Bulletin of Marine Ecology and Environment Status of China in 2021

Ministry of Ecology and Environment
People's Republic of China

The Bulletin of Marine Ecology and Environment Status of China in 2021 is hereby released in accordance with the Environmental Protection Law of the People's Republic of China and the Marine Environmental Protection Law of the People's Republic of China.

Minister
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Introduction

In 2021, all localities and departments thoroughly implemented Xi Jinping Thought on Ecological Civilization and his important instructions on marine ecological environment protection. In accordance with the decisions and plans made by the Communist Party of China (CPC) Central Committee and the State Council, and targeting the prominent problems in the marine ecological environment, they continued to advance the prevention and control of pollution in inshore waters in a coordinated manner between land and sea, with the main aim to improve marine ecological and environmental quality. Coordinated plans were made for comprehensive treatment of key sea areas, and efforts to protect the marine ecosystem and environment were made on all fronts, so as to achieve a good start of the 14th Five-Year Plan.

In 2021, we monitored seawater quality in 1,359 national monitoring sites, 230 riverine sections flowing into the sea, 458 sewage outlets with daily discharge volume exceeding or equal to 100 tons, 32 bathing beaches, and we also monitored the ecological status of 24 typical marine ecosystems.

The monitoring results showed that China's marine ecology and environment status was getting better while maintaining stability in 2021. The overall quality of marine water continued to improve, with 97.7% of the marine water under jurisdiction of China meeting the Seawater Quality Standard Grade I, up by 0.9% compared with the previous year. 81.3% of the coastal area had excellent or good water quality (meeting the standard Grade I and Grade II), up by 3.9% compared with last year. The polluted areas were mainly located at Liaodong Bay, Bohai Bay, Yangtze River Estuary, Hangzhou Bay, Zhejiang Coast, and Pearl River Estuary. The dominant indicators failing to meet the Seawater Quality Standard were inorganic nitrogen and active phosphate. The typical marine ecosystems were in a healthy or sub-healthy state. The water quality of all the monitored sea-entering rivers was slightly polluted on the whole. The environmental quality of main marine utilization areas was generally in good status.

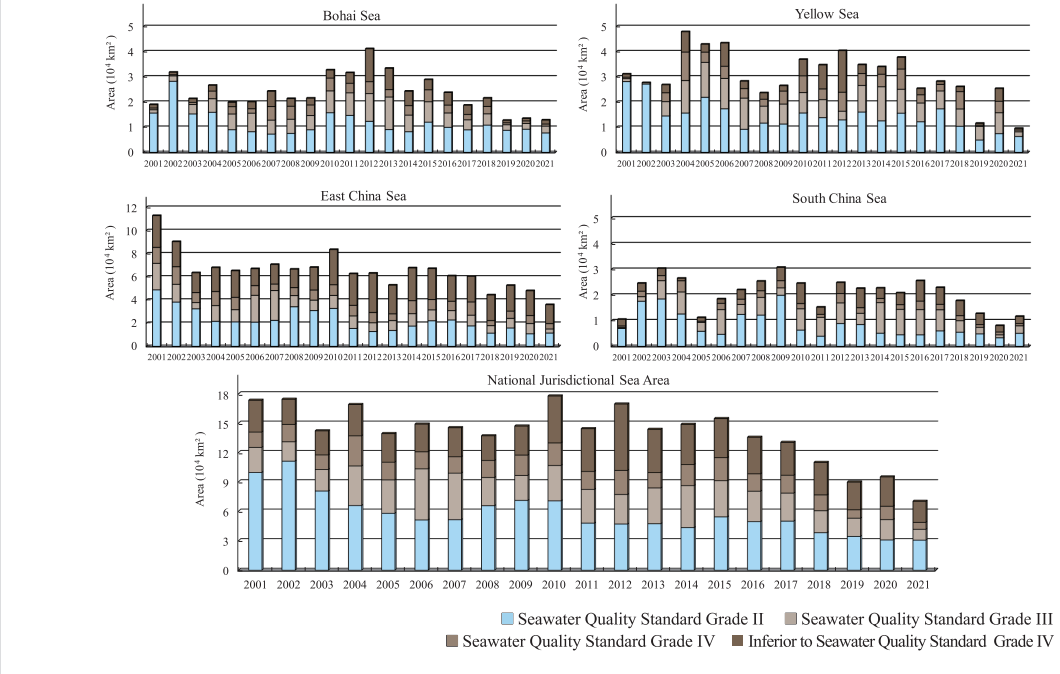
1 Marine Environmental Quality

1.1 Seawater Quality

1.1.1 Water Quality of Sea Areas under Jurisdiction of China

In the summer of 2021, seawater quality in 1,359 state monitoring sites were monitored.

Sea area meeting the Seawater Quality Standard Grade I accounted for 97.7% of the total, which increased by 0.9% from the previous year. The area with water quality not meeting the Seawater Quality Standard Grade IV was 21,350 km², decreased by 8,720 km² from the previous year. The dominant pollution indicators were inorganic nitrogen and active phosphate.



Total sea area under jurisdiction of China with water quality not meeting the Seawater Quality Standard Grade I from 2001 to 2021

Water quality status of sea areas under jurisdiction of China in 2021

Seawater Quality in Each Region

Bohai Sea The sea area with water quality not meeting the Seawater Quality Standard Grade I was 12,850 km², decreased by 640 km² compared with the previous year. The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 7,710 km², 2,720 km² and 820 km², respectively. The sea area with water quality not meeting Grade IV was 1600 km² and mainly located at Liaodong Bay and Bohai Bay .

Yellow Sea The sea area with water quality not meeting the Seawater Quality Standard Grade I were 9,520 km², decreased by 15,840 km² compared with the previous year. The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 6,310 km², 1,830 km² and 720 km², respectively. The sea area with water quality not meeting Grade IV was 660 km² and mainly located at Haizhou Bay.

East China Sea The sea area with water quality not meeting the Seawater Quality Standard Grade I was 35,970 km², decreased by 12,030 km² compared with the previous year. The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 11,450 km², 3,490 km² and 4,720 km², respectively. The sea area with water quality not meeting Grade IV was 16,310 km² and mainly located at Yangtze River Estuary, Hangzhou Bay, and the coastal areas in Zhejiang Province.

South China Sea The sea area with water quality not meeting the Seawater Quality Standard Grade I was 11,660 km², increased by 3,580 km² compared with the previous year. The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 5,070 km², 2,920 km² and 890 km², respectively. The sea area with water quality not meeting Grade IV was 2,780 km² and mainly located at Pearl River Estuary.

Total sea area with water quality inferior to Grade I under jurisdiction of China in 2021

unit: km²

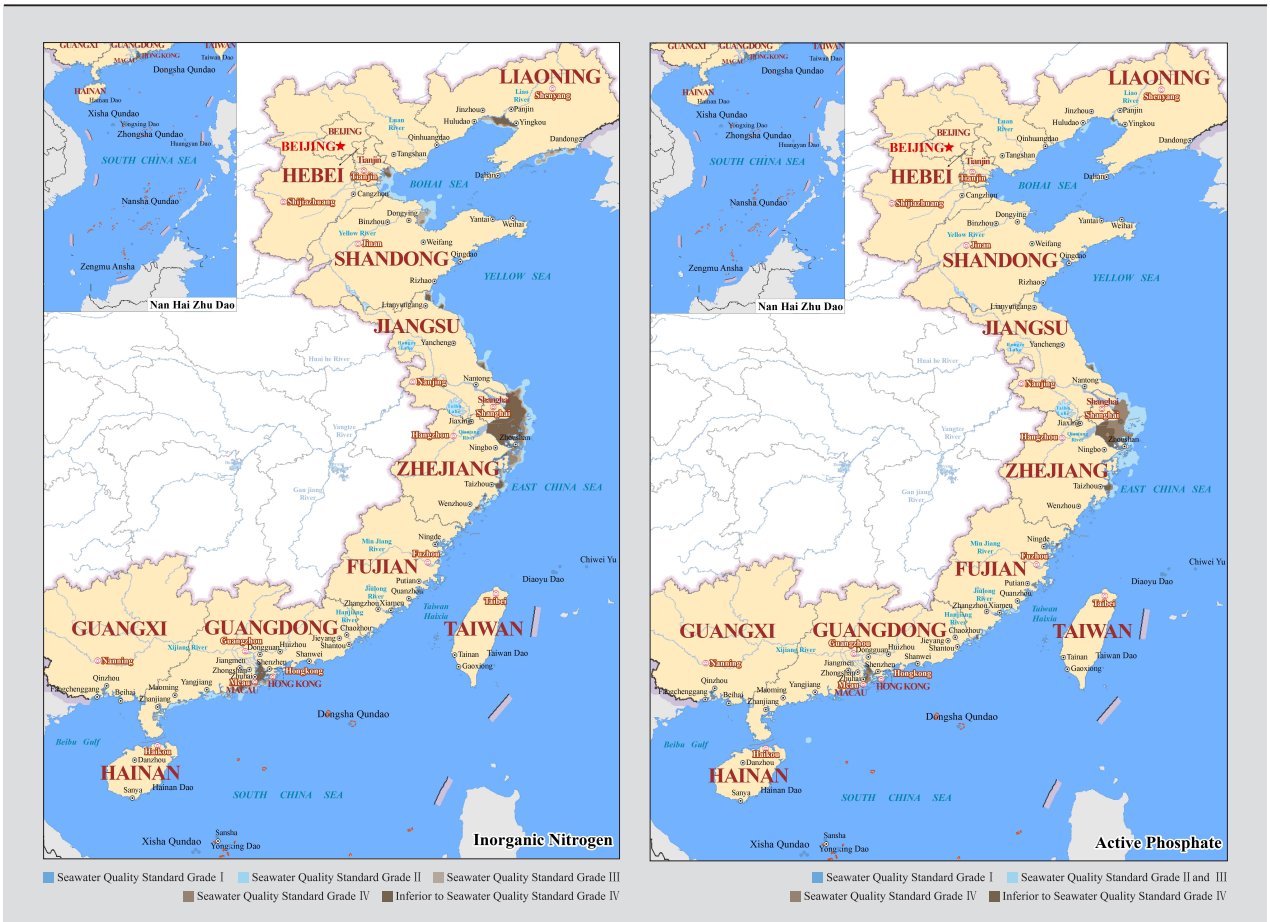
Sea Area	Grade II	Grade III	Grade IV	Inferior to Grade IV	Total
Bohai Sea	7,710	2,720	820	1,600	12,850
Yellow Sea	6,310	1,830	720	660	9,520
East China Sea	11,450	3,490	4,720	16,310	35,970
South China Sea	5,070	2,920	890	2,780	11,660
Total	30,540	10,960	7,150	21,350	70,000

Main Pollution Indicators

Inorganic Nitrogen The sea area with inorganic nitrogen content not meeting the Seawater Quality Standard Grade I was 61,290 km². The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 23,590 km², 10,480 km² and 6,290 km², respectively. The area with water quality not meeting the Seawater Quality Standard Grade IV was 20,930 km² and mainly located at Liaodong Bay, Bohai Bay, Yangtze River Estuary, Hangzhou Bay, the coastal areas in Zhejiang Province, and Pearl River Estuary.

Active Phosphate The sea area with active phosphate content not meeting the Seawater Quality Standard Grade I was 40,400 km². The area with water quality meeting the Seawater Quality Standard Grade II and III was 22,950 km², and that meeting the Seawater Quality Standard Grade IV was 9,940 km². The area with water quality not meeting the Seawater Quality Standard Grade IV was 7,510 km² and mainly located at Liaodong Bay, Yangtze River Estuary, Hangzhou Bay, the coastal areas in Zhejiang Province, and Pearl River Estuary.

The sea area with both inorganic nitrogen and active phosphate content not meeting the Seawater Quality Standard Grade IV was 7,100 km² and mainly located at Liaodong Bay, Yangtze River Estuary, Hangzhou Bay, the coastal areas in Zhejiang Province, and Pearl River Estuary.



