

Microplastics ingested by copepods in Jiaozhou Bay, the Yellow Sea

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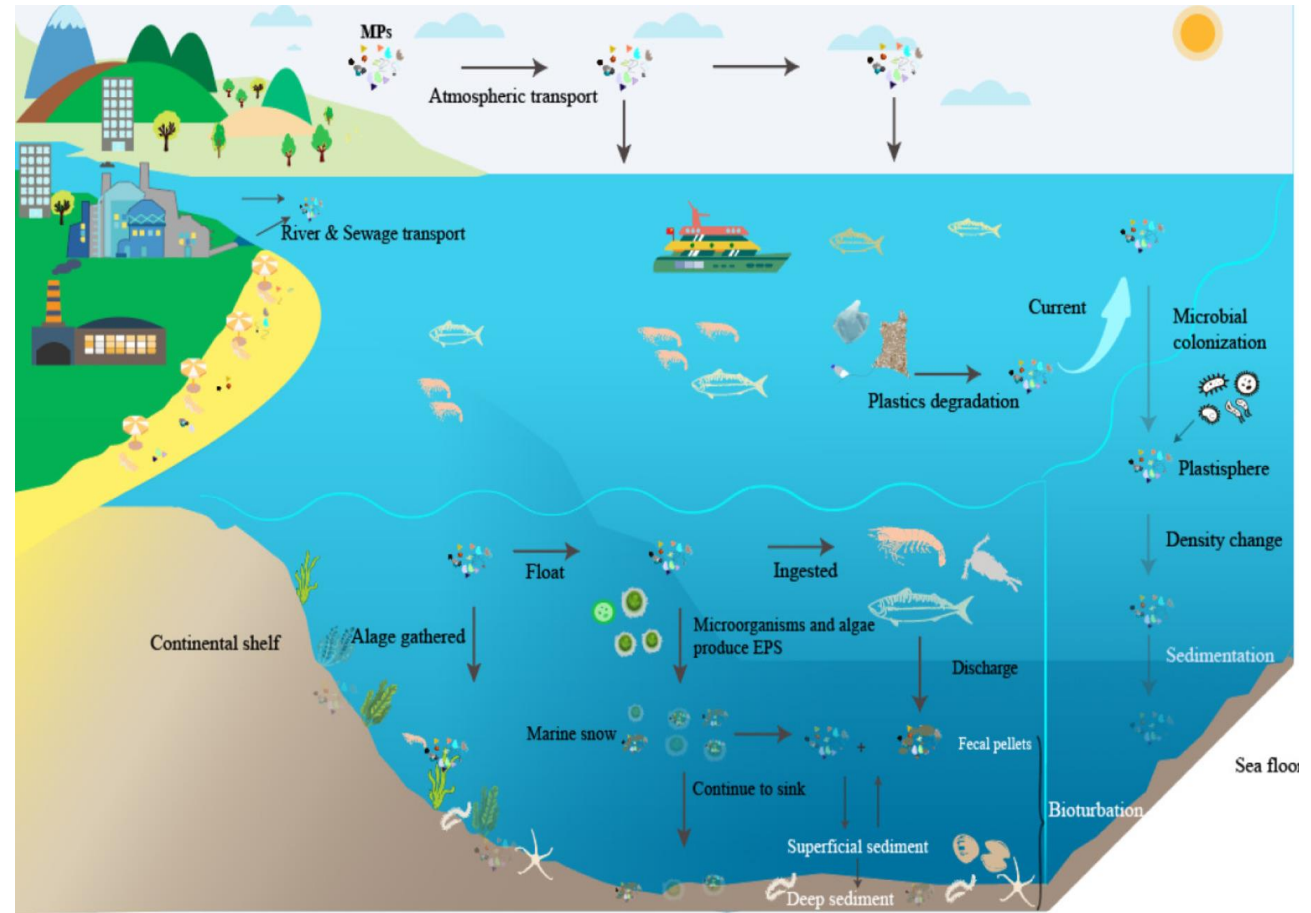
Microplastics: Major Ecological and Environmental Concern

➤ **Microplastics (MPs):** plastic debris less than 5 mm in diameter



(Zhang et al., 2021)

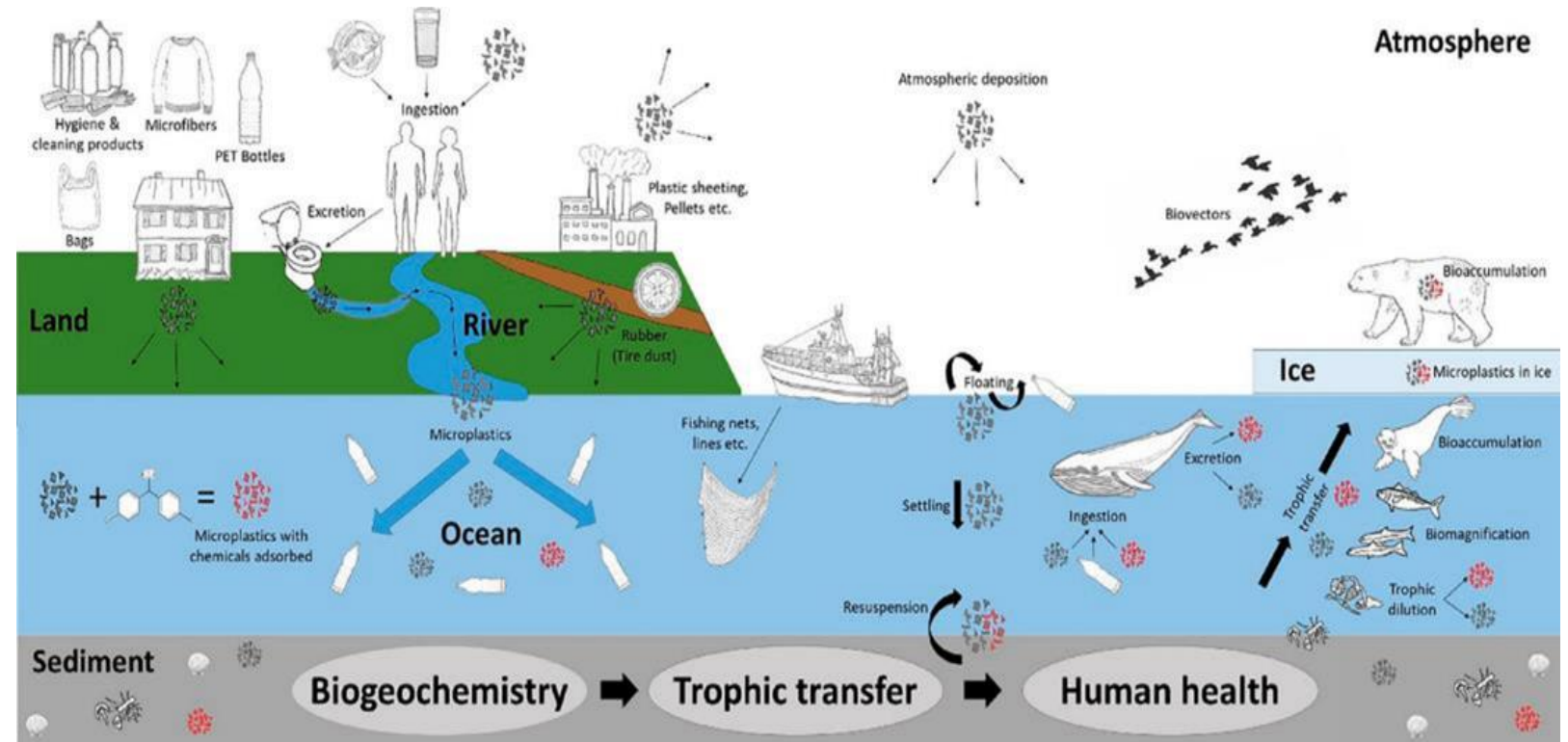
➤ MPs are ubiquitous and a growing threat to marine biota and ecosystems



