

생물다양성 보전과 황해 광역 해양생태계 관리계획

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Biodiversity Conservation and the Yellow Sea Large Marine Ecosystem Project

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요 약

황해 광역 해양생태계(YSLME) 프로젝트의 목적을 소개하고 구체적인 활동을 서술하였다. YSLME는 생산성이 높으나 가장 오염이 많이 되어 있는 곳이기도 하다. YSLME 프로젝트의 목적은 경계진단분석을 통해 파악된 환경문제의 피해를 전략 실행 프로그램(SAP)을 통해 줄이는데 있다. 생물다양성을 위협하는 가장 주요한 원인은 갯벌간척 등을 통한 서식지 훼손이다. 1900년대 초 이래로 한국측 갯벌 40% 이상, 중국측 갯벌의 60% 이상이 훼손된 상태다. 남획과 오염등은 연안환경의 생물다양성 손실을 가져온다. 이 손실을 막기 위한 실행프로그램으로 정치가, 공무원, 과학자, 학생, 일반시민등 다양한 시민계층을 대상으로 환경의식을 고취시키는 캠페인을 벌여왔다. 또한 다른 시민환경단체와 연대하여 황해 파트너쉽을 구성하였다. 환경단체들은 국제기구 단체들과 달리 지역주민과 공고한 네트워크를 가지고 있기 때문에 지역의 환경보존노력을 위한 매우 중요한 파트너로 인식되고 있다. 소규모 지원프로젝트를 통해 환경단체들을 효과적으로 연계시킬 수 있었다. 세계야생동물기금 및 기타 연구기관과 공동연구를 통해 YSLME의 SAP를 수립하기 위한 생물다양성 평가 보고서를 발간하였다. SAP에서는 생물다양성을 위한 지역별 목표를 다음과 같이 설정하였다: 서식밀도 증대, 멸종위기종을 포함한 모든 생물종의 분포와 유전적 다양성 확보, 2007년 표준지침에 의거한 서식지 유지, 외래종 유입 위협의 감소. YSLME 프로젝트의 다음단계는 SAP를 승인하고 이를 성공적으로 이행함으로써 미래세대를 위한 생물다양성을 유지하는 것이다.

Abstract – The paper describes the objectives of Yellow Sea Large Marine Ecosystem (YSLME) project, focusing on procedural and practical aspects. YSLME is a highly productive sea yet possibly one of the most impacted large marine ecosystems, in terms of anthropogenic stressors, due the enormous coastal population. The aim of the YSLME project is the reduction of ecosystem stress through identification of the environmental problems in the Transboundary Diagnostic Analysis (TDA) that are then addressed in the Strategic Action Programme (SAP). One of the major problems found to be affecting biological diversity is habitat modification through wetland reclamation, conversion and degradation. Since the early 1900's more than 40% of intertidal wetlands have been reclaimed in Korea, and 60% of Chinese coastal wetlands have been converted or reclaimed. Damaging fishing practices, pollution and coastal eutrophication have further degraded the coastal environment reducing the biological diversity. To combat this loss, the YSLME project has mounted a public awareness campaign to raise environmental consciousness targeted at all different levels of society, from politicians at parliamentary workshops, local government officer training events, scientific conferences and involvement of scientists in the project research and reporting, to university and high school students in our visiting internship programmes and environmental

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camps. We have also built networks through the Yellow Sea Partnership and by liaising and working with other environmental organizations and NGOs. NGO's are recognised as important partners in the environmental conservation as they already have extensive local networks that can be lacking in international organisations. Effective links have been built with many of these NGOs through the small grants programme. Working with WWF's YSESP project and other academic and research institutions we have conducted our own biodiversity assessments that have contributed to the science-based development of the SAP for the YSLME. Our regional targets for biodiversity outlined in the SAP include: Improvements in the densities, distributions and genetic diversity of current populations of all living organisms including endangered and endemic species; Maintenance of habitats according to standards and regulations of 2007; and a reduction in the risk of introduced species. Endorsement of the SAP and its successful implementation, during the proposed second phase of the YSLEM project, will ensure that biological diversity is here to benefit future generations.

Keywords: Biological diversity(생물다양성), Habitat protection(서식지 보호), Public awareness(대중의식 고취), NGOs(비정부기구), Strategic Action Programme(전략실행프로그램)

1. INTRODUCTION

The Large Marine Ecosystem (LME) concept was introduced by NOAA (National Oceanic and Atmospheric Administration) to describe distinct coastal bodies of water, separated from surrounding seas by oceanographic or physical features. NOAA identified 64 LMEs (eg. Benguela Current, Black Sea & Yellow Sea) and these water bodies are important as they produce 95% of the world's fish catch (Sherman [2006]). However, being coastal seas where populations tend to be concentrated in high densities, they are also heavily impacted by man's activities. To reduce the anthropogenic impact on these important seas more than 16 GEF funded projects have been launched to protect these LMEs.

