2022

Bulletin of Marine Ecology and Environment Status of China

Ministry of Ecology and Environment
People's Republic of China

The Bulletin of Marine Ecology and Environment Status of China in 2022 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
Ministry of Ecology and Environment
People's Republic of China

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CONTENTS

Overview

In 2022, under the guidance of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, all localities and departments comprehensively studied and implemented the guiding principles of the 20th National Congress of the Communist Party of China (CPC), 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 CPC Central Committee and the State Council, the new development concept has been fully, accurately, and comprehensively implemented, and the construction of a new development pattern has been accelerated, with focuses on addressing prominent issues in the marine ecological environment, and improving the quality of the marine ecological environment. The marine ecological environment protection and governance system has been continuously improved, and the battle of comprehensive governance of key sea areas has had a smooth start, with a new phase opened in building beautiful bays and beautiful oceans.

In 2022, we monitored seawater quality in 1,359 national monitoring sites, 230 riverine sections flowing into the sea, 457 sewage outlets with daily discharge volume exceeding or equal to 100 tons. We also monitored the ecological status of 24 typical marine ecosystems. Environmental monitoring was carried out on 56 ocean dumping zones, 20 offshore oil/gas exploration zones, 32 bathing beaches, and 35 marine fishery areas.

The monitoring results showed that China's marine ecology environment status was steady with sound improvement in 2022. The overall quality of marine water environment remains stable, with 97.4% of the marine water under jurisdiction of China meeting the Seawater Quality Standard Grade I. 81.9% of the coastal area had excellent or good water quality (meeting Grade I and Grade II standards), up by 0.6 percentage point compared with last year. The polluted areas were mainly located at Liaodong Bay, Bohai Bay, Laizhou Bay, Yangtze River Estuary, Hangzhou Bay, and Pearl River Estuary. The dominant pollution indicators were inorganic nitrogen and active phosphate. 7 typical Marine ecosystems were in a healthy state, 17 were in a sub-healthy state, and none were unhealthy. The water quality of all the monitored sea-entering rivers was good on the whole. The overall environmental quality of ocean dumping zones and oil/gas exploration zones was basically stable, and the water quality of bathing beaches and marine fishery waters was generally good.

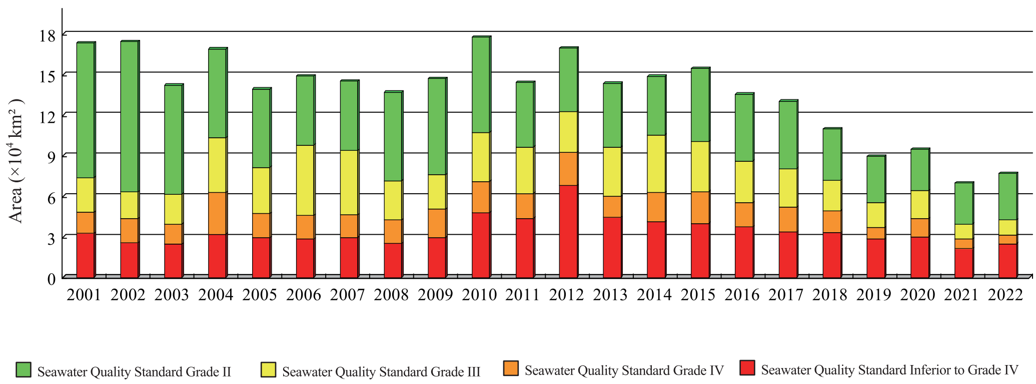
1 Marine Environmental Quality

1.1 Seawater Quality

1.1.1 Water Quality of Sea Areas under Jurisdiction of China

In the summer of 2022, seawater quality in 1,359 state monitoring sites were monitored.

Sea area meeting the Seawater Quality Standard Grade I accounted for 97.4% of the total, which decreased by 0.3 percentage point from that in the previous year.



Total sea area under jurisdiction of China with water quality failing to meet the Seawater Quality Standard Grade I from 2001 to 2022

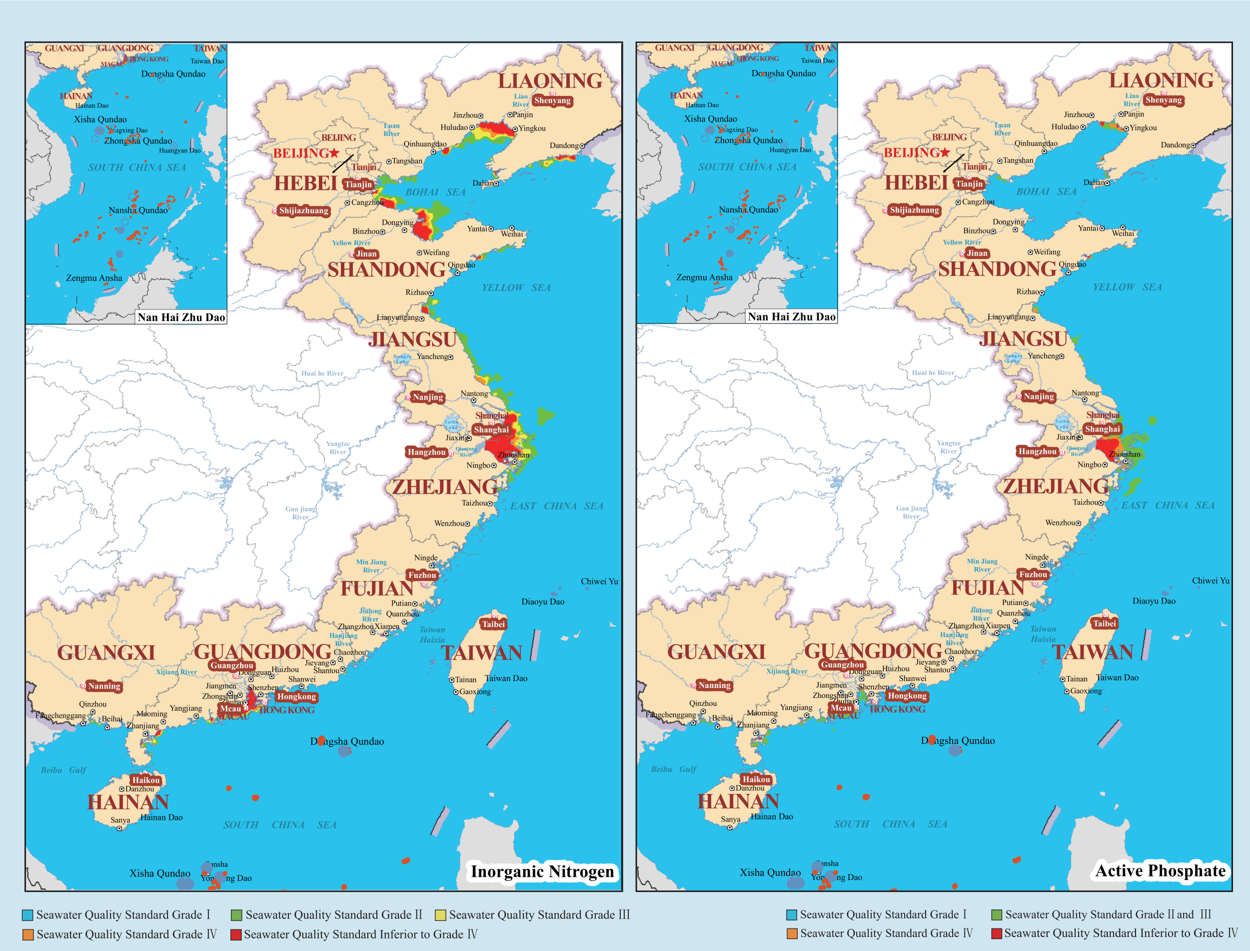
Seawater Quality Standard Grade Ⅰ Seawater Quality Standard Grade Ⅱ Seawater Quality Standard Grade Ⅲ
Seawater Quality Standard Grade Ⅳ Seawater Quality Standard inferior to Grade Ⅳ

Water quality status of sea areas under jurisdiction of China in 2022

The main pollution indicators were inorganic nitrogen and active phosphate.

The sea area with inorganic nitrogen content failing to meet the Seawater Quality Standard Grade I was 72,000 km². The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 30,850 km², 10,590 km² and 5,980 km², respectively. The area with water quality inferior to the Seawater Quality Standard Grade IV was 24,580 km² and mainly located at Liaodong Bay, Bohai Bay, Laizhou Bay, Yangtze River Estuary, Hangzhou Bay, and Pearl River Estuary.

The sea area with active phosphate content failing to meet the Seawater Quality Standard Grade I was 30,170 km². The area with water quality meeting the Seawater Quality Standard Grade II and III was 19,300 km², and that meeting the Seawater Quality Standard Grade IV was 4,800 km². The area with water quality inferior to the Seawater Quality Standard Grade IV was 6,070 km² and mainly located at Liaodong Bay and Hangzhou Bay.



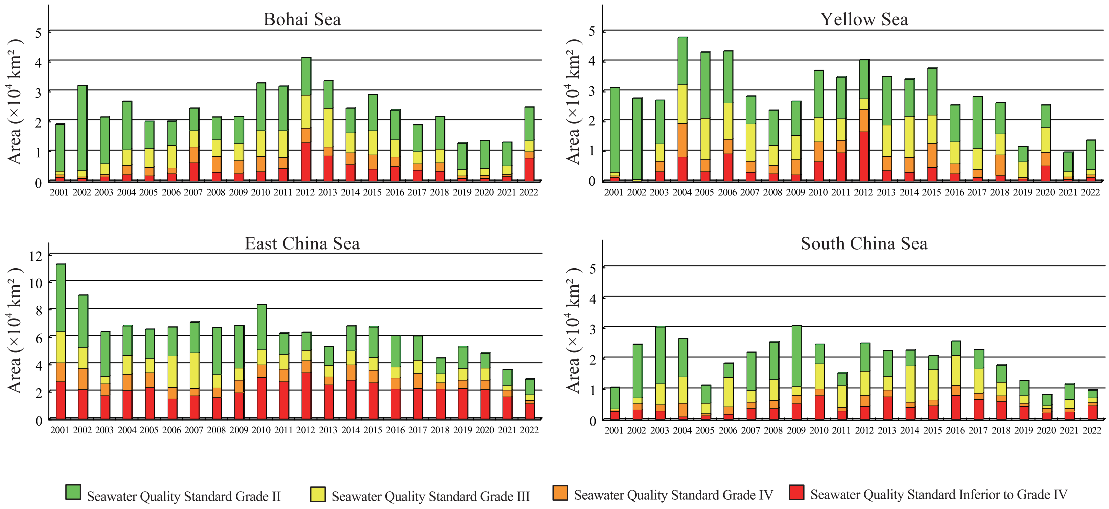
Seawater quality status in terms of inorganic nitrogen and active phosphate content in sea areas under jurisdiction of China in 2022

Bohai Sea The sea area with water quality failing to meet the Seawater Quality Standard Grade I was 24,650 km² , increased by 11,800 km² compared with that in the previous year. The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 10,910 km², 3,790 km² and 2,150 km², respectively. The sea area with water quality failing to meet Grade IV was 7,800 km² and mainly located at Liaodong Bay, Bohai Bay and Laizhou Bay.

Yellow Sea The sea area with water quality failing to meet the Seawater Quality Standard Grade I were 13,710 km², increased by 4,190 km² compared with that in the previous year. The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 9,850 km², 1,650 km² and 1,000 km², respectively. The sea area with water quality inferior to Grade IV was 1,210 km² and mainly located at the northern Yellow Sea and coastal waters of the Haizhou Bay.

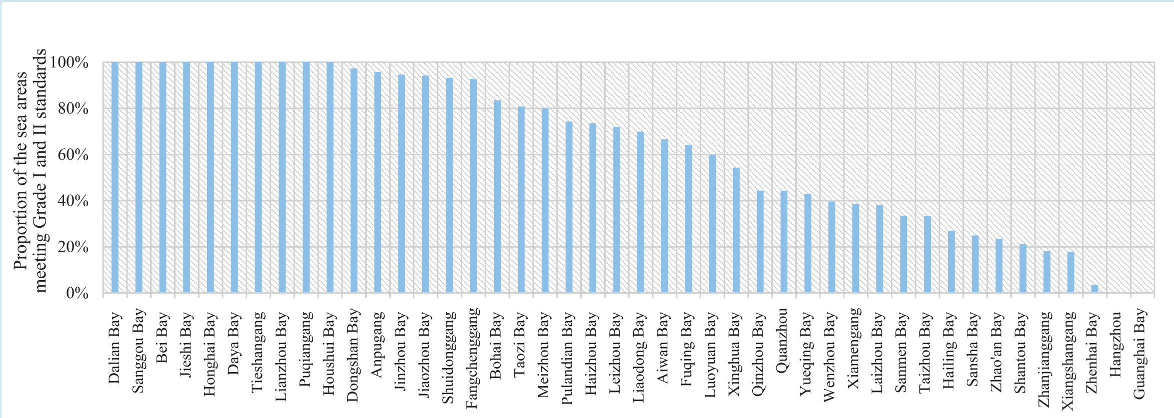
East China Sea The sea area with water quality failing to meet the Seawater Quality Standard Grade I was 28,940 km², decreased by 7,030 km² compared with that in the previous year. The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 11,190 km², 4,030 km² and 2,370 km², respectively. The sea area with water quality inferior to Grade IV was 11,350 km² and mainly located at Yangtze River Estuary and Hangzhou Bay.