(Li et al., 2023)

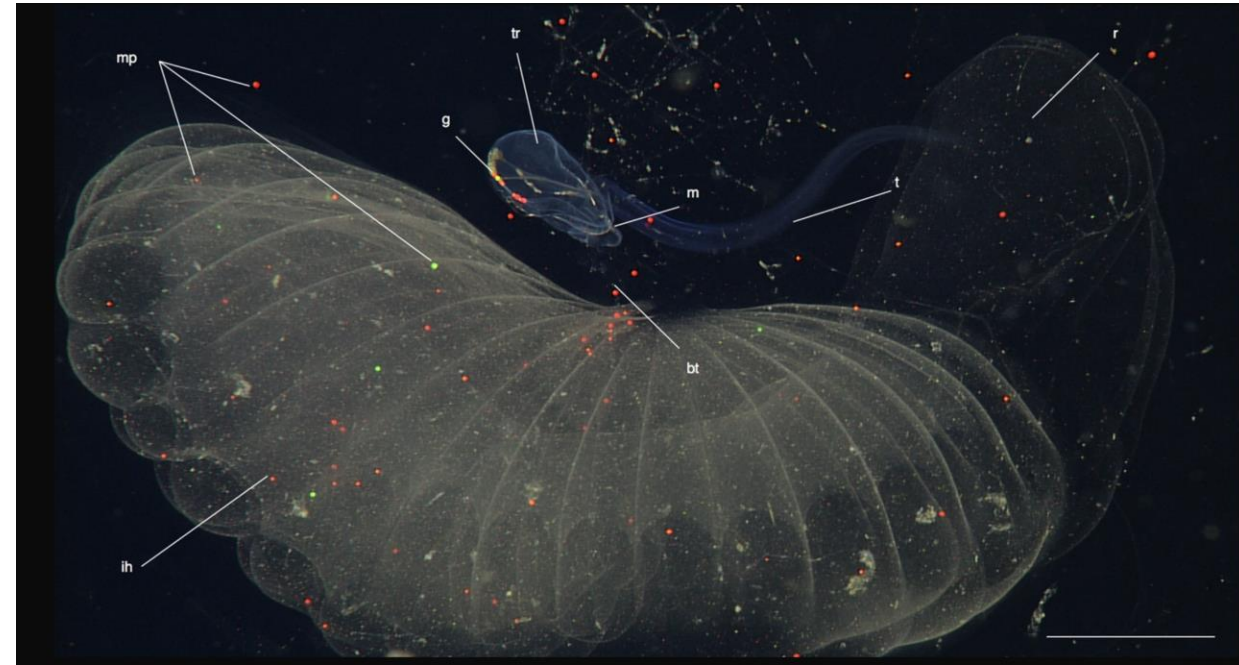
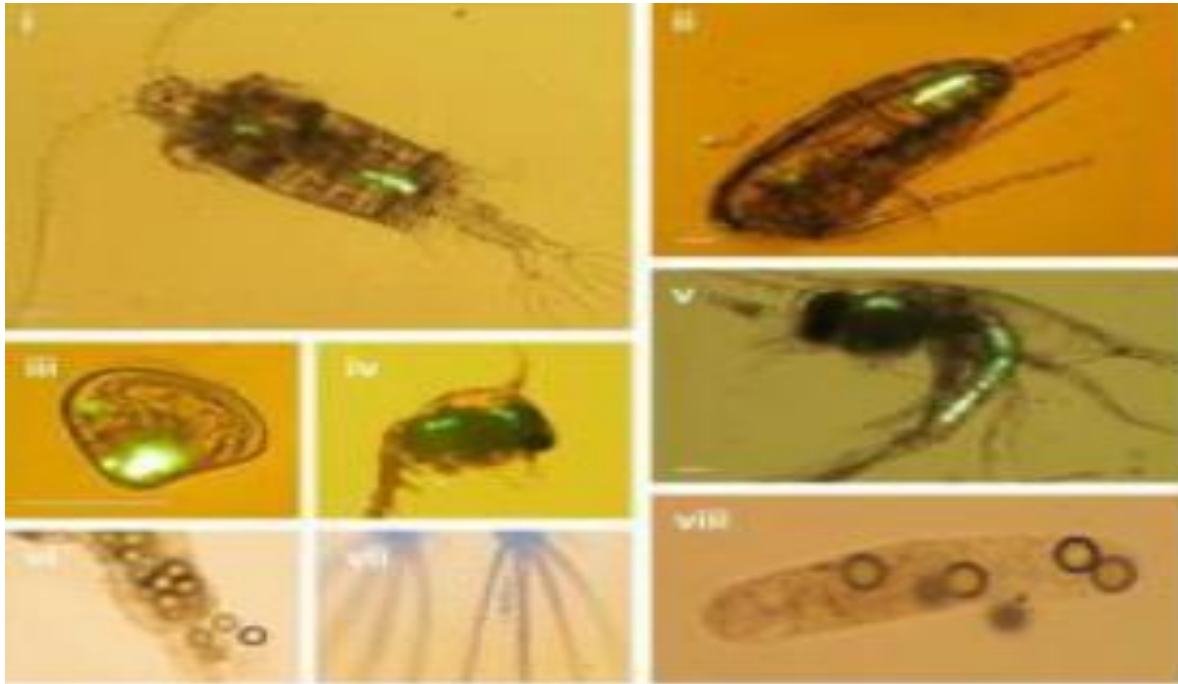
Microplastics: food chain transfer

- MPs in the environment can be ingested by various marine organisms and be transferred along the food chain, which is of particular concern in recent years.