The UNDP/GEF project entitled "Reducing environmental stress in the Yellow Sea Large Marine Ecosystem" or YSLME project started January 2005 to address some of the transboundary problems in the Yellow Sea and preserve these precious resources. It is scheduled to finish in June 2010 after a six month extension was agreed by participating countries, China and Republic of Korea, to enable a smooth transition from this first phase of the project to the second phase that is under preparation.

This first phase of the project followed the GEF supported use of the Transboundary Diagnostic Analysis (TDA) where priority transboundary problems are identified and the causes analyzed by technical teams established by the participating countries. The problems identified in the TDA are then addressed in the Strategic Action Programme (SAP), which outlines the management actions required to overcome these problems. Both of these documents are available on the project's website (www.yslme.org).

2. THE ENVIRONMENTAL PROBLEMS IN THE YELLOW SEA

The TDA identified five major problems: overfishing; unsustainable mariculture; pollution; changes in ecosystem structure; and habitat modification. Among these, habitat modification has the most direct impact on biological diversity. In the Yellow Sea there are three major drivers causing habitat modification: reclamation; conversion and degradation.

Reclamation has led to the loss of more than 40% of coastal wetlands in R. Korea since the early 1900's (Barter [2002]). Initially, reclamation in R. Korea was carried out on a relatively small scale, but more recently under the Reclamation Act of Public Waters (1962) central government has been responsible for several large scale and controversial reclamation projects such as Saemangeum and Shihwa Lake that have had significant environmental impacts (Moore *et al.* [2001]). Currently, local government is responsible for much of the reclamation as it provides employment, taxes and economic development, and is a convenient way of disposing of city waste (e.g. a massive landfill site for urban waste was planned on Ganghwa's coastal wetlands by the Incheon City government) (Kim [2006]). Initially this conversion of publicly-owned wetlands into privately-owned land was supported by local populations, even though they had little say in the matter, as it was assumed development would increase living standards (Kim [2006]). However there has been an increasingly vocal opposition with the realisation of the value of wetlands in terms of fisheries and the other ecosystem services that it supports (Hwang [1999]).

Conversion, another major driver of habitat modification, is where the ecological function has been changed, in China 60% of Yellow Sea coastal wetlands (Yuan *et al.* [2001]) have been

converted to other uses or reclaimed. In Jiangsu province this a major cause of wetland loss, wetlands have been converted to salt ponds, agriculture and aquaculture. It is estimated that out of the 30,000 km² of wetland that have been generated in Jiangsu province as a result of deposition of sediments in the last 4000 years only 900 km² remain undeveloped (An *et al.* [2007]).

Degradation, is more difficult to discern as it is not as visible, but occasionally there are clues that the equilibrium in the ecosystem has been disturbed, such as the recent macroalgal blooms of *Enteromorpha* off Qingdao just prior to the summer Olympics in 2008, the increasing frequency of harmful algal blooms (UNDP/GEF 2007d) and jellyfish blooms (Cheng *et al.* [2005]; Xian *et al.* [2005]; Purcell *et al.* [2007]). The enormous population growth in the surrounding region and climate change are indirectly driving the degradation of Yellow Sea coastal wetlands (UNDP/GEF [2007d]) though coastal pollution, eutrophication, harmful fishing practices and unsustainable mariculture.

The reclamation, conversion and degradation of intertidal wetlands reduces both the available area and the quality of the resource that the organisms depend on. These coastal wetlands are not only economically important habitats for shellfish fisheries and culture, but many of the commercially important fish species also use these areas as nursery or feeding grounds at some stage in their life cycle. Additionally many endangered bird species depend on these wetlands as feeding and breeding grounds on their migration routes (Bartner [2002]; Barter [2003]). Moreover these wetlands perform important biogeochemical functions such as sediment retention, carbon sequestration, nutrient cycling, prevention of saltwater intrusion and coastline stabilisation.

3. FINDING SOLUTIONS AND BUILDING PARTNERHIPS

The YSLME project is taking a variety of approaches to addressing these problems. One important method is through the involvement of stakeholders on many different levels from parliamentary members, to government officers, scientists, NGOs, universities and research institutions all the way to school children through our "youth programmes".

