# THE YELLOW SEA ECOREGION: A GLOBAL BIODIVERSITY TREASURE

### A global biodiversity treasure under pressure

The Yellow Sea LME is an important global resource. This international waterbody supports substantial populations of fish, invertebrates, marine mammals, and seabirds. Among the world's 64 large marine ecosystems (LMEs), the Yellow Sea LME has been one of the most significantly affected by human development. Large human populations live in the basins that drain into the Yellow Sea. Seaside cities with tens of millions of inhabitants include Qingdao, Tianjin, Dalian, Shanghai, Seoul/Inchon, and Pyongyang-Nampo. People in these urban areas are dependent on the Yellow Sea as a source of food, economic development, recreation, and tourism.

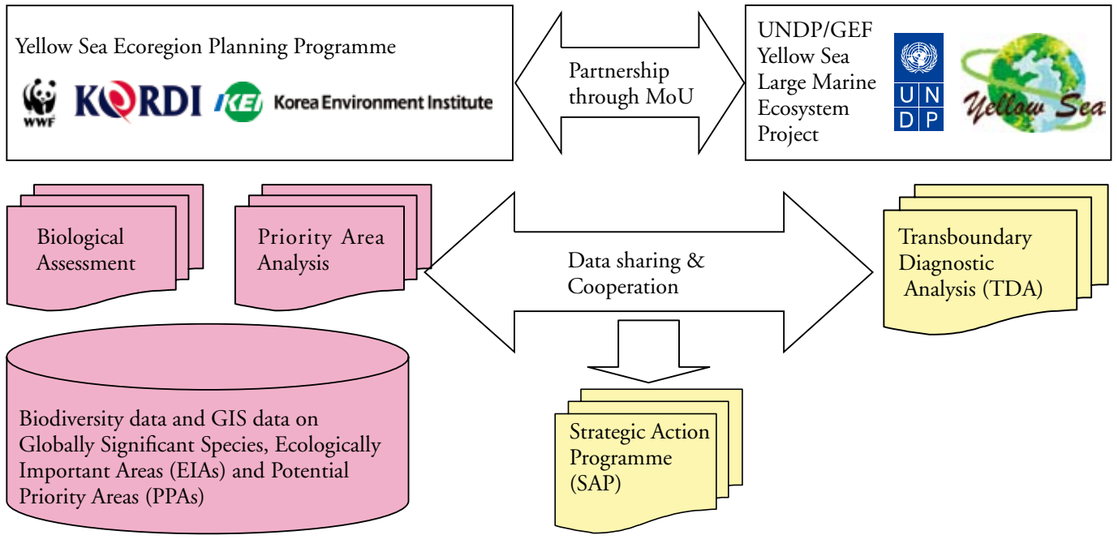
Yet the Yellow Sea is under serious threat from industrial and agricultural waste, extensive economic development in the coastal zone, the unsustainable exploitation of natural resources, and unsustainable fishery practices. This has resulted in the loss of biomass, biodiversity, and habitat.

### A regional strategy and action plan

The global importance of the Yellow Sea Ecoregion has been recognised by governments and the international community in recent years. Starting in 1992, the Chinese and South Korean governments together developed a transboundary approach to the management of the Yellow Sea area with the assistance of UNDP, UNEP, the World Bank, and NOAA. In 2005, a UNDP/GEF project, the Yellow Sea Large Marine Ecosystem project, was officially launched with participation of the Chinese and South Korean governments.

Meanwhile, in 2002, WWF and other conservation NGOs and research institutes in China, South Korea and Japan began an assessment of Yellow Sea Ecoregion biodiversity. The objective of this regional partnership was to prioritise conservation actions based on scientific data.

In 2005, the Yellow Sea Ecoregion Planning Programme (a joint initiative between WWF, KORDI and the Korea Environment Institute) and the UNDP/GEF Yellow Sea Large Marine Ecosystem Project signed a memorandum of understanding (MoU). The MoU aims to promote one regionally coordinated biodiversity strategy and action plan amongst both projects and the sharing of biodiversity assessments and analysis data.





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WWF KORDI KEI Korea Environment Institute

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About the Yellow Sea Ecoregion Planning Programme: The Yellow Sea Ecoregion Planning Programme is an international partnership between WWF, KORDI, and KEI for conservation of biodiversity of the Yellow Sea Ecoregion.



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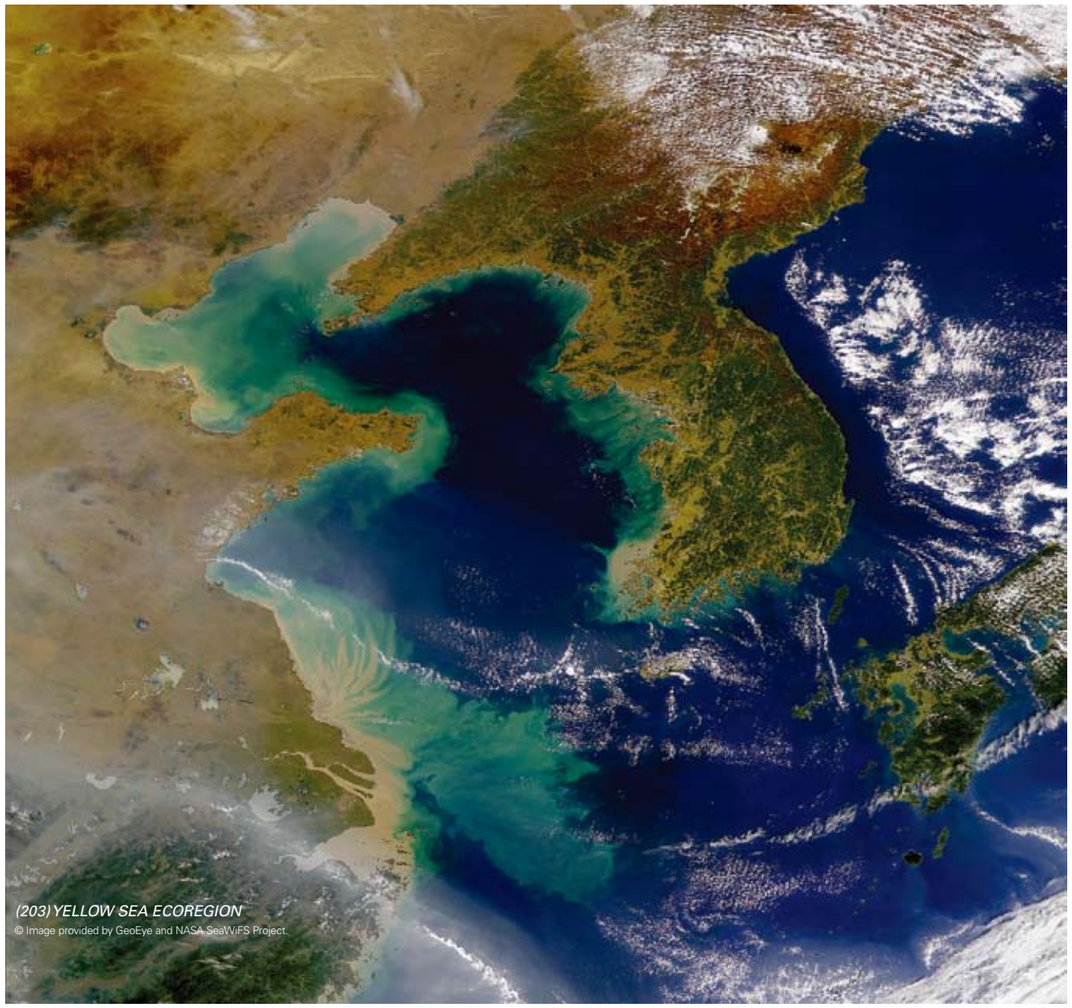
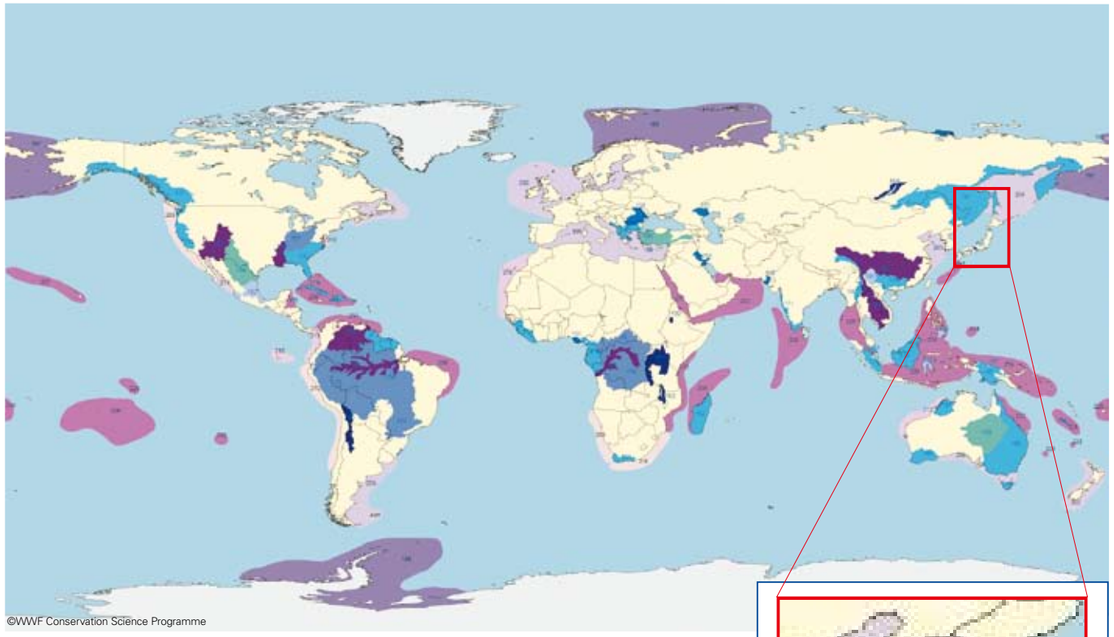
# Yellow Sea Ecoregion

## A global treasure, a global responsibility




WWF KORDI KEI Korea Environment Institute

# THE YELLOW SEA ECOREGION: A GLOBAL BIODIVERSITY TREASURE




*Yellow Sea Ecoregion in the Global 200 (Marine and Freshwater Ecoregions only)*


*(203) YELLOW SEA ECOREGION*

## The Global 200 - Blueprint for a living planet

In 1997, WWF embarked on ecoregion conservation as a response to the increased pace of degradation of the world's endangered habitats and species.

To begin with, WWF identified the most valuable and sometimes vulnerable ecoregions in the world which best represent the breadth of biodiversity and ecological processes.

The list of priority ecoregions identified by WWF scientists is known as The Global 200 Ecoregions.

The Global 200 recognize the fact that, whilst tropical forests and coral reefs harbour the most biodiversity and are the traditional targets of conservation organizations, unique manifestations of nature are found in temperate and boreal regions, and in deserts and mountain chains, which occur nowhere else on Earth and which risk being lost forever if they are not conserved.

## The Yellow Sea Ecoregion

### Representative

The Yellow Sea Ecoregion (#203) is a marine representative of the Temperate Shelf and Seas in the North Temperate Indo-Pacific Ocean. It is one of the 43 marine ecoregions in the Global 200, which encompasses the most distinctive examples of the five major marine habitat types, from polar seas to tropical coral reefs.

### Comprehensive

The Yellow Sea Ecoregion is not just a marine representative, but also a global representative of the earth's biodiversity. It is also one of the 238 ecoregions in the Global 200, which includes terrestrial and freshwater ecoregions.

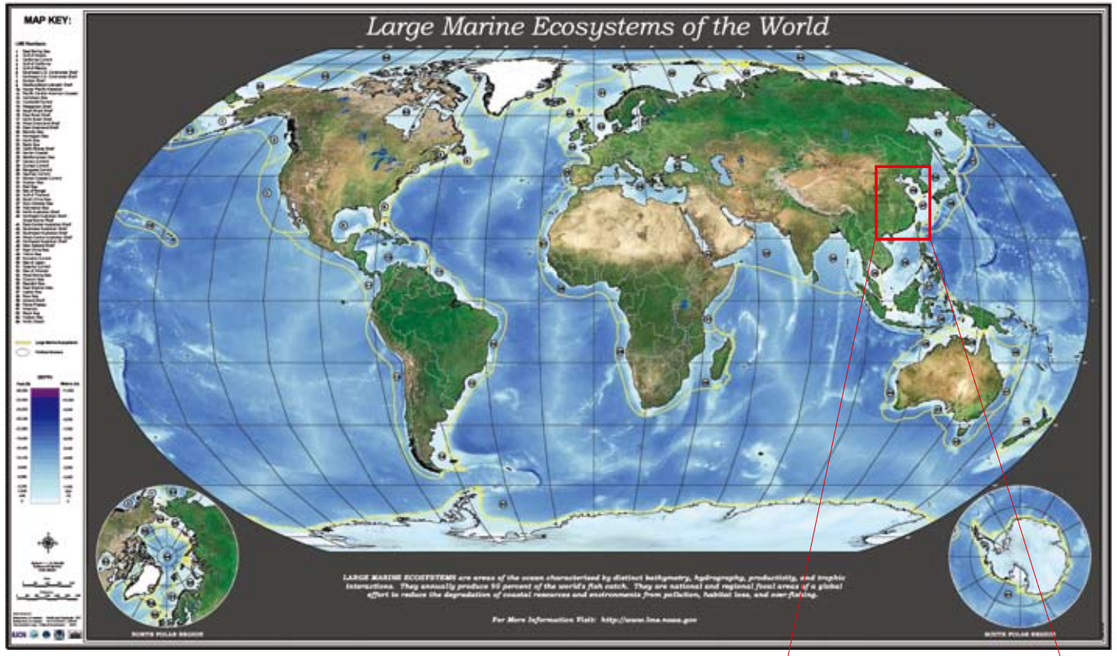
### Ecoregion

Yellow Sea Ecoregion follows the natural marine ecosystems unit, not political or administrative boundaries, therefore it is an appropriate scale for biodiversity comparison and analysis.

### What is an ecoregion?

Biodiversity is not spread evenly across the Earth but follows complex patterns determined by climate, geology and the evolutionary history of the planet. These patterns are called ecoregions. WWF defines an ecoregion as a large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions.

The boundaries of an ecoregion are not fixed and sharp, but rather encompass an area within which important ecological and evolutionary processes most strongly interact.




*The Yellow Sea Large Marine Ecosystem (LME #48) and the East China Sea Large Marine Ecosystem (LME #47)*

## Large Marine Ecosystems (LMEs)

### 64 LMEs produce 95 percent of the world's annual marine fishery biomass yields

LMEs encompass coastal areas of river basins and estuaries to the seaward boundaries of continental shelves and the outer margins of major current systems. They are relatively large regions on the order of 200,000 km2 or greater, characterized by distinct: (1) bathymetry, (2) hydrography, (3) productivity, and (4) trophically dependent populations.

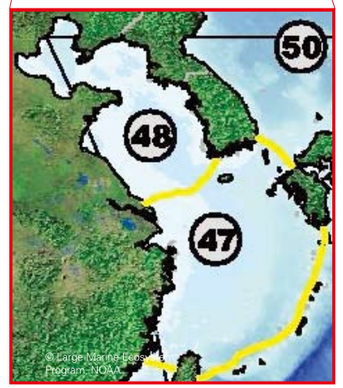
On a global scale, 64 LMEs produce 95 percent of the world's annual marine fishery biomass yields. Most of the world's ocean pollution, overexploitation, and coastal habitat alteration occur within their waters.

Studies have been conducted of the principal driving forces affecting changes in biomass yields for 33 of the 64 LMES. They have been peer-reviewed and published in ten volumes (http://www.lme.noaa.gov). Based on lessons learned from the LME case studies, a five-module strategy has been developed to provide science-based information for the monitoring, assessment, and management of LMES. The modules are focused on LME: (1) productivity, (2) fish and fisheries, (3) pollution and health, (4) socioeconomics, and (5) governance.

## Yellow Sea Large Marine Ecosystem and East China Sea Large Marine Ecosystem

The Yellow Sea Large Marine Ecosystem (LME #48) and the East China Sea Large Marine Ecosystem (LME #47) are part of this global map of the highly productive large marine ecosystems.

(Information on the Yellow Sea Large Marine Ecosystem is available at http://www.lme.noaa.gov, and is used here with the kind permission of Dr. Kenneth Sherman, Director of NOAA's Large Marine Ecosystem Program)




*(#48) YELLOW SEA LARGE MARINE ECOSYSTEM*

*(#47) EAST CHINA SEA LARGE MARINE ECOSYSTEM*

# Globally significant mammals in the Yellow Sea Ecoregion

## A table of mammal indicator species and their global significance

| Indicator Species | | Criteria for habitat and vulnerable species of global significance | | |
|---|---|---|---|---|
| **Scientific names** | **Common English names** | **Criterion 1: Endemism** | **Criterion 2: Vulnerable Species** | **Criterion 3: Commercially Important Species(not adopted)** |
| *Neophocaena phocaenoides* | Finless porpoise | C(assubspecies),K?(needDNA aynalysisto identify subspecies) | C(protected but victims bycatch), K (protected but consumed) | |
| *Phoca largha* | Largha seal | C K | C (1000 around Bohai sea), K (400-500 in indicated area during the summer) | |
| *Eschrichtius robustus* | Gray whale | | C, K, IUCN CR (100 ind. remain) | |
| *Lutra lutra* | Eurasian otter | | K, IUCN NT listed (no record in China) | |
| *Balaenoptera borealis* | Sei Whale | | IUCN EN | |
| *Balaenoptera musculus* | Blue Whale | | IUCN EN | |
| *Balaenoptera physalus* | Fin Whale | | IUCN EN | |
| *Eubalaena japonica* | North Pacific Right Whale | | IUCN EN | |


*Finless porpoise*


*Largha seal haul-out area in Korean DMZ*


*Eurasian otter*

Notes to the table

Each indicator species were assessed against Criterion 1, 2 and 3. When an indicator species meets Criterion 1 according to data available in China, then it is indicated by C (China).

Note 1: In Criterion 1,2 and 3 columns, C indicates that a criterion is applicable to the corresponding species according to data from China, K: South Korea.

Note 2: IUCN CR and IUCN EN indicate the species is classified as Critically Endangered (CR) or Endangered (EN) in the IUCN Red List of Threatened Species.

