, Republic of Korea
Tel: 82-2-2105-2762
Fax: 82-2-2105-2779
Email: oceancho@kmi.re.kr

Mr. Jianguang FANG
Director, Mariculture Ecology and Carrying Capacity Division
Yellow Sea Fisheries Research Institute
106 Nanjing Road
Qingdao 266071
Tel: 86-532-8582-2957
Fax: 86-532-8581-1514
Email: fangjg@ysfri.ac.cn

Mr. Xianshi JIN
Fishery Biologist
Director of Fishable Resources & Ecosystem Management Division
Yellow Sea Fisheries Research Institute
106 Nanjing Road
Qingdao, Shandong, 266071
China
Tel: 86-532-584-9430/583-6344
Fax: 86-532-581-1514
Email: jin@ysfri.ac.cn

Mr. Jang-Uk LEE
Professor, Pukyong National University
#599-1 Daeyeon 3-Dong, Namgu,
Busan, 608-737
Republic of Korea
Tel. 82-51-343-3898
Fax: 82-51-622-3306
E-mail: julee0922@korea.com

Mr. Suh-Yong CHUNG
Professor
/Member of International Committee
College of Law
Myongji University
50-3 Namgajwadong, Seodaemongu,
Seoul, 120-728
Tel: 82-2-300-0818
Fax: 82-2-300-0804
Email: mahlerchung@yahoo.com

Mr. In Kwon JANG
Director
West Sea Mariculture Research Center
National Fisheries Research & Development Institute
Sinjindo-ri 75, Geunheung-myeon, Taean-gun, Chungnam 357-945, Republic of Korea
Tel: 82-41-675-3773
Fax: 82-41-675-7077
Email: jangik@nfrdi.re.kr

Ms. Young Shil KANG
Senior Scientist
Marine Ecosystem Team
NFRDI
408-1 Sirang-ri, Gijang-eup, Gijang-kun
Busan 619-705
Republic of Korea
Tel: 82-51-720-2520
Fax: 82-51-720-2266
Email: yskang@nfrdi.re.kr

Mr. Sang-Go LEE
Faculty of Marine Business and Economics
College of Fisheries Sciences
Pukyung National University
599-1 Daeyeon 3-dong, Nam-gu
Busan 608-737
Republic of Korea
Tel: 86-51-620-6636
Fax: 82-51-621-8168
Email: sglee@pknu.ac.kr

Ms. Jingmei LI
College of Economics
Ocean University of China
23 Hong Kong East Road
Qingdao, Shandong 266077
Tel: 86-532-8590-1559(O)
86-532-8581-2346 (H)
Mobile: 86-138-6395-0669
Fax: 86-532-8590-1560
Email: jingmeili66@yahoo.com

Mr. Fengkui LIANG
Director
Department of International Co-operation
State Oceanic Administration
1 Fuxingmenwai Avenue
Beijing 100860 China
Tel: 86-10-6801-9791
Fax: 86-10-6804-8051
Email: fkliang@soa.gov.cn

Mr. Hongbin LIU
Ocean University of China
5 Yushan Road, Qingdao, Shandong 266003
Tel: 86-532-8203-2533
Fax: 86-532-8203-2833
Email: hliu@qingdaonews.com

Mr. Sadayosi TOBAI
Yellow Sea Ecoregion Planning Programme
Ecoregion Coordinator
WWF Japan
Nihonseimei Akabanebashi Bldg., 6Fl.
3-1-14 Shiba Minto-ku
Tokyo, 105-0014
Japan
Tel: 81-3-3769-1783
Fax: 81-3-3769-1717
Email: tobai@wwf.or.jp

Mr. Dong Beom YANG
Principal Research Scientist
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-6157
Fax: 82-31-408-4493
Email: sjyoo@kordi.re.kr

Mr. Sinjae YOO
Senior Research Scientist
Marine Living Resources Research Division
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-6221
Fax: 82-31-408-5934
Email: sjyoo@kordi.re.kr

Ms. Ming YU
Law School of Ocean University of China
No. 23 Hong Kong Dong Road,
Qingdao, Shandong Province, 266071, China
Tel. 86-532-8598-1335
Fax: 86-532-8598-1335
Mobile: 86- 13964259972
Email: yumingnancy@hotmail.com

Mr. Zongling WANG
First Institute of Oceanography
6 Xianxialing Road Hi-Tech Industrial Park
Qingdao, Shandong 266001
China
Tel: 86-532-8896-7447
Fax: 86-532-8896-7447
Email：wangzl@fio.org.cn

Mr. Quan WEN
Chief Scientist
SOA Key Lab of Coastal Ecosystem and Environment Research
National Marine Environmental Monitoring Center
42 Linghe Street
Dalian, Liaoning 116023
China

Mr. Xuelei ZHANG
First Institute of Oceanography
6 Xianxialing Road Hi-Tech Industrial Park
Qingdao, Shandong 266001
China
Tel: 86-532-8896-7476
Fax: 86-532-8896-7548
Email: zhangxl@fio.org.cn

Tel: 86-411-8478-2522
Fax: 86-411-8478-2522
Email: gwen@nmemc.gov.cn

Mr. Mingyuan ZHU
Professor
First Institute of Oceanography, SOA
6 Xianxialing Road Hi-Tech Industrial Park
Qingdao, Shandong 266001
China
Tel: 86-532-8896-7548
Fax: 86-532-8896-7447
Mobile: 86-136-0898-3422
Email: myzhu@public.qd.sd.cn

PROJECT MANAGEMENT OFFICE (PMO)

Mr. Yihang JIANG
Project Manager
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-7825
Fax: 82-31-400-7826
email: yihang@yslme.org

Mr. Isao ENDO
Environmental Economics Officer
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-7793
Fax: 82-31-400-7826
Email: isao@yslme.org

Mr. Mark WALTON
Environmental Specialist
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-7832
Fax: 82-31-400-7826
Email: mark@yslme.org

Ms. Euidea YUN
IT Specialist
UNDP/GEF Yellow Sea Project
Korea Ocean Research and Development Institute
1270 Sa-dong, Sangnok
Ansan City, Gyeonggi Province 426-744
Republic of Korea
Tel: 82-31-400-7825
Fax: 82-31-400-7826
Email: euidea@yslme.org

OBSERVER

Mr. Hyung-Tack HUH
Sr. Scientist Emeritus, KORDI
Fellow, Korean Academy Of Science & Technology
Chairman, IOC/WESTPAC
Korea Ocean Research and Development Institute
1270 Sa-dong Sangnok-gu Ansan-si
Gyeonggi-do 426-744
Republic of Korea
Tel: 82-31-400-6201

Mr. Songlin WANG
Marine Programme Officer
WWF China
Room 1609, Wen Hua Gong
Beijing Working People's Culture Palace
Beijing, 100006
China
Tel: 86-10 6522 7100 Ext. 3809; 86-139-1067-0753
Fax: 86-10-6522-7300
E-mail: slwang@wwfchina.org

Fax: 82-31-408-5934
Email: hthuh@kordi.re.kr

Ms. Wei ZHENG
Ph.D candidate, Environmental Economics
First Institute of Oceanography, SOA
6 Xianxialing Road, Hi-Tech Industrial Park
Qingdao 266061
China
Tel: 86-10-6801-9791
Fax: 86-138-6394-8740
Email: susan0537@163.com

CHINA OCEAN NEWS (LOCAL CONFERENCE SECRETARIAT)

Mr. Guangsheng GAI
President
China Ocean News
No. 1 Fuxingmenwai
Beijing, China 100860
Tel: 86-10-6804-7740
Fax: 86-10-6803-3233
Email: gsgai@263.net

Ms. Wenhui GE
China Ocean News
1 Fuxingmenwai Avenue
Beijing, 100860 China
Tel: 86-10-6804-7741
Fax: 86-10-6803-3233
Email: gewenhui@163.com

Ms. Chenmeng ZHAI
China Ocean News
1 Fuxingmenwai Avenue
Beijing, 100860
China
Tel: 86-10-6804-7741
Fax: 86-10-6803-3233
Email: chinaoceannews@hotmail.com

Annex II

List of Documents

Working Documents	
UNDP/GEF/YS/AWG.2/1	Provisional Agenda
UNDP/GEF/YS/AWG.2/2	Guidelines for Preparing Management Actions for SAP
UNDP/GEF/YS/AWG.2/3	Report of the Meeting
UNDP/GEF/YS/AWG.2/4	Draft Guideline for Feasibility Study
UNDP/GEF/YS/AWG.2/5	Preliminary Management Actions with respect to the Project's objectives
UNDP/GEF/YS/AWG.2/6	Guidelines for Identifying Demonstration Projects
UNDP/GEF/YS/AWG.2/7	Proposal on establishment and workplan of a Draft Group for Preparing SAP
Information Documents	
UNDP/GEF/YS/AWG.2/inf.1	Provisional List of Documents
UNDP/GEF/YS/AWG.2/inf.2	Provisional List of Participants
UNDP/GEF/YS/AWG.1/3	Report of the "First Strategic Action Programme Ad-hoc Working Group"
UNDP/GEF/YS/AWG.1/4	Draft Structure of SAP for the Yellow Sea
UNDP/GEF/YS/AWG.2/inf.3	Draft Environmental Valuation Guidelines