Ingestion of microplastics by natural zooplankton groups

- MPs have small particle sizes that are similar to the food size range consumed by zooplankton, making them one of the most vulnerable groups to MPs



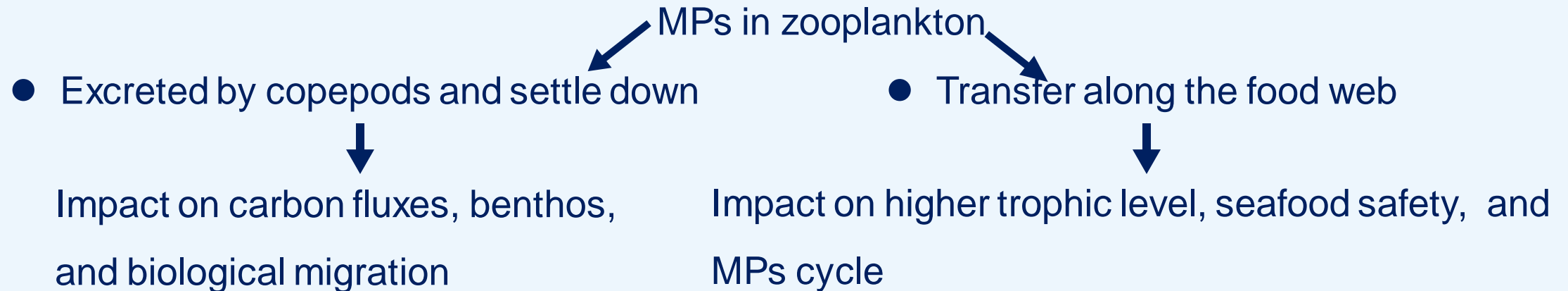
Potential impacts of MP ingestion by zooplankton in natural waters

Potential impacts of MP ingestion by zooplankton on marine ecosystems

1. Toxicity to zooplankton individuals

- The chronic effects of low MP retention on copepods

2. Changes in ecosystem processes



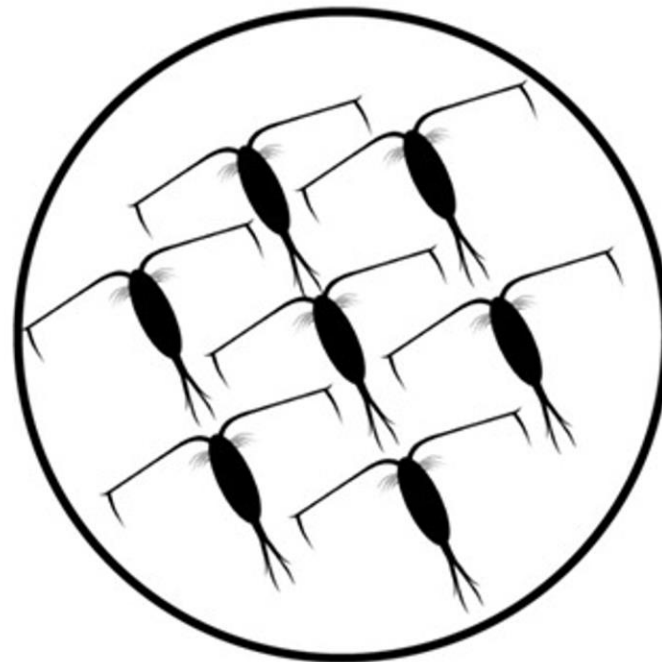
Due to the scarcity of field data, we need to know the status of MPs in zooplankton in natural environment

Important role of copepods in microplastic food chain transfer

- Copepod, the most dominant zooplankton in the ocean, was studied in this research.
- Understanding the amount and characteristics of MPs in zooplankton is important to reveal the food web transfer of MPs and other ecological risks.

Copepods

Primary producers



Higher trophic levels



An important link

Scientific objectives

Content



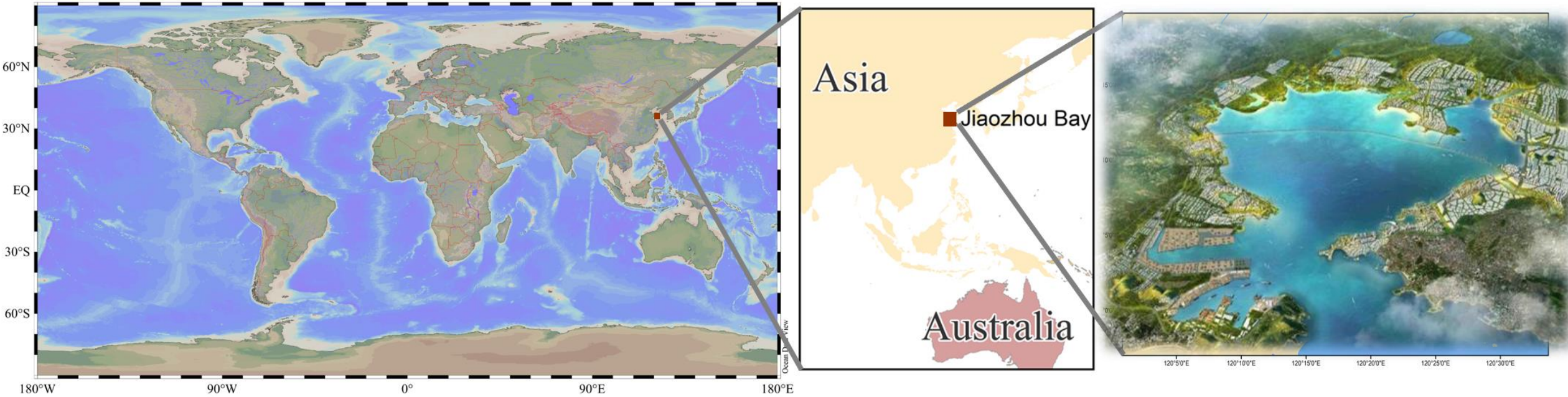
Objectives



- The **amount and characteristics** of MPs in copepods
- The **seasonal changes** in MPs ingested by copepods
- The **environmental factors** affecting the ingestion of MPs by copepods

- ◆ Provide insights into the basic patterns of seasonal characteristics in MPs ingested by copepods in typical temperate bays
- ◆ Reveal the potential ecological risk of MPs via copepod ingestion in similar coastal regions.

