

# 中国海洋塑料垃圾污染及治理实践

## China's Policies and Actions Against for Marine Plastic litters Pollution

穆景利

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# Contents

## 01 塑料垃圾与微塑料

Plastic debris and microplastics

## 02 中国海洋塑料污染现状

Marine plastic pollution in China

## 03 中国塑料垃圾污染防治政策与行动

China's policy and action against plastic pollution

## 04 挑战与展望

Challenges and Perspectives

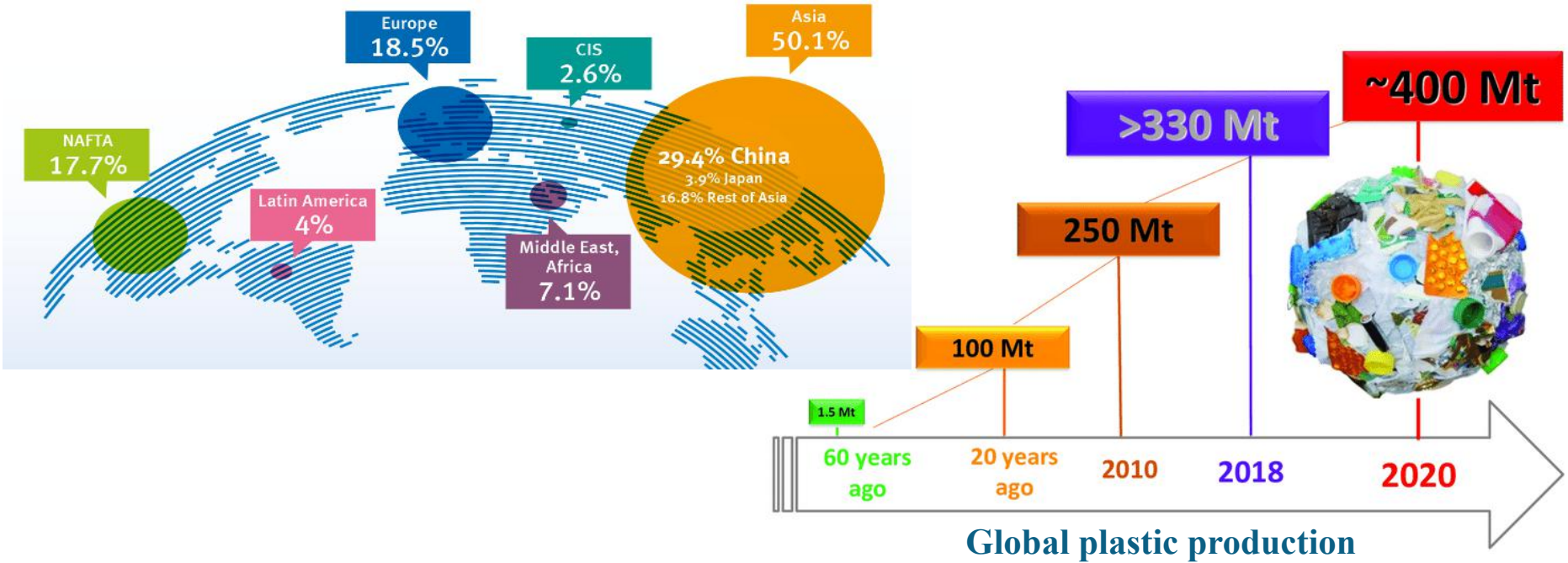


## 01 塑料垃圾与微塑料

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**Plastic debris and microplastics**

# Global plastic production

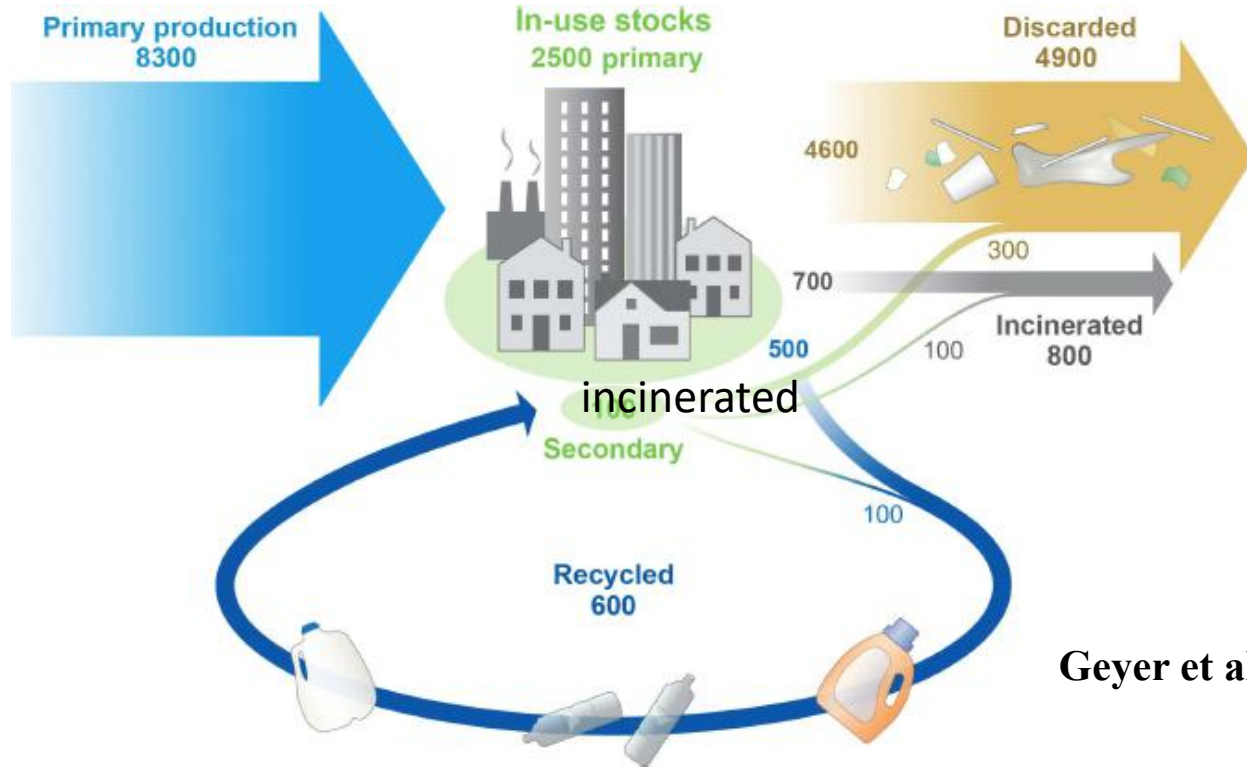


❑ Increased exponentially since the 1950s, and reached about 400 million tons in 2020.

❑ More than 50% of global plastic production in Asia.

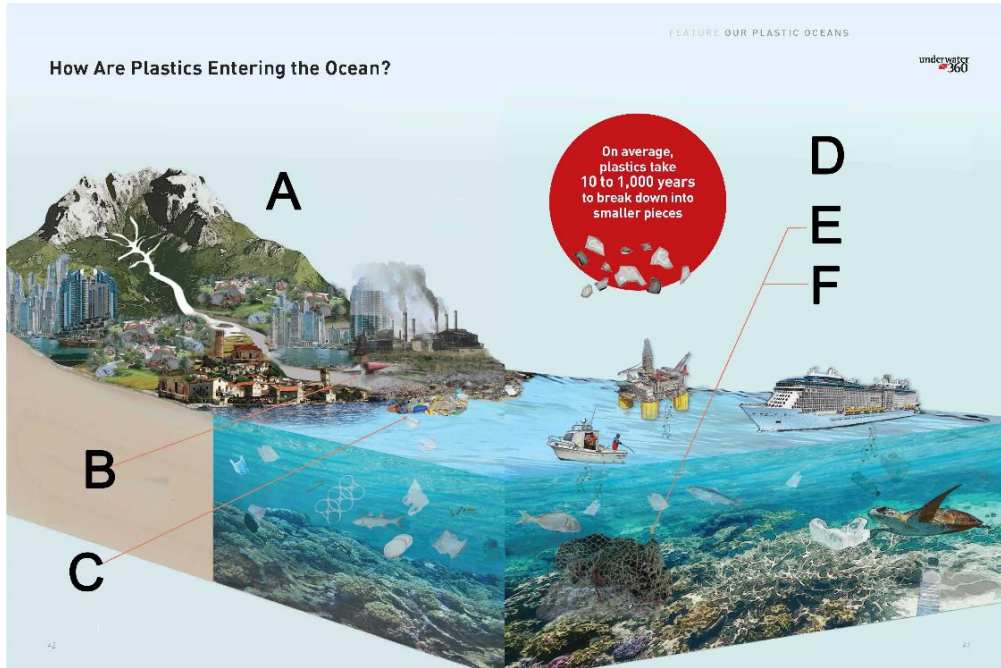
*Plastic Europe, 2020*

# Plastic in Marine environment



- ❑ As of 2015, 6300 Mt of plastic waste had been generated, around 9% of which had been recycled, 12% was incinerated, and 79% was accumulated in the natural environment.
- ❑ Roughly 12,000 Mt of plastic waste will be in landfills or in the natural environment by 2050.