Photos by: WON, Changman, Qian ZHU, Tobai Sadayosi, Jo Soon-Man, GeoEye and NASA SeaWiFS Project,Large Marine Ecosystem Program - NOAA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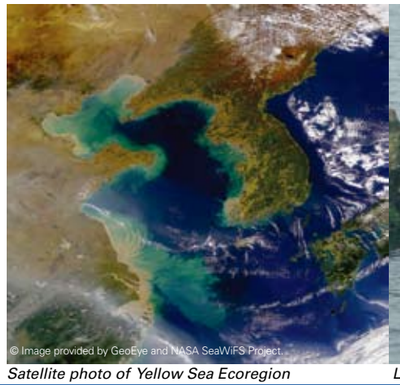
# Mammals of the Yellow Sea Ecoregion and their habitats




*Satellite photo of Yellow Sea Ecoregion*


*Largha seal haul-out area in Korean DMZ*

## Mammals of the Yellow Sea Ecoregion

### About the area

The Yellow Sea Ecoregion is one of the world's largest areas of continental shelf. The Yellow Sea Ecoregion encompasses the Bohai Sea, the Yellow Sea and the East China Sea. It is a transboundary area, and extends from the coastlines of China, North Korea, and South Korea to a depth of 200m..

Valuable nutrients flow from the Yangtze and Yellow rivers and combine with sunlight and shallow waters to create an area that teems with abundant marine life.

### Diversity of mammal species

Seventeen species of whales and dolphins and four species of seals and sea lions are found in the Yellow and Bohai seas. In addition, the ecoregion is an important habitat for Eurasian otter *(Lutra lutra)*, a species that is not strictly a marine mammal and which lives in estuaries and marine coves in the south-western part of the Korean peninsula, as well as the Finless Porpoise *(Neophocaena phocaenoides)*, which lives in the estuary area of the Yangtze.

### The frozen sea – a critical breeding area for Largha Seal

The Bohai Sea is the only area of the Yellow Sea Ecoregion that freezes extensively in winter. In November each year, Largha seals *(Phoca largha)* migrate in pairs to breed on ice floes here. Scientists suspect that Largha seals in this region may be a geographically as well as genetically isolated from other northwest Pacific populations, although genetic analysis is required to confirm this.

### Marine DMZ (Demilitarised Zone) – a safe haven for marine mammals

The relatively undisturbed DMZ area on the Korean Peninsula is a critical habitat for cranes and other migratory birds. A marine habitat within the DMZ also provides a safe habitat for more than 350 Largha seals in summer.


*Borders of the Yellow Sea Ecoregion*

**What is an ecoregion?**

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## Mammals and People

Records of whaling activities from Japanese and Russian boats show that there were significant catches of whales in Korean waters in the first half of the 20th century. In the 1950s, Korean vessels began whaling in coastal waters, and in the 1970s whalers expanded their activities into the northern Yellow Sea and East China Sea. When South Korea joined the IWC (International Whaling Commission) in the mid-1980s whaling was largely stopped in South Korea.

In China all marine cetaceans currently are National Grade 2 protected animals. While Largha seals were once hunted in China with up to 500 seals killed in a peak year, hunting of the species was prohibited in 1983 and it is now a National Grade 2 protected animal.


*Finless porpoises get damaged by fishing net*

## Threats to Mammals

Although capture, killing and selling of protected marine mammals are strictly prohibited in China, incidental bycatch do occur because of extensive fisheries in coastal waters and the Yangtze River, which results in increased mortality.

Pollution is a serious problem in Yellow Sea Ecoregion and it leads to reproductive failure and lower immune system of marine mammals. Fragmentation of populations by coastal development affects Eurasian otters in South Korea.

# The Yellow Sea Ecoregion - a Global Treasure, a Global Concern

### Global Treasure

The Yellow Sea Ecoregion (203) has been selected by WWF as one of the Global 200 ecoregions, areas that are key to global biodiversity conservation. This marine ecosystem is also one of the Large Marine Ecosystems (LME) of the world.

### Global Concern

The global importance of the Yellow Sea Ecoregion has been recognised by governments and the international community in recent years. Starting in 1992, the Chinese and South Korean governments together developed a transboundary approach to the management of the Yellow Sea area with the assistance of UNDP, UNEP, the World Bank, and NOAA. In 2005, a UNDP/GEF project, the Yellow Sea Large Marine Ecosystem project, was officially launched with participation of the Chinese and South Korean governments.

Meanwhile, in 2002, WWF and other research institutes in China, South Korea and Japan began an assessment of Yellow Sea Ecoregion biodiversity. The objective of this regional partnership was to prioritise conservation actions based on scientific data.

### An urgent need: Identifying conservation priorities at a transboundary ecoregional scale

In order to conserve the full array of biodiversity and ensure the use of its services by people are sustainable, it is necessary to conduct assessments beyond political boundaries and at an ecoregional scale.

An ecoregional approach helps ensure that we do not overlook areas that are particularly unique or threatened, allowing for smarter trade-offs and greater positive impacts that are more likely to endure over time.


*Yellow Sea Ecoregion (203)*

*LME #48 Yellow Sea Large Marine Ecosystem (red area)*

UNDP Yellow Sea

*UNDP/GEF Yellow Sea Project*

WWF KORDI KEI Korea Environment Institute

*WWF/KORDI/KEI Yellow Sea Ecoregion Planning Programme*

# Methodology for finding priority mammal species and their Ecologically Important Areas

### Cooperation among scientific experts from China and South Korea

Scientists from universities and environmental research institutes in China and South Korea have worked together to review and identify priority mammal species and their habitats of global significance. Together they have set a common methodology and reached an agreement on priorities.

### Biological Assessment

Using a set of mutually agreed criteria that are key to biodiversity conservation representativeness, endemism, threatened status, and intact habitat - scientists analysed nationally available data to select appropriate indicator species and their habitat.

### Priority Area Analysis

Using a further set of criteria, experts then prioritised the previously selected indicator species and their habitat. To do this, scientists took into account the connectivity of the habitats of migratory species on a transboundary scale - such as breeding areas, migratory routes and summer haul-out areas that occur between China, North Korea and South Korea. For many of the whale indicator species, there was not enough data available to identify their critical habitat.

Experts mapped the important habitat areas of each indicator species. This allowed scientists to visualise areas that are important for more than one species.

### Results

Mammal Ecologically Important Areas (MEIAs) are areas that experts deem critical for mammal indicator species. Nine indicator species were assessed under the criteria to identify globally significant species and their habitat. Of these indicator species, two species met the endemism criterion and eight species met venerable species criterion. Those indicator species that met any of these criteria were identified as globally significant species. Then areas critical for the survival of these species were identified as the indicator species ecologically important areas. In total, three MEIAs were identified.

The Yellow Sea Ecoregion Planning Programme will publish the full results of its Biological Assessment and Priority Area Analysis so that they become accessible by scientists and government agencies in the future.


*Scientific experts from China, and South Korea, Japan and other countries cooperated to analyse priority areas*


*Important areas for largha seal in China*


*Important areas for largha seal in Korea*

# A call to action

The analysis and results provided key data for developing a regional conservation strategy and monitoring its successes. In particular, the results will help to:

1) Establish a network of representative marine protected areas at the ecoregional scale;

2) Evaluate effectiveness of existing protected areas;

3) Monitor status of biodiversity.

In order to conserve these globally significant species and their habitats, various stakeholders need to take concerted actions. Community-based organisations, the scientific community, national and local government agencies, legislative bodies, non-government organisations including religious groups, the general public, the media, donor communities, industries, consumers, and youth groups all have important roles to play. For example, national and local government agencies can contribute by strengthening cross-sectoral coordination in the establishment and improvement of the management of marine protected areas (MPAs). Filling major knowledge gaps in ecology and human impacts on indicator species is also an important action to take.

## Globally Siginificant Areas for Mammals in Yellow Sea Ecoregion (China and South Korea)

### - Yellow Sea Ecoregion Planning Programme -

WWF KORDI KEI


Geographic Coordinate System : WGS-84
Projection : Lambert Conformal Conic

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**Bathymetry**

- Under 200m
- 200m - 100m
- 100m - 90m
- 90m - 70m
- 70m - 50m
- 50m - 30m
- 30m - 10m
- 10m - 0m

Mammal EIA

| No | Mammal EIA |
|---|---|
| 1 | Yangzte River and Estuary |
| 2 | Dalian – Baengnyeong |
| 3 | Jeollado Coasts and Islands |

# Globally significant birds in the Yellow Sea Ecoregion

## A table of bird indicator species and their global significance

| Indicator Species | | Criteria for habitat and vulnerable species of global significance | | | |
|---|---|---|---|---|---|
| Scientific names | Common English names | Endemism (Definition: >50% of the population occurs in the Yellow Sea Ecoregion at some time of its life cycle.) | Criterion 2: Vulnerable Species | Criterion 3: Commercially Important Species (n/a: not applicable) | Criterion 4: Ramsar Criteria on Waterbird |
| *Grus japonensis* | Red-crowned crane | Yes | C K IUCN EN | **n/a** | Yes |
| *Grus monacha* | Hooded crane | Yes | C K IUCN VU | **n/a** | Yes |
| *Grus vipio* | White-naped crane | Yes | C K IUCN VU | **n/a** | Yes |
| *Platalea minor* | Black-faced spoonbill | Yes | C K IUCN EN | **n/a** | Yes |
| *Egretta eulophotes* | Chinese egret | Yes | C K IUCN VU | **n/a** | Yes |
| *Ciconia boyciana* | Oriental white stock | Yes | C K IUCN EN | **n/a** | Yes |
| *Anas formosa* | Baikal teal | Yes | C K IUCN VU | **n/a** | Yes |
| *Cygnjus cygnus* | Whooper swan | Yes (10 000) | C K | **n/a** | Yes |
| *Larus saundersi* | Saunders's gull | Yes | C K IUCN VU | **n/a** | Yes |
| *Haemantopus ostralegus* | Oystercatcher | Yes | K | **n/a** | Yes |
| *Tringa guttifer* | Nordmann's greenshank | Yes | IUCN EN | **n/a** | Yes |
| *Eurynorhynchus pygmeus* | Spoonbill sandpiper | Yes | IUCN EN | **n/a** | Yes |
| *Numenius madagascariensis* | Far eastern curlew | Yes | IUCN NT | **n/a** | Yes |
| *Anser cygnoides* | Swan Goose | Yes (Korean population. Among two populations, perhaps Russian FE birds migrate to Korea.) | IUCN EN | **n/a** | Yes |
| *Grus leucogeranus* | Siberian crane | Yes (Staging areas in Bohai Wan) | IUCN CR | **n/a** | Yes |
| *Larus relictus* | Relict Gull | Yes (Non-breeding migrant. Count data limited in Korea.) | IUCN VU | **n/a** | Yes |

Notes

Each indicator species were assessed against Criterion 1, 2 and 3. When an indicator species meets Criterion 1 according to data available in China, then it is indicated by C (China).

Note 1: In Criterion 1,2 and 3 columns, C indicates that a criterion is applicable to the corresponding species according to data from China, K: South Korea.

Note 2: IUCN CR, IUCN EN, and IUCN VU indicate the species is classified as Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) respectively in the IUCN Red List of Threatened Species.

Note 3: In Criterion 4 column Yes indicates the Ramsar criteria on waterbirds were applied to the corresponding species.

Photos by: PARK, Jinyoung, KIM, Jinhan, GeoEye and NASA SeaWiFS Project

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*Red-crowned crane*

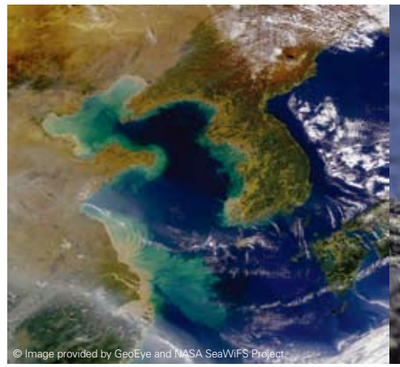

*Saunders's gull*


*Saunders's gull*


*Spoonbill sandpiper*


*Whooper swan*

# Birds of the Yellow Sea Ecoregion and their habitats




*Satellite photo of Yellow Sea Ecoregion*


*Black-faced spoonbill*

## Birds of the Yellow Sea Ecoregion

### About the area

The Yellow Sea Ecoregion is one of the world's largest areas of continental shelf. The Yellow Sea Ecoregion encompasses the Bohai Sea, the Yellow Sea and the East China Sea. It is a transboundary area and extends from the coastlines of China, North Korea, and South Korea to a depth of 200m.

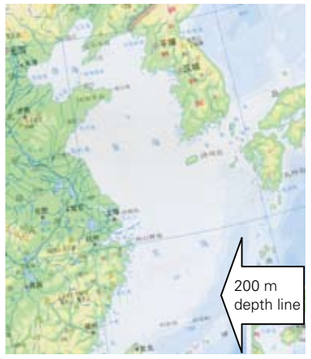
Valuable nutrients flow from the Yangtze and Yellow rivers and combine with sunlight and shallow waters to create an area that teems with abundant marine life.

### Diversity of bird species

Yellow Sea Ecoregion supports a large number of wetland and marine bird species. In China, 173 species of waterbirds and 9 species of seabirds have been recorded, and in South Korea, 162 waterbirds species including egrets, ibis, storks, cranes, ducks, geese, swans, shorebirds, and gulls have been observed.

### A refuge for migrating birds

The Yellow Sea Ecoregion is often likened to a very important 'international airport' for migratory birds. This is because each year over a million waterbirds fly to many wetlands in the Yellow Sea Ecoregion to rest and 'refuel' by feeding on rich aquatic animals and plants, so that they can safely continue their long journey to destinations as far away as Alaska or Australia. Scientific data shows that in South Korea alone, coastal wetlands support more than 10% of populations of 14 shorebird species. The Yellow Sea Ecoregion also provides habitat for 22 species listed in China's nationally compiled red list of endangered species and 11 globally threatened birds in South Korea.




*Geography of Yellow Sea Ecoregion*

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## Birds and People

Historically, the hunting of waterbirds has long been a source of food as well as a commercial activity. Until recently, the hunting of shorebirds in China was done mostly for commercial purposes. But with improved economic conditions, pressure from hunting has dropped. It is now illegal in China to hunt birds in the wild.

People have converted natural wetlands in coastal areas into large areas of artificial wetlands, which now provide important habitat for waterbirds. For example, saltpans provide roosting areas for shorebirds at high tide, and estuary dams have become home for a large number of ducks, including the Baikal teal, a globally vulnerable species. Artificial wetlands may have lost the original ecological character of natural wetlands, but they nevertheless still play an important role in supporting waterbirds.


*YSE is located in the centre of International Site Networks for migratory waterbirds in the East Asian-Australasian region*

## Threats to Birds

Large-scale habitat loss is the single most serious threat to waterbirds in the Yellow Sea Ecoregion. Habitat loss is mainly caused by conversion of coastal wetlands by reclamation into agricultural land, saltpans, fishponds and other industrial and urban development. In South Korea, about 43% of intertidal wetlands were lost during the 20th century. In China, about 37% of intertidal wetlands have been converted in the last 50 years. Other threats include pollution of the aquatic environment, over hunting and illegal hunting of some species, human disturbance and competition for aquatic products between people and birds. The introduction and spread of invasive alien plant species is another recognised threat to waterbirds in China.

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### Global Treasure

The Yellow Sea Ecoregion (203) has been selected by WWF as one of the Global 200 ecoregions, areas that are key to global biodiversity conservation. This marine ecosystem is also one of the Large Marine Ecosystems (LME) of the world.

### Global Concern

The global importance of the Yellow Sea Ecoregion has been recognised by governments and the international community in recent years. Starting in 1992, the Chinese and South Korean governments together developed a transboundary approach to the management of the Yellow Sea area with the assistance of UNDP, UNEP, the World Bank, and NOAA. In 2005, a UNDP/GEF project, the Yellow Sea Large Marine Ecosystem project, was officially launched with participation of the Chinese and South Korean governments.

Meanwhile, in 2002, WWF and research institutes in China, South Korea and Japan began an assessment of Yellow Sea Ecoregion biodiversity. The objective of this regional partnership was to prioritise conservation actions based on scientific data.

### An urgent need: Identifying conservation priorities at a transboundary ecoregional scale

In order to conserve the full array of biodiversity and ensure the use of its services by people are sustainable,it is necessary to conduct assessments beyond political boundaries and at an ecoregional scale.

An ecoregional approach helps ensure that we do not overlook areas that are particularly unique or threatened, allowing for smarter trade-offs and greater positive impacts that are more likely to endure over time.

# Methodology - finding priority bird species and their Ecologically Important Areas

### Cooperation among scientific experts from China and South Korea

Scientists from universities and environmental research institutes in China and South Korea have worked together with Wetlands International (a conservation NGO) to review and identify priority bird species and their habitats of global significance. Together they have set a common methodology and reached an agreement on priorities.

### Biological Assessment

Using a set of mutually agreed criteria that are key to biodiversity conservation-representativeness, endemism, threatened status, commercial importance and Ramsar criteria on waterbirds - scientists analysed nationally available data to select appropriate indicator species and their habitat and they have compiled national biological assessment papers for China and South Korea.

### Priority Area Analysis

Using a further set of criteria, experts then prioritised the previously selected indicator species and their habitat. To do this, scientists took into account endemism, threatened status, and commercial importance as a set of criteria for the Priority Area Analysis, though no species were applicable for commercial importance criterion.

Because participating scientists have conducted ground surveys themselves in the most important areas of China and South Korea, they were able to draw very detailed maps of important areas onto a single satellite image map. Based on this detailed important area map, each area was re-examined to assess which bird indicator species are important for which areas.

### Results

As a result of the above processes, scientists adopted a list and a map of areas that are critical for bird species (Bird Ecologically Important Areas (BEIAs).16 waterbird species were assessed as indicator species under the criteria to identify globally significant species and their habitat. Of these indicator species, 16 species met the endemism criterion as well as the venerable species criterion, but no species were applicable under the commercially important species criterion. Ramsar criteria on waterbirds were assessed not only for 16 indicator species but also for other waterbird species. Those indicator species that met any of these criteria were identified as globally significant species. Then habitat areas of these globally significant species, where those areas are critical for the survial of the species, were identified as indicator species ecologically important areas. In total, 42 Bird Ecologically Important Areas were identified.

