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Report of Biodiversity Regional Data Synthesis

The results from the activities to collect national biodiversity data and information from China and Republic of Korea were compiled to create a regional synthesis. This work was carried out from February to September 2006. The results of the regional synthesis will contribute to the Biodiversity section of the Transboundary Diagnostic Analysis (TDA).

Wetlands International - China was contracted to prepare the regional synthesis, and the draft final report is attached hereafter. During the 3rd RWG-B Meeting, a representative of Wetlands International will present the results-to-date, highlight the regional status and trends of importance, and show the biodiversity data gaps.

After reviewing the report and presentation, participants will discuss the information presented, and suggest how certain notable data and information could be included in the biodiversity section of the TDA.

Due to the delay in receiving national reports on data and information collection, the preparation of the regional synthesis was also delayed, which in turn, negatively impacted the preparation schedule of the regional TDA.

Report on Status of Biodiversity in the Yellow Sea Ecoregion

First Draft

Reducing Environmental Stress
in the Yellow Sea Large Marine Ecosystem

Sponsor: United Nations Office for Project Services, YSLME

Implementation organization: Wetlands International-China

Content

1 Introduction

The Yellow Sea – a Global Resource

The Yellow Sea is that semi-enclosed body of water bounded by the Chinese mainland to the west, the ROK Peninsula to the east, and a line running from the north bank of the mouth of the Yangtze River (Chang Jiang) to the south side of Cheju Island. It covers an area of about 400,000 km and measures about 1,000 km (length) by 700 km (maximum width). The floor of the Yellow Sea is a geologically unique, post-glacially submerged, and shallow portion of the continental shelf. The seafloor has an average depth of 44 m, a maximum depth of about 140m, and slopes gently from the Chinese continent and more rapidly from the ROK Peninsula to a north-south trending seafloor valley with its axis close to the ROK Peninsula. This axis represents the path of the meandering Yellow River (Huang He) when it flowed across the exposed shelf during lowered sea level and emptied sediments into the Okinawa Trough. The Sea annually receives more than 1.6 billion tons of sediments, mostly from the Yellow River (Huang He) and Yangtze River, which have formed large deltas.

The Yellow Sea is connected to the East China Sea in the south, forming a linked circulation system. Major rivers discharging directly into the Yellow Sea include the Han, Yangtze, Datung, Yalu, Guang, and Sheyang. The Liao He, Hai He, and Yellow River around the Bo Hai have important effects on salinity in the western Yellow Sea, whereas the Yangtze River exerts strong influence on the hydrography of the southernmost part of the Sea. Recent reductions in Yellow River flow have led to changes in hydrography and water circulation, thereby leading to ecosystem changes. All rivers have peak runoff in summer and minimum discharge in winter.

Biotic communities of the south-eastern Yellow Sea are complex in species composition, spatial distribution, and community structure possibly due to the complicated oceanographic conditions of the area. Faunal communities are composed of various taxonomical groups of warm and cold water species as well as cosmopolitan and amphi-Pacific ones. Yet the diversity and abundance of the fauna are comparatively low. Marked seasonal variations are the main characteristics of all components of the biotic communities. Turbidity and sediment type appear to be the major parameters that affect the distribution of planktonic and benthic organisms in the coastal waters of the Yellow Sea.

Although primary productivity is important as a fundamental property of an ecosystem, no reasonable large-scale estimates are available for the Yellow Sea. Existing estimates based on local measurements vary from 68~320 g C m yr (Yang, 1985; Choi et al, 1988, Chung and Park, 1988). The primary productivity of the Yellow Sea seems to vary widely depending on the location and season.

The phytoplankton populations are composed mainly of neritic diatoms. The dominant

species are *Skeletonema costatum, Coscinodiscus, Melosira sulcata,* and *Chaetoceros.* Their composition shows a distinct seasonal shift. Blooms occur in late winter to early spring, and summer to early autumn, and are concentrated to the southern coast of Liaoning and Shandong and the coast of Jiangsu. The average bio-mass in the northern region and the southern region in the sea is 2460 x 10 cellsm or cells/m and 950 x 10 cellsm or cells/m , respectively, lower than that of the Bo Hai and East China Sea . The average benthic bio-mass in the northern Yellow Sea Cold Water Mass and the southern Yellow Sea is 41 g/m and 20 g/ m , respectively. Out of the total benthic bio-mass, mollusks are most important (about 50 percent), echinoderms second (about 20 percent), polychaetes third (about 11 percent) and crustaceans fourth (about 9 percent). Among these bottom animals, most are important food items in the Yellow Sea ecosystem, and some are commercially important species (e.g., fleshy prawn, southern rough shrimp, and Japanese squid).

The fauna of resource populations in the Yellow Sea are composed of species groupings associated with various ecotypes, such as warm water species, warm temperate species, cold temperate species, and cold water species. Warm temperate species in the Yellow Sea fauna are the major components of the bio-mass and account for more than 70 percent of the total abundance of resource populations; warm water species and boreal species account for about 10 percent. The fauna in the Yellow Sea are recognized as a sub-East Asia province of the North Pacific Temperate Zone. Because most of the species inhabit the Yellow Sea year round, the resource populations in the fauna have formed an independent community.

Fish are the main living resource and 276 fish species are found. Of these, 45 percent are warm water forms, 46 percent warm temperate forms, and 9 percent cold temperate forms. The number of species of crustaceans is relatively small—only 54 species—of which warm water and boreal forms account for 65 and 35 percent, respectively. Because of the cold temperature, some warm water shrimps do not enter the northern Yellow Sea (e.g., *Metapenaeus joyneri, Parapenaeopsis tenellus*), while some cold water shrimps are not found in the northern East China Sea (e.g., *Crangon affinis, Crangon orangon*).

The species structure of the fish component of the ecosystem changed during the past 30 years. Overfishing of high quality bottom fish species has led to their replacement by lower value, smaller pelagic species. The project will develop a recovery strategy for depleted fish stocks based on an ecosystem-based perspective.

The cephalopods are composed of only 14 species. Warm water forms and warm temperate forms account for 65 and 35 percent, respectively; there are no cold water species. Of the warm temperature species, Sepia andreana and Euprymna morsei, are endemic to the Yellow Sea and do not appear in the East China Sea. Of about 11 mammal species (e.g., minke whale, sperm whale, humpback whale, fin-less porpoise), most are cold temperature forms (e.g., harbor seal, northern fur seal, Steller's sea cow lion, fin whale, blue whale, right whale, and gray whale). Of these, fin whale and right

whale migrate into the northern Yellow Sea to 39°N in winter and spring, and harbor seal migrate into the northern Bo Hai in winter and spring for reproduction.

The habitats of resource populations in the Yellow Sea can be divided into two groups—nearshore and migratory. Nearshore species include skates, greenline, black snapper, scaled sardine, and spotted sardine. These species are mainly found in bays, estuaries, and around islands, and they move to the deeper waters in winter. The migratory species (e.g., small yellow croaker, hairtail, and Pacific herring) have distinct seasonal movements and some (e.g., chub mackerel, Spanish mackerel, and filefish) migrate out of the Yellow Sea to the East China Sea in winter. The distribution of these two groups often overlaps, especially in over-wintering and spawning periods.