# Sources of Plastic in Marine environment



Geyer et al., Sci. Adv. 2021,

A) 80% of plastic entering the oceans comes from **land-based sources**

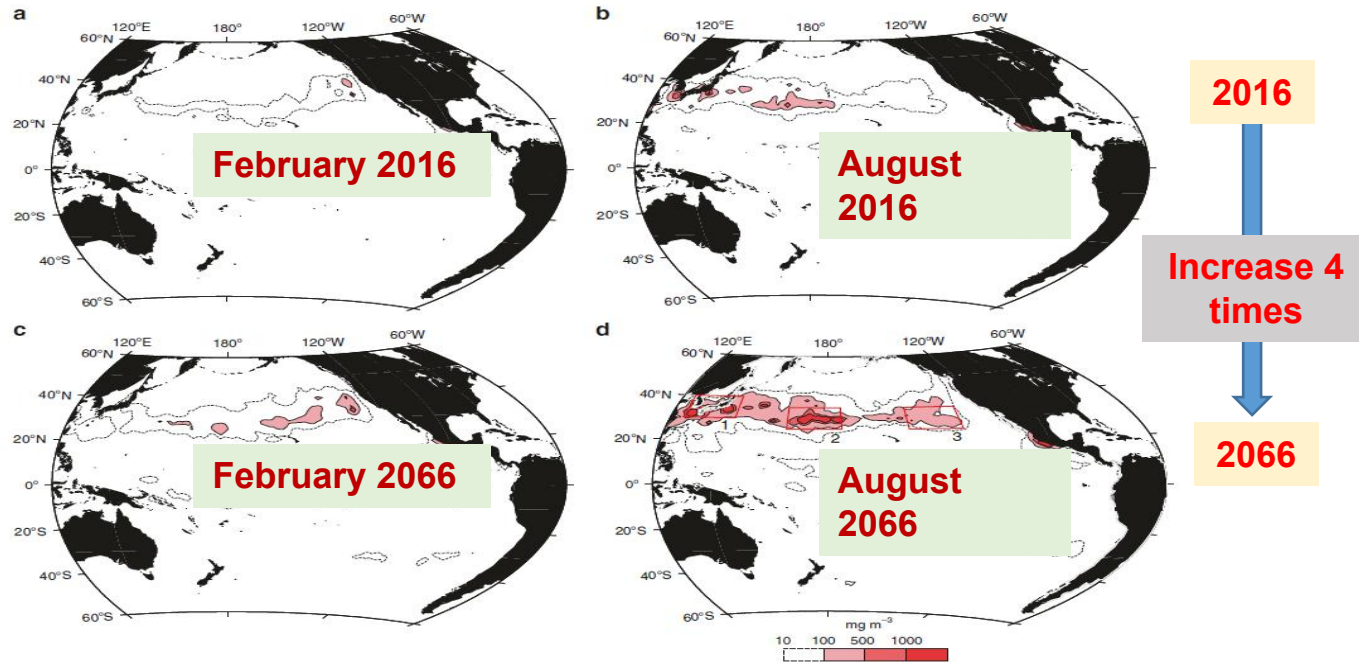
B) 75% of plastics from land-based sources comes from uncollected waste or litter, entering the oceans via **rivers, sewage outlets, and storm drains**

C) Rivers deposit **2.75 Million** metric tonnes of plastic into the seas every year

D) 20% of ocean plastics come from **marine-based sources** including **oil rigs, fishing vessels, and boats transporting** either goods or passengers

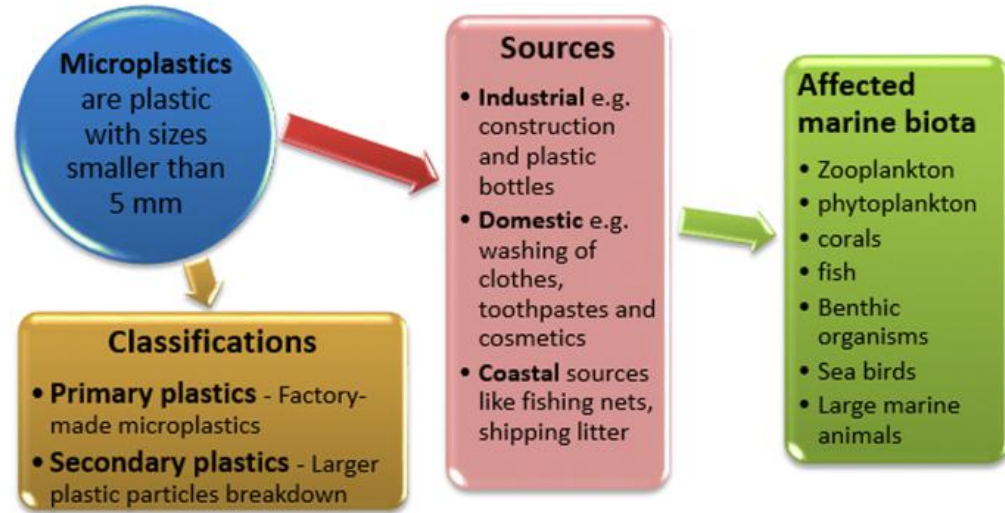
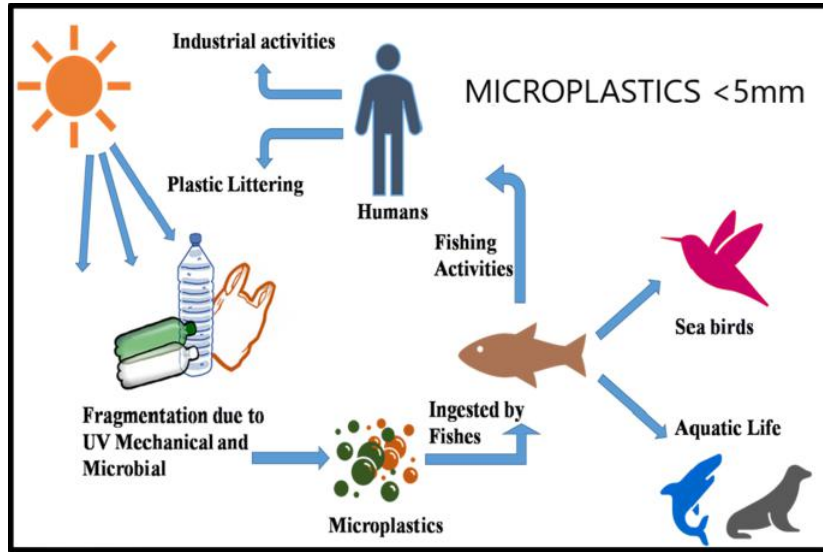
**It is estimated that 150 MMT of plastic were circulating in the marine environment as of 2016 (World Economic Forum, 2016).**





## Abundances of Plastic fragments floating in the Pacific: status and prediction

# Micro plastics (微塑料)

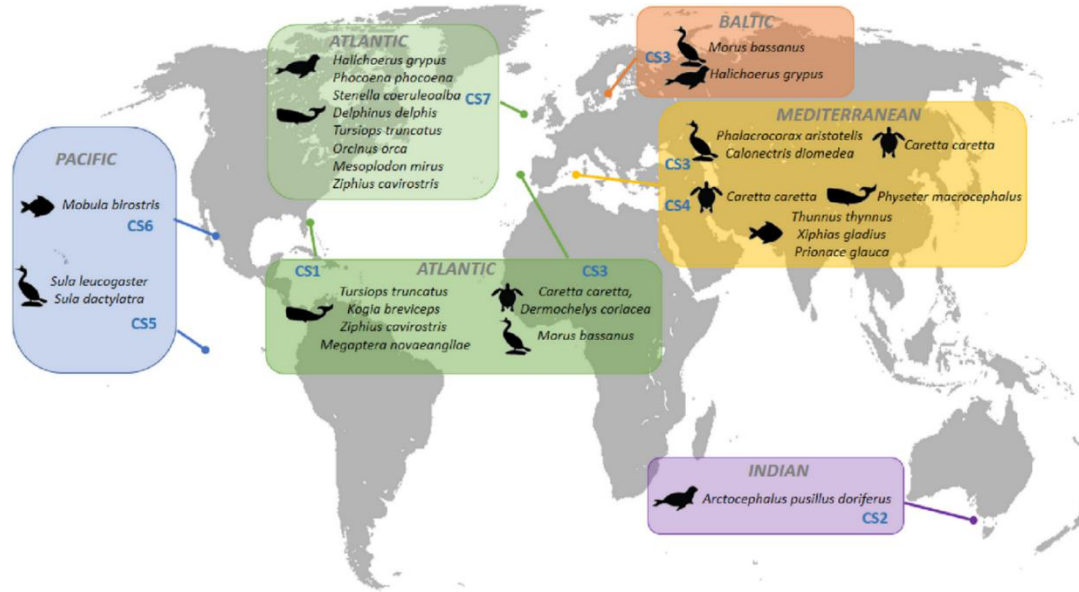


Pereao et al., ESPR, 2020

- ❑ Large plastic debris degrades into smaller fragments via physical, biological, or chemical weathering processes, and thus becomes microplastics (MPs, < 5mm).
- ❑ Primary MPs, industrial and domestic cleaning products generate most of the primary MPs;
- ❑ Secondary MPs, fragmented from large plastics into small size of debris.