The Yellow Sea Ecoregion Planning Programme will publish the full results of its biodiversity assessment and priority area analysis so that they become accessible by scientists and government agencies in the future.

# A call to action

The results provided key data for developing a regional conservation strategy and monitoring itssuccesses. In particular, the results will help to:

1) Establish a network of representative marine protected areas at the ecoregional scale;

2) Evaluate effectiveness of existing protected areas;

3) Monitor status of biodiversity.

In order to conserve these globally significant species and their habitats, various stakeholders need to take concerted actions. Community-based organisations, the scientific community, national and local government agencies, legislative bodies, non-government organisations including religious groups, the general public, the media, donor communities, industries, consumers, and youth groups all have important roles to play. For example, national and local government agencies can contribute by strengthening cross-sectoral coordination in the establishment and improvement of the management of marine protected areas (MPAs). Filling major knowledge gaps in ecology and human impacts on indicator species is also an important action to take.


*Yellow Sea Ecoregion (203)*

*LME #48 Yellow Sea Large Marine Ecosystem (red area)*

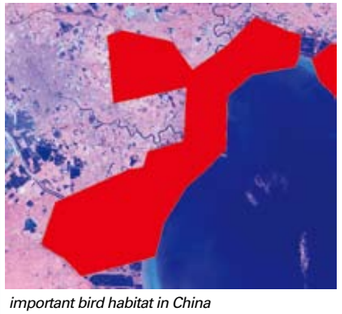
UNDP Yellow Sea

*UNDP/GEF Yellow Sea Project*

WWF KORDI KEI Korea Environment Institute

*WWF/KORDI/KEI Yellow Sea Ecoregion Planning Programme*


*Scientific experts from China, and South Korea, Japan and other countries cooperated to analyse priority areas*



*important bird habitat in China*

*important bird habitat in South Korea*

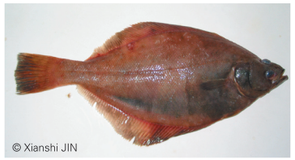

| No | Bird EIA | No | Bird EIA | No | Bird EIA | No | Bird EIA | No | Bird EIA |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Jiuduansha | 10 | Bohaiwan SW | 19 | Sihwaho Lake | 28 | Seonjedo Island | 37 | Gocheonamho Lake |
| 2 | Chongming Dongtan | 11 | Bohaiwan NW | 20 | Jangdan | 29 | Daebudo Island | 38 | Gangjin Bay |
| 3 | Yancheng Coast | 12 | Bohaiwan N | 21 | Yudo | 30 | Cheonsu Bay | 39 | Suncheon Bay |
| 4 | Lianyungang Coast | 13 | Beidaihe | 22 | Ganghwado Island | 31 | Yubudo Island | 40 | Junam Reservoir |
| 5 | Jiaozhouwan | 14 | Liaodongwan N | 23 | Yeongheungdo Island | 32 | Geumgang River | 41 | Naktong Estuary |
| 6 | Rongcheng Coast | 15 | Dalianwan | 24 | Yeongjongdo Island | 33 | Mangyeonggang Estuary | 42 | Jejudo Island |
| 7 | Laizhouwan | 16 | Changshan Islands | 25 | Songdo Island | 34 | Dongjingang Estuary | | |
| 8 | Huanghe River Delta | 17 | Yalujiang Coast | 26 | Namyang Bay | 35 | Haenam | | |
| 9 | Bohaiwan S | 18 | Hangang and Imjingang Estuaries | 27 | Asan Bay | 36 | Yeongamho, Geumho and Yeongsanho Lakes | | |

# Globally significant fish in the Yellow Sea Ecoregion

## A table of indicator fish species and their global significance

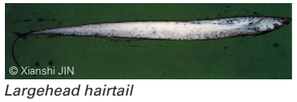
| Indicator Species | | Criteria for habitat and vulnerable species of global significance | | |
|---|---|---|---|---|
| **Scientific names** | **FishBase name and/ or FAO English name (other common name)** | **Criterion 1: Endemism** | **Criterion 2: Vulnerable Species** | **Criterion 3: Commercially Important Species** |
| *Larimichthys polyactis* | (Small) Yellow croaker | CKJ | (not definite, need further defition) | C K J |
| *Clupea pallasii pallasii* | Pacific herring | CKJ (isolated stock) | CK | C |
| *Gadus macrocephalus* | Pacific cod | CKJ (isolated stock) | C K | Cva Kva |
| *Penaeus chinensis* | Fleshy prawn (Chinese/ Korean shrimp) | CKJ | C K | C Kva Jva |
| *Pagrus major* | Red seabream | | C | Cva Jva |
| *Trichiurus lepturus* | Largehead hairtail | | | C K J |
| *Pleuronectidae spp.* | Flatfishes(mainly Cleisthenes herzensteini) | C | C | C K J |
| *Cleisthenes pinetorum* | Pointhead founder | | | Kvo Kva |
| *Scomber japonicus* | Chub mackerel | | | C K J |
| *Engraulis japonicus* | Japanese anchovy | C | C | Cvo K |
| *Scomberomorus niphonius* | Japanese Spanish mackerel | C | | C Kva |
| *Acetes spp.* | Acetes shrimp | C K J | C K | C |
| *Takifugu obscurus* | River puffer | K J | K | |
| *Atrobucca nibe* | Blackmouth croaker | | J | |
| *Lepidotrigla microptera* | Redwing searobin | | K J | |
| *Argyrosomus japonicus* | Japanese meagre | | J | |
| *Chimaera phantasma* | Silver chimaera (Ghost shark) | | J | |
| *Trachidermus fasciatus* | Roughskin sculpin | C J | | |
| *Coilia nasus* | Estuary tailfin anchovy | C K J | K (no data) J | |
| *Muraenesox cinereus* | Daggertooth pike conger | | K | J |
| *Paralichthys olivaceus* | Olive flounder as a representitative of flounders | | | CKJ |
| *Dentex tumifrons* | Yellowback seabream as a representitative of sea breams | | | Jva |
| *Lophius litulon* | Yellow goosefish | | K | Kva |
| *Protosalanx chinensis* | Chinese noodlefish | | K | |
| *Sebastes koreanus* | Korean rockfish | K | | |
| *Raja pulchra* | Mottled skate | K | K | Kva |
| *Pampus echinogaster* | Silver pomfret | | | C K |
| *Periophthalmus modestus* | Shuttles hoppfish | | K | |
| *Collichthys spp.* | e.g.) Bighead croaker | | | K |
| *(genus) Photololigo spp.* | Swordtip squid as a representative of squids & cuttlefish e.g. Photololigo edulis | | | K J |
| *Loligo spp. (Loligo japonica, L. beka)* | Common squids | | C | Cvo |
| *Todarodes pacificus* | Japanese flying squid | | | Cvo K |
| *Portunus trituburculatus* | Gazami crab(Blue crab) | K | K | C K |
| *Acipenser sinensis* | Chinese sturgeon | | C IUCN CR | |


*small yellow croaker*




*Sohachi, a species of flatfishes*


*Pacific cod*




*Largehead hairtail*

Notes:

Each indicator species were assessed against Criterion 1, 2 and 3. When an indicator species meets Criterion 1 according to data available in China, then it is indicated by C (China).

Note 1: In Criterion 1,2 and 3 columns, C indicates that a criterion is applicable to the corresponding species according to data from China, K: South Korea, J: Japan

Note 2: IUCN CR indicates the species is classified as Critically Endangered in the IUCN Red List of Threatened Species

Note 3: Cva: the species is commercially important by value in China, Kva: the species is commercially important by value in South Korea, Jva: the species is commercially important by value in Japan

Note 4: Cvo: the species is commercially important by volume in China

Photos by:

Xianshi JIN, GeoEye and NASA SeaWiFS Project

Publishers: WWF, Korea Ocean Research and Development Institute (KORDI), Korea Environment Institute (KEI)

Date of publication: March 2006

About the Yellow Sea Ecoregion Planning Programme: The Yellow Sea Ecoregion Planning Programme is an international partnership between WWF, KORDI, and KEI for conservation of biodiversity of the Yellow Sea Ecoregion.

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KEI: Lee Changhee, KEI, chlee@kei.re.kr, www.kei.re.kr

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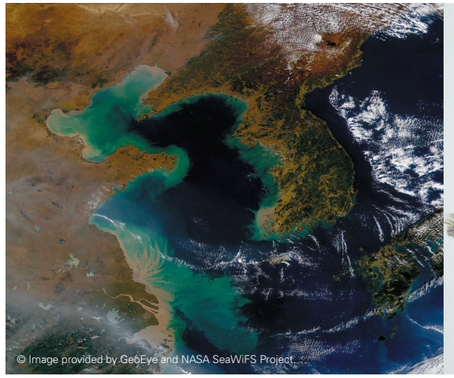
# Fish of the Yellow Sea Ecoregion and their habitats




*Satellite photo of Yellow Sea Ecoregion*


*Small Yellow Croaker –once the most common fish of the Yellow Sea Ecoregion*

## Fish of the Yellow Sea Ecoregion

### About the area

The Yellow Sea Ecoregion is one of the world's largest areas of continental shelf. The Yellow Sea Ecoregion encompasses the Bohai Sea, the Yellow Sea and the East China Sea. It is a transboundary area and extends from the coastlines of China, North Korea, and South Korea to a depth of 200m.

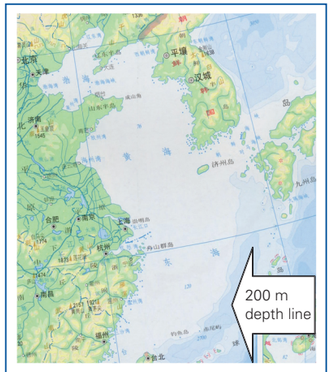
Valuable nutrients flow from the Yangtze and Yellow rivers and combine with sunlight and shallow waters to create an area that teems with abundant marine life.

### Diversity of fish species

In the Yellow Sea alone, 276 species of fish have been recorded. Compositions of about 100 commercial fisheries species in the Yellow Sea are: 66% demersal fish (bottom dwelling fish), 18% pelagic fish (swimming in the water column), 7% cephalopods (octopus and squid), and 7% crustacea (shrimps), of which 45% is warm-water species, 46% warm-temperate species, and 9% cold-temperate species. In the Bohai Sea, 109 species of fish are found and data in South Korea shows that 339 species of fish are on the record for the Yellow Sea.

### A unique cold water mass in the centre of the Yellow Sea

There is a 70-80 metre deep depression in the central part of the Yellow Sea. This depression holds a cold water mass throughout the year that provides an important habitat for cold-temperate fish species that are otherwise found in more northern seas.




*Borders of the Yellow Sea Ecoregion*

**What is an ecoregion?**

Biodiversity is not spread evenly across the Earth but follows complex patterns determined by climate, geology and the evolutionary history of the planet. These patterns are called ecoregions. WWF defines an ecoregion as a large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions.

The boundaries of an ecoregion are not fixed and sharp, but rather encompass an area within which important ecological and evolutionary processes most strongly interact.

## Fish and People

### Fish - A source of food and income and a foundation of life for coastal communities

Fisheries in the Yellow Sea Ecoregion generate a significant income as well as are a major source of food. A wide variety of fish, over 100 species, have commercial value. In China, the total fisheries output value from five provinces and municipalities along the Yellow Sea was about 80 billion RMB in 1997, accounting for about 1/3 of the national fisheries output. In South Korea, the catches from the Yellow Sea and the East China Sea on average for the last 30 years account for 30% of the national fisheries production.

Fisheries also have helped to support coastal communities to maintain their livelihoods and community structure.

## Threats to Fish and Fisheries

Fish in the Yellow Sea Ecoregion is one of the most intensively exploited fisheries resources in the world. Increasing pollution and extensive reclamation of coast areas have also affected reproduction of fish.

### A case of Small Yellow Croaker – From the one of the most abundant fish to up to 80% reduction

Small yellow croaker was one of the most abundant species in total fish catch in 1950's and 1960's in the Yellow Sea. In South Korea, it accounted for about 1/3 of the total catch in 1960's. However, the catch of small yellow croaker dramatically declined in following years because of overfishing. In China, small yellow croaker was the most dominant species in 1959 by occupying 37% in the catch, but it declined to only 9% in 1981. In South Korea, catch of small yellow croaker was similarly reduced by more than 80% between 1957 and 1983 while fishing intensity double from 1970's to 1980s.

In the 1990's, data from China shows some signs of recovery of small yellow croaker.

# The Yellow Sea Ecoregion - a Global Treasure, a Global Concern

### Global Treasure

Yellow Sea Ecoregion (203) has been selected by WWF as one of the Global 200 ecoregions, areas that are key to global biodiversity conservation. This marine ecosystem is also one of the Large Marine Ecosystems (LME) of the world.

### Global Concern

The global importance of the Yellow Sea Ecoregion has been recognised by governments and the international community in recent years. Starting in 1992, the Chinese and South Korean governments together developed a transboundary approach to the management of the Yellow Sea area with the assistance of UNDP, UNEP, the World Bank, and NOAA. In 2005, a UNDP/GEF project, the Yellow Sea Large Marine Ecosystem project, was officially launched with participation of the Chinese and South Korean governments.

Meanwhile, in 2002, WWF and other conservation NGOs and research institutes in China, South Korea and Japan began an assessment of Yellow Sea Ecoregion biodiversity. The objective of this regional partnership was to prioritise conservation actions based on scientific data.

### An urgent need: Identifying conservation priorities at a transboundary ecoregional scale

In order to conserve the full array of biodiversity and ensure the use of its services by people are sustainable, it is necessary to conduct assessments beyond political boundaries and at an ecoregional scale.

An ecoregional approach helps ensure that we do not overlook areas that are particularly unique or threatened, allowing for smarter trade-offs and greater positive impacts that are more likely to endure over time.

# Methodology - finding priority fish species and their Ecologically Important Areas

### Cooperation among scientific experts from China, South Korea, and Japan

Scientists from fisheries and ocean research institutes in China, South Korea and Japan have worked together to review and identify priority fish species and their habitats of global significance. Together they have set a common methodology and reached an agreement on priorities.

### Biological Assessment

Using a further set of criteria, experts then prioritised the previously selected indicator species and their habitat. To do this, scientists took into account representativeness of habitat, endemism, threatened status, commercial importance, intact habitat, and genetic diversity reduction. According to this common criterion, each scientist analysed nationally available data to select appropriate indicator species and their important habitat. Then they compiled national Biological Assessment papers based on data from China, South Korea, and Japan.

In addition to fish, scientists have added some squid and crab species that are important to fisheries in the Yellow Sea Ecoregion

### Priority Area Analysis

Using a further set of criteria, experts then prioritised the previously selected indicator species and their habitat. Scientists agreed that spawning aggregation areas are particularly important areas because they are geographically small but well defined and also they are critical areas to maintain populations. Scientists also pointed out that cold-water mass area is a unique and an important habitat because they support those isolated cold temperate species populations.

Experts then mapped the important habitat areas of each indicator species. This allowed scientists to visualise areas that are important for more than one species.

### Results

Fish Ecologically Important Areas (FEIAs) are areas that experts deem critical for fish species. 40 indicator species were assessed under the criteria to identify globally significant species and their habitat. Of these indicator species, 14 species met the endemism criterion, 22 species met vulnerable species criterion, and 23 species met commercially important species criterion. Those indicator species that met any of these criteria were identified as globally significant species. Then habitat areas of these globally significant species, where those areas are critical for the survial of the species, were identified as indicator species ecologically important areas. In total, 16 FEIAs were identified.

The Yellow Sea Ecoregion Planning Programme will publish full results of biodiversity assessment and priority area analysis so that they become accessible by scientists and government agencies in the future.

# A call to actions

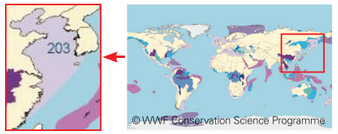
The analysis and results provided key data for developing a regional conservation strategy and monitoring its successes. In particular, the results will help to:

1) Establish a network of representative marine protected areas at the ecoregional scale;
2) Evaluate effectiveness of existing protected areas;
3) Monitor status of biodiversity.

In order to conserve these globally significant fish species and their habitats, various stakeholders need to take concerted actions.

Community-based organisations, the scientific community, national and local government agencies, legislative bodies, non-government organisations including religious groups, the general public, the media, donor communities, industries, consumers, and youth groups all have important roles to play.

For example, national and local government agencies can contribute by strengthening cross-sectoral coordination in the establishment and improvement of the management of MPAs. Filling major knowledge gaps in ecology and human impacts on indicator species is also an important action to take.