South China Sea The sea area with water quality failing to meet the Seawater Quality Standard Grade I was 9,540 km², decreased by 2,120 km² compared with that in the previous year. The area with water quality meeting the Seawater Quality Standard Grade II, Grade III and Grade IV were 2,440 km², 1,560 km² and 1,020 km², respectively. The sea area with water quality inferior to Grade IV was 4,520 km² and mainly located at Pearl River Estuary.

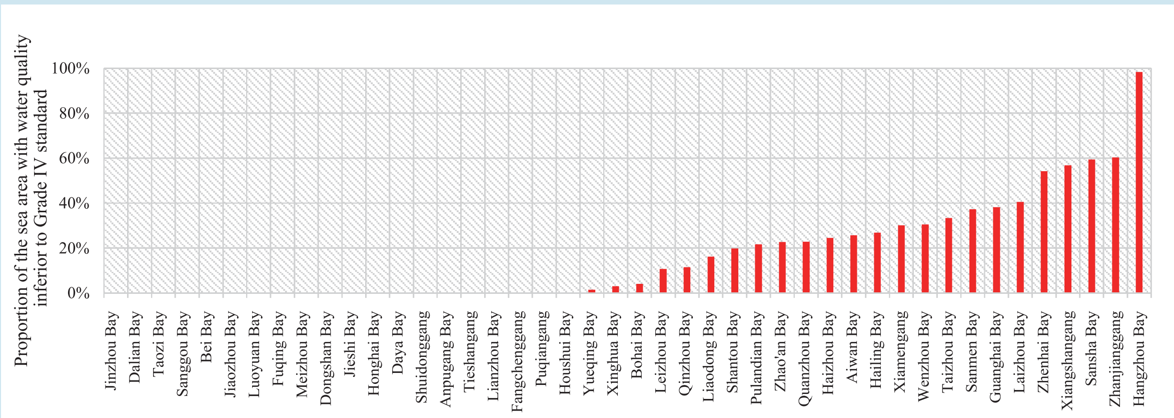


Various sea areas with water quality failing to meet the Seawater Quality Standard Grade I from 2001 to 2022

In 2022, among the 44 bays* larger than 100 km², 10 bays met Grade I and II standards in all three monitoring seasons (spring, summer and autumn)** , and 20 bays met Grade IV standard or above. The proportion of sea area meeting Grade I and II standards in 23 bays increased compared with that in the previous year, 11 bays remained almost at the same level, and 10 bays saw a decrease in that proportion.



The proportion of the sea areas meeting Grade I and II of Seawater Quality Standard in the 44 bays larger than 100 km²



The proportion of the sea areas with water quality inferior to Grade IV Standard in the 44 bays larger than 100 km²

* A bay refers to a sea area where the ocean penetrates deep into the land to form a distinct curve, surrounded by land and the area of which is no less than the semicircle area with the width of the entrance as diameter.

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

1.1.2 Seawater Quality of Coastal Areas

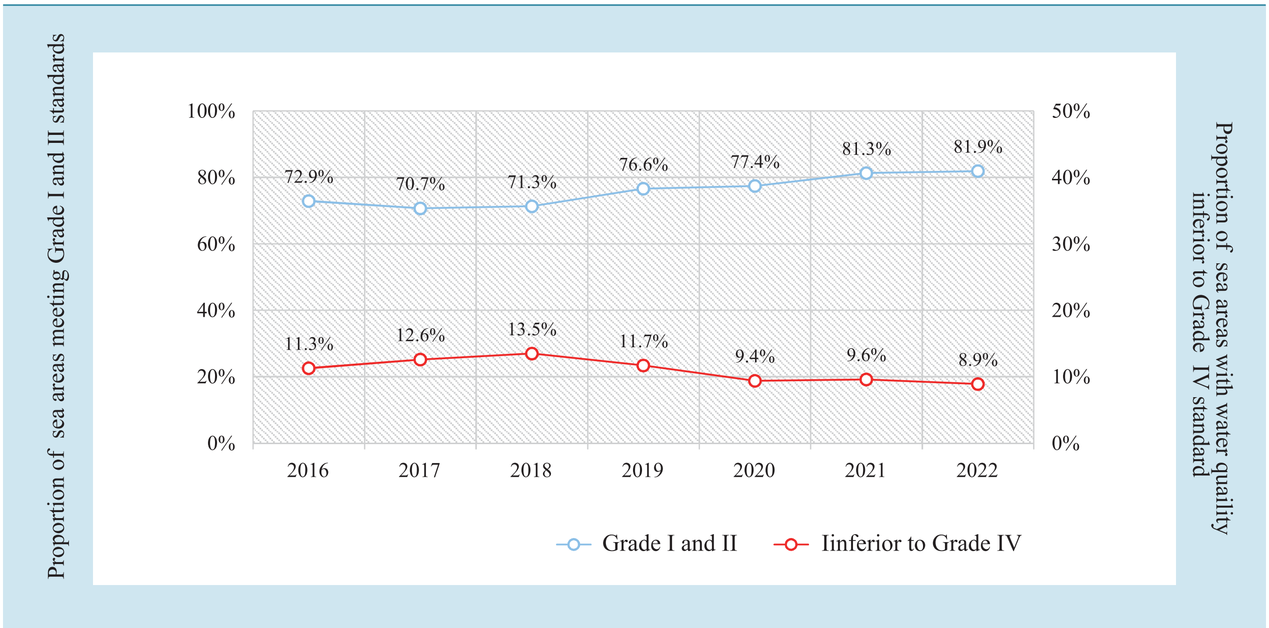
Seawater Quality of Coastal Areas

In 2022, the comprehensive assessment based on the monitoring conducted in spring, summer and autumn indicated that the seawater quality of coastal area was steadily improved. The proportion of seawater in coastal area meeting the Seawater Quality Standard Grade I and II accounted for 81.9%, which increased by 0.6 percentage point from that of the previous year, among which the sea area meeting the Grade I standard decreased by 4.9 percentage point and that meeting the Grade II standard increased by 5.5 percentage point from that of the previous year. The proportion of sea area with water quality inferior to Grade IV standard accounted for 8.9%, decreased by 0.7 percentage point compared with that of the previous year, and the main pollution indicators were inorganic nitrogen and active phosphate.

Proportion of the seawater in coastal areas at different quality standards in China in 2022 and their inter-annual variation

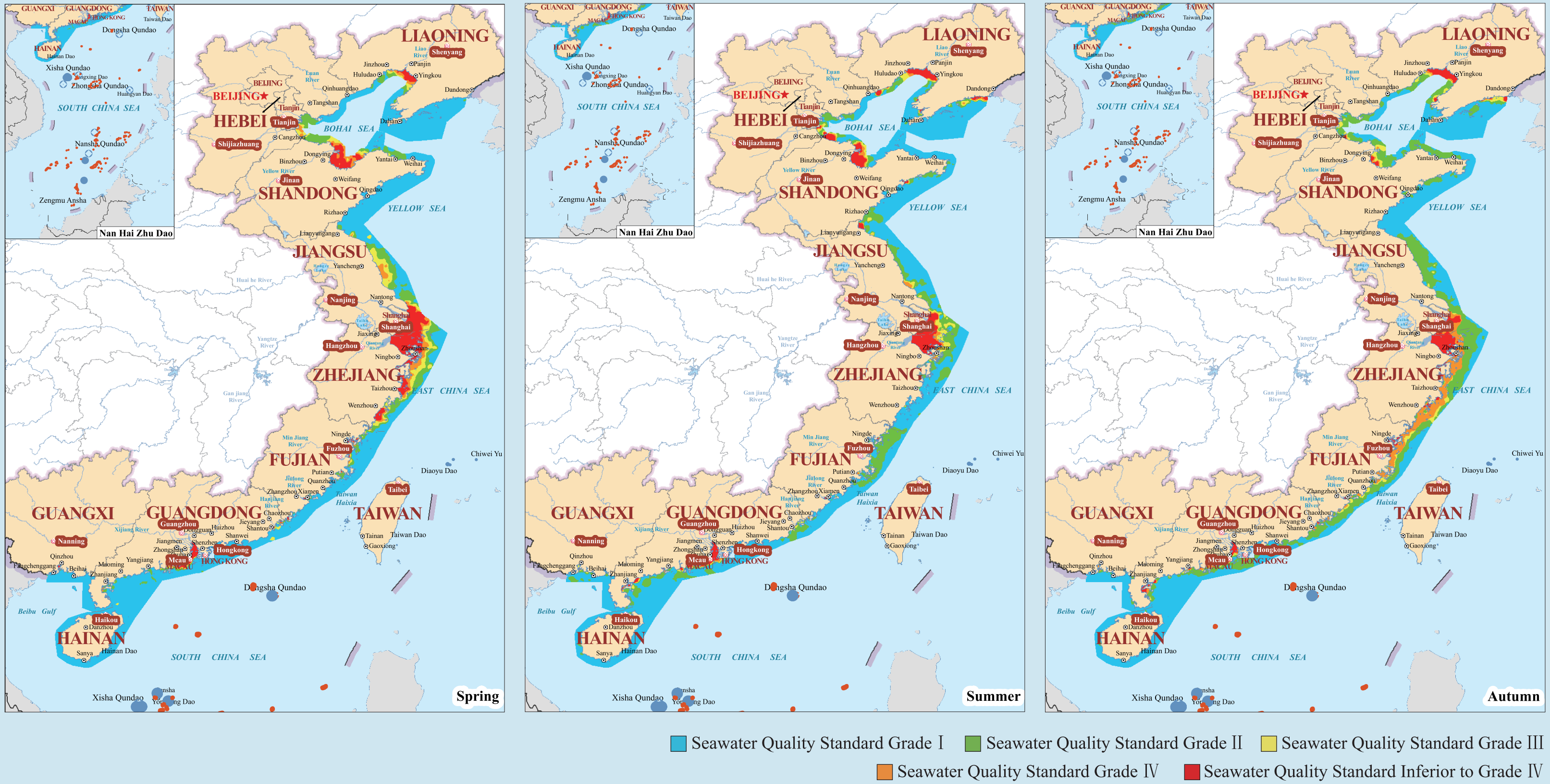
unit: %

Season	Year	Grade I	Grade II	Grade III	Grade IV	Inferior to Grade IV	Grade I and II
Spring	2022	66.4	12.7	5.6	4.3	11.0	79.1
	2021	73.3	8.6	5.4	3.7	9.0	81.9
Compared with the previous year		↓6.9	↑4.1	↓0.2	↑0.6	↑2.0	↓2.8
Summer	2022	66.7	19.0	3.4	2.1	8.8	85.7
	2021	70.8	15.5	4.0	2.4	7.3	86.3
Compared with the previous year		↓4.1	↑3.5	↓0.6	↓0.3	↑1.5	↓0.6
Autumn	2022	52.5	28.4	3.5	8.8	6.8	80.9
	2021	56.4	19.2	6.3	5.7	12.4	75.6
Compared with the previous year		↓3.9	↑9.2	↓2.8	↑3.1	↓5.6	↑5.3
Average	2022	61.9	20.0	4.1	5.1	8.9	81.9
	2021	66.8	14.5	5.2	3.9	9.6	81.3
Compared with the previous year		↓4.9	↑5.5	↓1.1	↑1.2	↓0.7	↑0.6



The proportion of the sea areas meeting Grade I and II of Seawater Quality Standard and inferior to Grade IV of Seawater Quality Standard in the coastal water areas from 2016 to 2022

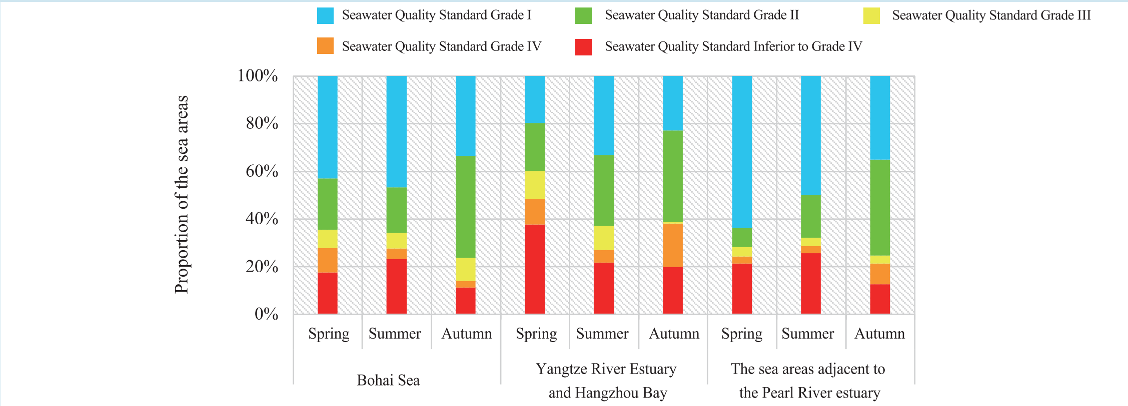
The sea area of coastal area with inorganic nitrogen content meeting the Seawater Quality Standard Grade I and II accounted for 82.6%, which increased by 0.6 percentage point from that in the previous year. The sea area with water quality inferior to Grade IV standard accounted for 8.6%, decreased by 0.6 percentage point compared with that in the previous year. The seawater of coastal area with active phosphate content meeting the Seawater Quality Standard Grade I and II accounted for 92.4%, which remained at the same level as that of the previous year. The sea area with water quality inferior to Grade IV standard accounted for 2.7%, increased by 0.2 percentage point compared with that of the previous year.