Case Study: Jiaozhou Bay

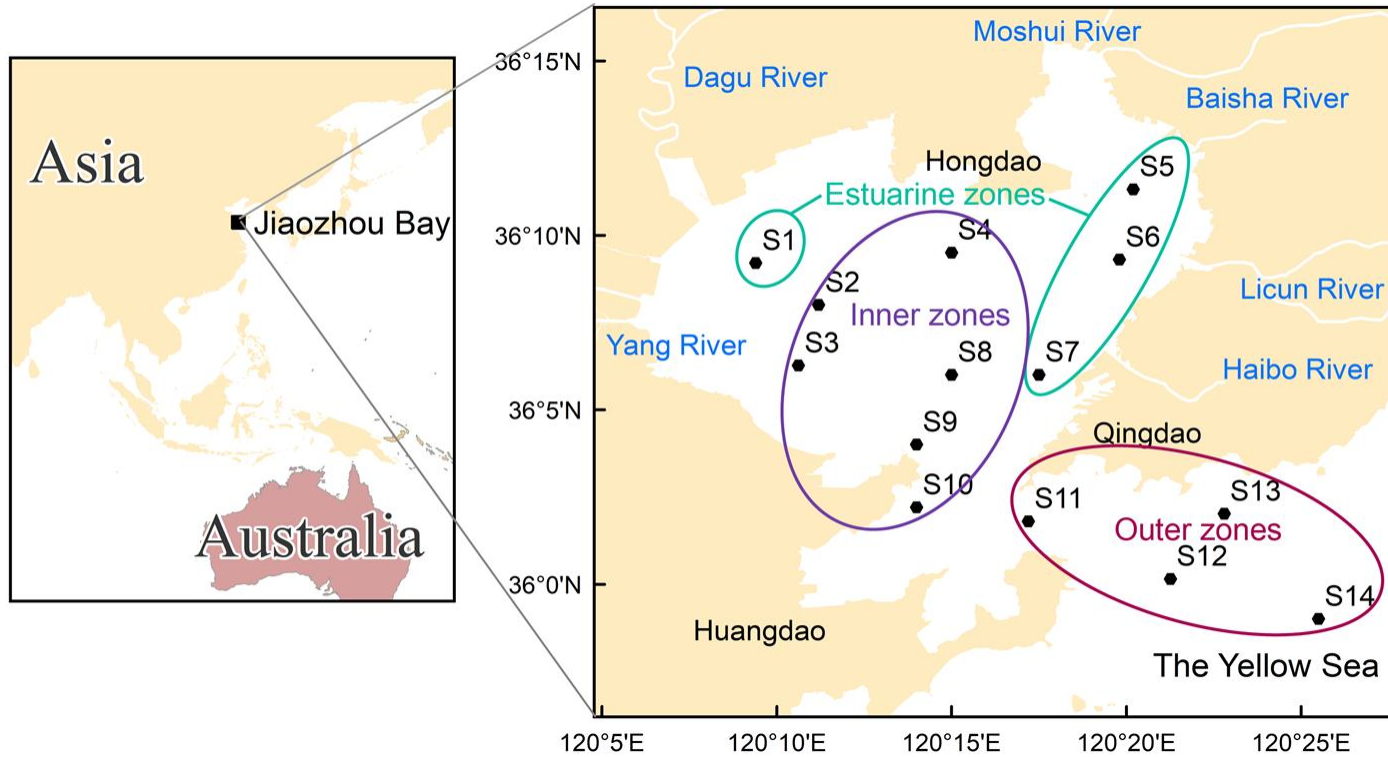


- **Hotspot** of MPs accumulation: surrounded by Qingdao city, intensive human activities.
- **Sources of pollutions:** urbanization, ports, tourism, aquaculture, domestic and industrial sewage.



Material and methods

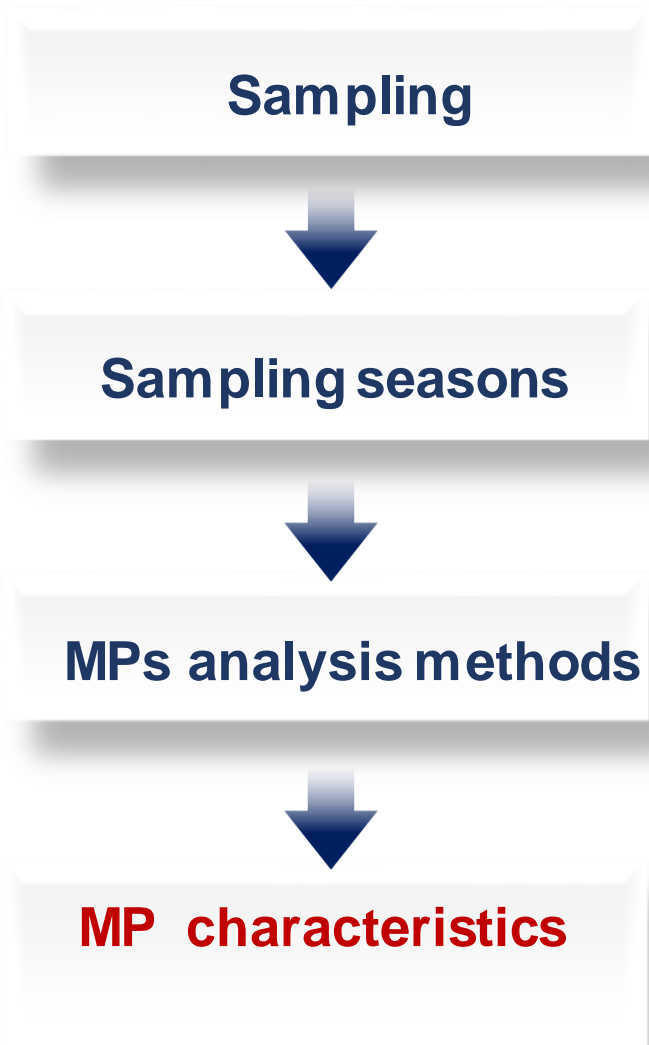
Sampling Stations



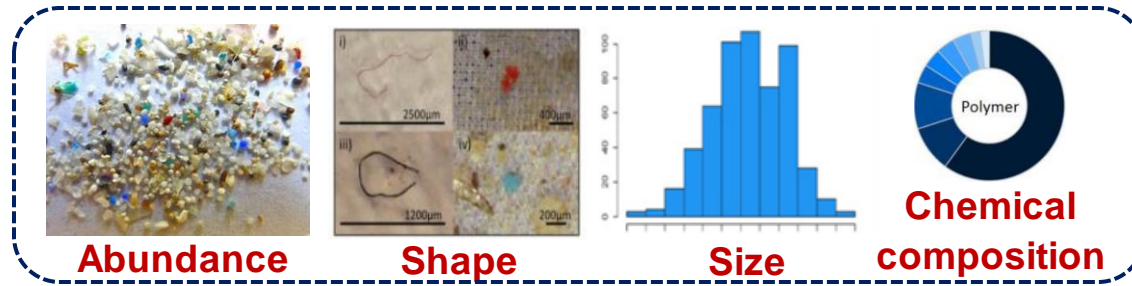
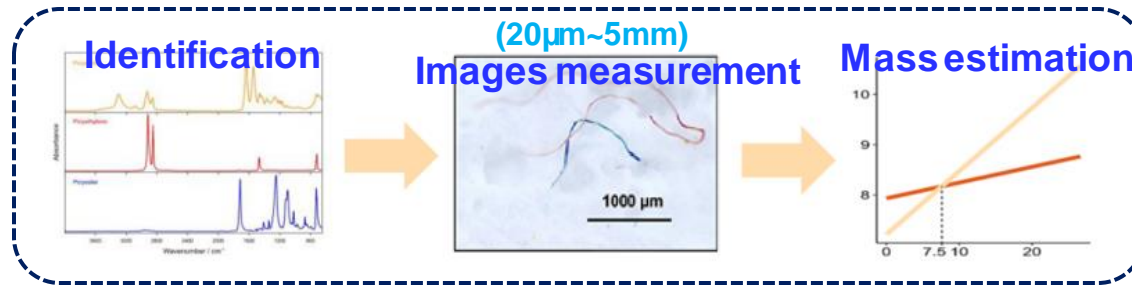
Different areas	Sampling Stations
Estuarine zones	S1 S5 S6 S7
Inner zones	S2 S3 S4 S8 S9 S10
Outer zones	S11 S12 S13 S14



