Bulletin of Marine Ecology and Environment Status of China in 2018

Ministry of Ecology and Environment
of the People's Republic of China

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Introduction

Under the guidance of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, the idea of building Ecological Civilization together with the statement of constructing marine power have been fully implemented by different regions and governmental departments. Carrying on the spirits of the National Ecological and Environmental Meeting, the work of marine ecological and environmental protection is being advanced in accordance with the established strategies made by the Central Committee of CPC and the State Council. As the result, the handover and rearrangement of the responsibility of marine environmental and ecological protection is being advanced smoothly, and all dimensions of marine environmental protection made progress and achieved sound results, laying a solid foundation for the future.

In 2018, the national water quality monitoring was carried out at 1,649 seawater stations, 194 riverine transects flowing into the sea，453 sewage outlets with daily discharge volume exceeding 100 m^3, and 36 bathing beaches. In several typical estuaries, sediment quality monitoring were implemented. The ecological status routine surveys were implemented at 1,705 marine biodiversity stations, 21 typical marine ecosystems, 89 marine protection area and 24 coastal wetlands. The marine environmental quality monitoring was implemented at 48 important fishery areas.

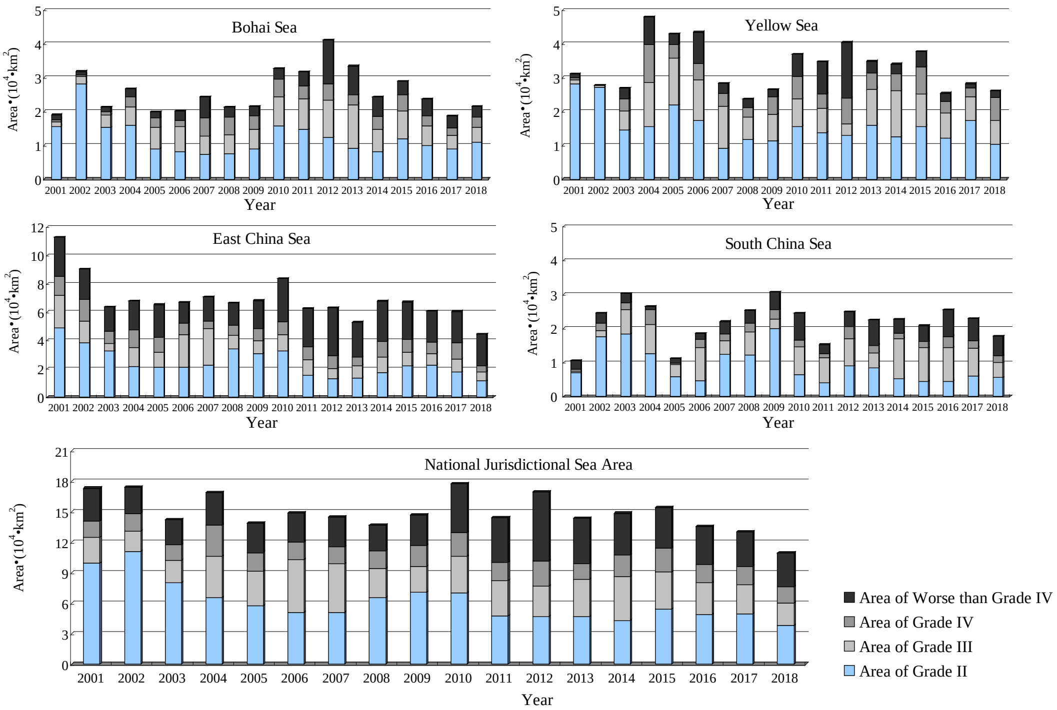
The monitoring results showed that China's marine ecology and environment status was stable and presented a good momentum of improvement. The seawater quality was getting better as a whole. The sea area according with Seawater Quality Standard Grade I accounted for 96.3% of the jurisdictional seas of China. In the coastal area, seawater quality of 74.6% stations were either excellent or good, increased by 6.7 percentage points compared with the previous year. The polluted areas were mainly located at Liaodong Bay, Bohai Bay, Laizhou Bay, Jiangsu Coast, Yangtze River Estuary, Hangzhou Bay, Zhejiang Coast, and Pearl River Estuary. The dominant indicators exceeding the Seawater Quality Standard were inorganic nitrogen and active phosphate. The health status of typical marine ecosystems and the protected objects of marine protected areas remained basically stable. The monitored transects which failed to meet the Environmental Quality Standards for Surface Water Grade V decreased by 6.1 percentage points. The marine environment qualities in the ocean dumping zones and oil/gas exploration zones basically met the environmental protection requirements of marine functional zones. The environmental quality of marine fishery areas was generally in good status. Compared with the previous year, both the frequency and the cumulative area of recorded red tides have significantly decreased.

1 Marine Environmental Quality

1.1 Seawater Quality

1.1.1 Seawater Quality of Jurisdictional Seas of China

In 2018, sea area meeting Seawater Quality Standard Grade I accounted for 96.3% of the total area. The sea area with water quality worse than Seawater Quality Standard Grade IV was 33,270 km², decreased by 450 km² compared with the previous year.



Total sea area with water quality below Seawater Quality Standard Grade I in jurisdictional seas of China in summer from 2001 to 2018

Total sea area with water quality below Seawater Quality Standard Grade I in jurisdictional seas of China in 2018 (km^2)

Sea Area	Grade II	Grade III	Grade IV	Below Grade IV	Total
Bohai Sea	10,830	4,470	2,930	3,330	21,560
Yellow Sea	10,350	6,890	6,870	1,980	26,090
East China Sea	11,390	6,480	4,380	22,110	44,360
South China Sea	5,500	4,480	1,950	5,850	17,780
Jurisdictional Seas of China	**38,070**	**22,320**	**16,130**	**33,270**	**109,790**

Water quality status of jurisdictional seas of China in 2018

Seawater Quality in Each Region

Bohai Sea The sea area with water quality worse than Seawater Quality Standard Grade I was 21,560 km^2, increased by 2,820 km^2 compared with the previous year. The sea area with water quality worse than Seawater Quality Standard Grade IV was 3, 330 km^2, decreased by 380 km^2 compared with the previous year and mainly located at Liaodong Bay, Bohai Bay, Laizhou Bay, and Luanhe River Estuary. The dominant indicators exceeding the standard were inorganic nitrogen and active phosphate.

Yellow Sea The sea area with water quality worse than Seawater Quality Standard Grade I was 26,090 km^2, decreased by 2,130 km^2 compared with the previous year. The sea area with water quality worse than Seawater Quality Standard Grade IV was 1,980 km^2, increased by 740 km^2 compared with the previous year and were mainly located at Northern Yellow Sea and Jiangsu Coast. The dominant indicators exceeding the standard were inorganic nitrogen and active phosphate.

East China Sea The sea area with water quality worse than Seawater Quality Standard Grade I was 44,360 km^2, decreased by 16,120 km^2 compared with the previous year. The sea area with water quality worse than Seawater Quality Standard Grade IV was 22,110 km^2, decreased by 100 km^2 compared with the previous year and mainly located at the coastal areas of Yangtze River Estuary, Hangzhou Bay, Xiangshangang

Bay, Sanmen Bay, and Sansha Bay. The dominant indicators exceeding the standard were inorganic nitrogen and active phosphate.

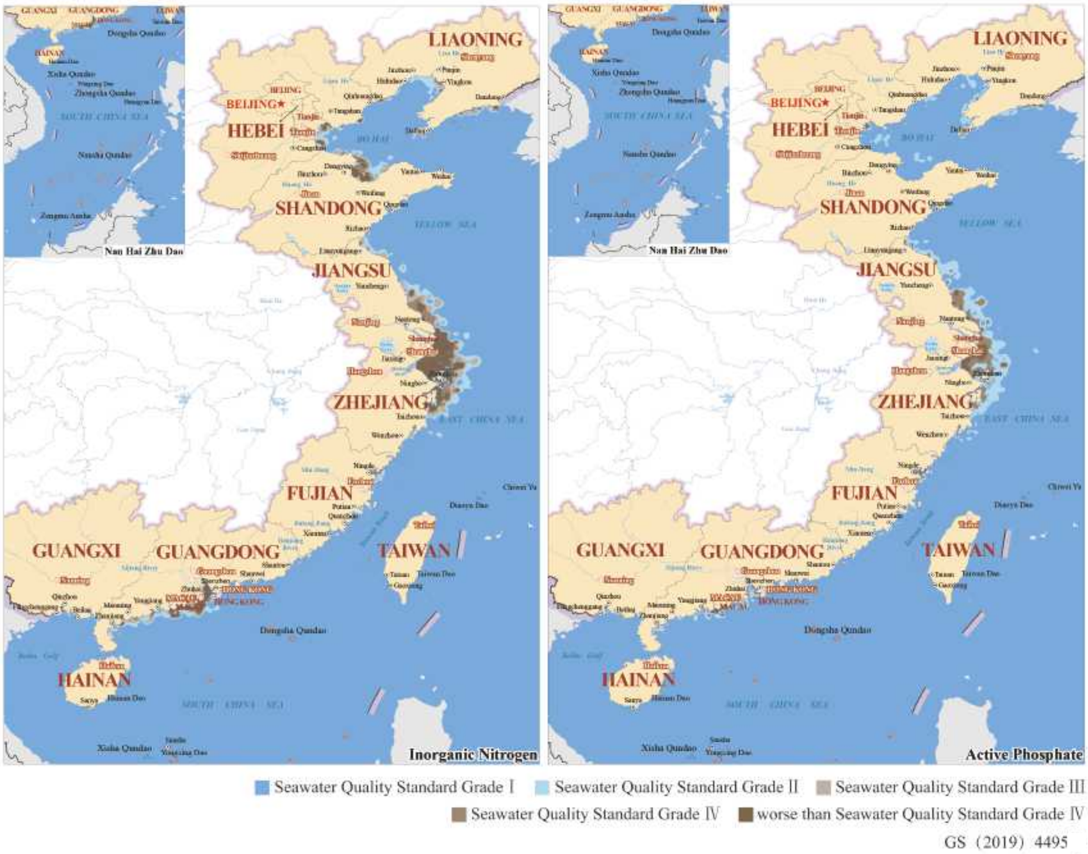
South China Sea The sea area with water quality worse than Seawater Quality Standard Grade I was 17,780 km^2, decreased by 5,110 km^2 compared with the previous year. The sea area with water quality worse than Seawater Quality Standard Grade IV was 5,850 km^2, decreased by 710 km^2 compared with the previous year and mainly located at Pearl River Estuary, Qinzhou Bay, and Dafengjiang Estuary. The dominant indicators exceeding the standard were inorganic nitrogen, active phosphate, and petroleum.

Dominant Indicators Exceeding the Standard

Inorganic Nitrogen The sea area with inorganic nitrogen contents worse than the Seawater Quality Standard Grade I was 95,440 km^2, decreased by 410 km^2 compared with the previous year. The sea area with inorganic nitrogen contents worse than Seawater Quality Standard Grade IV was 32, 430 km^2, increased by 1,700 km^2 compared with the previous year and mainly located at Liaodong Bay, Bohai Bay, Laizhou Bay, Jiangsu Coast, Yangtze River Estuary, Hangzhou Bay, Zhejiang coast, and Pearl River Estuary.

Active Phosphate The sea area with active phosphate contents worse than Seawater Quality Standard Grade I was 69,740 km^2, decreased by 12,510 km^2 compared with the previous year. The sea area with active phosphate contents worse than Seawater Quality Standard Grade IV was 7,160 km^2, decreased by 6,600 km^2 compared with the previous year and mainly located at Bohai Bay, Laizhou Bay, Jiangsu coast, Yangtze River Estuary, Hangzhou Bay, Zhejiang coast, and Pearl River Estuary.

Petroleum The sea area with petroleum contents worse than the Seawater Quality Standard Grade I and II were 5,920 km^2, decreased by 4,710 km^2 compared with the previous year and mainly located at the coastal areas of Pearl River Estuary and Leizhou Peninsula.



Seawater quality status of inorganic nitrogen and active phosphate in jurisdictional seas of China in 2018

1.1.2 Seawater Quality of Coastal Areas

The integrated assessment results of three seasons (spring, summer and autumn) indicated that the seawater quality of coastal area* generally remained stable and was gradually improved. The category of coastal seawater quality was relatively good, and dominant pollution indicators were inorganic nitrogen and active phosphate. Among 417 coastal seawater monitoring stations in the national monitoring program, seawater quality of 74.6% stations were excellent and good, which increased by 6.7 percentage points compared with the previous year. Of all the stations, 46.1%, 28.5%, 6.7% and 3.1% met Seawater Quality Standard Grade I, Grade II, Grade III and Grade IV respectively, and 15.6% worse than Grade IV.

Among the coastal provinces (autonomous regions and municipalities), the coastal areas of Hebei, Guangxi, and Hainan had excellent water quality. Liaoning, Shandong, and Fujian had good coastal seawater quality. The coastal seawater quality of Jiangsu and Guangdong was moderate, that of Tianjin was poor, and that of Shanghai and Zhejiang was extremely poor. Compared with the previous year, the coastal seawater quality of Liaoning, Tianjin, Shandong, Shanghai, Zhejiang, Fujian, Guangxi, and Hainan remained stable, and the coastal seawater quality of Hebei, Jiangsu, and Guangdong was improved.

* Coastal area is classified according to the National Marine Functional Zone (Year 2011-2020).

Among 61 coastal cities, 25 cities, namely, Jinzhou, Huludao, Qinhuangdao, Tangshan, Cangzhou, Jieyang, Shanwei, Huizhou, Maoming, Beihai, Fangchenggang, Haikou, Yangpu, Chengmai, Lingao, Danzhou, Changjiang, Dongfang, Ledong, Sanya, Lingshui, Wanning, Qionghai, Wenchang and Sansha, had excellent coastal seawater quality. The coastal seawater quality of 13 cities, namely, Dandong, Dalian, Binzhou, Yantai, Weihai, Qingdao, Rizhao, Fuzhou, Putian, Quanzhou, Xiamen, Zhangzhou and Shantou, was good. The coastal seawater quality of 6 cities, namely, Lianyungang, Yancheng, Wenzhou, Yangjiang, Zhanjiang and Qinzhou, was moderate. The coastal seawater quality of 9 cities, namely, Yingkou, Tianjin, Dongying, Nantong, Ningbo, Taizhou, Ningde, Chaozhou and Jiangmen, was poor. The coastal seawater quality of 8 cities, namely, Panjin, Weifang, Shanghai, Jiaxing, Zhoushan, Shenzhen, Zhongshan and Zhuhai, was extremely poor.

1.1.3 Water Quality of Key Bays

In 2018, among the 44 bays with an area larger than 100 km^2, 16 bays had seawater quality worse than Seawater Quality Standard Grade IV during the four seasons. The dominant indicators exceeding the standard were inorganic nitrogen and active phosphate.

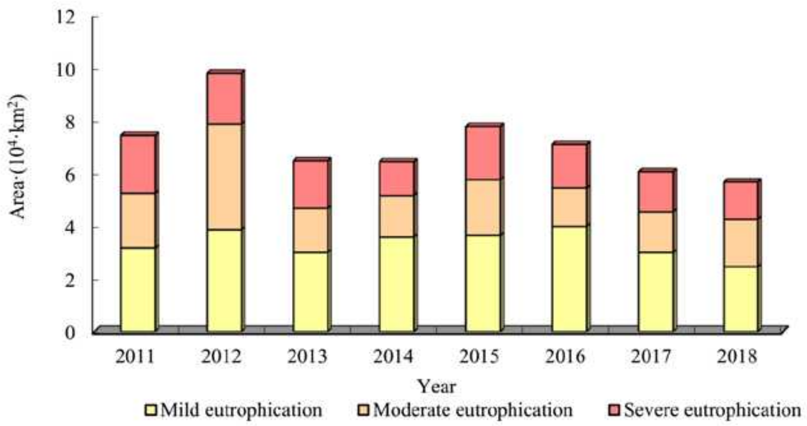
Seawater quality status of key bays in summer of 2018

1.1.4 Eutrophication*

In 2018, the eutrophic sea area was 56,680 km² in summer. The sea areas with mild, moderate, and severe eutrophication were 24,590 km², 17,910 km² and 14,180 km² respectively. Severe eutrophication areas were mainly located at the coastal areas of Liaodong Bay, Bohai Bay, Yangtze River Estuary, Hangzhou Bay, and Pearl River Estuary. On the whole, the eutrophic sea area in jurisdictional seas of China declined from 2011 to 2018.