When water temperatures begin to drop significantly in autumn, most resource populations migrate offshore toward deeper and warmer waters and concentrate mainly in the Yellow Sea depression. There are three over-wintering areas: The mid-Yellow Sea, 34 to 37°N, with depths of 60 to 80 m; the southern Yellow Sea, 32 to 34°N, with depths about 80 m; and the northern East China Sea. The cold temperate species (e.g., eel-pout, cod, flatfish, and Pacific herring) are distributed throughout these areas, and many warm temperate species and warm water species (e.g., skates, gurnard, Saurida elongata, jewfish, small yellow croaker, spotted sardine, fleshy prawn, southern rough shrimp, and cephalopods) are also found there from January to March. In the southern Yellow Sea, all species are warm temperate and warm water species (e.g., small yellow croaker, Nibea alibiflora, white croaker, jewfish, Septipinna taty, red seabream, butterfish, and chub mackerel). Their main over-wintering period is from January to April. The deep-water areas of the central Yellow Sea and northern East China Sea are the over-wintering grounds for most species that migrate over long ranges.

Little information is available about the distribution of seabirds in the Yellow Sea area and off the east coast of China, but it is believed not many birds are in the area. Two known birds are the streaked shearwater (Calonectris lecomelas) and the Bulwer's petrel (Bulweria bulwerii), both of which breed off the coast of eastern China. Of the endangered (or possibly extinct) seabirds of China, two live in the Yellow Sea region: 1) The relict gull (*Larus relictus*), which was collected for its breeding plumage. It used to breed near Sogo Nur, Gansu (1931 sightings), and Tanggu, Tianjin (1935 sighting and specimens). There have been no recent sightings; and 2) The Chinese crested tern (*Sterna bernstein*), which was last sighted at Qingdao in 1937. It may be extinct but an unconfirmed sighting of 10 to 20 birds on Thailand in 1980 has raised hopes that it might still be extant.

The dalmatian pelican (*Pelecanus crispus*) is bred inland at Lop jur, Xinjiang Uygur Zizhiqu, but no recent information is available. The saunders' gull (*Laurua saunders*) breeds in the north of China and Mongolia where its breeding grounds are unknown. However, it winters in the southern estuarine areas of Ningho, Zhejiang, and Shanghai. Of 370 bird species identified in ROK, 112 breed there and 17 localities have been designated breeding grounds.

The Yellow Sea, the East China Sea, and the East Sea/Sea of Japan were seasonally occupied by some of the large whales: fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and grey whale (*Eschrichtius robustus*). The grey whale may be part of a nearly extinct northwest pacific population that summers in the Okhotsk Sea. If any of these species are seen in these waters now, they represent just a remnant of the pods that used to migrate and breed there. ROK has designated the grey whale as one of its national treasures. Other endangered marine mammals that live in the region are the black right whale (*Eubalaena glacialis*), whitefin dolphin (*Lipotes vexillifer*), Kurile harbor seal (*Phoca kurilensis*), and Japanese sea lion (*Zalophus clifornianus japonicus*). The striped dolphin (*Stenella coeruleoalba*, northwest pacific stock) is believed exploited beyond sustainable yield.

The Yellow Sea LME is an important global resource. This international water-body supports substantial populations of fish, invertebrates, marine mammals, and seabirds. Many of these resources are threatened by both land and sea-based sources of pollution and habitat loss resulting from extensive economic development in the coastal zone, and by the unsustainable exploitation of natural resources (primarily overfishing). Additionally, there is significant international shipping traffic through the waters of the Yellow Sea, with associated threats from spills and collisions with marine mammals.

In the western Yellow Sea, pollution sources include industrial wastewater from Qingdao, Dalian, and Lianyungang port cities; oil discharged from vessels and ports; and oil and oily mixtures from oil exploration. More than 100 million tons of domestic sewage and about 530 million tons of industrial wastewater from coastal urban and rural areas are discharged into the nearshore areas of the Yellow Sea each year. The major pollutants carried by sewage and wastewater are oils, mercury, cadmium, lead, COD, and inorganic nitrogen.

The eastern Yellow Sea has bad pollution in the shallow inlets of its southern coastline where the many islands prevent mixing with open ocean water and red tides persist. The chaetognatha (*Sagitta crassa* and *S. enflata*) and the copepods (*Acartia clausi, Paracalanus parvus,* and *Centropages abdominalis*) decreased significantly in 1981 compared with 1967 figures due to an increase of marine pollution levels in Jinhae Bay. The area affected included several famous swimming beaches, tourist hotels, and places of interest. Mass mortalities of the hard clam Meretrix lusoria populations in the Jeonbug Farming Area of Gyewhari and Naechodo, in the western region of ROK, were coincident with high densities of the pathogenic bacteria Vibrio anguillarum, the parasitic cercaria Bacciger harengulae, and a high concentration of pesticides. Harmful Algal Blooms (HAB) occurring in the coastal waters off southern and eastern ROK have caused loss to the aqua-culture industry and probably large-scale mortality of natural fin- and shellfish. However, the frequency and the area of the outbreak of HABs in the coastal waters off western ROK (Yellow Sea) are lower than those off southern and eastern ROK. High turbulence intensity and turbidity caused by strong tidal current might inhibit the growth of HAB organisms.

Recently, however, the frequency and the area of the outbreaks have increased in the Yellow Sea coast, particularly, in the area where huge artificial constructions such as an underwater dam or dike were built. The constructions might restrict the circulation of water masses and reduce the turbulence intensity and turbidity. Under this circumstance red tide organisms grow fast and form red tide patches. The number and frequency of the trade ships between western cities in ROK and eastern cities in PRC have continuously increased. Therefore, the transport of red tide organisms in ballast waters might be partially responsible for the increase in the frequency and the area of red tides. Huge discharge from the Yangtze River during the summer monsoon season sometimes reach the southern end of the ROK peninsula, thereby, and might carry the seed organisms or somehow inoculate existing spores.

Ecosystem in stress

The Yellow Sea is a classic example of a semi-enclosed area, but remarkable for its massive population and increasing anthropogenic pressure. Shallow but rich in resources, it is most favorable for coastal and offshore fisheries, and its waters are a highway for international shipping.

Approximately 600 million people (approximately 10% of the world population) live in the area that drains into the Yellow Sea. Large cities near the sea with tens of millions of inhabitants include Qingdao, Tianjin, Dalian, Shanghai, Seoul/Inchon, and Pyongyang/Nampo. People of these large, urban areas are dependent on the Yellow Sea as a source of marine resources for human nutrition, economic development, recreation and tourism.

Throughout the millennia of civilization in East Asia, periods of prosperity have been those in which the nations bordering the Yellow Sea have used the Sea cooperatively and efficiently. Such was certainly the case in the Tang dynasty of PRC, the Silla dynasty of ROK, and the Nara period of Japan. Conversely, when there was bad or inefficient use of this resource, all the coastal nations suffered. As the Yellow Sea coastal countries strive to develop and improve the welfare of their people, an optimal use of Yellow Sea resources could be the beginning of a new era of cooperation.

The commercial utilization of the living resources in the Yellow Sea dates back several centuries. With the introduction of bottom trawl vessels in the early twentieth century, many stocks began to be intensively exploited by PRC, ROK, and Japanese fisherman and some economically important species such as the red seabream declined in abundance in the 1920s and 1930s (Xia 1960). The stocks remained fairly stable during World War II. However, due to a great increase in fishing effort throughout the entire Yellow Sea, nearly all the major stocks were being heavily fished by the mid-1960s. Since then, the composition of the fish catch has changed greatly, and the catch-per-unit-square kilometer has decreased to 2.3 MT in recent years.

The Yellow Sea is one of the most intensively exploited areas in the world. The number of species commercially harvested is about 100 including cephalopods and crustacea.