Although there is a good deal of environmental concern amongst parliamentary members in both China and R. Korea, most have no formal scientific background. To raise awareness of the marine issues of most concern, the YSLME project held

two parliamentary conferences. Prominent scientists gave presentations on a variety of subjects ranging from biological and physical processes in the Yellow Sea, the threats and pressures on resources, the current status and trends in biodiversity, the use of monitoring to understand the environmental changes, the role of parliamentarians in ensuring sustainable use and the use of legislation and law enforcement. After each session a discussion was initiated to ensure understanding and participation. This innovative approach was widely acknowledged to be the very successful.

Key local government officials involved in coastal planning in R. Korea and China were targeted for workshops designed to improve environmental management. The first focused on Multi-Attribute Decision Analysis (an approach to incorporate various issues (economy, environment, and society) into the decision-making process) while the second concentrated on marine spatial planning. These activities improved both awareness of marine environmental issues and the capacity to manage them.

Government and scientific institutions form an important part of the project, initially they were responsible for gathering information on the country reports into the environmental status and trends of the Yellow Sea (UNDP/GEF [2007c]; UNDP/GEF [2007b]) that were integral in the drafting of the TDA (UNDP/GEF [2007a]). This process, and other institutional contracts that are mainly focused on transboundary issues, helps build trust amongst scientists from the different countries as they work along side each other, promotes official recognition of the major transboundary problems and helps set regional priorities for management actions that will be incorporated into the SAP.

The next generations' awareness of the problems faced by the marine environment is ensured through involvement of universities such as Yonsei and Korea University through our visiting internship programme and the hosting of UN model debates, and the participation of high schools through the Youth Programme. Three, two day camps have been organized for groups of high school students from China and Korea involving a mixture of lectures and practical hands-on experience out on the sea shore to raise their environmental awareness.

We also encourage cooperation on environmental issues with a variety of stakeholders from international organizations such as NOWPAP, WWF and PEMSEA to local NGOs such as PGA Wetland Ecology Institute and Birds Korea through the creation of the Yellow Sea Partnership (YSP). We maintain a website where members update each other on events and suc-

cesses, and hold an annual YSP workshop with rotating organizers, to discuss problems, solutions, successes and future events.

However one of the most successful ways of raising awareness is to engage participation of NGO's. NGO's are a highly effective way of encouraging grass root activism that reaches out into local populations in a way that international organizations often find difficult, given the language and cultural barriers. The YSLME project utilizes this resource through a targeted small grants programme with 5 grants awarded each year through a competitive selection process. The programme has evolved, initially in the first year it focused on activities to promote environmental education. In the second year we concentrated on building the capacity of local stakeholders in managing marine and coastal environments. We financed projects such as "Enhancing the ability of the local stakeholders to effectively understand the impacts and technical ways of sustainable mariculture in Sanggou Bay" by the Rongcheng Fisheries Association; "Fishermen's self monitoring of marine litter in Boryeong, Korea" by the Korea Marine Rescue Center; and "Promoting civil participation in coastal conservation utilizing the Muan Tidal flat Center" by the Eco-Horizon Institute. The results are available at www.yslme.org. In the third year we concentrated on "Activities that stimulate the development and adoption of management schemes that improve protection of the marine environment and sustainable resource use in the Yellow Sea". Five projects are currently running including "Improving management of padi fields; habitat of the black face spoonbills" by the PGA Wetland Ecology Institute; "Establishing preliminary guidelines, processes and basic designs for the enhancement, restoration and "Wise Use" of the "Mokpo Urban Wetland" by Birds Korea and a fascinating study by local stakeholders and Nanjing University to create awareness of the environmental impacts of coastal pollution by sharing information with stakeholders coming from the analysis of heavy metal levels in shellfish harvested from the Yancheng Reserve in a project titled "Ecological pre-warning assessment on environmental quality in the core area in Yancheng Biosphere Reserve: heavy metal pollution status of macrobenthos caused by economic development in recent years". The final reports will be available on the website at the end of the year.

Following GEF guidelines, both littoral countries produced an analysis of the environmental status and trends, with specific focuses on pollution, ecosystem, fisheries and biodiversity. These reports detailed the current knowledge on the status of biodiversity: describing man's impact on habitats, and spe-