Eutrophic sea areas in jurisdictional seas of China in 2018 (km^2)

Sea Area	Mild eutrophication	Moderate eutrophication	Severe eutrophication	Total
Bohai Sea	3,220	660	370	4,250
Yellow Sea	9,240	4,630	310	14,180
East China Sea	7,960	10,030	11,740	29,730
South China Sea	4,170	2,590	1,760	8,520
Total sea area	**24,590**	**17,910**	**14,180**	**56,680**



Total eutrophic sea areas in jurisdictional seas of China in 2011 - 2018

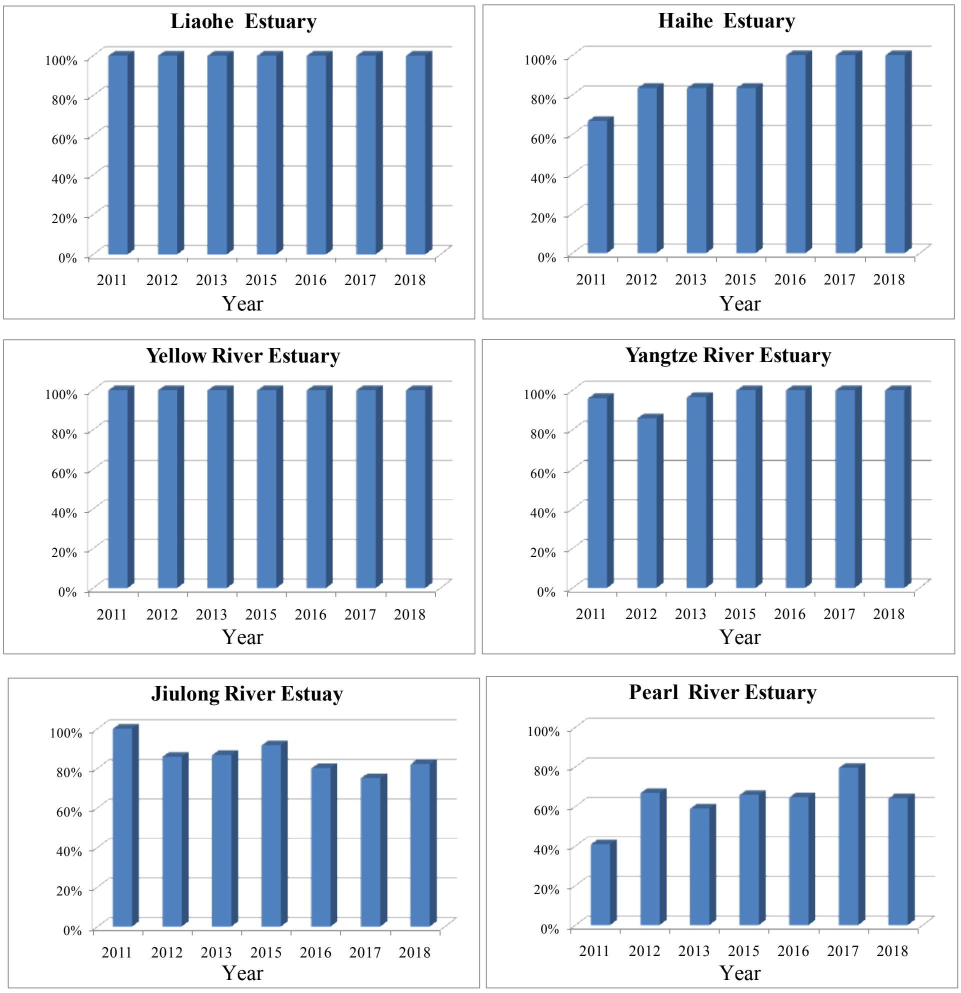
* Eutrophication status is classified based on the calculated result of eutrophication index (E), which has the calculation formula of $E = COD_{Cr} \times$ inorganic nitrogen × active phosphate × $10^6/4500$. $E \geq 1$ indicates eutrophication, $1 \leq E \leq 3$ indicates mild eutrophication, $3 < E \leq 9$ indicates moderate eutrophication, and $E > 9$ indicates severe eutrophication.

Eutrophication status of jurisdictional seas of China in 2018

1.2 Sediment Quality

Monitoring of sediment quality in Liaohe Estuary, Haihe Estuary, Yellow River Estuary, Yangtze River Estuary, Jiulong River Estuary and Pearl River Estuary were implemented in 2018. The sediment qualities* in these estuaries presented upward trends on the whole. The percentage of sediment stations classified as good in Liaohe Estuary, Haihe Estuary, Yellow River Estuary, and Yangtze River Estuary was 100.0%. The percentage of sediment station classified as good in Jiulong River Estuary was 81.8%. A few stations had copper and zinc contents exceeded Marine Sediment Quality Standard Grade I. The sediment quality in Pearl River Estuary was moderate with 64.1% stations classified as good. Dominant pollutants were copper, petroleum, and arsenic, among which copper and petroleum contents at 10.3% stations were worse than Marine Sediment Quality Standard Grade III, and arsenic contents at 33.3% stations exceeded Marine Sediment Quality Standard Grade I.

*The sediment quality of an individual monitored station:
Good: no more than one indicator was worse than the Marine Sediment Quality Standard Grade I, and no indicator was worse than Marine Sediment Quality Standard Grade III;
Fair: More than one indicator was worse than Marine Sediment Quality Standard Grade I, and no indicator was worse than Marine Sediment Quality Standard Grade III.
Poor: One or more indicators were worse than Marine Sediment Quality Standard Grade III.



Percentage of sediment stations classified as "good" in estuaries of 2011-2018

1.3 Radioactivity Level in Marine Environment

In 2018, the radioactivity level was monitored in the jurisdictional seas of China, adjacent seas of nuclear facilities, and western Pacific Ocean.

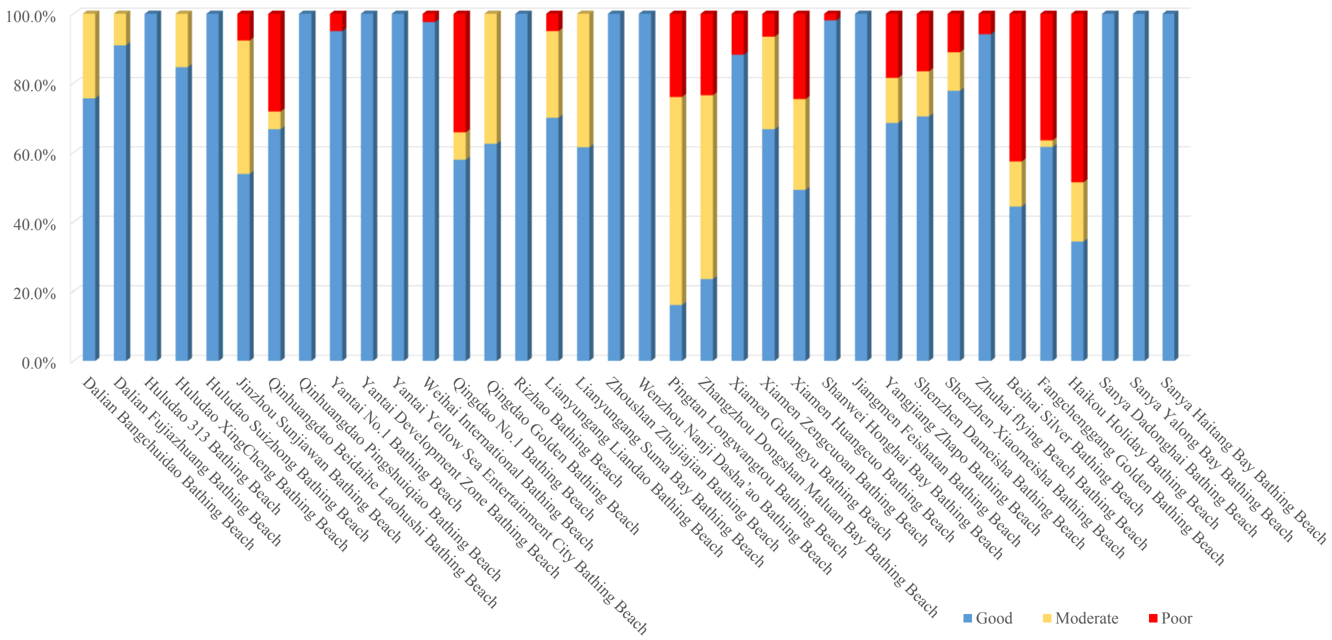
No abnormality was observed in terms of the radioactivity level of seawater and the air-absorbed dose rate of gamma ray in the jurisdictional seas of China. The activity level of natural radionuclides in coastal waters and marine organisms were at the background level, and no abnormality was observed with regard to the activity level of artificial radionuclides.

The activity levels of radionuclides in seawater, sediments, and marine organisms in the adjacent sea areas of the nuclear power plants of Hongyanhe (Liaoning Province), Haiyang (Shangdong Province), Tianwan (Jiangsu Province), Qinshan (Zhejiang Province), Sanmen (Zhejiang Province), Ningde (Fujian Province), Fuqing (Fujian Province), Daya Bay (Guangdong Province), Yangjiang (Guangdong Province), Fangchenggang (Guangxi Province), and Changjiang (Hainan Province) were within the radioactive background value range of the marine environment in China.

The western Pacific Ocean in the east and southeast of Fukushima (Japan) remained affected by the 2011 Fukushima Nuclear Power Plant Incident. The activity of cesium-137 in seawater was higher than the background level before the incident. The characteristic nuclides (cesium-134) of the nuclear incident was still detectable. The radioactive levels in marine organisms and sediments remained normal.

1.4 Water Quality of Bathing Beaches

In the swimming season of 2018, of the 36 monitored bathing beaches, the days with good seawater quality accounted for 74.8%, the days with moderate seawater quality 11.6%, and the days with poor seawater quality 13.6%. The integrated assessment of the whole swimming season in this year showed that 12 bathing beaches, including Huludao 313 Bathing Beach, Huludao Suizhong Bathing Beach, Qinhuangdao Pingshuiqiao Bathing Beach, Yantai Development Zone Bathing Beach, Yantai Huanghai Amusement City Bathing Beach, Rizhao Bathing Beach, Zhoushan Zhujiajian Bathing Beach, Wenzhou Nanji Dasha’ao Bathing Beach, Jiangmen Feishatan Bathing Beach, Sanya Dadonghai Bathing Beach, Sanya Yalong Bay Bathing Beach and Sanya Haitang Bay Bathing Beach, were in good water quality. The water quality was mainly impacted by high fecal coliform concentration, and some bathing beaches were impacted by petroleum pollution or floating seagrass.



Status of water quality of bathing beaches in coastal cities of China in 2018

2 Marine Ecological Status

2.1 Marine Biodiversity

In 2018, the marine biodiversity routine survey was implemented at 1,705 stations in jurisdictional seas of China. Data were collected on species compositions and distribution patterns of plankton, benthos, seagrass, mangrove, coral reef, and other organisms. The survey produced the following results: identification of 718 phytoplankton species, 686 zooplankton species, 1,572 macro-benthic species, 7 seagrass species, 11 mangrove species; and 85 reef-building coral species. Plankton and benthos biodiversity index showed a trend of increasing biodiversity from north to south in China, following the natural characteristic of species distribution.

In the Bohai Sea, 171 phytoplankton species (diatoms and dinoflagellates as dominating groups), 85 zooplankton species (copepod and jellyfish as dominating groups), and 286 macrobenthic species (annelids, mollusks and arthropods as dominating groups) were identified.

In the Yellow Sea, 212 phytoplankton species (diatoms and dinoflagellates as dominating groups), 113 zooplankton species (copepod and jellyfish as dominating groups), and 305 macrobenthic species (annelids, arthropods and mollusks as dominating groups) were identified.

In the East China Sea, 468 phytoplankton species (diatoms and dinoflagellates as dominating groups), 439 zooplankton species (copepod and jellyfish as dominating groups), and 699 macrobenthic species (annelids, arthropods and mollusks as dominating groups) were identified.

In the South China Sea, 486 phytoplankton species (diatoms and dinoflagellates as dominating groups), 505 zooplankton species (copepod and jellyfish as dominating groups), 972 macrobenthic species (mollusks, arthropods and annelids as dominating groups), 7 seagrass species, 11 mangrove species, and 85 reef-building coral species were identified.

Plankton and macro-benthos species composition, abundance, diversity index and dominant species in key monitored areas in 2018 summer

Monitored Areas	Phytoplanton				Zooplankton				Macro-benthos			
						Macro-zooplankton						
	Species number	Density ($\times 10^4$cells/m^3)	Diversity index	Dominant species	Species number	Density (ind./m^3)	Diversity index	Dominant species	Species number	Density (ind./m^2)	Diversity index	Dominant species
Luanhe - Beidaihe Estuary	62	25,567	2.44	*Skeletonema costatum* *Chaetoceros decipiens*	17	281	1.46	*Sagitta crassa* *Obelia spp.*	40	36.8	1.52	*Branchiostoma tsingtaunese* *Xenophthalmus pinnotheroides*
Yellow River Estuary	46	753	2.22	*Skeletonema costatum* *Thalassionema frauenfeldii*	21	240	2.06	*Centropages dorsispinatus* *Sagitta crassa*	52	150.5	2.18	*Glycinde gurjanovae* *Moerella jedoensis*
Yangtze River Estuary	134	15,090	1.17	*Skeletonema costatum*	77	653	1.87	*Centropages dorsispinatus* *Sagitta enflata*	89	174.3	2.07	*Heteromastus filiforms* *Listriolobus brevirostris*
Pearl River Estuary	77	122	1.86	*Skeletonema costatum*	149	290	2.46	*Acartia spinicauda* *Lucifer hanseni*	25	47.5	0.61	*Potamocorbula laevis*
Jinzhou Bay	17	33	2.66	*Skeletonema costatum* *Chaetoceros curvisetus*	13	370	1.35	*Centropages dorsispinatus* *Sagitta crassa*	18	55.0	1.00	*Mitrella bella* *Lumbricomereis heeropoda*
Bohai Bay	42	876	1.18	*Skeletonema costatum* *Pseudo-nitzschia pungens*	25	101	1.96	*Oikopleura dioica* *Sagitta crassa*	65	118.0	2.46	*Ceratia nagashima* *Linopherus pancibranchiata*
Laizhou Bay	40	64	1.95	*Chaetoceros paradoxus* *Chaetoceros siamense*	23	117	1.44	*Acartia pacifica* *Sagitta crassa*	86	981.1	3.20	*Heteromastus filiforms* *Glycinde gurjanovae*
Jiaozhou Bay	64	1,300	1.92	*Skeletonema costatum* *Eucampia zodiacus*	41	172	1.89	*Acartia pacifica* *Calanus sinicus*	83	245.3	2.66	*Nephtys oligobranchia* *Sternaspis scutata*
Hangzhou Bay	32	55	1.97	*Coscinodiscus jonesianus* *Coscinodiscus oculus-iridis*	48	201	1.86	*Tortanus vermiculus* *Acartia spinicauda*	11	4.6	0.36	*Sternaspis scutata*
Yueqing Bay	48	64	2.19	*Coscinodiscus jonesianus* *Schroederella delicatula*	42	207	2.37	*Acartia spinicauda* *Sagitta bedoti*	60	114.1	2.20	*Nephtys oligobranchia*
Eastern Fujian Coast	145	176	3.28	*Skeletonema costatum* *Thalassionema nitzschioides*	88	180	3.00	*Acartia pacifica* *Euchaeta concinna*	103	96.1	2.79	*Notomastus cf. aberans* *Aglaophamus dibranchis*
Daya Bay	81	12,278	1.4	*Skeletonema costatum* *Chaetoceros affinis*	63	42	2.28	*Acartia erythraea* *Pleurobrachia globosa*	47	47.4	1.38	*Laevidentalium eburneum* *Branchiostoma belcheri*
Northern Jiangsu Wetland	69	234	2.49	*Skeletonema costatum* *Coscinodiscus jonesianus*	35	196	2.10	*Diphyes chamissonis* *Euchaeta concinna*	46	60.4	1.83	*Glycera subaenea*
Changxing Island	39	1,775	2.73	*Skeletonema costatum* *Eucampia zodiacus*	25	379	2.70	*Sagitta crassa* *Oikopleura dioica*	78	384.4	2.44	*Sternaspis scutata* *Capitella capitata*
Miaodao Islands	48	300	3.14	*Ceratium tripos* *Chaetoceros curvisetus*	24	181	1.96	*Sagitta crassa* *Labidocera rotunda*	55	535.0	3.54	*Sigambra bassi* *Nephtys oligobranchia*

Note： The species diversity index is used to measure the species number and the individual number evenness among different species, and calculated by the formula $H' = -\sum(P_i \cdot \log_2 P_i)$, where *P* is the ratio of the number of individual for species *i* to the total individuals for all species in the sample.