Material and methods



- February (winter)
- May (spring)
- August (summer)
- November (autumn)



Results and discussion

- **Seasonal variation of the number MPs per copepod in Jiaozhou Bay**

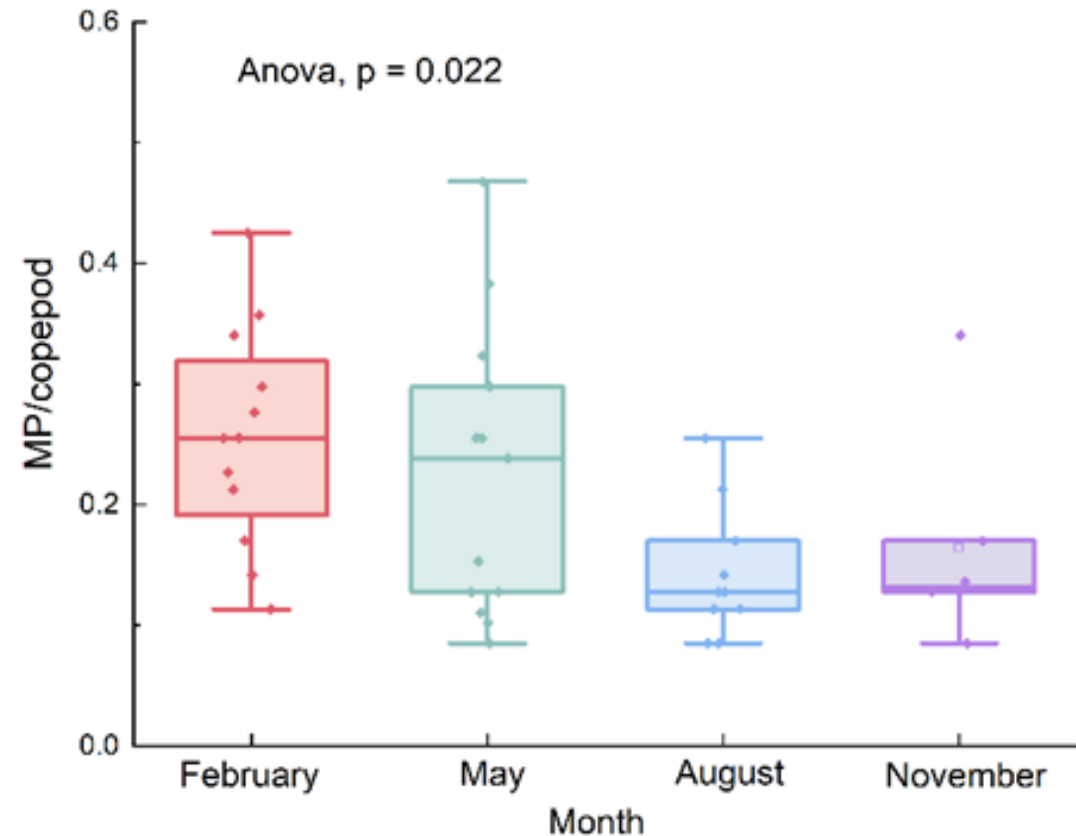
Winter: 0.26 ± 0.09

Spring: 0.23 ± 0.12

Summer: 0.14 ± 0.05

Autumn: 0.16 ± 0.09

The MP/copepod in **winter and autumn** were **significantly higher** than that in summer ($p < 0.05$)



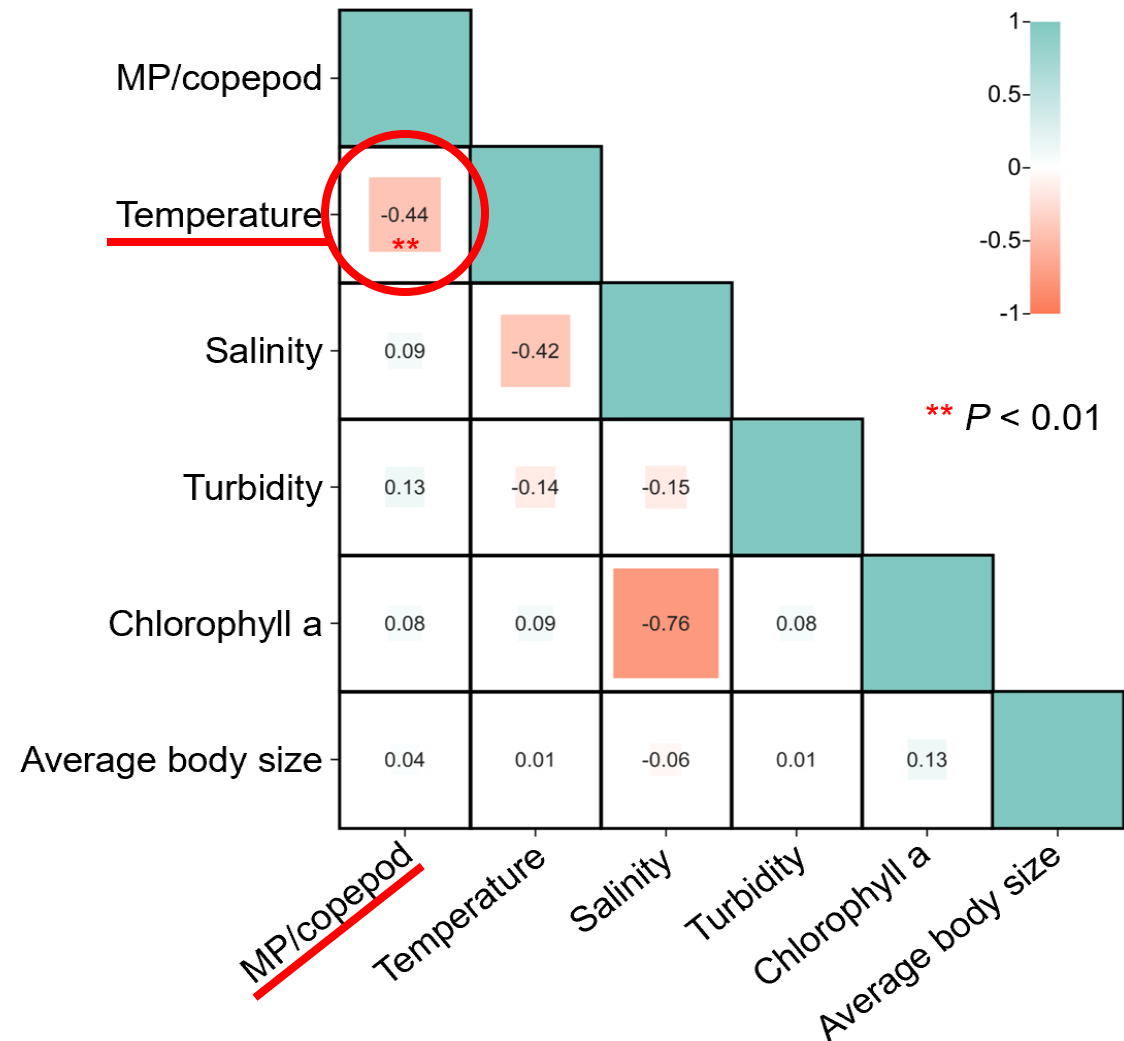
MP/copepod referred to the average number of MPs in each copepod