Seawater quality status of the coastal areas in China in 2022

Seawater Quality of Three key Areas*

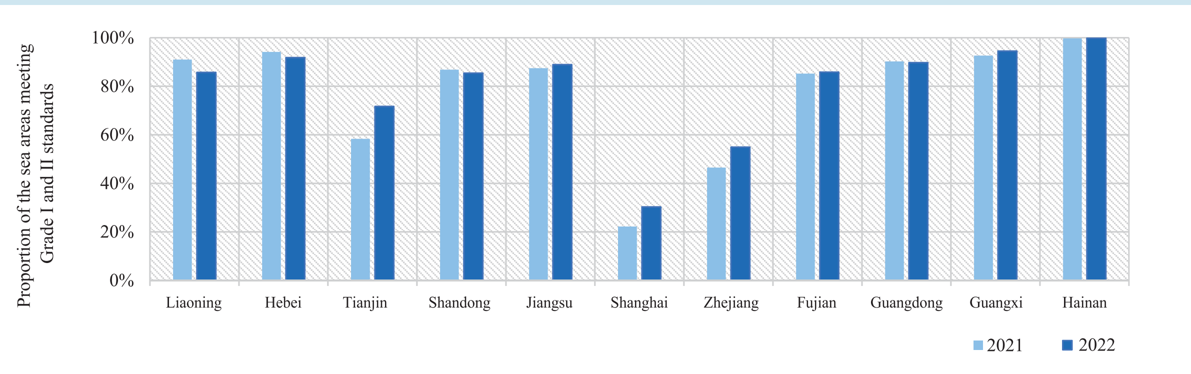
The seawater quality of three key areas meeting the Seawater Quality Standard Grade I and II accounted for 63.0%, which increased by 0.5 percentage point from the that of the previous year. Among them, the proportion of sea areas meeting Grade I and II standards in the Bohai Sea decreased by 7.8 percentage point from that of the previous year, that of the Yangtze River estuary and the Hangzhou Bay down by 8.0 percentage point, and that of the sea areas adjacent to the Pearl River estuary down by 0.2 percentage point.



Proportion of the three key areas at different quality standards in 2022

Seawater Quality of Coastal Provinces

Compared with the previous year, the sea area meeting the Seawater Quality Standard Grade I and II in Tianjin, Jiangsu, Shanghai, Zhejiang and Guangxi increased, that in Fujian, Guangdong and Hainan remained almost at the same level, and that in Liaoning, Hebei, and Shandong decreased. Compared with the previous year, the sea area with water quality inferior to Grade IV standard in Hebei, Tianjin, Shanghai, Zhejiang and Guangxi decreased, that in Jiangsu, Fujian, Guangdong and Hainan remained almost at the same level, and that in Liaoning and Shandong increased.



Proportion of the sea areas meeting Grade I and II standards in coastal provinces in 2021 and 2022

* Three Key Areas, namely the Bohai Sea,the Yangtze River estuary and the Hangzhou Bay, and the sea areas adjacent to the Pearl River estuary, were identified in "*the Action Plan for Comprehensive Treatment of Key Sea Areas*".

Feature

Continued efforts in comprehensive treatment of key sea areas

The Ministry of Ecology and Environment joins hands with 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, the China Coast Guard and other departments and units, focusing the prominent ecological and environmental issues in key sea areas, and promotes the implementation of *the Action Plan for Comprehensive Treatment of Key Sea Areas* (hereinafter "the Action Plan"), adhering to the principles of coordinated efforts in land and sea, among departments, and between central and local governments. The China Coast Guard, together with the Ministry of Industry and Information Technology, the Ministry of Ecology and Environment, and the National Forestry and Grassland Administration, jointly launched the "Blue Sea 2022" special law enforcement compaign for marine ecological and environmental protection as well as natural resource development and utilization. The Ministry of Ecology and Environment has established working mechanisms such as guidance and assistance, management and consultation, dynamic supervision, and evaluation and assessment, guiding 8 coastal provinces and municipalities as well as relevant coastal cities included in the Action Plan, to develop implementation plans and work records, in order to solidly promote the implementation of key tasks in land and sea pollution control, marine ecological protection and restoration, and capacity building on marine environmental risk emergency response.

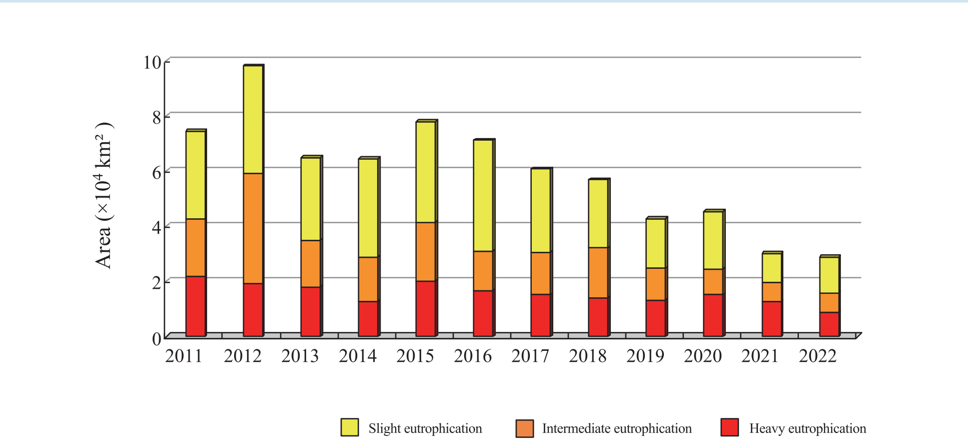
1.2 Eutrophication

In 2022, the sea areas under eutrophication status* totaled 28,770 km² in summer, decreased by 1,400 km² from that of the previous year. The sea areas with Slight, Intermediate, and Heavy eutrophication were 12,900 km², 6,940 km² and 8,930 km², respectively. Heavy eutrophication areas were mainly located near Liaodong Bay, Yangtze River Estuary, Hangzhou Bay, and Pearl River Estuary. From 2011 to 2022, total eutrophication sea areas under China's jurisdiction trended to decline.

Sea areas under eutrophication status under China's jurisdiction in 2022

unit: km^2

Sea Area	Slight Eutrophication	Intermediate Eutrophication	Heavy Eutrophication	Total
Bohai Sea	2,530	640	1,640	4,810
Yellow Sea	2,140	190	460	2,790
East China Sea	5,770	4,130	4,910	14,810
South China Sea	2,460	1,980	1,920	6,360
Total	12,900	6,940	8,930	28,770



Variation of eutrophication areas under jurisdiction of China during 2011 - 2022

* Eutrophication status is classified based on the calculated result of eutrophication index (E), the calculation formula being E=COD×inorganic nitrogen×active phosphate×10^6/4500, where $E \geqslant 1$ 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 in the sea areas under China's jurisdiction in 2022

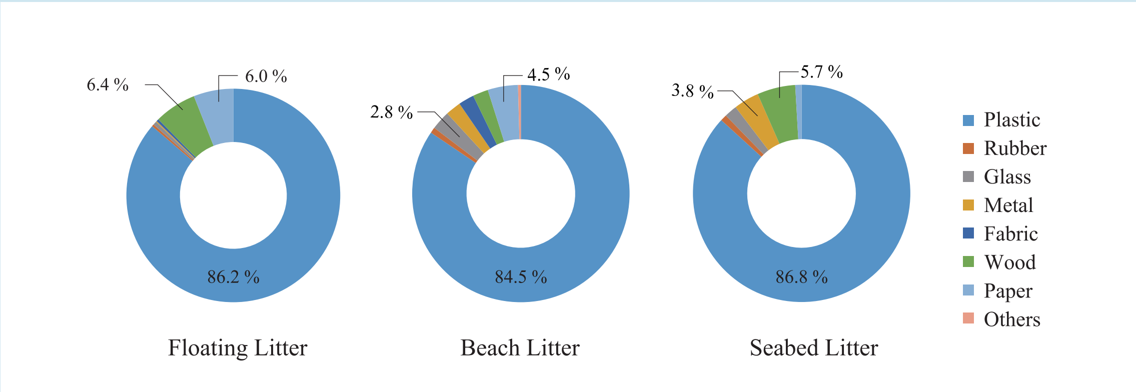
1.3 Marine Litter

In 2022, marine litter was monitored in 60 coastal areas. The monitored contents included the types and densities of litter in surface waters, on beaches, and on seabed.

Floating Litter* The average quantity density of floating litter by visual surveys was 65 items/km². The average quantity density of floating litter by trawling surveys was 2,859 items/km², with an average weight density of 2.8 kg/km². Plastics was the most common type and accounted for 86.2% of the total amount, followed by wood and paper, which accounted for 6.4% and 6.0% respectively. The plastic litter mainly consisted of foams, ropes, fragments, films and bottles.

Beach Litter ** The average quantity density of beach litter was 54,772 items/km², with an average weight density of 2,506 kg/km². Plastics was the most common type and accounted for 84.5% of the total amount, followed by paper and glass, which accounted for 4.5% and 2.8% respectively. The plastic litter mainly consisted of cigarette filters, caps, foams, plastic packaging materials, fragments, bags, and ropes.

Seabed Litter*** The average quantity density of seabed litter was 2,947 items/km², with an average weight density of 54.7 kg/km². Plastics was the most common type and accounted for 86.8% of the total amount, followed by wood and metal, which accounted for 5.7% and 3.8% respectively. The plastic litter mainly consisted of ropes and packing bags.



Main types of marine litter along coastal areas in China in 2022

* Floating litter by visual surveys: observing macro-litter (2.5 cm≤diameter＜1 m) and mega-litter (diameter≥1 m); Floating litter by trawling surveys: collecting meso-litter (0.5 cm≤diameter＜2.5 cm) and macro-litter (2.5 cm≤diameter ＜1 m)

** Beach Litter: collecting macro-litter (2.5 cm≤diameter＜1 m) and mega-litter (diameter≥1 m).

*** Seabed Litter: collecting macro-litter (2.5 cm≤diameter＜1 m) and mega-litter (diameter≥1 m).

Quantitative distribution of marine litter（items/km²）, histogram shows the 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 2022

1.4 Radioactivity Level in Marine Environment

In 2022, marine radioactivity monitoring was carried out in 124 sites of sea areas under China's jurisdiction and 13 sea areas adjacent to nuclear power plants.

The natural radionuclide activity concentration of the sea areas was within the background level. No abnormality was observed in the artificial radionuclide activity concentration, and the activity concentrations of Sr-90 and Cs-137 in sea water were far below the limit set in the seawater quality standard. The natural radionuclide activity concentration of the coastal marine organisms was within the background level. No abnormality was observed in the artificial radionuclide activity concentration, and the activity concentrations of Sr-90 and Cs-137 in marine organisms were below the limit set in the Concentration Limits of Radioactive Materials in Food (GB14882-1994).

The activity concentration of radionuclide related to facility activities in 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 nuclear power plants was far below the national dose limits, and had no impact on environmental safety and public health.

2 Marine Ecological Status

2.1 Marine Biodiversity

In 2022, marine biodiversity monitoring was carried out in 19 key areas, to track the species composition and quantitative distribution of marine organisms including phytoplankton, zooplankton, and macrobenthos.

Bohai Sea

Shuangtaizi Estuary

77 species of phytoplankton were identified, with the diatoms accounting for 84% and the dinoflagellates for 14%. The diversity index was 2.91. The dominant species were *Skeletonema costatum* and *chaetoceros curvisetus*. 46 species of zooplankton were identified, with the arthropods accounting for 46% and the planktonic larvae for 28%. The diversity index was 2.51. The dominant species of macrozooplankton were *Pavacalanus parvus* and *Sagitta crassa*. 47 species of macrobenthos were identified, with the annelids and the arthropods accounting for 34% and 30% respectively. The diversity index was 2.26. The dominant species of macrobenthos were *Sternaspis sculata* and *Ringicula doliaris*.

Luanhe Estuary-Beidaihe

76 species of phytoplankton were identified, with the diatoms accounting for 86% and the dinoflagellates for 13%. The diversity index was 2.70. The dominant species were *Rhizosolenia calcaravis* and *Cerataulina pelagica*. 28 species of zooplankton were identified, with the planktonic larvae accounting for 32% and the arthropods for 25%. The diversity index was 1.62. The dominant species of macrozooplankton were *Dolioletta gegenbauri* and *Sagitta crassa*. 78 species of macrobenthos were identified, with the annelids and the arthropods accounting for 55% and 27% respectively. The diversity index was 3.06. The dominant species of macrobenthos were *Branchiostoma belcheri tsingtauense* and *Grandifoxus cuspis*.

Bohai Bay

46 species of phytoplankton were identified, with the diatoms accounting for 76% and the dinoflagellates for 22%. The diversity index was 2.19. The dominant species were *Skeletonema costatum* and *Pseudo-nitzschia pungens*. 47 species of zooplankton were identified, with the planktonic larvae accounting for 40% and the arthropods for 36%. The diversity index was 2.75. The dominant species of macrozooplankton were *Pleurobrachia globosa* and *Sagitta crassa*. 48 species of macrobenthos were identified, with the annelids and the molluscs accounting for 48% and 33% respectively. The diversity index was 2.62. The dominant species of macrobenthos were *Musculus senhousei* and *Lineus* sp.