Seawater quality status in terms of inorganic nitrogen and active phosphate content in sea areas under jurisdiction of China in 2021

1.1.2 Seawater Quality of Coastal Areas

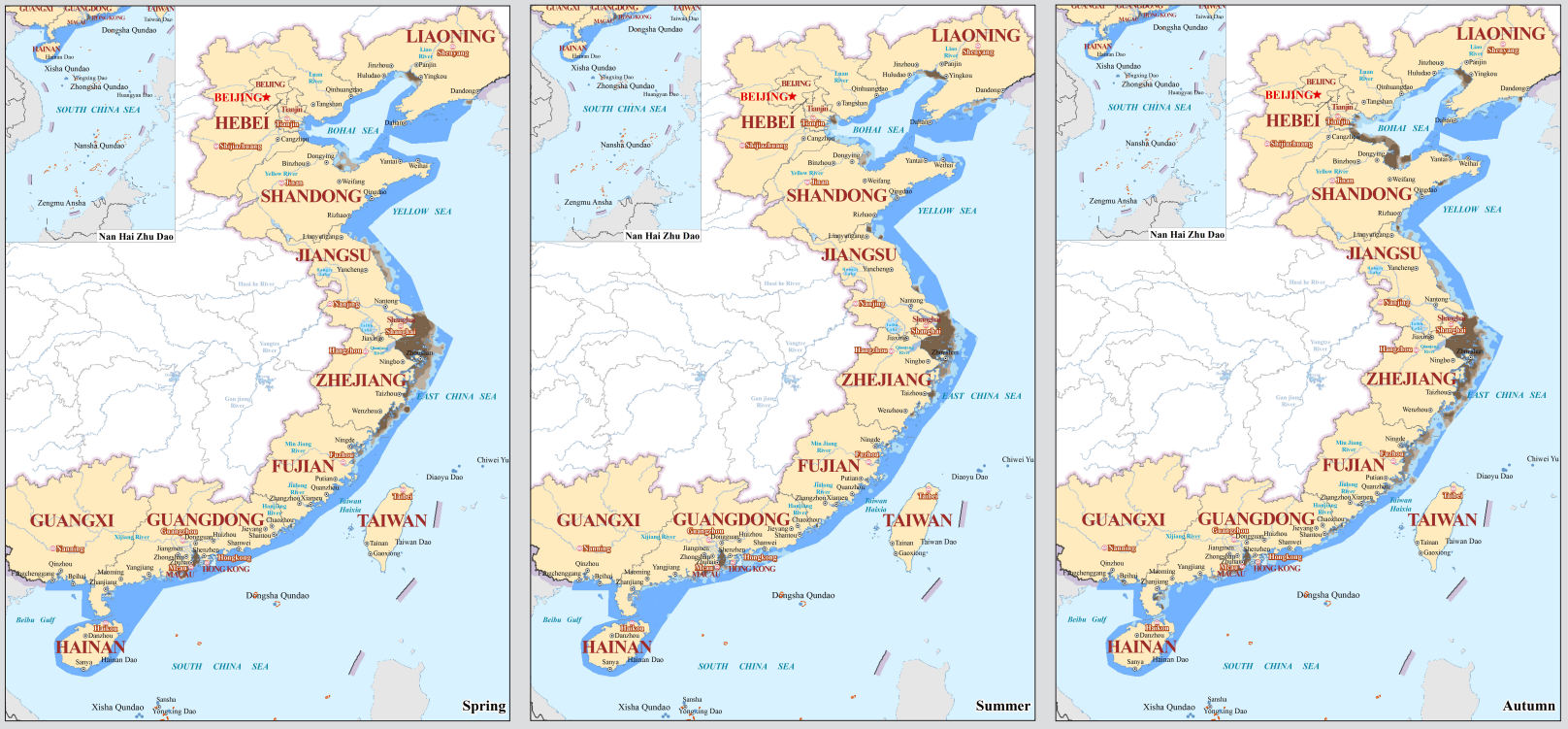
The comprehensive assessment based on the monitoring conducted in spring, summer and autumn* indicated that the seawater quality of coastal areas in China was steadily improved. The sea area meeting the Seawater Quality Standard Grade I and II accounted for 81.3%, up by 3.9% from the previous year, of which the area meeting the Grade I increased by 6.1% while that meeting the Grade II decreased by 2.2%. The sea area with water quality not meeting the standard of Grade IV accounted for 9.6% on average, increased by 0.2% from the last year. The main pollution indicators were inorganic nitrogen and active phosphate.

Proportion of the coastal water areas at different quality levels in China in 2021 and their inter-annual comparison

unit: %

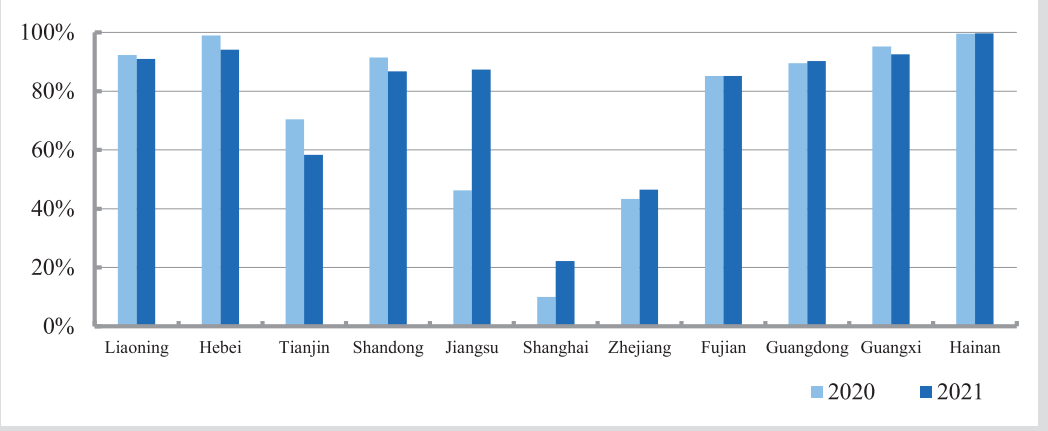
Season	Year	Grade I	Grade II	Grade III	Grade IV	Inferior to Grade IV	Grade I and II
Spring	2021	73.3	8.6	5.4	3.7	9.0	81.9
	2020	68.7	11.1	6.9	4.5	8.8	79.8
Compared with the previous year		↑4.6	↓2.5	↓1.5	↓0.8	↑0.2	↑2.1
Summer	2021	70.8	15.5	4.0	2.4	7.3	86.3
	2020	56.0	22.6	6.9	4.4	10.1	78.6
Compared with the previous year		↑14.8	↓7.1	↓2.9	↓2.0	↓2.8	↑7.7
Autumn	2021	56.4	19.2	6.3	5.7	12.4	75.6
	2020	57.5	16.4	9.2	7.6	9.3	73.9
Compared with the previous year		↓1.1	↑2.8	↓2.9	↓1.9	↑3.1	↑1.7
Average	2021	66.8	14.5	5.2	3.9	9.6	81.3
	2020	60.7	16.7	7.7	5.5	9.4	77.4
Compared with the previous year		↑6.1	↓2.2	↓2.5	↓1.6	↑0.2	↑3.9

* The seawater quality was monitored from April to May in spring, from July to August in summer and from October to November in autumn.



Water quality status distribution of the coastal water areas in China in 2021

The sea area meeting the Seawater Quality Standard Grade I and II in Jiangsu, Shanghai and Zhejiang increased compared with the previous year, that in Liaoning, Hebei, Tianjin, Shandong, Guangxi decreased, and that in Fujian, Guangdong and Hainan remained almost the same. The sea area with water quality not meeting the standard of Grade IV in Jiangsu and Shanghai decreased from the last year, that in Liaoning, Hebei, Tianjin, Shandong, Zhejiang and Guangxi in creased, and that in Fujian, Guangdong and Hainan remained almost the same.



The proportion of the water areas meeting Grade I and II of Seawater Quality Standard in coastal provinces and municipalities in 2021 and their inter-annual comparison

1.1.3 Water Quality of Bays

In 2021, among the 44 bays larger than 100 km², 15 bays had seawater quality meeting the Seawater Quality Standard Grade I and II in all three monitoring seasons (spring, summer and autumn), and 11 bays had seawater quality not meeting the Seawater Quality Standard Grade IV. The dominant pollution indicators were inorganic nitrogen and active phosphate. The sea area meeting the Seawater Quality Standard Grade I and II in 13 bays increased compared with the previous year, that in 19 bays decreased, and that in 12 bays showed no remarkable changes.

Water quality status distribution of 11 bays in the summer of 2021

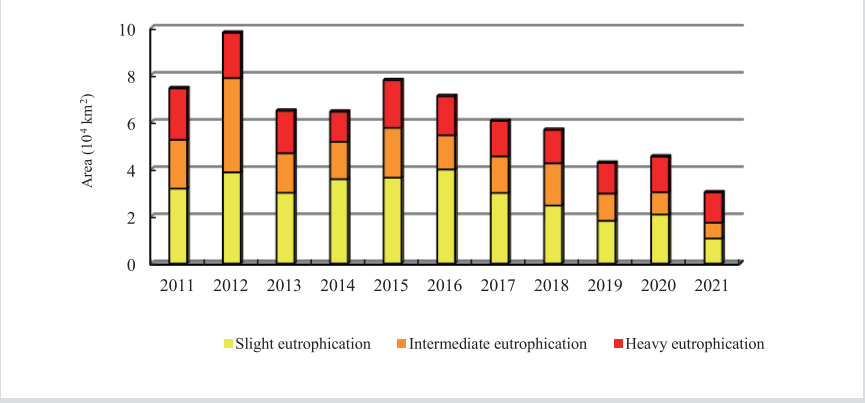
1.2 Eutrophication

In 2021, sea areas under eutrophication status* totaled 30,170 km² in summer, decreased by 15,160 km² from the previous year. The sea areas with Slight, Intermediate, and Heavy eutrophication were 10,630 km², 6,660 km² and 12,880 km², respectively. Heavy eutrophication areas were mainly located at Liaodong Bay, Yangtze River Estuary, Hangzhou Bay, and Pearl River Estuary. From 2011 to 2021, total eutrophicating sea areas under jurisdiction of China trended to decline.

Sea areas under eutrophication status within jurisdiction of China in 2021

unit: km²

Sea Area	Slight Eutrophication	Intermediate Eutrophication	Heavy Eutrophication	Total
Bohai Sea	2,040	1,010	520	3,570
Yellow Sea	1,260	730	290	2,280
East China Sea	6,120	4,040	10,620	20,780
South China Sea	1,210	880	1,450	3,540
Total	10,630	6,660	12,880	30,170



Variation of eutrophicating areas under jurisdiction of China during from 2011 to 2021

* 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 $\times$ active phosphate $\times 10^6/4500$. $E \geqslant 1$ indicates eutrophication, $1 \leqslant E \leqslant 3$ indicates Slight eutrophication, $3 < E \leqslant 9$ indicates Intermediate eutrophication, and $E > 9$ indicates Heavy eutrophication.

Eutrophication status distribution of jurisdictional seas of China in 2021

1.3 Marine Litter and Microplastics

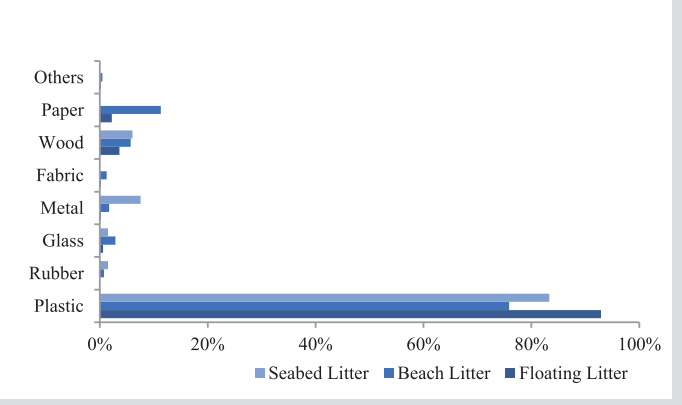
1.3.1 Marine Litter

In 2021, marine litter was monitored in 51 coastal areas. The monitored contents included the types and densities of litter in surface waters, on beaches, and on the seabed.

Floating Litter* The average quantity density of floating litter by visual surveys was 24 items/km^2. The average quantity density of floating litter by trawling surveys was 4,580 items/km^2, with the average weight density of 3.6 kg/km^2. Plastic was the most common type and accounted for 92.9% of the total amount, followed by wood, which accounted for 3.7%. Most of the plastic litter included ropes, fragments, foams and bags.

Beach Litter The average quantity density of beach litter was 154,816 items/km^2, with an average weight density of 1,849 kg/km^2. Plastic was the most common type and accounted for 75.9% of the total amount, followed by paper and wood, which accounted for 11.3% and 5.7% respectively. Most of the plastic litter included cigarette filters, foams, fragments, ropes and plastic packaging materials.

Seabed Litter The average quantity density of seabed litter was 4,770 items/km^2, with an average weight density of 11.1 kg/km^2. Plastic was the most common type and accounted for 83.3% of the total amount, followed by metal and wood, which accounted for 7.6% and 6.1% respectively. Most of the plastic litter included fragments, bags and ropes.



Main types of marine litter along coastal areas in China in 2021

* Based on *Guideline for Monitoring and assessment of Marine litter (on Trail):*
Floating litter by visual surveys: observing macro-litter (2.5 cm≤size＜1 m) and mega-litter (size≥1 m);
Floating litter by trawling surveys: collecting meso-litter (0.5 cm≤size＜2.5 cm) and macro-litter (2.5 cm≤size＜1 m).

Quantitative distribution of marine litter (items/km^2), histogram shows then logarithmic values of the density, "0" means no litter collected

Floating litter by visual surveys Floating litter by trawling surveys Beach litter Seabed litter

Quantitative distribution of marine litter along coastal areas in China in 2021

1.3.2 Marine Microplastics

In 2021, microplastics in surface waters were monitored at 6 sections in the Bohai Sea, Yellow Sea, East China sea and South China sea.

The average density of microplastics in surface waters was 0.44 items/m^3. The average density of microplastics in the Bohai Sea, Yellow Sea, East China sea and South China sea was 0.74 items/m^3, 0.54 items/m^3, 0.22 items/m^3 and 0.29 items/m^3, respectively. Most of the microplastics were fibers, foams, fragments and flakes, and their components were mainly polyethylene terephthalate, polypropylene, polystyrene and polyethylene.