The abundance of most species is relatively small, and only 23 species exceed 10,000 MT in annual catch. These are the commercially important species and account for 40 to 60 percent of the annual catch. Demersal species used to be the major component of the resources and accounted for 65 to 90 percent of annual total catch. The resource populations of demersal species such as small yellow croaker, hairtail, large yellow croaker, flatfish, and cod declined in bio-mass by more than 40 percent when fishing effort increased threefold from the early 1960s to the early 1980s.

Overfishing has also caused a decline in stock abundance for searobin, red seabream, Otolithoides mijuy, Nibea albiflora, and white croaker. However, under the same fishing pressure, the abundance of some species such as cephalopods, skates, and daggertooth pike-congers appears to be fairly stable. This may be due to their scattered distribution or their tolerant nature.

Shifts in species dominance in the Yellow Sea are outstanding. The dominant species in the 1950s and early 1960s were small yellow croaker and hairtail, while Pacific herring and chub mackerel became dominant during the 1970s. Some smaller-bodied, fast-growing, short-lived, and low-value fish (e.g., Setipinna taty, anchovy, scaled sardine) increased markedly in about 1980 and have taken a prominent position in the ecosystem resources thereafter. As a result, some larger-sized and higher trophic level species were replaced by smaller-bodied and lower trophic level species, and the resources in the Yellow Sea declined in quality. About 70 percent of the bio-mass in 1985 consisted of fish and invertebrates smaller than 20 cm, and the mean body length in the catches of all commercial species was only 12 cm while the mean body length in the 1950s and 1960s exceeded 20 cm. The trophic levels in 1985 and in the 1950s were estimated to be 3.2 and 3.8, respectively. Thus it appears that the external stress of fishing has affected the self-regulatory mechanism of the Yellow Sea ecosystem.

Aquaculture is a major use of the coastal waters of the Yellow Sea. Mariculture is commonly practiced in all coastal provinces of PRC, and it is most advanced in Shandong and Liaoning provinces. In both the Qingdao and Dalian regions the same fishery communes that culture invertebrates also cultivate seaweed. The major species of invertebrates cultured are oysters, mussels, razor clams, cookies, short-necked clams, pearl oysters, scallops, and hard clams.

The area in mariculture in 1978 was 1.48 x 10 ha, and 5.4 x 10 ha in 1997. The yield of fresh flesh from bivalves was 2.0 x 10 t, 44 percent of the total mariculture yield in 1978; in 1997 it was 3 x 10 t. Scallops (*Chlamys farreri*) are luxurious seafood. Sea cucumbers (*Stichopus japonicus*) live below Laminaria and/or Mytilus and are harvested by divers after two years' growth. Meretrix meretrix, Mactra antiquata, Brachydontes senhousei, and Aloidis sp. are also cultured in some regions, and the large Chinese shrimp (Penaeus orientalis) also grows successfully in the coastal regions of the Yellow Sea.

The total yield of invertebrate mariculture of ROK in 1997 was 301,873 metric tons (MT) representing 29.7% of ROK's total mariculture production (1,015,134 MT), including

200,973 MT of oysters (20 percent) and 63,572 MT of mussels (6.3 percent) (MOMAF (Ministry of Maritime Affairs & Fisheries), 1998. Annual Report of Fisheries Trend. 286p.) Major species of mariculture include oyster, mussel, abalone, hard clam, short-necked clam, Cyclina, Mactra, ark shell (*Anadara broughtonii*), pen shell (*Atrina pectinata*), and hen clam (*Mactra sulcataria*). Various abalones (*Haliotis discus hannai, H. discus, H. sieboldi, H. gigantea, H. japonica*) are in high demand.

Seaweed is an important crop in the Yellow Sea. Seaweed grows naturally on the lower rocks of the intertidal/sub-intertidal region; most prefer subtropical conditions. Sargassum pallidum is dominant and Plocamium telfairiae is common in the west Yellow Sea. There, Pelvetia siliquosa is locally abundant. Bryopsis plumosa is a minor species, and Dictyopteris undulata is rare. Pelvetia siliquosa is found on the Shandong Peninsula, the Liaodong Peninsula, and the ROK Peninsula. The seaweed grows more luxuriantly in the ROK waters, and for hundreds of years the Koreans have exported large quantities of this seaweed to PRC. It was sold in North China markets under the name of deer-horn vegetable. The seaweed's availability has declined, and now the seaweed Ishige okamurai and seaweed Sargassum (Hizikia) fusiforme are marketed as substitutes—also called Lujiaocai.

The most important cultivated seaweed in PRC is the brown Laminaria japonica introduced from Hokkaido, Japan. The cold water kelp is now grown in more than 3,000 ha of PRC's coastal waters, with a production of 10,000 dry tons/year. Half of this is consumed directly and half is used for extraction of alginates. There are 15 hatcheries on the north PRC coast, and the young plants are transferred to the growing frames in the sea when the seawater temperature drops below 20°C. L. japonica grows 3-m fronds at Quingdao and 5-m fronds at Dalian where the water cools down more quickly in fall and the growing season is longer. The respective yields are 30 and 50 dry tons/ha/year.

Oil exploration has been successful in the PRC and DPRK portions of the Yellow Sea. In addition, the sea has become more important with the growth in trade among its bordering nations. The main PRC ports are Shanghai, Lu-ta, Tientsin, Qingdao, and Ch'in-huang-tao; the main TOK port is Inchon, the outport of Seoul; and that for DPRK is Nampo, the outport for P'yongyang.

Tourism is an industry in its infancy in both PRC and ROK. Several sites of picturesque beauty around the coastlines of these countries could be promoted as tourist attractions. As access to PRC and ROK becomes easier for foreign visitors, the tourist industry will expand. The Karst coast near Dalian, the granite mountains of the western Liaoning coast in PRC, and the islands and swimming beaches of ROK, in particular Cheju Island, will be in even greater demand.

Past Studies

Studies for the Yellow Sea Ecoregion have been conducting by the governments of China and South Korea, as well as various organizations at either international or regional levels in the past years.

The Cooperation Agreement on Environment Conservation between China and South Korea was signed by the governments of both countries in 1993. As a part of the agreement, ecology conservation in the Yellow Sea has been paid much attention by both countries. Following the positive initiation from the countries, various research institutes and departments have conducted a series of studies and monitoring activities for the Yellow Sea Ecoregion, and relevant reports have been delivered by both countries since 1993.

Wetlands International has organised studies on migratory shorebirds along the Yellow Sea coast (except North Korea) for the past ten years. As a result, at least 40 sties have been identified as international or potentially international significance. Problems on shorebird conservation and related suggestions have been given in the report for each year.

Nature reserves and local environmental organizations along the Yellow Sea have also conducted studies on wetlands monitoring and restoration in their own regions. Data from the activities is the important reference for their future work.

2 Synthesis

2.1 Habitats and their Status

Marine

Deep Water

The category of Deep Water area in this report includes the area where deeper than 20m. The average water depth in the Yellow Sea is 44m, with the range from 20-140m. The deepest area is to the north of Cheju Island with a depth of 140m.

Based on a long time of monitoring and investigation to the Yellow Sea, it is indicated that quality of seawater of Yellow Sea (part) has been worsening due to discharge of wastewater from land-based sources, Ships and Marine Pollution Sources.

Shallow Water

The category of Shallow Water area in this report includes the area which depth is between 6m to 20m. Currently, about 200,000 km^2 coastal area has been polluted in China and their quality is below the 1^{st} class standard. About 40,000 km^2 area of seawater is below 4^{th} class standard and can not meet the requirement of development of mariculture, ports and sea exploitation.

