

# 19 Yellow Sea

## Overview

The Yellow Sea is a semi-enclosed sea bounded by the Chinese mainland on the west, the Korean Peninsula on the east and a line running from the north bank of the mouth of the Yangtze River to the south side of Cheju Island.

The name of the Yellow Sea comes from the color of its water. A large amount of yellow silt is carried into the Yellow Sea by the Yellow River from the Loess Plateau, the Huai River and the Yangtze River. The Sea receives a large amount of silt and sand from these rivers, which accumulates as bottom sediments.

## Location

### Basic information<sup>8</sup>

Surface area : 466,200 km<sup>2</sup>

Volume : 18,648 km<sup>3</sup>

Average depth : 40 m

Maximum depth : 103 m

## Nature

### < Background >

The Yellow Sea used to be dry land but the last glacial cycle brought dramatic environmental changes to the area, such as the Holocene marine transgression, which flooded the region and creating the Yellow Sea. At present, the Yellow Sea is a large inland sea with a total area of 466,200

km<sup>2</sup>. It is located between longitudes 117°E and 126°E, and latitudes 31°N and 41°N, and surrounded by mainland China and the Korean peninsula. Reaching 103 m at its deepest point, the average depth of the Yellow Sea is 40 m.<sup>1,8</sup>

This vast sea is mainly composed of water from the Yellow River, Yalu River and Yangtze River from China, and the Keum (Geum) River and Nakdong River from the Korea peninsula, as well as sand, mud and other types of sediment as a result of water influx. The Yellow River in particular, which is the second longest river in China, has the largest amount of sediment loading in the world and accounts for the majority of the sediment accumulation in the Sea. These sediments also form a large number of intertidal flats on the Yellow Sea, covering an area of approximately 20,000 km<sup>2</sup>. In total, the annual amount of influx from rivers is 1,500 billion m<sup>3</sup> of water with more than 460 billion m<sup>3</sup> of rainfall and 1.6 billion m<sup>3</sup> of sediment.<sup>1</sup>

### Climate

The Yellow Sea extends broadly from the China mainland to the Korean Peninsula, and is meteorologically located between the subtropical Pacific Low and the Siberian High. Accordingly, while the mean temperature in July is 24 °C in the north and 28 °C in the south, the average temperatures in January are -8 °C and -4 °C, respectively. The average sea surface temperatures also drop in winter, falling between -2 °C and 0 °C in January and February. Because of this cooling, the surfaces of Liaodong Bay, Bohai Bay, northern Korea Bay and the areas around the Yalu River Estuary freeze for 2-4 months every year. As spring comes closer and the temperature rises, the ice breaks up and begins to drift.<sup>1</sup>

### Hydrology

There are five major water masses in the Yellow Sea. The Yellow Sea Warm Current Water is warm and saline. It originates from the boundary of strong fronts formed during winter in the region that is west-northwest of Cheju Island. The Yellow Sea Bottom Cold Water forms as a result of convection in winter, and appears in the bottom layer of the trough region in summer. The Korea Coastal Water is seawater that has been tidally mixed with run-off and river discharge from the Korean Peninsula. The China Coastal Water contains coastal water from the Bohai Sea and flows southward throughout the year. The Yangtze River Diluted Water is the freshest water in the marginal seas of the Pacific Ocean.<sup>2</sup>

Based on temperature and salinity data, the circulation pattern of the Yellow Sea can be characterized into two seasonal types. In winter, there exists the northward Yellow Sea Warm Current in the interior and two southward coastal flows along the Chinese and Korean coasts. In summer, there is a southward coastal current and a northward Korean coastal flow, with a cyclonic flow system between the two. However, a lack of direct evidence on the current systems means that the description of the Yellow Sea Warm Current is inconclusive, especially regarding its origin in winter and its pattern in summer.<sup>2</sup>