Distribution of marine microplastics in monitored surface waters in 2021

1.4 Radioactivity Level in Marine Environment

In 2021, marine radioactivity monitoring was carried out in 147 sites of sea areas under jurisdiction of China, 12 sea areas adjacent to nuclear power plants, and the western Pacific Ocean waters.

The natural radionuclide activity concentration of the sea areas was within the background level, and no abnormality was observed in the artificial radionuclide activity concentration, and the artificial radionuclide activity concentration in the sea water was far below the limit based on *Seawater Quality Standard*. The natural radionuclide activity concentration of the coastal marine organisms was within the background level, and no abnormality was observed in the artificial radionuclide activity concentration.

The activity concentration of facility-related radionuclide in environmental media such as seawater, sediment and marine organisms in the sea areas adjacent to nuclear power plants was generally within the fluctuation range over the years. The evaluation results showed that the radiation dose to the public from the operation of all the nuclear power plants was far below the national dose limits, and had not affected environmental safety or public health.

The Western Pacific waters remained affected by the Fukushima nuclear accident in Japan. The activity concentration of Cesium-137 in seawater remained at the same level as in the previous year.

2 Marine Ecological Status

2.1 Typical Marine Ecosystems

In 2021, the health status* of 24 typical marine ecosystems, including estuary, bay, mudflat, coral reef, mangrove and sea grass bed were monitored. The monitored typical marine ecosystems were all in Healthy or Sub-healthy condition, specifically, 6 were Healthy and 18 were Sub-healthy.

Estuary Ecosystem The 7 monitored estuary ecosystems were all in Sub-healthy condition. The seawater was in heavy eutrophic condition in some estuaries. The sediment qualities were relatively Good on the whole. Marine biological qualities were Good on the whole, whereas relatively high levels of heavy metal was detected in the shellfish from a few estuary ecosystems. In most estuary ecosystems, the density of phytoplankton was higher than the normal range, the density and biomass of zooplankton were lower than the normal range, the density of fish eggs and larvae was significantly low, and the biomass of macrobenthos was lower than the normal range.

Bay Ecosystem The 8 monitored bay ecosystems were all in Sub-healthy condition. The seawater was in heavy eutrophic condition in a few bays. The sediment qualities were relatively Good on the whole. Marine biological qualities were generally Good. In most bay ecosystems, the density of phytoplankton was higher than the normal range, the density and biomass of zooplankton exceeded the normal range, the density of fish eggs and larvae was significantly low, and the density and biomass of macrobenthos were lower than the normal range.

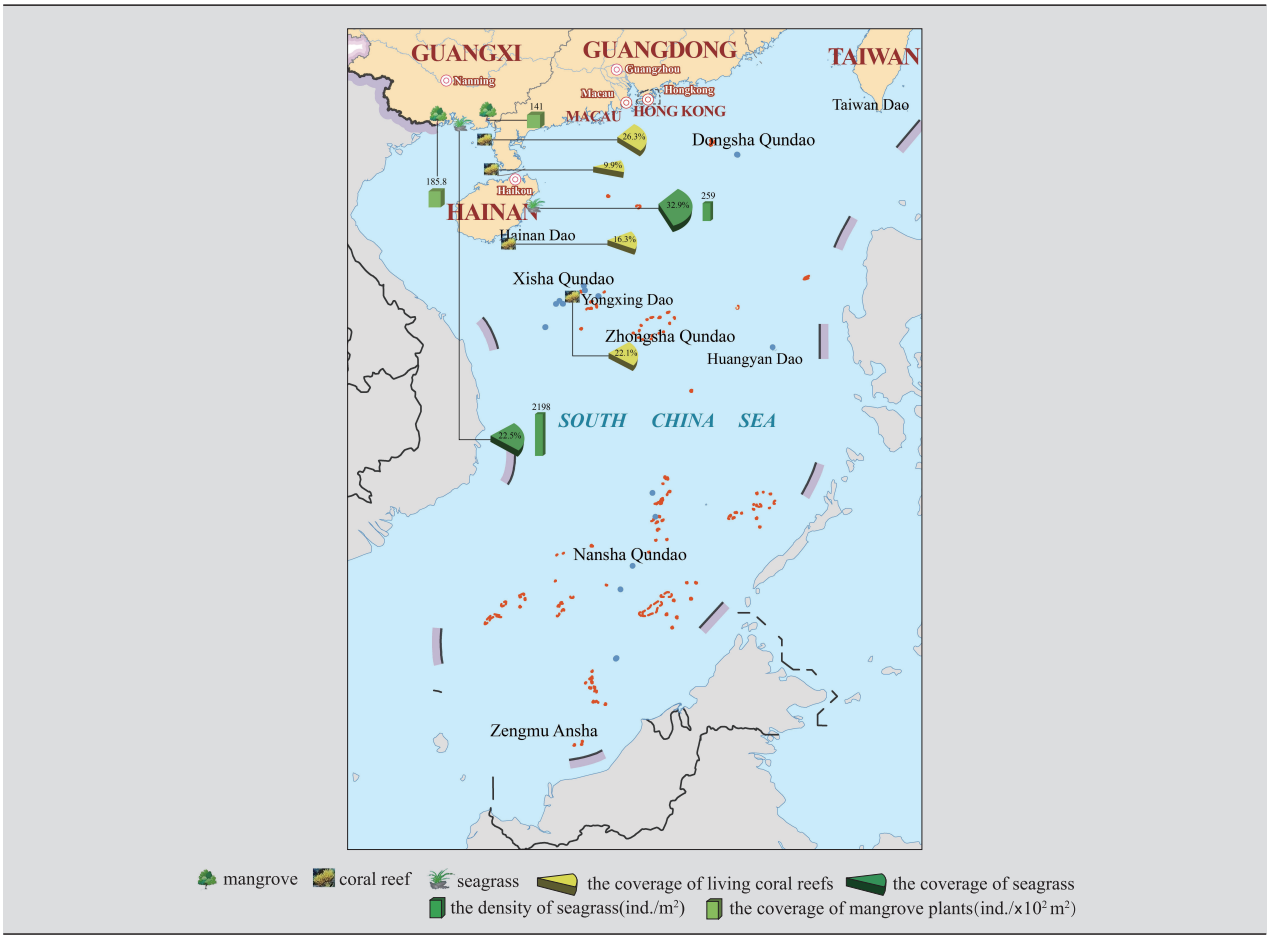
Mudflat Ecosystem The Northern Jiangsu mudflat ecosystem was in Sub-healthy condition. The density of phytoplankton and zooplankton were both higher than the normal range. For macrobenthos, their density was lower than the normal range and their biomass was higher than the normal range. The area of mudflat vegetation was about 238.0 km^2. The dominant vegetation species in the ecosystem was *Spartina alterniflora* (alien invasive cordgrass), followed by seepweed and reed.

*The health status of marine ecosystems falls into three categories, namely, healthy, sub-healthy, and unhealthy conditions.
Healthy: Ecosystems maintain their natural attributes. Biological diversity and ecosystem structure are basically in stable conditions, and ecosystems function well. Ecological pressures brought about by human activities are within the carrying capacity of the ecosystems.
Sub-healthy: Ecosystems basically maintain natural attributes. Biological diversity and ecosystem structure experience certain degrees of changes, but the main service functions of the ecosystems are maintained. The ecological pressures caused by environmental pollution, human activities, and unreasonable use of resources exceed the carrying capacity of the ecosystems.
Unhealthy: The natural attributes of ecosystems are changed significantly. Biological diversity and ecosystem structure experience significant changes, and main ecosystem service functions are seriously weakened or totally lost. Ecological pressures caused by environmental pollution, human activities, and unreasonable use of resources exceed the carrying capacity of the ecosystems.

Coral Reef Ecosystem Among the 4 monitored coral reef ecosystems, 3 were in Healthy condition, whereas 1 was in Sub-healthy condition. The number of species of living coral significantly increased compared with that in the previous year in the Leizhou Peninsula. The number of species of living coral and coral fish significantly increased compared with that in the previous year in the Hainan East Coast. The health status kept improving and the number of species of living coral and coral fish significantly increased compared with that in the previous year in the Xisha Islands. In Guangxi Beihai, there was serious coral bleaching and the number of species of living coral significantly decreased compared with that in the previous year.

Mangrove Ecosystem The 2 monitored mangrove ecosystems were in Healthy condition. The density of mangroves, the density and biomass of macrobenthos significantly increased compared with that in the previous year in Guangxi Beihai. The density of mangroves and macrobenthos significantly increased compared with that in the previous year in the Beilun Estuary.

Seagrass Bed Ecosystem The Guangxi Beihai seagrass bed ecosystem was in Healthy condition, with the density and coverage of seagrass significantly higher than that in the previous year. The seagrass bed ecosystem in the Hainan East Coast was in Sub-healthy condition, with the density of seagrass significantly lower than that in the previous year.



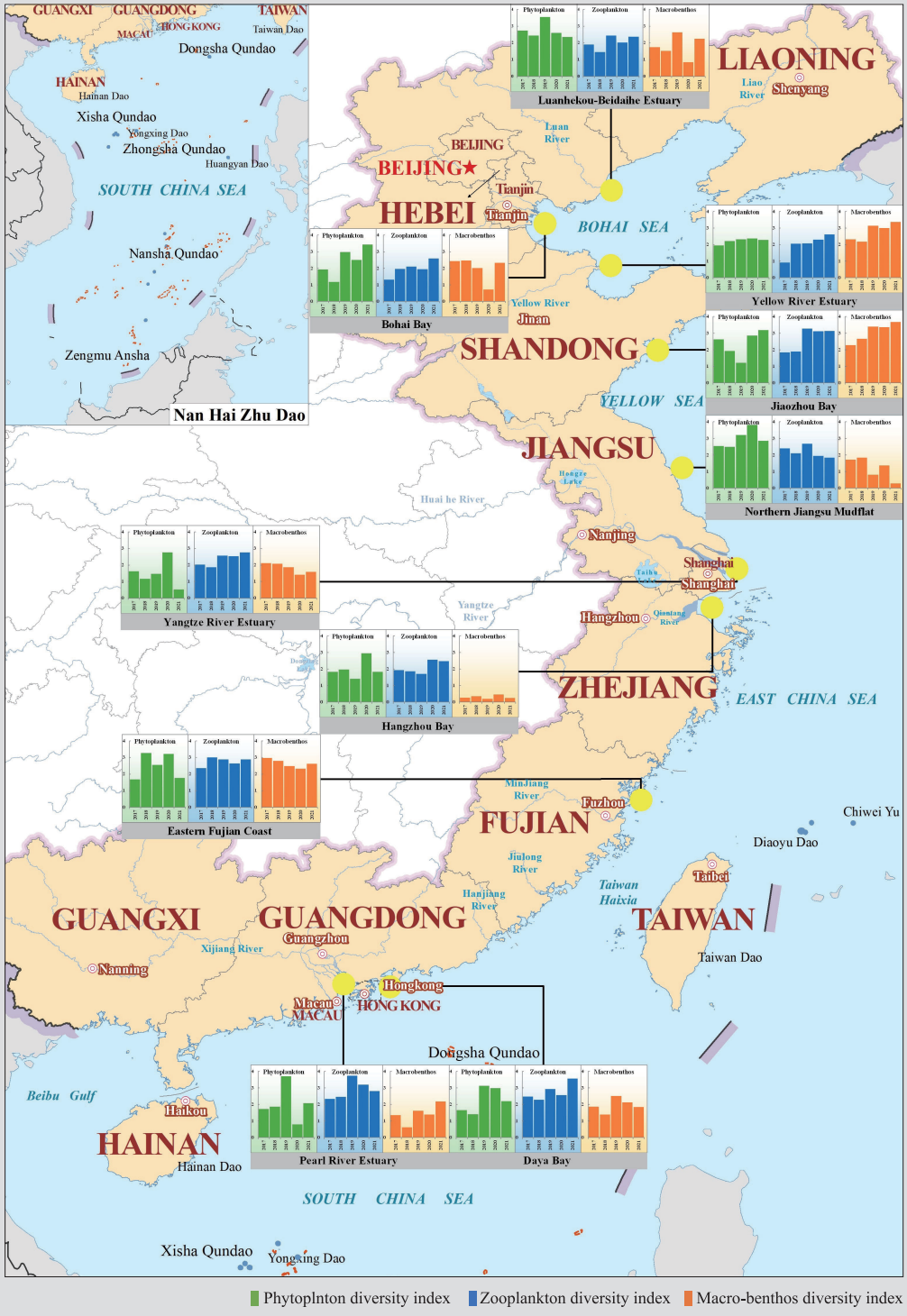
Biodiversity status of reef-building coral, mangrove, and seagrass in monitored areas in 2021

Health status of typical marine ecosystems in 2021

Number of species, density, diversity index and dominant species of plankton and macrobenthos in the monitored areas in 2021