The biodiversity index of plankton and macro-benthos in the key monitored areas in summer of 2014 - 2018

Biodiversity status of seagrass, mangroves, and reef-building corals in key monitored areas

2.2 Health Status of Typical Marine Ecosystems

In 2018, the health status of typical ecosystems, including estuary, bay, wetland, coral reef, mangrove, and seagrass bed, were monitored. The typical marine ecosystems in the healthy, sub-healthy, and unhealthy conditions* accounted for 23.8%, 71.4% and 4.8% respectively.

Estuary Ecosystem The typical estuary ecosystems having been monitored were all in sub-healthy condition. Some estuaries were in eutrophic conditions. The residual level of cadmium and lead in some shellfish were relatively high. The density of phytoplankton was relatively high in most estuary ecosystems. The density of ichthyoplankton was generally low.

Bay Ecosystem Most bay ecosystems were in sub-healthy condition, whereas Hangzhou Bay was in unhealthy condition. Some bay ecosystems were in eutrophic conditions. The residual level of cadmium, lead and arsenic in some shellfish living in monitored bays were relatively high. The phytoplankton density was high in most bay ecosystems. The density

* The health status of marine ecosystems are divided into three categories, namely, healthy, sub-healthy, and unhealthy.
Healthy: Ecosystems maintain their natural attributes. Biological diversity and ecosystem structure are basically in stable conditions, and ecosystems play main service functions normally. Ecological pressures, such as environmental pollution, destruction resulted from human activities, and unreasonable development of resources, are well within the enduring capabilities of the ecosystems.
Sub-healthy: Ecosystems basically maintain natural attributes. Biological diversity and ecosystem structure experience certain degrees of changes. However, ecosystems still can play main service functions. Yet ecological pressures, such as environmental pollution, destruction resulted from human activities, and unreasonable development of resources, already exceed the enduring capabilities of the ecosystems.
Unhealthy: The natural attributes of ecosystems present evident changes. Biological diversity and ecosystem structure experience relatively great changes, and main ecosystem service functions are in serious deterioration or totally lost. Ecological pressures, such as environmental pollution, destruction resulted from human activities, and unreasonable development of resources, significantly exceed the enduring capabilities of the ecosystems.

of ichthyoplankton was generally low in the monitored bays, with a gradually upward trend.

Wetland The Northern Jiangsu Wetland ecosystem was in sub-healthy condition. The dominant vegetation types in the ecosystem were cordgrass (*Spartina alterniflora*), seepweed and reed. The species diversity of phytoplankton and zooplankton was high. The intertidal biological community remained stable. The density of ichthyoplankton was extremely low.

Coral Reef Ecosystem The coral reef ecosystems in the southwest coast of Leizhou Peninsula and Guangxi Beihai were in healthy condition, whereas the coral reef ecosystems in the Eastern Hainan Coast and Xisha Islands were in sub-healthy condition. The living coral reef coverage in the southwest coast of Leizhou Peninsula decreased compared with five years ago. The hard coral recruitment reached more than 1 ind./m^2 in the coral reef ecosystem of Guangxi Beihai. The coverage of living coral reefs in the Eastern Hainan Coast remained at a low level. The coverage of living coral reef in Xisha Islands increased compared with the previous year.

Mangrove Ecosystem The mangrove ecosystems in the Guanxi Beihai and Beilun Estuary were in healthy condition. The area and community type of mangroves remained stable, with high species diversity and habitat integrity. Macro-benthos was high in species richness with increased density and biomass. The number of observed bird species was gradually increasing.

Seagrass Bed Ecosystem The seagrass bed ecosystem in the Eastern Hainan Coast was in healthy condition, whereas that in Guangxi Beihai was in sub-healthy condition. The density of seagrass decreased from 891 ind./m^2 to 610 ind./m^2 in the seagrass bed ecosystem of the Eastern Hainan Coast compared with the previous year. The seagrass bed of Guangxi Beihai was still in a degradation trend characterized by decreased density and coverage of seagrass. The density of seagrass bed decreased from 85 ind./m^2 to 72 ind./m^2 compared with the previous year.

Basic status of typical marine ecosystems in 2018

Ecosystem type	Monitored area name	Area (km^2)	Health status	Influence factor
Estuary	Shuangtaizi Estuary	3,000	Sub-healthy	Seawater was eutrophic. The density of phytoplankton was extremely high. The density and biomass of zooplankton were extremely low. The density of ichthyoplankton was extremely low.
	Luanhekou–Beidaihe Estuary	900	Sub-healthy	The density of phytoplankton was extremely high. The density and biomass of zooplankton were extremely low. The biomass of macro-benthos was extremely low. The density of ichthyoplankton was extremely low.
	Yellow River Estuary	2,600	Sub-healthy	Seawater was eutrophic. The biomass of zooplankton was extremely low. The density of macro-benthos was extremely low, but the biomass of macro-benthos was extremely high. The density of ichthyoplankton was extremely low.
	Yangtze River Estuary	13,668	Sub-healthy	Seawater was eutrophic. Hypoxia area was observed. Some shellfish were detected with high levels of oil, Cd, Pb, and As. The densities of phytoplankton and macro-benthos were extremely high. The density of ichthyoplankton was extremely low.
	Pearl River Estuary	3,980	Sub-healthy	Seawater was eutrophic. The density of phytoplankton was extremely low. The density of macro-benthos was extremely low.
Bay	Jinzhou Bay	650	Sub-healthy	The density of zooplankton was extremely low, and the biomass of macro-benthos was extremely high.
	Bohai Bay	3,000	Sub-healthy	Seawater was eutrophic. The density of phytoplankton was extremely high. The density of zooplankton was extremely high, but the biomass of zooplankton was extremely low.
	Laizhou Bay	3,770	Sub-healthy	Seawater was eutrophic. The biomass of zooplankton was extremely high. The density and biomass of macrobenthos were extremely high.
	Hangzhou Bay	5,000	Unhealthy	Seawater was eutrophic. The density of phytoplankton was extremely low, whereas the biomass was extremely high. The density and biomass of macrobenthos were extremely low. The density of ichthyoplankton was extremely low.
	Yueqing Bay	464	Sub-healthy	Seawater was eutrophic. The density of phytoplankton was extremely low. The macro-benthos was extremely high in density and extremely low in biomass.
	Eastern Fujian Coast	5,063	Sub-healthy	The density of phytoplankton was extremely high. The density of zooplankton was extremely high. The density of ichthyoplankton was extremely low.

	Daya Bay	1,200	Sub-healthy	Some shellfish were detected with relatively high levels of Cd, Pb, and As. The density of phytoplankton was extremely high. The zooplankton was extremely low in density and extremely high in biomass. The density and biomass of macro-benthos were extremely low. The density of ichthyoplankton was extremely low.
Wetland	Northern Jiangsu Wetland	15,400	Sub-healthy	The density and biomass of macro-benthos were extremely high. The density of ichthyoplankton was extremely low.
Coral reef	Leizhou Peninsula	1,150	Healthy	The coverage of living coral reefs was lower than that five years ago.
	Guangxi Beihai	120	Healthy	The hard coral recruitment reached a relatively high level at 1 ind./m^2.
	Eastern Hainan Coast	3,750	Sub-healthy	The coverage of living coral reefs remained at the low lever.
	Xisha Islands	400	Sub-healthy	The coverage of living coral reefs was higher than that in the past year, and the species composition was stable.
Mangrove	Guangxi Beihai	120	Healthy	The mangrove area and community type were basically stable, with high species diversity and habitat integrity.
	Beilun Estuary	150	Healthy	The area size and community type kept stable. Parts of mangrove trees were affected by insect pests *Acanthopsyche suberalbata*, and the damaged tree was *Aeficeras corniculatum*.
Seagrass bed	Guangxi Beihai	120	Sub-healthy	The seagrass ecosystem was still in the condition of degradation.
	Eastern Hainan Coast	3,750	Healthy	The density of the seagrass bed decreased compared with the past year.

Health status of typical marine ecosystems in 2018

2.3 Marine Protected Area

Monitoring was implemented in 89 marine protected areas in 2018. At 25 marine protected areas, the protected objects were observed, among which the beaches, coasts, bedrock islands, and historic sites remained stable, the coverage of living coral reef declined, the areas of shell bank continuously reduced. The invasive species survey was implemented in 15 protected areas, and cordgrass (*Spartina alterniflora*) was observed in all areas.

1.Hebei Changli Gold Coast National Marine Nature Reserve
The density of *Branchiostoma belcheri* was 17.5 ind./m², and the biomass was 0.71 g/m². Both density and biomass were decreased when compared with those in the last year.

2.Binzhou Shell Island and Wetland National Nature Reserve
The area of shell bank was 36.49 ha, which was decreased than that in the last year. However, the black-billed gulls listing Categories of International Union for Conservation of Nature(IUCN) was found in this protected area.

3.Dongying Estuary Shallow Sea Shellfish Ecological National Marine Special Protected Area
Species number, density and biomass of shellfish decreased significantly when compared with those in the last year.

4.Dongying Lijin Benthic Fish Ecological National Marine Special Protected Area
The density of juvenile fish was 2.8 ind./m², and the biomass could reach up to 20.6 g/m².

5.Yellow River Delta National Nature Reserve
IUCN endangered species Oriental white stork and vulnerable species black-hilled gull were found in this protected area.

6.Shandong Changyi Ocean Ecological National Marine Special Protected Area
The distribution area of Tamarix chinensis was approximately 2070 ha.

National Marine Nature Reserve National Marine Special Protected Area National Marine Park
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7.Weihai Xiaoshi Island National Marine Special Protected Area
The distribution area of Stichopus japonicus was 200 ha, and the density was approximately 0.5 ind./m², which increased significantly when compared with that in the last year.

8.Weihai Liugong Island National Marine Special Protected Area
The ecological of uninhabited islands including Yashi island, Heiyu island, Qing island, Huang island, Lianlin island, Dahong island, Xiaohong island remained constantly.

9. Liugong Island National Marine Park
No obvious changes was found in the historic sites of Liugong Island and Ri Island. The ecological environmental was stable in this protected area.

10. Shandong Wendeng Marine Ecological National Marine Special Protected Area
The biomass of Trachidermus fasciatus was 0.35 g/m², and the density was 0.0061ind./m². The biomass and density decresed when compared with that in the last year.

11.Jiangsu Yancheng Wetland Rare Birds National Nature Reserve
The IUCN endangered species Curlew and giant sandpiper were found here.

12.Zhejiang Shengsi Maan Islands National Marine Park
The species of shellfish increased when compared with that in the last year, while the biomass and density were decreased in this year.

13.Zhejiang Putuo Zhongjieshan Islands National Marine Park
The number of species and density of shellfish increased and the biomass decreased when compared with that in the last year. The species number of algae decreased, but the biomass increased when compared with that in the last year.

14.Xiangshan Jiushan Islands National Nature Reserve
49 Chinese crested terns, more than 1,000 black-tailed gulls and 5,000 crested terns IUCN critically vulnerable species were found in this protected area.

15.Yueqing Ximen Island National Marine Special Protected Area
The species of the mangrove was *Kandelia obovate*, with an average density of 3.95 ind./m².

16.Pingtan Comprehensive Experimental Area Haitan Bay National Marine Park
The distribution area of fairy clams was 1626 ha, the density was 0.04 ind./m², and the biomass was 1.54 g/m².

17.Guangdong Nanpeng Islands National Nature Reserve
605 Chinese white dolphins were monitored in this protected area. However, only one newborn was found.

18.Guangdong Pearl River Estuary Chinese White Dolphin National Nature Reserve
2381 Chinese white dolphins were found.

19.Guangdong Yangjiang Hailing Island National Marine Park
Shili silver beach covered an area of 110.84 ha, and Dajiao bay beach covered an area of 32.48 ha. The total area decreased when compared with that in the last year.

20.Hainan Wanning Dazhou Island National Marine Ecological Nature Reserve
The coverage of living coral was only 11.3%, which declined when compared with that in the last year.

21.Hainan Sanya Coral Reefs National Nature Reserve
The coverage of living coral was 22.9%, which increased compared with that in the last year.

22.Guangdong Xuwen Coral Reefs National Nature Reserve
The living coral coverage was 6.95%, which decreased significantly compared with that in the last year.

23.Guangdong Leizhou Wushi National Marine Park
The beach area was 102.90 ha and decreased compared with that in the last year.

24.Guangxi Shankou Mangrove Ecological National Nature Reserve
In May, 10,000 m² of mangroves in the shawei buffer zone were attacked by the *Oligochroa cantonella Caradja*.

25.Guangxi Weizhou Island National Marine Park
The coverage of living coral was 27.2%, which decreased significantly compared with that in the last year.

The distribution of *Spartina alterniflora* in 15 surveyed marine protected areas in 2018

No.	Name of marine protected areas	Distribution of *Spartina alterniflora*
1	Beidagang Wetland Nature Reserve	Continuous distribution
2	Binzhou Shell Island and Wetland National Nature Reserve	Patchy distribution
3	Dongying Guangrao Nereis Ecological National Marine Special Protected Area	Continuous distribution
4	Dongying Estuary Shellfish Ecological National Marine Special Protected Area	Continuous distribution
5	Laizhou Bay *Bonellia Bonelliellia* National Aquatic Germplasm Resource Reserve	Continuous distribution
6	Yellow River Delta National Nature Reserve	Continuous distribution
7	Qingdao Jiaozhou Bay National Marine Park	Continuous distribution
8	Jiangsu Yancheng Wetland Rare Birds National Nature Reserve	Continuous distribution
9	Jiangsu Dafeng Elk National Nature Reserve	Continuous distribution
10	Shanghai Chongming Dongtan Bird National Nature Reserve	Continuous distribution
11	Shanghai Jiuduansha Wetland National Nature Reserve	Continuous distribution
12	Xiangshan Port Blue Point Mackerel National Aquatic Germplasm Resources Reserve	Continuous distribution
13	Zhangjiang Estuary Mangrove National Nature Reserve	Continuous distribution
14	Jiulongjiang Estuary Provincial Natural Reserve	Continuous distribution
15	Hailing Island Mangrove National Wetland Park	Sporadic distribution

2.4 Coastal Wetlands

In May, September, and October of 2018, the birds and vegetation were monitored at 24 coastal wetlands. In Panjin (Liaoning), Tangshan (Hebei), Binhai (Tianjin), Binzhou (Shandong), Dongying (Shandong), Weifang (Shandong), Qingdao (Shandong), Yancheng (Jiangsu), Chongming (Shanghai), Wenzhou (Zhejiang), and Yangjiang, Techeng Isle (Guangdong), seven bird species in IUCN Red List of Threatened Species (three endangered and four vulnerable) were observed. The vegetation monitored included seepweed, reed, *Tamarix chinensis*, *Scripus mariqueter*, cordgrass (*Spartina alterniflora*), 11 species of mangrove, and 7 species of seagrass.