The nutrient salt like gross nitrogen and gross phosphorus in some shallow water areas greatly exceeds acceptable seawater quality levels, and is responsible for causing frequent red tides. The sediments in part of bays have been contaminated by heavy

metals. Moreover, organisms have been affected by heavy metals and petroleum hydrocarbons. Serious impact of water pollution on the ecological function of the coastal areas in the System would continue in the future.

Coastal

Coastal areas serve as the spawning as well as nursery grounds for resident species of the Yellow Sea. Many migratory species, such s skates and pomfrets, migrate seasonally between coastal and offshore areas.

Tidal

The Yellow Sea is in semi-open shape. Influenced by the effect of underwater relief and the reflection of coast, the tide wave from the Pacific is resulted in diversified features. Tides in the Yellow Sea coast are mainly regular semidiurnal tide except in the coast of Yalujiang River Mouth, Chengshanjiao non-tide spot and North Jiangsu non-tide spot, where tides are mainly irregular semidiurnal or irregular diurnal tide.

The tidal currents of the Pacific Ocean runs from the south to the Yellow Sea. Because of the topography of Liaodong Peninsular, some of the tidal currents run to Yalujiang River Mouth and Liaodong Bay. Due to the tide is deflected by the earth's rotation to the right, in an anti-clockwise direction, some of the tide go to the east and southeast. The tidal range is much greater in Korea than in China. The high tides are higher in summer and in autumn than in winter and spring.

Coastline

Most coasts in Yellow Sea Ecoregion are plain coasts, with extensive tidal flats, except those rocky coasts in Liaodong Peninsular and Shandong Peninsular in China and Kyeungnam Do, Cheju Do, Busan Shi and Chollanam Do in South Korea.

The dynamics of coast in the Yellow Sea is decided by the amount of silt adopted by coasts of different section and the strength of marine power and their mutual interaction process. The dynamic state and evolution of coast had changed in terms of space and time, and the changes are normally shown in three types: silting, erosion and relative stable states; and in long-time and short- time changing cycles.

Wetlands

Wetlands are: "Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static, flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six metres." This definition encompasses reef flats and seagrass beds in coastal areas, through mudflats, mangroves, estuaries, rivers, freshwater marshes, swamp forests and lakes, as well as saline marshes and lakes.

Wetlands in the Yellow Sea include marshlands, lakes, periodic waters, rivers, sandy foreshores, lagoons, muddy foreshores, saline mudflats, estuaries, sand and gravel bottom, etc.

Marshlands: Total area of the marshlands was observed to decrease around 30% over the past 30 years. Documents had recorded obvious indications in the alteration of ecosystems and in the goods and services that they can offer of the marshlands. Such significant alteration in the ecosystems was the effects of increased urbanization, economic activities and accompanying pollution.

Standing waters (lakes): A decrease of 30% of the total surface area of lakes occurred over the past 30 years. Persistent eutrophication of the lakes had substantially altered the species structure and composition, and contaminated the source water for human consumption.

Periodic waters (e.g.,rice paddy fields): About 10% of the total area of rice paddy fields were lost over the past 30 years. However, efforts were made by the Government to protect the rice paddy fields from losing their areas further.

Running waters (rivers): Over the past 30 years, total surface area of the rivers in the system had decreased by 30%. Many tributaries of the rivers had even dried up. Increased economic activities resulting from growing economic development have caused pollution and decreased flow volume of the rivers. Great changes in the ecological functions of the rivers occurred.

Sandy foreshores: Heavy erosion occurred to around 2/3 of the sandy foreshores in the System. The erosion was due to mainly sand mining of the beaches and extensive agricultural activities along the coastal plains. Species community structure and abundance of the aquatic life in the sandy shores have greatly altered. Species such as Nereidae and lancelets, etc., which were found in these habitats before, have now becoming rare. Biodiversity has reduced substantially.

Lagoons: The loss of lagoons in Shandong Province was obvious, decreasing from the original 29 to only 3-4 nowadays in 30 years. For the whole System, in the same period, more than 30% of the lagoons were lost. Production of sea cucumbers around the Yuehu Lake area in Shangdon Province used to be thousands of kilograms per annum but now the production has greatly reduced to only tens of kilograms per annum. Such tremendous decrease in the production of sea cucumbers was due to uncontrolled over-exploitation. Overgrowth and subsequent deterioration of the macro-seaweeds further modified the ecosystems, altering the goods and services that the systems could provide.

Muddy foreshores: More than 30% of the mud bottoms in the System were lost over the past 30 years due to increased activities on mariculture, opening up of salt- pans and agriculture. Substantial changes occurred in species composition and abundance of benthic organisms in the muddy foreshores, e.g., of Changkou area. The benthos used to have about 170 species In the 1950s, were reduced to some 70 species in 1980s, and to

only a few in 1990s, that were resistant to pollution conditions. The introduction of Spartina had greatly altered the ecological systems, causing reduction in biodiversity. Habitat area for rare species Tornaria was significantly reduced.

Wetlands of saline habitats: The salt marshes are the habitats for a number of endangered species such as the red-crown crane and reindeer. Measures to protect the salt marshes were taken by the Chinese Government. As a result of the protection, not more than 30% of their areas were lost over the past 30 years. Salt marshes in the Chengshantou have been well maintained with swans seen coming back. However, signs of some ecological changes occurred in recent years, due to indiscriminate discharge of sewage from the surrounding urban centers.

Estuaries: Some damages to habitats due to human activities occurred to the estuaries at the mouth of Huaihe River but the damaged area accounted to less than 30% of the total. In estuaries along the mouths of Yalujiang River and Huaihe River, the small-sized species of food fish, which used to be abundant in the 1950s disappeared in 1980s. The number of economic species was reduced in these habitats and ecological function of the habitats as spawning and breeding grounds for fish and shrimps has also becoming threatened.

Sand and gravel bottom: The sand and gravel bottom used to be the important habitats for an endangered species, the lancelet (*Branchiostoma belcherii*). However, lancelets could not be found in such habitats nowadays, which are losing their ecological functions.

2.2 Status of vulnerable (and protected) species

According to the analysis by Biodiversity Working Group, vulnerable species includes seven categories as follows: 1) Hemichordata and Polychaete, 2) Mollusc, 3) Shrimp and Brachiopoda, 4) Fish, 5) Sea turtle, 6) Chinese sturgeon， Chinese paddlefish and Chinese finless porpoise, 7) Bird and 8) Algae. Please see Annex1 for vulnerable species in the Yellow Sea Ecoregion (not complete yet).

The species problem includes: (1) Vulnerability of ecologically important species; (2) Decline of endemic species; (3) Impacts of exotic species on native species; (4) Degradation of genetic biodiversity of some concerned species.

Almost all the above species become vulnerable or threatened in the system along with fast development of society and economy around the region. The major immediate causes of vulnerability of the species are: a) degradation and loss of habitat, b) over-harvest, c) natural habitat loss due to invasion of exotic species, d) Commercial catch, etc.

The root causes in connection to vulnerability of the species are: (a) Fast development of economy, (b) Rapidly growing population, (c) Lifestyle change and food favorite to seafood and (d) requirement for more tour space, etc.

2.3 Habitats of global significance

Identification of ecologically global significance habitats is in terms of criterions in the international conventions and/or agreements. Ecologically significant habitats in the Yellow Sea Ecoregion include: estuaries, bays, tidal flats, coastal wetlands, deep and shallow water. Among these habitats, tidal flats have the most abundant biodiversity resources and have the biggest number of globally significant sites. The tidal flats are the favorite habitats for waterbirds and benthic organisms. According to the waterbird surveys along the coastline of Yellow Sea Ecoregion, at least 40 sites have been identified as globally or potentially globally significant for waterbirds. Compared with the data between the coasts of China and South Korea, it is shown that the west coast of South Korea has rather higher density of globally significant sites for migratory waterbirds.