Results and discussion

- **Key environmental factors affecting the ingestion of MPs by copepods**

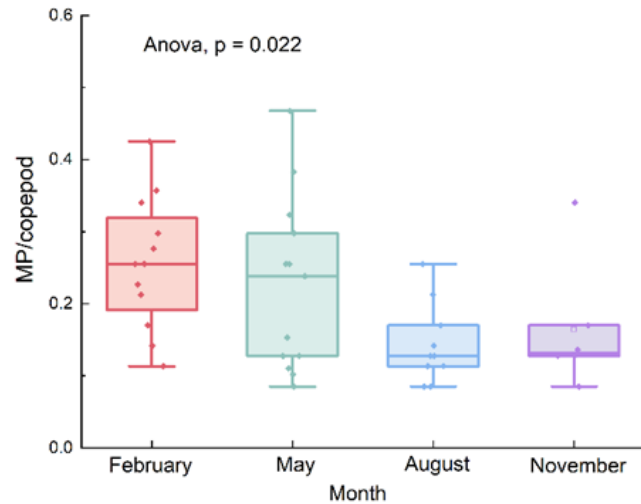
- **MP/copepod** value is **negatively** correlated with the seawater **temperature** ($p < 0.05$)

- No significant correlation was found between the MP/copepod value and the average body size or other environmental factors ($p > 0.05$)



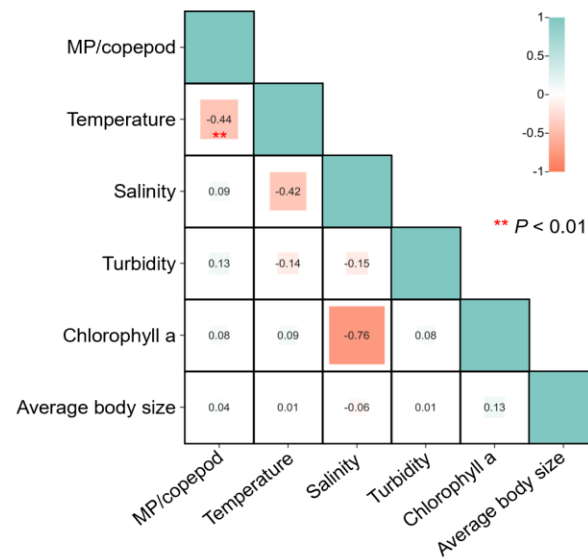
Results and discussion

● Seasonal change in MPs in copepods and key environmental factors



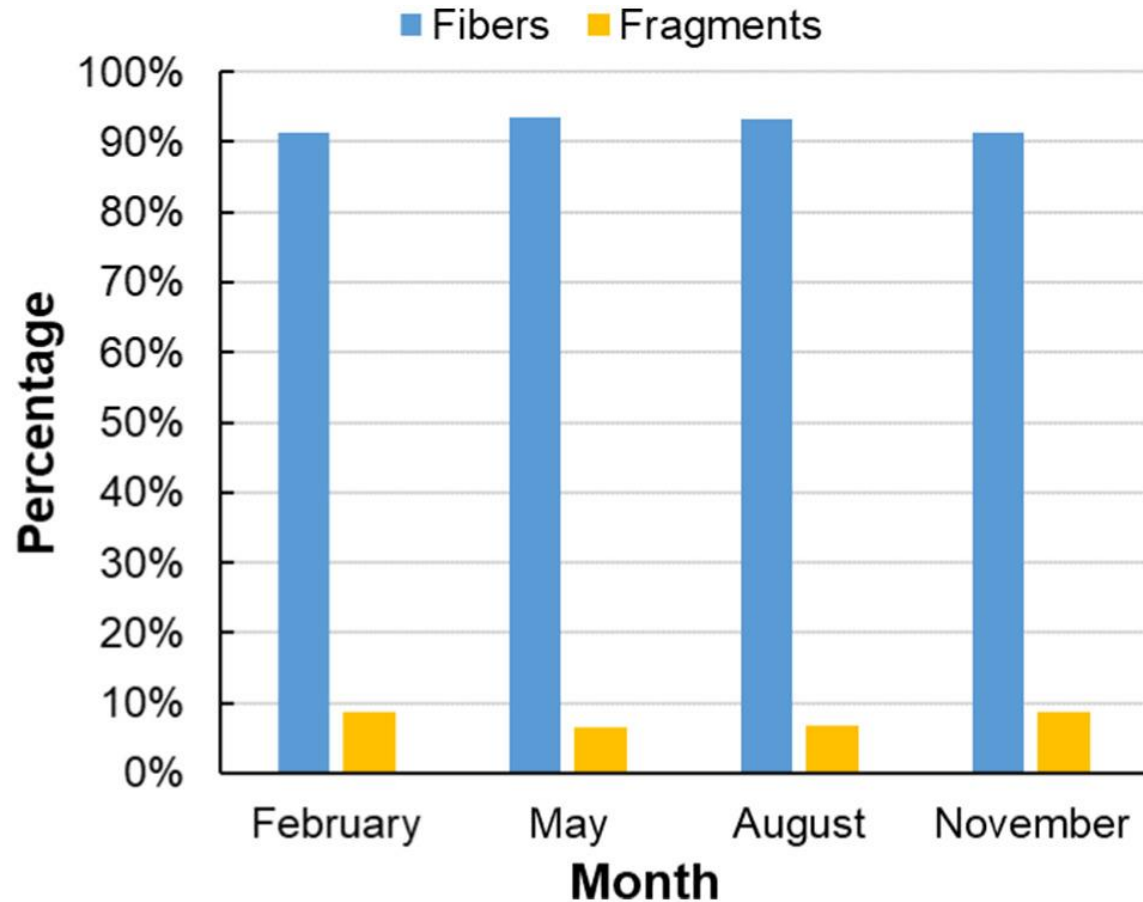
➤ The **low metabolic rates** but **moderate ingestion rates** of copepods at low temperatures may be the reason for the high MP retention in winter