# Biological and Ecological safety



Bluefin tuna  
(*Thynnus thynnus*)  
21.18% (18/85)



Swordfish  
(*Xiphias gladius*)  
10.71% (9/84)



Blue shark  
(*Prionace glauca*)  
25.26% (24/95)

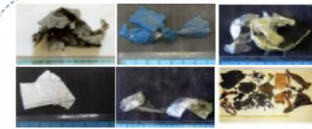


Loggerhead sea turtle  
(*Caretta caretta*)  
68.82% (53/77)



Sperm whale  
(*Physeter macrocephalus*)  
76.92% (10/13)

## PLASTICS



## SHEETLIKE



## OTHER



## THREADLIKE

## FRAGMENTS

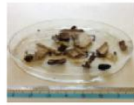


## FOAMED

## RUBBISH



## FISH HOOK



## VARIOUS RUBBISH

## POLLUTANTS

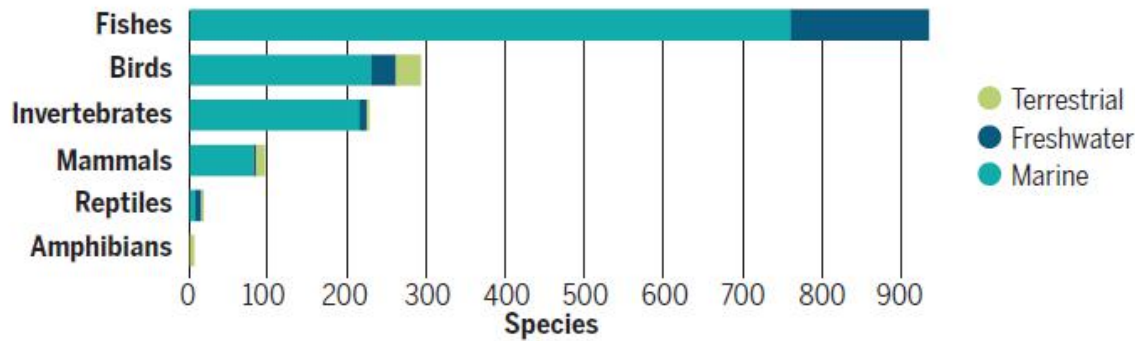


## TAR

Adverse impacts of marine litter is documented on >1400 species. The primary impacts include ingestion and entanglement. Smaller plastic fragments can give rise to toxic effects, oxidative stress, downregulated gene expression, and behavioral disorders.

Claro et al., 2019

**There is increasing concern about chemical contamination via ingestion.**



## Global evaluation of plastic ingestion by animals

- Ingested by a diverse group of species at the bases of trophic webs, such as invertebrates, fish and birds, **which suggests that trophic transfer could result in further plastic distribution across food webs.**
- It is anticipated that **the frequency of occurrence of physical effects on individual environmental receptors will continue to increase if current trends continue without mitigation measures**

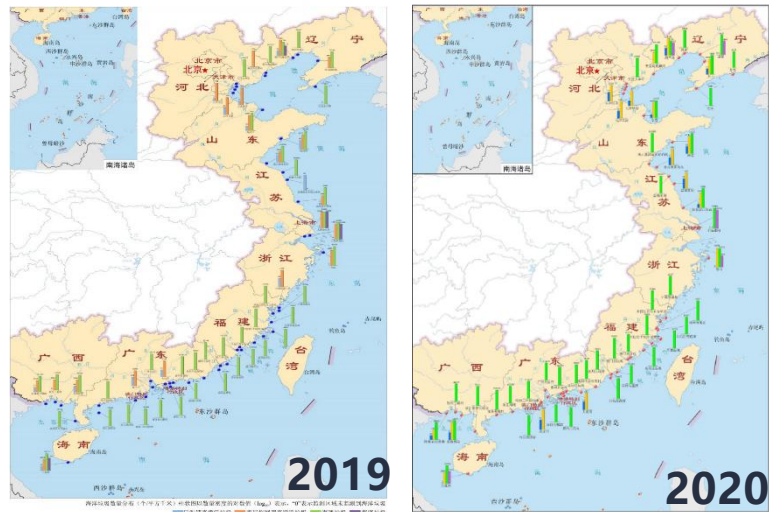
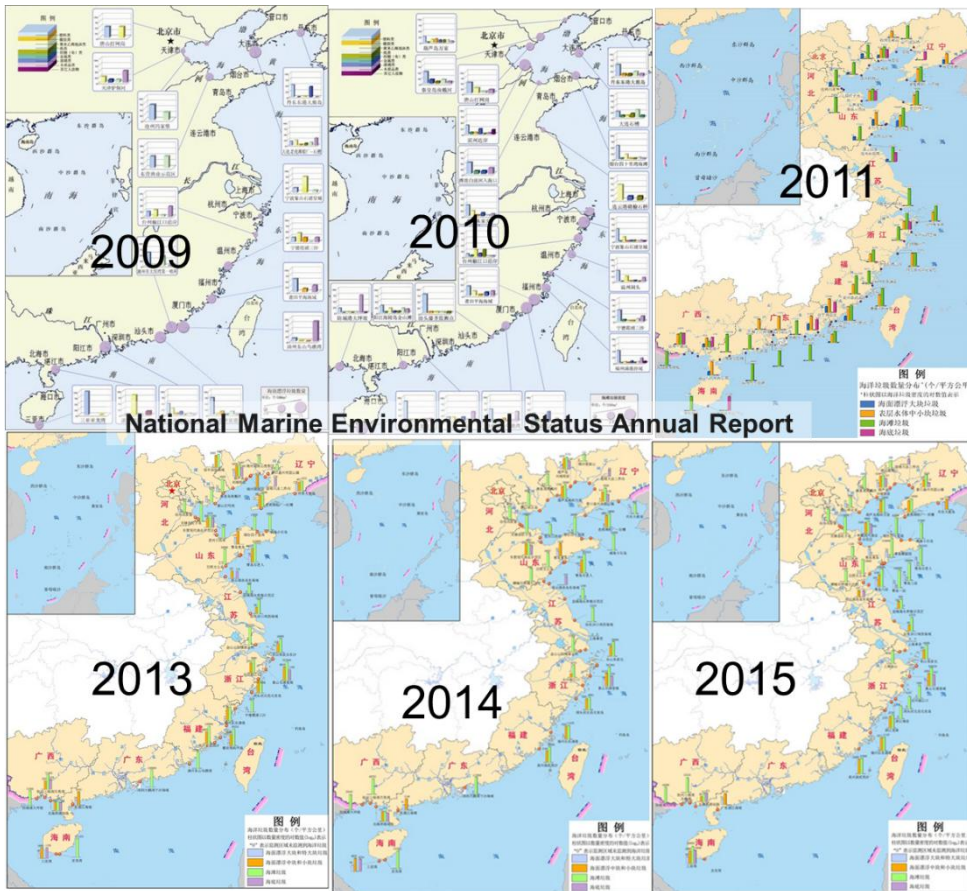


## 02 中国海洋塑料污染现状

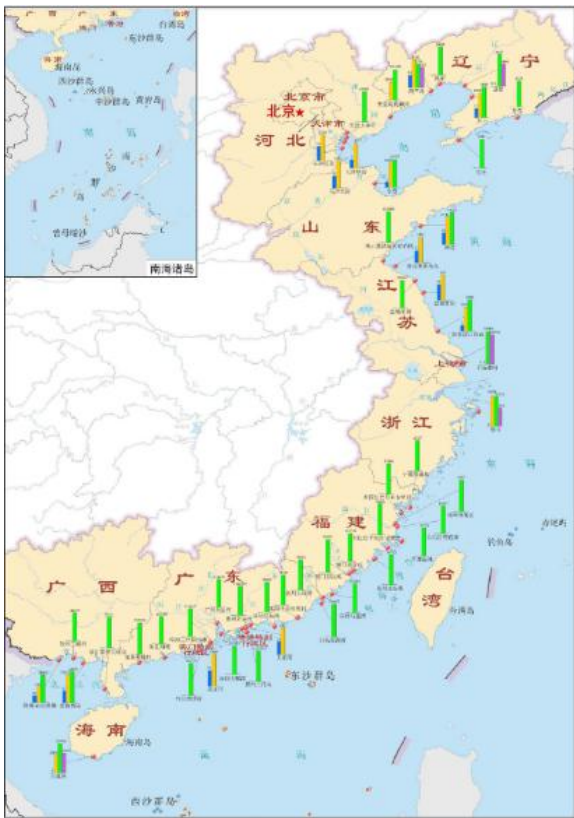
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**Marine plastic pollution in China**