The result of bird monitoring at coastal wetlands

Coastal wetland	No.of Species	Threatened Species*		
		CR	EN	VU
Panjin (Liaoning)	30	—	*Numenius madagascariensis, Calidris tenuirostris*	*Saundersilarus saundersi*
Tangshan (Hebei)	17	—	*Numenius madagascariensis, Calidris tenuirostris*	*Ichthyaetus relictus*
Binhai (Tianjin)	22	—	*Calidris tenuirostris*	—
Binzhou (Shandong)	22	—	*Calidris tenuirostris*	*Saundersilarus saundersi*
Dongying (Shandong)	35	—	*Numenius madagascariensis, Ciconia boyciana*	*Saundersilarus saundersi*
Weifang (Shandong)	28	—	*Numenius madagascariensis, Calidris tenuirostris*	*Saundersilarus saundersi*
Qingdao (Shandong)	13	—	*Numenius madagascariensis*	—
Yancheng (Jiangsu)	29	—	*Numenius madagascariensis, Calidris tenuirostris*	—
Chongming (Shanghai)	10	—	*Calidris tenuirostris*	*Anser cygnoid*
Jiuduansha (Shanghai)	12	—	—	—
Ningbo (Zhejiang)	10	—	—	—
Wenzhou (Zhejiang)	21	—	*Numenius madagascariensis*	*Egretta eulophotes*
Zhangzhou (Fujian)	13	—	—	—
Yangjiang (Guangdong)	14	—	—	*Egretta eulophotes*
Techeng Isle (Guangdong)	15	—	*Calidris tenuirostris*	—
Zhanjiang (Guangdong)	16	—	—	—
Shankou (Guangxi)	11	—	—	—
Beilun Estuary (Guangxi)	14	—	—	—
Dongzhaigang (Hainan)	5	—	—	—

Note："—" indicates no threatened birds specified were monitored.

*The threatened species were defined as species whose threatened status are "Critically endangered (CR)", "Endangered (EN)" or "Vulnerable (VU)" on the *International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species.*

3 Status of Main Pollution Sources into the Sea

3.1 Riverine Sources

In 2018, 194 monitoring transects of rivers flowing into the sea were under the national monitoring program.

In general, rivers flowing into the sea in China were under slight pollution*, and the water quality was improved compared with the previous year. Among the 194 monitored transects, no transect reached Environmental Quality Standards for Surface Water Grade I, which was similar to that in 2017; 40 transects reached Grade II standard, accounting for 20.6%, which increased by 6.8 percentage points compared with 2017; 49 transects reached Grade III, accounting for 25.3%, which decreased by 8.5 percentage points; 52 transects reached Grade IV, accounting for 26.8%, which increased by 2.2 percentage points; 24 transects fell into Grade V, accounting for 12.4%, which increased by 5.7 percentage points; and 29 transects failed to reach Grade V, accounting for 14.9%, which decreased by 6.1 percentage points. The dominant pollution indicators were chemical oxygen demand (COD_{cr}), permanganate index, and total phosphorus (TP). In some monitored transects, ammonia-N, five day

* Integrated water quality of rivers flowing into the sea is divided into five grades:

Excellent: proportion of rivers according with Grade I~III≥90%;

Good: 75% ≤proportion of rivers according with Grade I~III＜90%;

Slight pollution: proportion of rivers according with Grade I~III＜75%, and proportion of rivers failing to according with Grade V＜20%;

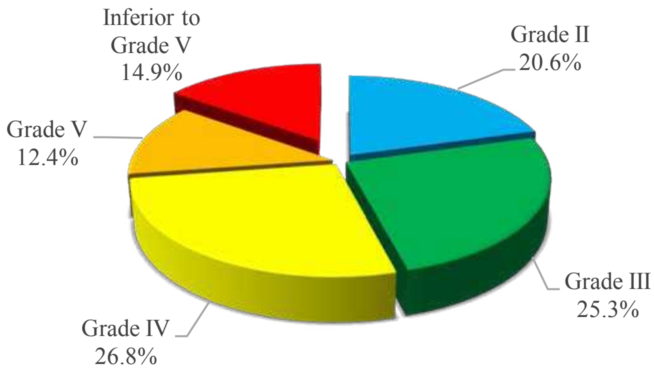
Moderate pollution: proportion of rivers according with Grade I~III＜75%, and 20%≤proportion of rivers failing to according with Grade V＜40%;

Heavy Pollution: proportion of rivers according with Grade I~III＜60%, and proportion of rivers failing to according with Grade V≥40%.

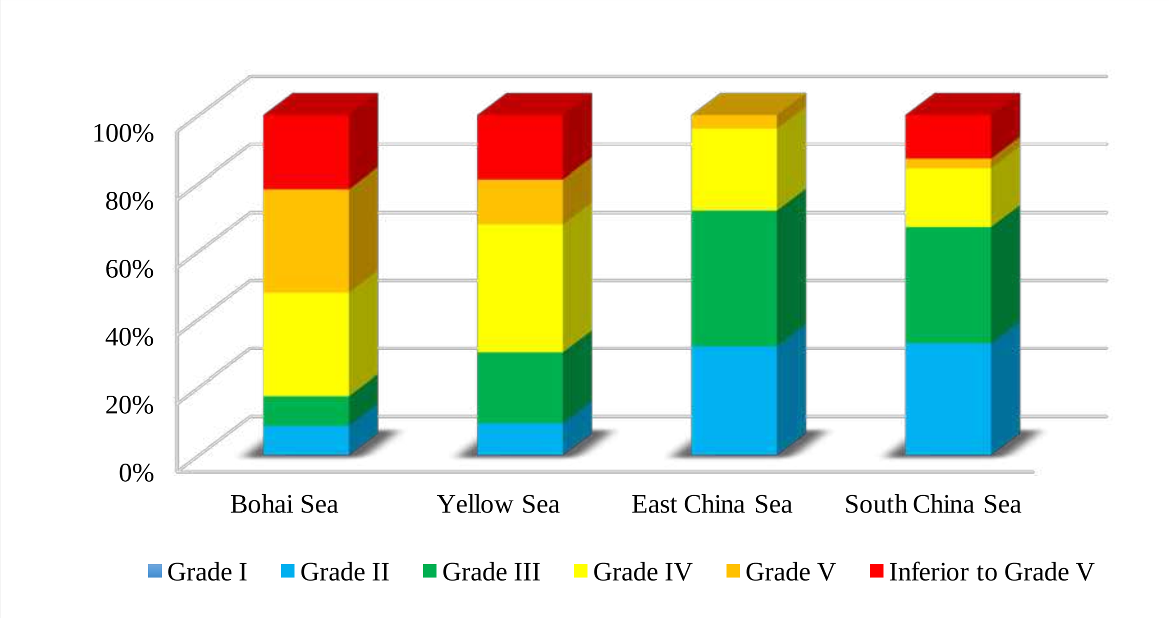
biochemical oxygen demand (BOD_5), fluoride, volatile phenol, petroleum, dissolved oxygen, anionic surfactant, and mercury failed to meet the surface water quality standard.

The statistics for water quality categories of monitored riverine transects in 2018

Sea Area	Water quality categories						
	Grade I	Grade II	Grade III	Grade IV	Grade V	Inferior to Grade V	Total
Bohai Sea	0	4	4	14	14	10	46
Yellow Sea	0	5	11	20	7	10	53
East China Sea	0	8	10	6	1	0	25
South China Sea	0	23	24	12	2	9	70
Total	0	40	49	52	24	29	194



Proportion of water quality categories of riverine transects of China in 2018

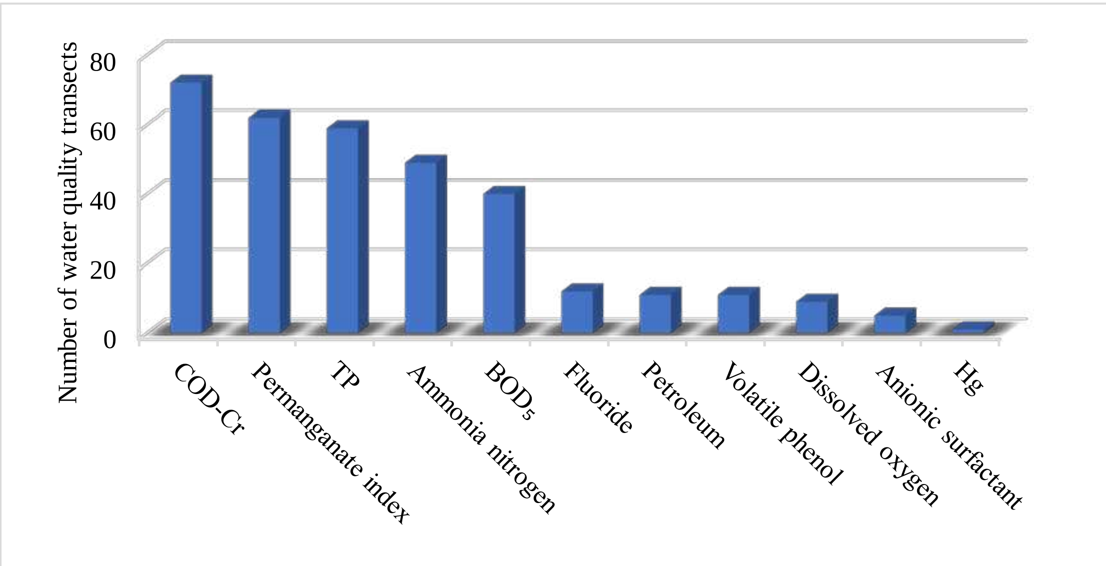


Proportion of water quality categories of riverine transects of different sea areas in 2018

In the coastal provinces (autonomous regions and municipalities), the water quality category of rivers in Shanghai was excellent; in Fujian and Hainan was good; in Liaoning, Hebei, Shandong, Zhejiang, and Guangxi were under slight pollution; in Jiangsu and Guangdong were under moderate pollution; and in Tianjin were under heavy pollution.

Proportion of water quality categories of riverine transects in coastal provinces (autonomous regions and municipalities) and dominant pollution indicators in 2018

Province	Water Quality	Grade I	Grade II	Grade III	Grade IV	Grade V	Inferior to Grade V	Dominant pollution indicators
Liaoning	Slight Pollution	0	16.7	22.2	38.9	11.1	11.1	COD_{Cr}, ammonia-N, permanganate index
Hebei	Slight Pollution	0	16.7	16.7	16.7	41.7	8.3	COD_{Cr}, permanganate index, BOD_5
Tianjin	Heavy Pollution	0	0	0	12.5	25.0	62.5	COD_{Cr}, permanganate index, BOD_5
Shandong	Slight Pollution	0	10.0	3.3	46.7	26.7	13.3	COD_{Cr}, permanganate index, TP
Jiangsu	Moderate pollution	0	3.2	25.8	32.3	12.9	25.8	permanganate index, COD_{Cr}, TP
Shanghai	Excellent	0	100.0	0	0	0	0	--
Zhejiang	Slight Pollution	0	38.5	23.1	38.5	0.0	0	TP, COD_{Cr}, ammonia-N
Fujian	Good	0	18.2	63.6	9.1	9.1	0	TP, COD_{Cr}, ammonia-N
Guangdong	Moderate pollution	0	30.0	32.5	15.0	0.0	22.5	ammonia-N, TP, COD_{Cr}
Guangxi	Slight Pollution	0	9.1	54.5	27.3	9.1	0	TP, ammonia-N
Hainan	Good	0	52.6	26.3	15.8	5.3	0	COD_{Cr}, ammonia-N, permanganate index



Statistics on water pollution indicators of riverine transects of China in 2018

Water pollution indicators of monitored riverine transects of China in 2018

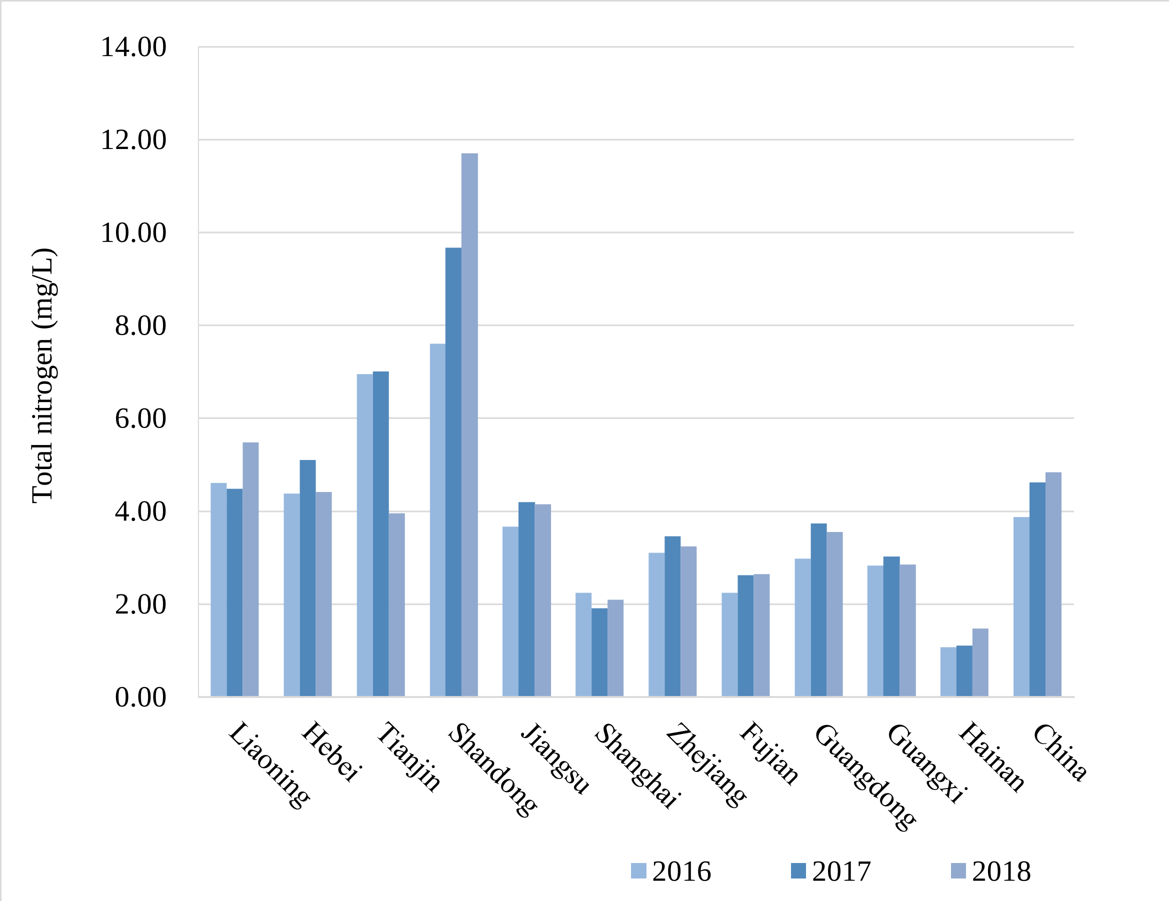
Sea Area	Exceeding Ratio >30%	30%≥ Exceeding Ratio ≥10%	Exceeding Ratio <10%
All	COD_{Cr} (37.1), permanganate index(32.0), TP(30.4)	Ammonia-N (25.3), BOD_5(20.6)	fluoride(6.2), volatile phenol(5.7), petroleum(5.7), dissolved oxygen(4.6), anionic surfactant(2.6), mercury (0.5)
Bohai Sea	COD_{Cr} (71.7), permanganate index(60.9), TP(39.1), BOD_5(34.8), ammonia-N (32.6)	volatile phenol(17.4), fluoride(13.0)	petroleum(8.7), anionic surfactant(6.5), mercury (2.2)
Yellow Sea	COD_{Cr} (52.8), permanganate index(50.9), TP(39.6), ammonia-N (32.1), BOD_5(32.1)	petroleum(11.3), fluoride(11.3)	volatile phenol(3.8), anionic surfactant(1.9)
East China Sea	—	TP(20.0), ammonia-N (12.0)	COD_{Cr} (8.0), dissolved oxygen(8.0)
South China Sea	—	TP(21.4), ammonia-N (20.0), COD_{Cr} (12.9), BOD_5((10.0), permanganate index(10.0), dissolved oxygen(10.0)	anionic surfactant(1.4), petroleum(1.4), volatile phenol(1.4)

Note: Data in brackets represent the exceeding ratio of pollution indicators (unit: %).