### < Surrounding environment >

#### Habitat

The Yellow Sea coastline, which extends along China, North Korea, and South Korea, is home to the world's second-largest area of tidal flats, of which some 2,500 km<sup>2</sup> are part of Korea's west coast. The coastal wetlands along Korea's west coast play an important role as a resting area for migratory birds traversing the East Asian-Australasian Flyway, as well as a spawning ground for various fish. These coastal wetlands are expected to increase their importance in the future with issues such as tsunamis and sea level rise due to climate change. They also supply a wealth of fishery products, providing economic profits and food to fishery communities.<sup>3</sup>

#### Biota

The Yellow Sea is particularly an important area of the East Asian-Australasian Flyway (EAAF), one of the nine major flyways on Earth. Many migratory birds benefit from it. Nine species of sea birds and 173 species of water birds come to rest in Chinese territory and 162 species of water birds rest in Korea. In total, about two million migratory birds, if not more, visit the ecoregion when going north and about one million when going south. This fact clearly indicates that the region plays an important role as a stopping point.<sup>1</sup>



A migratory bird in a wetland of the Yellow Sea<sup>1</sup>

### History and Culture

#### < The formation of the Pan Yellow Sea Region >

The Pan Yellow Sea Region dates back to ancient times. Throughout its long history, the Pan Yellow Sea Region has been an important location for the exchange of commodities, technology and people among the three countries of Japan, Korea, and China. The heyday of coastal trading was the period between the seventh and tenth centuries when the countries were under the rule of Tang in China (618-907 AD), Yamato-Nara-Heian in Japan (646-856 AD) and Shilla in Korea (669-935 AD). The maritime trading system during this period had catalyzed the regions and cities along the Yellow Sea to become densely networked. The focal points of this coastal trading were the Liaoning and Shandong Provinces of China, and the west and south coastal regions of Korea and Kyushu in Japan.<sup>4</sup>

#### < Chinese people and Yellow Sea >

The Chinese people have known how to make use of the sea for thousands of years. Navigation (mainly for trade, travel and transportation), fishing and salt production have been the mainstay industries of the coastal people along the Yellow Sea and other Chinese seas. Shandong, a province of China bounded the Yellow Sea, is one of the birthplaces of China's ancient culture. The Chinese people had learned to fish at sea by boats with oars and had mastered basic navigation technology before the Xia Dynasty (2183-1752 BC). At least 2,700 years ago, the navigators of China opened the maritime route from the Shandong Peninsula to Japan, via Korea through the Yellow Sea, and started cultural and commercial exchanges with Korea and Japan, via the Yellow Sea.

There are many fairy tales in China describing the beautiful places in 'the East Sea', the general term for the Yellow Sea and the East China Sea. Tales such as 'Shan Hai Jing', 'The Eight Immortals', 'Journey to the West' and 'Jingwei Fills the Sea' describe the life of the people relating to the Yellow Sea. In the old days in China, people would say to an old person celebrating their birthday "I Wish you a long, long, happy life, as long as the long-running water in the East Sea and a pine tree in the South Mountain", instead of "Happy birthday to you!", like people do nowadays. To see a mirage on the sea from the Penglai Pavilion, an ancient watch tower on the coast of Shandong Peninsula, has been what many people have yearned for since the old days.

### Social Environment

#### < Population >

The Pan Yellow Sea Region covers the coasts of northern China (Bohai Rim), south-western Japan (the Kyushu area) and western and southern Korea. It had a population of 256 million people in 2006. It is one of the fastest growing economic zones in East Asia with a regional GDP of 1.5 trillion USD in 2006. Rapid economic integration began in the early 1990s when the Chinese economy opened its markets to the world. Since then, the Pan Yellow Sea Region has made significant progress in economic exchange across its borders.<sup>4</sup>