# Marine litter in China

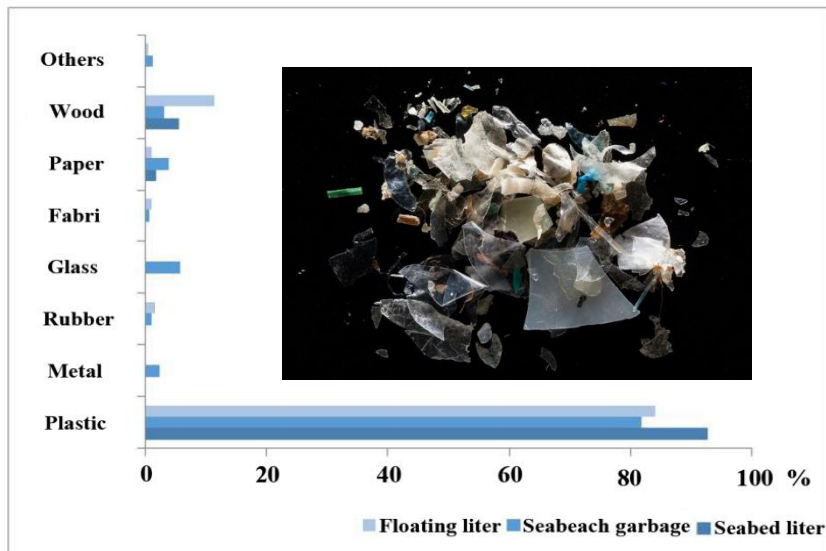






Distribution of marine litter abundance in 2020  
(Ministry of Ecology and Environment of the People's  
Republic of China, MEE)

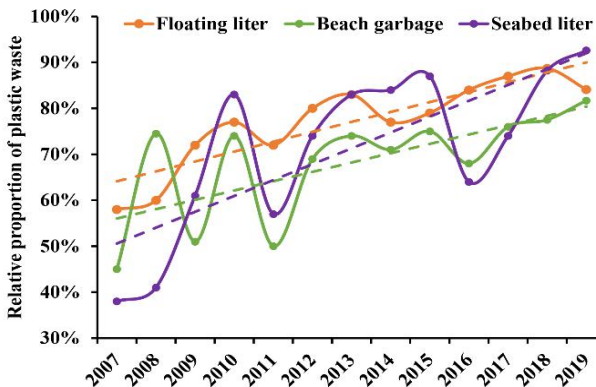
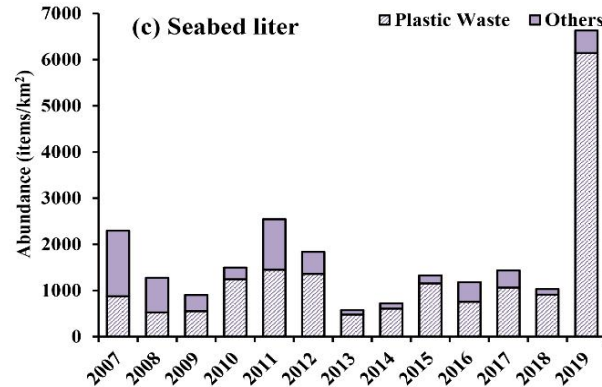
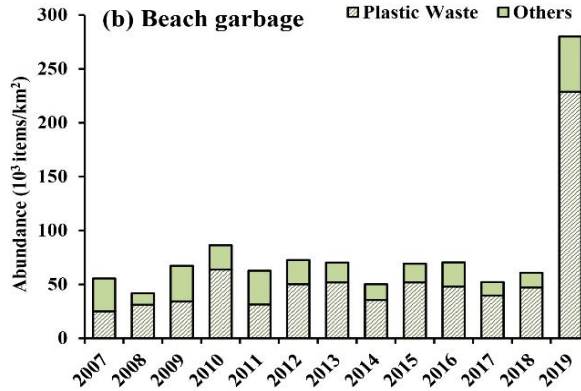
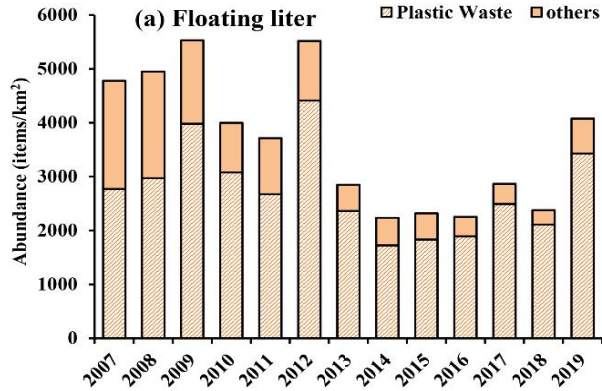
## Litters in marine environment, 2020



Main types of marine litter in 2020

- ❑ **Floating: 5363 items/km<sup>2</sup> , 9.6 kg/km<sup>2</sup>);**
- ❑ **Beach garbage: 21 6689 items/km<sup>2</sup> , 1244 kg /km<sup>2</sup>;**
- ❑ **Seabed litter: 7348 items/km<sup>2</sup>, 12.6 kg/km<sup>2</sup>;**

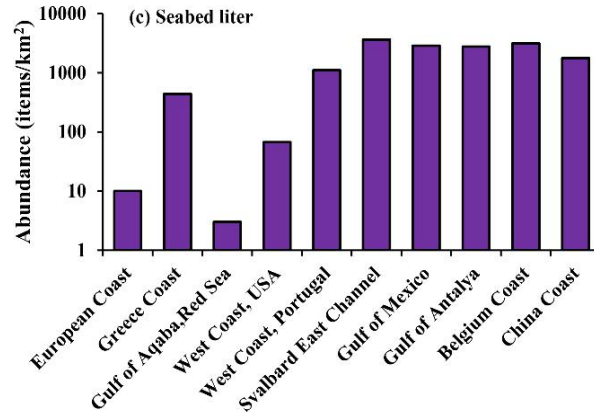
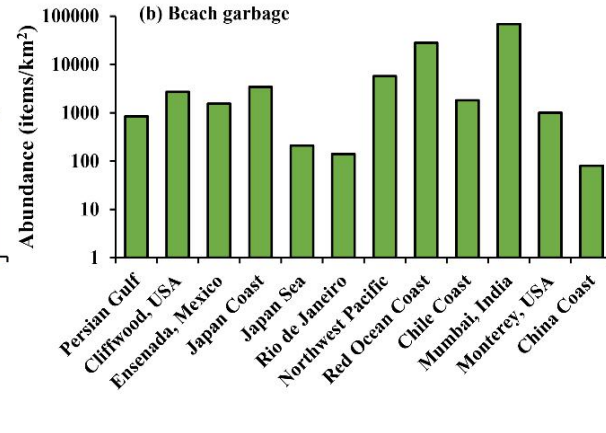
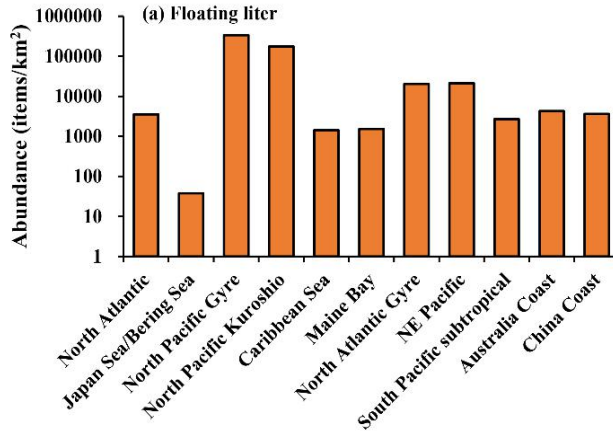
# Temporal variations of marine litter abundance and relative proportion of plastic waste during 2007 to 2019, China



✓ During 2007 to 2019, the average abundances of floating, sea beach and seabed litters showed **no significantly temporal variation, but the relative proportion of plastic waste showed an increasing trend.**