The estuaries and marine areas normally are the main habitats for migratory and pelagic species, e.g. Cetaceans, Pinnipedias, fish, sea turtles, etc.

2.4 Biodiversity Conservation Issues

Habitat Loss and Degradation

Coastal development

The main threat to the coastal habitats is land reclamation, especially at in estuaries and shallow bays. It is estimated that up to 880,000 ha. of the Yellow Sea mudflat has been reclaimed. Approximately 37% of the inter-tidal areas in the Chinese portion of the Yellow Sea have been reclaimed since 1950, and since 1917, 43% of the mudflats in South Korea have also been lost. China has plans to reclaim a further 45% of its existing mudflat in the Yellow Sea, and South Korea plans to reclaim a further 34%.

The mudflat been reclaiming along the coast, are mainly for aquiculture, mariculture, saltworks, oil platforms, tourism, etc. The waste materials and pollutants from industrial complexes and cities located along the coast and visitors to the coast for tourism and recreation also degrade the habitats.

In this System, capture fisheries in the region is now replaced by aquaculture as the main source of fish supply. Degradation of ecosystems has affected not only the scientific value but also the daily livelihood of the coastal and riverside communities. Certain cultural heritage spots have also been seriously destroyed. These have affected greatly the social life of the local population.

Pollution

Seawater is the key body of marine environment, and also the habitat of most marine organisms. Pollutants from various sources run into seawater at first and then expand and cause the pollution of marine organism and sediment, future damage human health. The main pollutants in seawater of Yellow Sea Ecoregion are still N, PO_4^{-2}, oil and COD,

and the nutrient concentration in the region displays an increase tendency. In addition, the pollution of heavy metals such as Pb and Hg badly threats to the offshore water.

Sewage and pollutant discharges of the Yellow Sea Ecoregion mainly come from rivers, land-based pollution sources, ships and marine pollution sources, dredging and dumping and marine oil platforms etc.

Over the past decade, increased pollution of the waters had resulted in adverse impact on the social life of the human communities in the System. This was evidenced by that, (a) there was a loss of 30-50% of the coastal areas, which would be potential for development of recreational activities; and (b) many of the rivers were unfit for swimming. Drastic decreases in the production of penaeid shrimps (Penaeus spp.) and scallop (Pecten spp.) due to the effect of pollution of waters in the System were evident. A 50% decrease in the fisheries activities was observed. A slight increase in the incidences of diseases due to pollution of the waters in the System was observed over the past decade.

The red tide, which is an important pollution index of marine environment, has greatly damaged the Yellow Sea. Based on research on oceanic plankton, 40 species were found to cause red tides. Red tides formerly were confined to closed bays, but since 1990s, they became more wide spread, affecting all coastal and even many marine areas.

Changes in river flows and sedimentation

The two longest rivers in China, the Yangtze River and the Yellow River, are undergoing significant changes that will greatly reduce the amount of sediment being transported into the Yellow Sea, according to statistics relating to the construction of 12 large reservoirs along the trunk stream of the Yellow River. In addition, there are also 3,380 small and medium size reservoirs and 50,000 water-pumping projects. Due to the serious shortage of water resources and the great consumption of water by industry and agriculture, the volume of runoff into the sea has been dramatically decreased and even run dry.

The Three Gorges Dam Project attracts the world’s attention, because on the one hand it will greatly prompt the economic and social development in the Yangtze River watershed as well as China, but on the other hand will also have significant effects on the eco-environment. After the Three Gorges Dam is completed, about 67% of silt will deposit in the reservoir and the quantity of sand with large granules in the river will greatly decrease, which will wash out the river bed down-stream and destroy the underwater delta outside of the estuary

Over harvesting of marine and coastal resources

In view of the open-access or common property nature of the fisheries resources, fishing efforts are expected to intensify to meet the market demands in the System. The situation of over-exploitation in fisheries resources will be getting worse.

Catches of the major economic species exceeding their MSY (maximum sustainable yield) levels occurred to all coastal seas in China, including this System. Fisheries resources were highly over-exploited and the problem was really serious.

Over exploitation of fisheries resources obviously has trans-boundary implications in that it would deplete the fish stocks, particularly for the migratory and pelagic species.

Coastal

Destructive fishing practices include the indiscriminate trawling along the coastal seabeds, fishing with explosives in lakes, and use of pesticides for fishing. As a result of these destructive fishing practices, aquatic habitats were destroyed leading to collapse of fish populations and biodiversity conservation.

Destructive fishing practices destroy spawning and breeding grounds of the fish, reducing the recruitment potential for marine and ocean stocks.

Deep water

Being suffered from over-exploitation of resources and destruction of marine habitats, the population of rare marine species in China has decreased greatly and the quantity of some traditional marine fishes and shellfish has declined. At the present, due to the exhaustion of resources, there are no fishing season of *Gadus*, Small Yellow Croaker (*Pseudosciaena polyactis Bleeke*), Large yellow croaker, *Cybiidae* and Plaice in Yellow Sea.

In Republic of Korea, the Yellow Sea has long been a major fishing ground. During the period from 1960 to 1990, annual catches by Korean fishing vessels gradually increased until the mid 1980s, rising from 130,000 metric tons (mt) in the 1960s, to 300,000 mt in the 1970s, and peaking at 450,000 mt in the 1980s.

Most of the marine resources have been declined in stock abundance since large-scale mechanisation fishing in the 1970s (to be confirmed yet).

Alien species

The integrated investigation on exotic/introduced species has not been conducted yet, but there are some typical examples. Introduced from Japan, kelp and Suringar (*Undaria pinnatifida*) have been growing widely along the coast of Yellow Sea Ecoregion and composed natural communities; *Spartina anglica* from UK and USA have been dispersed along the coast of Yellow Sea Ecoregion, especially in Jiangsu Province. In addition, scallops introduced from Japan and USA have been an important mariculture species. Moreover, there are some introduced species of other marine organism.

2.5 Biodiversity Conservation Actions

China

In 1996 the government of China promulgated China Ocean Agenda 21 including major policies on conservation of its natural ecosystems, which state: “Sustainable use of marine biological resources is to be maintained. It is necessary to establish nature reserves of coral reefs, mangroves, seagrass beds and islands as well as protected areas of spawning and feeding sites for fish and crabs with an aim to conserve the species and special ecosystems. The fishery of coastal area has to be managed well without destructive overfishing. Shallow sea and mudflat mariculture has to be managed in a way of wise use including developing appropriate areas for aquaculture based on pollution-free clean technique. Appropriate catching of economic fish species is allowed, if its reproduction and sustainable use can be maintained. It is encouraged to develop mariculture production in an agricultural/pastoral way, thus to increase high quality resources. Rational use and management of resources of exclusive economic zones should be strengthened.”

In 1988 government of China promulgated White Paper on Marine Policy of China where some detailed regulations and measures on conservation of marine natural eco-system which include: 1) Establishment of Marine Nature Reserves, 2) Fishing Grounds Management, 3) Protection of Coastline.

1) Establishment of Marine Nature Reserves. The first nature reserve related to the sea is the Shedao NR in the Yellow Sea that was established in 1963. Since then amount of 42 NRs, with the total areas of 1,970,143 ha at different levels have been established by various departments concerned.