Monitored Area	Phytoplanton				Zooplankton				Macrobenthos			
					Number of Species	Macro-zooplankton						
	Number of Species	Density ($\times 10^4$cells/m^3)	Diversity index	Dominant species		Density (ind./m^3)	Diversity index	Dominant species	Number of Species	Density (ind./m^2)	Diversity index	Dominant species
Yalujiang Estuary	72	380	2.77	*Chaetoceros curvisetus* *Eucampia zodiacus*	39	405	2.94	*Sagitta crassa* *Calanus sinicus*	83	515.0	2.22	*Branchiostoma belcheri tsingtauense* *Ogyrides orientalis*
Shuangtaizi Estuary	68	33	3.18	*Skeletonema costatum* *Pseudo-nitzschia pungens*	38	445	2.10	*Sagitta crassa* *Centropages dorsispinatus*	48	95.6	1.76	*Sternaspis sculata* *Phellia gausapata*
Luanhe - Beidaihe Estuary	45	1,675	2.36	*Skeletonema costatum* *Pseudo-nitzschia pungens*	35	231	2.37	*Pleurobrachia globosa* *Sagitta crassa*	55	122.6	2.24	*Xenophthalmus pinnotheroides* *Callianassa harmandi*
Yellow River Estuary	51	3,556	2.29	*Chaetoceros curvisetus* *Asterionellopsis glacialis*	44	196	2.63	*Pleurobrachia globosa* *Oithona similis*	86	654.3	3.38	*Glycinde gurjanovae* *Heteromastus filiforms*
Yangtze River Estuary	122	31,297	0.52	*Skeletonema costatum*	93	269	2.76	*Tortanus vermiculus* *Acartia pacifica*	54	82.4	1.58	*Heteromastus filiforms* *Sinocorophium sinensis*
Minjiang Estuary	21	1,159	2.11	*Chaetoceros curvisetus* *Pseudo-nitzschia pungens*	87	127	2.96	*Subeucalanus subcrassus* *Paracalanus crassirostris*	42	82.5	2.24	*Ophiocnemis marmorata* *Notomastus cf. aberans*
Pearl River Estuary	169	5,380	2.07	*Thalassiosira mala* *Chaetoceros curvisetus*	94	551	2.82	*Acartia spinicauda* *Acartiella sinensis*	92	82.9	2.18	*Paraprionospio pinnata* *Xenophthalmus pinnotheroides*
Bohai Bay	51	349	3.43	*Skeletonema costatum* *Microcystis agruginosa*	34	181	2.59	*Evadne tergestina* *Corophium major*	37	122.5	2.33	*Musculus senhousia* *Ringicula doliaris*
Laizhou Bay	48	285	2.72	*Chaetoceros curvisetus* *Helicotheca tamesis*	52	190	2.82	*Doliolum denticulatum* *Eirene menoni*	109	1,187.6	3.41	*Heteromastus filiforms* *Glycinde gurjanovae*
Jiaozhou Bay	65	151	3.18	*Skeletonema costatum* *Cerataulina pelagica*	77	993	3.14	*Acartia pacifica* *Sagitta crassa*	90	669.2	3.68	*Heteromastus filiforms* *Nephtys oligobranchia*
Hangzhou Bay	121	16,898	1.84	*Skeletonema costatum*	85	84	2.49	*Labidocera euchaeta* *Acanthomysis longirostris*	10	6.2	0.25	—
Yueqing Bay	123	465	2.25	*Skeletonema costatum* *Nitzschia delicatissima*	106	178	3.12	*Pseudeuphausia sinica* *Acartia pacifica*	36	46.5	1.99	*Aglaophamus dibranchis* *Cylichna biplicata*
Eastern Fujian Coast	48	3,565	1.77	*Chaetoceros curvisetus* *Pseudo-nitzschia pungens*	95	589	2.89	*Sagitta enflata* *Paracalanus crassirostris*	88	90.7	2.63	*Sternaspis sculata* *Aglaophamus dibranchis*
Daya Bay	160	2,634	2.20	*Skeletonema costatum* *Thalassionema nitzschioides*	137	93	3.56	*Sagitta enflata* *Subeucalanus subcrassus*	50	45.3	1.84	*Amphioplus laevis* *Timoclea scabra*
Beibu Gulf	120	1,746	2.62	*Skeletonema tropicum* *Thalassionema nitzschioides*	207	219	3.05	*Sagitta enflata* *Subeucalanus subcrassus*	124	55.3	2.04	*Amphiodia obtecta*
Northern Jiangsu Mudflat	122	996	2.86	*Skeletonema costatum* *Thalassiosira curviseriata*	61	409	1.84	*Labidocera euchaeta* *Acartia pacifica*	17	7.2	0.28	*Nassarius variciferus*

Note: "-" indicates that no species with dominance index $Y \geqslant 0.02$ was detected in the area. The species diversity index is used to measure the species number and the individual number evenness among different species, and calculated by Shannon-Wiener index with the formula $H' = -\sum (P_i \cdot \log_2 P_i)$, where P_i 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 macrobenthos in the monitored areas from 2017 to 2021

State of Marine Biodiversity

According to incomplete statistics, 28,661 species of marine organisms have been recorded in China. According to the classification system of five kingdoms, there are 575 species in the prokaryotic kingdom, 4,894 species in the protist kingdom, 291 species in the fungal kingdom, 1,496 species in the plant kingdom, and 21,405 species in the animal kingdom. The main biological groups include 59 phyla, including diatoms (1,678 species), granuloreticulosa (1,491 species), cnidarians (1,669 species), flatworms (1,297 species), annelids (1,205 species), mollusks (4,588 species), arthropods (6,127 species), and chordates (4,470 species).

There are 116 species (classes) of rare and endangered marine wildlife listed in the *List of Key Protected Wild Animals in China*, including spotted seals, Chinese white dolphins, Bryde's whales and other wildlife protected as the National Grade I. Among the 2,053 marine species in China indexed in International Union for Conservation of Nature (IUCN), 141 species are classified as threatened, accounting for 6.9% of the total number. Among the 141 species, 17 species are further classified as critically endangered, 48 species are classified as endangered, and 76 species are classified as vulnerable.

Strengthen the Monitoring and Protection of Rare and Endangered Marine Species

Rare and endangered species are flagship organisms in marine ecosystems and important indicator species for reflecting marine ecosystem quality and stability. In 2020 and 2021, pilot monitoring of Bryde's whale and Chinese white dolphin was carried out in the sea areas from the Weizhou Island to Xieyang Island, and from Sanniang Bay to Dafengjiang Estuary of Guangxi, and a total of 50 monitoring voyages were carried out, with a total voyage distance of more than 2,500 km. The Bryde's whale were found at 93 monitoring sites and 44 Bryde's whales were identified. The Chinese white dolphins were found at 73 monitoring sites and 126 Chinese white dolphins were identified.

In recent years, China has strictly controlled reclamation, promoted ecological restoration of sea areas, islands, coastlines and coastal wetlands, and established a system of marine protected areas with national parks as the mainstay, supported by nature reserves and supplemented by nature parks, which provides an important foundation for the recovery of populations and habitats of rare and endangered marine species in China.

The scene of a survey of Bryde's whales adjacent to Weizhou Island, Guangxi

2.2 Marine Nature Reserve

By the end of 2021, 66 marine nature reserves and 79 marine special reserves (including marine parks) have been established in China, covering a total area of 7.9098 million ha.

The ecological status of the 12 monitored national marine nature reserves remained stable on the whole in 2021. The ecological and environmental status* of 4 reserves was assessed. The Liaoning Dalian Spotted Seal National Nature Reserve, and Guangdong Xuwen Coral Reef National Nature Reserve were assessed to be in good ecological and environmental status (Grade I) on the whole. And overall, the Shandong Yellow River Delta National Nature Reserve, and Jiangsu Yancheng Wetland National Nature Reserve, Rare Birds were assessed to be in moderate status (Grade II).

1. Liaoning Yalujiang Estuary Coastal Wetland National Nature Reserve
Saundersilarus saundersi as Class I species of the *List of Key Protected Wild Animals in China* (LKPWAC), *Calidris tenuirostris*, *Numenius madagascariensis* and *Numenius arquata* as Class II species were monitored.

2. Liaoning Dalian Spotted Seal National Nature Reserve
The ecological and environmental status was Grade I.
A total of 304 individuals of *Phoca largha* (Class I species) were monitored. The sea water quality met the Seawater Quality Standard Grade I. The area of unused sea accounted for 96.8%.

3. Liaoning Liao River Estuary National Nature Reserve
Grus japonensis and *Saundersilarus saundersi* as Class I species of LKPWAC, *Numenius madagascariensis*, *Numenius arquata* and *Limicola falcinellus* as Class II species were monitored.

4. Hebei Changli Gold Coast National Nature Reserve
The average quantity density of lancelet was 67.5 ind./m^2, the average biomass density was 6.2 g/m^2.

5. Shandong Binzhou Shell Island and Wetland National Nature Reserve
The area of shell bank was 41.7 ha, which increased compared with that of the previous year.
Saundersilarus saundersi as Class I species of LKPWAC, *Numenius madagascariensis* and *Numenius arquata* as Class II species were monitored.

6. Shandong Yellow River Delta National Nature Reserve
The ecological and environmental status was Grade II.
A total of 521 individuals of *Ciconia boyciana* (Class I species) were monitored. The area of natural coastal wetland accounted for 39.9%. The area of *Spartina alterniflora* accounted for 3.4%.

7. Jiangsu Yancheng Wetland National Nature Reserve, Rare Birds
The ecological and environmental status was Grade II.
A total of 75 individuals of *Grus japonensis* (Class I species) were monitored. The area of natural coastal wetland accounted for 58.2%. The area of *Spartina alterniflora* accounted for 1.8%.

8. Fujian Zhangjiang Estuary Mangrove National Nature Reserve
Numenius madagascariensis and *Limicola falcinellus* as Class II species of LKPWAC, *Bruguiera gymnorrhiza*, *Avicennia marina*, *Kandelia candel*, *Aegiceras corniculatum*, *Hibiscus tiliaceus* and *Acanthus ilicifolius* were monitored. *Spartina alterniflora*, *Ipomoea cairica*, *Lantana camara* and other 13 alien invasive plants were recorded.

9. Guangdong Neilingding Island—Futian National Nature Reserve
Bruguiera gymnorrhiza, *Avicennia marina*, *Kandelia candel*, *Aegiceras corniculatum*, *Sonneratia caseolaris* and *Sonneratia apetala* were monitored. *Ipomoea cairica*, *Lantana camara*, *Mikania micrantha* and other 8 alien invasive plants were recorded.

10. Guangdong Xuwen Coral Reef National Nature Reserve
The ecological and environmental status was Grade I.
The average coverage of live coral was 9.9%. The percentage of albefaction coral was 0.2%. The sea water quality was fine. The area of unused sea accounted for 99.99%.

11. Guangxi Shankou Mangrove Ecological National Nature Reserve
Bruguiera gymnorrhiza, *Avicennia marina*, *Kandelia candel*, *Aegiceras corniculatum* and *Rhizophora stylosa* were monitored.

12. Guangxi Beilun Estuary National Nature Reserve
Bruguiera gymnorrhiza, *Avicennia marina*, *Kandelia candel* and *Aegiceras corniculatum* were monitored.

The ecological status of monitored national marine nature reserves in 2021

*According to *the Standard for Conservation Effectiveness Assessment of Ecology and Environment in Nature Reserve (on Trial)*, the ecological and environmental status of natural reserves can be divided into three grades:

Grade I: The status of key protected objects, ecosystem structure, ecosystem service, and water environment quality is good on the whole, and the major threat factors and violations are well under control.

Grade II: The status of key protected objects, ecosystem structure, ecosystem service, and water environment quality is moderate on the whole, and the major threat factors and violations are barely under control.

Grade III: The status of key protected objects, ecosystem structure, ecosystem service, and water environment quality is ordinary on the whole, and the major threat factors and violations are poorly controlled.

2.3 Coastal Wetlands

By the end of 2021, 15 coastal wetlands of international importance, 7 coastal wetlands of national importance and 24 national wetland parks have been identified or established in China, covering a total area of 886,000 ha, 88,000 ha and 42,000 ha respectively.

The ecological status* of the 15 monitored coastal wetlands of international importance remained stable on the whole, and *Spartina alterniflora* was the main invasive alien species, covering a total area of 26,357 ha.

Birds observations and vegetation surveys were carried out once in each of the 8 wetland regions including Liaoning Zhuanghe, Liaoning Shuangtai Estuary, Shandong Yellow River Delta Wetlands, Jiangsu Yancheng National Nature Reserve, Fujian Zhangjiangkou National Mangrove Nature Reserve, Guangdong Futian Mangrove Nature Reserve, Guangxi Shankou Mangrove Nature Reserve and Guangxi Beilun Estuary National Nature Reserve. *Grus japonensis*, *Ciconia boyciana*, *Platalea minor*, *Saundersilarus saundersi*, *Egretta eulophotes* and *Pelecanus onocrotalus* as Class I species of the *List of National Key Protected Wild Animals in China*, and *Cygnus olor*, *Platalea leucorodia*, *Calidris tenuirostris*, *Numenius madagascariensis*, *Numenius arquata*, *Limicola falcinellus* and *Phalacrocorax Pelagicus* as Class II species were recorded. Among the surveyed vegetation are salt marsh plants such as *Suaeda salsa*, *Phragmites australis*, *Tamarix chinensis*, and *Spartina alterniflora*, as well as mangrove species such as *Avicennia marina*, *Kandelia candel*, *Aegiceras corniculatum*, *Rhizophora stylosa*, *Bruguiera gymnorrhiza*, *Sonneratia caseolaris*, *Acanthus ilicifolius*, *Hibiscus tiliaceus*, and *Sonneratia apetala*.