Among the rivers flowing into the sea of China, 37.1% of the monitored transects failed to meet the surface water quality standard for COD_{Cr}, which was the highest of all indicators, with a range of concentration of 1.0–167.0 mg/L and a mean concentration of 18.8 mg/L; the proportion of failing to meet the standard for permanganate index was 32.0%, with a range of concentration of 0.2–28.0 mg/L and a mean concentration of 5.0 mg/L; the proportion of failing to meet the standard for TP was 30.4%, with a range of concentration varied from undetected to 10.380 mg/L and a mean concentration of 0.199 mg/L; the proportion of failing to meet the standard for ammonia-N was 25.3%, with a range of concentration from undetected to 76.80 mg/L and a mean concentration of 1.16 mg/L; the proportion of failing to meet the standard for BOD_5 was 20.6%, with a range of concentration from undetected to 67.7 mg/L and a mean concentration of 3.0 mg/L.

In 2018, the total nitrogen (TN) mean concentration of rivers flowing into the sea was 4.83 mg/L, which increased by 4.5% compared with the previous year. Of the 194 riverine transects, the annual average TN concentration of 45 transects was above the national average value (4.83 mg/L). The annual average TN concentration of 15 transects in Shandong, Liaoning, Guangdong, and Jiangsu, exceeded 10 mg/L.

Among the coastal provinces (autonomous regions and municipalities), Liaoning, Shandong, and Hainan exhibited increased TN mean concentration of rivers by 20% compared with the previous year.



Mean TN concentration of sea-entering rivers in coastal provinces and across the country in 2016–2018

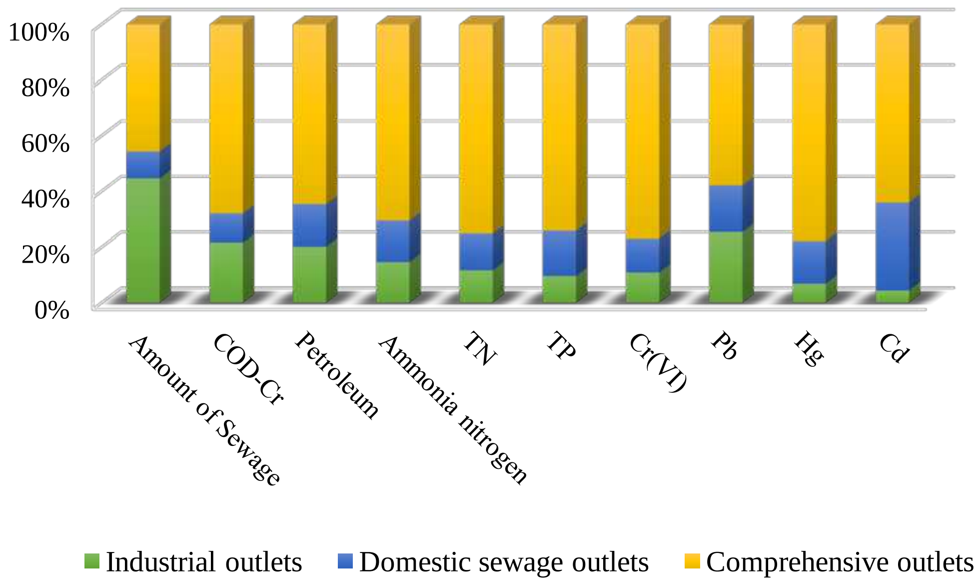
3.2 Pollutant Discharge Outlets

In 2018, 453 of industrial sewage outlets, domestic sewage outlets, and comprehensive sewage outlets with daily discharge volume exceeding 100 m^3 were monitored.

The total sewage discharge amount of 453 monitored outlets was approximately 8.66424 billion tons. Among various types of sewage outlets into the sea, comprehensive outlets accounted for the largest contribution to sewage discharge, followed by industrial outlets, and domestic sewage outlets made the least contribution. The largest discharge amounts of different dominant pollutants were all from comprehensive outlets.

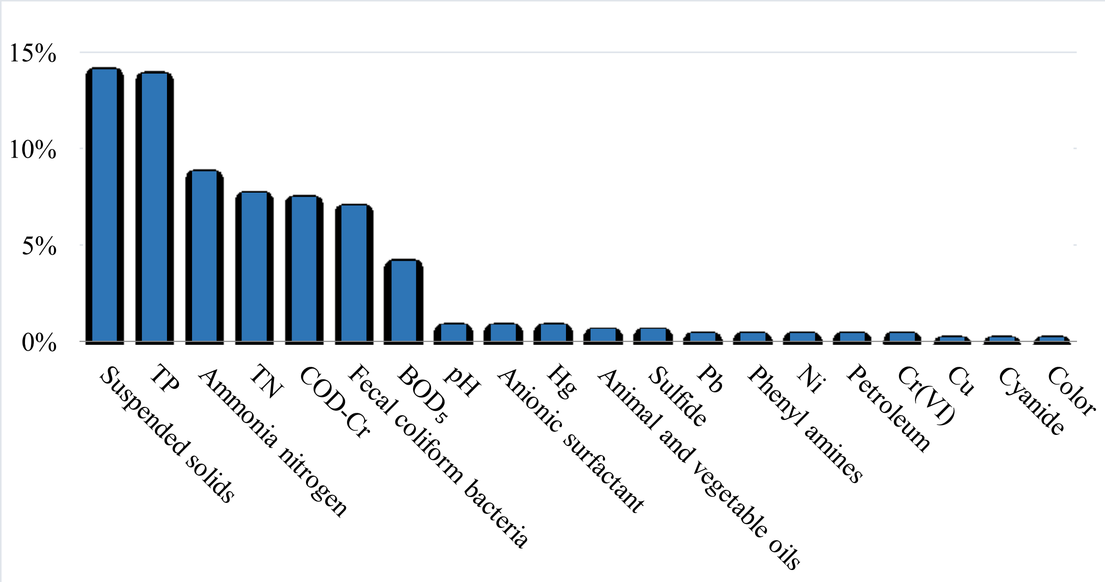
Discharge amount of sewage and dominant pollutants from different types of sewage outlets into the sea in 2018

Type of Sewage Outlets	Number of sewage outlets	Amount of Sewage （$\times 10^4$ ton）	COD_{Cr} (ton)	Petroleum (ton)	Ammonia-N (ton)	TN (ton)	TP (ton)	Cr(VI) (kg)	Pb (kg)	Hg (kg)	Cd (kg)
Industrial outlets	188	387,643	32,078	92.7	915	5,984	124	435.42	2095.45	19.15	18.00
Domestic sewage outlets	63	83,641	15,318	69.5	921	6,657	207	482.89	1,382.08	42.50	128.38
Comprehensive outlets	202	395,140	100,229	295.4	4381	38,232	949	3,053.74	4,760.35	215.29	260.49
Total	453	866,424	147,625	457.6	6217	50,873	1280	3,972.05	8,237.88	276.94	406.87



Proportion of dominant pollutants discharged from different types of sewage outlets into the sea in 2018

Many sewage outlets experienced excessive amount of suspended solids, TP, ammonia-N, TN, COD_{Cr}, and fecal coliform, with the exceeding standard rate above 5%. In some sewage outlets, BOD_5, pH, anionic surfactant, mercury, animal and vegetable oils, sulfide, lead, phenyl amines, nickel, petroleum, hexavalent chromium, copper, cyanide, and color failed to meet the water quality standard. Other pollutants did not exceed the standard.



Exceeding proportion of pollutants discharged from sewage outlets into the sea in 2018

Among the four sea areas, East China Sea showed the highest discharge amount of sewage, whereas Bohai Sea had the lowest. Regarding the dominant pollutants, the maximum discharge of hexavalent chromium and mercury was in the Yellow Sea; the maximum discharge of TP, lead, and cadmium was in the South China Sea; and the maximum discharge of all other pollutants was in the East China Sea.

Total amount of sewage and dominant pollutants from sewage outlets into the sea in different sea areas in 2018

Sea Area	Number of sewage outlets	Amount of Sewage (×10^4 ton)	COD_{Cr}(ton)	Petroleum (ton)	Ammonia nitrogen (ton)	TN (ton)	TP (ton)	Cr(VI) (kg)	Pb (kg)	Hg (kg)	Cd (kg)
Bohai Sea	64	68,720	7,227	12.9	464	3,717	59	297.10	215.77	28.41	68.06
Yellow Sea	81	117,183	33,034	116.4	1,313	9,961	252	2,007.29	3,325.41	133.12	90.10
East China Sea	179	556,800	79,800	282.7	2,282	26,533	458	1,283.82	1,120.51	62.91	116.21
South China Sea	129	123,722	27,563	45.7	2,158	10,662	511	383.84	3,576.19	52.51	132.50

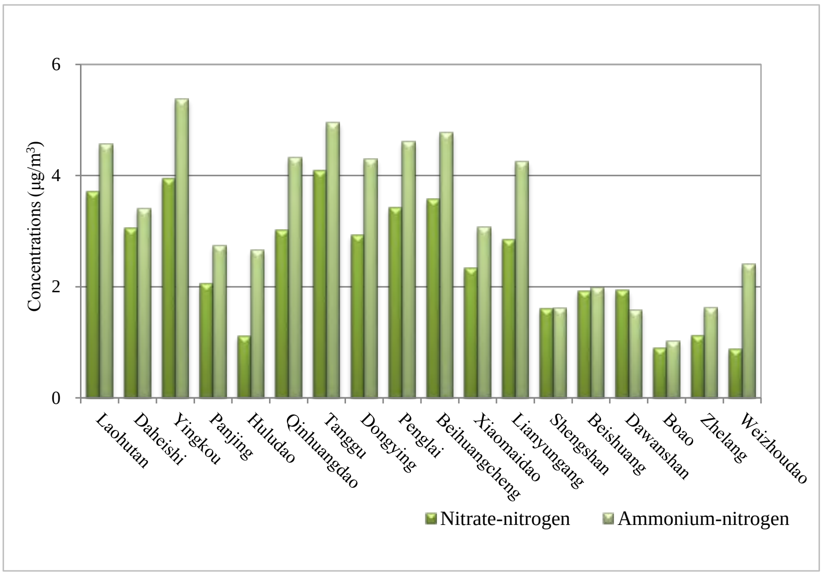
Among the coastal provinces (autonomous regions and municipalities), Fujian showed the largest sewage discharge amount from sewage outlets into the sea, followed by Zhejiang and Guangdong. The COD_{Cr} discharge amount of sewage outlets into the sea in Zhejiang was the largest, followed by those in Shandong and Fujian.

Total discharge amount of sewage and dominant pollutants from sewage outlets into the sea in coastal provinces (autonomous regions and municipalities) in 2018

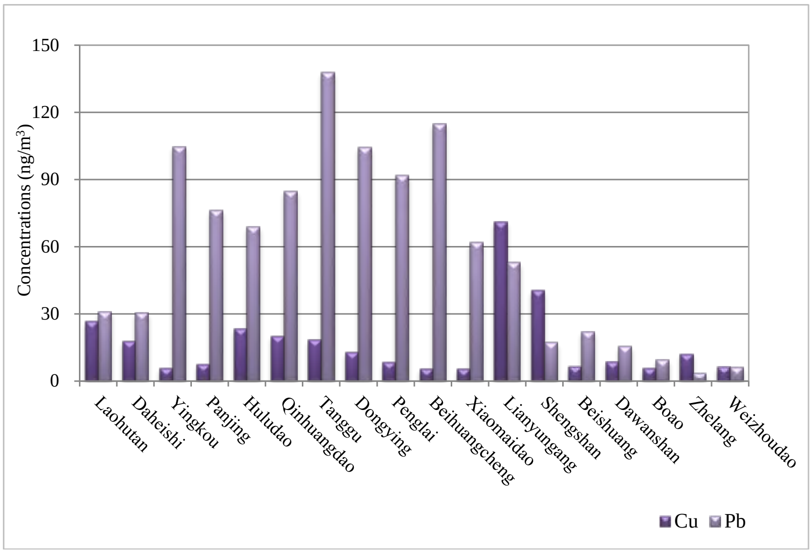
Province	Number of sewage outlets	Amount of Sewage （$\times 10^4$ ton）	COD_{Cr}(ton)	Petroleum (ton)	Ammonia nitrogen (ton)	TN (ton)	TP (ton)	Cr(VI) (kg)	Pb (kg)	Hg (kg)	Cd (kg)
Liaoning	30	48,548	12,151	43.0	493	3,023	98	233.19	3.03	4.74	—
Hebei	10	52,510	2,448	—	231	2,191	24	87.12	38.64	20.51	—
Tianjin	12	1,866	615	1.1	41	208	5	33.22	28.99	0.01	0.05
Shandong	72	77,735	23,271	75.9	938	7,777	170	1,945.12	3,377.69	132.86	157.55
Jiangsu	21	5,244	1,777	9.2	74	479	15	5.73	92.82	3.41	0.56
Shanghai	10	24,640	4,667	23.5	235	2,120	34	143.57	254.33	17.04	35.09
Zhejiang	85	206,736	56,207	189.1	1,445	19,307	301	910.39	750.70	16.89	63.31
Fujian	84	325,424	18,926	70.0	602	5,106	123	229.86	115.48	28.98	17.81
Guangdong	74	84,815	16,053	22.1	1,507	6,849	293	383.62	2,722.57	46.08	115.10
Guangxi	30	10,109	2,875	12.4	125	1,337	136	—	678.30	4.41	4.39
Hainan	25	28,798	8,635	11.1	526	2,476	83	0.22	175.32	2.02	13.00

3.3 Deposition of Atmospheric Pollutants

Pollutants in Marine Atmospheric Aerosols Monitoring of pollutants in marine atmospheric aerosols was implemented at Laohutan and Daheishi in Dalian, Yingkou, Panjin, Huludao, Qinhuangdao, Tanggu, Dongying, Penglai, Beihuangcheng, Xiaomaidao in Qingdao, Lianyungang, Shengshan in Zhoushan, Beishuang in Fujian, Dawanshan in Zhuhai, Zhelang in Guangdong, Weizhoudao in Guangxi, and Boao in Hainan. The highest concentration of nitrate in aerosols was observed at the Tanggu Station at 4.1 $\mu g/m^3$, and the lowest was at the Weizhoudao Station at 0.9 $\mu g/m^3$; the highest concentration of ammonium in aerosols was observed at the Yingkou Station at 5.4 $\mu g/m^3$, and the lowest was at the Boao Station at 1.0 $\mu g/m^3$; the highest copper concentration (71.0 ng/m^3) was observed at the Lianyungang Station, and the lowest (5.3 ng/m^3) was at the Xiaomaidao Station in Qingdao; and the highest lead concentration (137.7 ng/m^3) was observed at the Tanggu Station, and the lowest (3.4 ng/m^3) was at the Zhelang Station in Guangdong.