Status of the Pan Yellow Sea Economic Zone, 2006

Country/region	Area (km <sup>2</sup> )	Population (1,000 persons)	GRDP (billion USD)	GRDP per capita (USD)	Trade (billion USD)
Japan*	39,671	13,569	375	28,190	88
China*	500,460	214,269	590	3,236	254
Korea*	52,218	27,208	516	21,767	237
Total of Pan Yellow Sea Region	592,349	256,046	1.5 trillion	17,731	609

Notes 1) Japan\* : Fukuoka, Kumamoto, Nagasaki, Oita, Miyazaki, Saga, Kagoshima, Shimonoseki City

China\* : Tianjin City, Liaoning, Hebei, Shandong

Korea\* : Busan, Incheon, Ulsan, Gyeonggi, Chung-nam, Jeon-buk, Jeon-nam, Gyeong-nam

Notes 2) GRDP was normalized with the exchange rate for 2006 (USD 1=CNY 7.97, USD 1=JPY 119.00, USD 1=KRW 929.6)

#### < Land use >

The pristine habitats and ecosystems in the Yellow Sea ecoregion have greatly deteriorated because of environmental destruction. Tidal flats in China have decreased by 37% in comparison to those of the 1950s. In Korea, 43% of coastal tidal flats have been lost since 1917. The major reasons cited are reclamation due to human development in coastal areas and the expansion of the aquaculture industry. The original coastlines have been converted to farmlands, saltpans and farm operations for fish, shrimp and shellfish because of land reclamation by drainage. 630,000 km<sup>2</sup> of the Yellow Sea ecoregion's coastal areas have been covered by farms and 30% percent of the area's tidal flats have been turned into saltpans. The degradation of the natural environment caused by various developments is now a serious problem, not only for plants, shellfish, shrimp and invertebrates, but also for their predators such as birds and mammals.<sup>1</sup>

#### < Industry >

In the modern age, regional integration in the Pan Yellow Sea Region has been principally driven by market forces. In particular, multi-national enterprises have played a key role in crafting an economically integrated region. They invest across borders, construct closely-knitted manufacturing networks, and sharply accelerate trade flow in the region, in order to make the most of economic complementarities of the three countries in the Pan Yellow Sea Region. China's Bohai Rim area has abundant labor, vast natural resources and huge markets, whilst the Japanese and Korean side of the Pan Yellow Sea Region have ample capital and a range of advanced technologies with different degrees. This structure has been further exploited by the industrial restructuring processes of Japanese and Korean firms. Since the 1980s, Japanese have relocated domestic production sites overseas due to the sharp rises in land prices, wages and currency of Japan. This relocation process has been replicated by Korean companies since the early 1990s. At the same time, in its search for technologies and capital to transform its economy, the Chinese government provided a wide array of incentives to encourage Japanese and Korean firms to move into China, such as free industrial sites and long-term tax incentives. These two different dimensions have coincided to stimulate rapid economic integration within the Pan Yellow Sea Region.<sup>4</sup>

#### Shipping

Geographical proximity has also deepened regional ties in the Pan Yellow Sea Region. Most cities in the region are closely located to each other. For instance, Busan is only 200 km from Fukuoka City, while Fukuoka City and Japan's capital city of Tokyo are about 5 times further, or 1000 km apart. In addition, most cities in the Pan Yellow Sea Region are well connected across borders via sea and air. The rapid development of the sea transporting system in the Pan Yellow Sea Region is substantially lowering the cost of transporting goods by container ship compared to other parts of the world. According to the OECD, the cost to send a container from other regions of the world to China, Japan and Korea in 2006 were only 1.2%, 0.8% and 0.5% of total import value respectively, whereas those to the US and Australia were 4.8% and 6.4% respectively.<sup>4</sup>

### Environmental Problems

#### < Water and sediment quality >

##### Water quality

The quality of the coastal waters of the Yellow Sea according to the Ministry of Environmental Protection of China is generally good, with 87% of the monitored area meeting Grade I ~ II<sup>a</sup> marine water quality standard, which was about 4% less than in 2009. For the remaining monitoring points, 7.4% met Grade III standard and 5.6% met or failed to meet Grade IV standard. The main pollutants were inorganic nitrogen and phosphate.<sup>5</sup>