*Yellow Sea Ecoregion (203)*

*LME #48 Yellow Sea in Large Marine Ecosystems*

UNDP China — Yellow Sea

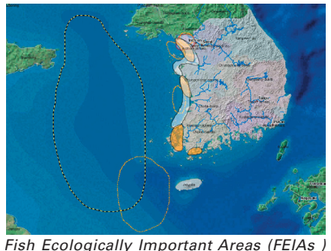
*UNDP/GEF Yellow Sea Project*

WWF — KORDI — KEI Korea Environment Institute

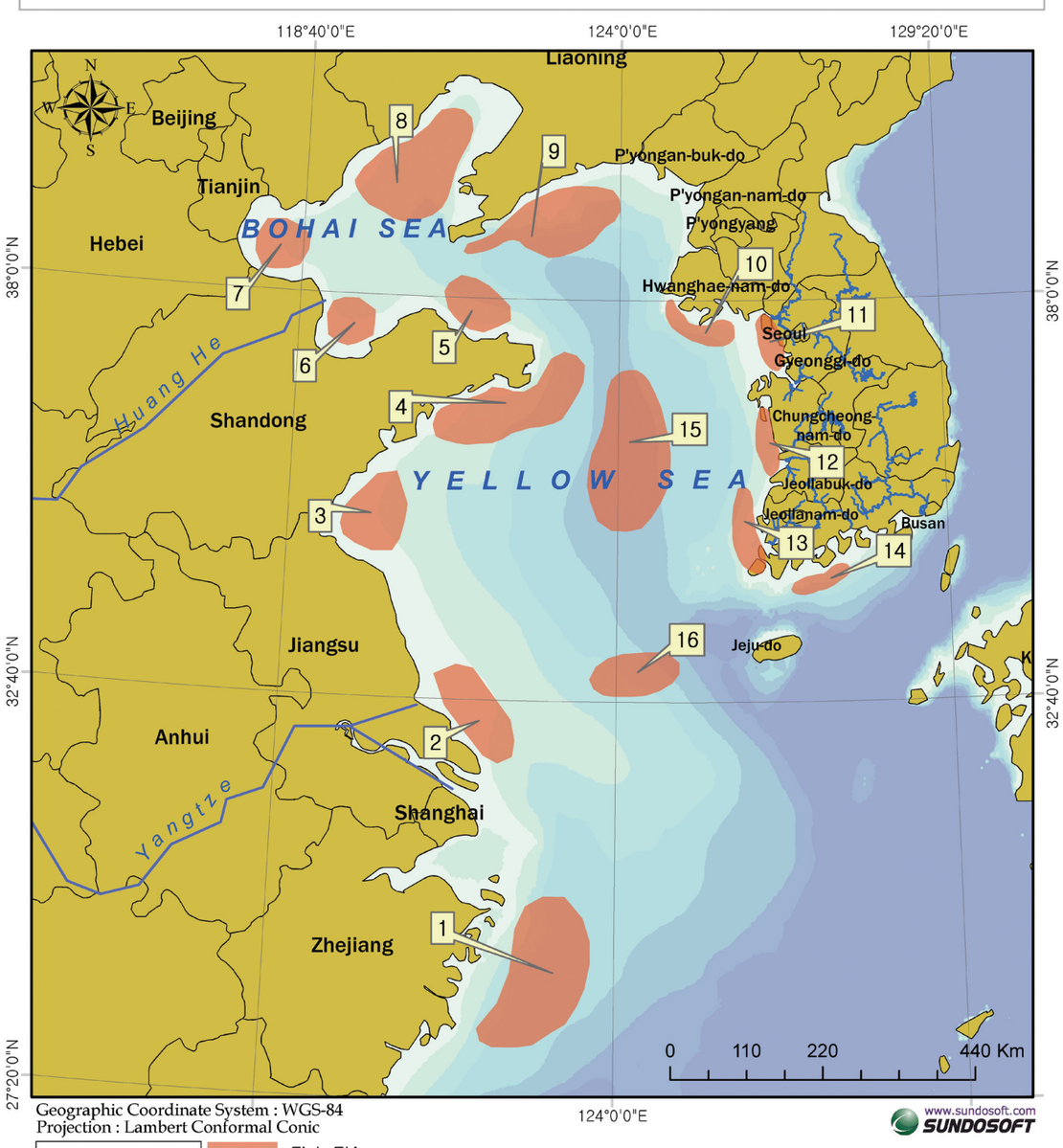
*WWF/KORDI/KEI Yellow Sea Ecoregion Planning Programme*

*Scientific experts from China, South Korea, Japan and other countries cooperate to analyse priority areas.*

*Important areas for a single fish species (Takifugu obscurus) according to Korean data.*



*Fish Ecologically Important Areas (FEIAs ) were identified by overlapping important areas for many different species*




| No | Fish EIA | No | Fish EIA |
|---|---|---|---|
| 1 | Zhoushan | 9 | Haiyang Dao |
| 2 | Lusi | 10 | Hwanghae-do South Coast |
| 3 | Haizhou Bay | 11 | Gyeonggi-do Coast |
| 4 | Shidao-Rushan | 12 | Greater Geumgang River Esturay |
| 5 | Yanwei | 13 | Jeollanam-do West Coast |
| 6 | Laizhou Bay | 14 | Jeollanam-do South Coast |
| 7 | Bohai Bay | 15 | Yellow Sea Cold Water Mass |
| 8 | Liaodong Bay | 16 | Southern Yellow Sea |

# A call to action

The results provided key data for developing a regional conservation strategy and monitoring its successes. In particular, the results will help to:

1) Establish a network of representative marine protected areas at the ecoregional scale;
2) Evaluate effectiveness of existing protected areas;
3) Monitor status of biodiversity.

In order to conserve coastal mollusk biodiversity, in particular, these sets of globally significant species and their globally significant areas, various stakeholders need to take concerted actions. Community-based organisations, the scientific community, national and local government agencies, legislative bodies, non-government organisations including religious groups, the general public, the media, donor communities, industries, consumers, and youth groups all have important roles to play. For example, national and local government agencies can contribute by strengthening cross-sectoral coordination in the establishment and improvement of the management of marine protected areas (MPAs). Filling major knowledge gaps in ecology and human impacts on indicator species is also an important action to take.

# Globally Significant Coastal Mollusks in Yellow Sea Ecoregion

## Table of coastal mollusk indicator species and their global significance

| Indicator Species | | Criteria for habitat and vulnerable species of global significance | | |
|---|---|---|---|---|
| **Scientific names** | **Common English names** | **Criterion 1: Endemism** | **Criterion 2: Vulnerable Species** | **Criterion 3: Commercially Important Species** |
| *Mactra veneriformis* | Surf clam | | | Cuva<br>Kvo Kuva |
| *Ruditapes philippinarum* | Shortnecked clam | | | Cvo Cva Cuva<br>Kvo Kva, K |
| *Meretrix spp.* | Hard clams | | | Kuva, K |
| *Rapana venosa* | Top shell | | | Kvo Kva Kuva |
| *Mactra chinensis* | Hen clam | | | Cuva<br>Kvo Kva Kuva |
| *Haliotidae spp* | Abalones | | | Cvo Cva Cuva<br>Kva Kuva |
| *Atrina pectinata* | Fun musse | | | Kva Kuva |
| *Fulvia mutica* | Cockle shell | | | Kva Kuva |
| *Cyclina sinensis* | Ciclina clam | | | Kuva |

Notes to the table

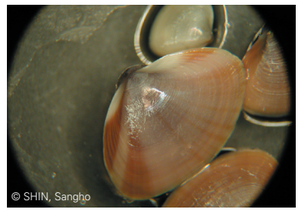
Each indicator species were assessed against Criterion 1, 2 and 3. When an indicator species meets Criterion 1 according to data available in China, then it is indicated by C (China).

Note 1:In Criterion 1,2 and 3 columns, C indicates that a criterion is applicable to the corresponding species according to data from China, K: South Korea.

Note 2:Kvo: commercially important by volume in South Korea, Kva: commercially important by value in South Korea, and Kuva: commercially important by unit value in South Korea

*Shortnecked clam*

*Surf clam*



*Hen clam*

*Hard clam*

Photos by:
JE, Jonggeel, SHIN, Sangho, GeoEye and NASA SeaWiFS Project

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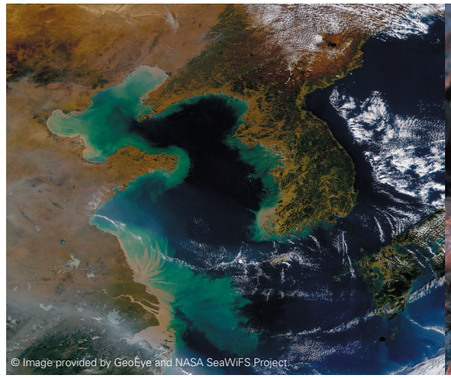
# Coastal Mollusks of the Yellow Sea Ecoregion and their habitats



*Satellite photo of Yellow Sea Ecoregion*

*Ruditapes philippinarum Shortnecked clam*

# Coastal Mollusks of the Yellow Sea Ecoregion

### About the area

The Yellow Sea Ecoregion is one of the world's largest areas of continental shelf. The Yellow Sea Ecoregion encompasses the Bohai Sea, the Yellow Sea and the East China Sea. It is a transboundary area, and extends from the coastlines of China, North Korea, and South Korea to a depth of 200m.

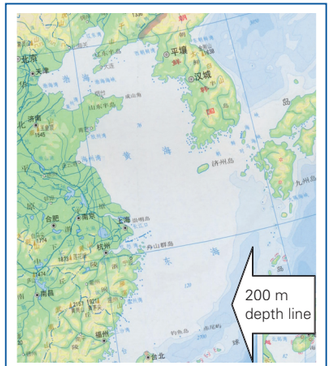
Valuable nutrients flow from the Yangtze and Yellow rivers and combine with sunlight and shallow waters to create an area that teems with abundant marine life.

### Diversity of coastal invertebrates including mollusk species

In the Yellow Sea Ecoregion, major taxonomic groups among the marine invertebrate species are Polychaeta (marine worms), Mollusca (clams, oysters, squids, octopus), Crustacea (shrimp and crabs), Echinodermata (sea urchins, sea stars, and sea cucumbers).

In the Chinese part of the intertidal area, species group compositions of invertebrates are 9 species of Cnidaria (sea anemones, corals, jellyfish, and hydroids), 100 Plychaeta, 171 Mollusca, 107 Crustacea, and 22 Echinodermata. Mollusks form the most dominant taxonomic group in both the Bohai Sea and the Yellow Sea by accounting for about 50% of biomass among benthic biomass.

In the South Korean part of the Yellow Sea, about 500 species of marine invertebrate species have been recorded. There are 135 species of Mollusks, 106 Arthropoda (crustaceans), 87 Annelida (marine worms), 24 Echinoderms, 34 Cnidaria (sea anemones, corals, jellyfish, and hydroids), and 7 Porifera (sponges). Mollusks are one of the most dominant taxonomic groups in terms of biomass in subtidal and intertidal areas.



*Borders of the Yellow Sea Ecoregion*

**What is an ecoregion?**

Biodiversity is not spread evenly across the Earth but follows complex patterns determined by climate, geology and the evolutionary history of the planet. These patterns are called ecoregions. WWF defines an ecoregion as a large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions.

The boundaries of an ecoregion are not fixed and sharp, but rather encompass an area within which important ecological and evolutionary processes most strongly interact.

# Coastal Mollusks and People

Coastal mollusks provide a significant source of income and food supply for local communities and regional economies both in China and South Korea.

In China, mariculture of coastal mollusks occupies a large portion of coastal area. The shellfish mariculture area in five provinces in the Yellow Sea Ecoregion was 371,100 ha in 1997, which accounts for about 70% of mariculture areas. The volume of shellfish mariculture production from the Yellow Sea Ecoregion is equally significant at 3 million tons in 1997, which accounts for about 80% of the total mariculture production and also nearly 50% of the China´ s national shellfish production. In South Korea, a major part of fishing activities on tidal flats are for mollusks. Each year, about 50,000-90,000 tons of clams are harvested, and another 1,000 tons of mud octopus and 500 tons of polychaetes are caught as main products from mud flats.

# Threats to Coastal Mollusks

Expansion of mariculture, reclamation and loss of wetlands, and marine pollution are affecting coastal habitat on which coastal mollusks depend for their survival.

In China, mariculture has brought negative impacts as well as economic achievements, including polluted discharge from shrimp and fishponds.

Reclamation poses a serious threat to coastal mollusks in South Korea. Estuarine tidal flats are the preferred habitat for the hard clam. Most of the production of this mollusk species comes from the Saemangeum estuary area on the Yellow Sea coast. However, the area is the site of the Saemangeum reclamation project and with the completion of this project, most of the hard clams will disappear from this area.

# The Yellow Sea Ecoregion - a Global Treasure, a Global Concern

### Global Treasure

The Yellow Sea Ecoregion (203) has been selected by WWF as one of the Global 200 ecoregions, areas that are key to global biodiversity conservation. This marine ecosystem is also one of the Large Marine Ecosystems (LME) of the world.

### Global Concern

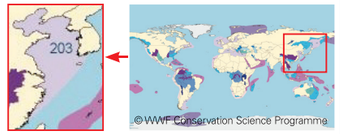
The global importance of the Yellow Sea Ecoregion has been recognised by governments and the international community in recent years. Starting in 1992, the Chinese and South Korean governments together developed a transboundary approach to the management of the Yellow Sea area with the assistance of UNDP, UNEP, the World Bank, and NOAA. In 2005, a UNDP/GEF project, the Yellow Sea Large Marine Ecosystem project, was officially launched with participation of the Chinese and South Korean governments.

Meanwhile, in 2002, WWF and other research institutes in China, South Korea and Japan began an assessment of Yellow Sea Ecoregion biodiversity. The objective of this regional partnership was to prioritise conservation actions based on scientific data.

### An urgent need: Identifying conservation priorities at a transboundary ecoregional scale

In order to conserve the full array of biodiversity and ensure the use of its services by people are sustainable, it is necessary to conduct assessments beyond political boundaries and at an ecoregional scale.

An ecoregional approach helps ensure that we do not overlook areas that are particularly unique or threatened, allowing for smarter trade-offs and greater positive impacts that are more likely to endure over time.




*Yellow Sea Ecoregion (203)*

*LME #48 Yellow Sea in Large Marine Ecosystem*

UNDP China — Yellow Sea

*UNDP/GEF Yellow Sea Project*

WWF — KORDI — KEI Korea Environment Institute

*WWF/KORDI/KEI Yellow Sea Ecoregion Planning Programme*

# Methodology - finding priority coastal mollusk species and their Ecologically Important Areas

### Cooperation among scientific experts from China and South Korea

Scientists from universities and ocean research institutes in China and South Korea have worked together to review and identify priority coastal mollusk species and their habitats of global significance. Together they have set a common methodology and reached an agreement on priorities.

### Biological Assessment

Using a set of mutually agreed criteria, scientists developed a set of criteria for indicator species that are key for biodiversity conservation. Among many of the marine invertebrate species groups, the scientists selected coastal mollusks, and more specifically coastal Bivalvia and Gastropoda groups (clams and sea snails groups) as indicator species. The scientists chose representative habitat types, endemism, species richness, threatened status, and commercial importance as a set of criteria. According to these common criteria, each scientist has analysed nationally available data to select appropriate indicator species and ecologically important areas and they compiled national Biological Assessment papers for China and South Korea.

### Priority Area Analysis

Using a further set of criteria, experts then prioritised the previously selected indicator species and their habitat. Scientists adopted endemism, threatened status, and commercial importance as a set of criteria for the Priority Area Analysis.

Thirdly, the scientists overlaid important areas for each indicator species. This allowed scientists to visualise overlapping areas that are important for more than one species.

### Results

Coastal Mollusk Ecologically Important Areas (CMEIAs) are the areas that are important for coastal mollusk species. Twelve indicator species were assessed under the Priority Area Analysis criteria to identify globally significant species and their habitat. Of these indicator species, no species met the endemism criterion and venerable species criterion, and nine species were applicable under the commercial importance criterion. Those indicator species that met any of these criteria were identified as globally significant species. Then habitat areas of these globally significant species, where those areas are critical for the survial of the species, were identified as indicator species ecologically important areas. In total, 20 Coastal CMEIAs were identified.

The Yellow Sea Ecoregion Planning Programme will publish the full results of biodiversity assessment and priority area analysis, so that they become accessible by scientists and government agencies in the future.

*Scientific experts from China, South Korea, Japan and other countries cooperate to analyse priority areas*


*Distribution of hard clams in South Korea*


*High mollusk and other species diversity (>60 species) sites in South Korea*

## Globally Siginificant Areas for Coastal Mollusks in Yellow Sea Ecoregion (China and South Korea)

**- Yellow Sea Ecoregion Planning Programme -**

WWF — KORDI — KEI


Geographic Coordinate System : WGS-84
Projection : Lambert Conformal Conic

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**Bathymetry**

- Under 200m
- 200m - 100m
- 100m - 90m
- 90m - 70m
- 70m - 50m
- 50m - 30m
- 30m - 10m
- 10m - 0m

Coastal Mollusk EIA

| No | Coastal Mollusk EIA | No | Coastal Mollusk EIA | No | Coastal Mollusk EIA |
|---|---|---|---|---|---|
| 1 | Lianyungang | 8 | Changdao | 15 | Jeollabuk-do |
| 2 | Rizhao | 9 | Tanggu | 16 | West Jeollanam-do |
| 3 | Qingdao | 10 | Qinghuangdao | 17 | Chujado Island |
| 4 | Rushan | 11 | Huludao | 18 | Cheongsando Island |
| 5 | Roncheng | 12 | Dalian | 19 | Yeoja Bay |
| 6 | Weihai | 13 | Gyeonggi Bay | 20 | Jejudo Island |
| 7 | Yantai | 14 | Chungcheongnam-do | | |

# Globally Significant Coastal Plants in the Yellow Sea Ecoregion

## Table of coastal plant indicator species and their global significance

| Indicator Species | | Criteria for habitat and vulnerable species of global significance | | |
|---|---|---|---|---|
| Scientific names(Synonym) | Criterion 1: Endemism | Criterion 2: Vulnerable Species | Criterion 3: Commercially Important Species | Criterion 4:Representation of all major habitat types(Definition: Subtidal, intertidal, sandy beach) |
| *Zostera marina* | | K | | sub-tidal flat |
| *Suaeda glauca(Suaeda asparagoides)* | | | C | intertidal wetland |
| *Suaeda maritima* | | | | intertidal wetland |
| *Suaeda japonica* | | | | intertidal wetland |
| *Salicornia herbacea(Salicornia europaea)* | | K | CK | intertidal wetland |
| *Aeluropus littoralis var. sinensis* | | | | intertidal wetlandestuary |
| *Phragmites communis* | | | C | intertidal wetlandestuary |
| *Tamarix chinensis* | | | | intertidal wetlandestuary |
| *Scirpus triqueter* | | K | | intertidal wetland |
| *Scirpus mariqueter* | C | | | intertidal wetland |
| *Carex scabrifolia* | | | | intertidal wetlandestuary |
| *Carex kobomugi* | | | | sand dune |
| *Zoysia sinica* | | | | intertidal wetland |
| *Vitex trifolia var. simplicifolia* | | | C (medicinal plant use, but no statistics on commercial importance) | sand dune |
| *Glehnia littoralis* | | C,K | | sand dune |
| *Rosa rugosa* | | C,K | | sand dune |
| *Triglochin maritimum* | | K | | intertidal wetland |
| *Limonium tetragonum* | | K | | intertidal wetland |
| *Artemisia scoparia* | | K | | intertidal wetland |
| *Aster tripolium* | | K | | intertidal wetland |
| *Lathylus japonica* | | | | sand dune |
| *Calystegia soldanella* | | | | sand dune |

Notes

Each indicator species were assessed against Criterion 1, 2 and 3. When an indicator species meets Criterion 1 according to data available in China, then it is indicated by C (China).