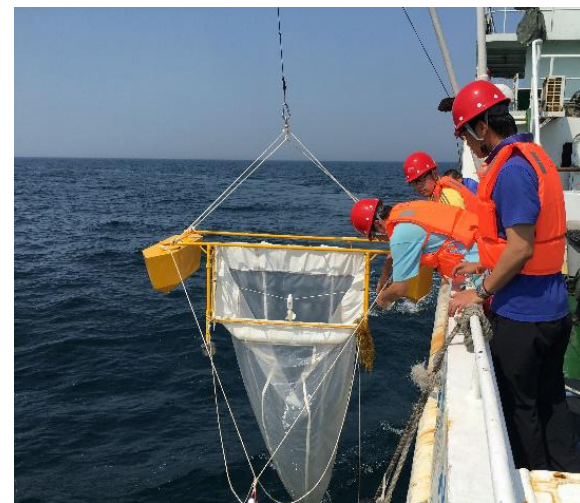
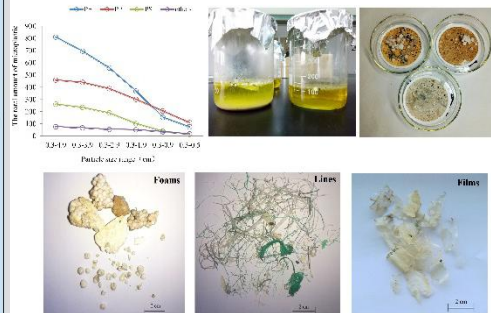
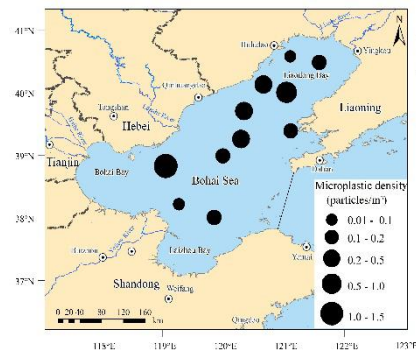


# Comparison of marine litter contamination between China and other countries or areas



✓ Generally, litter contamination in China was of the same order in magnitude as those reported in European and American Countries.

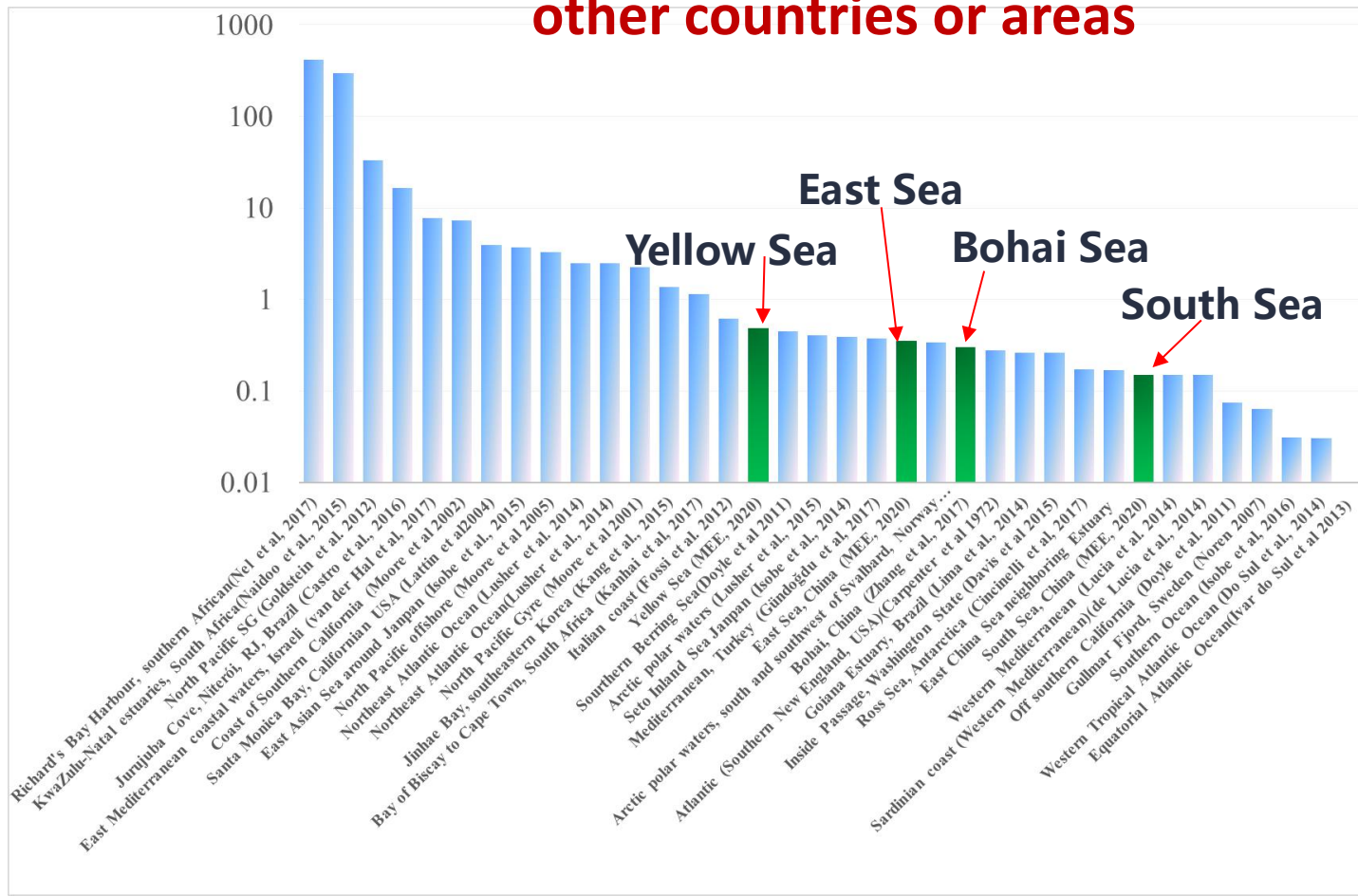
# Microplastics in offshore waters, China



- ✓ **Yellow sea:** 0.44 (0.09 ~ 1.41) item/m<sup>3</sup>
- ✓ Bohai Sea: 0.33 (0.08 ~ 1.34) item/m<sup>3</sup>
- ✓ East Sea: 0.32 (0.12 ~ 0.72) item/m<sup>3</sup>
- ✓ South Sea: 0.15 (0.04 ~ 0.38) item/m<sup>3</sup>
- ✓ Types: fibers, fragments, granules, and line.
- ✓ Polymer: PP, PET, PE.

Abundances of floating microplastic in the offshore waters in 2020

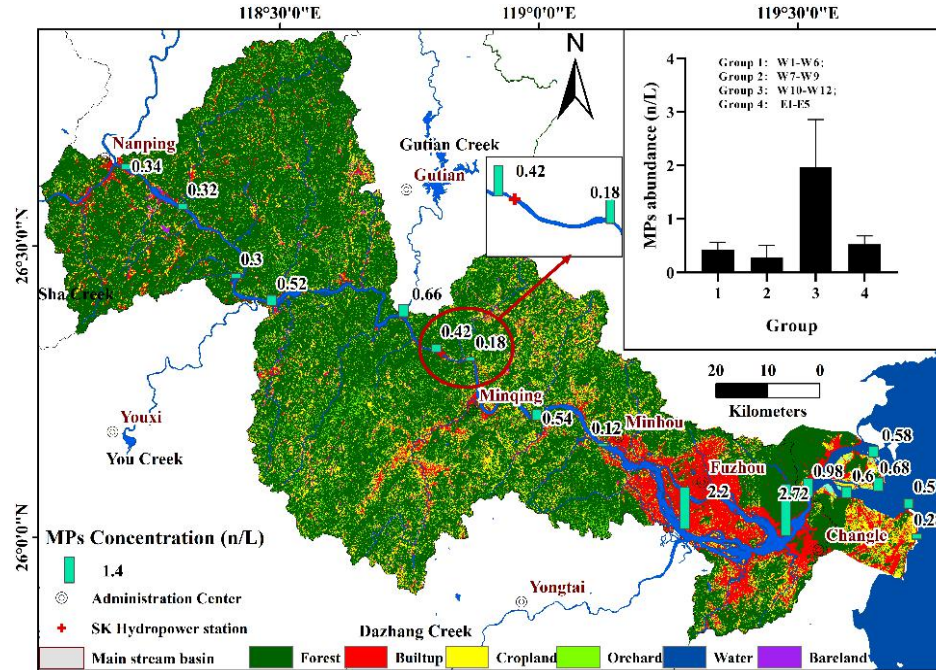
# Comparison of microplastics in offshore waters between China and other countries or areas