Annex III

Agenda

1. Opening of the Meeting

2. Review of outcomes from the 1st Ad-hoc Working Group meeting on the Regional Targets

3. Expected outputs from the Meeting

4. Introduction of Document, “Guidelines for Preparing Management Actions for SAP”

5. Presentation by regional experts on preliminary management actions with respect to the Project’s objectives (Biodiversity, Ecosystem, Fisheries, Pollution, and Socio-economy)

6. Brainstorming session: Identification of management actions

7. Consideration on demonstration projects (e.g., identification of relevant management actions to be demonstrated, demonstration sites, and implementation mechanism)

8. Introduction of Document “Draft Guideline for Feasibility Study,” and discussion on feasibility studies (e.g., requirements for feasibility studies: necessary expertise, personnel, and workplan)

9. Consideration and agreement on the establishment and workplan of a drafting group for preparing SAP

10. Preparation of the National Strategic Action Plans

11. Other business

12. Adoption of the Meeting Report

13. Closure of the Meeting

Annex IV

Agreed Management Actions for SAP Regional Targets with Respect to the Project's Objectives of:

Biodiversity – IV-1

Ecosystem – IV-2

Fisheries – IV-3

Pollution – IV-4

Biodiversity Management Action

Problems identified in CCA	"Problem Issue"	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned & On-going Management Actions			Feasible Management Actions by 2020						Technical Feasibility	Remark
				Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Feasibility	Institutional	Feasibility	Legislative	Feasibility		
Changes in abundance and diversity of endemic and endangered spp.		Maintain and improve current populations/distributions and genetic diversity of endangered and endemic spp.(Reduce human impact , reduce bycatch of endangered spp)	Regional Conservation Plan for endemic and endangered (E&E) species.	**Act. 1) Establish regional converstion plan**	**Create regional mechanism for coorperation and national mechanism for coordition**	**Regional conservation plan and National laws**	PRC: ? ROK: regular monitoring on **marine organisms including** some mammals	**PRC: ?** ROK: National mechanism to co-ordinate between governments and Institute for mammals	PRC: ? **ROK: National law and enforcement**	**Act. 1) Establish regional converstion plan**	M	**Create regional mechanism for coorperation and national mechanism for coordition**	M	**Regional conservation plan and National laws**	M		
				Act.2) Establish regular regional monitoring of populations/distributions and genecit diversities of E&E spp.	Create **regional mechanism for coorperation and national mechanism for coordition**	**Regional conservation plan and National laws**	Some on birds, PRC: limited monitoring, ROK: regular monitoring **on marine organisms** including some mammals	**PRC: SOA & scattered in other agencies,** ROK: National mechanism to co-ordinate between government and Institute for mammals	PRC: National legislation exists **ROK: National law and enforcement**	Establishing regular regional monitoring of populations/distributions and genecit diversities of E&E spp.	M: once minimum	Create **regional mechanism for coorperation and national mechanism for coordition**	M	**Regional conservation plan and National laws**	M		
				Act. 3) Periodically evaluating the effectiveness of the Regional Conservation Plan.	**Create regional mechanism for coorperation and national mechanism for coordition**	**Regional conservation plan and National laws**	Some on birds, PRC: N/A, ROK: **regular evaluating the wet land including** mammals	PRC: SOA & scattered in other agencies, ROK: National mechanism to co-ordinate between government and Institute **for wet land and mammals**	PRC: National legislation exists ROK: National law and enforcement **in some cases**	Periodically evaluating the effectiveness of the Regional Conservation Plan.	M: once minimum	**Create regional mechanism for coorperation and national mechanism for coordition**	M	**Regional conservation plan and National laws**	M		
				Act. 4) Habitat restoration (physically, chemically, biologically)	Creat national mechanisms to co-ordinate between government agencies and stakeholders	develop any new regulation and enforcement based on existing laws or newly developed standards	PRC: preliminary cases, ROK: preliminary cases (Research project for establishing algae ground)	**PRC: N/A** ROK: National mechanism to co-ordinate among governments, Institute and **stakeholders for algae ground**	**PRC: legislations on marine envrionment issues** **ROK: legislations on marine ecosystem conservation and management issues**	Habitat restoration (physically, chemically, biologically)	L	Creat national mechanisms to co-ordinate between government agencies and stakeholders	L	develop any new regulation and enforcement based on existing laws or newly developed standards	L		
				Act. 5) Establishment of new **nature reserve** and MPAs. **(based on what? It is based on institutional action etc))**	Creat national mechanisms to co-ordinate between government agencies and stakeholders	develop any new regulation and enforcement based on existing laws or newly developed standards	PRC: comprehensive plan for new MPAs, ROK: comprehensive plan for new MPAs	**PRC: SOA & scattered in other agencies, ROK: National mechanism to co-ordinate among governments, Institute and stakeholders including NGOs**	**PRC: national laws, ROK: national laws**	Establishment of new **nature reserve** and MPAs.	H	Creat national mechanisms to co-ordinate between government agencies and stakeholders	H	develop any new regulation and enforcement based on existing laws or newly developed standards	H		
				Act. 6) Encourage and strengthen public involvement in the action plans: all secters, including NGOs	**Establish regional and national mechanism for** environmental awareness and educational programms	Develop any enforce ment to enhance **public involvement**	PRC: very limited, ROK: some involvement of NGOs with limited extent	**Environmental awareness and educational programms exist**	**ROK: Comprehensive guidlines**	Encourage and strengthen public involvement in the action plans: all sectors, including NGOs	H	**Establish regional and national mechanism** for environmental awareness and educational programms	H	Develop any enforce ment to enhance **public involvement**	H		
Habitat loss and degradation		Maintain current habitats according to standards and regulations of 2007 (According to Chinese and Korean functional zoning plans)	Regional Guidelines for Coastal Habitat Management	Act. 1) Integrated management for critical habitats	Create regional mechanism for coorperation	Agreement on regional coastal habitat guideline	PRC: marine function zoning, ROK: only in specific areas	limited national co-ordination	PRC: several comprehensive, ROK: several comprehensive	Integrated management for critical habitats	H	Create regional mechanism for coorperation	H	Agreement on regional coastal habitat guideline	H		
				Act. 2) Strictly limiting of new coastal reclamations	Create national mechanisms to corrdinate between government agencies	national laws on coastal habitat management	PRC: a national plan in consideration, ROK: a national plan in consideration **(I though ROK had agreed not to relclaim any more land- Serveral relevant laws to minimize, but no legislation prevent ….)**	**PRC: SOA**	**(ROK - Has legislation prevent new land reclamation?) PRC: "Sea Area use Administration Law" ROK: Law of coastal area management and serveral relevant laws**	Strictly limiting of new coastal reclamations	H	Create national mechanisms to corrdinate between government agencies	H	national laws on coastal habitat management	H		
				Act. 3) Encourage and strengthen public involvement in the action plans: all secters, including NGOs	**Establish regional and national mechanisms** for strengthen awareness and compiliance by local government to the regional guideline	**New policies to promote**	PRC: very limited, ROK: some involvement of NGOs with limited extent	**Environmental awareness and educational programms exist**	**ROK: Comprehensive guidelines**	Encourage and strengthen public involvement in the action plans: all secters, including NGOs	H	**Establish regional and national mechanisms** for strengthen awareness and compiliance by local government to the regional guideline	H	**New policies to promote**	M		
				Act. 4) Assess ecosystem services of well managed critical habitat, including economy losses and gains	Strengthen national mechanisms to co-ordinate between government agencies and stakeholders	Clear national and regional guidelines on assessment	PRC: preliminary cases, ROK: preliminary cases	Limited national co ordination between government agencies and stakeholders	**ROK: Law on the prevention of marine pollution and several relevant laws**	Assess ecosystem services of well managed critical habitat, including economy losses and gains	M	Strengthen national mechanisms to co-ordinate between government agencies and stakeholders	M	Clear national and regional guidelines on assessment	M		
				Act. 5) Integrated management of different components to sustain social-economic development: demonstration	**Establish mechanism to integrate and sharing of data among components, demonstration project(s)**	**Agreement on sharing data among components**	PRC: **plan in consiteration**, ROK: plan in consideration	**ROK: Sharing data in limited components**	**ROK: Guidelines for sharing data**	Integrated management of different components to sustain social-economic development: demonstration	H	**Establish mechanism to integrate and sharing of data among components, demonstration project(s)**	H	**Agreement on sharing data among components**	H		
			Regional Plan for MPAs	Act. 1) Establishment of new nature reserves at **national level**	Create regional mechanism for coorperation	**National law**	PRC: comprehensive plan for new MPAs, ROK: comprehensive plan for new MPAs	**PRC: SOA & scattered in other agencies ROK: National mechanism to co-ordinate among governments, Institute and stakeholders including NGOs**	**PRC: national laws, ROK: National laws**	**Establishment of new nature reserves [at the regional level?]**	H	Create regional mechanism for coorperation	H	Agreement on regional plan for MPAs	H		
				Act. 2) Better management of existing nature reserves**(incl. capacity building, sustained funding)**	Create national mechanisms to corrdinate between government agencies	national laws on **nature reserves**	PRC: UNDP Yancheng Project, ROK: UNDP Korea Wetland Project	**ROK: National mechanism to co-ordinate among governments, Institute and stakeholders including NGOs in the limited area**	**PRC: national laws on nature reserves ROK: National laws**	Better management of existing nature reserves	H	Create national mechanisms to corrdinate between government agencies	H	national laws on MPAs	H		
				Act. 3) Reduce pollution in and around critical habitats (Refer to Pollution Group)	Create mechanism for transboundary MPAs management	**Refer to Pollution Group**	**Refer to Pollution Group**	**Refer to Pollution Group**	**Refer to Pollution Group**	Reduce pollution in and around critical habitats (Refer to Pollution Group)	H	Create mechanism for transboundary MPAs management	L	**Internationally accepted regulation(s) on transboundary MPAs [note: are you suggesting to introduce globally accepted regulations???]**	L		
				Act. 4) Encourage and strengthen public involvement in the action plans: all secters, including NGOs	Create mechanism on sustainable finacing for MPAs	**New policies to promote**	PRC: very limited, ROK: some involvement of NGOs with limited extent	Environmental awareness and educational programms exist	**ROK: Comprehensive guidlines**	Encourage and strengthen public involvement in the action plans: all sectors, including NGOs	H	Create mechanism on sustainable finacing for MPAs	H	**[don't need anything?]**			
				Act. 5) Identify priority habitats for MPAs	Establish regional and **national** co-operative mechanism to share information & data	Clear regional guidelines on identification	**PRC: N/A ROK: Comprehensive plan for identification**	**PRC: N/A ROK: National mechanism to co-ordinate among governments, Institute and stakeholders for algae ground**	**PRC: N/A ROK: Comprehensive guidelines**	Identify priority habitats for MPAs	H	Establish regional co-operative mechanism to share information & data	H	Clear regional guidelines on identification	H		
				Act. 6) Assess effectiveness of MPAs on habitats and populations	Establish regional and **national** co-operative mechanism to share information & data	Clear regional guidelines on assessement	**PRC: N/A ROK: N/A**	**PRC: N/A ROK: N/A**	**PRC: N/A ROK: N/A**	Assess effectiveness of MPAs on habitats and populations	M	Establish regional co-operative mechanism to share information & data	M	Clear regional guidelines on assessement	M		
		Reduce risk from invasive spp.	**Ballast water control**	**Control and monitoring of ballast water treatment and discharge**	**Regional mechanism for coorperation and national mechanism for coordination**	**International/regional agreement and national legislations**	**PRC: yes, ROK:Yes**	**PRC: yes, ROK:Yes**	**International/regional agreement and national legislations**	**Control and monitoring of ballast water treatment and discharge**	**M**	**Regional mechanism for coorperation and national mechanism for coordination**	**H**				
			New spp. introduction Control	**Precautionary introduction and strict control of alien spp.**	**Mechanism to conduct risk assessment**	**Strengthen legislation on invasive spp. Issues**	**PRC: yes, ROK:Yes**	**PRC: in consideration, ROK: established**	**legislation on species introduction & quarantine**	**Precautionary introduction and strict control of alien spp.**	**H**	**Mechanism to conduct risk assessment**	**H**	**Legislation on invasive spp. Controls**	**H**		