Note 1: In Criterion 1,2 and 3 columns, C indicates that a criterion is applicable to the corresponding species according to data from China, K: South Korea.

Note 2: IUCN CR, IUCN EN, and IUCN VU indicate the species is classified as Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) respectively in the IUCN Red List of Threatened Species.

Note 3: In Criterion 4 column Yes indicates the Ramsar criteria on waterbirds were applied to the corresponding species.

Photos by: MIN, Byungmee, GeoEye and NASA SeaWiFS Project

Publishers: WWF, Korea Ocean Research and Development Institute (KORDI), Korea Environment Institute (KEI)

Date of publication: March 2006

About the Yellow Sea Ecoregion Planning Programme: The Yellow Sea Ecoregion Planning Programme is an international partnership between WWF, KORDI, and KEI for conservation of biodiversity of the Yellow Sea Ecoregion.

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**UNDP/GEF Yellow Sea Project is a sponsor of this pamphlet.**

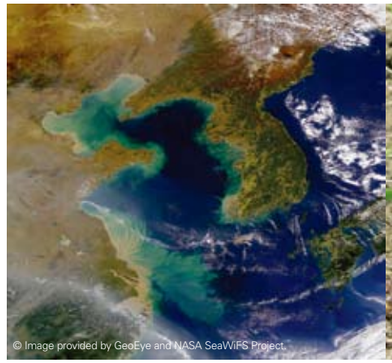

*Salicornia herbacea*


*Phragmites communis*


*Carex kobomugi*


*Rosa rugosa*

# Coastal Plants of the Yellow Sea Ecoregion




*Satellite photo of Yellow Sea Ecoregion*


*Salicornia herbacea - a representative coastal plant of intertidal wetlands*

## Coastal Plants and the Yellow Sea Ecoregion

### About the area

The Yellow Sea Ecoregion is one of the world's largest areas of continental shelf. The Yellow Sea Ecoregion encompasses the Bohai Sea, the Yellow Sea and the East China Sea. It is a transboundary area, and extends from the coastlines of China, North Korea, and South Korea to a depth of 200m.

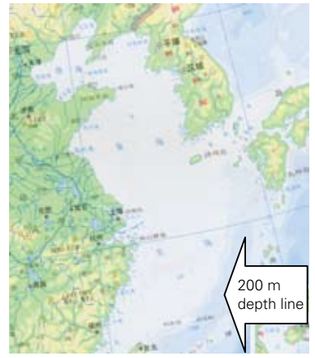
Valuable nutrients flow from the Yangtze and Yellow rivers and combine with sunlight and shallow waters to create an area that teems with abundant marine life.

### Diversity of coastal plant species and community types

The term coastal plant has a broad meaning and can include many different sub groups of plant species in the Yellow Sea Ecoregion. Included in the definition of coastal plants by the Yellow Sea Ecoregion Planning Programme are vascular plant species in coastal dunes and beaches, intertidal flats, and sub-tidal areas. They do not include phytoplanktons (small plant planktons), although they are also an important part of the marine ecosystem of the Yellow Sea Ecoregion.

In China, coastal marshes can be divided into 10 major community types such as the *Suaeda salsa* type in the upper intertidal zone to inland, the *Salicornia europaea* type inside and outside sea dikes, or the *Scirpus mariqueter* type intertidal zones with solid sandy bottom. Sea grass species, such as the *Zostera* species (eelgrasses), are found in waters off Shandong, Hebei and Liaoning Provinces.

In South Korea, representative species among halophyte species (plants that live in salt marshes and sea coast) are: *Zostera marina* (eelgrass; abundant and dominant in sub-tidal flats), *Phragmites communis* (reed; found in estuaries), *Zyosia sinica*, *Suaeda maritima* and *Carex scabrifolia* (found in mean high tide level areas), and *Suaeda japonica* (in intertidal flats).




*Geography of Yellow Sea Ecoregion*

**What is an ecoregion?**
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## Coastal Plants and People

Coastal plants have been providing a variety of ecosystem services both directly and indirectly to people in the Yellow Sea Ecoregion.

Some coastal plants are economically important. Seed oil of *Suaeda glauca* was studied and found to contain medicinal properties. This plant is also eaten in China. Reeds have long been harvested as a building material and to make paper in China. Coastal plants also provide indirect benefits. Eelgrass in shallow coastal waters support fisheries by providing spawning grounds for fish and natural communities of coastal plants help protect coastlines from erosion.

*Reeds being harvested in China for making paper*

## Threats to Coastal Plants

Large-scale habitat loss is a serious threat to coastal plants in the Yellow Sea Ecoregion.
Habitat loss is mainly caused by conversion of coastal wetlands by reclamation into agricultural land, saltpans, fishponds and other industrial and urban development. Extensive coastal habitat loss has already happened in the Yellow Sea Ecoregion. In South Korea, about 43% of intertidal wetlands have been lost during the 20th century. In China, about 37% of intertidal wetlands have been converted in the last 50 years.
Sea grass beds in China have been in decline since 1940 and more than one third of them have been lost due to pollution and damage by boat propellers and anchors.

# The Yellow Sea Ecoregion - a Global Treasure, a Global Concern

### Global Treasure

The Yellow Sea Ecoregion (203) has been selected by WWF as one of the Global 200 ecoregions, areas that are key to global biodiversity conservation. This marine ecosystem is also one of the Large Marine Ecosystems (LME) of the world.

### Global Concern

The global importance of the Yellow Sea Ecoregion has been recognised by governments and the international community in recent years. Starting in 1992, the Chinese and South Korean governments together developed a transboundary approach to the management of the Yellow Sea area with the assistance of UNDP, UNEP, the World Bank, and NOAA. In 2005, a UNDP/GEF project, the Yellow Sea Large Marine Ecosystem project, was officially launched with participation of the Chinese and South Korean governments.

Meanwhile, in 2002, WWF and other research institutes in China, South Korea and Japan began an assessment of Yellow Sea Ecoregion biodiversity. The objective of this regional partnership was to prioritise conservation actions based on scientific data.

### An urgent need: Identifying conservation priorities at a transboundary ecoregional scale

In order to conserve the full array of biodiversity and ensure the use its services by people are sustainable, it is necessary to conduct assessments beyond political boundaries and at an ecoregional scale.

An ecoregional approach helps ensure that we do not overlook areas that are particularly unique or threatened, allowing for smarter trade-offs and greater positive impacts that are more likely to endure over time.


*Yellow Sea Ecoregion (203)*

*LME #48 Yellow Sea Large Marine Ecosystem (red area)*

*UNDP/GEF Yellow Sea Project*

*WWF/KORDI/KEI Yellow Sea Ecoregion Planning Programme*

# Methodology - finding priority coastal plant species and their Ecologically Important Areas

### A work through international cooperation among scientific experts from China and South Korea

Scientists from universities and environmental research institutes in China and South Korea cooperated to review and identify priority coastal plant species and their habitat of global significance. Two international workshops and two national workshops were organised to set a common methodology and reached an agreement on priorities.

### Biological Assessment

Using a set of mutually agreed criteria that are key to biodiversity conservation - endemism, threatened species status, and commercial importance - scientists analysed nationally available data to select appropriate indicator species and ecologically important areas, and compiled national Biological Assessment papers for China and South Korea.

### Priority Area Analysis

Using a further set of criteria, scientists further prioritised the selected important species and important habitats. Scientists adopted representative habitat types, endemism, threatened status, and commercial importance as a set of criteria for the Priority Area Analysis. Taxonomy of coastal plant species is a complex issue as there are more than one scientific name given to what may be the same species. The scientists judiciously reviewed this issue during the analysis.

Scientists then overlaid important habitat areas of each indicator species. This allowed scientists to visualise overlapping areas that are important for coastal plant species.

### Results

Coastal Plant Ecologically Important Areas (CPEIAs) are areas that are important for coastal plant species. 22 indicator species were assessed under the Priority Area Analysis criteria to identify globally significant species and their habitat of global significance. Of these indicator species, 1 species met the endemism criterion, 9 species met venerable species criterion, and 4 species met commercially important species criterion. Those indicator species that met any of these criteria were identified as globally significant species. Then habitat areas of these globally significant species, where those areas are critical for the survial of the species, were identified as indicator species ecologically important areas. In total, 17 CPEIAs were identified.

The Yellow Sea Ecoregion Planning Programme will publish the full results of the biodiversity assessment and the priority area analysis so that the results will be accessible by scientists and government agencies in the future.

*Scientific experts from China, South Korea, Japan and other countries cooperated to analyse priority areas.*


*Important area for reed Phragmites communis in South Korea*


*Important area for a number of Indicator Species in South Korea*

# A call to actions

The results provided key data for developing a regional conservation strategy and monitoring its successes. In particular, the results will help to:

1) Establish a network of representative marine protected areas at the ecoregional scale;

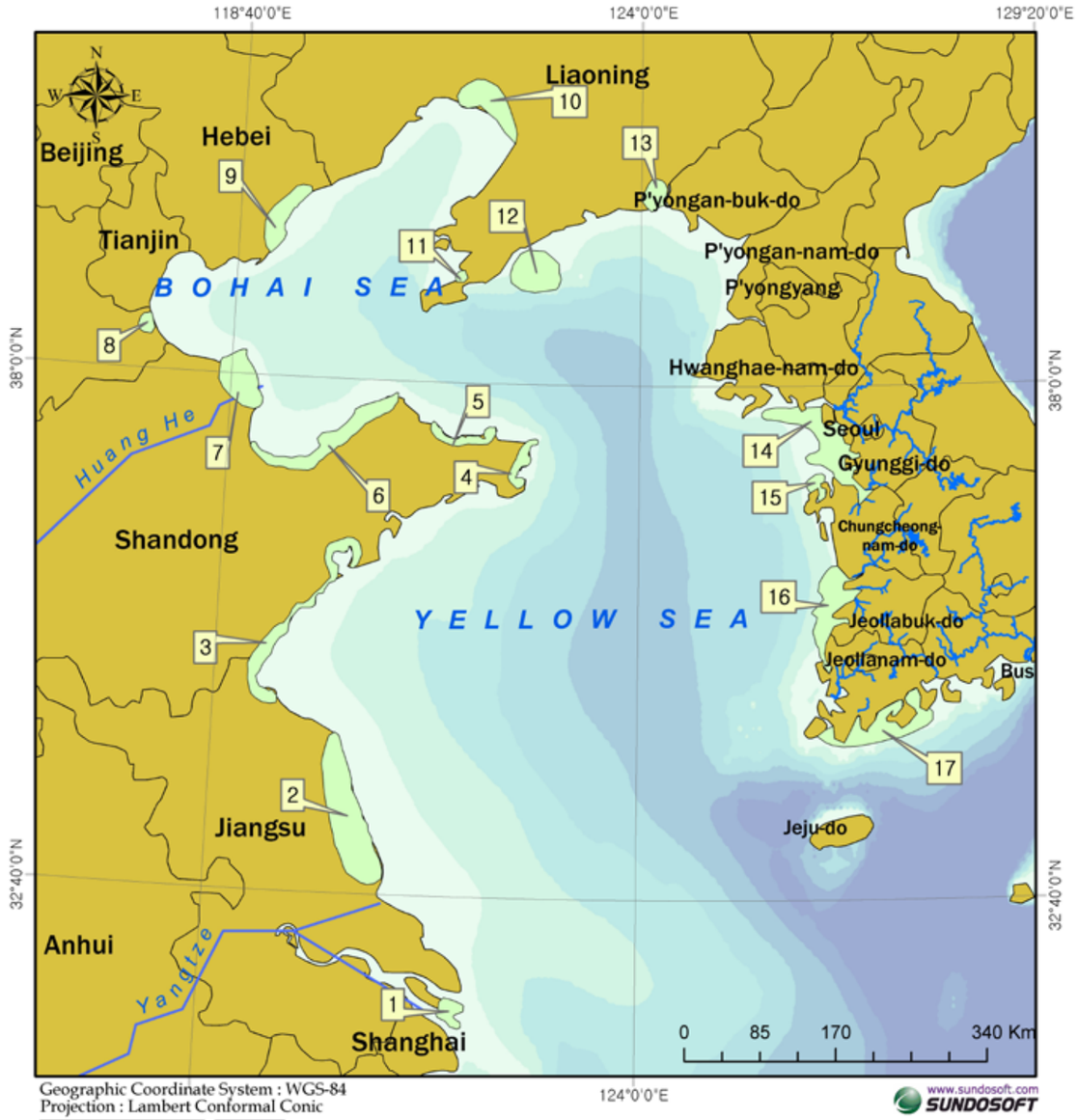
2) Evaluate effectiveness of existing protected areas;

3) Monitor status of biodiversity.

In order to conserve these globally significant species and their habitats, various stakeholders need to take concerted actions. Community-based organisations, the scientific community, national and local government agencies, legislative bodies, non-government organisations including religious groups, the general public, the media, donor communities, industries, consumers, and youth groups all have important roles to play. For example, national and local government agencies can contribute by strengthening cross-sectoral coordination in the establishment and improvement of the management of marine protected areas (MPAs). Filling major knowledge gaps in ecology and human impacts on indicator species is also an important action to take.

## Globally Siginificant Areas for Coastal Plants in Yellow Sea Ecoregion (China and South Korea)

### - Yellow Sea Ecoregion Planning Programme -




Geographic Coordinate System : WGS-84
Projection : Lambert Conformal Conic

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**Bathymetry**

- Under 200m
- 200m - 100m
- 100m - 90m
- 90m - 70m
- 70m - 50m
- 50m - 30m
- 30m - 10m
- 10m - 0m

Coastal Plant EIA

| No | Coastal Plant EIA | No | Coastal Plant EIA | No | Coastal Plant EIA |
|---|---|---|---|---|---|
| 1 | Yangtze River Estuary | 8 | Nandagang Marsh | 15 | Sinduri |
| 2 | Yangcheng Beach | 9 | Qinghuangdao Sand Beaches | 16 | Mangyeong and Dongjin Esutuaries -Hampyeong Bay |
| 3 | Lu-su Coast | 10 | Liaohe River Delta | 17 | Jindo - Suncheon Bay |
| 4 | Rongcheng Beach | 11 | Dalian Bay | | |
| 5 | Jiaodong Peninsula Coast | 12 | Changhai Islands | | |
| 6 | Laizhou Bay East Coast | 13 | Yalujiang River Mouth | | |
| 7 | Huanghe River Delta | 14 | Baengnyeongdo-Ganghwado-Jaweoldo Islands | | |

# Globally Significant Algae in the Yellow Sea Ecoregion

## A table of algae indicator species and their global significance

| Indicator Species | Criteria for habitat and vulnerable species of global significance | | |
|---|---|---|---|
| Scientific names | Criterion 1: Endemism | Criterion 2: Vulnerable Species | Criterion 3:Commercially Important Species |
| *Laminaria japonica* | | | C K |
| *Sargassum qingdaoense* | C | | |
| *Undaria pinnatifida* | | | C K |
| *Silvetia siliquosa (Pelvetia siliquosa)* | C K | C K | |
| *Hizikia fusiformis* | K | C | K |
| *Porphyra yezoensis* | | | C K |
| *Porphyra katadae var. hemiphylla* | C | | |
| *Porphyra oligospermatangia* | C | | |
| *Porphyra tenera* | | C | |
| *Gracilaria lemaneiformis (Gracilaria verrucosa)* | | | C |
| *Gracilaria chorda* | K | | |
| *Tsengiella spinulosa* | C | | |
| *Tsengia nakamurae* | C | | |
| *Solieria tenuis* | C | | |
| *Caulerpa okamurae* | K | | Kva |
| *Ishige okamurae* | K | | |
| *Chondrus ocellatus* | | | Kva |
| *Gelidium amansii* | | | Kva |

Notes to the table

Each indicator species were assessed against Criterion 1, 2 and 3. When an indicator species meets Criterion 1 according to data available in China, then it is indicated by C (China).

Note 1 In Criterion 1,2 and 3 columns, C indicates that the criterion is applicable to the corresponding species according to data from China, K: South Korea.

Note 2 Kva indicates that the corresponding species is commercially important by value in South Korea

Note 3 From biodiversity conservation point of view, Laminaria japonica is NOT a globally significant species where it is an introduced species such as in China.

photos by: C.K.Tseng et al. offered by Ding Lanping, Tobai Sadayosi.

Publishers: WWF, Korea Ocean Research and Development Institute (KORDI), Korea Environment Institute (KEI)

Date of publication: March 2006

About the Yellow Sea Ecoregion Planning Programme: The Yellow Sea Ecoregion Planning Programme is an international partnership between WWF, KORDI, and KEI for conservation of biodiversity of the Yellow Sea Ecoregion.

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**This pamphlet was funded by the Japan Fund for Global Environment.**

**UNDP/GEF Yellow Sea Project is a sponsor of this pamphlet.**

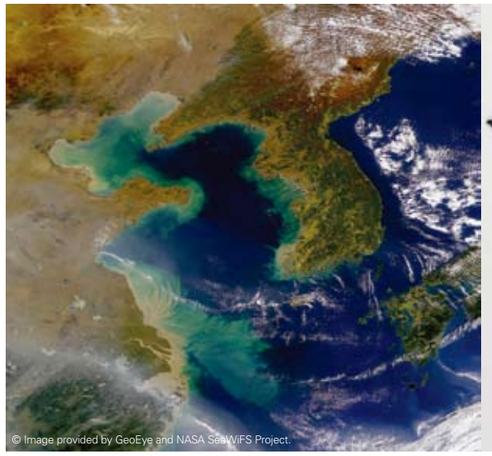

*Laminaria japonica*


*Porphyra katadai var hemiphylla*


*Porphyra tenera*


*Undaria pinnatifida*

# Algae of the Yellow Sea Ecoregion and their habitats




*Satellite photo of Yellow Sea Ecoregion*


*Silvetia siliquosa - a seaweed unique to the Yellow Sea Ecoregion*

## Algae and the Yellow Sea Ecoregion

### About the area

The Yellow Sea Ecoregion is one of the world's largest areas of continental shelf. The Yellow Sea Ecoregion encompasses the Bohai Sea, the Yellow Sea and the East China Sea. It is a transboundary area, and extends from the coastlines of China, North Korea, and South Korea to a depth of 200m.

Valuable nutrients flow from the Yangtze and Yellow rivers and combine with sunlight and shallow waters to create an area that teems with abundant marine life.