Yellow River Estuary

46 species of phytoplankton were identified, with the diatoms accounting for 89% and the dinoflagellates for 9%. The diversity index was 2.80. The dominant species were *Ditylum brightwellii* and *Pseudo-nitzschia pungens*. 63 species of zooplankton were identified, with the arthropods accounting for 38% and the planktonic larvae for 32%. The diversity index was 3.31. The dominant species of macrozooplankton were *Oithona similis* and *Sagitta crassa*. 106 species of macrobenthos were identified, with the annelids and the molluscs accounting for 36% and 30% respectively. The diversity index was 3.44. The dominant species of macrobenthos were *Sigambra bassi* and *Sternaspis sculata*.

Laizhou Bay

38 species of phytoplankton were identified, with the diatoms accounting for 87% and the dinoflagellates for 11%. The diversity index was 2.61. The dominant species were *Chaetoceros paradoxus* and *Bacteriastrum hyalinum*. 48 species of zooplankton were identified, with the arthropods accounting for 38% and the planktonic larvae for 35%. The diversity index was 2.83. The dominant species of macrozooplankton were *Oithona similis* and *Sagitta crassa*. 130 species of macrobenthos were identified, with the annelids and the molluscs accounting for 40% and 31% respectively. The diversity index was 3.27. The dominant species of macrobenthos were *Ruditapes philippinarum* and *Heteromastus filiforms*.

Yellow Sea

Yalujiang Estuary

68 species of phytoplankton were identified, with the diatoms accounting for 81% and the dinoflagellates for 18%. The diversity index was 2.10. The dominant species were *Eucampia zoodiacus* and *Chaetoceros debilis*. 44 species of zooplankton were identified, with the arthropods accounting for 50% and the planktonic larvae for 27%. The diversity index was 2.73. The dominant species of macrozooplankton were *Oithona similis* and *Sagitta crassa*. 82 species of macrobenthos were identified, with the annelids and the arthropods accounting for 55% and 28% respectively. The diversity index was 2.31. The dominant species of macrobenthos were *Ruditapes philippinarum* and *Branchiostoma belcheri tsingtauense*.

Changshan Islands

75 species of phytoplankton were identified, with the diatoms accounting for 81% and the dinoflagellates for 17%. The diversity index was 3.48. The dominant species were *Chaetoceros curvisetus* and *Ceratium tripos*. 64 species of zooplankton were identified, with the arthropods accounting for 40% and the planktonic larvae for 32%. The diversity index was 2.53. The dominant species of macrozooplankton were *Calanus sinicus* and *Sagitta crassa*. 62 species of macrobenthos were identified, with the annelids and the molluscs accounting for 32% and 29% respectively. The diversity index was 2.26. The dominant species of macrobenthos was *Sternaspis sculata*.

Miaodao Islands

49 species of phytoplankton were identified, with the diatoms accounting for 82% and the dinoflagellates for 16%. The diversity index was 2.54. The dominant species were *Ceratium fusus* and *Odontella regia*. 60 species of zooplankton were identified, with the cnidarians accounting for 35% and the arthropods for 21%. The diversity index was 3.15. The dominant species of macrozooplankton were *Pavacalanus parvus* and *Sagitta crassa*. 106 species of macrobenthos were identified, with the annelids and the molluscs accounting for 50% and 22% respectively. The diversity index was 3.46. The dominant species of macrobenthos were *Moerella jedoensis* and *Philine kinglipini*.

Jiaozhou Bay

71 species of phytoplankton were identified, with the diatoms accounting for 75% and the dinoflagellates for 24%. The diversity index was 1.83. The dominant species were *Skeletonema costatum* and *Pseudo-nitzschia pungens*. 79 species of zooplankton were identified, with the planktonic larvae accounting for 37% and the arthropods for 25%. The diversity index was 2.73. The dominant species of macrozooplankton were *Pavacalanus parvus* and *Acartia pacifica*. 97 species of macrobenthos were identified, with the annelids and the molluscs accounting for 24% and 19% respectively. The diversity index was 3.27. The dominant species of macrobenthos were *Heteromastus*

filiforms and *Nephtys oligobranchia*.

Northern Jiangsu Mudflat

108 species of phytoplankton were identified, with the diatoms accounting for 69% and the dinoflagellates for 24%. The diversity index was 3.42. The dominant species were *Pseudo-nitzschia pungens* and *Coscinodiscus wailesii*. 41 species of zooplankton were identified, with the arthropods accounting for 44% and the planktonic larvae for 32%. The diversity index was 1.98. The dominant species of macrozooplankton were *Labidocera euchaeta* and *Acartia pacifica*. 9 species of macrobenthos were identified, with the molluscs accounting for 67%. The diversity index was 0.53. The dominant species of macrobenthos was *Oliva mustelina*.

East China Sea

Yangtze River Estuary

88 species of phytoplankton were identified, with the diatoms accounting for 58% and the dinoflagellates for 23%. The diversity index was 1.15. The dominant species were *Skeletonema costatum* and *Pseudo-nitzschia pungens*. 88 species of zooplankton were identified, with the arthropods accounting for 55% and the planktonic larvae for 22%. The diversity index was 2.42. The dominant species of macrozooplankton were *Acartia pacifica* and *Labidocera euchaeta*. 78 species of macrobenthos were identified, with the annelids and the molluscs accounting for 47% and 27% respectively. The diversity index was 1.64. The dominant species of macrobenthos was *Heteromastus filiforms*.

Hangzhou Bay

127 species of phytoplankton were identified, with the diatoms accounting for 79% and the dinoflagellates for 17%. The diversity index was 2.80. The dominant species were *Coscinodiscus jonesianus* and *Ditylum brightwellii*. 66 species of zooplankton were identified, with the arthropods accounting for 45% and the planktonic larvae for 23%. The diversity index was 2.27. The dominant species of macrozooplankton were *Tortanus vermiculus* and *Acartia pacifica*. 9 species of macrobenthos were identified, with the annelids accounting for 78%. The diversity index was 0.88. The dominant species of macrobenthos were *Capitella capitata* and *Aglaophamus dibranchis*.

Yueqing Bay

145 species of phytoplankton were identified, with the diatoms accounting for 73% and the dinoflagellates for 26%. The diversity index was 2.68. The dominant species were *Skeletonema costatum* and *Thalassionema nitzschioides*. 125 species of zooplankton were identified, with the arthropods accounting for 44% and the cnidarians for 17%. The diversity index was 3.41. The dominant species of macrozooplankton were *Eirene brevistylus* and *Acartia pacifica*. 33 species of macrobenthos were identified, with the annelids and the arthropods accounting for 42% and 18% respectively. The diversity index was 2.44. The dominant species of macrobenthos were *Aglaophamus dibranchis* and *Sternaspis sculata*.

Minjiang Estuary

89 species of phytoplankton were identified, with the diatoms accounting for 80% and the dinoflagellates for 19%. The diversity index was 2.69. The dominant species were *Skeletonema costatum* and *Pseudo-nitzschia pungens*. 83 species of zooplankton were identified, with the arthropods accounting for 53% and the cnidarians for 18%. The diversity index was 3.46. The dominant species of macrozooplankton were *Penilia avirostris* and *Subeucalanus subcrassus*. 66 species of macrobenthos were identified, with the annelids and the molluscs accounting for 50% and 17% respectively. The diversity index was 2.51. The dominant species of macrobenthos were *Paraprionospio pinnata* and *Nephtys oligobranchia*.

Eastern Fujian Coast

100 species of phytoplankton were identified, with the diatoms accounting for 84% and the dinoflagellates for 15%. The diversity index was 2.52. The dominant species were *Chaetoceros curvisetus* and *Skeletonema costatum*. 92 species of zooplankton were identified, with the arthropods accounted for 58% and the planktonic larvae for 16%. The diversity index was 3.30. The dominant species of macrozooplankton were *Lucicutia gaussae* and *Muggiaea atlantica*. 78 species of macrobenthos were identified, with the annelids accounting for 56%. The diversity index was 2.65. The dominant species of macrobenthos were *Heteromastus filiforms* and *Nephtys oligobranchia*.

South China Sea

Pearl River Estuary

96 species of phytoplankton were identified, with the diatoms accounting for 65% and the dinoflagellates for 13%. The diversity index was 0.33. The dominant species were *Phaeocystis globosa* and *Skeletonema costatum*. 101 species of zooplankton were identified, with the arthropods accounting for 51% and the planktonic larvae for 23%. The diversity index was 2.61. The dominant species of macrozooplankton were *Acartia spinicauda* and *Subeucalanus subcrassus*. 102 species of macrobenthos were identified, with the annelids and the molluscs accounting for 42% and 26% respectively. The diversity index was 2.49. The dominant species of macrobenthos were *Paraprionospio pinnata* and *Aglaophamus dibranchis*.

Daya Bay

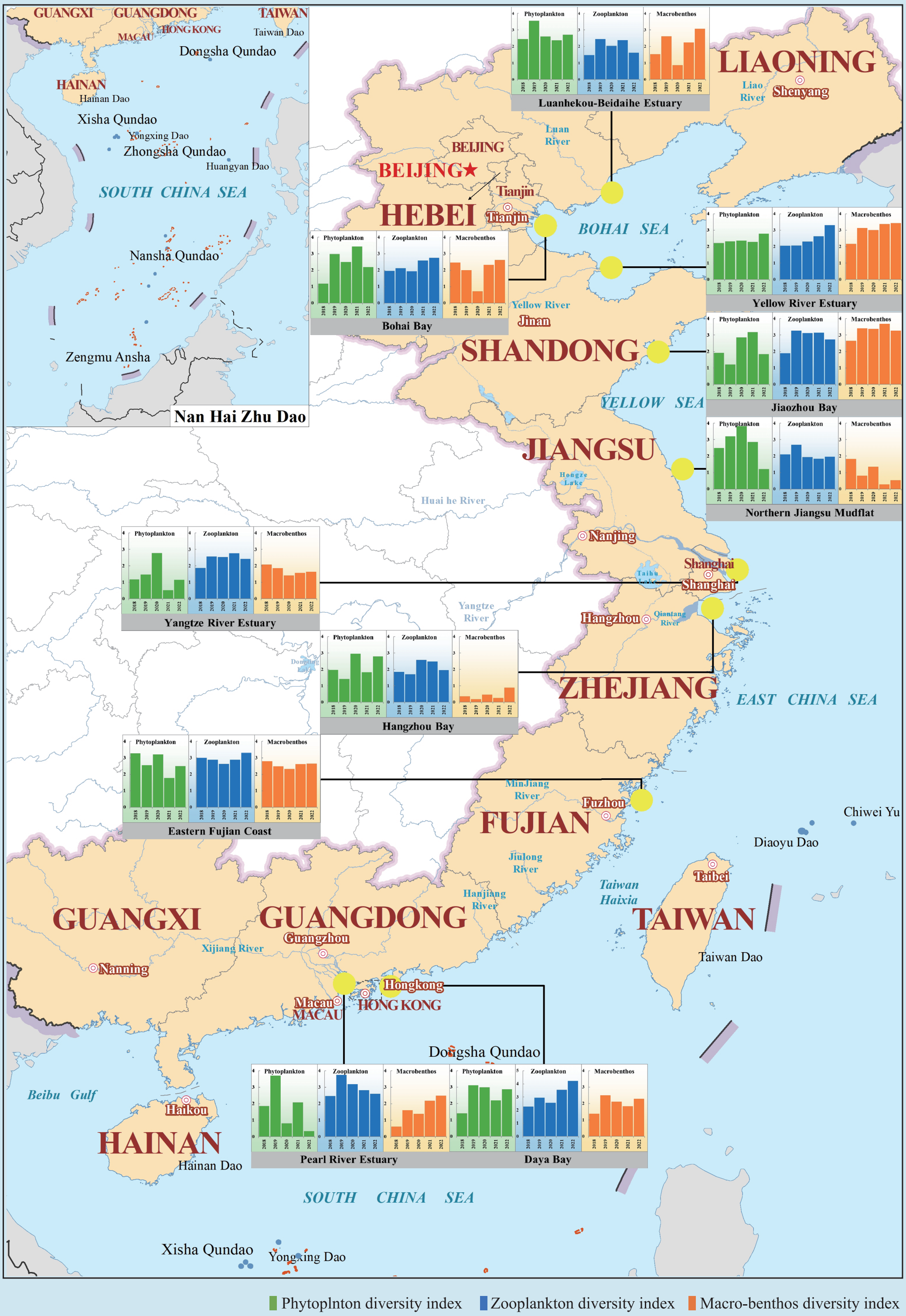
83 species of phytoplankton were identified, with the diatoms accounting for 86% and the dinoflagellates for 13%. The diversity index was 2.88. The dominant species were *Pseudo-nitzschia delicatissima* and *Thalassionema nitzschioides*. 141 species of zooplankton were identified, with the arthropods accounting for 55% and the cnidarians for 19%. The diversity index was 4.22. The dominant species of macrozooplankton were *Subeucalanus subcrassus* and *Paracalanus crassirostris*. 70 species of macrobenthos were identified, with the annelids and the arthropods accounting for 51% and 24% respectively. The diversity index was 2.28. The dominant species of macrobenthos were *Timoclea scabra* and *Paraprionospio pinnata*.

Beibu Gulf

138 species of phytoplankton were identified, with the diatoms accounting for 72% and the dinoflagellates for 27%. The diversity index was 1.21. The dominant species were *Chaetoceros curvisetus* and *Skeletonema costatum*. 209 species of zooplankton were identified, with the arthropods accounting for 55% and the cnidarians for 12%. The diversity index was 3.00. The dominant species of macrozooplankton were *Sagitta enflata* and *Subeucalanus subcrassus*. 145 species of macrobenthos were identified, with the annelids and the arthropods accounting for 46% and 28% respectively. The diversity index was 2.84. The dominant species of macrobenthos was *Amphiodia clarki*.