# MPs pollution in representative estuaries of China

Location	Tools	Methods	Size (mm)	Average abundance (items/m <sup>3</sup> )	Main composition	Main shape	References
Yangtze River Estuary	screw pump	FTIR	0.06- 5	<b>157.2±75.8</b>	PE、 PP	fiber	Zhao et al., 2019
	12 V DC Teflon pump	Visual identification	0.032-5	<b>4137.3±2461.5</b>	/	fiber	Zhao et al.,2014
	air lift pump	FTIR	20 μm-5 mm	900	PES	fiber	Luo et al., 2019
Pearl River Delta	Manta net	FTIR	333 μm-5 mm	0.127	PE、 PP	fragment	Mai et al., 2019
Pearl River Estuary	Water sampler	micro-Raman spectroscopy	50 μm-5 mm	<b>8902</b>	PA、 cellophane、 PP、 PE	Granule, film	Yan et al., 2019
	Manta net	FTIR	333 μm-5 mm	<b>2.4±0.7</b>	PE、 PP、 PS	fragment、 film、 polystyrene foam	Lam et al., 2020
Jiaojiang Estuary	Teflon pump	micro-Raman spectroscopy	333 μm-5 mm	955.6±848.7	PP、 PE	fiber、 granule	Zhao et al., 2015
Oujiang Estuary				680.0±284.6			
Minjiang Estuary				<b>1245.8±531.5-1170.8±953.1</b>			
Mingjiang Estuary	metal pail	FTIR	333 μm-5 mm	<b>1112 ±913</b>	PET	fiber	Huang et al., 2020
Jiulong River Estuary	Manta net	FTIR	0.33 mm-5 mm	438.8±190.7	PE、 PP	granule、 foam	Tang et al., 2018

# Spatial distribution of microplastic concentrations in Minjiang River Watershed

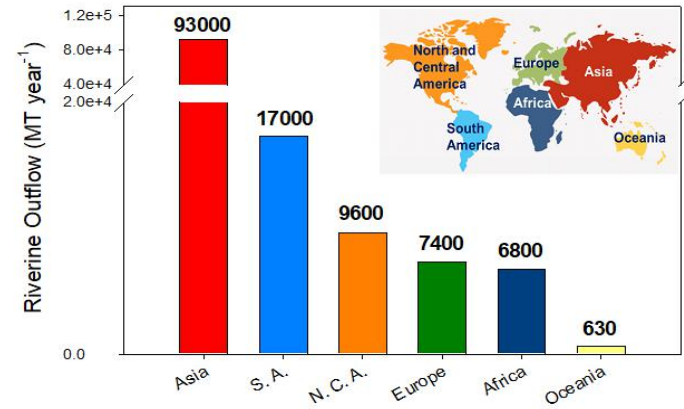


- ✓ Minjiang River estuary, mean microplastic concentration near urbanized area was higher than those found in sites closed to sea water or less affected by human activities
- ✓ Generally, **higher level of urbanization would lead to higher level of plastic pollution.**

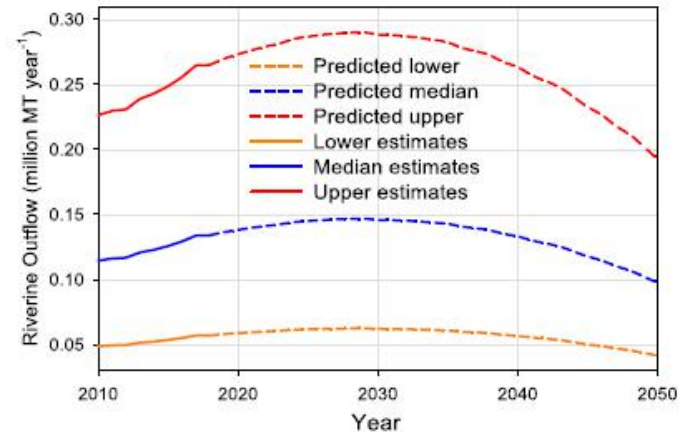


# The modeled riverine plastic outflows using the HDI and MPW

MPW		HDI	
Rivers	(Mt)	Rivers	(Mt)
Yangtze	15.5	Yangtze	1.7
Indus	2.44	Brahmaputra	1.04
Huanghe	1.92	Ganges	0.788
Haihe	1.49	Vaippar	0.62
Nile	1.4	Amazon	0.567
Bramaputra	1.23	Bekasi	0.377
Zhujiang	0.94	Vaigai	0.363
Amur	0.714	Mekong	0.34
Niger	0.665	Irrawaddy	0.323
Mekong	0.637	Congo	0.283



**57,000-265,000 (median: 134,000) MT year<sup>-1</sup> in 2018**







## 03 中国防治海洋塑料垃圾政策与行动

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**China's Policies and Actions Against Plastic Pollution**

# Regulations and Rules

## The National Development and Reform Commissions (NDRC)

2018, Revise a 2008 order, which banned the production and sale of plastic bags less than 0.025 millimetres thick. The order also made it compulsory for retailers to charge customers for plastic bags.



## General Office of the State Council

On January 1, 2018, a ban on the importation of 24 kinds of solid materials — including low-grade polyethylene terephthalate used in plastic bottles — was introduced.



# China's Plastic Ban: China limits use of non-degradable bags

China has implemented a new policy to curb the use of non-degradable plastic shopping bags starting 2021. Supermarkets and delivery companies are now replacing their traditional bags with degradable ones.



商家	塑料袋名称	标志	材质	执行标准	零售批发价 (承重)
和合谷 崇文门国瑞城店	生物降解 塑料购物袋	双	PBAT+PLA+St	GB/T38082-2019	0.5元 (2kg)
7-11便利店 崇文门国瑞城店	生物降解 塑料购物袋		PBAT+PLA+St20	GB/T21661	0.6元 (6kg)
义利 幸福大街店	可降解 塑料购物袋		(PE-HD)-D2W1	Q/HZH02	0.4元 (2kg)
顺天府超市 西城区大柵店	全生物降解 购物袋	双	PBAT	GB/T38082-2019	0.7元 (6kg)
便利蜂 幸福大街店	全生物降解 购物袋	双	PBAT+PLA+St20	GB/T38082-2019	0.6元 (4kg)
永辉超市 崇文门国瑞城店	生物降解 塑料购物袋	双	PBAT+PLA+St20	GB/T38082-2019	大1元 小0.6元
物美超市 崇文门国瑞城店	生物降解 塑料购物袋	双	PBAT+PLA+MD	GB/T38082-2019	大1.2元 小0.6元
肯德基 崇文门国瑞城店	全生物降解 塑料购物袋		(PBAT+PLA) +St20	GB/T38082-2019	免费 (饮品 袋, 0.65kg)
麦当劳 崇文门国瑞城店	生物降解 塑料购物袋	双	(PBAT+PLA) -MD7	GB/T38082-2019	免费 (饮品 袋, 0.6kg)
汉堡王 崇文门国瑞城店	生物降解 塑料购物袋	双	PBAT70+PLA8 +St22	GB/T38082-2019	免费 (饮品 袋, 1kg)
85°C 北京崇文店	生物降解 塑料购物袋		PLA+PBAT+MD	GB/T38082-2019	0.1元 (2kg) 成本0.3元
面包新语 北京崇文店	降解塑料购物袋		PE-HD	GB4806.7-2016	0.3元 (2kg)
北京迈德嘉汇 商贸有限公司 岳各庄批发市场	降解塑料购物袋		PE-D2W	Q/HY03-2020	约0.26元
北京天彩丰盈 商贸有限公司 岳各庄批发市场	生物可降解 购物袋		PE-HD	GB/T21661-2008	10元/50张 (6kg)
美团买菜 线上	生物降解塑料 购物袋	双	PBAT+PLA+TD	GB/T38082-2019	免费 (5kg)





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## Garbage sorting leads to healthy life, green development

*Environment*

Garbage sorting has become a hot topic in China. The Chinese leadership underlined efforts to cultivate the habit of garbage classification to improve the living environment and contribute to green and sustainable development.

By 2020, A total of 237 Chinese cities have started to practice garbage sorting.  
Of 46 large cities, 30 have issued regulations on the classification of household garbage.