2) Fishing Grounds Management. (1) As early as in 1957 the former Ministry of Aquatic Production promulgated a Regulation of Breeding and Protection of Aquatic Resources (draft). It was the first trial to identify items of fish resources for protection. In 1979 the State Council officially issued the Regulation of Breeding and Protection of Aquatic Resources, in which 26 sea fish species including *Trichiurus*, 7 shrimp and crab species, 14 mollusc species including *Haliotis*, 6 species of algae including *Porphyra* and 10 species of aquatic mammals including *Lipotes vexillifer* are listed as protected species. More detailed protection rules are stipulated by provinces (autonomous regions/municipalities) according to their own specific conditions. (2) Establishment of Regime on Fishing Banned Period. The fishing banned period is set in accordance with biological properties of specific fish species and specific sites.

3) Protection of Coastline. Various forest shelterbelts have been set up in plain area of Yellow Sea District, including breakwater forest and dyke forest.

South Korea

South Korea has developed a number of civil laws, Domestic Laws, Regulations and Acts pertinent to the conservation of coastal area and it’s biodiversity resources, e.g.

Constitutional Law, Framework Act on Environmental Policy, Natural Environment Preservation Act, Fisheries Act, Fishing Area Control Act, Natural Parks Act, etc.

Pursuant to the Natural Parks Act taken by RoK government, areas requiring protection and management are designated as a Park (at National, Provincial or County [Gun] level) in order to preserve the ecological and scenic values, with the greater focus on scenic values and human enjoyment.

The first National park along the Yellow Sea coast was designated in 1968. As of 2006, there are 4 National parks in the System, with the total area of 3341 km^2.

International recognition

A series of International Conventions and Agreements have been initiated relevant to the long term and effective conservation of the Yellow Sea Ecoregion, e.g. Convention on Wetladns of International Importance especially as Waterfowl Habitat (Ramsar Convention), The Convention on the Law of the Sea, The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), The Basel Convention, The Convention on Biological Diversity, The United Nations Conference on Environment and Development (UNCED), South Korea and China Steering Committee Meeting on Yellow Sea Ecosystem, etc.

3 Conclusions

As one of the Global 200 Ecoregions, the Yellow Sea Ecoregion is extremely important for global biodiversity, either on species or their habitats. While it is also very clear that it would be a big challenge to achieve effective conservation of biodiversity and their habitats, due to the very extensive nature of the region with the high dependence of the marine and coastal resources.

Successful biodiversity conservation will depend on the adoption of coordinated national polices and plans for the wise and sustainable use of the intertidal and sub-coastal areas of the Yellow Sea. Local community support will be an essential factor in the successful development and implementation of these policies and plans.

The exceptional importance of the yellow Sea biodiversity, both on a global scale and as a resource shared by China, North Korea and South Korea, makes it highly desirable that conservation should be implemented on an ecoregion-basis. The challenge is to facilitate a process in which a Yellow Sea Ecoregion management plan is adopted and implemented by three governments. Only then will the future for the globally important biodiversity of the Yellow Sea become brighter, and the sustainable development of society and economy around the Ecoregion be achieved.

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Group Name	Latin Name	English Name	Chinese Name	Korean Name	Distribution in YS (Description)	Quantity or catch		IUCN Threatened Categories	Trend	Major Causes	IUCN Red List	China Red List Category	Korean Red Listing (To be defined)	References
						Date of Peak Catch	Date of Lowest Catch		↓ or ↑					
Algae														
	Porphyra tenera	Purple laver	甘紫菜		Liaoning,Shandong, Jiangsu Province	No data	No data	No data	↓	Unkown				1
	Hizikia fusiformis	Unknown	羊栖菜		Liaoning,Shandong Province	No data	No data	No data	↓	Unkown				1
	Silvetia siliquosa	Unknown	鹿角菜		Liaoning,Shandong Province	No data	No data	No data	↓	Unkown				1
Hemichordata														
	Glassobalanus palybanchioporus	Unknown	多鳃孔舌形虫		Endemic,the coastal area of Shandong and Jiangsu	No data	No data	Endangered EN A2acd	Unknown	habitat degradation		√		7, 8, 10, 12
	Balanoglossus misakiensis	acornheaded worm	三崎柱头虫		Endemic,important range in Jiaozhou Bay	No data	No data	Endangered EN A2acd	Unknown	habitat degradation		√		7, 8, 12
	Saccoglossus hwangiauensis	Unknown	黄岛长吻虫		Endemic,important range in Jiaozhou Bay	No data	No data	Endangered EN A2acd	Unknown	habitat degradation		√		7, 8, 11
Polychaete														
	Perinereis aibuhitensis Grube	Unknown	双齿围沙蚕		range in coastal waters	8500t in Jiangsu in 1989 (18)	No data	No data	Unknown	over-harvest				8, 12
Molluscs														
	Mactra veneriformis Reeve	Unknown	四角蛤蜊		range in coastal waters	No data	No data	No data	↓	Unkown				5
	Meretrix spp.	Hard clam	文蛤		range in coastal waters	No data	No data	No data	↓	Unkown				5
	Sinonovacula constricta	Agamaki clam	缢蛏		Important range in Liaoning,Shandong Province	No data	No data	No data	↓	Unkown				5, 12
	Chlamys farreri	Farrer scallop	栉孔扇贝		Major range in Liaoning,Shandong	14 ind/m2 in Sanggou Bay in 1985(3)	No data	No data	Unknown	Unkown				8, 12
	Ostrea gigas	Pacific oyster	长牡蛎		range in coastal waters	No data	No data	No data	Unknown	Unkown				8
Shrimps														
	Penaeus chinensis	Chinese shrimp	中国对虾		range in coastal waters	catch 3741t, the northern Yellow Sea, 1988, 16	catch 884t, 1985, the northern Yellow Sea, 16	No data	Unknown	Over-fishing				4, 12
Brachiopoda														
	Lingula anatina Lamarak	Lingula	海豆芽		Important range in Shandong peninsula,Jiangsu,water depth 0-30m	No data	No data	No data	Unknown	habitat degradation				8, 12
	Terebratella eoreanica Adams et Reeves	Unknown	酸浆贝		Important range in Liaodong peninsula,Shandong peninsula,north of Jiangsu,water depth 0-76m	No data	No data	No data	Unknown	habitat degradation				8, 12
Chordata														
	Branchtotoma belcheri tsingtauense	Unknown	青岛文昌鱼		Endemic,Jiaozhou Bay	390个/m2, Haizhou Bay, 1986, (4)	No data	Vulnerable VU A2ac; B1b(i,ii,iii)c(i,ii,iii)	↓	habitat degradation		√		7, 8
Fish														
	Larimichthys polyactis	Small Yellow Croaker	小黄鱼		Shandong and Jiangsu Province,water less then 105m	38770t landing of Jiangsu, 1956, 15	landing 640t 1983, Jiangsu, 15	Vulnerable VU A2d+4d	↓	Over-fishing		√		4, 7, 12