Ecosystem Management Action

Problems identified in CCA	"Problem Issue"	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned & On-going Management Actions			Feasible Management Actions by 2020			Technical Feasibility	Remark
				Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Institutional	Legislative		
Ecosystem changes (lower trophic level and benthos)		Provide relevent information to understand and predict ecosystem status	Assess and monitor the impact of N/P/Si change	harmonized and coherent monitoring methodologies	Establish cross-basin monitoring network	**[note: noting needed???]**	countries have different sampling methods and seasons; regular survey only cover limited area; not designed to reveal basin-scale changes	no cross-basin monitoring due to lack of co-ordination among different agencies;[note: is this institutional????]		harmonized and coherent monitoring methodologies	Establish cross-basin monitoring network	**[note: noting needed???] regional agreements for joint monitoring?**		
			Assess and monitor the impact of climate change	harmonized and coherent monitoring methodologies	Establish cross-basin monitoring network	**[note: noting needed???]**	ditto	lack of taxonomists [note: did not understand] seems misplaced for impact of climate change; move to technical? Unless it's a need for more funding to train taxonomists		harmonized and coherent monitoring methodologies	Establish cross-basin monitoring network	**[note: noting needed???]**		
			Monitor the tranboundary impact of jellyfish blooms	develop monitoring methodologies	Establish monitoring network	**[note: noting needed???]**	ditto			develop monitoring methodologies	Establish monitoring network	**[note: noting needed???]**		
			Predict ecosystem change in the long run	develop models to predict ecosystem change and its impact on fisheries	establish regional science committee **to do what?**	incorporate the prediction into management policy	**no activities [delete] keep, so reader knows no current efforts are in place**	**no activities [delete] keep, so reader knows no current efforts are in place**		develop models to predict ecosystem change and its impact on fisheries	establish regional science committee **to do what?**	incorporate the prediction into management policy		
			Monitor the tranboundary impact of jellyfish blooms	develop **nat'l and reg'l** monitoring methodologies	Establish international monitoring network	**[note: noting needed???]**	no co-ordinated monitoring	no international monitoring network		develop **nat'l and reg'l** monitoring methodologies	Establish international monitoring network	**[note: noting needed???]**		**combine with Line #22**
			Monitor HAB occurrences	develop **regional?** monitoring methodologies	**[mechanism for] capacity building in HAB monitoring, prediction and management**	**[note: noting needed???]**	monitoring programmes only at national level and scattered among responsible agencies	**conduct periodic monitoring [is this Technical???]**		improve capability in HAB monitoring, prediction and mitigation	**conduct periodic monitoring [Is this Technical???]**	**[note: noting needed???]**		
Increased frequency of HABs	See Nitrogen enrichment and eutrophication	< 5 events on each coast (HAB inlcudes high biomass algal bloom)	See Nitrogen enrichment and eutrophication	control nutrients loading; environment friendy exploitation in coastal waters	**[See; are you saying mechanism to check?]** Nitrogen enrichment and eutrophication	establishing laws to meet the target regulations on HAB management and mitigation	**See Nitrogen enrichment and eutrophication [note: can Technical, Institutional and Legislative same???]**	**See Nitrogen enrichment and eutrophication[note: can Technical, Institutional and Legislative same???]**	**See Nitrogen enrichment and eutrophication[note: can Technical, Institutional and Legislative same???]**	**See Nitrogen enrichment and eutrophication[note: can Technical, Institutional and Legislative same???]**	**See Nitrogen enrichment and eutrophication[note: can Technical, Institutional and Legislative same???]**	**See Nitrogen enrichment and eutrophication[note: can Technical, Institutional and Legislative same???]**		actions for N enrichment should lower HAB events. Combine with above monitoring to ensure target is met.