Nan’ao Island

135 species of phytoplankton were identified, with the diatoms accounting for 74% and the dinoflagellates for 22%. The diversity index was 3.65. The dominant species were *Thalassionema nitzschioides* and *Thalassionema frauenfeldii*. 88 species of zooplankton were identified, with the arthropods accounting for 50% and the cnidarian for 20%. The diversity index was 2.55. The dominant species of macrozooplankton were *Acartia spinicauda* and *Subeucalanus subcrassus*. 57 species of macrobenthos were identified, with the annelids and the arthropods accounting for 64% and 17% respectively. The diversity index was 2.79. The dominant species of macrobenthos was *Prionospio queenslandica*.



The biodiversity indices of plankton and macrobenthos in the key monitored areas from 2018 to 2022

2.2 Typical Marine Ecosystems

In 2022, 24 typical marine ecosystems, including estuary, bay, mudflat, coral reef, mangrove and seagrass bed were monitored for their health status*. Among all the monitored typical marine ecosystems, 7 were in Healthy status, 17 were Sub-healthy, and none was Unhealthy.

Estuary Ecosystem

The 7 monitored estuary ecosystems were all in Sub-healthy status. The seawater was in heavy eutrophic condition in some estuaries. The sediment qualities were relatively good. Marine biological qualities were fairly good on the whole, whereas relatively high levels of petroleum hydrocarbons were detected in the bodies of shellfish from a few estuary ecosystems. In most estuary ecosystems, the density of phytoplankton and zooplankton exceeded the normal range, the density of fish eggs and larvae was significantly low, and the density and biomass of macrobenthos were both above the normal range.

Bay Ecosystem

The 8 monitored bay ecosystems were all in Sub-healthy status. The seawater was in heavy eutrophic condition in a few estuaries. The sediment qualities were relatively good. Marine biological qualities were generally good, whereas relatively high levels of lead (Pb) were detected in the bodies of shellfish from a few estuary ecosystems. In most bay ecosystems, the density of phytoplankton exceeded the normal range, the biomass of zooplankton was below the normal range, the density of fish eggs and larvae was significantly low, and the density and biomass of macrobenthos were higher than the normal range.

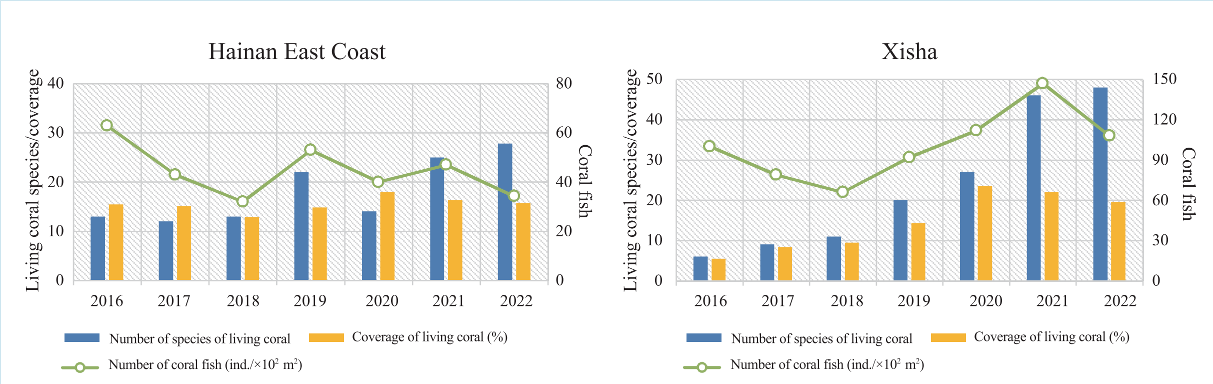
Mudflat Ecosystem

The Northern Jiangsu mudflat ecosystem was in Sub-healthy status. The density of phytoplankton was below the normal range. The biomass of zooplankton was below the normal range. The density of macrobenthos was below the normal range and their biomass exceeded the normal range. The area of mudflat vegetation was about 248.9 km^2. The vegetation in the ecosystem was dominated by the alien invasive species – *Spartina alterniflora*, and followed by seepweed and reed.

Coral Reef Ecosystem

The 4 monitored coral reef ecosystems were all in Healthy status. The coverage of living coral in the Leizhou Peninsula was relatively stable. In Beihai, Guangxi province, the number of live coral species increased from the previous year, and the population of hard coral significantly recovered. In the East Coast of Hainan, the number of living coral species increased from the previous year. In the Xisha Islands, the number of live coral species also increased compared with that in the previous year, and the coral reef fish species were abundant.

*The health status of marine ecosystems are divided into three categories: healthy, sub-healthy, and unhealthy.
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 their natural attributes. Biological diversity and ecosystem structure experience certain degrees of changes, but the ecosystems still maintain their major functions. 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 functions are seriously weakened or lost. Ecological pressures caused by environmental pollution, human activities, and unreasonable use of resources exceed the carrying capacity of the ecosystems.



Changes in coral reef species, coverage and coral reef fishes in coral reef ecosystems from 2016 to 2022

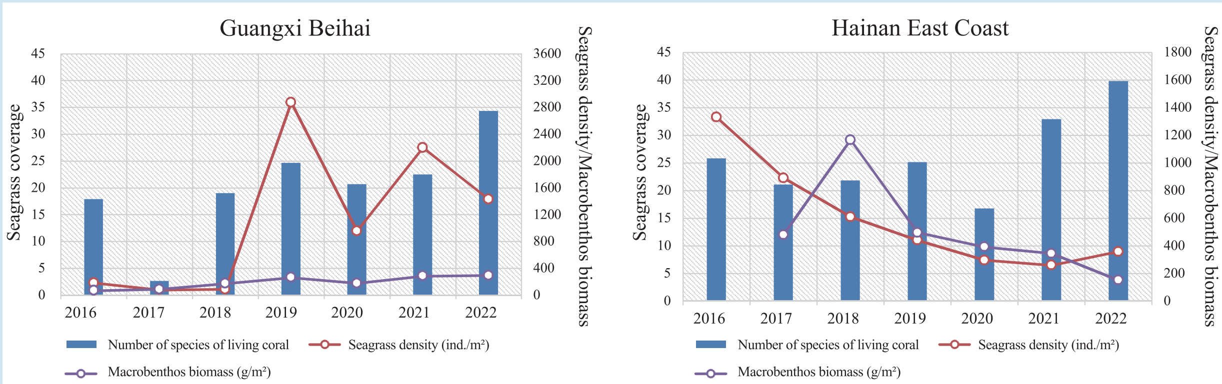
Mangrove Ecosystem

The 2 monitored mangrove ecosystems were in Healthy status. In Beihai of Guangxi, the density of mangroves was relatively stable, and the average coverage significantly increased compared with that in the previous year. In Beilun Estuary, the density of mangrove and the biomass of macrobenthos significantly increased from the previous year. The seedlings grew well in the mangrove replenishment area, promising good restoration effect.

Seagrass Bed Ecosystem

In Beihai of Guangxi, the seagrass bed ecosystem was in Healthy status, with an average coverage of 34.3% and an average density of 1,430 plants/m², and the seagrass coverage significantly increased compared with that in the previous year. The seagrass bed ecosystem in the East Coast of Hainan was in Sub-healthy status, with an average coverage of 39.8% and an average density of 358 plants/m². The cover of seagrass significantly increased and the biomass of macrobenthos significantly decreased compared with the previous year.

Changes in the density of mangroves and the biomass of macrobenthos in the mangrove ecosystem in Beihai, Guangxi province from 2016 to 2022



Changes in the coverage and density of seagrass and the biomass of macrobenthos in seagrass bed ecosystems from 2016 to 2022

Biodiversity status of reef-building coral, mangrove, and seagrass in monitored areas in 2022

Health status of typical marine ecosystems in 2022

2.3 Marine Protected Areas

By the end of 2022, 66 marine nature reserves and 79 marine special reserves (including marine parks) had been established in China, covering a total area of 7.9098 million hectares.

The ecological and environmental status* of 7 national nature reserves related to oceans was assessed. The Dalian Spotted Seal National Nature Reserve in Liaoning, Xuwen Coral Reef National Nature Reserve in Guangdong, Hepu Dugong National Nature Reserve in Guangxi, and Beilun Estuary National Nature Reserve in Guangxi were assessed to be in good ecological and environmental status (Grade I) on the whole. The ecology and environment in Yellow River Delta National Nature Reserve in Shandong, Yancheng Wetland and Rare Birds National Nature Reserve in Jiangsu, and Shankou Mangrove Ecological National Nature Reserve in Guangxi were assessed to be in average status (Grade II).

1. Liaoning Dalian Spotted Seal National Nature Reserve
The ecological and environmental status was Grade I .
The individuals of *Phoca largha* (Class I species of the List of Key Protected Wild Animals in China (LKPWAC)) monitored decreased, compared with that of the previous year.

2. Shandong Yellow River Delta National Nature Reserve
The ecological and environmental status was Grade II.
The individuals of *Ciconia boyciana* (Class I species of LKPWAC) monitored decreased, compared with that of the previous year. The area of natural coastal wetland accounted for 39.2%. The area of *Spartina alterniflora* accounted for 2.4%.

3. Jiangsu Yancheng Wetland National Nature Reserve, Rare Birds
The ecological and environmental status was Grade II .
The individuals of *Grus japonensis* (Class I species of LKPWAC) monitored increased, compared with that of the previous year. The area of natural coastal wetland accounted for 56.1%. The area of *Spartina alterniflora* accounted for 2.5%.

4. Guangdong Xuwen Coral Reef National Nature Reserve
The ecological and environmental status was Grade I.
The average coverage of live coral monitored remained stable on the whole, compared with that of the previous year.

5. Guangxi Shankou Mangrove Ecological National Nature Reserve
The ecological and environmental status was Grade II.
Bruguiera gymnorrhiza, *Avicennia marina*, *Kandelia candel*, *Aegiceras corniculatum*, and *Rhizophora stylosa* were monitored.

6. Guangxi Hepu Dugong National Nature Reserve
The ecological and environmental status was Grade I.
A total of 84 counts of *Sousa chinensis* (Class I species of LKPWAC) were monitored.

7. Guangxi Beilun Estuary National Nature Reserve
The ecological and environmental status was Grade I.
Bruguiera gymnorrhiza, *Avicennia marina*, *Kandelia candel*, and *Aegiceras corniculatum* were monitored.

The ecological and environmental status ● Grade I ● Grade II

The ecological status of monitored national marine nature reserves in 2022

* According to the Standard for Conservation Effectiveness Assessment of Ecology and Environment in Nature Reserve (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 average on the whole, and control of the major threat factors and violations is acceptable.

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

2.4 Coastal Wetlands

In 2022, there were 15 coastal wetlands of international importance in China, covering a total area of 883,800 ha.

Bird monitoring was carried out in 15 coastal wetlands of international importance. 22 bird species under Class I Protection in the List of National Key Protected Wild Animals in China, and 47 species under Class II Protection were recorded. The area of *Spartina alterniflora* in 6 wetlands of international importance was monitored. The areas covered by *Spartina alterniflora* in Chongming Dongtan Nature Reserve in Shanghai, Shankou Mangrove Nature Reserve in Guangxi, Dafeng Milu Deer National Nature Reserve in Jiangsu, Zhangjiangkou National Mangrove Nature Reserve in Fujian, Yellow River Delta Wetland in Shandong, and Yancheng wetlands in Jiangsu were 219 ha, 460 ha, 60 ha, 371 ha, 5,424 ha, and 20,000 ha respectively.

Feature

Actively carry out the protection and restoration of marine protected areas and important coastal wetlands

The National Forestry and Grassland Administration conducted two rounds of remote sensing monitoring of human activities in 102 national level natural protected areas related to oceans throughout the year. It also conducted satellite image interpretation of suspected problems in 901 national wetland parks, 63 internationally important wetlands, and 29 nationally important wetlands, including coastal wetlands, urged and guided relevant local authorities to earnestly verify and promptly rectify the problems. All relevant departments continued to strengthen the protection and restoration of coastal wetlands. The Ministry of Natural Resources issued the “Action Plan for Marine Ecological Protection and Restoration During the 14th Five-Year Plan Period”, and the Ministry of Natural Resources and the National Forestry and Grassland Administration jointly issued the “Rules for the Recognition of Qualified Area and Application of Achievements in Mangrove Afforestation (Trial)”. The National Forestry and Grassland Administration, the Ministry of Natural Resources, the Ministry of Ecology and Environment, the Ministry of Water Resources, the Ministry of Agriculture and Rural Affairs and other departments jointly issued the “Special Action Plan for the Prevention and Control of Spartina alterniflora (2022-2025)”. The National Forestry and Grassland Administration and the Ministry of Natural Resources jointly issued the “National Wetland Protection Plan (2022-2030)”. The Ministry of Natural Resources, in cooperation with the Ministry of Finance, supported the launch of 16 new marine ecological protection and restoration projects in coastal areas through central financial transfer payments. It has allocated 4.0 billion yuan in rewards and subsidies to implement the restoration of typical marine ecosystems such as mangroves, salt marshes, and seagrass beds, the management of invasive alien species such as *Spartina alterniflora*, and shoreline remediation.