Group Name	Latin Name	English Name	Chinese Name	Korean Name	Distribution in YS (Description)	Quantity or catch		IUCN Threatened Categories	Trend	Major Causes	IUCN Red List	China Red List Category	Korean Red Listing (To be defined)	References
						Date of Peak Catch	Date of Lowest Catch		↓ or ↑					
	Scomber japonicus	Japanese mackerel	日本鲭		range in coastal waters			Vulnerable VU A2d+4d	↓	Over-fishing		√		4, 7, 12
	Gadus macrocephalus	Pacific cod	鳕		range in coastal waters	landing133972t, Shandong, 1997, 15	landing 5115t 1990, Shandong, 15	Vulnerable VU A2d+4d	↓	Over-fishing		√		4, 7, 13
	Clupea pallasi	Pacific herring	太平洋鲱		range in coastal waters			Endangered EN A2d; C2b	↓	Over-fishing		√		4, 7, 13
	Pagrosomus major	red seabream snapper	真鲷		range in coastal waters	landing2664t, Shandong, 1959, 15	landing 118t 1962, Shandong, 15		Unknown	No data				4
	Cleisthenes herzensteini	pointhead plaice	高眼鲽		range in coastal waters				Unknown	No data				4, 13
	Larimictthys crocea	Large Yellow Croaker	大黄鱼		Major range in coastal areas of Jiangsu and Zhejiang Province	landing13029t, Jiangsu, 1970, 15	landing 346t 1983, Jiangsu, 15	Vulnerable VU A2d+4d	↓	Over-fishing		√		4, 7, 13
	Trachidermus fasciatus	roughskin sculpin	松江鲈		range in coastal waters	No data	No data	Endangered EN A2de+4bcde	↓	habitat degradation		√		7, 8, 12
	Acipenser sinensis	Chinese sturgeon	中华鲟		Endemic,the coastal area of Shandong and Jiangsu Province	No data	No data	Endangered EN A2ce; B1ab(i,ii,v); D1	Unknown	Over-fishing	ver 2.3(1994)	√		7, 8
	Psiphurus gladius	Chinese paddlefish	白鲟		Endemic,lower reaches of Yangtze River	No data	No data	Critically Endangered CR A2acde; B1ab(i,ii,iii,iv,v); D1	Unknown	Over-fishing		√		7, 8
Sea Turtle														
	Chelonta mydas	Common Green Turtle	绿海龟		China population is 5% of the World,range in coastal waters	No data	No data	Critically Endangered CR D	Unknown	Degradation of reproductive habitat		√		7, 8, 12
	Eretmochetys imbricata	hawksbill tturtle	玳瑁		China population is 2% of the World,range in coastal waters	1 was fished in Lianyungang waters, 1950, (20)	No data	Critically Endangered CR D	Unknown	Degradation of reproductive habitat		√		7, 8, 12
	Lepidochelys olivacea	Oliv e Ridley Sea Turtle	太平洋丽龟		China population is 1% of the World,the coastal area of Jiangsu Province	No data	No data	Critically Endangered CR D	Unknown	Degradation of reproductive habitat	ver 2.3 (1994)	√		7, 8, 12
	Dermockelys corlacea	Leather Turtle	棱皮龟		China population is 1% of the World,range in coastal waters	1 was fished in Lianyungang waters, 1981, (4)	No data	Critically Endangered CR D	Unknown	Degradation of reproductive habitat		√		7, 8, 12
Mammal														
	Neophocaena phocaenoides	Chinese finless porpoise	江豚		Minor range in coastal waters	ever fished, Jiangxi, 1982	No data	Endangered EN A1acd	↓	commercial catch	ver 2.3 (1994)	√		2, 7, 12
	Phoca largha	Hair seal	斑海豹		Minor range in coastal waters	105 were fished in estury of Shuangtaizi River, North of Liaodong Bay, April 2003, 14	No data	Endangered EN C2a(i,ii); E	↓	Degradation of reproductive habitat		√		2, 7, 12
	Eschrichtius robustus	Grayback	灰鲸		Minor range in coastal waters	No data	No data	No data	Unknown	No data	ver 2.3 (1994)			2, 12
Bird														
	Grus japonensis	red-crowned crane	丹顶鹤		China population is 60%-70% of the world,Liaodong Bay,the north coastal of Jiangsu Province	about 1000 individuals, Jiangsu, 2002, 17	No data	Endangered EN C1	↓	deterioration of wetland habitat	ver 3.1 (2001)	√		3, 7, 12
	Grus monacha	hooded crane	白头鹤		Liaodong Bay,the north coastal of Jiangsu Province	1400 individuals, Zhalong Nature Reserve, 1999, 17	No data	Vulnerable VU C1	↓	deterioration of wetland habitat	ver 3.1 (2001)	√		3, 7, 12

Group Name	Latin Name	English Name	Chinese Name	Korean Name	Distribution in YS (Description)	Quantity or catch		IUCN Threatened Categories	Trend	Major Causes	IUCN Red List	China Red List Category	Korean Red Listing (To be defined)	References
						Date of Peak Catch	Date of Lowest Catch		↓ or ↑					
	Grus vipio	white-naped crane	白枕鹤		China population is 60%-70% of the world,range in Heilongjiang and Jilin Province	61 were catched on Changlin Island, 2002, 17	No data	Vulnerable VU A2ce; C1	↓	deterioration of wetland habitat	ver 3.1 (2001)	√		3, 7, 12
	Platalea minor	Black-faced spoonbill	黑脸琵鹭		China population is over 80% of the world wintering population,the coastal area of China continent	30-45 were catched in estury of YaLu River and Chaoyang ,Liaoning Province, February 1997, 19	No data	Endangered EN A2ce; C1+2b; D1	Unknown	deterioration of wetland habitat	ver 3.1 (2001)	√		3, 7, 12
	Egretta eulophotes	Chinese Egret	黄嘴白鹭		China population is about 80% of the world,range in Liaoning,Shandong, Jiangsu Province	No data	No data	Near Threatened NT nearly met VU A1bd+2bd; C1	→	deterioration of wetland habitat	ver 3.1 (2001)	√		3, 7, 12
	Anas formosa	baikal teal	花脸鸭		the coastal area in Jiangsu	No data	No data	Vulnerable VU A1cd+2cd	↓	deterioration of overwinter wetland habitat	ver 3.1 (2001)	√		3, 7, 12
	Cygnus Cygnus	swan	大天鹅		Coastal west YS:Rongcheng City, Yancheng City	No data	No data	Near Threatened NT nearly met VU A1acd+2acd	Unknown	deterioration of overwinter wetland habitat		√		3, 7, 12
	Laurs saundersi	Saunder's gull	黑嘴鸥		China population is 60% of the world,Liaoning Province	No data	No data	Vulnerable VU A2c; C1	↓	deterioration of overwinter wetland habitat		√		3, 7

A Biodiversity Strategy for the Yellow Sea

Discussion Paper

Doug Watkins and Warren Lee Long, Wetlands International

The Task

Wetlands International has been contracted by the Project Management Office to develop a regional strategy for the conservation and restoration of habitats and the protection of vulnerable species. This Strategy is to include:

- A vision statement for regional biodiversity conservation.
- Elements of a regional strategy for biodiversity conservation and protection of vulnerable species.
- Suggested actions under each element of the strategy (including milestones and time frames).
- Conservation targets (to be achieved in 10 to 20 years time, to be expressed in terms of desired management status and also preferably biological indexes (target levels of a population or habitat)).

When developed further the Strategy also need to provide details on:

- Approaches to improving management for protected areas.
- Development of a representative regional network of well managed protected areas.
- Development of a regional monitoring system for biodiversity.

This discussion paper has been developed to seek feedback on the broad structure and content of such a Strategy.

Wetlands International is finding it a major challenge to develop the Strategy and has looked to other international models that could be applied to the Yellow Sea. The model presented in this discussion paper draws heavily from the coastal and marine component of the New Zealand Biodiversity Strategy (NZ Department of Conservation 2000).

Structure of the Strategy

This discussion paper presents a Strategy with five major components:

1. Scope: This is a very brief section that defines the geographic and thematic scope of the Strategy.

2. Vision for Biodiversity: This section contains a number of statements describing the vision for the management of human impacts on the biodiversity of the Yellow Sea. It provides a basis to develop common agreement on the outcomes that China and the Republic of Korea as seeking in the Yellow Sea.