# Raising the urban waste handling capacity

NDRC has issued the “14th Five-Year Plan” on waste classification,

China aims to re-use 60% of its trash by 2025

**By 2025, China expects to effectively control plastic pollution, substantially reduce the amount of plastic waste in landfills of key cities, establish a complete plastics management system and make progress in the development of alternative products.**



中华人民共和国国家发展和改革委员会  
National Development and Reform Commission



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机构设置



新闻动态



政务公开



政务服务

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## 国家发展改革委 住房城乡建设部关于印发 《“十四五”城镇生活垃圾分类和 处理设施发展规划》的通知

发改环资〔2021〕642号

各省、自治区、直辖市及计划单列市、新疆生产建设兵团发展改革委，各省、自治区住房和城乡建设厅，北京市城市管理委、天津市市容园林委、上海市绿化市容局、重庆市市政委，计划单列市城市管理局（市政公用局、城市建设局、市政园林局）：

为深入贯彻习近平总书记关于生活垃圾分类的重要批示指示精神，落实党中央、国务院决策部署要求，统筹推进“十四五”城镇生活垃圾分类和处理设施建设工作，加快建立分类投放、分类收集、分类运输、分类处理的生活垃圾处理系统，国家发展改革委、住房城乡建设部组织编制了《“十四五”城镇生活垃圾分类和处理设施发展规划》。现印发你们，请遵照执行。

国家发展改革委  
住房城乡建设部  
2021年5月6日

# Fujian Province Actions Against marine litter pollution

## Action 1: Establishing a holistic mechanism of inter-departmental coordination in joint marine pollution prevention and control

- Strengthen the source control of plastic debris. Explore the waste reduction and harmless management; “Ocean sanitation worker”
- Enforcing Evaluation System  
Assessment results of offshore floating garbage have been incorporated into the assessment of the environment protection target





## Action 2: Strengthen Sea-based source governance, upgrading facilities for marine aquaculture



Expanded Polystyrene, EPS

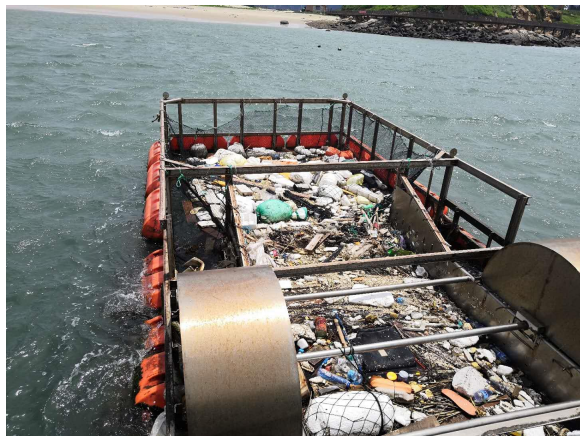


High Density Polyethylene, HDPE



## Action 3: Develop automatic garbage collection technology to reduce ocean plastic pollution

Self-driving interception and collection system for floating litter was tested to aid Fuzhou, help to collect hotspots of marine plastic pollution



叶轮式结构

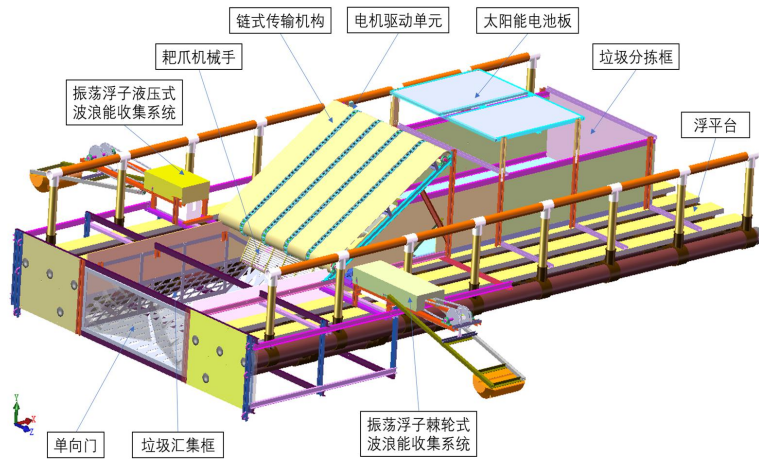
Impeller structure



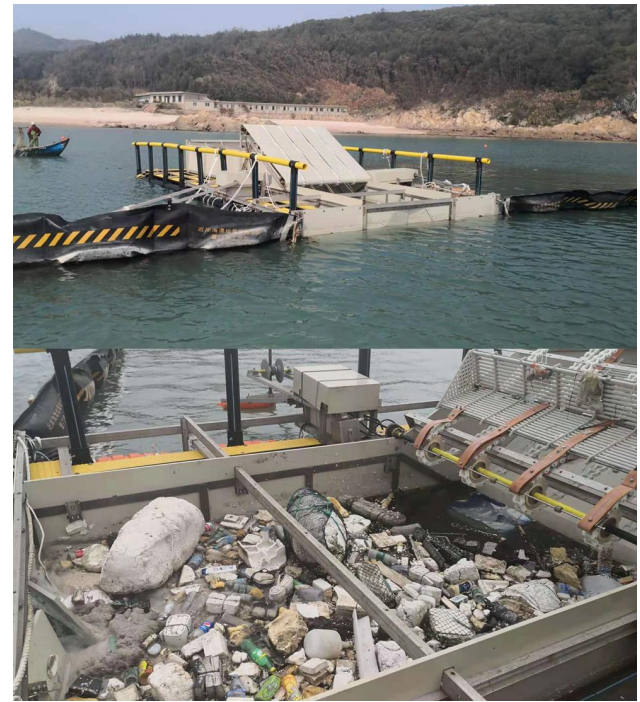
Dayu Island, Fuzhou, China

Pictures provided by Prof. Bijin Liu





## Using the Solar and wave energy



平台式结构

Platform structure

Pictures provided by Prof. Bijin Liu

# More Beautiful Bay



**Before**



**After**

Pictures provided by Prof. Bijin Liu

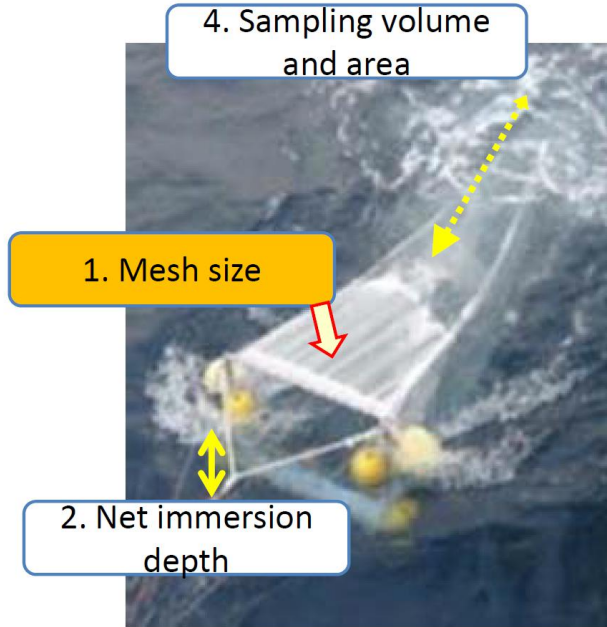
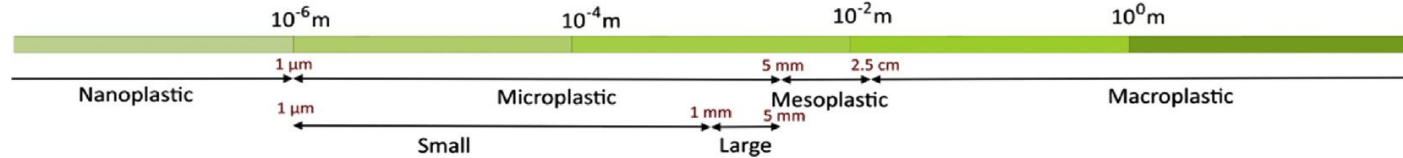


## 05 挑战与展望

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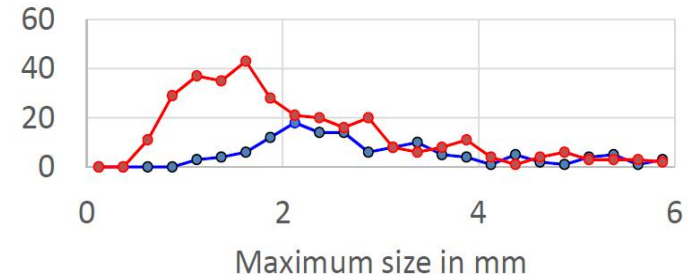
### Challenges and Perspectives

# 1. Limitation for plastics and microplastics quantification



- 3. Towing position side/tail
- 5. Towing duration and ship speeds
- 6. Subsampling