2.5 Marine Ecological Disasters

2.5.1 Red Tide

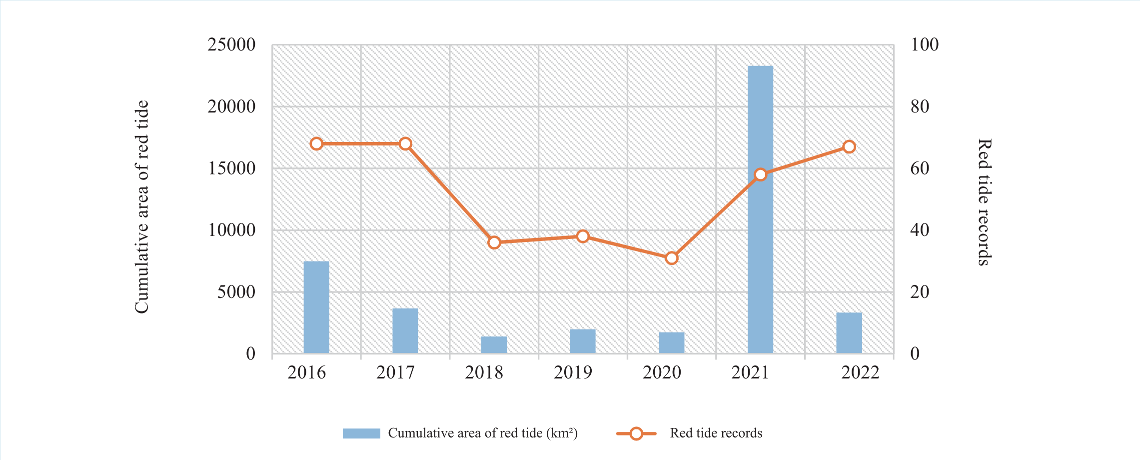
In 2022, a total of 67 red tide events were recorded in China's sea areas, with a cumulative area of 3,328 km². Among the four major sea areas, the East China Sea had the largest number of red tide events (29) and the biggest cumulative area (1,815 km²). Among the coastal provinces, autonomous regions and municipalities directly under the central government, the largest number of red tide events and the biggest cumulative area was found in the sea area of Zhejiang province, with 17 events and a cumulative area of 1552 km² recorded.

In 2022, 35 species of dominant organisms causing red tides were identified. Among them, Noctiluca scintillans caused 25 red tide events, more than any other dominant organisms; and red tides caused by Prorocentrum donghaiense affected the largest area cumulatively, totaling 655 km².

Red tides recorded in 2022

Province/ Autonomous Region	Time	Spotted Area	Dominant Organisms	Area (km²)
Zhejiang	April 10—15	Wenzhou sea area	*Azadinium* sp.	533
Fujian	April 23—27	Sea areas of Liushui, Baiqing and Su'ao, Pingtan	*Noctiluca scintillans*	120
Zhejiang	May 6—23	Dachen sea area in Jiaojiang District, Taizhou	*Prorocentrum donghaiense*	120
Zhejiang	May 10—24	Sea areas from Pishan Island in Yuhuan to Wenling of Taizhou	*Prorocentrum donghaiense*	200
Shandong	May 22—24	Dongying nearshore	*Noctiluca scintillans*	210
Fujian	June 1—9	Dongdai and Kengkou nearshore of Nanri Island, Putian	*Karlodinium digitatum*	40
Fujian	June 10—13	Sea areas of Liushui and Su'ao, Pingtan	*Karlodinium digitatum* *Karenia papilionacea*	10
Zhejiang	July 25—August 4	Sea areas south of Dachangtu Island and Daxizhai Island in Daishan	*Rhizosolenia fragilissima*	100
Zhejiang	July 26—August 5	Sea areas east of Zhujiajian, Taohua Island, and Xiazhi Island in Putuo, Zhoushan	*Cerataulina daemon*	250
Hebei	July 31—August 5	Qinhuangdao nearshore	*Skeletonema costatum* *Leptocylindrus danicus* *Pseudo-nitzschiapungens*	150
Hebei	August 9—18	Qinhuangdao nearshore	*Scrippsiella trochoidea* *Prorocentrum triestinum* *Pseudo-nitzschia pungens* *Leptocylindrus danicus*	150
Hebei	August 20—September 20	Qinhuangdao nearshore	*Ceratium furca*	348

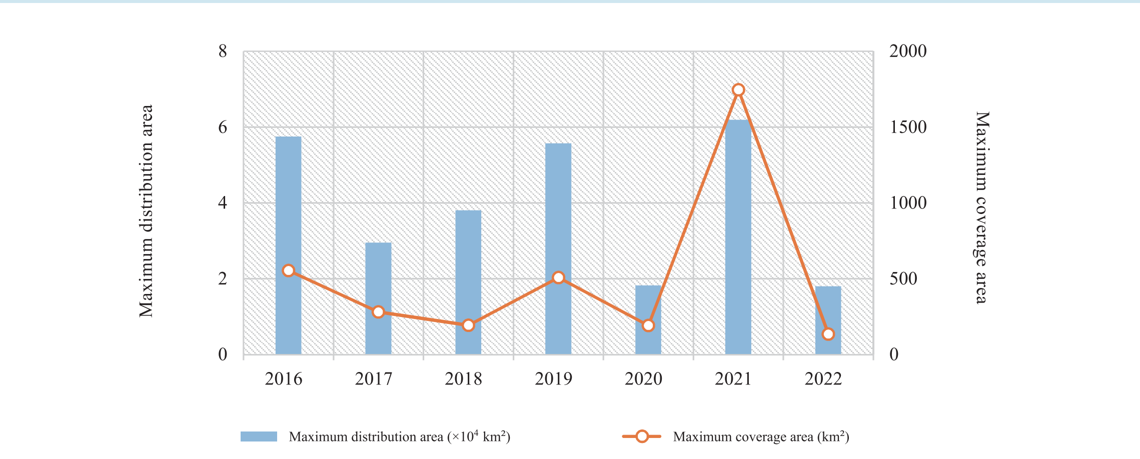
Note: The area listed in this table only count in the red tide area in the waters under jurisdiction of the provinces/autonomous regions, and only red tide events affecting at least 100 km² in area or causing direct economic losses were listed.



Number of red tide events and the affected cumulative area spotted in waters under China's jurisdiction from 2016 to 2022

2.5.2 Green Tide

During April to August 2022, a green tide event with the dominated algae of *Ulva prolifera* occurred in the Yellow Sea, and reached the maximum coverage area (135 km^2) on June 25 and the maximum distribution area (18,002 km^2) on July 1.



The scale of *Ulva prolifera* green tides in the Yellow Sea from 2016 to 2022

3 Main Pollution Sources into the Sea

3.1 Riverine Sources

In 2022, 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 80.0% of the total, which increased by 8.3 percentage points compared with the previous year; and the proportion of sections worse than surface water quality standard Grade V accounted for 0.4%, the same as that in the previous year. In general, the water quality were Good*.

Proportion of water sections at different quality levels of sea-entering rivers in different sea areas and dominant pollution indicators in 2022

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	20.7	34.5	43.1	1.7	0.0	COD, permanganate index, BOD_5
Yellow Sea	Good	0.0	19.3	64.9	15.8	0.0	0.0	—
East China Sea	Excellent	0.0	34.1	59.1	6.8	0.0	0.0	—
South China Sea	Good	0.0	45.1	43.7	9.9	0.0	1.4	—
All	Good	0.0	30.4	49.6	19.1	0.4	0.4	—

* Rivers flowing into the sea are classified into five grades through comprehensive water quality evaluation:

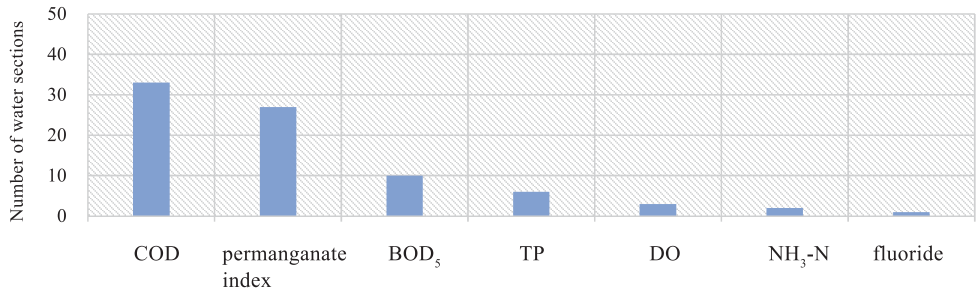
Excellent: 90% and above of waters meet Grade I – III quality level;

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.



The statistics for pollution indicators of water sections of sea-entering rivers in 2022

Pollution indicators of water sections of sea-entering rivers in China in 2022

unit: %

Sea Area`	Exceeding Ratio >30%	30%≥ Exceeding Ratio ≥10%	Exceeding Ratio <10%
Bohai Sea	COD (37.9)	permanganate index (29.3), BOD_5(10.3)	NH_3-N (1.7), fluoride (1.7)
Yellow Sea	—	COD (12.3), permanganate index (10.5)	BOD_5 (3.5), TP (1.8)
East China Sea	—	—	TP (2.3), NH_3-N (2.3), COD (2.3), BOD_5 (2.3)
South China Sea	—	—	permanganate index (5.6), TP (5.6), COD (4.2), DO (4.2), BOD_5(1.4)
All	—	COD (14.3), permanganate index (11.7)	BOD_5 (4.3), TP (2.6), DO (1.3), NH_3-N (0.9), fluoride (0.4)

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

Among the 230 sections of rivers flowing into the sea, 14.3% of the monitored sections had excessive levels of COD, which had the highest proportion among all pollution indicators, ranging between 2.0～45.0 mg/L and 15.0 mg/L on average; 11.7% of the monitored sections contained excessive levels of permanganate, with its concentration ranging 1.0～15.8 mg/L and 4.2 mg/L on average; the proportion of sections failing to observe the standard limit for BOD_5 was 4.3%, with the concentration ranging 0.3～5.8 mg/L and 2.3 mg/L on average; sections with limit-exceeding TP took up 2.6%, ranging 0.014～0.567 mg/L and 0.108 mg/L on average; 1.3% of the sections failed to observe the limit for DO, with the concentration ranging 3.3～15.6 mg/L and 8.5 mg/L on average; 0.9% of the sections had excessive levels of NH_3-N, with the concentration ranging 0.02～1.18 mg/L and 0.26 mg/L on average; and 0.4% of the sections went beyond the acceptable limit for fluoride, ranging 0.003～1.033 mg/L and 0.384 mg/L on average.

In 2022, the average TN (total nitrogen) concentration of all nationwide sea-entering rivers was 3.92 mg/L, an increase of 8.9% compared with the previous year. Among the 230 sections of rivers flowing into the sea, there were 76 sections with annual average TN concentration above the national average value.

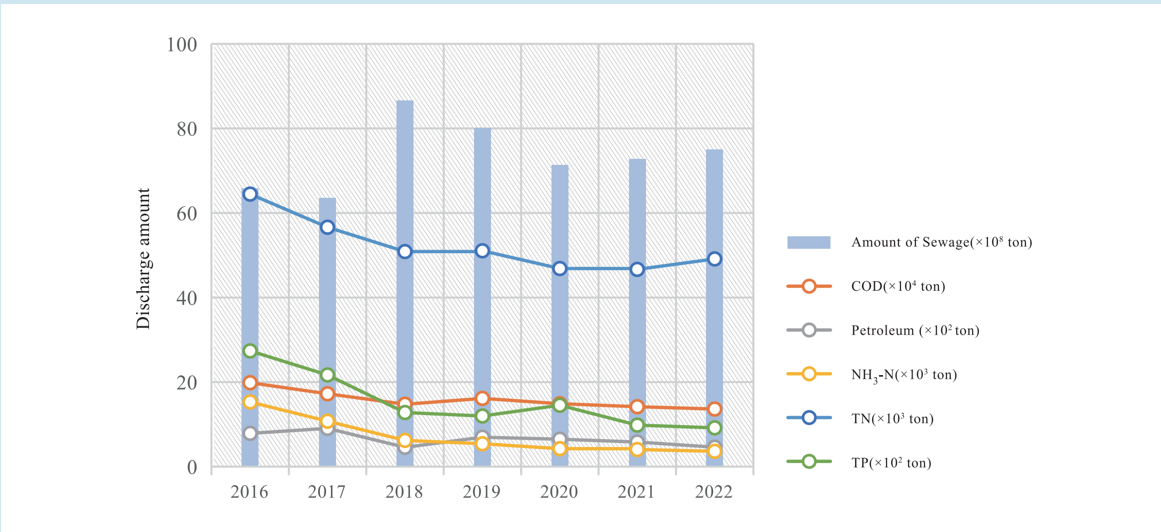
3.2 Pollutant Discharge Outlets

In 2022, 457 of industrial sewage outlets, domestic sewage outlets, and comprehensive sewage outlets with daily discharge volume exceeding or equal to 100 tons were monitored.

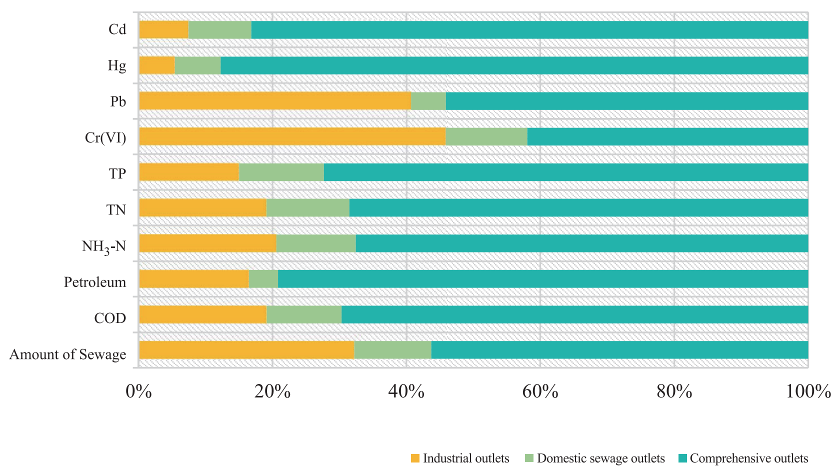
The total sewage discharge amount of 457 monitored outlets was approximately 7,501.99 million tons. Among the various types of sewage outlets into the sea, comprehensive outlets contributed the largest amount of sewage, followed by industrial outlets, and domestic sewage outlets the smallest. Among all the monitored pollutants, except for Cr (VI), the comprehensive outlets discharged the largest amount of pollutants.