➤ **Temperature**: an important effect on the ingestion and retention of MPs in copepods in Jiaozhou Bay



Results and discussion

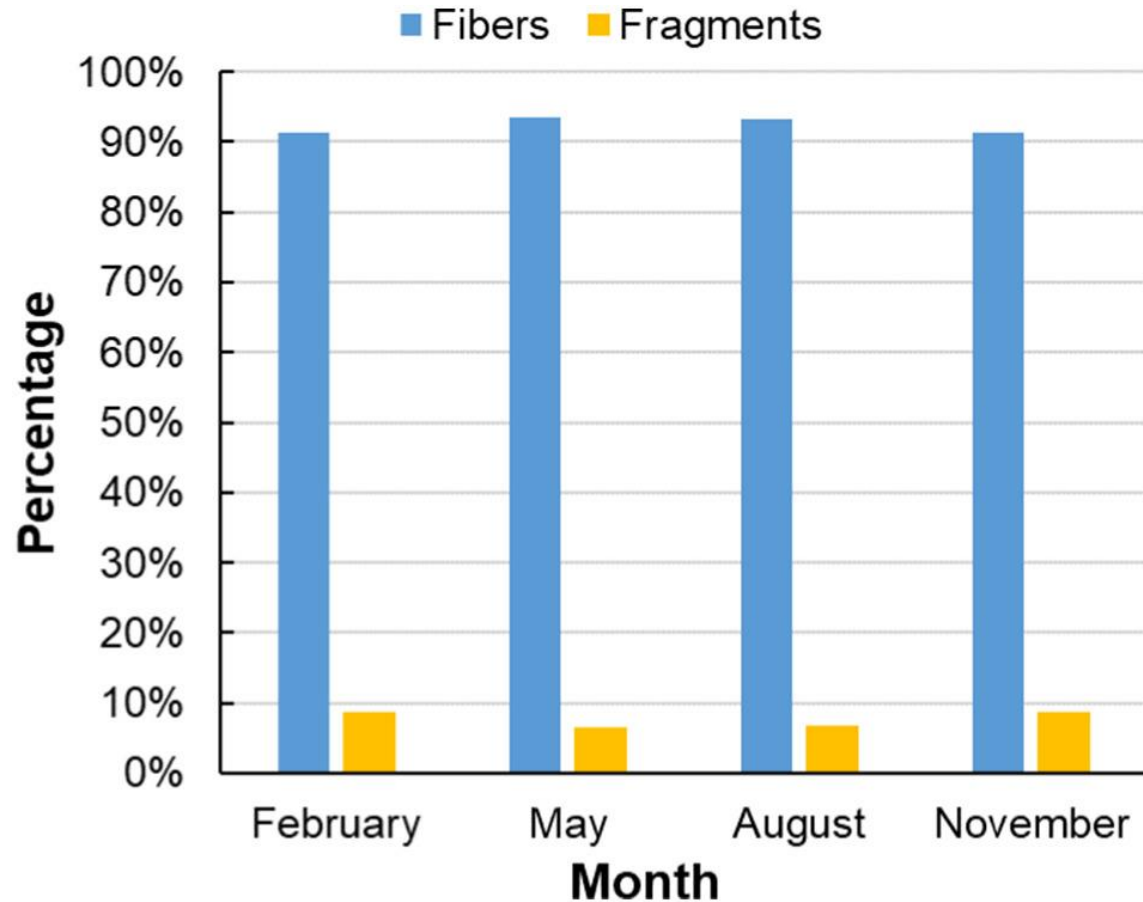
● Shape of MPs in copepods in Jiaozhou Bay



- Fibers and fragments were found in the copepods in Jiaozhou Bay
- **Fibers** are the dominant shape for MPs in copepods in all seasons
- **No significant differences** in shape composition of MPs in copepods among the seasons ($p > 0.05$)

Results and discussion

● Shape of MPs in copepods in Jiaozhou Bay



- MP fibers would have a more pronounced effect on copepod feeding than fragments
- **Fibers** might be **the most risky form of MPs** influencing coastal copepods and transferring along the food web

Results and discussion

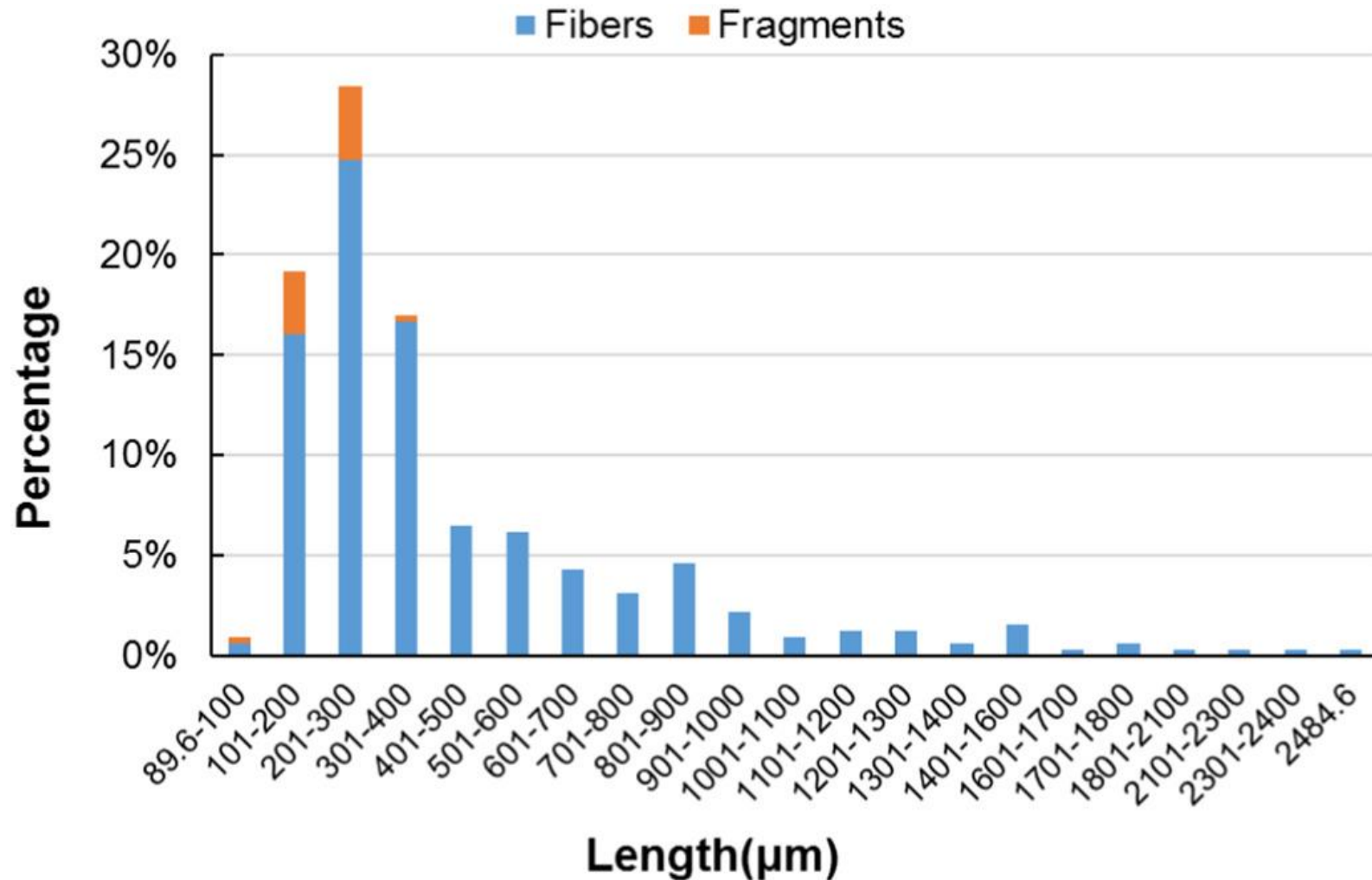
● Size of MPs in copepods in Jiaozhou Bay