The Ministry of Ecology and Environment Launches Pilot Monitoring of Ocean Carbon Sinks

In 2021, The Ministry of Ecology and Environment (MEE) actively carried out supporting researches for the carbon dioxide peaking and carbon neutrality goals in the marine environment field, strengthened the top-level design of carbon monitoring and assessment, and developed the *Pilot Work Plan for Carbon Monitoring and Assessment*. The monitoring was conducted in four cities, including Panjin in Liaoning Province, Nantong in Jiangsu Province, and Shenzhen and Zhanjiang in Guangdong Province. The pilot monitoring areas covered multiple types of ocean carbon sinks such as mangroves, salt marshes, seagrass beds and cultured seaweed. More than 10 indicators were monitored, such as carbon storage, carbon flux, air temperature, precipitation and photosynthetically active radiation, etc. More than 50,000 sets of data of carbon stock and carbon flux were obtained, and the construction of flux measurement systems in the pilot cities was promoted. In the next step, MEE will promote the pilot monitoring and assessment of ocean carbon sinks in an orderly manner, explore the establishment of technical methodology systems, and leverage the demonstrative effects to provide monitoring support for addressing climate change.

*The assessment result is from the 2020 White Paper on *the Ecological Status of Wetlands of International Importance in China.*

2.4 Marine Ecological Disasters

2.4.1 Red Tide

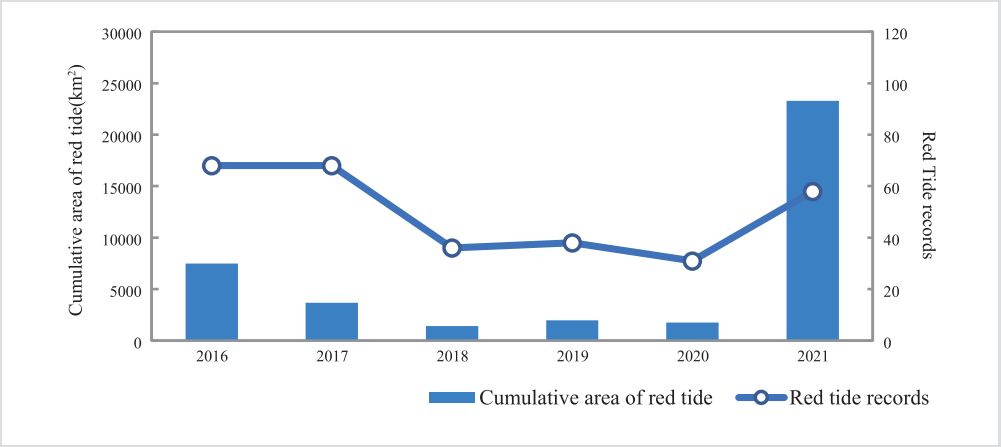
In 2021, a total of 58 red tide events were recorded in sea areas under jurisdiction of China, with a cumulative area of 23,277 km^2. Among the four major sea areas, the East China Sea had the largest number of red tide events (26 events) and the biggest cumulative area (7,096 km^2). Among the coastal provinces, autonomous regions and municipalities, the largest number of red tide events and the biggest cumulative area was found in the sea area of Zhejiang province, with 22 events and a cumulative area of 7,084 km^2 recorded.

In 2021, 26 species of dominant organisms that cause red tides were identified. Among them, *Noctiluca scintillans* caused 14 red tide events, more than any other dominant species. *Gonyaulax polygramma* caused the largest cumulative area of red tide, totaling 8,216 km^2.

Red tides recorded in 2021

Province	Time	Spotted Area	Dominant species	Area (km^2)
Guangxi	February 14-17	West of Weizhou Island	*Noctiluca scintillans*	6,000
Zhejiang	April 27- May 16	From Wenzhou nearshore to the territorial sea baseline	*Prorocentrum donghaiense*	722
Zhejiang	April 27- May 17	From Taizhou nearshore to territorial sea baseline	*Prorocentrum donghaiense*	926
Zhejiang	June 3-10	Along the Beiji archipelago, Nanji Archipelago and Cangnan county in the coast of Wenzhou	*Prorocentrum donghaiense*	764
Liaoning	July 20-22	Xieziwan Park, Diamond Bay and the southern sea area of Mianhuadao island in Ganjingzi District	*Alexandrium catenella* *Heterosigma akashiwo* *Prorocentrum minimum* *Prorocentrum micans* *Skeletonema costatum* *Noctiluca scintillans*	21
Zhejiang	September 1-8	Sea areas of the east coast of Taizhou, and the sea areas to the south of Yuhuan	*Chaetoceros curvisetus*	1,084
Zhejiang	September 19- October 6	Sea areas of Taizhou Wenling, Yuhuan coast and the sea areas to south of Dalu Island	*Akashiwo sanguinea*	1,311
Shandong	October 27- November 5	Dongying nearshore	*Akashiwo sanguinea* *Gonyaulax polygramma*	1,052
Shandong	November 27- December 16	Yantai-Weihai nearshore	*Gonyaulax polygramma*	921
Shandong	December 4-21	Nearshore of Huangdao and Jiaonan of Qingdao	*Phaeocystis globosa*	1,543

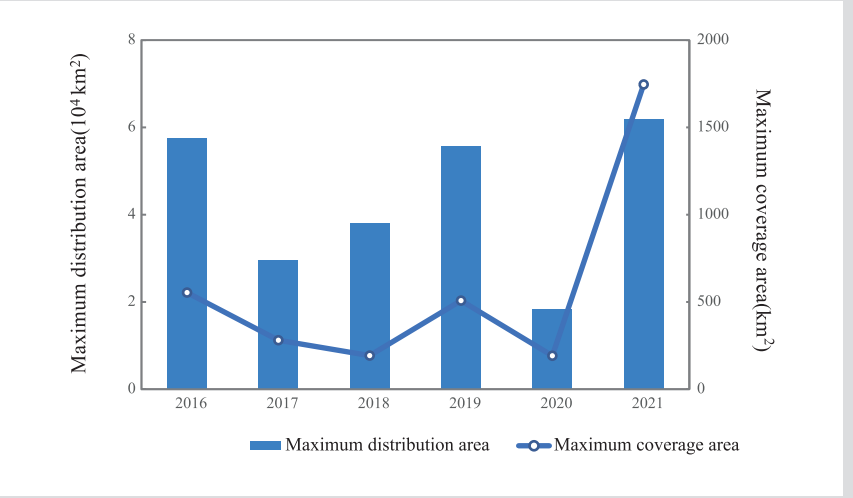
Note: The area listed in this table only count in the red tide area in the waters under jurisdiction of the provinces/autonomous regions, and only toxic red tide events or those exceeding 400 km^2 in area were listed.



Number of red tide events and their cumulative area spotted in waters under China's jurisdiction from 2016 to 2021

2.4.2 Green Tide

During April to August 2021, a green tide event with the dominated algae of *Ulva prolifera* occurred in the Yellow Sea, and reached the maximum distribution area (61,898 km^2) on June 21 and the maximum coverage area (1,746 km^2) on June 26.



The scale of *Ulva prolifera* green tides in the Yellow Sea from 2016 to 2021

3 Main Pollution Sources into the Sea

3.1 Riverine Sources

In 2021, 230 water sections of rivers flowing into the sea were monitored under the national monitoring program*. Among the monitored sections, the proportion of sections meeting surface water quality standard Grade I, Grade II and Grade III accounted for 71.7% of the total, which increased by 4.5% compared with the previous year, and the proportion of sections worse than surface water quality standard Grade V accounted for 0.4%, decreased by 0.9% compared with the previous year. In general, rivers flowing into the sea in China were under Slight Pollution**. The dominant pollution indicators were chemical oxygen demand (COD_{Cr}), permanganate index, five-day biochemical oxygen demand (BOD_5), total phosphorus (TP) and ammonia-N.

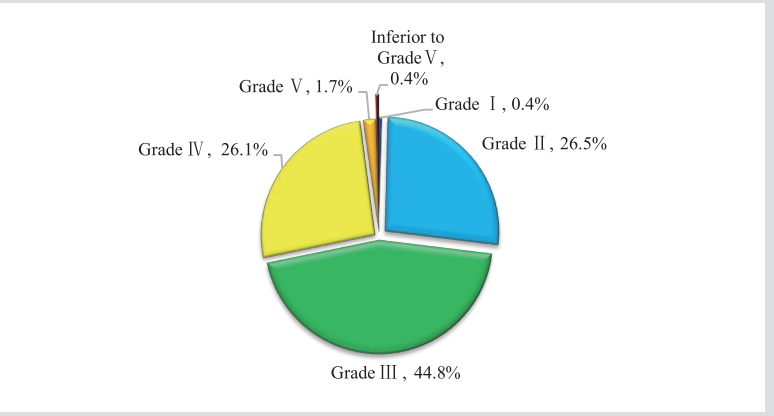
Proportion of water sections at different quality levels of sea-entering rivers in different sea areas and dominant pollution indicators in 2021

unit: %

Sea Area	Water Quality	Grade I	Grade II	Grade III	Grade IV	Grade V	Inferior to Grade V	Dominant Pollution Indicators
Bohai Sea	Slight Pollution	0.0	17.2	32.8	48.3	1.7	0.0	permanganate index, COD_{Cr}, BOD_5
Yellow Sea	Good	0.0	22.4	56.9	20.7	0.0	0.0	-
East China Sea	Good	0.0	32.6	46.5	18.6	2.3	0.0	-
South China Sea	Good	1.4	33.8	43.7	16.9	2.8	1.4	-

* According to *the National Surface Water Environmental Quality Monitoring Network Programme in 14th Five Year Plan Period,* during the 14th Five Year Plan period, 230 water sections of rivers flowing into the sea were set. When compared with the results of the previous year, the results in 2020 were calculated according to the statistical results of 230 sections.

** Integrated water quality of rivers flowing into the sea is classified into five grades:
Excellent: 90% and above of waters meet Grade I ~ III quality level;
Good: 75% (including 75%) ~ 90% of waters meet Grade I ~ III;
Slight Pollution: less than 75% of waters meet Grade I ~ III, and less than 20% of waters are inferior to Grade V;
Moderate Pollution: less than 75% of waters meet Grade I ~ III, and 20% (including 20%) ~ 40% of waters are inferior to Grade V;
Heavy Pollution: less than 60% of waters meet Grade I ~ III, and 40% and above of waters are inferior to Grade V.



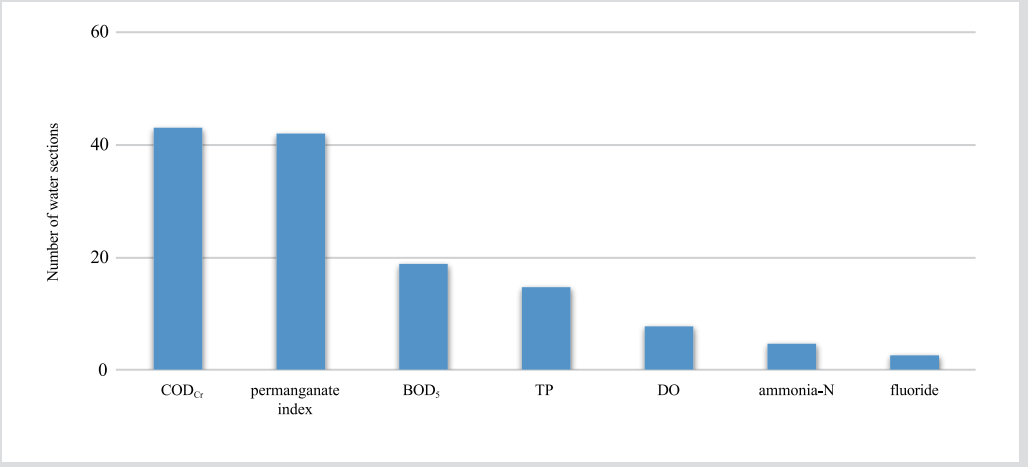
Proportion of water sections at different quality levels of sea-entering rivers nationwide in 2021

In the coastal provinces (autonomous regions and municipalities), the water quality of monitored sections of sea-entering rivers was excellent in Shanghai; good in Liaoning, Jiangsu, Zhejiang, Guangdong and Hainan; and slight pollution in Hebei, Tianjin, Shandong, Fujian and Guangxi.