Fisheries Management Action

Problems identified in CCA	"Problem Issue"	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned & On-going Management Actions			Feasible Management Actions by 2020			Technical Feasibility	Remark
				Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Institutional	Legislative		
Decline in landings of many commercially-important species		25-30% reduction in catch and fishing effort (2004)	Reduce no. of boat/power	**Data linkage between the reduction in fishing effort and and the fish biomass. Boat buy-back and control of new boat building. Reduction of fishing effort to optimum level keep biomass at biological safety**	**Creation of alternative livelihoodsuntil all ex-fishermen have new employment**	**Laws to reduce no of boats/power and licenses, combined with policies to encourage other livelihoods. Subsidies for alternative livelihoods and boat buyback**	**Boat buy-back has already been initiated as has control of new boat building**	**Creatation of alternative livelihoodshas already been initiated**	**Laws to reduce no of boats/power and liscenses, combined with policies to encourage other livelihoods have already been initiated. Subsidies for alternative livelihoods and boat buyback**	**Boat buy-back and control of new boat buildinguntil fishing effort is reduced to the required level**	**Creatation of alternative livelihoods**	**Continued strengthening of thelaws to reduce no of boats/power and liscenses, combined with policies to encourage other livelihoods. Subsidies for alternative livelihoods and boat buyback**		
			Stop fishing in certain areas/ seasons	Identification of closed areas/seasons according to scientific knowledge of fish spp. **Comprehenvise monitoring of illegal fishing activities**	Increase in general public awareness of closed seasons and fishermens awareness of regulations and future benefits. Capacity building for enforcement.**Develop plan for monitoring illegal fishing**	Improvement of regulations. Stop illegal fishing.	Some closed areas during spawning season for selected spp. In China - summer fishing ban. Insufficient knowledge	**Mechanism for Increasing awareness of regulations.**	Conservation acts to protect fish stocks.	**More science based closure of areas and seasons. Summer fishing ban to be continued in China. Limitation of trawling to certain areas. Comprehensive monitoring of illegal fishing)**	**Increased awareness of regulations**	**Conservation acts to protect fish stocks**		
			Incr in mesh size	Identification of optimal size at capture and reduction of by-catch	Increase in public awareness of regulations and future benefits. Capacity building for enforcement.	Improvement of regulations of size limits, monitoring and enforcement. Increase in funding for the enforcement. Stop Illegal fishing	Optimal size at capture is only known for some commercial species	Public awareness of regulations and future benefits is increasing	Some regulation in place but need to improve enforcement.	Improved selectivity of fishing gears.	Increase in Public awareness of regulations and future benefits	Improvement of regulations. Regulations and enforcement to stop Illegal fishing		
			Improvement in Stock management	Use of precautionary approach and ITQ & EBFM based on improved monitoring. Establishment of database and joint stock analysis/ assessment	Coordination between scientists, managers, fishermen, gov depts and regionally. Establish regional organisation.	Self-regulation system by fishermen themselves and community-based management in the coastal areas. Widen the no of species for which landings data is recorded with independent checks	ROK - TAC for limited number of spp. China- Negative growth in landings and summer fishing ban.	Need to improve coordination between scientists, managers, fishermen, gov depts and regionally **→Move to legislative**	**[Some discussion in China for the introduction of community-based fishing regulation. -> needs to be deleted] Widespread in ROK for self-regulation system by fishermen. [No regional organisation-> move to Institutional?]. → OK**	Introduction of ITQ & EBFM based on improved monitoring and assessment.	Improved coordination between scientists, managers, fishermen, gov depts and regionally	Self-regulation system by fishermen themselves and community-based management in the coastal areas. **[Establish regional organisation.-> move to institutional] Improvement in funding [delete] → OK**		
		Rebuilding of depleted fish stocks to normal levels	Rebuilding Stocks	Release of juveniles. Habitat improvement (artificial reef)	Coordination between scientists, managers, fishermen, gov depts and regionally	Improvement of policy and funding for the release **of juveniles** and habitat improvement. Self-regulation system by fishermen themselves and community-based management in the coastal areas.	In China massive release of juveniles of many species but some need for evalutation of effects. In ROK some species released. Habitat improvement many artificial reefs deployed	Limited coordination between scientists, managers, fishermen, gov depts and regionally	**Limited environmental imput into the policy of stock enahancement and habtiat improvement.** Improvement of policy and funding for the release **of juveniles** and habitat improvement . Self-regulation system by fishermen themselves and community-based management in the coastal areas **(in ROK only).**	Contolled release of juveniles based on sound scientific knowledge, **with increase awareness of the genetic impacts.** Habitat improvement to be continued through artificial reef.	Better coordination between scientists, managers, fishermen, gov depts and regionally	Improvement of policy and funding for the juvenile release and habitat improvement **that take into account the environmental impacts.** Self-regulation system by fishermen themselves and community-based management in the coastal areas.		
	Unsustainable maricultural practices	Sustainable/Polyculture/ optimization of the distribution and the cultured spp Improvement culture techniques.	Develop Environmental-friendly mariculture models and technology	Increase implementation of Integrated Multi-trophic Aquaculture (IMTA)	Increase in Public awareness of the benefits of IMTA **[set up a mechanism for public awareness???]**	Use the licenses for the control of farm area and species cultured **(based on carrying capacity models) [note: using the licenses … will be sufficient for an ideal legslative action?] (licenses is the most ideal tools at this time, Jang)**	Integrated Multi-trophic Aquaculture (IMTA) is implemented in some areas in China	**Limited public awareness of the benefits of IMTA [maybe deleted, sounds not an institutional action] (I don't agree)**	**Need to introduce licenses for IMTA practise [is this on-going matter???] (YES) (Ongoing in open sea and land based cultures in Korea- Jang)**	Integrated Multi-trophic Aquaculture (IMTA) is implemented as the major technology. Increase the economic benefit from IMTA **(combined with Carrying capacity MODELS)(I agree, Jang)**	Training and capacity builiding	**Increase the percentage of licenses issued for IMTA in relation to monoculture [dounds like a Technical](maybe rephrase - change of policy so that governement can stipulate the species composition and area occupied)**		
				Move the mariculture from inshore to offshore and innovating the new technologies	**[mechanism to]**Increase in Public awareness of the benefits of offshore aquaculture. Coordination between different ministries, local goverment and private sectors	Legislating the reasonable and acceptable regulations for encouraging the offshore mariculture	**Need to develop (There are some) suitable innovative offshore aquaculture technologies (adapted) to different conditions[note: sounds not on-going] (yes, it is on-going in Korea)I**	**Increase (Limited number of) demonstration sites in commercial scale [note: not sounds pn-going](Yes)**	**Legislating the reasonable and acceptable regulations for encouraging the offshore mariculture [note: not sounds on-going] (limited legislation and regulations for encouraging sustainable offshore mariculture)(Yes)**	**Standard offshore technologies to different conditions are well developed [is this a feasible action to be proposed????] (YES)**	**BAP (Best Aquaculture Practice) demonstration in commercial scale [move to Technical?]**	Standards system and regulations for offshore mariculture are well established		
			Reduce nutrient discharge	Roll out of limited water exchange aquaculture land based systems including recirculating systems. Improvement of articial diet	**[increase: delete] [mechanism for] public awareness of the benefits of articial feeds.**	Laws to regulate nutrients discharge and Policies to discourage use of trash fish	**(There is substantial development in)Limited water exchange aquaculture systems, recirculating systems and improvement of articial diet (. However limited water exchange systems and recirculation systems are only used by very limited numbers farmers.)is being implemented [note: didn't understand!]**	**Increase demonstration sites in commercial scalenote: not sounds pn-going] (No sites to demonstate the benefits of these systems)(Government compensating expense for buying some artificial diet in Korea)**	Preparing laws or regulation to control nutrients discharge and policies to discourage use of trash fish **(in which country)(not in both countries)**	**(The rollout of…)Limited water exchange aquaculture systems and improvement of articial diet is practised in commercial scale [note: didn't understand]**	**BAP (Best Aquaculture Practice) demonstration in commercial scale [move to Technical?]**	Improved laws or regulations to control nutrients discharge and Policies to discourage use of trash fish		
			Effective diseases Control	Develop the diseases diagnosis and control techniques.Establish the network for diseases monitoring system	[add improve?] Coordination between central government, scientists and farmers. Establishing the pre-warning system of diseases	Regulation of notifiable diseases, and quarantine procedures. Regulations for preventing infectious disease transmisson	Diagnosis and control techniques for some diseases developed. The network for diseases monitoring system established	Coordination between central government, scientists and farmers is established. Pre-warning system of diseases needs **[to be improved note: sounds not like on-going]**	**More strict regulation of notifiable diseases, and quarantine procedures is needed. Regulations for preventing infectious disease transmisson is needed [note: sounds not on-going]**	Diagnosis and control techniques for all diseases is established. The network for diseases monitoring system is well operated	Coordination between central government, scientists and farmers is intensified. Pre-warning system of diseases should be operated all time	Application of stricter regulation for controlling diseases.		
Changes in abundance/biomass and species diversity of plankton		Provision of better scientific understanding for Adaptive Management(monitoring/ assessment/prediction)												
Loss of benthic habitat in coastal areas.														
Changes in abundance and diversity of endemic and endangered spp.		Maintain and improve current populations/distributions and genetic diversity of endangered and endemic spp.(Reduce human impact , reduce bycatch of endangered spp)												
Habitat loss and degradation (1)		Maintain current habitats according to standards and regulations of 2007 (According to Chinese and Korean functional zoning plans)												