<sup>a</sup> I: water source; national nature protection zone II: domestic drinking water source (Class I); rare aquatic biology habitat; egg-laying site for aquatic life forms; feeding and preying site for baby fishes III: domestic drinking water source (Class II); hibernation site, migration route and breeding site for aquatic life forms; swimming site IV: water use for industry; entertainment use where water does not touch the human body V: agriculture use; scenic body of water

### Sediment quality

High organic nutrient concentrations are found in the surface sediments of the central area of the southern Yellow Sea. Concentrations of trace elements, such as cadmium (Cd), copper (Cu) and zinc (Zn), are close to natural levels.<sup>6</sup>

### < Other Environmental Problems >

#### Over exploitation of fishery resources

Overfishing has become a significant problem in recent years. The ecoregion is one of the richest seas with outstanding fishery resources, however, the ocean is also one of the most overfished areas due to the development of the economy and fishery technologies. This has become a significant factor in the depletion of resources as well as environmental deterioration.

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.<sup>7</sup>

#### Harmful Algal Blooms (HAB)

In the coastal areas of the Yellow Sea, the number of red tide events has been increasing since the mid-1980s, and the scale has also expanded in recent years. Such huge outbreaks of phytoplankton are most likely caused by human activities in the coastal areas and the corresponding decrease in tidal flats. For example, one of the causes is the discharge of domestic and industrial wastewater into the ecosystem at high temperatures with high concentrations of nitrogen and phosphorus which are both essential for plankton growth. Likewise, the decrease in manila clams resulting from the loss of many tidal flats is also an important factor, because they feed on plankton. Some species of plankton causing red tide are known to contain toxins. As a result, there is a long-term risk to the health of humans and shorebirds who consume toxic plankton-fed shellfish and fish.<sup>1</sup>

### < Environmental Protection Measures >

#### Control over fisheries

The Chinese government has imposed strict controls on fishing effort. The fishing license system controls not only the total number of fishing boats, but also the total fishing effort. The government emphasized that during the 9th five-year plan (1996-2000), there would be zero-increase of fishing effort in Chinese waters. Apart from the control on fishing effort, fishing is completely prohibited in the Bohai, Yellow, and East China Seas during the months of July and August. Since 1988, there has been a total ban on trawl fishing in the Bohai Sea, with the aim of conserving the fish in the Yellow Sea. There was a recovery of small yellow croaker fish in the region, but greater effort is required to conserve the fish in the Yellow Sea.<sup>6</sup>

#### Transboundary cooperation

Due to the lack of a formal framework for achieving international cooperation in monitoring and research activities, China, the Democratic People's Republic of Korea, and the Republic of Korea have been trying to establish regional initiatives. These initiatives include a GEF (Global Environmental Fund)-funded project, Northwest Pacific Action Plan (NOWPAP), Tumen River Area Development Programme (TRADP), the Asia-Pacific Economic Cooperation Forum (APEC), Fisheries Marine Resources Conservation Working Groups, and the GEF/UNDP/IMO (Global Environmental Fund/United Nations Development Project/International Marine Organization) East Asia Seas project.

#### Related organizations and NGOs

- Northwest Pacific Action Plan (NOWPAP) <<http://www.nowpap.org/>>
- UNDP/GEF Yellow Sea LME Project <<http://www.pemsea.org/organization/yslme>>
- Korea Institute of Ocean Science & Technology (KIOST) <[http://eng.kiost.ac/kordi\\_eng/main/](http://eng.kiost.ac/kordi_eng/main/)>
- World Wildlife Fund (WWF) China <[http://en.wwfchina.org/en/what\\_we\\_do/marine/yellow\\_sea\\_ecoregion/](http://en.wwfchina.org/en/what_we_do/marine/yellow_sea_ecoregion/)>

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