Proportion of water sections at different quality levels of sea-entering rivers in coastal provinces (autonomous regions and municipalities) and dominant pollution indicators in 2021

unit: %

Province	Water Quality	Grade I	Grade II	Grade III	Grade IV	Grade V	Inferior to Grade V	Dominant Pollution Indicators
Liaoning	Good	0.0	52.2	30.4	17.4	0.0	0.0	-
Hebei	Slight Pollution	0.0	16.7	41.7	41.7	0.0	0.0	permanganate index, COD_{Cr}, BOD_5
Tianjin	Slight Pollution	0.0	0.0	0.0	87.5	12.5	0.0	COD_{Cr}, permanganate index, BOD_5
Shandong	Slight Pollution	0.0	15.0	35.0	50.0	0.0	0.0	permanganate index, COD_{Cr}, BOD_5
Jiangsu	Good	0.0	9.1	78.8	12.1	0.0	0.0	-
Shanghai	Excellent	0.0	40.0	60.0	0.0	0.0	0.0	-
Zhejiang	Good	0.0	43.5	34.8	21.7	0.0	0.0	-
Fujian	Slight Pollution	0.0	13.3	60.0	20.0	6.7	0.0	TP, COD_{Cr}, ammonia-N
Guangdong	Good	2.6	30.8	48.7	17.9	0.0	0.0	-
Guangxi	Slight Pollution	0.0	36.4	36.4	27.3	0.0	0.0	COD_{Cr}, permanganate index, dissolved oxygen (DO)
Hainan	Good	0.0	38.1	38.1	9.5	9.5	4.8	-



The statistics for pollution indicators of water sections of sea-entering rivers in 2021

Pollution indicators of water sections of sea-entering rivers in China in 2021

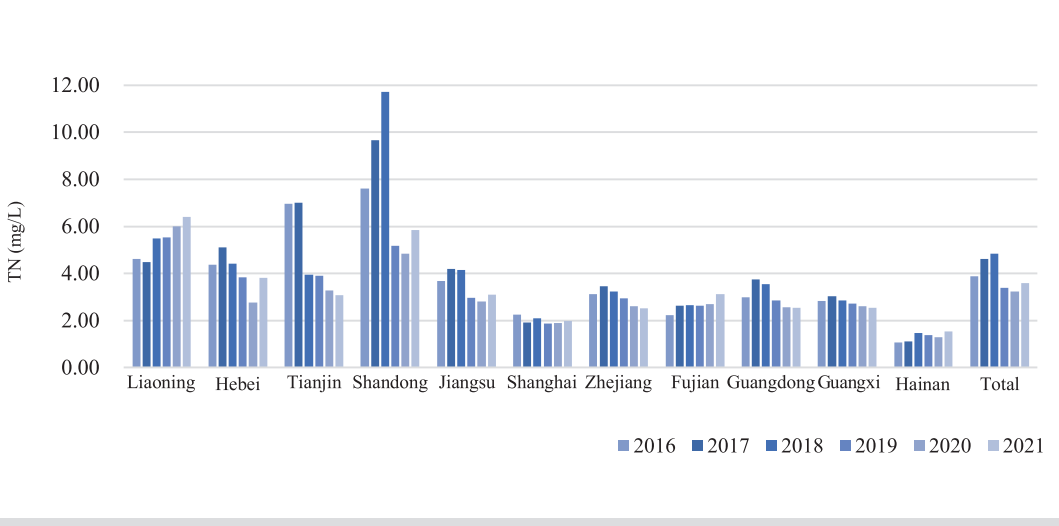
unit: %

Sea Area	Exceeding Ratio > 30%	30% ≥ Exceeding Ratio ≥ 10%	Exceeding Ratio <10%
All	-	COD_{Cr} (18.7), permanganate index (18.3)	BOD_5 (8.3), TP (6.5), DO (3.5), ammonia-N (2.2), fluoride (1.3)
Bohai Sea	permanganate index (48.3), COD_{Cr} (32.8)	BOD_5 (13.8)	TP (5.2), fluoride (3.4), ammonia-N (1.7)
Yellow Sea	-	COD_{Cr} (15.5), BOD_5 (12.1), permanganate index (10.3)	TP (8.6)
East China Sea	-	COD_{Cr} (16.3)	BOD_5 (7.0), DO (7.0), TP (4.7), ammonia-N (4.7), permanganate index (4.7), fluoride (2.3)
South China Sea	-	COD_{Cr} (11.3)	permanganate index (8.5), TP (7.0), DO (7.0), ammonia-N (2.8), BOD_5 (1.4)

Note: Figures in parentheses represent the exceeding rate of the indicator

Of the 230 sections of rivers flowing into the sea, 18.7% of the monitored sections had excessive surface water quality standard for COD_{Cr}, which had the highest proportion among all indicators, ranging between 2.0 ~ 76.0 mg/L and 17.1 mg/L on average; 18.3% of the monitoring sections contained permanganate above standard value, with its concentration ranging 0.6 ~ 22.2 mg/L and 4.5 mg/L on average; the proportion failing to meet the standard for BOD_5 was 8.3%, with the concentration ranging 0.2 ~ 28.4 mg/L and 2.8 mg/L on average; the proportion failing to meet the standard for TP was 6.5% with the concentration ranging 0.005 ~ 0.89 mg/L and 0.112 mg/L on average; and the proportion failing to meet the standard for ammonia-N was 2.2% with the concentration ranging 0.02 ~ 3.88 mg/L and 0.30 mg/L on average.

In 2021, the average TN concentration of all nationwide sea-entering rivers was 3.60 mg/L, which increased by 11.1% compared with the previous year. Of the 230 sections of rivers flowing into the sea, there were 80 sections with annual average TN concentration above the national average value, with 5 sections exceeded 10 mg/L. Among the coastal provinces (autonomous regions and municipalities), the annual average TN concentration increased from the previous year in Liaoning, Hebei, Shandong, Jiangsu, Shanghai, Fujian and Hainan; decreased from the previous year in Tianjin, Zhejiang, Guangdong and Guangxi.



Average TN concentration of sea-entering rivers in coastal provinces (autonomous regions and municipalities) from 2016 to 2021

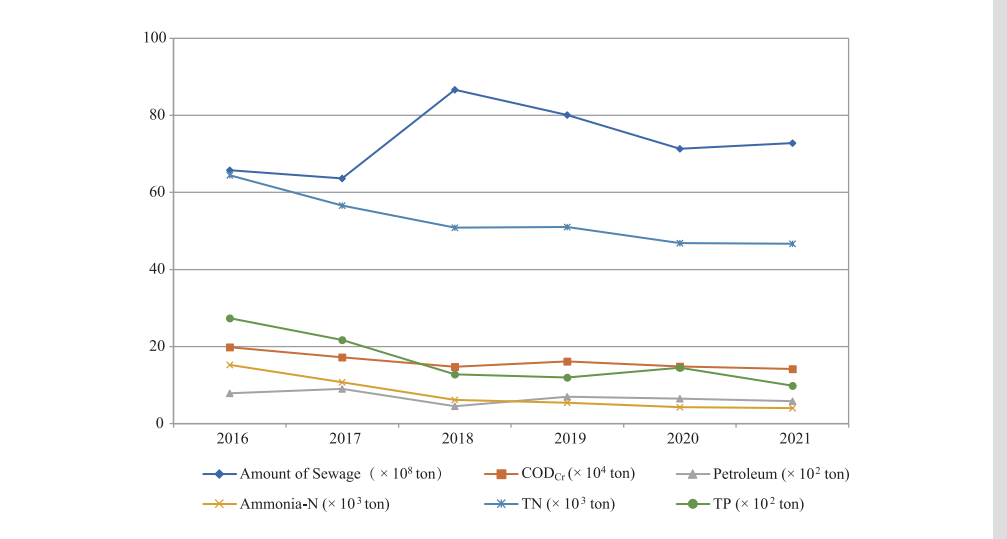
3.2 Pollutant Discharge Outlets

In 2021, 458 of industrial sewage outlets, domestic sewage outlets, and comprehensive sewage outlets with daily discharge volume exceeding or equal to 100 tons were monitored.

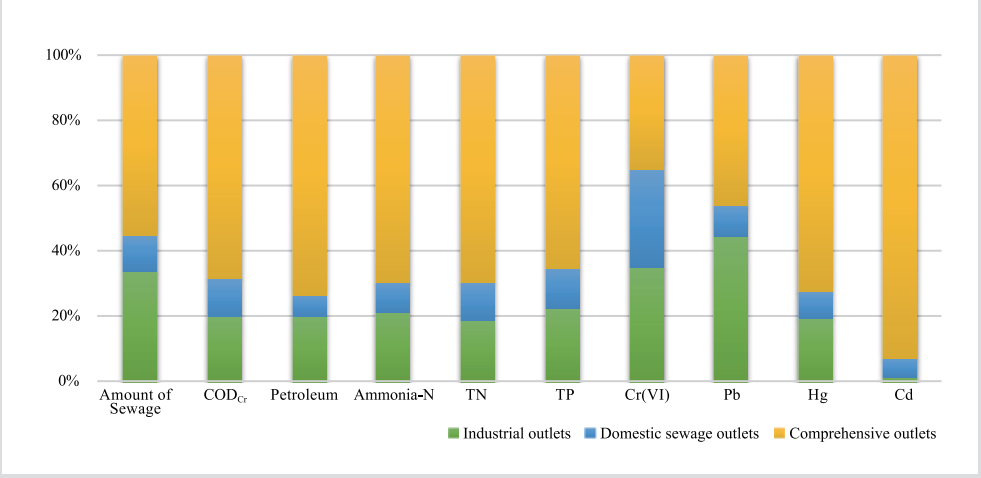
The total sewage discharge amount of 458 monitored outlets was approximately 7.27788 billion tons. Among various types of sewage outlets into the sea, comprehensive outlets contributed the largest amount of sewage, followed by industrial outlets, and domestic sewage outlets the smallest. Among all the monitored pollutants, except Cr(VI), the amount of pollutants of the comprehensive outlets was the largest.

Discharge amount of sewage and major pollutants from different types of seaward sewage outlets in 2021

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	217	246,135	28,253	116	866	8,839	221	700.4	2,537.5	64.3	13.8
Domestic sewage outlets	55	80,602	16,315	39	372	5,310	118	601.7	542.4	27.7	61.5
Comprehensive outlets	186	401,051	97,273	428	2,818	32,512	644	689.8	2,610.3	240.9	966.1

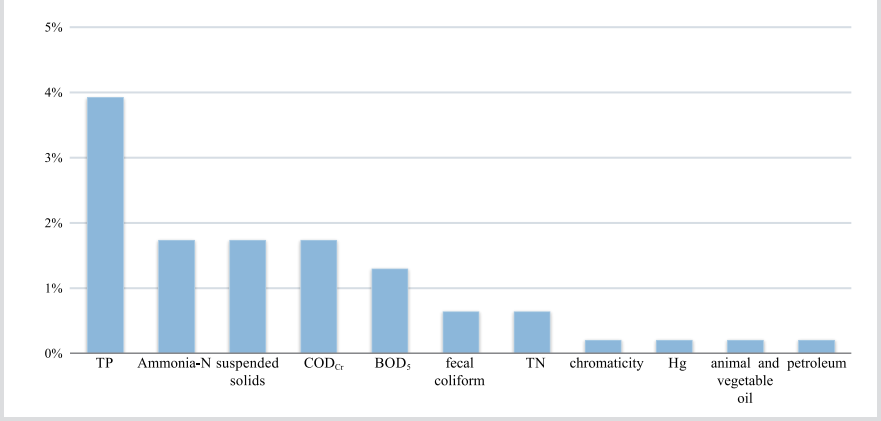


Discharge amount of sewage and major pollutants from seaward sewage outlets nationwide from 2016 to 2021



Proportion of sewage and major pollutants from different types of seaward sewage outlets in 2021

In some sewage outlets, content of TP, ammonia-N, suspended solids, COD_{Cr}, BOD_5, fecal coliform, TN, chromaticity, Hg, animal and vegetable oil and petroleum failed to meet the water quality standard. Other pollutants did not exceed the standard.



Exceeding proportion of pollutants discharged from seaward sewage outlets in 2021

Among the four major sea areas, the East China Sea received the largest amount of sewage, followed by the South China Sea and the Yellow Sea.

Among the coastal provinces (autonomous regions and municipalities), Zhejiang had the largest amount of sewage, followed by Fujian and Shandong.