Pollution Management Action

Problems identified in CCA	"Problem Issue"	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned & On-going Management Actions			Feasible Management Actions by 2020			Technical Fefasibility	Remark
				Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Institutional	Legislative		
Contaminants and their effects (1)	land based sources	1.Meet regulations in Codex alimentarius/ Stockholm Convention / MARPOL	Action 1.1 Monitoring and assessment	regular monitoring of all **pollutant** sources	establish regional monitoring network, and sharing of monitoring data among all agencies	develop new regulation and strict enforcement based on existing laws or newly developed standards in each country	monitoring programmes only at national level and scattered among responsible agencies	**management of input sources and sharing of information not well co-ordinated**	national/regional review of pollution-related conventions (reg'l GA)	continue monitoring programmes nationally, implement regional monitoring programme	**[set up a mechanism for] agreements and methodology to share data**	mandatory review of environmental quality standards every 5 years		
	non-point sources			identification and annual review of "hot spots" **(sources and sinks)**	regional forum for integrated review **on hot spots**		"hot spot" of river discharge identified in Poll. Regional Synthesis			regional forum every 5years , majoring monitoring technology, parameters, assessment on status and trends, main problems, etc. with the monitoring centers and organisations.	**improve national co-ordination of contaminant control through regular IMCC meetings [in the Regional forum?]**	harmonise existing regulation		
	atmospheric sources			**[develop regional guidance or guidelines for water, sediment, organism quality assessment .**	establish coordination mechanism for the management of contaminants	harmonize regional standards or guidelines/guidances	**[water, sediment, organism quality assessment ??? Exist at national levels, but may differ from country to country. No reg'l agreed methods.**		National legislation exist but not harmonized	**regional** research on **using agreed** quality **assessment** criteria		harmonise existing guidances/guidelines		
			Action 1.2 Control of contaminants discharge	**install facilities/equipment** to control or **reduce** industrial discharge		strict regulation	control with existing standards		**national** control standards exist	**regional** monitoring and assessment **of contaminant sources and fate**		**harmonize [better to use "improve"???]exsiting standards (improve existing standards, and harmonize with regional/int'l stds)**		
				reduce automobile emission		strict regulations	control with existing standards		standards and regulations exist	**[monitoring and assessment ???] as above**		**harmonize [better to use "improve"???]exsiting standards ??? as above**		
Nitrogen enrichment and eutrophication	point sources	2. Control of total loading to meet reference point (China will reduce total N loading from point sources 10% every 5 years) **what is the baseline to start the reduction?-input in 2005**	Action 2.1 Control of total loading	routine monitoring of all input sources and loads	**national ministries co-operate with each other and have regular discussions [ministerial level cooperative mechanism to have regular discussions]**	establishing bylaws to meet the target	China: marine environmental monitoring program, ~~environmentalmonitoring program~~	Need improvement of national co-ordination **[mechanism]**	National legislation exist. **Need harmonisation [delete need harmonisation] but legislation is disjointed, or different agencies responsible for similar issues**	data and information exchange	Enhance national co-ordination **[mechanism]**	**harmonise existing regulation among relevant national regulatory bodies**		
	non-point sources						Korea :marine environmental monitoring program, ~~environmental monitoring program,~~ estuarine monitoring program							
	atmospheric deposition						Limited understanding of N transfer from atmosphere to YS	no data and information exchange mechanism		expand research on atmospheric deposition	**provide additional funding to expand atmospheric input research [delete this item] why delete?**	annual review that target will be met for each current 5 yr period		
				environmental capacity to absorb nutrients	**regional working group (need for group to do what? Is this group different from regional forum?)**	**need for?** total-quantity-control regulation	limited understanding of environmental capacity of YS **(to absorb nutrients?)**	Need improvement of national co-ordination mechanism	**requirement from law and regulation [clarify the meaning]**	calculation **of loads** in hot spot area	Regional forum	**putting [total quantity control regulation?] in national planning system**		
				increase treatment ability to reduce discharge according to calculation	**annual IMCC meetings and in planning system[not clear]**	legalise annual check for targets being met	**China: national plan to reduce N 10% in 5 years plan, Korea has strict regulation to control N discharge [China: may reduce N by 10% in 5 years plan; Korea, may reduce N by more than 5% in 5 years]**	no regular IMCC discussions	China: regulation and plans for control of discharge, Korea has strict regulation to control N discharge	Review the current waste treatment facilities; provide recommendation for facility's future development every 5 years, promoting clean production and recycling use, improving treatment system and capacity, new treatment plant construction	regular IMCC discussion or regular inter-provincial discussion	**[improve laws and regulations] on clean production, recycling use, etc.**		
				Control of fertilizer use		**[enact law or regulations] to encourage eco-agriculture**				monitoring and assessment, technical recommendations to do what?, eco-agriculture demonstration		**[set up guidelines or enact law/regulations to] encourage eco-agriculture**		
				reduce emission from automobiles	**[mechanism for] data sharing and planning with relevant agencies**	**implement** total-quantity-control regulation	monitoring programmes only at national level and scattered among responsible agencies	no mechanism for discussion from ocean management agency to other ministries	scattered in law and regulation **what is scattered? The law itself?**	monitoring and assessment, technical recommendations **to do what?**	regular IMCC discussion or regular inter-provincial discussion	**[regulation for] total-quantity-control planning [and regulation: delete]**		**many of these actions are applicable to Line #9**
				reduce current concentrations in sea water	**[share: delete] monitoring data exchange mechansim**	**initiate** environmental-target-control regulation	monitoring programmes only at national level and scattered among responsible agencies	no sharing mechanism	scattered in law and regulation **what is scattered? The law itself?**	monitoring and assessment	regular IMCC discussion or regular inter-provincial discussion	**establish** environmental-targets-control regulation		
			Action 2.2 New approach for treatment of nutrients	use existing or construct additional wetlands to serve as nutrient sink for watersheds	**regular** IMCC discussion	legislation for utilization of wetland	**[coastal wetlands lost due to land reclamation, demo engineering: delete] why delete?**	no discussion mechanism among marine, wetland, wastewater treatment agencies	Korea - no further coastal land reclamation allowed	engineering in suitable site **what kind of engineering?,** monitoring and assessment **of the wetland protection or use of wetland as nutrient sink?**	regular IMCC discussion or regular inter-provincial discussion	regulation **for what?**		
	N:Si ratio - decrease N, increase Si	3.Improve FW seasonal fluxes	Action 3.1 Adaptively **adapt to? Adjust FW according to?** increasing Si concentrations	~~adaptively~~adjust FW fluxes **to the YS**	**cooperative [mechanism among agencies for] planning flux schedules, levels**	**agreed regional** regulations on adjusting FW fluxes	from rivers	no IMCC discussion	no laws and regulations	~~adaptively~~adjusting water flushing sediments **in into or from?** rivers **according to required Si level in YS**	regular IMCC discussion or **regular inter-provincial discussion**	**implement** regulations ~~or acts related~~ **to meet target**		
			Action 3.2 Monitoring and assessment on N:P:Si ratios	regional monitoring and assessment	**[mechanism for] data and information sharing**	**agreed** regional **monitoring** guidelines	national monitoring system	**no integrated monitoring [mechanism?] from different sources eg atmosperic, watershed,etc.**	no regional guidelines/guidance	**implement** regional monitoring program **with agreed regional guidelines**	regular IMCC discussion or **regular inter-provincial discussion**	**need to agree on** regional guidelines/guidance **(is this legislation?)**		
			Action 4.1 Waste reduction	Implement technologies for waste reduction, re-use, recovery, and disposal	**more govt support for recycling enterprises**	Compliance with waste management laws and regulations	Continuous execution of ocean waste collection project	**implement** industry policy and encourage and facilitate adequate funding for control of solid pollutants, including litter in rivers	**some regulation and policy** to support ocean waste reuse enterprises	implement national/regional monitoring programme	**continue env. awareness and education programmes [move to technical ??]**	more regular and stricter enforcement of marine litter laws		
Marine Litter	land based sources	4. Reduced standing stock of litter **from current level** (Increase public awareness; periodic clean ups)		develop regional indicators and monitoring programme	Regional Forum	Clear national & regional guidelines on marine litter	monitoring programmes only at national level	**devise mechanism for combining region-wide with nation-wide monitoring program**	some regulations scattered in law and regulation	regional/national monitoring program	**more govt support for recycling enterprises [delete??? Or to be moved to technical]**	Development of national/regional guidelines on integrated management of marine litter **with coastal management plan**		
	sea based sources		Action 4.2 Marine litter cleaning	cleaning and treatment **(please clarify)**	operational mechanism **(please clarify)**	**need to implement** regulations and acts	youth **awareness** programs **(e.g. beach cleanup, envt'l education) taking place in demo many sites**	**demostration [mechanism????]**	some regulations scattered in law and regulation	cleaning and treating **(please clarify)**	data and information exchange at regional/national/local levels	**[need to have ????] regulations and acts**		
				Need more environmental awareness and education **programs**	**national programs [delete]**	**need to implement** regulations and acts	scattered in different fields and sites **What is scattered?**	**expand env. awareness and education programmes exist [delete] (move to technical?)**	scattered in law and regulation	[[prepare national plannings to implement different programs???]	**national planning [incorporate into the left Technical] plans for cleaning beach and publicity**	**improve regulations and acts related to awareness and education]**		
				See Contaminants and their effects (1), but based on national standards (goes in box below?)										
Cultural	Contaminants and their effects (2)	bathing beach areas	Reduced to nationally acceptable levels											

Annex V

Agreed Guidelines for Demonstration Project and Site Selection

- **Timing of Demonstration Activities**

  Start September 2008 to December 2009

- **Selection Criteria for Demonstration Projects and Sites**

  1. Selection of management actions to demonstrate (criteria are listed in order of importance; actions should satisfy at least some criteria)

     - Effectiveness – easily obtainable results
     - Ease of demonstratability of action - results are easily understood by general public, ease of dissemination
     - Results that help raise public awareness
     - Combination of technical and institutional actions should both be demonstrated
     - Cross component action
     - Transboundary nature of actions
     - Opportunity to cooperate with other projects/organizations
     - Co-financing

  2. Site selection

     - Appropriateness of site to demonstrate management actions
     - Political willingness
     - Stakeholder willingness to participate
     - Replicability in other areas around the region

- **Procedure**

  1. Proposal – to be submitted to the RWG
  2. 2007 RWG - will propose candidate actions and sites considering the criteria above. Justification should be provided.
  3. RSTP – will review and make recommendations
  4. PSC - will decide.
  5. PMO – will draw up contracts in consultation with NPCs

Annex VI

Agreed Guidelines for Feasibility Studies of SAP

- **Deadline of the feasibility studies on costs and benefits analysis and political and social acceptability**

  Two feasibility studies should be completed before the submission of the draft SAP to the governments for their considerations.

- **Cost Benefit Analysis**

  - Target(s) should be selected considering the political and social importance.
  - The scale of the analysis may be small due to the constraints of time and budget.
  - Specific methods (e.g. CVM, TCM) of cost benefit analysis will be decided considering the characteristics of the targets to be selected.
  - Cost effectiveness analysis may be used in addition to the cost benefit analysis, if necessary.
  - Appropriate cooperation with natural scientists needs to be sought to incorporate relevant scientific knowledge into the analysis throughout the process.
  - An expert group should be organized to facilitate the implementation of the const benefit analysis.

- **Political and Social Acceptance**

  - The draft SAP will be circulated to the relevant stakeholders for their reviews and comments.
  - Public hearings (one each in each participating country) will be organized for the public. The formats of public hearings may include the forms of symposium, seminar and etc. Efforts should be made to invite the relevant media.
  - In the public hearings, the political and social acceptance feasibility for selected management action(s), with which the cost benefit analysis will be carried out, need to be addressed.
  - A summary report of the results of the circulation of the draft SAP to the relevant stakeholders as well as the public hearings will be provided.
  - A professional assessment by expert(s) will be added on the results of the circulation of the draft SAP to the relevant stakeholders as well as the public hearings.
  - Political and Social acceptance feasibility study needs to be carried out after the completion of the draft SAP, but before the submission to the participating governments for their considerations.
  - A personnel wished to inform the necessity of including the trend analysis in the feasibility study to the RWG-Investment Meeting to be held in October, 2007.
  - The meeting discussed and generally agreed the issues (UNDP/GEF/YS/AWG.2/4, page 3) proposed by the PMO for the political and social acceptance feasibility study.
  - A specific opinion was provided to revised the proposed issues as follows (Document UNDP/GEF/YS/AWG.2/4, p. 3):

    - Have all relevant stakeholders been identified and fully consulted?