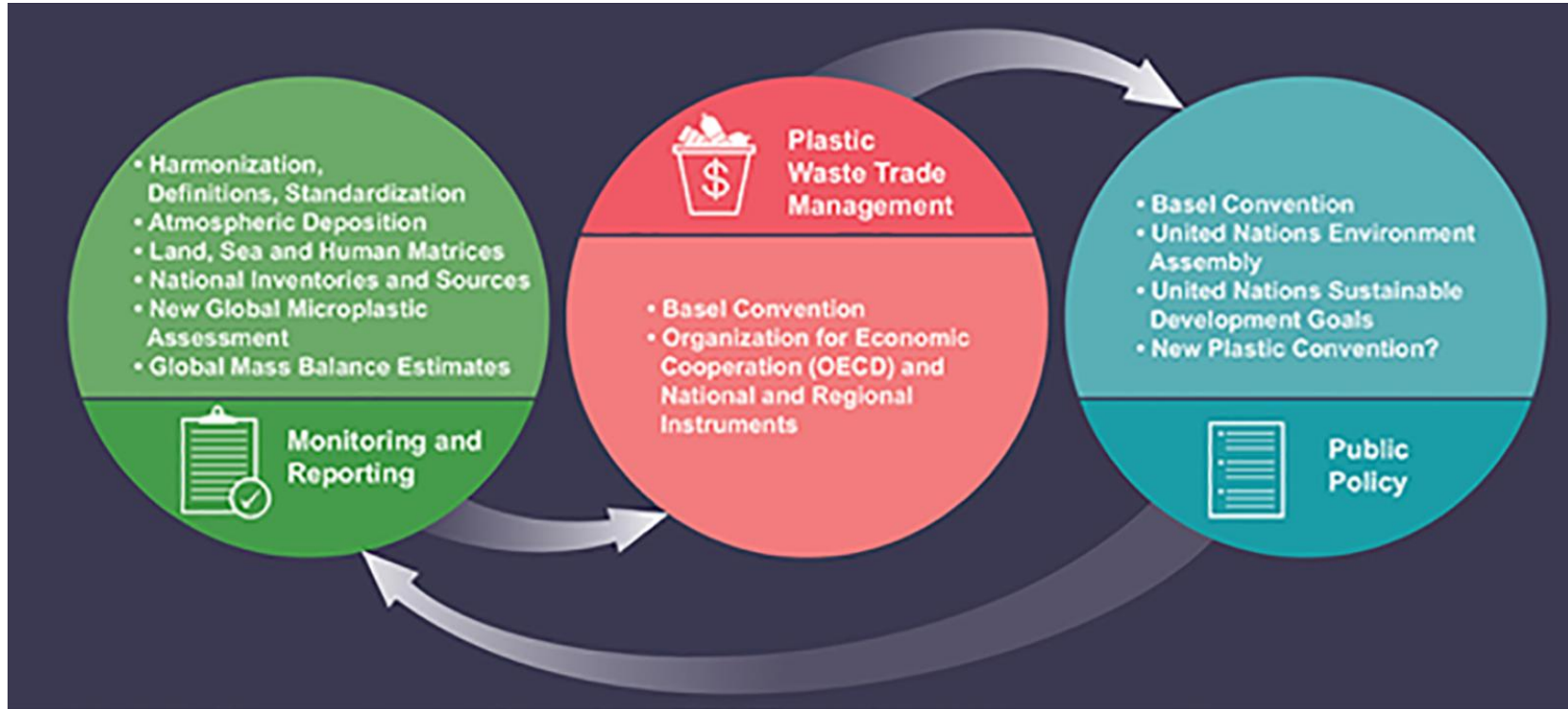
Comparison of size distribution between 0.35mm and 1.0mm mesh sizes



The lack of cohesive and standardized approaches hampers spatial and temporal comparisons of MP levels between and across these marine reservoirs



# Integrated, global monitoring system for plastic pollution is needed to provide comprehensive, harmonized data for environmental, societal, and economic assessments



## 2. How harmful are microplastics ? Do plastics affect human health?

nature

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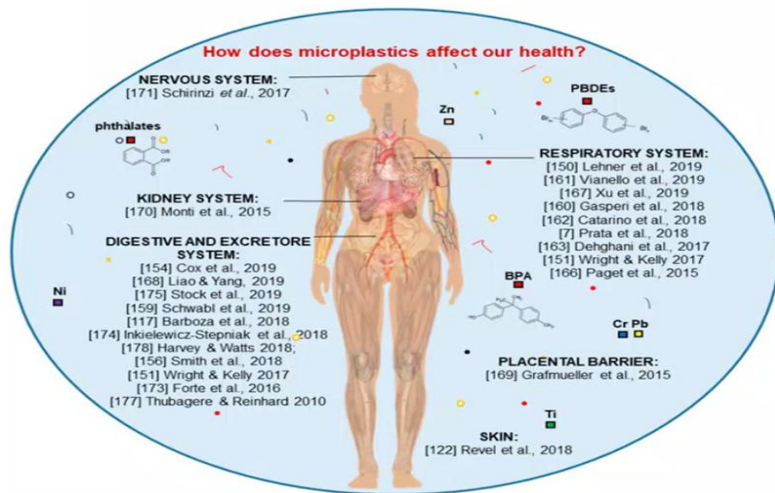
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NEWS FEATURE | 04 May 2021

### Microplastics are everywhere – but are they harmful?

Scientists are rushing to study the tiny plastic specks that are in marine animals – and in us.



- ❑ Researchers don't yet know is whether this is dangerous. Everyone eats and inhales sand and dust, and it's not clear if an extra diet of plastic specks will harm us.
- ❑ Most of what you ingest is going to pass straight through your gut and out the other end.
- ❑ I think it is fair to say **the potential risk might be high.**

### 3. Nanoplastics -- an underestimated problem?

nature  
nanotechnology

PERSPECTIVE

<https://doi.org/10.1038/s41565-021-00886-4>

Check for updates

## Nanoplastics are neither microplastics nor engineered nanoparticles

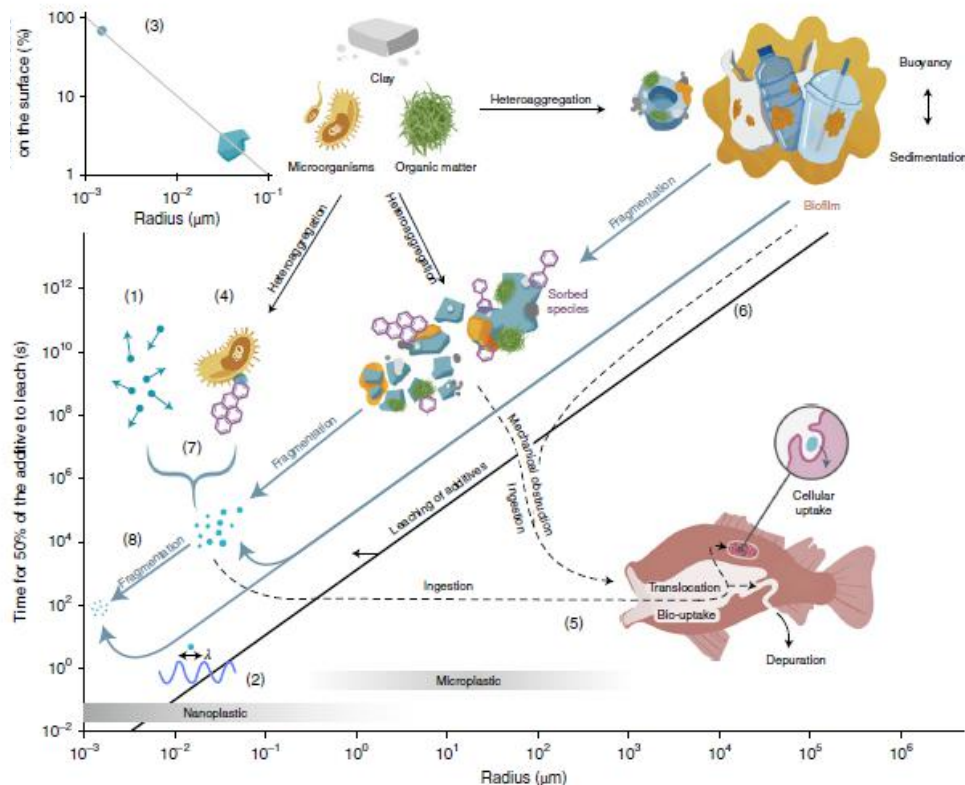
Julien Gigault<sup>1</sup>, Hind El Hadri<sup>2</sup>, Brian Nguyen<sup>3</sup>, Bruno Grassl<sup>2</sup>, Laura Rowenczyk<sup>3</sup>, Nathalie Tufenkji<sup>3</sup>, Siyuan Feng<sup>4</sup> and Mark Wiesner<sup>4</sup>

Increasing concern and research on the subject of plastic pollution has engaged the community of scientists working on the environmental health and safety of nanomaterials. While many of the methods developed in nano environment, health and safety work have general applicability to the study of particulate plastics, the nanometric size range has important consequences for both the analytical challenges of studying nanoscale plastics and the environmental implications of these incidental nanomaterials. Related to their size, nanoplastics are distinguished from microplastics with respect to their transport

## Huge gaps in knowledge

We don't even know how much nanoplastics there is in the different ecosystems

and great need for research



# Tackling marine plastic pollution and protecting our oceans



- ❑ In 2020, the world's attention turned to the COVID-19 pandemic. But even as we poured all of energy and resources into tackling it, many pointed to wider issues as contributing factors. **Nature and biodiversity loss. Climate change. Pollution and waste.** The three planetary crises. All of which are destroying the natural world and threatening our future
- ❑ Throughout all of this upheaval and debate, **we must not forget the vast blue world of the ocean.**



# Thank you for your attention!



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