Total amount of sewage and major pollutants from sewage outlets received by different sea areas in 2021

Sea Area	Number of Sewage outlets	Amount of Sewage ($\times10^4$ ton)	COD_{Cr} (ton)	Petroleum (ton)	Ammonia-N (ton)	TN (ton)	TP (ton)	Cr (VI) (kg)	Pb (kg)	Hg (kg)	Cd (kg)
Bohai Sea	62	70,412	6,820	32	195	2,590	82	227.2	2,802.0	58.3	11.3
Yellow	80	89,719	21,855	119	543	6,416	162	400.4	972.2	87.2	99.0
East China	166	419,588	79,228	377	2,070	27,343	477	686.3	1,215.5	111.4	899.1
South	150	148,070	33,938	55	1,249	10,312	262	678.0	700.6	76.0	32.0

Total discharge amount of sewage and major pollutants from sewage outlets into the sea in coastal provinces (autonomous regions and municipalities) in 2021

Province	Number of Sewage outlets	Amount of Sewage ($\times10^4$ ton)	COD_{Cr} (ton)	Petroleum (ton)	Ammonia-N (ton)	TN (ton)	TP (ton)	Cr (VI) (kg)	Pb (kg)	Hg (kg)	Cd (kg)
Liaoning	31	5,814	1,539	22	12	195	6	—	—	—	—
Hebei	6	47,420	634	—	18	1,138	44	10.0	1,435.9	10.8	2.3
Tianjin	16	5,715	1,116	3	23	316	7	79.4	15.9	2.2	4.1
Shandong	69	92,627	22,821	106	658	6,873	169	480.2	2,320.2	121.0	87.0
Jiangsu	20	8,556	2,565	20	28	483	18	58.1	2.2	11.4	16.9
Shanghai	10	27,597	6,111	23	152	1,974	34	—	70.2	36.6	10.8
Zhejiang	104	202,221	55,507	209	1,353	17,160	271	311.2	1,065.6	63.6	845.0
Fujian	52	189,769	17,611	145	565	8,208	172	375.1	79.6	11.2	43.3
Guangdong	72	91,188	18,840	35	505	5,687	132	626.8	510.5	30.0	13.2
Guangxi	41	20,177	4,771	14	174	1,506	46	27.3	147.7	17.1	18.0
Hainan	37	36,705	10,328	6	570	3,120	84	23.9	42.3	28.8	0.8

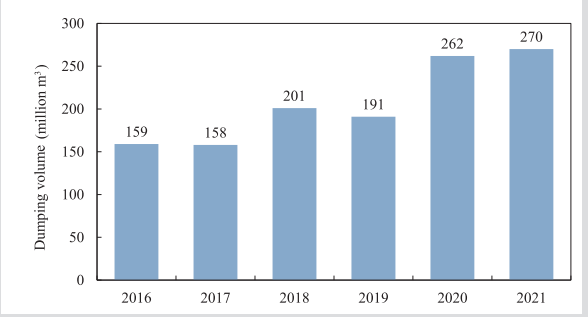
Note: "—" means the corresponding pollutant concentration is lower than the detection limit or monitoring is not carried out.

4 Environmental Status of Four Types of Marine Utilization Areas

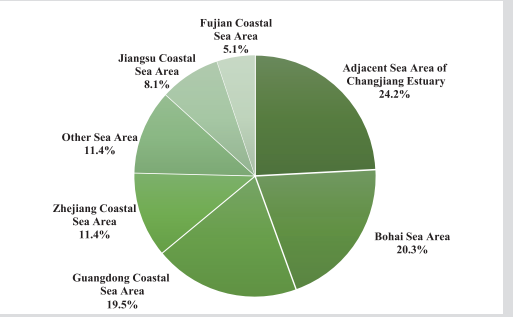
4.1 Ocean Dumping Zones

The total volume of waste and other matter for ocean dumping in 2021 amounted to 270.04 million m^3, increasing by 3.2% compared with the previous year. The main dumping was cleansing and dredged materials.

In 2021, the seawater qualities met or were better than the Seawater Quality Standard Grade III in the monitored and assessed dumping zones and their adjacent sea areas, and the sediment qualities met or were better than Marine Sediment Quality Standard Grade II. The water depth as well as the seawater quality and the sediment quality of the dumping zones remained stable compared with previous year. The dumping did not have apparent impact on the ecology and environment of the adjacent sea areas and other marine activities.



Volume of waste and other matter dumped at seas of China from 2016 to 2021



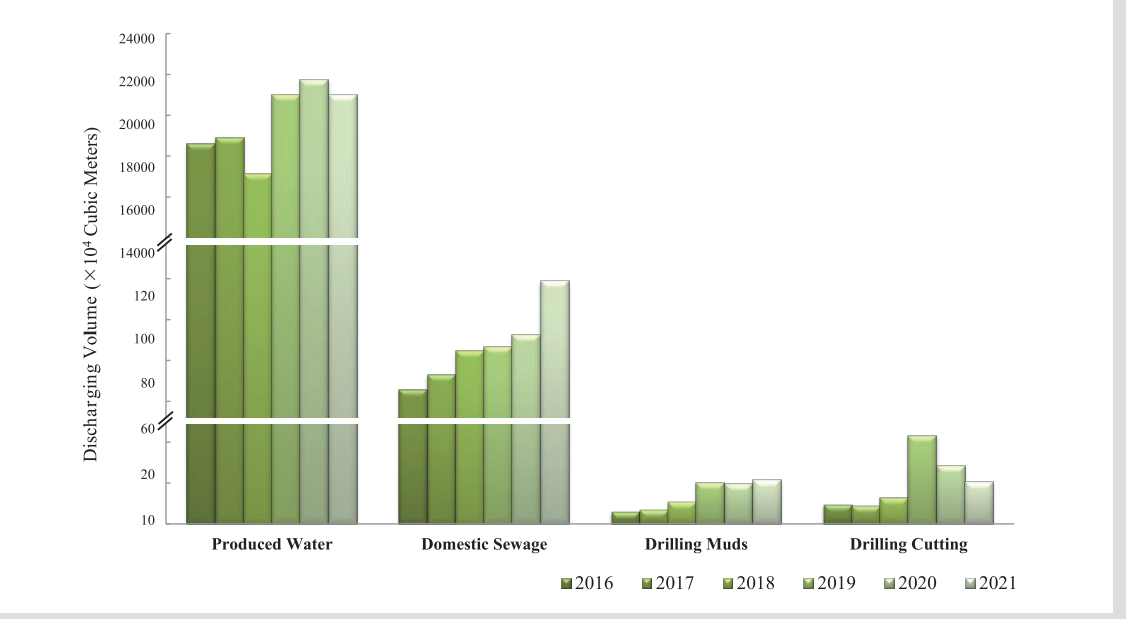
Proportion of dumping volume at different sea areas in 2021

Distribution of dumping zones nationwide in 2021

4.2 Oil/Gas Exploration Zones

In 2021, the volumes of produced water and drilling cuttings discharged into seas from offshore oil/gas platforms were about 209.82 million m^3 and 103,000 m^3 respectively, which decreased by 3.4% and 26.9% respectively compared with the previous year. Meanwhile, the volumes of domestic sewage and drilling muds discharged into seas were about 1,187,000 m^3 and 108,000 m^3, which increased by 28.4% and 11.2% respectively compared with the previous year.

In 2021, the marine environmental status of the most offshore oil/gas exploration zones and their adjacent sea areas in the Bohai Sea and East China Sea were monitored. The results showed that the petroleum and cadmium content in seawater met the Seawater Quality Standard Grade I in the monitored areas of the Bohai Sea, meanwhile, in some offshore oil/gas exploration zones of the Bohai Sea, COD or mercury content in seawater met the Seawater Quality Standard Grade II. The water qualities of the offshore oil/gas exploration zones in the East China Sea met Seawater Quality Standard Grade I.

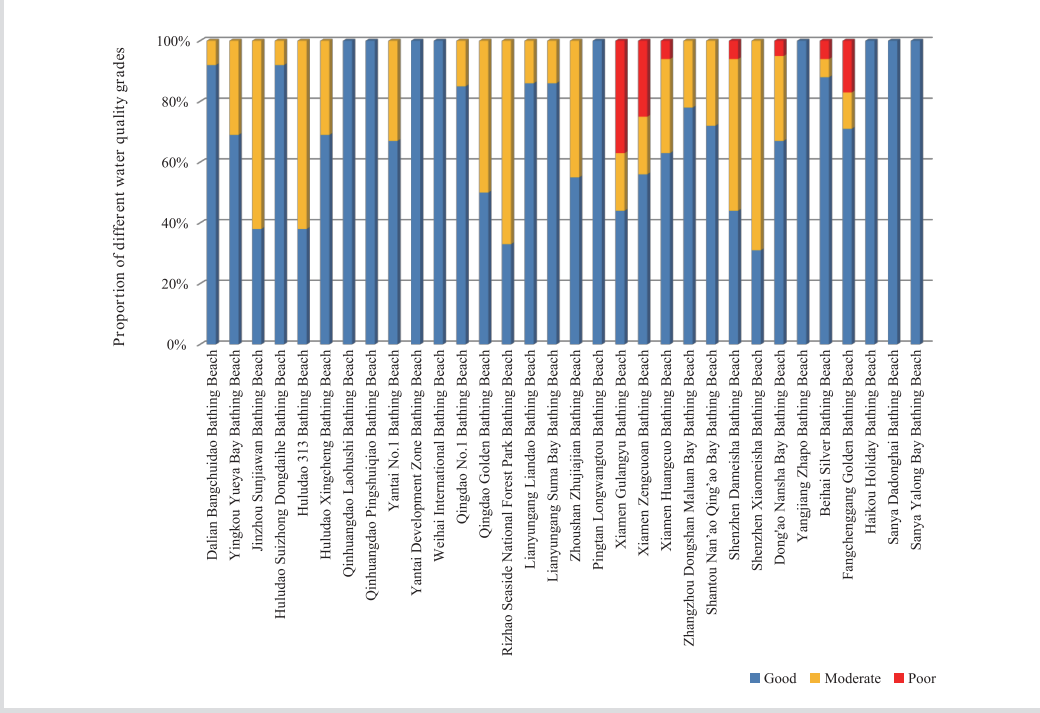


Volume of pollutants discharged into seas from offshore oil/gas platforms from 2016 to 2021

4.3 Bathing Beaches

In the swimming season of 2021, the water quality of 32 bathing beaches was monitored.

During the monitoring period, the water quality* of the 9 bathing beaches was rated as Good for each sampling, that of 16 bathing beaches was rated as Good or Moderate, and that of 7 bathing beaches was occasionally rated as poor. Among them, Qinhuangdao Laohushi Bathing Beach, Qinhuangdao Pingshuiqiao Bathing Beach, Yantai Development Zone Bathing Beach, Weihai International Bathing Beach, Pingtan Longwangtou Bathing Beach, Yangjiang Zhapo Bathing Beach, Haikou Holiday Bathing Beach, Sanya Dadonghai Bathing Beach and Sanya Yalong Bay Bathing Beach were in good seawater quality. Xiamen Gulangyu Bathing Beach, Xiamen Zengcuoan Bathing Beach, Xiamen Huangcuo Bathing Beach, Shenzhen Dameisha Bathing Beach, Dong'ao Nansha Bay Bathing Beach, Beihai Silver Bathing Beach and Fangchenggang Golden Bathing Beach were occasionally in poor seawater quality. The water quality was mainly impacted by fecal coliform, and some bathing beaches were impacted by floating seagrass.



Status of water quality of bathing beaches in coastal cities of China in 2021

*Water quality of Bathing Beaches:
Good: all indicators meet the requirements of "Good";
Moderate: at least one indicator meets the requirements of "Moderate", and no indicator indicates "poor";
Poor: at least one indicator meets the requirements of "Poor".

4.4 Marine Fishery Areas

In 2021, monitoring programs were implemented in 32 fishery areas, including spawning grounds, feeding grounds, migration routes, key protected aquatic habitats as well as aquatic germplasm resources reserves, covering 5.475 million ha.

The dominant pollution indicator that exceeded the seawater quality standards of key marine natural fishery areas was inorganic nitrogen. The proportions of areas meeting the seawater quality standards for content of inorganic nitrogen, active phosphate, petroleum, COD, and copper accounted for 40.9%, 53.4%, 100%, 84.5% and 99.95% of the total monitored areas respectively. Compared with the previous year, the proportions of areas with exceeding COD increased, while which with exceeding inorganic nitrogen, active phosphate and petroleum decreased.

The dominant pollution indicator that exceeded the standard in the water bodies of the key marine aquaculture areas was inorganic nitrogen. The proportion of water areas meeting the standard value for content of inorganic nitrogen, active phosphate, petroleum, COD and copper were 57.9%, 65.7%, 100%, 100% and 100% of the total monitored areas respectively. Compared with the previous year, the proportions of areas with exceeding active phosphate increased, while those with exceeding inorganic nitrogen, petroleum, COD and copper decreased.

The total monitored area for 7 National Aquatic Germplasm Resources Conservation Areas (marine) was 281,000 ha. The dominant pollution indicator was inorganic nitrogen. The proportion of areas meeting the standard value for content of inorganic nitrogen, active phosphate, petroleum, COD and copper were 37.6%, 72.4%, 100%, 66.4% and 99.8% of the total monitored areas respectively. Compared with the previous year, the proportions of areas with exceeding COD and copper increased, while those with exceeding inorganic nitrogen, active phosphate and petroleum decreased.

Sediments in the 21 key marine fishery areas were in Good condition. The proportions of areas meeting the standards for content of petroleum, copper, zinc, lead, cadmium, chromium, mercury, and arsenic accounted for 98.8%, 94.2%, 100%, 100%, 97.6%, 88.5%, 100% and 100% of the total monitored areas respectively. Compared with the previous year, the proportions of areas with exceeding petroleum, copper, cadmium, and chromium increased, while those with exceeding zinc decreased.

Among 17 monitored coastal fishing port along the Yellow-Bohai Sea and South China Sea, the proportion of fishing ports with content of inorganic nitrogen, active phosphate, and COD in seawaters meeting the standard value were 64.7%, 88.2% and 88.2%, respectively, and the average contents of petroleum, copper, zinc, lead, cadmium, mercury, arsenic and chromium in seawaters met standard value. The proportions of fishing ports meeting the standards for content of petroleum in sediment accounted for 90.9%, and the average contents of copper, zinc, lead, cadmium, mercury, arsenic and chromium in sediment met standard value.