      The national and regional governance analyses provide information and results on the stakeholders' relationships to each management action. Based on the information, there is a need to check whether [all, suggested to be deleted.] the relevant stakeholders that would be affected by the management actions have been

identified, [and, suggested to be deleted] are fully aware, [and agreed, suggested to be added] of the management actions [and their impacts, suggested to be deleted]. It is expected that NGOs involved in the Project would assist in this respect.

- **Procedure for the next steps**

  - The meeting agreed to discuss the detailed plans for cost benefit analysis and political and social acceptance feasibility study in the next RWG-Investment Meeting to be held in October, 2007.
  - Items to be discussed include whether to hire independent expert(s).

Biodiversity Management Action

Problems identified in CCA	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned & On-going Management Actions			Feasible Management Actions by 2020						Technical Feasibility	Remark
			Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Feasibility	Institutional	Feasibility	Legislative	Feasibility		
Changes in abundance and diversity of endemic and vulnerable spp.	Maintain and improve current populations/distributions and genetic diversity of endangered and endemic spp.(Reduce human impact , reduce bycatch of endangered spp)	Regional Conservation Plan for endemic and vulnerable (E&V) species.	Act. 1) Establish regional conservation plan	Create regional mechanism for cooperation and national mechanism for coordination	Regional conservation agreement and National laws	PRC: Sporadic monitoring ROK: regular monitoring on some marine organisms including some mammals	PRC: National conservation system for E & E Spp. ROK: National mechanism to co-ordinate between governments and Institute for mammals	National law and enforcement both PRC and ROK	Act. 1) Establish regional conservation plan	M	Create regional mechanism for coorperation and national mechanism for coordition	M	Establish regional conservation plan and better enforcement of National laws	M	3	There is al ready techincal studies and a willingnes between countries
			Act.2) Establish regular regional monitoring of populations/distributions and genetic diversities of E&E spp.	Create regional mechanism for cooperation and national mechanism for coordination	Regional conservation plan and National laws	some on birds, PRC: Sporadic monitoring ROK: regular monitoring on some marine organisms including some mammals	PRC: SOA & other agencies, ROK: National mechanism to co-ordinate between government and Institute for mammals	PRC: National legislation exists ROK: National law and enforcement	Establishing regular regional monitoring of populations/distributions and genetic diversities of E&E spp.	M (once minimum)	Create regional mechanism for coorperation and national mechanism for coordition	M	Establish regional conservation plan and better enforcement of National laws	M	2	Genetic diversity data is limited and expensive to gather. Similar case for Migratory bird flyways, RWG established and document used for reference
			Act. 3) Periodic evaluation of the effectiveness of the Regional Conservation Plan.	Create regional mechanism for cooperation and national mechanism for coordination	Regional conservation plan and National laws	Some on birds, PRC: irregular evaluation of reserves ROK: regular evaluation of the wet land and mammals	PRC: SOA & other agencies, ROK: National mechanism to co-ordinate between government and Institute for wet land and mammals	PRC: National legislation exists ROK: National law and enforcement in some cases	Periodic evaluation of the effectiveness of the Regional Conservation Plan.	M (once minimum)	Create regional mechanism for coorperation and national mechanism for coordition	M	Establish regional conservation plan and better enforcement of National laws	M	2	Difficulties in regional cooperation and uniformity of methodology. Need to sustain motivation
			Act. 4) Habitat restoration/improvement for E&V spp (physically, chemically, biologically)	Creat national mechanisms to co-ordinate between government agencies and stakeholders	develop any new regulation and enforcement based on existing laws or newly developed standards	PRC: preliminary cases, ROK: preliminary cases (Research project for establishing algae ground)	PRC: SOA and other agencies ROK: National mechanism to co-ordinate among governments, Institute and stakeholders for algae ground	PRC: legislations on marine envrionment issues ROK: legislations on marine ecosystem conservation and management issues	Habitat restoration/improvement for E&E spp (physically, chemically, biologically)	L	Creat national mechanisms to co-ordinate between government agencies and stakeholders	L	Develop new regulation and enforcement based on existing laws or newly developed standards	L	2	Technology is available, but maybe limited in scope and number. Not possible in areas already reclaimed.
			Act. 5) Establishment of new nature reserve and MPAs.	Creat national mechanisms to co-ordinate between government agencies and stakeholders	develop new regulation and enforcement based on existing laws or newly developed standards	PRC: comprehensive plan for new MPAs, ROK: comprehensive plan for new MPAs	PRC: SOA & other agencies, ROK: National mechanism to co-ordinate among governments, Institute and stakeholders including NGOs	PRC: national laws, ROK: national laws	Establishment of new nature reserve or MPAs.	H	Creat national mechanisms to co-ordinate between government agencies and stakeholders	H	develop new regulation and enforcement based on existing laws or newly developed standards	H	4	Already existing plans for new MPAs
			Act. 6) Encourage and strengthen public involvement in the action plans: all sectors, including NGOs	Establish regional and national mechanism for environmental awareness and educational programms	Develop policies and incentives to enhance public involvement	PRC: limited, ROK: some active involvement of NGOs	Environmental awareness and educational programms exist	Comprehensive guidelines and regulations	Encourage and strengthen public involvement in the action plans: all sectors, including NGOs	H	Establish regional and national mechanism for environmental awareness and educational programms	H	Develop policies and incentives to enhance public involvement	H	4	Some worry over public acceptance of new MPAs - especially of stakeholders
Habitat loss and degradation	Maintain current habitats according to standards and regulations of 2007	Regional Guidelines for Coastal Habitat Management	(Initial Action) Identify regional priority habitats prior to establishment of MPAs	Establish regional and national co-operative mechanism to share information	Clear regional guidelines on identification	PRC: a knowledge base that can be used for identification of critical habitats ROK: Comprehensive plan for identification	PRC: N/A ROK: National mechanism to co-ordinate among governments, Institute and stakeholders for algae ground	PRC: Guidelines for MPA establishment include identification of critical habitats ROK: Comprehensive guidelines	Identify priority habitats for MPAs	H	Establish regional co-operative mechanism to share information	M	Clear regional guidelines on identification	M	4	Knowledge and techniques in place
			Act. 1) Devlopment of management plan for critical habitats	Inter-departmental government coordination. Create regional mechanism for coorperation	Agreement on regional guideline for management of critical coastal habitats	PRC: marine function zoning and sea area use plan. ROK: limited to specific areas	limited national co-ordination	PRC: legislation that addresses several aspects. ROK: ongoing legislation for MPAs but not critical habitats	Devlopment of management plan for critical habitats	H	Create regional mechanism for coorperation	H	Agreement on regional guideline for management of critical coastal habitats	H	3	ROK- only general laws on coastal habitat protection exist, special committee are formed for critical issues. PRC - lack of methodology for assessing critical habitats
			Act. 2) Strict limits on new coastal reclamation	Create national mechanisms to coordinate between government agencies	national laws on coastal habitat management	PRC: a national plan in consideration, ROK: a national plan in consideration.	Responsible agencies: PRC: SOA & Ministry of Land resources. ROK - MOMAF and others	ROK - Several relevant laws to minimize further reclaimation, PRC: Law on the Administration of the use of Sea Areas	Restriction on new coastal reclamation according to curent government plans	ROK:H PRC: M	Create national mechanisms to corrdinate between government agencies	H	national legislation on coastal habitat management	H	3	PRC - national coastal reclaimation plan in consideration, increase demand from coastal economy devlopment. ROK: increase in land use
Habitat loss and degradation	Maintain current habitats according to standards and regulations of 2007	Regional Guidelines for Coastal Habitat Management	Act. 3) Encourage and strengthen public involvement in the action plans: all sectors, including NGOs	Establish regional and national mechanisms for strengthen awareness and compiliance by local government to the regional guideline	Develop policies and incentives to enhance public involvement	PRC: limited, ROK: some active involvement of NGOs	Environmental awareness and educational programms exist. ROK: Govermental support for educational programme development	Comprehensive guidelines and regulations for the public involvement	Encourage and strengthen public involvement in the action plans: all sectors, including NGOs	H	Establish regional and national mechanism for environmental awareness and educational programms	H	Develop policies and incentives to enhance public involvement	H	4	As above
			Act. 4) Assessment of ecosystem services from well managed critical habitats	Strengthen national mechanisms to co-ordinate between government agencies and stakeholders	Clear national and regional guidelines on assessment	PRC: preliminary cases, ROK: preliminary cases	Limited national co-ordination between government agencies and stakeholders	ROK: Law on the prevention of marine pollution and several relevant laws. PRC: Legislation on EIA	Assessment of ecosystem services from well managed critical habitat.	PRC: M ROK: H	Strengthen national mechanisms to co-ordinate between government agencies and stakeholders	M	Clear national and regional guidelines on assessment	M	3	Methodology is still being developed