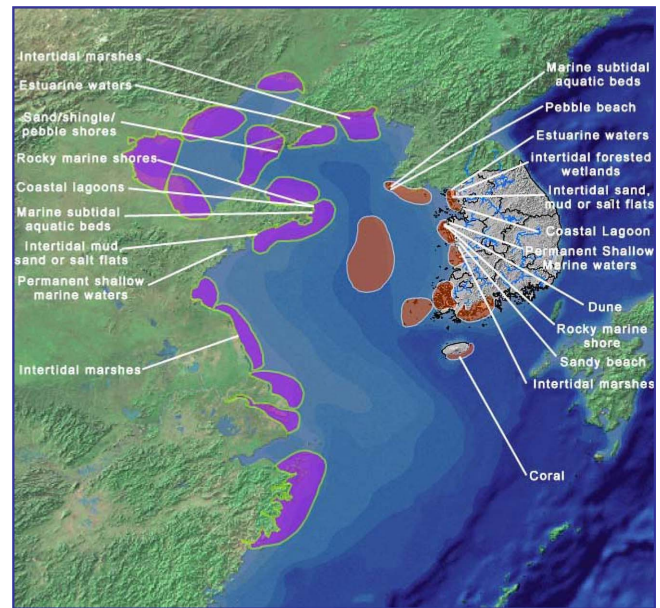


Fig. 1. Critical areas for conservation in terms of the best examples of each of the coastal wetlands habitat types described by the Ramsar Convention overlaid on a map of WWF's Yellow Sea Ecoregion Planning Programme designation of ecologically important areas (EIAs) in purple and orange shading.

cies and genetic diversity. Based on these reports, current literature and WWF's Ecoregion Planning Programme that carried out an analysis of the ecologically important areas based on habitats occupied by representative species from the taxonomic groups, experts in China and R. Korea identified the best examples of each of the coast wetland habitat types described by the Ramsar Convention.

Experts from China and R. Korea classified the coastal habitat around the Yellow Sea according to designation by the Ramsar Convention, each habitat was then scored according to various criteria such as habitat size, connectivity, current and future anthropogenic impact, presence on vulnerable and endemic species to determine the best examples of each habitat type (Fig. 1). Logically each habitat type is an ecological niche, and each niche supports a group of organisms some of which are specifically adapted to living in that environment and some are generalists. Therefore, providing the area is large enough to support viable populations and connected to other habitats to allow genetic exchange, preservation of these diverse habitats should ensure the conservation of biological diversity. The concepts of representativeness, connectivity and adequacy in terms of size, have been central in much of the recent MPA literature (IUCN-WCPA[2008]; UNEP-WCMC [2008]). Moreover, given the insufficiencies of the available data, this method is suggested as the most effective way of identifying areas that are

important in the conservation of biological diversity.

Baseline biodiversity assessments have been performed in the highest scoring of these representative Ramsar habitats. Two sites in China (the Yalu Nature Reserve and the Rongcheng seagrass beds) and three sites in R. Korea have been surveyed (the Han River estuary, the tidal mudflats south of Ganghwa Island, and Garolim Bay) and the results are available on the website (Park *et al.* [2008]; Park *et al.* [2009]; Zhang [2009]). Based on this information and management effectiveness studies carried out in conjunction with the WWF YSESP, one site in each study was selected for demonstration of SAP management actions.

4. FOCUSING LEGISLATION

The SAP is a document that provides solutions for the trans-boundary problems identified in the TDA. It sets concrete targets to be reached by the year 2020, suggests ecosystem based management actions to achieve these targets, and identifies a co-operation & co-ordination mechanism to help oversee the implementation of the YSLME SAP in the form of the YSLME Commission. The objective of the SAP is to improve the Yellow Sea's capacity to provide ecosystem services. These are the supporting, regulating, provisioning and cultural services that are crucial for the economic, health and spiritual wellbeing of the population surrounding the Yellow Sea. The ability to provide these services, called "Ecosystem Carrying Capacity" in the SAP, is being impacted by the aforementioned drivers of ecosystem change: overfishing; unsustainable mariculture; pollution; changes in ecosystem structure; climate change, and habitat modification. To address the transboundary problems affecting supporting services a number of management actions are outlined in the SAP including: The establishment and implementation of a regional conservation plan to preserve biodiversity; the control of further reclamation; the development of regional guidelines for coastal habitat management; the establishment of a network of MPAs; the promotion of public awareness of the benefits of biodiversity conservation; the introduction of the precautionary approach and strict control of introductions of non-native species and the control and monitoring of ballast water discharges. Country specific actions are further detailed in the National Strategic Action Plans (NSAP), drafted by the individual countries.

The YSLME SAP and the National SAPs are currently in the endorsement and approval stages, respectively. Once approved, the countries will be obliged to implement these plans. To

assist in the implementation of the SAP a proposal for approximately US \$ 7 million is being submitted to the Global Environmental Facility (GEF). The objectives of the 2nd Phase is "to foster long-term sustainable institutional, policy, and financial arrangements for effective ecosystem-based management of the Yellow Sea LME, in accordance with the YSLME Strategic Action Programme". The commitment to improve the Yellow Sea's ecosystem health is demonstrated in co-financing commitments from the participating countries of over US \$ 200 million.

We hope that through the implementation of the regional and national SAPs we can improve the capacity of the Yellow Sea to provide ecosystem services and hence improve the fate of biological diversity with in the region and beyond.

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