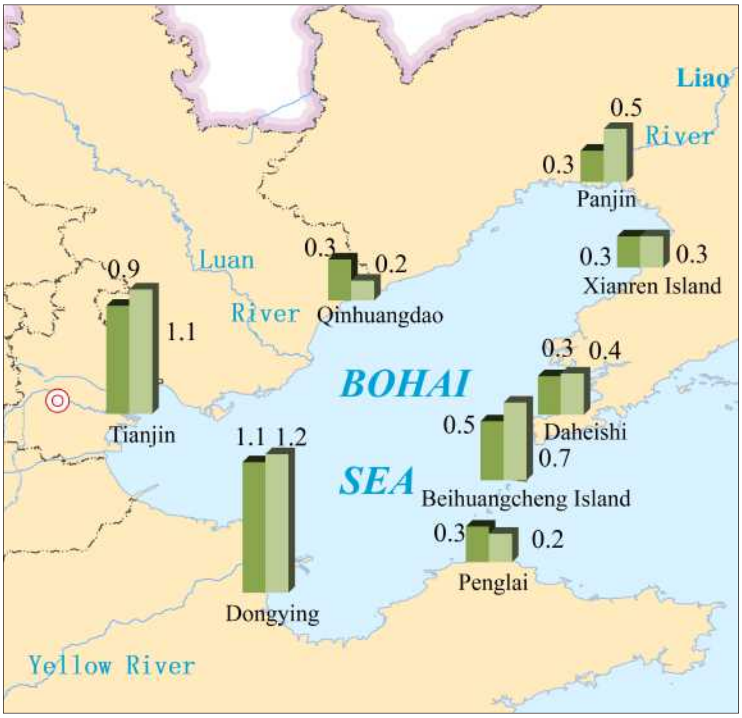


Concentrations of nitrate-nitrogen and ammonium-nitrogen in aerosols at various monitoring stations in 2018



Concentrations of copper and lead in aerosol at various monitoring stations in 2018

Wet Deposition Flux of Atmospheric Pollutants in Bohai Sea Monitoring of the wet deposition fluxes of atmospheric pollutants was implemented at Daheishi in Dalian, Xianrendao in Yingkou, Panjin, Qinhuangdao, Tanggu, Dongying, Penglai, and Beihuangcheng. The highest wet deposition fluxes of nitrate and ammonium were observed at Dongying Station at 1.1 and 1.2 t/(km^2•a), respectively. The lowest of nitrate were observed at Daheishi station, Penglai Station, Qinhuangdao Station, Panjin Station, and Xianrendao Station at 0.3 t/(km^2•a). The lowest of ammonium were observed at Qinhuangdao Station and Penglai Station at 0.2 t/(km^2•a). The highest wet deposition flux [3.2 kg/(km^2•a)] of copper was observed at Dongying Station, and the lowest [0.8 kg/(km^2•a)] was at Yingkou Station. The highest wet deposition flux of lead [0.9 kg/(km^2•a)] was observed at Dongying Station, and the lowest [0.3 kg/(km^2•a)] was at Daheishi Station.



t/(km^2·a) Nitrate-nitrogen Ammonium-nitroge

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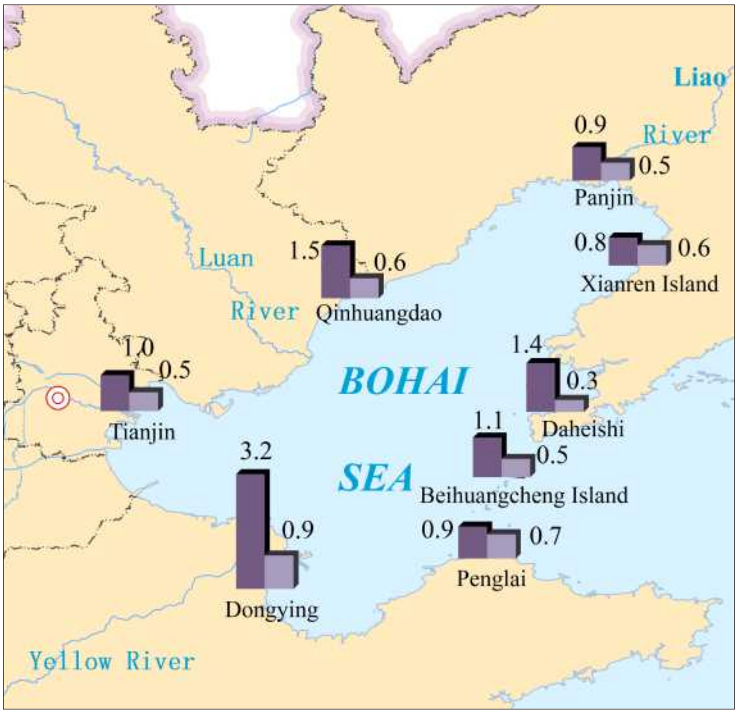
Wet deposition fluxes of nitrate-nitrogen and ammonium-nitrogen at various monitoring stations in the Bohai Sea in 2018



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Wet deposition fluxes of copper and lead at various monitoring stations in the Bohai Sea in 2018

3.4 Marine Litter and Microplastics

3.4.1 Marine Litter

In 2018, distribution of marine litter was monitored in 57 coastal areas. The monitoring contents included the types and density of litter in surface waters, on beaches, and on seabed. The coastal areas with high marine litter densities were mainly in tourism and recreational areas, agricultural and fishery areas, port areas and surrounding areas.

Litter in Surface waters

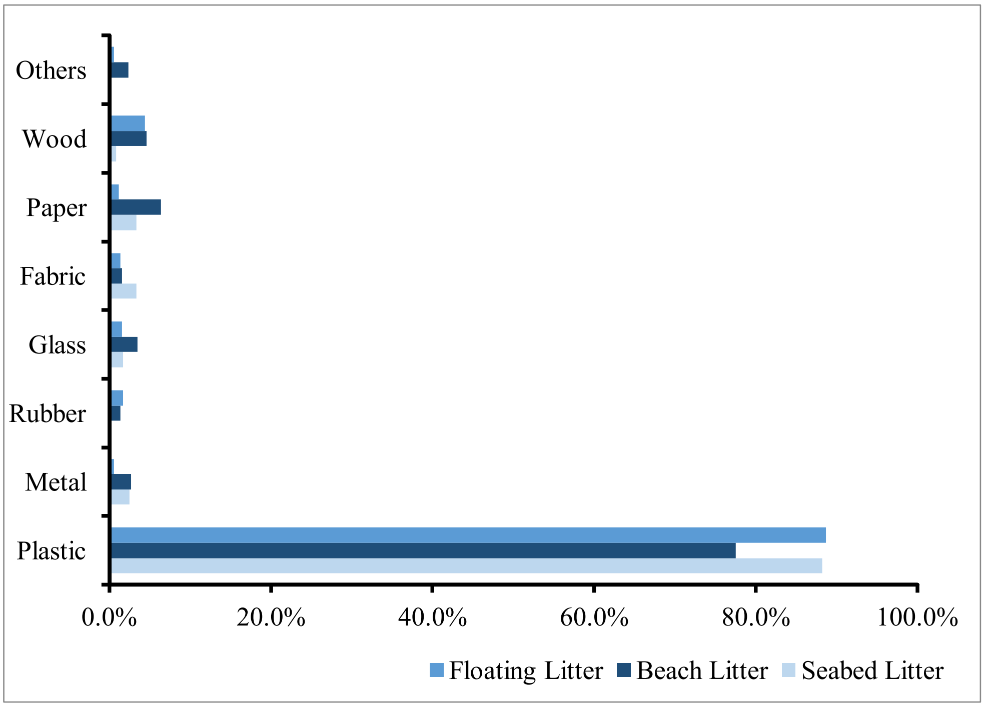
The average quantity density of floating macro-litter was 21 items/km^2. The average quantity density of floating meso-litter was 2,358 items/km^2, with the average weight density of 24 kg/km^2. Plastics were the most common items and accounted for 88.7% of the total amount, followed by wood, which accounted for 4.4%. Most of the plastic litters were polystyrene foams, plastic bags, and bottles.

Beach Litter

The average quantity density of beach litter was 60,761 items/km^2, with an average weight density of 1,284 kg/km^2. Plastics were the most common items and accounted for 77.5% of the total amount, followed by paper and wood, which accounted for 6.4% and 4.6%, respectively. Most of the plastic litters were polystyrene foams, plastic products (such as bags, bottles, and caps), and cigarette filters.

Seabed Litter

The average quantity density of seabed litter was 1,031 items/km^2, with an average weight density of 18 kg/km^2. Plastics were the most common items and accounted for 88.2% of the total amount, followed by textile and paper, which both accounted for 3.4%. Most of the plastic litters were bags, bottles, and ropes.



Main types of marine litter along coastal areas in China in 2018

Quantitative distribution of marine litter along coastal areas in China in 2018

3.4.2 Marine Microplastics

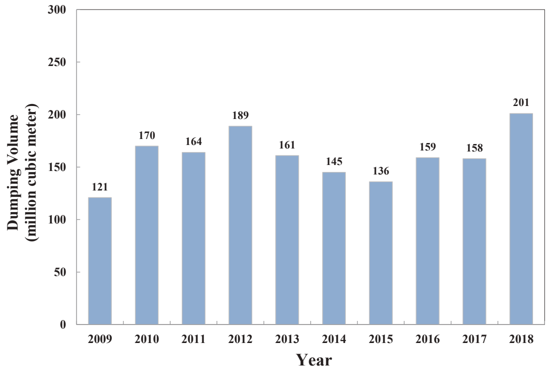
In 2018, microplastics in surface waters were monitored in the Bohai Sea, Yellow Sea, and South China seas. The average density of microplastics in surface waters was 0.42 items/m^3, and the highest density was 1.09 items/m^3. The average densities of microplastics in the Boha Sea, Yellow sea, and South China sea were 0.70 items/m^3, 0.40 items/m^3, and 0.18 items/m^3 respectively. Most of the microplastics were fragments, fibers, and lines, and their components were mainly polypropylene, polyethylene, and polyethylene terephthalate.

Density distribution of floating microplastics in surface waters in China in 2018

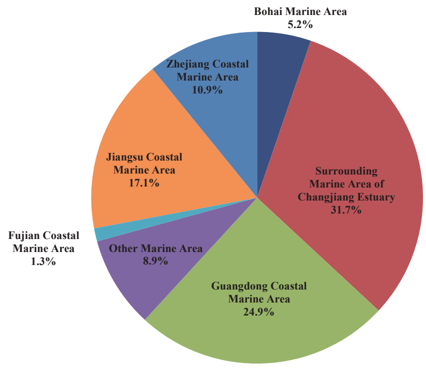
4 Environmental Status of Ocean Dumping Zones and Oil/Gas Exploration Zones

4.1 Ocean Dumping Zones

The total volume of wastes and other matter for ocean dumping of the year 2018 in China amounted to 200.67 million m^3, an increase from the previous year. Dumped substances were mainly clean dredged materials, in addition to a small amount of inert inorganic geological materials. The water and sediment qualities in the dumping zones and their adjacent sea areas basically met the environmental protection requirements of marine functional zones. The water depth and water and sediment qualities of the dumping zones kept stable compared with those in the previous year. The dumping activities did not have apparent impact on the ecology and environment of the adjacent sea areas and other marine uses.



Volume of dredged materials dumped at seas of China in 2009-2018



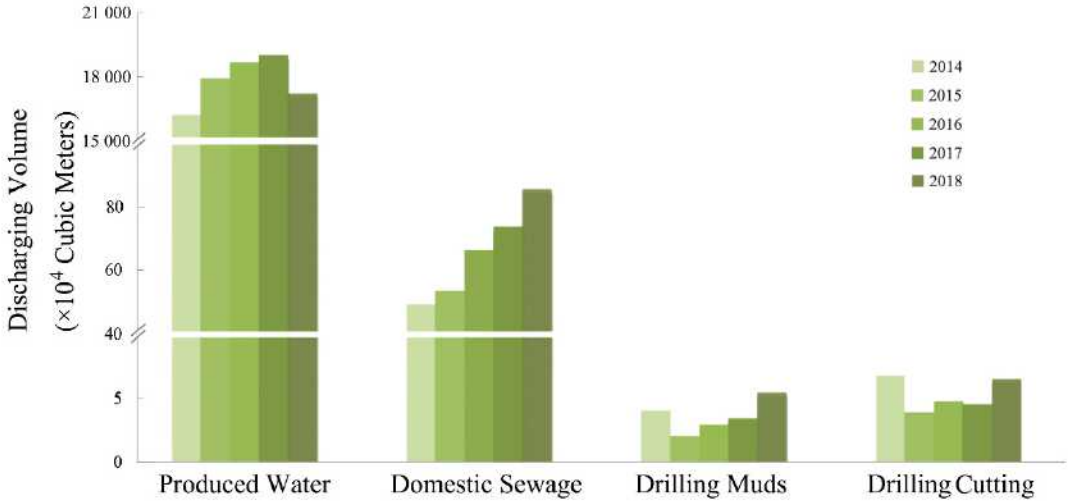
Proportion of dredged materials dumped at different sea areas in 2018

Dumping volume at sea and distribution of dumping zones and their environmental quality status in 2018

4.2 Oil/Gas Exploration Zones

In 2018, the volume of produced water discharged into seas from offshore oil/gas platforms was 171.49 million m^3, a decrease of 9.3% compared with 2017. The volumes of domestic sewage, drilling muds, and drilling cutting discharged into seas were 850,000 m^3, 53,994 m^3 and 64,605 m^3 respectively, which increased by 15.9%, 58.3%, and 43.7% respectively compared with the previous year.

The marine environmental quality of the offshore oil/gas exploration zones and their adjacent sea areas kept stable compared with the previous year. The proportion of seawater qualities meeting Seawater Quality Standard Grade I increased significantly in the offshore oil/gas exploration zones and their adjacent sea areas of the Bohai Sea, where the mercury content in seawater of some offshore oil/gas exploration zones and their adjacent sea areas decreased. The water qualities of the offshore oil/gas exploration zones and their adjacent sea areas in the East China Sea and South China Sea reached Seawater Quality Standard Grade I. The sediment quality of the offshore oil/gas exploration zones reached Marine Sediment Quality Standard Grade I. Generally, the water and sediment qualities of the offshore oil/gas exploration zones and their adjacent sea areas basically met the environmental protection requirements of the marine functional zones.



Volume of pollutants discharged into seas from offshore oil/gas platforms in 2014–2018

5 Environmental Quality of Marine Fishery Areas

In 2018, monitoring programs were implemented in 48 fishery areas, including spawning grounds, feeding grounds, migration routes, aquatic reserves, and aquatic germplasm resources reserves, covering 5.925 million hectares..

The dominant pollution indicator that exceeded the seawater quality standard was inorganic nitrogen for important fishery areas, including spawning grounds, feeding grounds, migration routes, and aquatic reserves. The proportions of areas with inorganic nitrogen, active phosphate, petroleum, and COD contents in seawater reaching the seawater quality standard accounted for 24.6%, 56.0%, 95.6% and 66.1% of the total monitored areas respectively. The proportions in areas that exceeded the standard for inorganic nitrogen, active phosphate, petroleum, and COD decreased compared with the previous year.

The dominant pollution indicators that exceeded the standard in the water bodies of the key marine aquaculture areas were inorganic nitrogen and active phosphate. The proportions areas that exceeded the standards for inorganic nitrogen, active phosphate, petroleum, and COD in the water bodies were 40.1%, 49.4%, 62.8% and 92.8% of the total monitored areas respectively. The proportions in areas that exceeded the standards for inorganic nitrogen and COD decreased, whereas the proportions of areas that exceeded the standards for active phosphate and petroleum increased compared with the previous year.

The monitored area for eight National Aquatic Germplasm Resources Conservation Areas (marine) was 323,000 hectares. The dominant pollution indicator that exceeded the standard in the water bodies was inorganic nitrogen. The proportions in areas that exceeded the standards for inorganic nitrogen, active phosphate, petroleum, and COD were 25.3%, 91.0%, 76.7% and 59.6% of the total monitored areas respectively.

Sediments in the 33 key marine fishery areas were in good condition. The proportions of areas meeting the standards for petroleum, copper, zinc, lead, cadmium, mercury, arsenic and chromium, accounted for 99.3%, 98.9%, 100.0%, 98.8%, 99.8%, 100.0%, 99.6% and 96.5% of the total monitored areas respectively.