Discharge amount of sewage and major pollutants from different types of seaward sewage outlets in 2022

Type of Sewage Outlets	Number of outlets	Amount of Sewage ($\times10^4$ ton)	COD (ton)	Petroleum (ton)	NH_3-N (ton)	TN (ton)	TP (ton)	Cr(VI) (kg)	Pb (kg)	Hg (kg)	Cd (kg)
Industrial outlets	212	241,566	26,046	76	748	9,381	138	896.7	1,866.3	18.3	30.0
Domestic sewage outlets	51	86,161	15,235	20	431	6,098	116	237.8	238.1	23.1	37.8
Comprehensive outlets	194	422,472	95,009	365	2,454	33,656	664	819.6	2,481.4	297.1	334.9

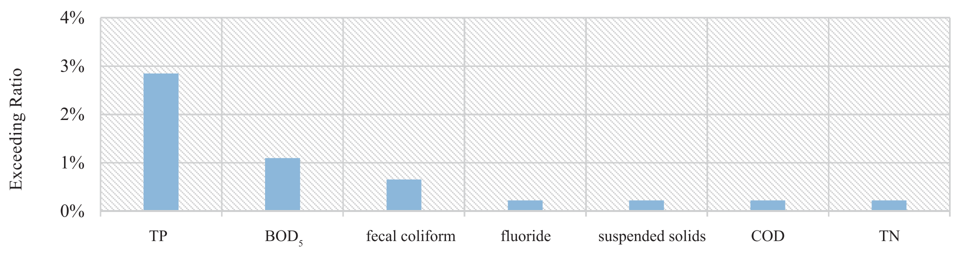


Discharge amount of sewage and major pollutants from seaward sewage outlets nationwide from 2016 to 2022



Proportion of sewage and major pollutants from different types of seaward sewage outlets in 2022

Among the pollutant indicators monitored, TP, BOD_5, fecal coliform, fluoride, suspended solids, COD and TN registered excessive levels in certain outlets. Other pollutants did not exceed the standard limit.



Exceeding ratios of pollutants discharged from seaward sewage outlets in 2022

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 directly under the central government, Zhejiang discharged the largest amount of sewage, followed by Fujian and Guangdong.

Total amount of sewage and major pollutants from sewage outlets received by different sea areas in 2022

Sea Area	Number of outlets	Amount of Sewage ($\times10^4$ ton)	COD (ton)	Petroleum (ton)	NH_3-N (ton)	TN (ton)	TP (ton)	Cr(VI) (kg)	Pb (kg)	Hg (kg)	Cd (kg)
Bohai Sea	59	61,828	6,278	55	123	2,755	52	32.0	2,111.7	23.6	28.9
Yellow Sea	80	89,907	21,010	80	614	7,410	159	655.6	856.9	110.4	60.1
East China Sea	173	434,290	77,042	279	1,732	28,216	435	355.1	1,424.9	173.9	280.6
South China Sea	145	164,173	31,961	48	1,165	10,754	272	911.4	192.2	30.6	33.2

Total discharge amount of sewage and major pollutants from sewage outlets into the sea in coastal provinces, autonomous regions and municipalities in 2022

Province	Number of outlets	Amount of Sewage ($\times10^4$ ton)	COD (ton)	Petroleum (ton)	NH_3-N (ton)	TN (ton)	TP (ton)	Cr(VI) (kg)	Pb (kg)	Hg (kg)	Cd (kg)
Liaoning	28	4,744	568	0	13	193	3	—	—	—	—
Hebei	5	39,131	688	6	23	1,356	21	—	1,523.2	12.7	1.0
Tianjin	16	5,825	954	1	19	368	7	—	65.8	1.2	9.0
Shandong	71	94,488	22,824	108	646	7,615	166	609.9	1,126.6	115.1	37.1
Jiangsu	19	7,548	2,254	20	36	633	14	77.7	253.0	5.0	41.8
Shanghai	10	22,040	4,176	14	103	1,382	34	—	26.2	19.8	5.7
Zhejiang	113	219,219	56,692	219	1,048	18,371	280	57.2	1,202.0	120.5	253.7
Fujian	50	193,031	16,174	46	581	8,464	121	297.9	196.7	33.6	21.2
Guangdong	70	106,372	18,245	24	576	6,504	148	816.8	65.7	19.6	7.1
Guangxi	37	16,472	2,879	9	132	1,340	42	52.5	83.0	1.6	10.0
Hainan	38	41,330	10,837	16	457	2,910	82	42.0	43.5	9.4	16.0

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

Feature

Systematically strengthening the supervision and management of sea-entering sewage discharge outlets

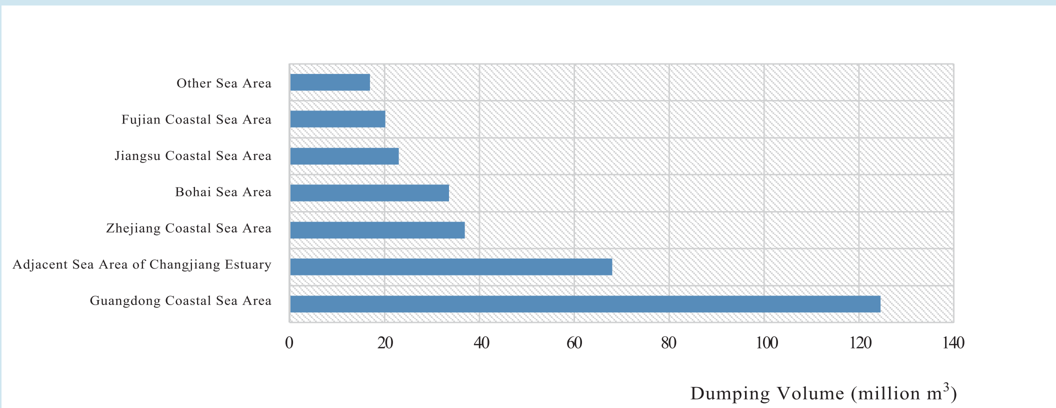
The General Office of the State Council has issued the *Implementation Opinions on Strengthening the Supervision and Management of River and Sea-Entering Pollutant Discharge Outlets*, which laid out relevant requirements for strengthening the supervision and management of pollutant discharge outlets from five aspects: overall requirements, investigation and source tracing, category-based rectification, supervision and management, and supporting measures. The Ministry of Ecology and Environment (MEE), in collaboration with the Ministry of Water Resources, issued the *Notice on Implementing the Implementation Opinions of the General Office of the State Council on Strengthening the Supervision and Management of River and Sea-Entering Pollution Discharge Outlets*, and formulated the *Measures for the Supervision and Management of Sea-Entering Pollution Discharge Outlets (Trial)*, the *Technical Guidelines for the Supervision and Management of River and Sea-Entering Pollution Discharge Outlets & Technical Guidelines for the Setting of Pollution Discharge Outlets into Seas*, as well as standard specifications for the terminology, classification, tracing, and rectification of pollution discharge outlets that discharge into rivers and seas. MEE also strengthened on-site research, technical assistance, and exchanges and training, to guide and supervise coastal areas in earnest implementation of relevant work.

4. Environmental Status of Four Types of Marine Utilization Areas

4.1 Ocean Dumping Zones

The total volume of ocean dumping in 2022 amounted to 323.66 million m^3, increasing by 19.9% compared with the previous year. The main substance dumped was cleaning dredged materials. In 2022, the environmental status of 56 marine dumping areas and their adjacent sea areas were monitored. The results showed that the seawater quality met or was better than the Seawater Quality Standard Grade III in the monitored and assessed dumping zones and their adjacent sea areas, and the sediment quality met or was better than the Marine Sediment Quality Standard Grade II. The water depth as well as the seawater quality and sediment quality of the dumping zones remained stable compared with previous year.

Volume of waste and other matter dumped to seas of China from 2016 to 2022



Proportion of dumping volume in different sea areas in 2022

Distribution of dumping zones nationwide in 2022

Feature

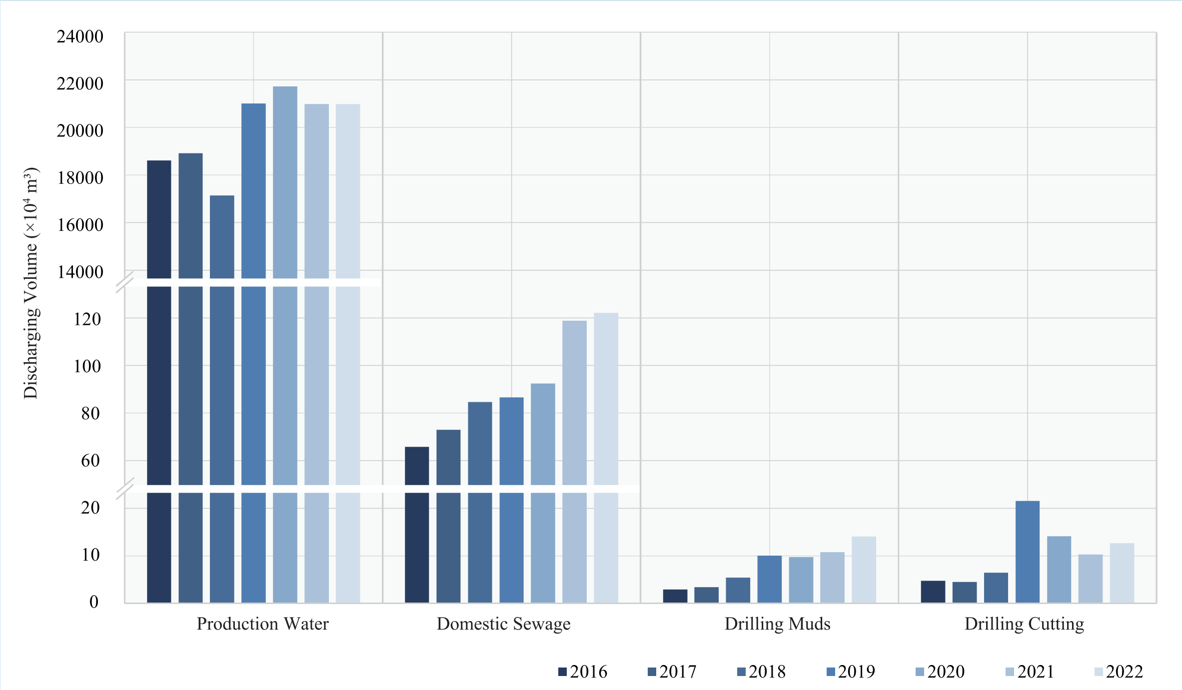
Reinforce the supervision and management of marine projects and ocean dumping

The Ministry of Ecology and Environment takes the initiative to provide administrative licensing services in the field of marine ecological environment, promotes marine ecological environment protection and high-quality economic development in a coordinated manner, and takes active efforts to ensure security in six areas of employment, basic living needs, operation of market entities, food and energy security, stable industrial and supply chains, and the normal functioning of primary-level governments and keep employment, the financial sector, foreign trade, foreign and domestic investments and expectations stable. Efforts have also been made to strengthen the management of environmental impact assessment for marine engineering construction projects, study and develop the *Technical Guidelines for Environmental Impact Assessment - Marine Environment*. Focusing on national major projects, environmental impact assessment approval services were carried out in accordance with the law and regulations, ensuring the smooth construction of national major projects such as the land part of the container terminal project in the Xiaoyangshan North Operating Area of Yangshan Deepwater Port Area and the expansion project of the International Container Hub Port in Yangpu District, Hainan.

MEE has strengthened the supervision and management of marine dumping and public services, closely followed the implementation of national strategies such as the coordinated development of Beijing-Tianjin-Hebei Area, the integrated development of the Yangtze River Delta, and the construction of the Guangdong-Hong Kong-Macao Greater Bay Area, and newly selected 4 temporary marine dumping areas to ensure the normal operation of large coastal ports and waterways and the dumping needs of major national projects. Efforts have been made to effectively implement the reform requirements of "streamlining management and serving", and the Basin and Sea Area Bureau has undertaken the review and approval of "issuance of marine dumping permits for waste", further improving the timeliness of permit processing. Off-site supervision methods have been comprehensively utilized such as ship AIS and satellite remote sensing to strengthen the supervision of marine dumping.

4.2 Oil/Gas Exploration Zones

In 2022, the volumes of production water discharged into seas from offshore oil/gas platforms were about 209.79 million m³, which remained almost the same as that in the previous year. Meanwhile, the volumes of domestic sewage, drilling muds and drilling cuttings discharged into seas were about 1,221,000 m³, 141,000 m³ and 127,000 m³, which increased by 2.9%, 30.0% and 23.0% respectively compared with the previous year.