Biodiversity Management Action

Problems identified in CCA	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned & On-going Management Actions			Feasible Management Actions by 2020						Technical Feasibility	Remark
			Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Feasibility	Institutional	Feasibility	Legislative	Feasibility		
		Promote the use of MPAs	Act. 5) Integrate management actions of different project components to sustain social-economic development: demonstration**	Establish mechanism to integrate and sharing of data among components, demonstration project(s)	Agreement on sharing data among components	plan in consideration	Project data are available in National reports		Integrated management of different components to sustain social-economic development: demonstration	H	Establish mechanism to integrate and sharing of data among components, demonstration project(s)	H			4	
			Act. 1) Establishment of more nature reserves at national level. Establish a representative network of MPAs	Create regional mechanism for coorperation. Establishment of MPA network for information exchange.	Strengthen National legislation. Establish regional guidelines on MPAs.	PRC: comprehensive plan for new MPAs, ROK: comprehensive plan for new MPAs	PRC: SOA & other agencies ROK: National mechanism to co-ordinate among governments, Institute and stakeholders including NGOs	PRC: national legislation on MPAs exist, ROK: National laws exist	Establishment of new nature reserves. Establish a representative network of MPAs	H	Create regional mechanism for coorperation. Encourage information exchange with in network.	H	Agreement on regional guidelines for MPAs	H	4	Already plans for new MPAs
			Act. 2) Better management of nature reserves	Create national mechanisms to corrdinate between government agencies (incl. capacity building, sustained funding).	Strengthen enforcement of national regulations on nature reserves	Several Reserves/MPAs	National mechanism to co-ordinate among governments, Institute and stakeholders including NGOs.	PRC: national regulations on nature reserves ROK: National laws	Better management of nature reserves	H	Create national mechanisms to coordinate between government agencies	H	ROK: Strengthen national laws on MPAs PRC: Strengthen National regulations on MPAs	H	4	Plans exist to strengthen laws/regulations on MPAs
			Act. 3) Reduce pollution in and around critical habitats (Refer to Pollution Group)	Refer to Pollution Group	Refer to Pollution Group	Refer to Pollution Group	Refer to Pollution Group	Refer to Pollution Group	Reduce pollution in and around critical habitats (Refer to Pollution Group)	H	See pollution component		See pollution component		3	Plans exist to reduce total pollution load, some worry on the effectiveness of such regulations (refer to Pollution Component)
			Act. 4) Encourage and strengthen public involvement in the action plans: all sectors, including NGOs	Establish regional and national mechanism for environmental awareness and educational programms	Develop policies and incentives to enhance public involvement	PRC: limited, ROK: some involvement of NGOs	Environmental awareness and educational programms exist. ROK: Govermental support for educational programme development	Comprehensive guidelines and regulations for the public involvement	Encourage and strengthen public involvement in the action plans: all sectors, including NGOs	H	Improve environmental awareness and educational programms	H	Develop policies and incentives to enhance public involvement	H	4	As above
			Act. 5) Assess management effectiveness of MPAs	Establish regional and national co-operative mechanism to share information	Clear regional guidelines on assessement	PRC: Plan in consideration ROK: Some surveys in MPAs	PRC: SOA ROK: Some Coordination between Local and National Governments	PRC: Legislation under consideration ROK: Laws recommending assessment	Assess management effectiveness of MPAs	H	Establish regional co-operative mechanism to share information	H	Clear regional guidelines on assessement	H	4	Knowledge and techniques available (but under development in PRC)
	Reduce risk from introduced spp.	Ballast water control	Control and monitoring of ballast water discharge (including treatment)	Regional mechanism for cooperation and national mechanism for coordination	International/regional agreement and national legislations	PRC: yes, ROK: Ongoing project to develop treatment tech and efficient monitoring method	PRC: Bureau of Maritime Affairs, ROK: MOMAF	International/regional agreement and national legislations	Control and monitoring of ballast water discharge (Including treatment)	H	Regional mechanism for coorperation and national mechanism for coordination	H	Improved Enforcement of International regulations	H	3	At present only Canada has monitoring, control is easy. Treatment is difficult
		Control of introduced spp.	Precautionary introduction and strict control once introduced	Mechanism to conduct risk assessment	Strengthen legislation on species introductions	PRC: preliminary risk assessment procedures have been developed, ROK: ongoing project to assess and control introduced spp. (MOMAF). Development of integrated management plan to assess ecosystem risk from Introduced spp.	PRC: MOA, Ministry of Commerce and Trade & Ministry of Forestry. ROK: MOMAF& ME.	legislation on species introduction & quarantine	Precautionary introduction and strict control once introduced	H	Mechanism to conduct risk assessment	H	Strengthen legislation on species introduction	H	3	Difficulty in methodology and increased demand for more species for culture

** Internal project guidline

Problems identified in CCA	"Problem Issue"	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned & On-going Management Actions			Feasible Management Actions by 2020			Technical Feasibility	Remark	Demo acts
				Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Institutional	Legislative			
Ecosystem changes (lower trophic level and benthos)		better understanding and prediction of ecosystem changes for adaptive management	Assess and monitor the impact of N/P/Si ratio change	harmonise monitoring methodologies and assess imapcts	Establish cross-basin monitoring network & implement monitoring activities	develop a regional protocol for marine survey & monitoring; develop regional framework to incorporate the assessment into management policy	countries have different sampling methods and timing; regular surveys only cover limited area; not designed to reveal basin-scale changes; limited assessments	no cross-basin monitoring network due to lack of co-ordination among different agencies	non-harmonised existing national protocol between countries for marine survey & monitoring	harmonise monitoring methodologies and assessment of impacts	Establish cross-basin monitoring network & implement monitoring activities	harmonise national protocol for marine survey & monitoring; develop regional framework to incorporate the assessment into management policy	4	existing national monitoring networks	3
			Assess and monitor the impact of climate change	develop and/ or harmonise monitoring methodologies and assess impacts	Establish basin-scale monitoring network & implement monitoring activities	develop a regional protocol for marine survey & monitoring; develop regional framework to incorporate the assessment into management policy	ditto	no basin-scale monitoring network due to lack of co-ordination among different agencies; insufficient national programmes to train and support taxonomists	non-harmonised existing national protocol between countries for marine survey & monitoring; no regional protocol exists	develop and/ or harmonise monitoring methodologies and assessment of impacts	Establish basin-scale monitoring network & implement monitoring activities; convince relevant government agencies to increase investment on taxonomical research	harmonise national protocol for marine survey & monitoring; develop regional framework to incorporate the assessment into management policy	3	national monitoring network exists, but limited geographical scope & variables	2
			Predict ecosystem change in the long run	develop comprehensive models to predict ecosystem change and its impact on fisheries	establish regional science committee to co-ordinate modelling activities	develop framework to incorporate the prediction into management policy; develop regional framework to incorporate the assessment into management policy	no comprehensive, co-ordinated modelling	no regional body to co-ordinate modelling activities	no existing framework to incorporate prediction into management policy	develop comprehensive models to predict ecosystem change and its impact on fisheries	establish regional science committee to co-ordinate modelling activities	develop framework to incorporate the prediction into management policy	4	basic modelling technology exist	

Problems identified in CCA	"Problem Issue"	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned & On-going Management Actions			Feasible Management Actions by 2020			Technical Feasibility	Remark	Demo acts
				Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Institutional	Legislative			
			Monitor the tranboundary impact of jellyfish blooms	develop nat'l and reg'l monitoring methodologies	Establish international monitoring network	not relevant	no common monitoring methodologies	no international monitoring network	not relevant	develop nat'l and reg'l monitoring methodologies	Establish international monitoring network	not relevant	4	Kor - has monitoring programmes; CHN - increasing damage; int'l interest is high	1
			Monitor HAB occurrences	improve capability in HAB monitoring, prediction and mitigation	establish regional HAB committee to co-ordinate assessment activities	develop regional framework to incorporate the assessment into management policy	monitoring programmes only at national level and scattered among responsible agencies	no regional HAB committee	no existing regional framework to incorporate assessment into management policy	improve capability in HAB monitoring and mitigation	establish regional HAB committee to co-ordinate assessment activities	develop regional framework to incorporate the assessment into management policy	4	on-going monitoring network; serious transboundary issue	
			establish Yellow Sea ecosystem database	Refer to RWG-I	Refer to RWG-I	Refer to RWG-I	Refer to RWG-I	Refer to RWG-I	Refer to RWG-I	Refer to RWG-I	Refer to RWG-I	Refer to RWG-I	4	DB under construction	
Increased frequency of HABs	See Nitrogen enrichment and eutrophication	< 5 events (late 1980s condition) (HAB inlcudes high biomass algal bloom)	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	See Nitrogen enrichment and eutrophication	Refer RWG-P	Refer RWG-P	