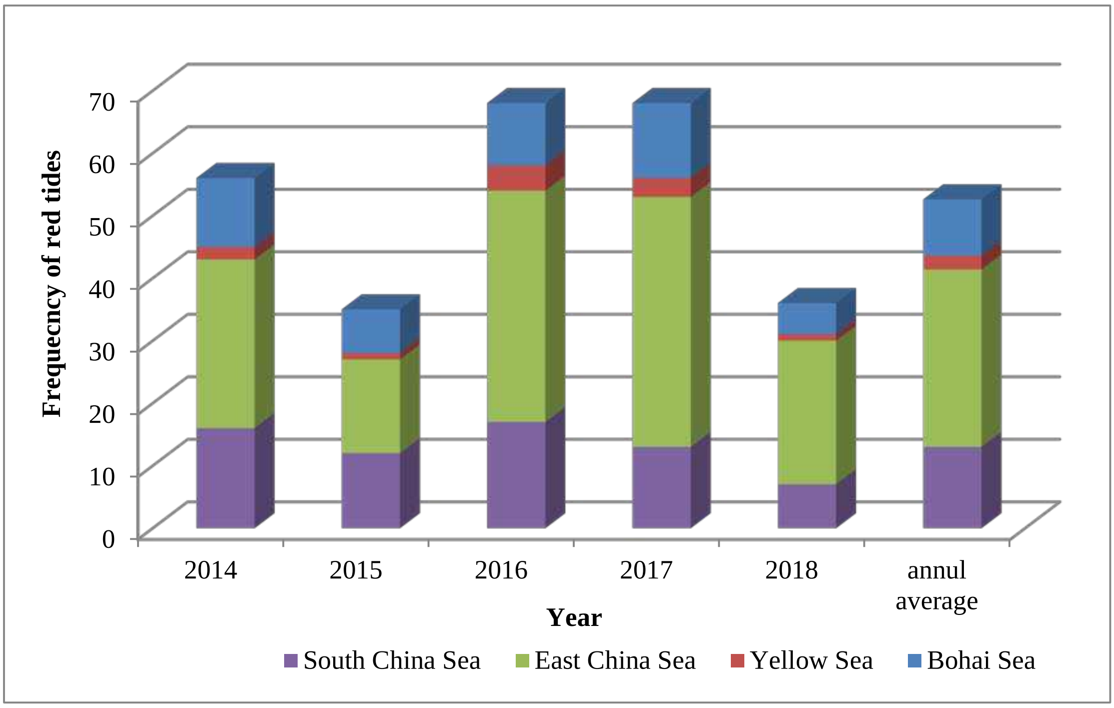
6 Status of Marine Environmental Disasters

6.1 Red Tide

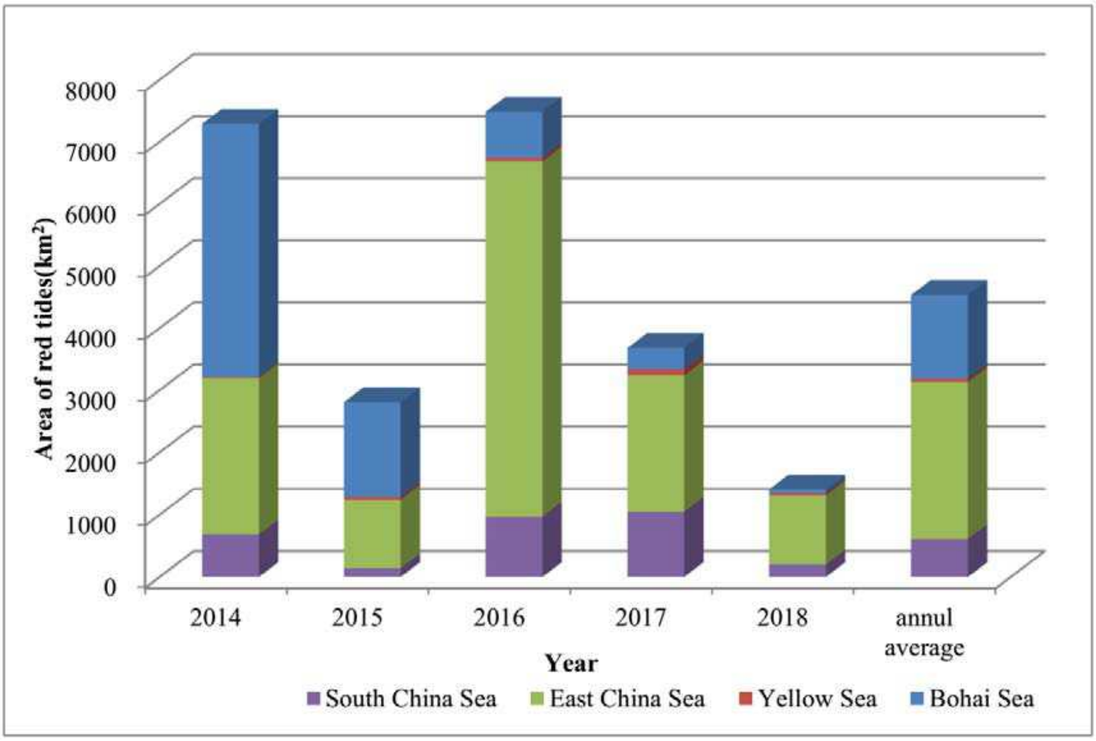
A total of 36 red tide events were recorded in jurisdictional seas of China, with a cumulative area of 1,406 km^2. The area hit hardest by red tides was East China Sea, with a total of 23 times and a cumulative area of 1,107 km^2. High-incidence period of red tides was in August. Compared with the previous year, the frequency of red tide events decreased by 32 times, and the cumulative area decreased by 2,273 km^2. Compared to the average of the past 5 years, the frequency of red tide events decreased by 17 times and the cumulative area decreased by 3,127 km^2.

Red tides recorded in jurisdictional seas of China during 2018

Sea area	Recorded times	Cumulative area（km^2）
Bohai Sea	5	62
Yellow Sea	1	35
East China Sea	23	1,107
South China Sea	7	202
Total	36	1,406



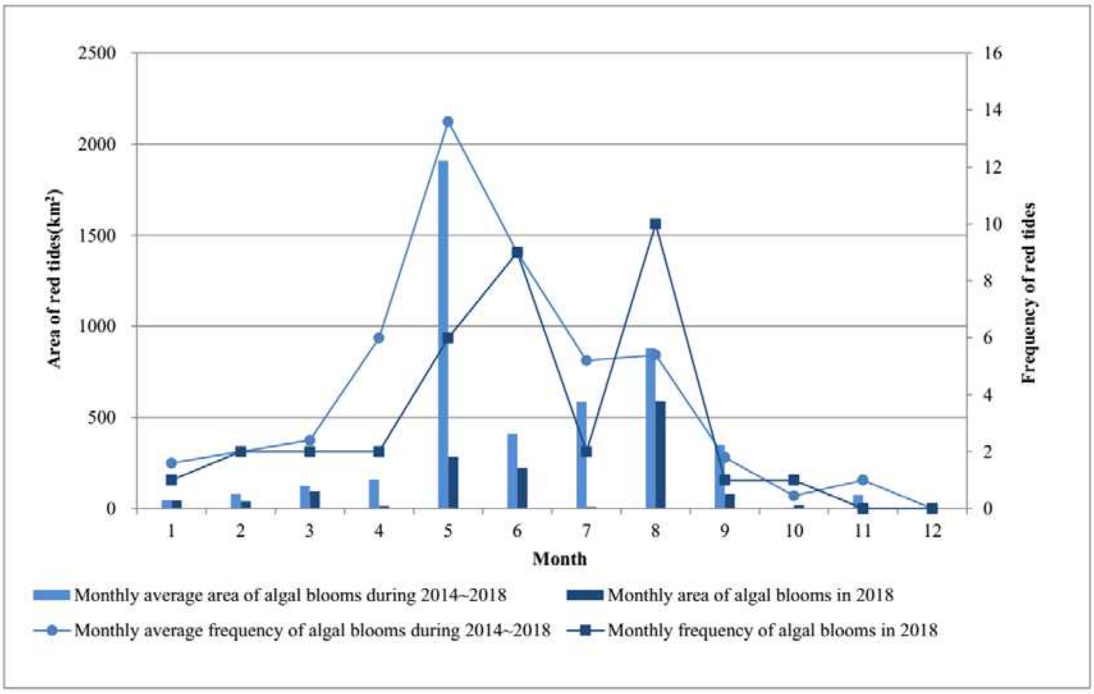
Frequency of red tide records in jurisdictional seas of China in 2014–2018



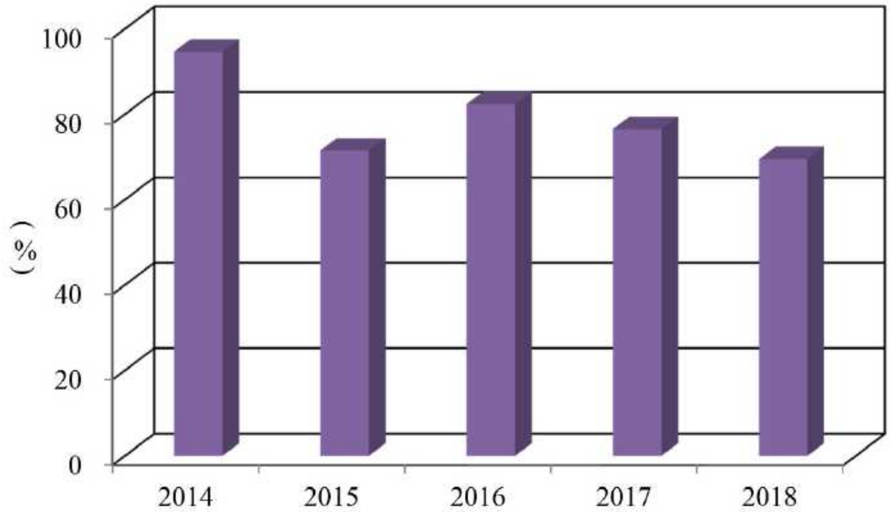
Area of red tide records in jurisdictional seas of China in 2014 – 2018

18 dominant species triggered red tides. Among them, *Karenia mikimotoi* was the top one dominant species, which caused as many as

seven red tides outbreaks, followed by *Skeletonema costatum*, which caused six red tides. *Prorocentrum donghaiense* caused five red tides. *Gymnodinium catenatum* and *Noctilucascintillans* caused three red tides each. *Chaetoceros curvisetus*, *Leptocylindrus danicus*, *Akashiwo sanguinea*, *Scrippsiella trochoidea*, and *Phaeocystis globosa* caused two red tides each. *Eucampia zoodicacus*, *Rhizosolenia setigera*, *R. stolterfothii*, *Ceratiumfurca*, *Cochlodinium geminatum*, *Gonyaulax polygramma*, *Chattonelta marina*, and *Mesodinium rubrum* caused one red tide each. *Dinophyta* and *Chromophyta* caused 25 red tides, accounting for 69% of the total.



Distribution of red tide events in 2014 – 2018



Proportion of *Dinophyta* and *Chromophyta* blooms to total red tide records in2014 – 2018

Distribution of red tides and their dominant species in 2018

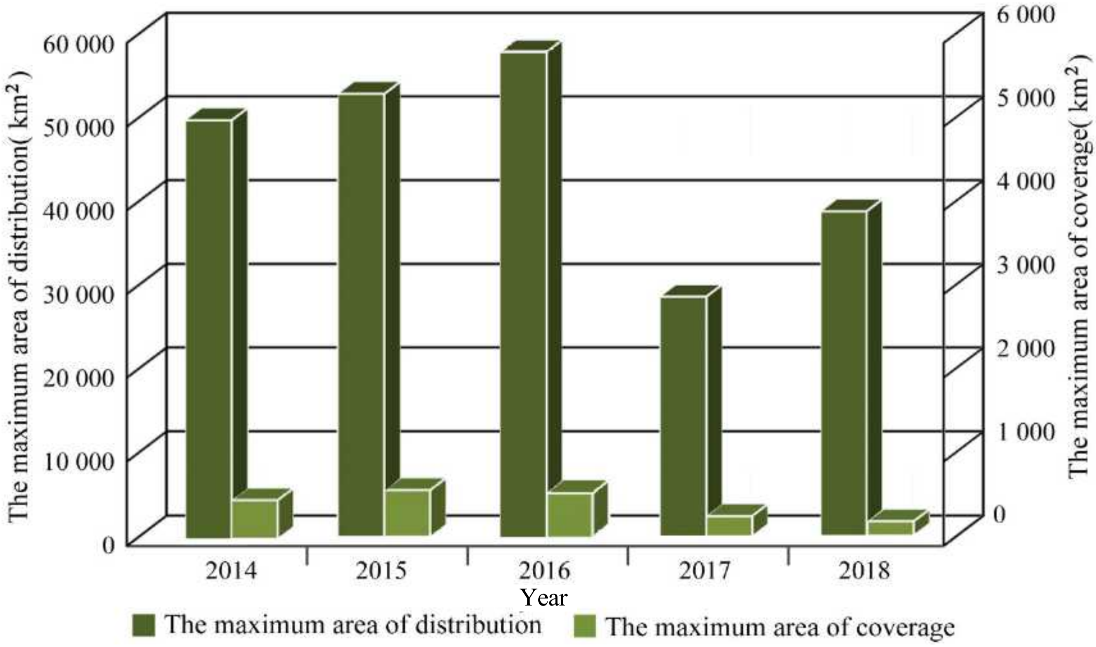
6.2 Green Tide

Ulva prolifera occurred in the Yellow Sea during April -August in 2018. On April 25, the green tides algae *Ulva prolifera* was found in waters of Nantong, Jiangsu Province. On May 26, *Ulva prolifera* was found in coastal waters of Shandong Province. On June 29, *Ulva prolifera* reached maximum scale, with the maximum distribution area of 38,046 km^2 and the maximum coverage area of 193 km^2. In late July, *Ulva prolifera* decreased significantly in the distribution area. In middle August, *Ulva prolifera* almost disappeared.

In 2018, the scale of *Ulva prolifera* presented the characteristics of long duration and small distribution and coverage areas. Compared to the average of the recent five years, maximum distribution area decreased by 16% and maximum coverage area decreased by 55%.

Scale of *Ulva prolifera* in the Yellow Sea in 2014 – 2018

Year	Max distribution area（km^2）	Max coverage area（km^2）
2014	50,000	540
2015	52,700	594
2016	57,500	554
2017	29,522	281
2018	38,046	193
Average	45,553	432



Maximum distribution and coverage areas of *Ulva prolifera* in 2014 – 2018

7 Pollution Emergencies

Collision and Explosion of Oil Tanker *SANCHI*. On January 6, 2018, the Panamanian oil tanker *SANCHI* and Chinese Hong Kong bulk carrier *Changfeng Crystal* collided approximately 160 nautical miles east of the Yangtze Estuary. On January 14, the tanker *SANCHI* exploded and sank after drifting approximately 280 km. Vessel, aircraft and satellite emergency monitoring showed that the maximum area of oil contamination zone was 328 km^2 on January 21, and then gradually decreased, and in March there was only a sporadic oil contamination zone scattering in a small area. The total area covered by oil film in the incident area was 1,706 km^2. As shown by the tracking monitoring results, the areas of seawater with petroleum contents exceeding the Seawater Quality Standards Grade I and II, III, and IV during the incident were 890, 485 and 95 km^2 respectively. Since March 4, the petroleum content of seawater in the incident area has met the Seawater Quality Standards Grade I. The contents of total suspended particulate matter and heavy metal copper, lead, and zinc around the sinking point were within the background value range. Water quality in the near-shore sea area, as well as the atmospheric environment of coastal cities were not affected by the accident.

Chemical Leakage at Wharf of Fujian Donggang Petrochemical Industry Co. Ltd in Quanzhou, Fujian Province. On November 4, 2018, the oil tanker *Tiantong 1* berthed at the wharf of Donggang Petrochemical

Industry Co. Ltd. in Quangang District, Quanzhou, Fujian Province. During shipment, approximately 69.1 tons of industrial cracking Carbon-9 (C-9) leaked. About forty tons of leakage was absorbed by the emergency disposal facility, with the rest of the oil volatilizing and a small amount dispersed in the seawater. On November 14, the remaining oil in the incident area and the remnants of the contamination attached to the fishing rafts, reefs, and beaches were cleaned up. Emergency monitoring showed that on November 6, the maximum petroleum content in the seawater of the incident area was 1.2 times higher than that of the Seawater Quality Standard Grade III. By November 8, petroleum content at 10 monitoring stations had met the Seawater Quality Standard Grade I, except for one monitoring station where the oil content exceeded the Grade I and II standard. On November 25, petroleum content in the seawater of the incident area met the Grade I standard. After the incident, C-9 characteristic organic pollutants were detectable in seawater, and their contents showed a downward trend. Since November 30, no C-9 characteristic organic pollutants had been detected in seawater.

8 Actions and Measures

8.1 Inspection of Enforcement of Marine Environmental Protection Law of People's Republic of China (MEPL)

An inspection group established by the Standing Committee of National People's Congress (The Group) conducted its inspection in 8 provinces (municipality) including Tianjin, Hebei, Liaoning, Zhejiang, Fujian, Shandong, Guangdong, and Hainan from September to October in 2018 to supervise and inspect the enforcement of MEPL.