5 Actions and Measures

5.1 Formulate and issue *the Marine Ecological and Environmental Protection Plan during the 14th Five-Year Plan Period*

In order to systematically plan for marine ecological and environmental protection and to put related measures into effect during the 14th Five-Year Plan period, the Ministry of Ecology and Environment, the National Development and Reform Commission, the Ministry of Natural Resources, the Ministry of Transport, the Ministry of Agriculture and Rural Affairs and the China Sea Police jointly formulated and published *the Marine Ecological and Environmental Protection Plan during the 14th Five-Year Plan Period (the Plan)*. The Plan, guided by the Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, is to thoroughly implement Xi Jinping Thought on Ecological Civilization. Oriented by solving the prominent problems in the marine ecological environment, the Plan takes the continuous improvement of the marine ecological environment as its core objective, focuses on building a beautiful bay, and will pay more attention to the public's demand for access to the sea, to overall protection and comprehensive governance, to demonstration projects' leading role and building long-term mechanism, to scientific and technological innovation and governance capacity improvement, as well as to in-depth participation in global marine ecological and environmental governance. On this basis, the main targets during the 14th Five-Year Plan period and the long-term goals for 2035 for marine ecological and environmental protection have been identified, and key tasks, such as land and sea pollution sources treatment and restoring typical marine ecosystems have been put forward.

5.2 Continue to carry out comprehensive treatment of key sea areas

In order to resolutely implement the decision and plans by the Party Central Committee and the State Council on deepening the battle against pollution with the comprehensive treatment of key sea areas as focus, the Ministry of Ecology and Environment, the National Development and Reform Commission, the Ministry of Natural Resources, the Ministry of Housing and Urban-Rural Development, the Ministry of Transport, the Ministry of Agriculture and Rural Affairs and the China Sea Police jointly formulated and released *the Action Plan for Comprehensive Treatment of Key Sea Areas*. To thoroughly implemented Xi Jinping Thought on Ecological Civilization, the Action plan is oriented by solving prominent ecological and environmental problems in Bohai Sea, Yangtze River Estuary & Hangzhou Bay and the pearl River Estuary. The Action Plan is formulated based on three key sea areas' marine ecological environment, natural endowment and development direction, and is adhere to the general tone of

seeking progress while maintaining stability. The Action Plan focuses on the prevention and control of land and sea pollution, ecological protection and restoration, prevention of environmental risks and building beautiful bays. Oriented by the idea of "one district, one policy", 10 key tasks are set including the investigation and regulation of sewage outlets into the sea and the improvement of water quality of rivers into the sea, striving to realize the continuous improvement of the ecological environment of the three key sea areas.

5.3 Optimize and improve the marine ecological monitoring and evaluation system

In 2021, the MEE further optimized and improved the marine ecological monitoring and evaluation system. Steps included 1) build a technical and methodological system for marine carbon monitoring and assessment. In September 2021, the MEE issued the *Carbon Monitoring and Assessment Pilot Work Program* and selected Panjin, Nantong, Shenzhen, and Zhanjiang as pilot coastal cities to monitor and assess salt marsh, mangrove, seagrass beds, and seaweed farming carbon sinks. 2) carry out the pilot monitoring of environmental DNA to improve the level of monitoring of marine biodiversity. A total of 27 monitoring sites were set up in the Yalujiang Estuary, and 46 species of fish in 14 orders, 24 families, and 43 genera were detected by using environmental DNA technology. 3) gain progress in the monitoring and supervising of coastal zone ecological quality. Based on the *Regional Ecological Quality Evaluation Method* (*on Trial*) issued by the MEE in October 2021, marine ecological protection & restoration, and development and utilization assessment of the coastal areas at county level was carried out. In 2021, the ecological quality of natural marine shorelines and sea space was stable.

5.4 Carry forward conservation of marine nature reserve and important coastal wetlands

Interpretation of satellite remote sensing image of suspected illegal constructions, for the first time with a full coverage of wetlands of international importance, wetlands of national importance, and national wetland parks was conducted by the State Forestry and Grassland Administration, which strengthened local governments' efforts on the rectifications of illegal constructions. Based on wetland patches' recognized importance in terms of ecological function on the national and regional scale, the classification of conservation value was set. Analysis reports of wetland conservation gaps in Liaohe River Delta and other important areas in 12 provinces was issued, and then wetland conservation was strengthened in various format. *Interim Admonition Measures of the State Forestry and Grassland Administration on Wetland Protection* were formulated. *Technical Guidelines for Marine Ecological Restoration (on Trial)* issued by the Ministry of Natural Resources will improve the scientific and normative ecological remediation of typical marine ecological systems including mangroves, salt marshes, seagrass beds, seaweed farms, coral reefs and oyster reefs, as well as integrated ecological systems including shorelands, estuaries, bays, and islands. The Ministry of Natural Resources and the State Forestry and Grassland Administration jointly issued the *Hand-*

book of Mangrove Ecological Restoration, which guided the local governments of Zhejiang, Fujian, Guangdong, Guangxi, and Hainan to carry out *Special Action Plan for Mangrove Conservation and Restoration (2020-2025)* and strengthen mangrove conservation and restoration. Technical guidelines for coastal zone conservation and restoration projects were revised and improved, which strengthened local governments' ability to resist storm surges and other disasters by conducting ecological conservation and restoration projects.

5.5 Continue to improve the protection and restoration of fishery resources

First, adjust and improve the system of summer fishing moratorium. In a comprehensive and balanced way, taking into account the current situation of fishery resources, fishermen's production and living conditions, and local supervision capacity, further optimize and improve the system of summer fishing moratorium, to unify the duration of fishing moratorium in waters to the south of 26.5°N. Introduce the policy of subsidies for the conservation of marine fishery resources, which explicitly laid out the policy to provide appropriate subsidies to domestic marine fishing vessels that implement conservation measures such as fishing moratorium in accordance with laws and regulations, and resolved the difficulties of fishermen during the fishing moratorium. Second, promote the construction of modern marine ranches. In 2021, the seventh batch of 17 national marine ranch demonstration areas were selected, and the total number of national marine ranch demonstration areas reached 153. At the same time, the construction of marine ranches will be included in the support scope of the "14th Five-Year plan" fishery development subsidy policy. Carry out annual evaluation and review of national-level marine pasture demonstration areas and strengthen supervision and management of such areas. Third, organize activities of proliferation and release of aquatic organisms. Nearly 398.5 million RMB was allocated from the central financial funds, mobilizing about 1 billion RMB nationwide, and more than 30 billion aquatic organisms were released. While improving China's offshore fishery resources and enhancing the stability of the species structure of marine economic fish, the overall income of fishermen has also seen an increase.

5.6 Strengthen the supervision of the mariculture ecological environment

In order to comprehensively strengthen the supervision of mariculture ecological environment, further resolving problems of environmental pollution and ecological damage caused by the irregular development in certain areas, the MEE and the Ministry of Agriculture and Rural Affairs jointly formulated and issued *the Opinions on Strengthening Supervision of the Ecological Environment of Mariculture*. The opinions focus on improving the quality of marine ecological environment, adhere to the principle of "zoning and classification, adjusting measures to local conditions and gradually carry forward measures". The Opinion stands on aspects of strengthening environmental assessment management, optimizing spatial layout, establishing sewage outlet information ledger, promoting sewage outlet

classification and regulation, formulating discharge standards, promoting tail water monitoring, implementing classified supervision, strengthening law enforcement inspection, strengthening policy support, strengthening organization and implementation, publicity and guidance, work together with relevant departments to protect the ecological environment and ensure the supply of seafood, help protect and build beautiful bays, and promote high-quality development of mariculture.

5.7 Reinforce the supervision and management of marine projects and ocean dumping

In 2021, MEE strictly conducts the examination and approval of marine projects and positively ensure "six priorities" and stability in six areas so as to orderly promote the coordinated development of environment and economics. To regulate EIA approval for marine engineering construction projects, MEE formulated *EIA Approval Principles for Marine Reclamation Projects* and *EIA Approval Principles for Submarine (Optical) Cable Projects*. In strict accordance with *Catalogue for the Classified Administration of Environmental Impact Assessments for Construction Projects (2021)*, MEE conducted classified management for marine construction projects. In the meantime, MEE took measures to reinforce the supervision and management of and the public service for ocean dumping, including the formulation of *National Plan of Ocean Dumping Sites (2021-2025)*. MEE approved 10 new-delimitated dumping sites and carries out capacity assessment of dumping sites, securing the construction and operation of port and shipping projects. MEE also deployed various off-site supervision techniques including AIS, satellites, and unmanned aerial vehicle in an integrated manner in order to strengthen the ecological and environmental protection and reinforce the supervision and management of ocean dumping and marine engineering including offshore oil and gas exploration and exploitation.

5.8 Collect excellent cases of building beautiful bay

In order to promote building beautiful bay, to provide good experience and practices for the whole country for reference, and create a good atmosphere of "learn from example, set a standard, set an example and set goals" for building beautiful bay, the MEE organized the collection of excellent cases of building beautiful bay in 2021. Among the 39 cases collected in 2021, 8 cases include Lingshan Bay of Qingdao, Beidaihe Section of Qinhuangdao Bay, Tiaozini section of Yancheng Dongtai, Qing'ao Bay of Shantou, Binhai New Town section of Fuzhou, Dapeng Bay of Shenzhen, bays of Dongtou of Wenzhou and Jinshitan Bay of Dalian, have brought various innovative practices and refined many effective models in aspects including comprehensive management of the bay, long-term supervision of marine ecological environment and improvement of the quality of marine environment for the public's access, and thus to be selected as the excellent case and nominated case of building beautiful bay.

Data Sources and Explanations for Assessment

The Bulletin of the Marine Ecology and Environment Status of China in 2021 was jointly compiled by the Ministry of Ecology and Environment, Ministry of Natural Resources, Ministry of Transport and Ministry of Agriculture and Rural Affairs, and National Forestry and Grassland Administration. The Bulletin was published by the Ministry of Ecology and Environment. Status of marine environmental quality, health of typical marine ecosystems, the ecological environment of marine natural protected areas, main pollution sources into the sea, bathing beaches, ocean dumping zones and oil/gas exploration zones were monitored and assessed by the Ministry of Ecology and Environment. Data on red tide and green tide were provided by the Ministry of Natural Resources. Data on the environmental quality of marine natural fishery areas were provided by the Ministry of Agriculture and Rural Affairs. The relevant information on the protection and management of marine nature reserves and important coastal wetlands was provided by the National Forestry and Grassland Administration.

The assessment of the seawater quality and eutrophication status of the sea areas under jurisdiction of China was based on the data collected from national monitoring sites in the summer. The assessment of the water quality of nearshore sea areas and major gulfs was based on the data collected from national monitoring sites in the spring, summer and autumn. The overall assessment is based *on Seawater Quality Standard (GB 3097-1997), Technical Specification for Offshore Environmental Monitoring Part 10 Evaluation and Report (HJ 442.10-2020),* and the methodology adopted is guided by *The Technical Regulations for Seawater Quality Evaluation (on Trial) (Marine Environmental Character No. 25 [2015]).*

The assessment for marine litter was based on *Guideline for Monitoring and Assessment of Marine Litter (on Trial) (Marine Environmental Character No. 31 [2015])*. The assessment for marine microplastics was based on *Technical Specifications for Marine Microplastics Monitoring (on Trial) (Marine Environmental Character No. 13 [2016])*. The evaluation of the radioactivity level of the marine environment is based *on Seawater Quality Standards (GB 3097-1997)* and *Restricted Concentration Standards of Radioactive Substances in Foods (GB 14882-1994).*

The typical marine ecosystem health assessment is based on the *Guidance for the Assessment of Coastal Marine Ecosystem Health (HY/T 087-2005)*. The data of marine biodiversity was from *the Living Species and their Illustrations in China's Seas, Catalogue of Life China 2021 Annual Checklist, and List of National Key Protected Wild Animals in China*. The ecological status of marine natural protected areas was assessed by using comparative analysis methods for evaluation with data monitored this and previous year. The assessment method for the ecologi-

cal environment status was based on *Standard for Conservation Effectiveness Assessment of Ecology and Environment in Nature Reserve (on Trial) (HJ 1203-2021)*.

Evaluation of Riverine Source was conducted according to *Environmental Quality Standards for Surface Water (GB 3838-2002)* and *Assessment of Environmental Quality for Surface Water(on Trial) (Marine Environmental Character No. 22 [2011])*. The evaluation indexes of water pollution sources directly discharged into the sea include all indicators applied to the current regulation over sewage outlets. The evaluation was conducted according to the standards of corresponding sewage outlets.

The environmental assessment for marine dumping zones was based on *Seawater Quality Standard (GB 3097-1997)*, and *Marine Sediment Quality (GB 18668-2002)*. The environmental assessment for the offshore oil/gas exploration zones was based on the *Technical Guidelines for Environmental Impact Assessment of Marine Engineering (GB/T 19485-2014)*, and *Seawater Quality Standard (GB 3097-1997)*. The assessment of the water quality of bathing beaches was based on *Seawater Quality Standard (GB 3097-1997),* and *Guideline for Marine Bathing Beach Monitoring and Assessment(HY/T 0276-2019)*.

The national statistics used in this bulletin does not include those of Taiwan Province, Hong Kong Special Administrative Region and Macao Special Administrative Region, except those data on administrative division and national territory area.

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