"Problem Issue"	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned &			Feasible Management Actions by 2020			Technical Feasibility	Remark
			Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Institutional	Legislative		
	1.Meet requirements in Codex alimentarius / Stockholm Convention / MARPOL	Action 1.1 Monitoring and assessment	regular monitoring of major pollutant sources, including atmospheric deposition; establish regional QA/QC guidelines for monitoring	establish regional monitoring network, and sharing of monitoring data among all agencies	develop new regulation and strict enforcement based on existing laws or newly developed standards in each country	monitoring programmes only at national level and scattered among responsible agencies	management of input sources and sharing of information not well co-ordinated	national/regional review of pollution-related conventions (reg'l GA)	continue monitoring programmes nationally, implement regional monitoring programme; regional workshop every 5years, majoring in monitoring technology, parameters, assessment on status and trends, main problems, etc. with the monitoring centers and organisations	set up a mechanism for agreements and methodology to share monitoring results	mandatory review of environmental quality standards every 5 years	4	nat'l monitoring programmes already exist; both countries already signatories to int'l conventions listed
			identification and annual review of "hot spots" (sources and sinks)	improved co-operation among agencies for the intensive monitoring of hotspots	develop new regulation for pollutant loading from hot spots	"hot spot" of river discharge identified in Poll. Regional Synthesis	CH - total quantity-based watershed management plans; KOR has co-operation among agencies dealing with hotspots	regulations exist, but are limited	establish diagnostic strategy for sources and sinks	regional forum for integrated review on hot spots; improve national co-ordination of contaminant control through regular IMCC meetings	harmonise existing regulation	3	necessary, but capacity to do so is currently limited
			develop regional methodologies for assessment of status & trends of contaminants in water, sediment and organisms; introduce assessment using agreed methodologies to ensure agreed pollution targets are met	establish coordination mechanism for the assessment of contaminants and sharing of ecotoxicological data	harmonise regional protocol	national methodologies exist for marine pollution assessment. No regional agreed methods.	assessments exist, but not well co-ordinated among different agencies	National legislation exist but not harmonised	develop regional methodologies for assessment of status & trends of contaminants in water, sediment and organisms; introduce assessment using agreed methodologies to ensure agreed pollution targets are met	establish coordination mechanism for the assessment of contaminants and sharing of ecotoxicological data	not relevant	3	necessary, but capacity to do so is currently limited
		Action 1.2 Control of contaminants discharge	install facilities/equipment to control or reduce discharge from industrial and municipal sources	establish intensive monitoring and inspection system for all agencies; establish mechanism to promote best available techniques and best environmental practices for related land and sea-based industries	improve enforcement & legislation	control with existing standards	CH - pollutant discharge limits don't include all toxic contaminants; incentives given for self control of pollutant loading; KOR - incentives given for self control of pollutant loading	national control standards exist	update facilities/equipment to control or reduce discharge from industrial and municipal sources; regional monitoring and assessment of contaminant sources and fate	establish intensive monitoring and inspection system for all agencies; establish mechanism to promote best available techniques and best environmental practices for related land and sea-based industries	harmonise national with international requirements of discharge	3	need more funding, technology, policy
	2. Reduction of total loading from point sources from 2006	Action 2.1 Control of total loading	routine monitoring of major input sources and loads	national ministries co-operate with each other and have regular discussions; ministerial level regional cooperative mechanism to have regular discussions	establishing bylaws to meet the target	marine environmental monitoring programmes exist nationally, but limited understanding of N transfer from atmosphere to YS	Weak national co-ordination mechanism; no data and information exchange mechanism	National legislation exist, but is disjointed	routine monitoring of major input sources and loads; data and information exchange; expand research on atmospheric deposition	Enhance national co-ordination mechanism	harmonise existing regulation among relevant national regulatory bodies; annual review that target will be met for each current 5 yr period	4	scientific research already initiated
			implement research on environmental capacity for nutrient assimilation	establish regional workshop to discuss and improve understanding of envtl capacity	establish total-quantity-control regulation	limited understanding of environmental capacity of YS for nutrient assimilation	weak national co-ordination mechanism	CH - insufficiently detailed laws addressing total loading control; KOR - total loading control law & regulation exist for major rivers	calculation of loads in hot spot area	establish regional workshop to discuss and improve understanding of envtl capacity	incorporate total loading control programme in national development plans	3	scientists have different opinion on how to calculate loads
			increase treatment capacity to reduce discharge according to environmental capacity	establish co-ordination between government agencies	legalise annual check for targets being met	China: national plan to reduce N 10% in 5 years plan, Korea has strict regulation to control N discharge	weak co-ordinating mechanism in place	China: regulation and plans for control of discharge, Korea has strict regulation to control N discharge	Review the current waste treatment facilities; provide recommendation for facility's future development every 5 years, promoting clean production and recycling use, improving treatment system and capacity, new treatment plant construction	establish co-ordination between government agencies	improve laws and regulations on clean production, recycling use, etc	4	already happening in many places

"Problem Issue"	Regional target (2020)	General action	Ideal Management Action			Analysis of Planned &			Feasible Management Actions by 2020			Technical Feasibility	Remark
			Technical	Institutional	Legislative	Technical	Institutional	Legislative	Technical	Institutional	Legislative		
	from 2000 levels (China will reduce total N loading from point sources 10% from 2006-2010)		implement best practice use of fertiliser	promote mechansim to implement eco-friendly agriculture	enact law and regulations to encourage eco-agriculture	some monitoring on fertiliser use	weak mechansim to implement eco-friendly agriculture	weak law and regulations to encourage eco-agriculture	monitoring and assessment; technical recommendations on better fertiliser use	implement mechanism to encourage use of organic fertilisers	strengthen law/regulations to encourage eco-agriculture and organic fertiliser use	4	some monitoring already in place
			reduce loading from sea based source	establish co-ordination between government agencies on monitoring and information exchange	initiate environmental-target-control regulation	KOR - current efforts in dredging to remove polluted sediments; CH - limited action in this area	monitoring programmes weakly co-ordinated among responsible agencies; no data sharing mechanism	weakly co-ordinated laws and regulation	monitoring and assessment of sea based sources; practice of sustainable mariculture; dredge to remove polluted sediments	establish co-ordination between government agencies on monitoring and information exchange	initiate environmental-target-control regulation	3	necessary, but contribution from sea based sources is lower than land-based sources, difficult to monitor and assess
		Action 2.2 New approach for treatment of nutrients	use existing or construct additional wetlands to serve as nutrient sink	establish co-ordination between government agencies on monitoring and information exchange	legislation to promote sustainable utilization of wetland	CH - wetlands used as N sink demonstration; KOR many artificial wetlands constructed for use as nutrient sink	limited co-ordinating mechanism among marine, wetland, wastewater treatment agencies	Korea - no further coastal land reclamation allowed; weakly co-ordinated laws and regulation	use existing or construct additional wetlands to serve as nutrient sink	establish co-ordination between government agencies on monitoring and information exchange	legislation to promote sustainable utilization of wetland	3	need funding and technology to maintain wetland
N:Si. Decrease N, Increase Si		Action 2.3 Monitoring and assessment on N:P:Si (refer N loading actions above and RWG-E actions on this issue)										4	existing national monitoring networks
	3. Reduced standing stock of litter from current level (Increase public awareness; periodic clean ups)	Action 3.1 Waste reduction	Implement technologies for waste reduction, re-use, recovery, and disposal	provide more funding opportunities for recycling enterprises	complete compliance with waste management laws and regulations; harmonise with int'l conventions	Continuous execution of ocean waste collection project	implement industry policy and encourage and facilitate adequate funding for control of solid pollutants, including litter in rivers	weak regulation and policy to support ocean waste reuse enterprises	Implement technologies for waste reduction, re-use, recovery, and disposal	provide more funding opportunities for recycling enterprises	more regular and stricter enforcement of marine litter laws; improved compliance with waste management laws and regulations; harmonise with int'l conventions	3	technology exists, but needs higher level of stakeholder environmental awareness
		Action 3.2 Marine litter cleaning	develop regional monitoring programme	establish co-operative mechanism to share data on marine litter	establish clear national & regional guidelines on marine litter monitoring and assessment	monitoring programmes only at national level	weak co-ordination at national level for monitoring; NOWPAP has established regional programme on marine litter	some regulations, but not well co-ordinated	develop and implement regional monitoring programme	establish co-operative mechanism to share data on marine litter	establish clear national & regional guidelines on marine litter monitoring and assessment	4	NOWPAP's regional programme includes YS region
			cleaning of marine litter in YS	develop operational approach for litter removal	establish relevant regulations and acts	youth awareness programs (e.g. beach cleanup, envt'l education) taking place in some areas	limited approaches for litter removal	some regulations, but not well co-ordinated	cleaning of marine litter in YS coastal waters	develop operational approach for litter removal	establish relevant regulations and acts	3	difficult to clean from waters, but easy on land
			Develop & implement regular environmental awareness and education programmes	formalise environmental awareness and education programmes into national plans	establish relevant regulations and acts	limited envt. awareness and education programmes	KOR - NGOs have strong awareness programmes, elementary schools have environment education classes; CH - some programmes	some regulations exist	Develop & implement regular environmental awareness and education programmes	mainstream environmental awareness and education programmes into national plans	establish relevant regulations and acts	4	already happening in KOR elementary schools, other activites already happening in the region
bathing beaches & other recreational waters	4. Reduce contaminants, particularly in bathing beaches and other marine recreational waters, to nationally acceptable levels	4.1 Reduce to nationally acceptable & WHO levels	regular monitoring of recreational waters; information dissemination of monitoring results	government-issued announcement to public about beach closures; co-share monitoring programmes among agencies	enforce monitoring of recreational waters; legalisation of closure of sub-standard recreational waters	national monitoring programmes exist	CH - local government-issued advisories to public about beach closures in some areas; KOR - central govt advisories issued in bathing beaches	guidelines exist for bathing beach water quality	regular monitoring of recreational waters; information dissemination of monitoring results	government-issued announcement to public about beach closures; co-share monitoring programmes among agencies	enforce monitoring of recreational waters; legalisation of closure of sub-standard recreational waters	4	some programmes already happening in the region