The Group found that since the 18th CPC National Congress, under the guidance of Xi Jinping Thought on Ecological Civilization, all departments at the central and provincial levels strictly implemented the decision-making and deployment of the CPC Central Committee, conscientiously implemented the Marine environmental Protection Law, and increased their efforts in strengthening the awareness of marine ecological environment protection, promoting the construction of the marine environmental protection mechanism, advancing comprehensive environmental remediation in the near-shore waters, and increasing law enforcement supervision and judicial protection efforts. Positive results have been achieved in terms of protection of marine ecological environment. There were, however, improvements to make.

In recognition of that, the Group proposed the following recommendations:

All departments at the central and provincial levels should further study and implement Xi Jinping Thouhgt on Ecological Civilization; Further increasing efforts to protect the marine ecological environment in accordance with law; Strengthening coordinated development of land and sea and comprehensively rectifying pollution sources entering the sea; Prioritizing environmental protection and strengthening the protection and restoration of marine ecosystems; Raising awareness of risk, and strictly preventing marine ecological disasters and emergencies; Comprehensively deepening the reform so as to improve the capacity of marine ecological environment protection, Further amending the laws and regulations on marine environmental protection.

8.2 The Critical Battle Against Pollution in the Bohai Sea Begins

To implement the decisions of the CPC Central Committee and the State Council, and to fulfill the requirements for the battle against pollution in the Bohai Sea set out by *Guidelines on Strengthening Ecological and Environmental Protection to Win the Battle Against Pollution* , the *Action Plan on the Battle of Integrated Governance of the Bohai Sea* (herein after the Action Plan) was jointly issued by the Ministry of Ecology and Environment (MEE), National Development and Reform Committee (NDRC), and Ministry of National Resources (MNR) on November 30, 2018.

- The Action Plan calls for improving the quality of the ecological environment in Bohai Sea as the core with the main focus on highlighting the ecological and environmental problems, and carrying out four major actions of control of pollution from land sources, control of marine pollution, ecological protection and restoration and environmental risk prevention, ensuring that no deteriorations in ecological environment of the Bohai Sea will be seen and that substantial results will be achieved in three years. The Action Plan proposed the following: Reducing land-based pollutants significantly and eliminate riverine waters of quality worse than the Environmental Quality Standards for Surface Water Grade V;

- Ensuring that the industrial outfalls are in compliance with relative standards;
- Clearing up illegal and unregulated outfalls;
- Building and improving the pollution prevention and control system for port, ship, aquaculture and waste; Exercising the strictest control of marine reclamation in order to improve ecological function of coastal areas and maintaining fishing community, and
- Enhancing the capacity of monitoring, early warning of environmental risks and immediate response to environmental accidents.

The Action Plan also present indicators with their minimum target value for performance evaluation as follows.

- the proportion of seawaters of quality above Grade II: 73%;
- the retention rate of natural coastal line: 35%;
- the area of recovered coastal wetland: 6900 hectares;
- the length of new restored coastline: 70 kilometers.

8.3 Institutional Rearrangement for Advanced Marine Ecological and Environmental Protection

The 3rd Plenary Session of the 19th Central Committee adopted the *Plan on Deepening Reform of Party and State Institutions*, and made it clear for the newly established Ministry of Ecology and Environment

(MEE) to take over the responsibility of marine environment protection. The adoption of the plan indicates a crucial strategic deployment, made in the new era by the Central Committee of the Communist Party of China with comrade Xi Jinping at its core, of promoting collaborated and integrated pollution prevention and governance of both land and sea.

The following years is critical time for us to be more engaged to win the battle against pollution and bring a moderate prosperity to China in a well rounded way, and to promote the institutional reform and marine environmental protection through the whole nation. In this context, environmental management should be conducted in ecological-friendly, participatory, and land-sea integrated approaches to improve marine environmental quality in the end. Therefore, 5 key tasks are to be completed, namely:

- Strengthening institutional building to accelerate the improvement of laws and regulations;
- Strengthening environmental governance to solve prominent problems in protecting marine environment;
- Making better use of responsibilities of monitoring and control to implement marine environmental policies in stricter ways;
- Strengthening capacity building to set up a more competent team of marine environmental protection;

- Exploring approaches of collaboration for deeper involvement in global marine governance.

8.4 Central Ecological and Environmental Protection Inspection to Assure Fulfillment of the Responsibilities of Marine Environmental Protection

In 2018, MEE established two inspecting groups to revisit and re-evaluate the performance of marine environmental protection in 20 provinces including Hebei to ensure full fulfillment of governmental responsibilities.

Key inspection areas of this revisit include illegal marine reclamation, encroachment and destruction of coastal wetlands and nature reserves, insufficiencies in management and control of sewage sources in Liaoning, Shandong, Jiangsu, Hebei, Guangxi and Guangdong Provinces. With the approval of the Party Central Committee and the State Council, relevant issues have been reported to the provincial party committees and provincial governments for further accountability to promote addressing marine ecological and environmental problems.

8.5 Supervision on the Work of Prevention of Ship-made Pollution

In 2018, maritime employees directly under the leadership of Ministry of Transport (MOT) conducted examination of pollution from over 270,000 ships, endorsed contingency plans for ship-made pollution for 2,616 ships, Oil Record Book, Waste Record Book, and Cargo Record Book for over 20,000 ships, received and handled 48,000 ship oil sewage cases, and 328,000ship waste cases.

Standard of controlling wastewater discharge of ships (GB3552-2018) was enforced. MOT, together with MEE and MOHURD enacted *Guidelines to Improve the System of Transferring and Disposing Ship Wastewater*. Meanwhile, MOT has issued *Provisional Regulation for the Management and Monitoring of Ship Ballast Water and Sediments* and actively promoted the allocation of ballast water rapid detection equipment. Meanwhile, regional cooperation on ship-made pollution under the framework of NOWPAP, North Pacific Coast Guard Forum, and GI China Project has been advanced.

8.6 Ecological and Environmental Protection of Marine Fishery

The system of protecting and managing fishing resource was further improved. In 2018, Ministry of Agricultural and Rural Affairs (MARA) adopted the system of ensuring proportion of juvenile fish in accordance with the strategic deployment made by the Central

Government. Moreover, MARA has adjusted and improved summer fishing moratorium, a system of protecting and managing fishery resources. The fishery resources investigation and monitoring showed that the implementation of relevant systems played a key role in protecting marine fishery resources, as can be seen in the following aspects.

- **Recovery of fish biomass.** It is found from the result of investigation of fishery resources of China seas that fish biomass of 2018 increased compared with 2016 after the implementation of the strictest moratorium system.
- **Optimized structure of marine resources.** Result of the investigations showed that the biomass of traditional commercial fishes is on the rise. What's more, the proportion of adult fish of ribbon fish (*Trichiurus haumela*), little yellow croaker (*Larimichthys polyactis*), silver fish (*Pampus argenteus*) and anchovy (*Engraulidae*) in 2018 has significantly increased compared with 2016, showing that the population structure of major commercial fishes has overall improved.
- **Enhanced replenishing capacity of fishery resource.** Implementation with period prolonging of the system of controlling the proportion rate of juvenile fish and the summer fishing moratorium have resulted in preventing the juvenile fish of such commercial fishes as ribbon fish (*Trichiurus haumela*), little yellow

croaker (*Larimichthys polyactis*), and silver fish (*Pampus argenteus*) from being exploited, resulting in enhanced replenishing capacity of fishery resources compared with the period of 2015-2016.

- **Fishery resources were rehabilitated.** This is mainly attributed to the significant reduction of the interruption by fishing equipment, such as bottom trawl or shrimp trawler, both in terms of frequency and the level at disruption, to the environment of fishing ground. This improvement was not only conducive to the restoration of the benthic ecological environment, but was also particularly important to the protection of the population of sunken eggs.

The ecological restoration of fishery resources was advancing steadily. which can be seen from the following aspects.

- **The benefits from enhancement and release of aquatic biota.** In 2018, the Central Finance arranged transfer payments of 400 million Yuan and attracted investments of 1.1 billion from provincial and local governments (390 million for marine biota). The payments and investments supported 2,040 activities of enhancement and release of aquatic biota with juveniles of 37.4 billion biomass units (marine biota of 24.77 billion biomass units) released. In addition to ecological benefits, these activities gained wide attention and participation of the society.
- **Steady development of marine ranching.** In 2018, the number of

national demonstration sites of marine ranching reached 86, including the newly established 22 national demonstration sites. Moreover, with the purpose of strengthening regulated management of marine ranching and artificial reef, *Measures for the Evaluation of Natioanl Marine Ranching Demonstration Sites* was released, and *Administrative Rules of Artifical Reef Construction Projects* was amended. To promote development of marine ranching, a national experience exchange meeting on marine ranching consruction was held in Yantai of Shandong Province.

Data Sources and Explanations for Assessment

The “Bulletin of the Marine Ecology and Environment Status of China in 2018” was jointly compiled by the Ministry of Ecology and Environment, Ministry of Natural Resources, Ministry of Transport and Ministry of Agriculture and Rural Affairs. The Bulletin was published by the Ministry of Ecology and Environment.

In 2018, data on marine environmental quality, marine ecological status, status of main pollution sources into the sea, environmental status of ocean dumping zones and oil/gas exploration zones and status of marine environmental disasters were provided by the Ministry of Ecology and Environment and the Ministry of Natural Resources. Data on the environmental quality of marine natural fishery areas were provided by the National Fishery Ecological Environment Monitoring Network of the Ministry of Agriculture and Rural Affairs. Data on supervision and administration of pollution prevention by ships and marine fishery eco-environment protection and management were provided by the Ministry of Transport and Agriculture and the Ministry of Agriculture and Rural Affairs respectively.

The assessment of the seawater quality and eutrophication status of the jurisdictional seas of China was based on the data on national monitoring stations in the summer. The assessment of the water quality of the bay environment was based on the data on national monitoring stations in the spring, summer, autumn and winter. The assessment indexes included inorganic nitrogen (NO_2-N, NO_3-N and NH_4-N), active phosphate, petroleum, and COD_{Cr}. The assessment indexes for the eutrophication status included inorganic nitrogen, active phosphate, and COD_{Cr}. The evaluation method was based on “The Technical Regulations for Seawater Quality Evaluation (Trial).” (Marine Environmental Character No. 25 [2015]).

Data from 417 national monitoring stations along coastal areas were used for nearshore water quality evaluation. The assessment indexes included pH, DO, COD, BOD_5, fecal coliform, coliform, inorganic nitrogen, non-ionic ammonia, active phosphorus, mercury, cadmium, plumbum, Cr, total chromium, arsenic, copper, zinc, selenium, cyanide, sulfide, volatile phenols, petroleum, HCH, DDT, malathion, parathion-methyl, and LAS. The evaluation was based on the Seawater Quality Standard (GB 3097-1997), and the Specification for Coastal Environmental Monitoring (HJ 442-2008).

The assessment indexes of the sediment quality included sulfide, TOC, mercury (Hg), copper (Cu), cadmium (Cd), lead (Pb), zinc (Zn), chromium (Cr), arsenic (As), DDT and PCB. The evaluation was based on the Marine Sediment Quality (GB 18668-2002) and Guideline for Assessing Status of Marine Sediment Quality (Trial edition) (Marine Environmental Reference No.26, 2015).

The assessment indexes of radioactivity level included uranium, thorium, radium-226, tritium, strontium-90, cesium-134 and cesium-137 in seawater, cobalt-58, cobalt-60, strontium-90, silver-110m, cesium-134 and cesium-137 in marine organisms, and manganese-54, cobalt-58, cobalt-60, zinc-65, strontium-90, cesium-134 and cesium-137 in marine sediments. Comprehensive environmental factors included temperature, salinity, density, ocean current, particle size of suspended particles, dissolved oxygen, pH, ammonia, nitrate, inorganic nitrogen, active phosphate, chlorophyll a, primary productivity and black carbon. The comparative analysis method was used for radioactivity evaluation.

The assessment indexes of the water quality of ocean beaches included fecal coliform, flotsam and petroleum,. The assessment method was based on Marine Water Quality Standard (GB 3097-1997), Technical Regulations for Monitoring Ocean Beaches (Trial) (Marine Environmental Character No. 34 [2015]), and Specification for Offshore Environmental Monitoring (HJ 442-2008). The Single factor evaluation method was adopted.

The assessment indexes of marine biodiversity included the species composition of plankton, benthos, seagrass, mangrove, coral, and other organisms in the jurisdictional seas of China, as well as the species number, density, diversity index and dominant species of plankton and macrobenthos in the key monitored regions in the summer. The health assessment of typical marine ecosystems was based on the following five categories: water environment, sediment environment, biological toxical residue, habitat and biological community. These categories could be used to evaluate the health status of typical ecosystems, including the estuary, bay, coastal wetland and coral reef, mangrove and seagrass bed. The assessment method was based on The Specifications for Marine Survey (GB/T 12763-2007), The Specifications for Marine Monitoring (GB 17378-2007), and The Guidance for the Assessment of Coastal Marine Ecosystem Health (HY/T 087-2005).

The evaluation object of marine protected area is the status of protected target. We used a comparative analysis of current year monitoring data with historical data to assess the trends of protected target. The evaluation method and criteria for coastal wetlands were from the Technical Regulations for Ecological Monitoring of Coastal Wetlands (HY/T 080-2005).

The seawater quality evaluation indexes of sea-entering rivers included pH, dissolved oxygen, permanganate index, COD, BOD_5, ammonia nitrogen, TP, copper, zinc, fluoride, selenium, arsenic, mercury, cadmium, hexavalent chromium, lead, cyanide, volatile phenol, petroleum, anionic surfactant, and sulfide. Evaluation was conducted according to Environmental Quality Standards for Surface Water (GB 3838-2002), and evaluation of standardized discharge was based on standard limits of Grade

III.

The evaluation indexes of water pollution sources directly discharged into the sea included all indicators in executive standards of sewage outlets. The evaluation was conducted according to the corresponding executive standards of sewage outlets.

The evaluation indexes of marine atmospheric pollutant deposition included nitrate, ammonium, copper, and lead. The evaluation was conducted based on Technical Specifications for Assessment of Atmospheric Deposition Flux of Pollutants to Maritime Areas (Trial) (Marine Environmental Character No. 30 [2015]).

The environmental assessment for marine debris was based on the Technical Regulations for Monitoring and Evaluating Marine Debris (Trial)(Marine Environmental Character No 31. [2015]) The environmental assessment for marine microplastics was based on Technical Regulations for Monitoring Marine Microplastics (Trial) (Marine Environmental Character No. 13 [2016])

The environmental assessment for marine dumping zones covered water depth, water quality, sediment quality, and benthic organisms. The assessment was based on the Seawater Quality Standard (GB 3097-1997), Marine Sediment Quality (GB 18668-2002), National Marine Functional Zoning (2011–2020), Technical Directives for the Division of Marine Functional Zonation (GB/T 17108-2006), and Technical Regulations for

Monitoring Marine Dumping Areas.

The environmental assessment for the offshore oil/gas exploration zones covered petroleum, COD, mercury, and cadmium in the seawater and organic carbon, petroleum, mercury, and cadmium in the sediment. The assessment was based on the Technical Guidelines for Environmental Impact Assessment of Marine Engineering (GB/T 19485-2014), National Marine Functional Zoning (2011–2020), Technical Directives for the Division of Marine Functional Zonation (GB/T 17108-2006), Seawater Quality Standard (GB 3097-1997), and Marine Sediment Quality (GB 18668-2002).

The water quality assessment indicators for important marine fishery waters were mainly based on Fisheries Water Quality Standards (GB 11607-1989), The excluded items referred to Marine Water Quality Standards (GB 3097-1997). Spawning grounds and feeding grounds for fish and shrimp, aquatic biological nature reserves and aquatic germplasm resource protected areas referred to Grade I standard and other regions referred to Grade II standard.

The national statistics used in this bulletin except those concerning state administrative structures and territorial areas, does not include those of Taiwan Province, Hong Kong Special Administrative Region and Macao Special Administrative Region.