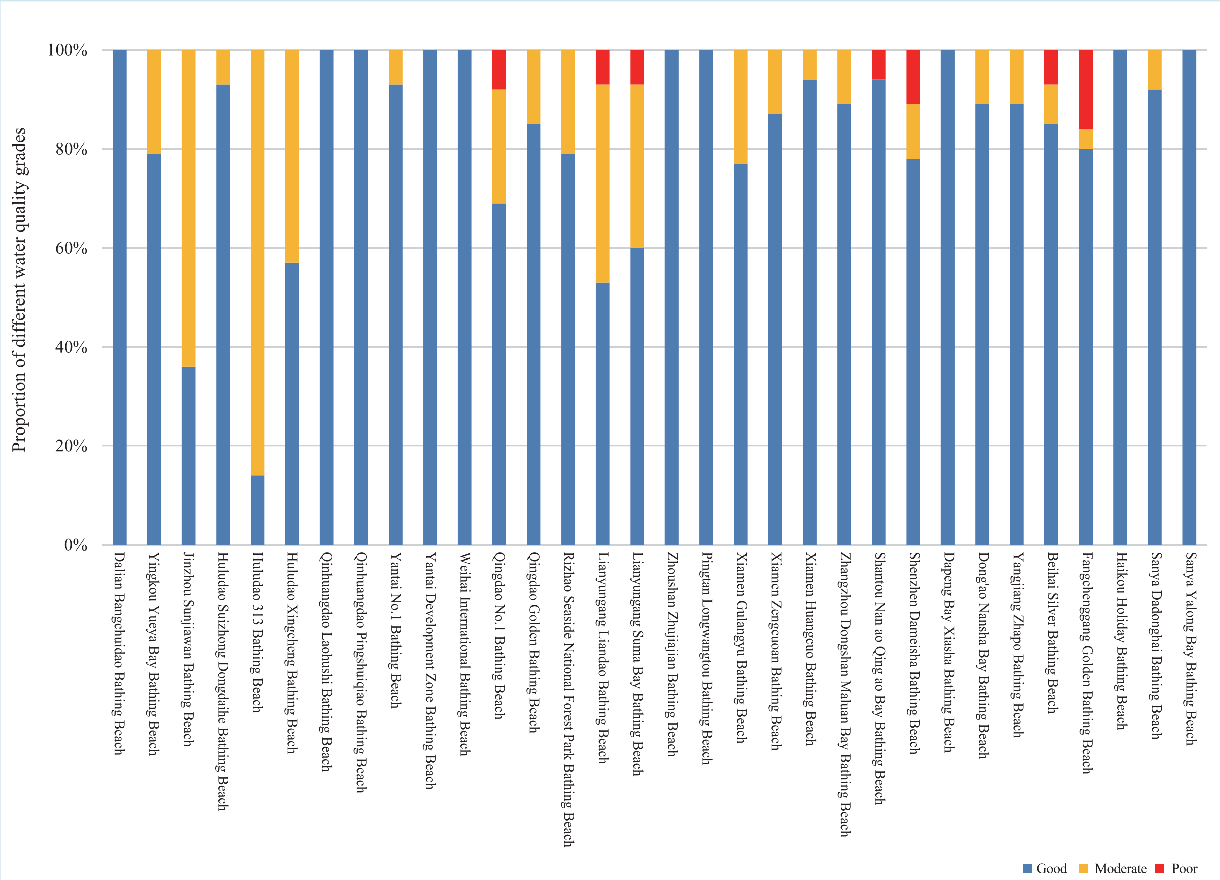
Volume of pollutants discharged into seas from offshore oil/gas platforms from 2016 to 2022

In 2022, the marine environmental status of 20 offshore oil/gas exploration zones and their adjacent sea areas in the Bohai Sea, East China Sea and South China Sea were monitored. The results showed that the proportion of seawater meeting Seawater Quality Standard Grade I increased in the offshore oil/gas exploration zones of the Bohai Sea, where the petroleum, COD and cadmium in seawater met the Seawater Quality Standard Grade I. Meanwhile, in some offshore oil/gas exploration zones of the Bohai Sea, 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 and South China Sea met Seawater Quality Standard Grade I. The sediment qualities of the offshore oil/gas exploration zones basically met Marine Sediment Quality Standard Grade I.

4.3 Bathing Beaches

In the swimming season of 2022, the water quality* of 32 bathing beaches was monitored.

Twenty-five bathing beaches were in good or moderate seawater quality during the monitoring period. Among them, including Dalian Bangchuidao Bathing Beach, Qinhuangdao Laohushi Bathing Beach, Qinhuangdao Pingshuiqiao Bathing Beach, Yantai Development Zone Bathing Beach, Weihai International Bathing Beach, Zhoushan Zhujiajian Bathing Beach, Pingtan Longwangtou Bathing Beach, Dapengwan Xiasha Bathing Beach, Haikou Holiday Bathing Beach and Sanya Yalong Bay Bathing Beach were in good seawater quality. Qingdao No.1 Bathing Beach, Lianyungang Liandao Bathing Beach, Lianyungang Sumawan Bathing Beach, Shantou Nan'ao Qing'ao Bathing Beach, Shenzhen Dameisha 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 petroleum.



Status of water quality of bathing beaches in coastal cities of China in 2022

*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 2022, 35 fishery areas were monitored, including spawning grounds, feeding grounds, migration routes, key protected aquatic habitats as well as aquatic germplasm resources reserves, covering 4.424 million hectares.

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, copper and zinc accounted for 39.8%, 67.5%, 99.4%, 91.5%, 99.9% and 99.995% of the total monitored areas respectively. The content of lead, cadmium, mercury, arsenic and chromium all met the standards. Compared with the previous year, the proportions of areas with exceeding inorganic nitrogen, petroleum, copper and zinc increased, while which with exceeding active phosphate and COD 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 and COD were 60.4%, 66.5%, 98.7% and 97.4% of the total monitored areas respectively, and the content of copper, zinc, lead, cadmium, mercury, arsenic and chromium were all meeting the standard value. Compared with the previous year, the proportions of areas with exceeding petroleum and COD increased, while those with exceeding organic nitrogen and active phosphate decreased.

The dominant pollution indicator that exceeded the standard in the water bodies of the 7 National Aquatic Germplasm Resources Conservation Areas (marine) was inorganic nitrogen. The proportion of areas meeting the standard value for content of inorganic nitrogen, active phosphate, petroleum, COD, copper and mercury were 9.5%, 75.9%, 92.3%, 53.0%, 98.2% and 99.98% of the total monitored areas respectively, and the content of zinc, lead, cadmium, arsenic and chromium were all meeting the standard value. Compared with the previous year, the proportions of areas with exceeding inorganic nitrogen, petroleum, COD, copper and mercury increased, while those with exceeding organic nitrogen, active phosphate, zinc and cadmium decreased.

Sediments in the 24 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 98.2%, 93.8%, 98.7%, 99.96%, 96.9%, 95.2%, 100% and 100% of the total monitored areas respectively. Compared with the previous year, the proportions of areas with exceeding petroleum, copper, zinc, lead and cadmium increased, while those with exceeding chromium decreased.

Feature

Continuously strengthening the conservation, protection, and restoration of aquatic biological resources

The Ministry of Agriculture and Rural Affairs issued the *Guiding Opinions on Doing a Good Job in the Proliferation and Release of Aquatic Organisms during the 14th Five-Year Plan* and the *Guiding Opinions on Strengthening the Conservation of Aquatic Organism Resources*, making arrangements for the conservation, proliferation and release of aquatic organism resources during the 14th Five-Year Plan and the future period. In 2022, a total of 400 million yuan of central government funding was allocated, driving the national investment of more than 1 billion yuan in releasing over 38 billion aquatic species, including 30 billion marine species. National level marine ranching demonstration zones continued to be set up. The eighth batch of 16 national level marine ranching demonstration zones were announced, and the total number reached 169. Further efforts were made to implement the action plan for the protection of flagship species such as Chinese white dolphins, Spotted seal and turtles. The operation of the “National Key Protected Aquatic Wildlife Information Management System” were put in use, to promote the identification management of aquatic wildlife. Jointly efforts by multiple departments including the State Forestry and Grassland Administration and the State Administration for Market Regulation were made to carry out special law enforcement actions such as the “Clean Wind Action” and the “Internet Shield Action” , in order to crack down on illegal and irregular activities involving aquatic wildlife.

Feature

Orderly Promoting the Supervision of Marine Aquaculture Ecological Environment

The Ministry of Ecology and Environment and the Ministry of Agriculture and Rural Affairs jointly promote the implementation of the *Opinions on Strengthening the Supervision of Marine Aquaculture Ecological Environment*, with the improvement of marine ecological environment quality as the core, to effectively strengthen the supervision of marine aquaculture ecological environment. A joint working mechanism and an expert group for technical support were established, and joint research and regular communication of work status were carried out to advance key actions and tasks on the ground. The Ministry of Ecology and Environment has organized the preparation of the *Technical Guidelines for the Formulation of Water Pollutant Discharge Control Standards for Local Aquaculture Industry*, guiding the formulation and revision of relevant standards for the discharge of tail water from coastal aquaculture, conducting remote sensing monitoring of the pollution discharge situation of coastal pond aquaculture, and strengthening the monitoring and supervision of marine aquaculture.

Feature

Taking the construction of beautiful bays as the main quest, systematically implement the “14th Five-Year Plan for Marine Ecological Environment Protection”

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 Maritime Police jointly promote the implementation of the *14th Five-Year Plan for Marine Ecological Environment Protection*, taking the construction of beautiful bays as the main quest. Key tasks and measures for marine ecological environment protection during the “14th Five-Year Plan” period were introduced, and gradually implemented in 283 bays* in China's coastal waters. A hierarchical governance system at "national, provincial, municipal, and Gulf" levels has been formed. Nearly all the ecological and environmental departments of coastal provinces (autonomous regions, municipalities directly under the central government) and coastal cities have issued their own “14th Five-Year Plan” marine ecological and environmental protection plans or key planning points. At present, relevant departments and coastal areas adhere to land and sea coordination, systematic governance, and precise implementation of policies, and work together to promote marine pollution prevention and control, ecological protection and restoration, coastal environmental improvement, and climate change response. Efforts were made to enhance the ecological environment governance and regulatory capabilities of land and sea coordination, and to promote the implementation of various task indicators in the 14th Five-Year Plan.

The Ministry of Ecology and Environment regards the construction of the Beautiful Bay** as a concentrated manifestation and important carrier of the construction of the Beautiful China in the field of marine ecological environment. It has compiled and issued the *Basic Requirements for the Construction of the Beautiful Bay and Reference Indicators for the Construction of the Beautiful Bay (Trial)*, proposing clear requirements, and setting concise and clear indicators, so that the general public can vividly understand and personally feel the environmental and ecological beauty of the Beautiful Bay and the effectiveness of governance. MEE has selected the first batch of 8 outstanding (nominated) cases of Qingdao Lingshan Bay and other beautiful bays, and called for the second batch of excellent cases. Liaoning, Hebei, Jiangsu, Zhejiang, Fujian, Shandong, Hainan and other provinces have issued provincial-level construction plans or requirements for beautiful bays, guiding coastal cities to strengthen the comprehensive management with "One Bay, One Policy" approach, and exploring a number of good experiences, practices, and models for the construction of beautiful bays.

According to the water quality monitoring and evaluation results of the coastal waters in 2022, out of 283 bays, 144 bays were with more than 85% of their areas of excellent water quality, and 111 bays were with 100% areas of excellent water quality, mainly distributed in Liaoning, Hebei, Tianjin, Shandong, Jiangsu, Guangdong, Guangxi, and Hainan. Compared with the previous year, the proportion of excellent water quality areas in 90 bays has increased and is distributed in coastal provinces. Among them, the proportion of bays with improved water quality in Tianjin, Zhejiang, Jiangsu, Guangxi, and Shandong exceeds 40%. The monitoring of coastal wetland protection shows that the area of 246 coastal wetlands in the bay is basically stable, while 37 coastal wetlands in the bay are degraded and damaged.

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* 283 geographical bay units across China's coastal waters, covering all the natural terrestrial coastline.

** A Beautiful Bay means its environment meets the standard that the water is clear, the beach is clean, biodiversity is present and people there are living in harmony with the nature. Also it should be able to provide aesthetic value and quality eco-products and meet the increasing needs of the people for a beautiful life.

Data Sources and Explanations for Assessment

The Bulletin of the Marine Ecology and Environment Status of China in 2022 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. Status of marine environmental quality, marine biodiversity, health of typical marine ecosystems, the ecological environment of marine natural reserves, 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 marine ecological disasters 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 Ministry of Natural Resources and 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 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 spring, summer and autumn. The overall assessment is based on *Seawater Quality Standard (GB 3097-1997)*, and *Technical specification for offshore environmental monitoring Part 10 evaluation and report (HJ 442.10-2020)*. The methodology adopted is guided by *The Technical Regulations for Seawater Quality Evaluation (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 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 assessment method for the ecological environment status of marine natural reserves 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 ocean dumping zones was based on *Ocean Dumping Matter Assessment Standatd (GB 30980-2014)*, *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)*, *Seawater Quality Standard (GB 3097-1997)*, and *Marine Sediment Quality (GB 18668-2002)*, and the indicators are based on *Effluent Limitations for Pollutants from Offshore Petroleum Exploration and Production (GB 4914-2008)*. 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 environmental assessment for Marine fishery areas was based on the *Fishery Water Quality Standard (GB 11607-1989)*, *Seawater Quality Standard (GB 3097-1997)*, and *Marine Sediment Quality (GB 18668-2002)*.

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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