3. Key Elements: This presents a set of elements on which to build the Strategy. These form the Objectives of the Strategy. Defining the elements is crucial because they provide the structure for the implementation of the Strategy.

4. Targets: These statements provide a basis to measure the success of the Strategy.

5. Actions: These are broadly defined activities that need to be undertaken to implement the Strategy.

1. Scope

The Biodiversity Strategy covers the marine (including estuaries, inshore coastal and offshore areas) and coastal environment within the Yellow Sea and the resident and migratory marine species (plants, benthic organisms, fish, marine mammals, birds and other organisms) inhabiting these areas.

2. A vision for biodiversity conservation in the Yellow Sea (2025)

- The natural marine and coastal habitats and ecosystems of the Yellow Sea are maintained in a healthy functioning state. Degraded marine habitats are recovering. A full range of marine and coastal habitats and ecosystems representative of the Yellow Seas indigenous marine biodiversity is protected.

- No human-induced extinctions of marine species within the Yellow Sea marine environment are occurring. Rare or threatened marine species are adequately protected from harvesting and other human threats, enabling them to recover.

- Marine biodiversity is appreciated, and harvesting or marine development is done in an informed, controlled and ecologically sustainable manner.

- No new undesirable introduced species are established, and threats to indigenous biodiversity from established exotic organisms are being reduced and controlled.

3. Elements of a regional strategy

Three groupings of elements are proposed:
- Enhancing the scientific information to inform decision making (1 element).
- Integrated marine and coastal planning and management (2 elements).
- Directly addressing biodiversity conservation (3 elements).

1. Improving knowledge of coastal and marine ecosystems
Substantially increase knowledge of coastal and marine ecosystems and the effects of human activities on them.

2. Integrated Marine and Coastal Area Management
Develop integrated processes for marine and coastal planning and management.

3. Sustainable marine resource use practices
Protect biodiversity in coastal and marine waters from the adverse effects of fishing and other coastal and marine resource uses.

4. Managing marine biosecurity risks
Develop an integrated system to identify biosecurity risks to marine biodiversity from invasive alien species and establish appropriate management responses to prevent and reduce these risks and to minimise their impacts.

5. Protecting marine habitats and ecosystems
Protect a full range of natural marine habitats and ecosystems to effectively conserve marine biodiversity, using a range of appropriate mechanisms, including legal protection.

6. Threatened marine and coastal species management
Protect and enhance populations of marine and coastal species threatened with extinction, and prevent additional species and ecological communities from becoming threatened.

4. Targets for 2015

In setting targets for biodiversity conservation in the Yellow Sea preference has been given to alignment with existing international targets. The targets listed below are derived primarily from the program of work for the Marine and Coastal Program of the Convention on Biodiversity.

Target 1: At least 10% of each of the bioregions of the Yellow Sea are effectively conserved.

Target 2: Sites of global significance for biodiversity are maintained.

Target 3: The rate of loss and degradation of natural habitats is decreased.

Target 4: Reduce the decline of, maintain or restore populations of species of selected taxonomic groups (eg. threatened species) dependent upon coastal and marine ecosystems.

Target 5: Further losses of known genetic diversity of exploited wild fish and other wild and cultured marine and coastal species are prevented.

5. Action Plan

Objective 1. Improving knowledge of coastal and marine ecosystems
Substantially increase knowledge of coastal and marine ecosystems and the effects of human activities on them.

Actions:

a) Improve knowledge of marine species, including taxonomy, distribution, habitat requirements, and the threats to species.

b) Survey, assess, and map habitats and ecosystems important for indigenous biodiversity and develop an agreed bioregional classification system.

c) Identify the uniqueness, representativeness, and importance of the biodiversity of the coastal and marine ecosystems of the Yellow Sea.

d) Identify, assess, map and rank the threats to the coastal and marine biodiversity of the Yellow Sea.

e) Develop an environmental monitoring system to provide information and a spatial understanding of: the status of marine species; fish stocks; habitats important for indigenous biodiversity; marine environmental health; threats to biodiversity; and the effectiveness of measures to avoid, remedy or mitigate the adverse effects of activities on marine biodiversity.

f) Promote awareness of the effects of human activities on marine biodiversity, and the opportunities and responsibilities to protect and maintain habitats and ecosystems of importance to biodiversity.

Objective 2. Integrated Marine and Coastal Area Management
Develop integrated processes for marine and coastal planning and management.

Actions:

a) Clarify and agree on comprehensive policy objectives for marine biodiversity management, considering all stakeholder and community interests. Define agency responsibilities.

b) Develop marine management plans at the National Government level.

c) Develop coastal management plans at the Provincial Government level.

d) Develop programmes to mitigate the adverse effects of land use on coastal biodiversity, and incorporate marine biodiversity priorities into programmes for sustainable land use.

e) Maintain or restore the biodiversity of globally significant and other priority sites in the coastal environment.

Objective 3. Sustainable marine resource use practices
Protect biodiversity in marine and coastal waters from the adverse effects of fishing and other resource uses.

Actions:
a) Develop and implementation programmes to sustain or restore harvested species and associated and dependent species to ecologically sustainable levels, and integrate marine biodiversity protection priorities into programmes for sustainable fisheries use, such as fisheries plans, using an ecosystem approach.

b) Identify the coastal and marine species and habitats most sensitive to harvesting and other disturbances and put in place measures to avoid, remedy or mitigate adverse effects from commercial fishing activities.

c) In the absence of, or uncertainty about, information required for the sustainable use of marine resources, apply the precautionary principle when setting sustainability measures for fishing or setting controls for other coastal and marine uses.

d) Improve the environmental impact assessment (EIA) of fishing and other marine and coastal resource use, and integrate these EIA into fisheries decision making processes (including sustainability measures and fisheries plans) and other marine management processes.

e) Avoid, remedy or mitigate the adverse impacts of human activities (such as marine transport and petrochemical extraction) on marine biodiversity and develop habitat restoration programmes where appropriate.

Objective 4. Managing marine biosecurity risks
Develop an integrated system to identify biosecurity risks to marine biodiversity from exotic organisms and establish appropriate management responses to prevent and reduce these risks and to minimise their impacts.

Actions:
a) Enhance control measures to prevent harmful species and diseases establishing and being spread within the Yellow Sea (by practices such as discharge of ballast water and the de-fouling of ship hulls).

b) Determine responsibilities for the management of established marine pests so that appropriate measures can be undertaken promptly and efficiently.

c) Identify the distribution of exotic species and assess the actual and potential impacts of these on marine ecosystems and biodiversity.

d) Increase pest control and management efforts to levels in line with biodiversity goals and develop new technologies and techniques to combat existing and emergent threats to marine biodiversity from marine pests.

Objective 5. Protecting marine habitats and ecosystems
Develop and appropriately manage a comprehensive, adequate and representative Protected Area system.

Actions:
a) Improve the effectiveness of the management of existing Protected Areas.

b) Assess the adequacy of the existing Protected Areas to meet the objective of a comprehensive, adequate and representative Protected Areas Network for the Yellow Sea.

c) Develop and implement a strategy to fill the gaps in the Protected Area Network.

Objective 6. Threatened marine and coastal species management
Protect and enhance populations of marine and coastal species threatened with extinction, and prevent additional species and ecological communities from becoming threatened.

Actions:
(a) Review/establish threatened species priority setting systems to assess coastal and marine species.

(b) Identify and protect threatened species and their key habitats.

(c) Implement recovery plans and population management plans for those threatened marine species ranked as high priority.