### Diversity of algae

Algae or seaweed are divided into a number of subgroups. Red algae, or Rhodophyta, are red or purple and most of the world's seaweeds belong to this group. The Brown algae (Phaeophyta) group also contains many familiar types of seaweed such as kelp. Green algae are the most advanced group. In addition, there are Dinoflagellata and Chrysophyta groups of algae that are mostly single-cell and small algae species.

In the tidal zone of the northern Shandong Peninsula in China, 42 species of red algae, 22 species of brown algae, and 11 species of green algae have been recorded. In the southern Yellow Sea, there are 84 algae species, including 15 species of green algae, 15 species of brown algae, and 28 species of red algae. Among phytoplankton (plant plankton) in the Bohai Sea and the Yellow Sea, Bacillariophyta group, which is a subgroup of Chrysophyta, is the largest group with 308 species.

In South Korea, a total of 395 species of algae have been identified, which consist of 43 species of blue-green algae, 45 species of green algae, 90 species of brown algae, and 217 species of red algae species. Among phytoplankton groups, Bacillariophyta had highest number of species (312 species).


*Geography of Yellow Sea Ecoregion*

**What is an ecoregion?**

Biodiversity is not spread evenly across the Earth but follows complex patterns determined by climate, geology and the evolutionary history of the planet. These patterns are called ecoregions. WWF defines an ecoregion as a large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions. The boundaries of an ecoregion are not fixed and sharp, but rather encompass an area within which important ecological and evolutionary processes most strongly interact.

## Algae and People

There is a long history of using algae in the region. People collect algae for food and recently some species of seaweeds are being used for industrial and medicinal materials such alginates. Algae are harvested from natural habitat as well as from aquaculture.

Aquaculture of algae has become an economically important industry both in China and South Korea. In China, *Laminaria* (Japanese kelp) and *Porphyra* (Laver or Nori) are main cultured species and the production of these species account for about 66% of total algae production in China. In South Korea, *Sargassum*, *Porphyra* and *Undaria* (Wakame) species are important crops; the annual production of seaweeds in the Yellow Sea coast in South Korea had a value of US$ 165 million in 1996.


*Seeweed aquaculture in South Korea*

## Threats to Algae

Some species such as *Silvetia siliquosa* has reduced its distribution due to water pollution. Construction of dams in estuaries has impacted culture of nori seaweed because of reduction in nitrogen and big changes in salinity. Over-harvesting has also affected some algae species.

# The Yellow Sea Ecoregion - a Global Treasure, a Global Concern

### Global Treasure

The Yellow Sea Ecoregion (203) has been selected by WWF as one of the Global 200 ecoregions, areas that are key to global biodiversity conservation. This marine ecosystem is also one of the Large Marine Ecosystems (LME) of the world.

### Global Concern

The global importance of the Yellow Sea Ecoregion has been recognised by governments and the international community in recent years. Starting in 1992, the Chinese and South Korean governments together developed a transboundary approach to the management of the Yellow Sea area with the assistance of UNDP, UNEP, the World Bank, and NOAA. In 2005, a UNDP/GEF project, the Yellow Sea Large Marine Ecosystem project, was officially launched with participation of the Chinese and South Korean governments.

Meanwhile, in 2002, WWF and other research institutes in China, South Korea and Japan began an assessment of Yellow Sea Ecoregion biodiversity. The objective of this regional partnership was to prioritise conservation actions based on scientific data.

### An urgent need: Identifying conservation priorities at a transboundary ecoregional scale

In order to conserve the full array of biodiversity and ensure the use of its services by people are sustainable, it is necessary to conduct assessments beyond political boundaries and at an ecoregional scale.

An ecoregional approach helps ensure that we do not overlook areas that are particularly unique or threatened, allowing for smarter trade-offs and greater positive impacts that are more likely to endure over time.


*Yellow Sea Ecoregion (203)*

*LME #48 Yellow Sea Large Marine Ecosystem (red area)*

UNDP Yellow Sea

*UNDP/GEF Yellow Sea Project*

WWF KORDI KEI Korea Environment Institute

*WWF/KORDI/KEI Yellow Sea Ecoregion Planning Programme*

# Methodology for finding priority algae species and their Ecologically Important Areas

### Cooperation among scientific experts from China and South Korea

Scientists from universities and ocedan research institutes in China and South Korea have worked together to review and identify priority algae species and their habitats of global significance. Together they have set a common methodology and reached an agreement on priorities.

### Biological Assessment

Using a set of mutually agreed criteria that are key to biodiversity conservation -representative species (abundant species), endemism, threatened status, and commercial importance-experts selected the macroalgae species in the green algae, red algae, and brown algae groups as targets of assessment. According to these common criteria, each scientist analysed nationally available data to select appropriate indicator species and ecologically important areas and they compiled national Biological Assessment papers for China and South Korea.

### Priority Area Analysis

Using a further set of criteria, experts then prioritised the previously selected indicator species and their habitat. Scientists adopted endemism, vulnerable species, and commercial importance as a set of criteria for the Priority Area Analysis. In identifying ecologically important areas for each Indicator Species of algae, some species had wide distribution and in such cases, scientists selected good reference areas for those species.

The scientists then overlaid important habitat areas of each indicator species, allowing scientists to visualise overlapping areas.

### Results

Areas that are important for algae species are called Algae Ecologically Important Areas (AEIAs). 23 indicator species were assessed under the criteria to identify globally significant species and their habitat. Of these indicator species, 11 species met the endemism criterion, 3 species met Venerable Species criterion, and 8 species met Commercially Important Species criterion. Those indicator species that met any of these criteria were identified as globally significant species. Then habitat areas of these globally significant species, where those areas are critical for the survial of the species, were identified as indicator species ecologically important areas. In total, 13 AEIAs were identified.

The Yellow Sea Ecoregion Planning Programme will publish the full results of the biodiversity assessment and the priority area analysis, so that the results will be accessible by scientists and government agencies to use in the future.

*Scientific experts from China, South Korea, Japan and other countries cooperated to analyse priority areas*


*Mapping data on common indicator species, Silvetia siliquosa and its ecologically important areas in China and South Korea*

# A Call to Action

The results provided key data for developing a regional conservation strategy and monitoring its successes. In particular, the results will help to:

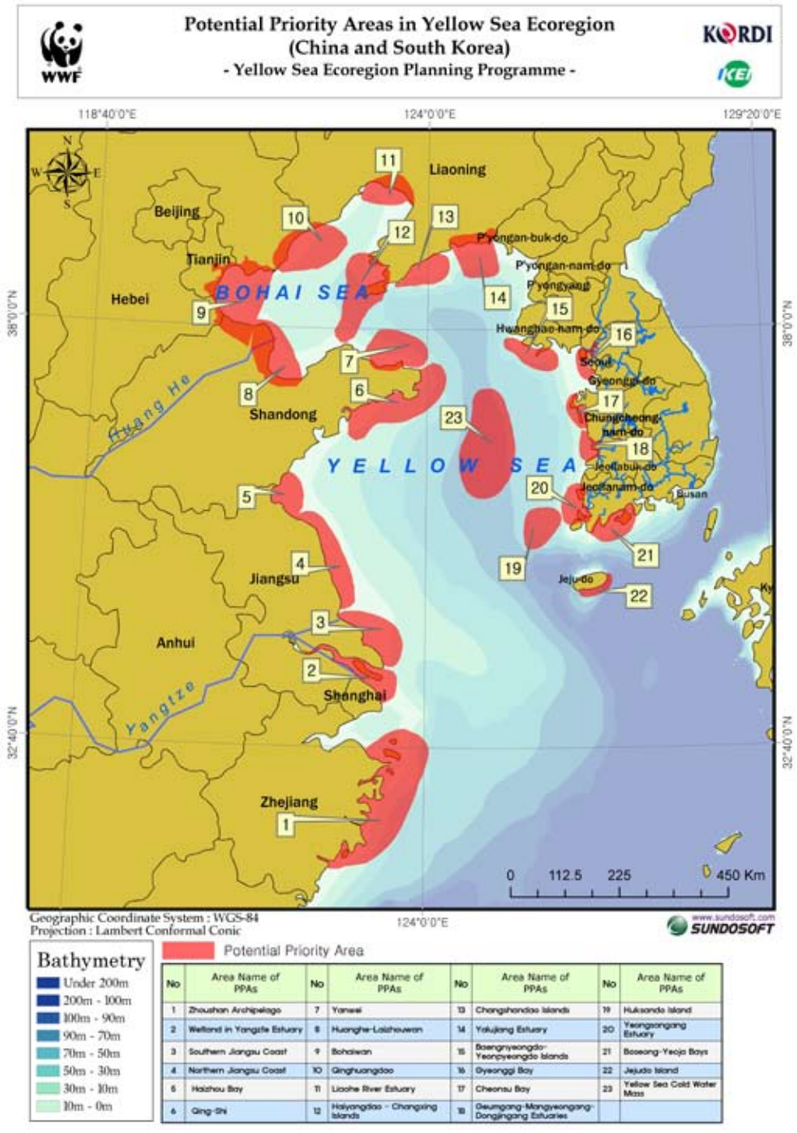
1) Establish a network of representative marine protected areas at the ecoregional scale;

2) Evaluate effectiveness of existing protected areas;

3) Monitor the status of biodiversity.

In order to conserve algae biodiversity, in particular, these sets of globally significant species and their globally significant areas, various stakeholders need to take concerted actions. Community-based organisations, the scientific community, national and local government agencies, legislative bodies, non-government organisations including religious groups, the general public, the media, donor communities, industries, consumers, and youth groups all have important roles to play. For example, national and local government agencies can contribute by strengthening cross-sectoral coordination in the establishment and improvement of the management of marine protected areas (MPAs). Filling major knowledge gaps in ecology and human impacts on indicator species is also an important action to take.


| No | Algae EIA | No | Algae EIA |
|---|---|---|---|
| 1 | Rizhao | 8 | Taean |
| 2 | Qingdao | 9 | Buan |
| 3 | Rongcheng | 10 | Wando |
| 4 | Weihai | 11 | TongYeong, Yokjido |
| 5 | Miaodao Qundao Islands | 12 | Busan |
| 6 | Qinhuangdao | 13 | Seogwipo |
| 7 | Changhai | | |




Photos by:WON, Changman, PARK, Jinyoung, Xianshi JIN, JE, Jonggeel, MIN, Byungmee, C.K.Tseng et al. offered by Ding Lanping, Tobai Sadayosi, GeoEye and NASA SeaWiFS Project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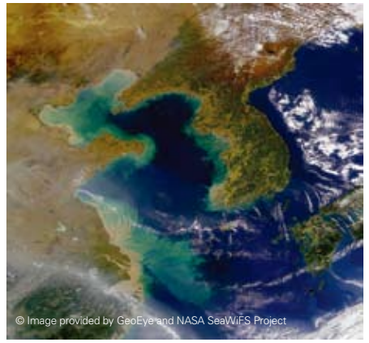
# Potential Priority Areas for Biodiversity Conservation of the Yellow Sea Ecoregion




*Satellite photo of Yellow Sea Ecoregion*


*Biodiversity of Yellow Sea Ecoregion*

## The Yellow Sea Ecoregion - A Global Treasure, A Global Concern

### About the area

The Yellow Sea Ecoregion is one of the world's largest areas of continental shelf. The Yellow Sea Ecoregion encompasses the Bohai Sea, the Yellow Sea and the East China Sea. It is a transboundary area, and extends from the coastlines of China, North Korea, and South Korea to a depth of 200m.

Valuable nutrients flow from the Yangtze and Yellow rivers and combine with sunlight and shallow waters to create an area that teems with abundant marine life.

### Global Treasure

Yellow Sea Ecoregion has been selected by WWF as one of the Global 200 ecoregions that are key to global biodiversity conservation. This marine ecosystem is also one of the Large Marine Ecosystems (LME) of the world.

### Global Concern

The global importance of the Yellow Sea Ecoregion has been recognised by governments and the international community in recent years. Starting in 1992, the Chinese and South Korean governments together developed a transboundary approach to the management of the Yellow Sea area with the assistance of UNDP, UNEP, the World Bank, and NOAA. In 2005, a UNDP/GEF project, the Yellow Sea Large Marine Ecosystem project, was officially launched with participation of the Chinese and South Korean governments.

Meanwhile, in 2002, WWF and other research institutes in China, South Korea and Japan began an assessment of Yellow Sea Ecoregion biodiversity. The objective of this regional partnership was to prioritise conservation actions based on scientific data.

## Biodiversity, People and Threats

The Millennium Ecosystem Assessment, which the United Nations, governments and a broad range of other stakeholders around the world supported, summarised in its report in 2005 that:

'Everyone in the world depends completely on Earth's ecosystems and the services they provide, such as food, water, disease management, climate regulation, spiritual fulfilment, and aesthetic enjoyment.'

Everyone in Yellow Sea Ecoregion also depends completely on this marine and coastal ecosystem and the services they provide. For example, fish and other marine invertebrates such as squids and clams provide food. They also provide many jobs and a large amount of cash through which local and national economies benefit. Coastal plants and clams in coastal areas help to reduce pollution by taking in excessive nutrients.

The Yellow Sea Ecoregion's biodiversity, marine ecosystem and ecosystem services have already been greatly changed and are still facing threats.

For example, overfishing has reduced commercially important fish species by more than 40% from the early 1960s to the 80s. Reclamation and other forms of conversion have changed coastal habitat. In South Korea, about 43% of intertidal wetlands were lost during the 20th century and in China, about 37% of intertidal wetlands have been converted in the last 50 years. These threats to and losses of biodiversity and ecosystem services have impacted the well-being of people in the Yellow Sea Ecoregion.

### An urgent need: Finding conservation priorities at a transboundary ecoregional scale

In order to maintain the full array of biodiversity - species, communities, ecosystems, and ecological processes, it is necessary to assess biodiversity beyond political boundaries and at the ecoregional scale.

An ecoregional approach helps ensure that we do not overlook areas that are particularly unique or threatened,allowing for smarter trade-offs and greater positive impacts that are more likely to endure over time.


*(203) Yellow Sea Ecoregion*

*LME #48 Yellow Sea Large Marine Ecosystem*

UNDP Yellow Sea

*UNDP/GEF Yellow Sea Project*

WWF KORDI KEI Korea Environment Institute

*WWF/KORDI/KEI Yellow Sea Ecoregion Planning Programme*


*Will the next generation continue to enjoy a healthy Yellow Sea Ecoregion?*

# Methodology for finding Potential Priority Areas

### Cooperation among scientific experts from China, South Korea, Japan and international conservation NGOs

Scientists from universities and ocean, fisheries, and environmental research institutes in China, South Korea, Japan and international conservation NGOs cooperated to review and identify priority species and their habitat of global significance. Together they have set a common methodology and reached an agreement on priorities areas for biodiversity conservation.

### Biological Assessment

Scientists first developed a set of criteria for indicator species and habitat types that are important for biodiversity conservation. The scientists designated six animal and plant groups (taxonomic groups: mammal, bird, fish, coastal mollusk, coastal plant, and algae groups) and developed a set of criteria (representative species and/or habitat types, endemism, threatened status, and commercial importance criteria). The scientists then applied a combination of these criteria to each taxonomic group.

According to these common criteria, each scientist analysed nationally available data in China and South Korea, and for the fish assessment, data available in Japan was also analysed. The scientists then finalised appropriate indicator species and ecologically important areas and compiled national Biological Assessment papers.

### Priority Area Analysis

Secondly, the scientists reviewed a further set of criteria that defines globally significant indicator species and their ecologically critical habitat. The objective of this step was to prioritise among important species and important habitats. Each taxonomic group again reviewed and adopted the group's own appropriate set of criteria.

Thirdly, the scientists overlaid maps of important habitat for each indicator species within their taxonomic group. This allowed the scientists to visualise overlapping areas and to delineate areas that are important for a number of Indicator species. These areas were named Ecologically Important Areas (EIAs). In total, six EIA maps were produced:

1) Mammal Ecologically Important Areas (MEIAs),

2) Bird Ecologically Important Areas (BEIAs),

3) Fish Ecologically Important Areas (FEIAs),

4) Coastal Mollusk Ecologically Important Areas (CMEIAs),

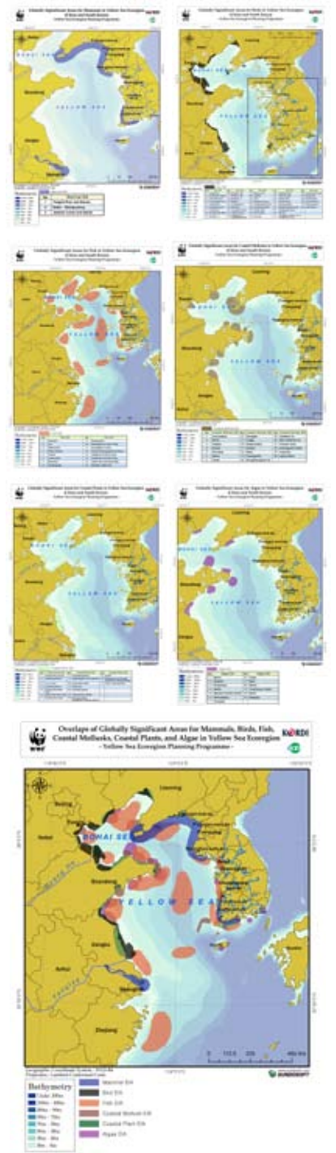
5) Coastal Plant Ecologically Important Areas (CPEIAs),

6) Algae Ecologically Important Areas (AEIAs).

Fourthly, the scientists examined overlapping areas of the six Ecologically Important Areas. In order to delineate areas that are suitable as units of biodiversity conservation, not only exact overlapping areas but also size and connectivity of Ecologically Important Areas are examined. The areas that the scientists identified and mapped according these rules were named Potential Priority Areas (PPAs).

Finally, the scientists checked that all major habitat types were included in the list of Potential Priority Areas. An Ecologically Important Area that covered an unrepresented habitat type (cold water mass) was added to the list.

*Scientific experts from China, South Korea, Japan and other countries cooperated to analyse priority areas*




# The Results - 23 Potential Priority Areas for biodiversity conservation identified

122 Indicator Species in six taxonomic groups were analysed for their global significance and 111 Ecologically Important Areas were identified. In total, 23 Potential Priority Areas were identified in the Yellow Sea Ecoregion. This was the first time such a comprehensive and trans-regional assessment and analysis of priority areas for biodiversity conservation for the Yellow Sea Ecoregion was conducted.

The Yellow Sea Ecoregion Planning Programme will publish the full results of the biodiversity assessment and the priority area analysis so that the results will be accessible by scientists and government agencies to use in the future.

# A Call to Action

The results provided key data for developing a regional conservation strategy and monitoring

its successes. In particular, the results will help to:

1) Establish a network of representative marine protected areas at the ecoregional scale;

2) Evaluate effectiveness of existing protected areas;

3) Monitor the status of biodiversity.

In order to conserve biodiversity, in particular, these 23 sets of globally significant Potential Priority Areas, various stakeholders need to take concerted actions. Community-based organisations, the scientific community, national and local government agencies, legislative bodies, non-government organisations including religious groups, the general public, the media, donor communities, industries, consumers, and youth groups all have important roles to play. For example, national and local government agencies can contribute by strengthening cross-sectoral coordination in the establishment and improvement of the management of marine protected areas (MPAs). Filling major knowledge gaps in ecology and human impacts on indicator species is also an important action to take.

# Potential Priority Areas (PPAs) in the Yellow Sea Ecoregion

## Table of Potential Priority Areas (PPAs) and Ecologically Important Areas of Six Taxonomic Groups in the Yellow Sea Ecoregion

| Area code | Area Name of Potential Priority Areas (PPAs) | Mammal Ecologically Important Areas (MEIAs) | Bird Ecologically Important Areas (BEIAs) | Fish Ecologically Important Areas (FEIAs) | Coastal Mollusc Ecologically Important Areas (CMEIAs) | Coastal Plant Ecologically Important Areas (CPEIAs) | Algae Ecologically Important Areas (AEIAs) |
|---|---|---|---|---|---|---|---|
| PPA1 | Zhoushan Archipelago | n/a | n/a | FEIA1 Zhoushan | n/a | n/a | n/a |
| PPA2 | Wetland in Yangzte Estuary | MEIA1 Yangzte River and Estuary | BEIA1 JiuduanshaBEIA2 Chongming Dongtan | n/a | n/a | CPEIA1 Yangtze River Estuary | n/a |
| PPA3 | Southern Jiangsu Coast | n/a | n/a | FEIA2 Lusi | n/a | n/a | n/a |
| PPA4 | Northern Jiangsu Coast | n/a | BEIA3 Yancheng coast | n/a | CMEIA1 Lianyungang | CPEIA2 Yancheng Beach | n/a |
| PPA5 | Haizhou Bay | n/a | BEIA4 Lianyungang coast | FEIA3 Haizhou Bay | CMEIA1 LianyungangCMEIA2 Rizhao (smaller part) | CPEIA3 Lu-su Coast | AEIA1 Rizhao |
| PPA6 | Qing-Shi | n/a | BEIA6 Rongcheng coast | FEIA4 Shidao-Rushan | CMEIA4 RushanCMEIA5 Rongcheng | CPEIA4 Rongcheng Beach | AEIA2 QingdaoAEIA3 Rongcheng |
| PPA7 | Yanwei | n/a | n/a | FEIA5 Yanwei | CMEIA6 WeihaiCMEIA7 Yantai | CPEIA5 Jiaodong Peninsula Coast | AEIA4 Weihai |
| PPA8 | Huanghe-Laizhouwan | n/a | BEIA7 LaizhouwanBEIA8 Huanghe delta | FEIA6 Laizhou bay | n/a | CPEIA6 Laizhou Bay East CoastCPEIA7 Huanghe Delta | n/a |
| PPA9 | Bohaiwan | n/a | BEIA9 Bohaiwan SBEIA10 Bohaiwan SWBEIA11 Bohaiwan NWBEIA12 Bohaiwan N | FEIA7 Bohai Bay | CMEIA9 Tanggu | CPEIA8 Nandagang Marsh | n/a |
| PPA10 | Qinghuangdao | n/a | BEIA12 Bohaiwan NBEIA13 Beidaihe | FEIA8 Liaodong Bay | CMEIA10 Qinhuangdao | CPEIA9 Qinhuangdao Sand Beaches | AEIA6 Qinhuangdao |
| PPA11 | Liaohe Estuary | n/a | BEIA14 Liaodongwan N | n/a | n/a | CPEIA10 Liaohe River Delta | n/a |
| PPA12 | Haiyangdao - Changxing Islands | MEIA2 Dalian - Baengnyeong | BEIA15 Dalianwan | FEIA8 Liaodong Bay (small part) | CMEIA12 Dalian Bay | CPEIA11 Dalian Bay | n/a |
| PPA13 | Changshandao Islands | MEIA2 Dalian - Baengnyeong | BEIA16 Changshan Islands | FEIA9 Haiyang dao | n/a | CPEIA12 Changhai Islands | AEIA7 Changhai |
| PPA14 | Yalujiang Estuary | MEIA2 Dalian - Baengnyeong | BEIA17 Yalujiang coast | FEIA9 Haiyang dao (small part) | n/a | CPEIA13 Yalujiang River Mouth | n/a |
| PPA15 | Baengnyeongdo-Yeonpyeongdo Islands | MEIA2 Dalian - Baengnyeong | n/a | FEIA10 Hwanghae-do South Coast | n/a | CPEIA14 Baengnyeongdo-Ganghwado-Jawoldo | n/a |
| PPA16 | Gyeonggi Bay | n/a | BEIA18 Hangang estuary and Imjingang estuaryBEIA19 Sihwaho lake BEIA20 Jangdan BEIA21 Yudo BEIA22 Ganghwado Island BEIA23 Yeongheung-doBEIA24 Yeongjong island BEIA25 Songdo islandBEIA26 Namyang bayBEIA27 Asan bayBEIA28 Seonjedo IslandBEIA29 Daebudo | FEIA11 Gyeonggi-do Coast | CMEIA13 Gyeonggi Bay | CPEIA14 Baengnyeongdo-Ganghwado-Jawoldo | n/a |
| PPA17 | Cheonsu Bay | n/a | BEIA30 Cheonsu bay | FEIA12 Greater Geum River Estuary(smaller part) | CMEIA14 Chungcheongnam-do | CPEIA15 Sinduri | AEIA8 Taean |
| PPA18 | Geumgang-Mangyeongang-Dongjingang Estuaries | n/a | BEIA31 Yubudo islandBEIA32 Geumgang riverBEIA33 Mangyeonggang estuaryBEIA34 Dongjingang estuary | FEIA12 Greater Geum River Estuary(smaller part) | CMEIA15 Jeollabuk-do | CPEIA16 Mangyeong and Dongjin esutuaries -Hampyeong bay | AEIA9 Buan |
| PPA19 | Huksando Island | n/a | n/a | FEIA13 Jeollanam-do west coast | CMEIA16 West Jeollanam-do | n/a | |
| PPA20 | Yeongsangang Estuary | MEIA3 Coasts and Islands of Jeolla-do | BEIA36 Youngamho, Geumho and Youngsanho lakesBEIA37 Gocheonamho lake | FEIA13 Jeollanam-do west coast | n/a | CPEIA16 Mangyeong and Dongjin esutuaries -Hampyeong bay (smaller part)CPEIA17 Jindo - Suncheon bay (smaller part) | n/a |
| PPA21 | Boseong-Yeoja Bays | MEIA3 Coasts and Islands of Jeolla-do | BEIA38 Gangjin BayBEIA39 Suncheon bay | FEIA14 Jeollanam-do south coast | CMEIA17 East Jeollanam-do 1CMEIA18 East Jeollanam-do 2CMEIA19 East Jeollanam-do 3 | CPEIA17 Jindo - Suncheon bay | AEIA10 Wando |
| PPA22 | Jejudo Island | n/a | BEIA42 Jeju Island | n/a | CMEIA20 Jeju island | n/a | AEIA13 Seogwipo |
| PPA23 | Yellow Sea Cold Water Mass | n/a | n/a | FEIA16 Yellow Sea Cold Water Mass | n/a | n/a | n/a |

# An Opportunity to Develop a Regionally Coordinated MPA Network for the Yellow Sea Ecoregion - A Call to Action

## Integrating a Representative and Effective Network of MPAs into a Regional Strategic Action Programme of UNDP/GEF Yellow Sea Project

In order to fulfill global responsibilities on MPAs in accordance with WSSD and CBD among other international goals and conventions, the UNDP/GEF Yellow Sea Large Marine Ecosystem Project offers an excellent opportunity.

This project also offers the State Oceanic Administration of China (SOA), the Ministry of Maritime Affairs and Fisheries of South Korea (MOMAF), and other relevant ministries that manage protected areas in the Yellow Sea Ecoregion a regionally coordinated strategic goals and a representative and effectively managed network on MPAs.

This will allow SOA and MOMAF to play leading roles in developing and implementing national policies and action plans on MPAs that will help achieve common strategic goals. Other ministries that manage protected areas in coastal and marine areas in the Yellow Sea Ecoregion also have important roles to play in order to achieve MPA goals.

UNDP Yellow Sea

Strategic Action Programme (SAP)

国家海洋局 State Oceanic Administration People's Republic of China

해양수산부 MINISTRY OF MARITIME AFFAIRS & FISHERIES

# Establishing a Representative and Effective Network of MPAs in the Yellow Sea Ecoregion

In order to successfully establish a representative and effective network of MPAs, the following strategic action programme must take place:

### ACTION 1) EVALUATE MANAGEMENT EFFECTIVENESS OF EXISTING MPAs

In order to improve management effectiveness of MPAs, evaluating the current effectiveness of MPAs is essential.

A number of international guidelines and tools have been developed to measure effectiveness of MPAs.

### ACTION 2) DESIGN AND DEVELOP A NETWORK OF REPRESENTATIVE MPAs

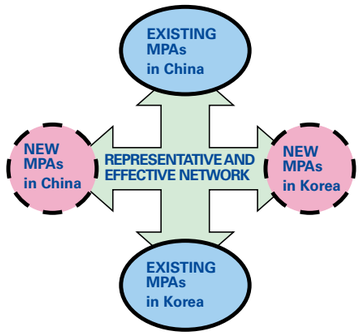
All biogeographic regions should be represented. Within each region, all major habitats should be represented. Conservative and widely accepted definitions should be used when identifying regions and habitats. (Secretariat of the Convention on Biological Diversity (2004)).

### ACTION 3) DESIGNATE NEW MPAs

Designating new MPAs in Ecologically Important Areas (EIAs) and Potential Priority Areas (PPAs) will help fill the gaps in the MPA network.

### ACTION 4) DESIGNATE TRANSBOUNDARY SCALE MPAs

Because the Yellow Sea Ecoregion encompasses a number of coastal states, designation of MPAs should be done at a transboundary scale.

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WWF KORDI KEI Korea Environment Institute

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About the Yellow Sea Ecoregion Planning Programme: The Yellow Sea Ecoregion Planning Programme is an international partnership between WWF, KORDI, and KEI for conservation of biodiversity of the Yellow Sea Ecoregion.

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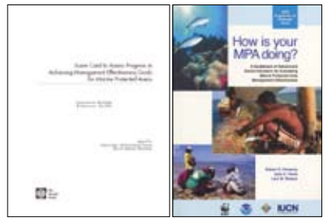
**Tools to evaluate management effectiveness of MPAs**




*World Bank (2004) Score Card to Assess Progress in Achieving Management Effectiveness Goals (left)*

*Pomeroy, R.S., Parks, J.E. and Watson, L.M. (2004). How is your MPA doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Areas Management Effectiveness. IUCN, Gland, Switzerland and Cambridge, UK. (right)*

# Marine Protected Areas and the Yellow Sea Ecoregion

## - A strategy for Biodiversity Conservation

*Potential Priority Areas of the Yellow Sea Ecoregion*


*MPAs in China*


*MPAs in South Korea*

# Marine Protected Areas

### WHAT IS A MARINE PROTECTED AREA?

A Marine Protected Area (MPA) is "any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment (IUCN, 1999)."

MPAs may include no-take zones (areas where fisheries are banned) aquatic resources protection areas, marine parks, and nature reserves in coastal and marine areas.

### BENEFITS OF MARINE PROTECTED AREAS

MPAs have a number of recognised benefits for conservation and the management of marine biodiversity (See box).

### EXAMPLES OF BENEFITS OF MARINE PROTECTED AREAS

BENEFIT 1: protecting ecosystem structure, functioning and beauty, allowing recovery from past damage, and serving as stepping stones for migratory/dispersive species;

BENEFIT 2: protecting the genetic variability of exploited species;

BENEFIT 3: providing other direct and indirect social and economic benefits, such as attractions for tourists, by providing benefits to traditional users of biodiversity, or preserving reefs or kelp beds which prevent wave erosion of the shore or shelter moorings.

### BENEFITS TO FISHERIES MANAGEMENT

BENEFIT 1: producing fish of exploitable size, which then directly disperse "spill over" into the surrounding area where they become available to fishers;

BENEFIT 2: protecting key habitats or life-stages from fishery related damage (e.g. protecting critical spawning and nursery habitats, vulnerable juveniles, and spawning adults); producing more offspring (from a greater density of breeding adults within MCPAs) which are then dispersed by currents to eventually recruit into surrounding fisheries

*(Source: Secretariat of the Convention on Biological Diversity (2004). TECHNICAL ADVICE ON THE ESTABLISHMENT AND MANAGEMENT OF A NATIONAL SYSTEM OF MARINE AND COASTAL PROTECTED AREAS, SCBD, 40 pages (CBD Technical Series no. 13).*

# Marine Protected Areas

## – A Global Responsibility

MPAs have gained recognition as an effective tool for conservation and sustainable use of marine biodiversity in a number of international conventions and action plans.

**The World Summit on Sustainable Development (WSSD) set a global MPA target for 2012**

In order to achieve sustainable fisheries, the WSSD Plan of Implementation calls for the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012.

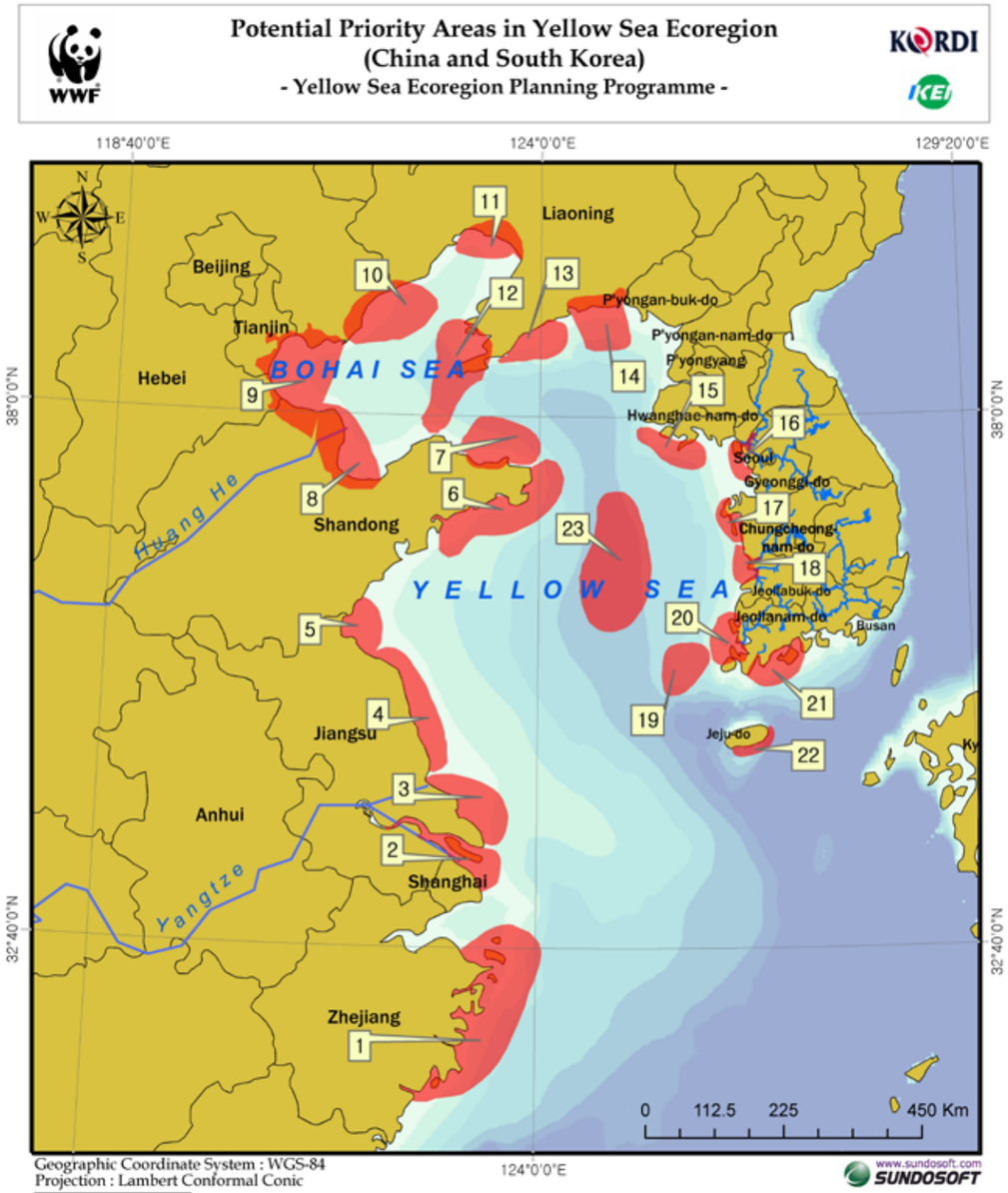
**The Convention on Biological Diversity (CBD) adopted MPAs as one of five key tools**

The Convention on Biological Diversity (CBD) adopted marine and coastal protected areas (MCPAs) as one of five key elements in its 1998 programme alongside four other important marine issues (Integrated marine and coastal area management (IMCAM), Marine and coastal living resources (MCLR), Mariculture,Alien species and genotypes).

**The Ramsar Convention on Wetlands calls on establishing MPAs for fish**

The Ramsar Convention on Wetlands adopted a resolution on MPAs (Resolution IX.4) in 2005. The resolution asks governments to establish coastal and marine protected areas as a tool for biodiversity conservation and fisheries resources management. It also call for additional Ramsar sites to be designated, especially by those contracting parties that have not yet designated Ramsar sites under criteria on fish.

# Potential Priority Areas in the Yellow Sea Ecoregion

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# Current Marine Protected Areas (MPAs) in the Yellow Sea Ecoregion (China and South Korea)


*Locations of the marine protected areas in China*


*Locations of the marine protected areas in South Korea*

## Table of Marine National and Local Nature Reserves in Yellow Sea Ecoregion (China)

| Marine national nature reserves (NNRs) | Location | Areas(hm2) | Important conservation targets | Management authority |
|---|---|---|---|---|
| *Snake Island-Laotieshan Mountain NNR* | Lushun, Liaoning Province (Prov.) | 17 000 | Vipers and birds and their habitats | SEPA |
| *Yalu River Costal Wetland NNR* | Donggang, Liaoning Prov. | 112 180 | Tidelands, wetlands, water birds and migrating birds | SEPA |
| *Changli Golden Seaboard NNR* | Changli, Hebei Prov. | 30 000 | landscape and marine ecosystem | SOA |
| *Chongming Dongtan NNR* | Chongming County, Shanghai | 4 900 | Estuary wetland | SFA |
| *Yancheng Birds NNR* | Yancheng, Jiangsu Prov. | 453 000 | Hooded Cranes and tidelands, wetlands | SEPA |
| *Nanji Islands NNR* | Pingyang County, Zhejiang Prov. | 20 106 | Islands, molluscs and marine ecosystem | SOA |
| *Tianjin ancient seaboards and wetlands NNR* | Tianjin | 21 180 | Ancient seaboards relics of conch dykes and oyster beaches, wetlands ecosystem | SOA |
| *Huanghe River Delta* | Dongying, Shandong Prov. | 153 000 | Original wetland ecosystem and water birds | SFA |
| *Shuangtai Estuary water birds NNR* | Panjin, Liaoning Prov. | 80 000 | Hooded cranes, Siberian cranes, Swan goose, etc. | SFA |
| **Marine local nature reserves (LNRs)** | **Location** | **Areas(hm2)** | **Conservation Targets** | **ManagementAuthority** |
| *Dalian Haiwang nine-islands marine NR* | Dalian, Liaoning Prov. | 2 143 | Seashore physiognomy, seaboard scenes and seabirds | Liaoning Provincial Gov. |
| *Dalian Laopian Island NR* | Dalian, Liaoning Prov. | 1 580 | Marine creatures and ecosystem, Karst and marine abrasion physiognomy landscape | Liaoning Provincial Gov. |
| *Sanshan Island NR* | Dalian, Liaoning Prov. | 200 | Chlamys (Azumapecten) farrer, Haliotis discus hannai, and other rare seafood | MOA |
| *Jinshitan Geology NR* | Dalian, Liaoning Prov. | 2 200 | Particular geological structures, paleontologic fossils and particular seaboard physiognomy | SEPA |
| *Zhujiatun marine abrasion NR* | Dalian, Liaoning Prov. | 1 350 | Marine abrasion physiognomy | SEPA |
| *Liaodong Bay wetland-marine NR* | Panjin, Liaoning Prov. | 80 000 | Water birds, Largha seals and other rare marine creatures | Liaoning Provincial Gov. |
| *Rare marine creatures NNR* | Changhai County, Liaoning Prov. | 220 | Breeding area for Chlamys (Azumapecten) farrer, Haliotis discus hannai and 黄刺参(Stichopus japonicus??) and habitat for prawns migration. | SEPA |
| *Suizhong arenaceous seaboard and biodiversity NR* | Suizhong County, Liaoning Prov. | 20 7700 | arenaceous seaboard and marine ecosystem | SOA |
| *Huanghua Chenier NR* | Huanghua, Hebei Prov. | 117 | Chenier and plants within the area | SOA |
| *Leting Shijiutuo Island NR* | Leting County, Hebei Prov. | 3 775 | Animals exp. Birds and plants | Hebei Provincial Gov. |
| *Miaodao Islands marine NR* | Changdao County, Shangdong Prov. | 875 600 | Birds and warm temperate zone island ecosystem | SOA |
| *Qingdao Dagongdao Island ecosystem NR* | Qingdao, Shandong Prov. | 1 600 | Birds, marine creatures and their habitats | Shandong Provincial Gov. |
| *Qianliyan Island ecosystem NR* | Yantai, Shangdong Prov. | 1 823 | ever-green broad-leaved forests and birds | Shandong Provincial Gov. |
| *Wuli shells dykes and wetland NR* | Wuli County, Shangdong Prov. | 80 480 | Chenier seaboard—wetland | Shandong Provincial Gov. |
| *Rongcheng Chengshantou Marine NR* | Rongcheng, Shangdong Prov. | 3 000 | Seaboard physiognomy and lagoon ecosystem | SOA |
| *Rongcheng Sanggouwan NR* | Rongcheng, Shandong Prov. | 13 333 | Rare marine creatures | SEPA |
| *Jimo Marine creatures NR* | Jimo, Shandong Prov. | 915 | Economic marine products | SEPA |
| *Jinshan three-islands marine NR* | Jinshan County, Shanghai | 4 000 | Marine ecosystem, sub-tropic zone plants | SOA |
| *Wuzhishan birds islands NR* | Zhoushan Islands, Zhejiang Prov. | 470 | Seabirds | Zhejiang Provincial Gov. |
| *Ningpo marine relics NR* | Ningpo, Zhejiang Prov. | 456 | Ancient sea embankment relics | SOA |


Publishers: WWF, Korea Ocean Research and Development Institute (KORDI), Korea Environment Institute (KEI)

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About the Yellow Sea Ecoregion Planning Programme: The Yellow Sea Ecoregion Planning Programme is an international partnership between WWF, KORDI, and KEI for conservation of biodiversity of the Yellow Sea Ecoregion.


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# Marine Protected Areas and the Yellow Sea Ecoregion

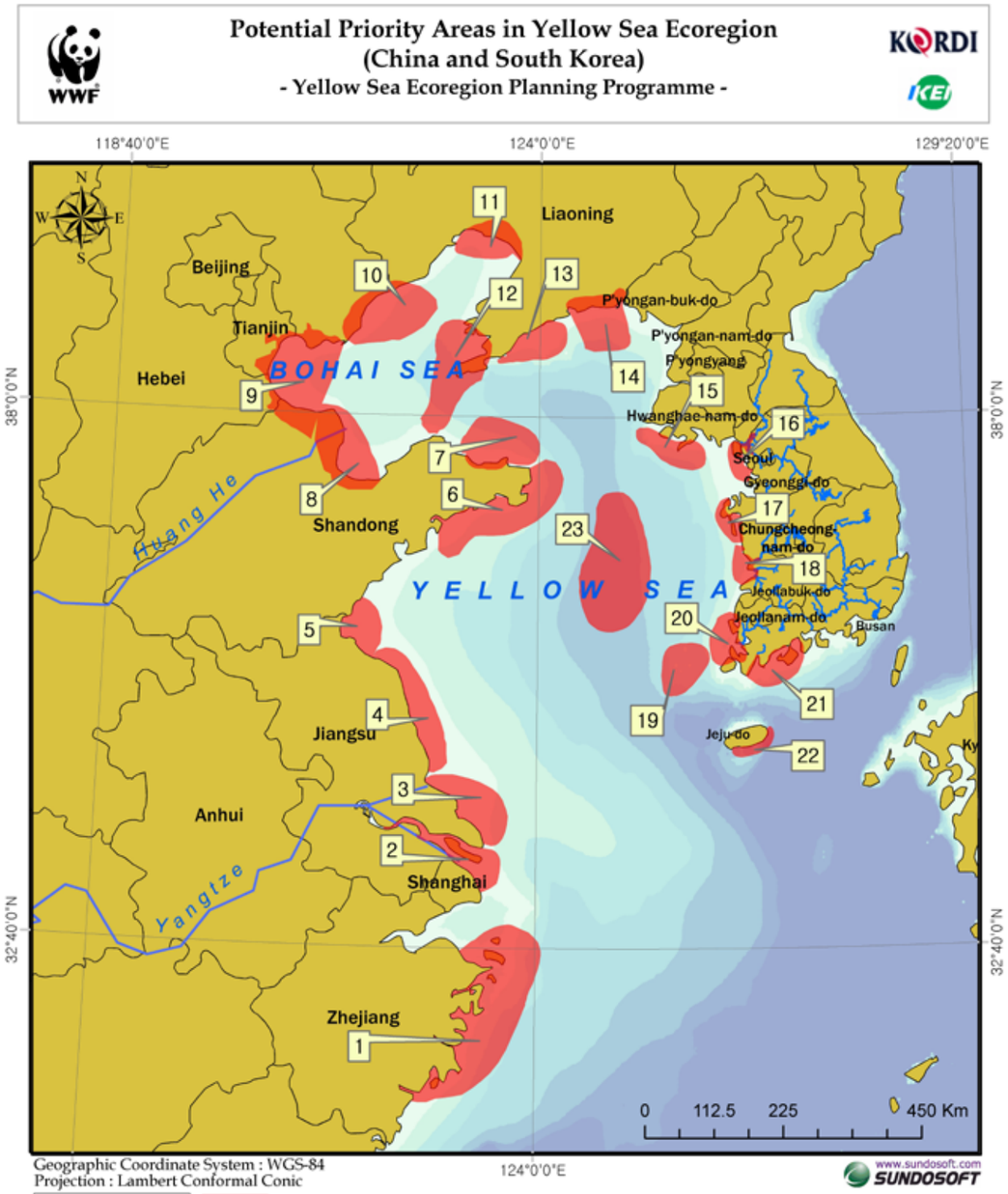
## - A strategic action for Biodiversity Conservation

## Annex 1: Current Marine Protected Areas (MPAs) in China and Potential Priority Areas


*Potential Priority Areas of the Yellow Sea Ecoregion*


*MPAs in China*

## Potential Priority Areas in the Yellow Sea Ecoregion

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## Current MPAs in the Yellow Sea Ecoregion (China)


*China's MPA map is reproduced here with a kind permission by State Oceanic Administration of China (www.soa.gov.cn)*

# Marine Protected Areas and the Yellow Sea Ecoregion

## - A strategic action for Biodiversity Conservation

### Annex 2: Current Marine Protected Areas (MPAs) in South Korea and Potential Priority Areas


*Potential Priority Areas of the Yellow Sea Ecoregion*


*Current MPAs in South Korea*


Publishers: WWF, Korea Ocean Research and Development Institute (KORDI), Korea Environment Institute (KEI)

Date of publication: March 2006

About the Yellow Sea Ecoregion Planning Programme: The Yellow Sea Ecoregion Planning Programme is an international partnership between WWF, KORDI, and KEI for conservation of biodiversity of the Yellow Sea Ecoregion.



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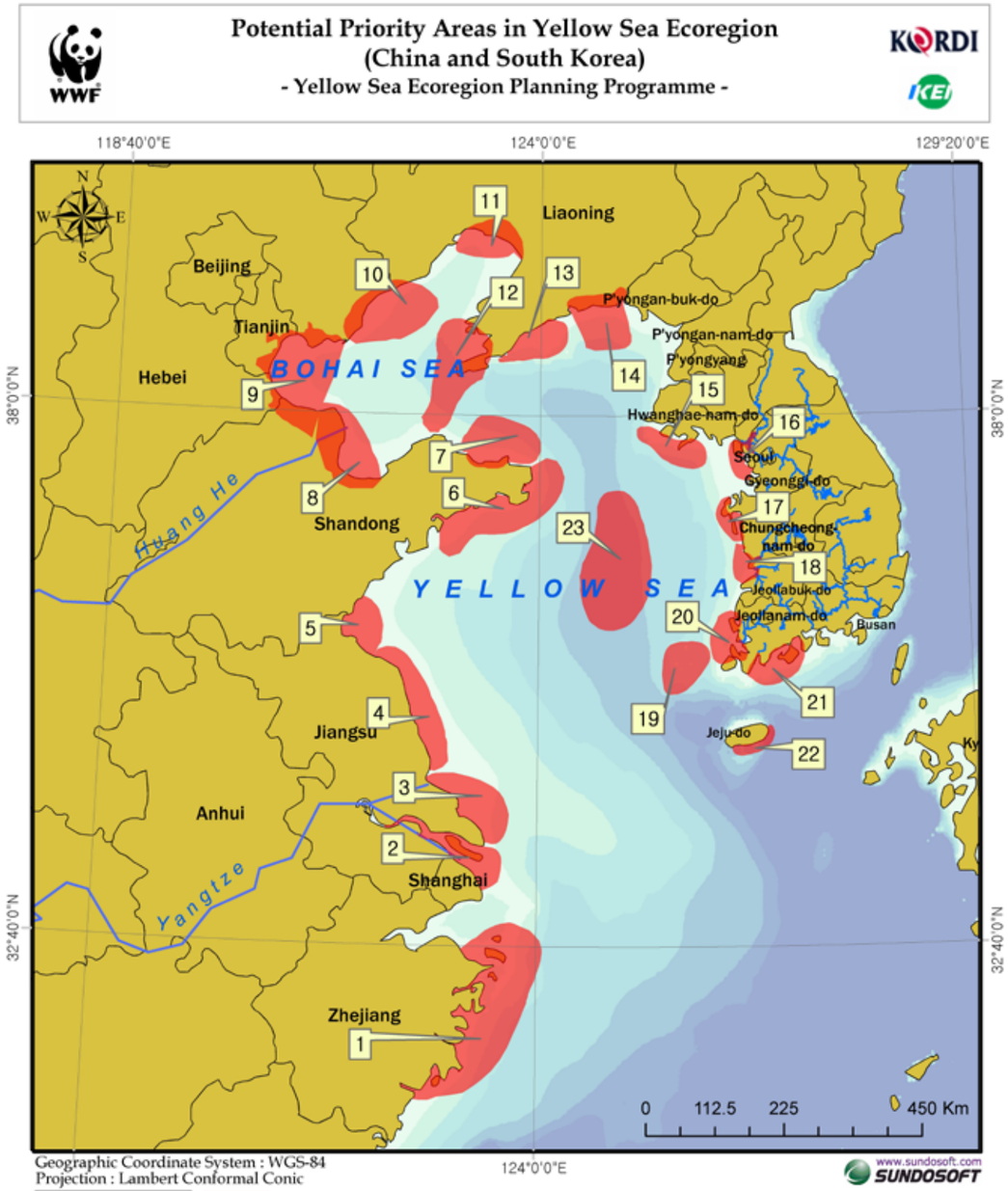
## Potential Priority Areas in the Yellow Sea Ecoregion

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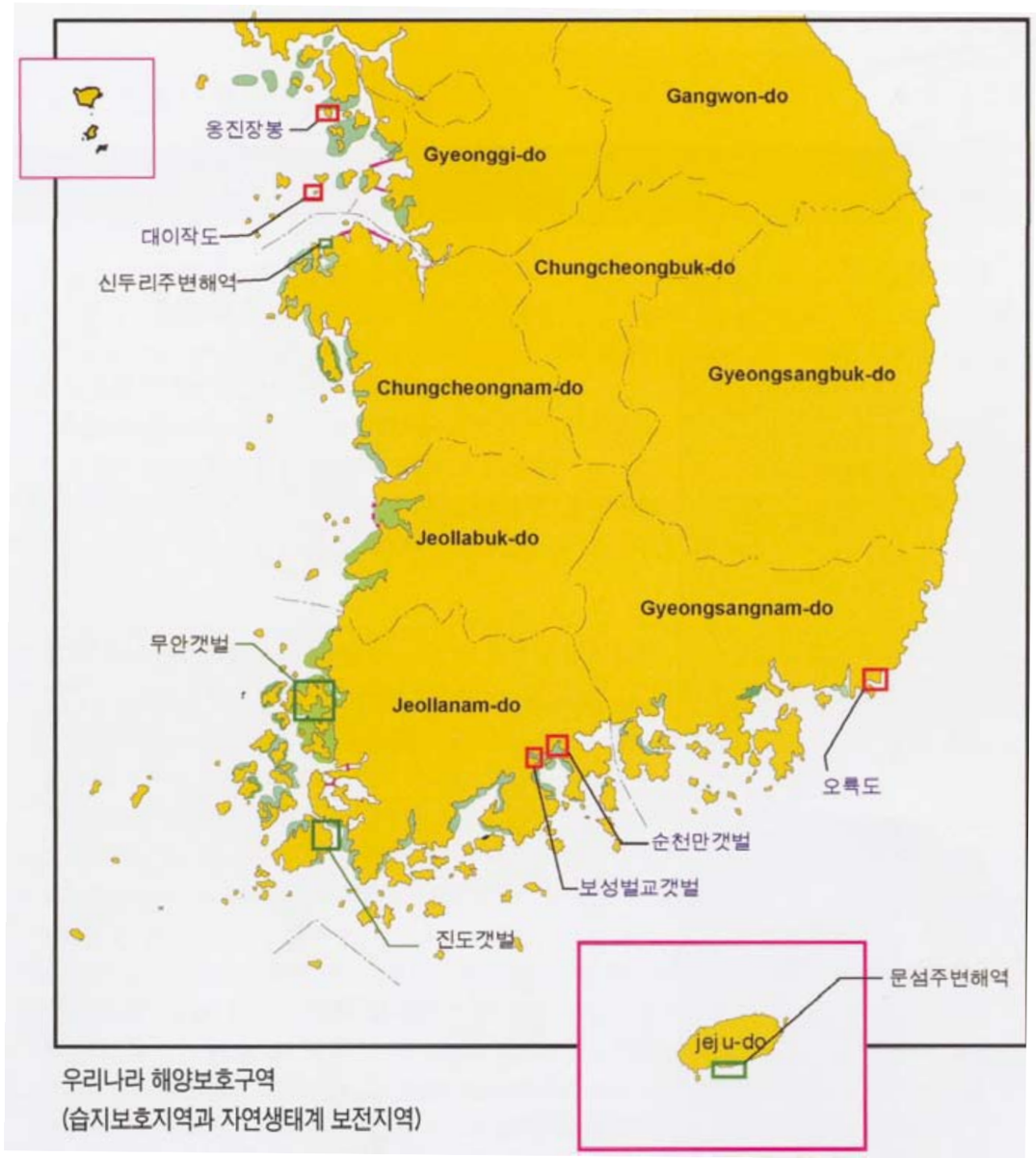
## Current Marine Protected Areas (MPAs) in the Yellow Sea Ecoregion (South Korea)




*Marine Protected Areas in South Korea*
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