		February	May	August	November	Annual
All shapes	Sample size (n)	104	153	44	23	324
	mean±SD (μm)	425±348	466±403	526±395	374±237	454±376
	Range (μm)	90-2485	90-2329	115-1752	136-1122	90-2485
Fiber	Sample size (n)	95	143	41	21	300
	mean±SD (μm)	445±357	483±411	546±401	389±243	473±384
	Range (μm)	90-2485	92-2329	115-1752	136-1122	90-2485
Fragments	Sample size (n)	9	10	3	2	24
	mean±SD (μm)	209±59	221±78	252±119	218±61	220±72
	Range (μm)	125-292	90-298	146-380	174-261	90-380

- Range: 90 to 2485 μm
- Average: 454 ± 376 μm
- The lengths of MPs in the four seasons were **not significantly different** ($p > 0.05$)

Results and discussion

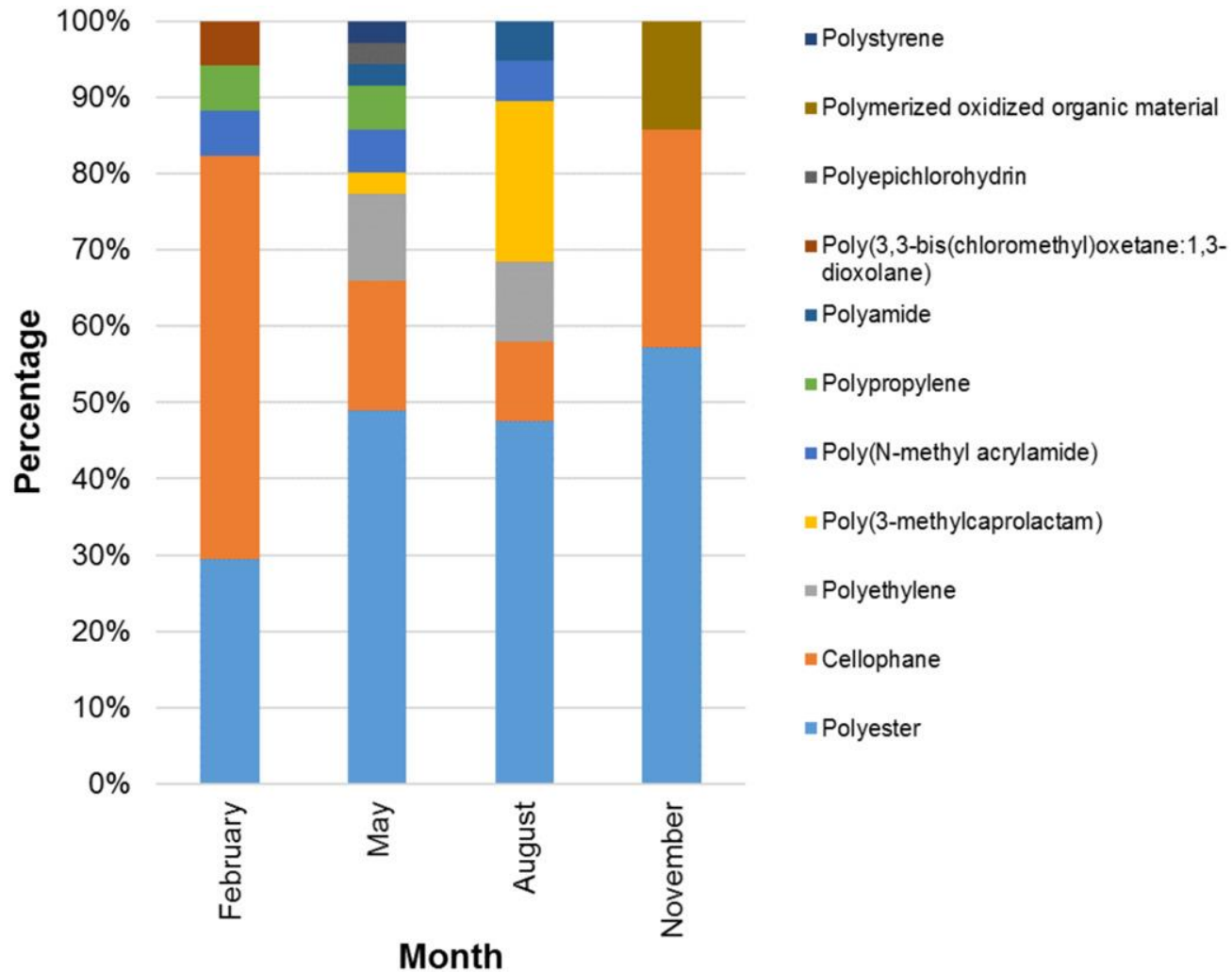
● Size of MPs in copepods in Jiaozhou Bay



- The highest frequency (28.4%) of MPs occurred in the **201–300 μm** range
- **< 1000 μm** MPs (92.3%) : the **dominant size** of MPs in copepods in Jiaozhou Bay

Results and discussion

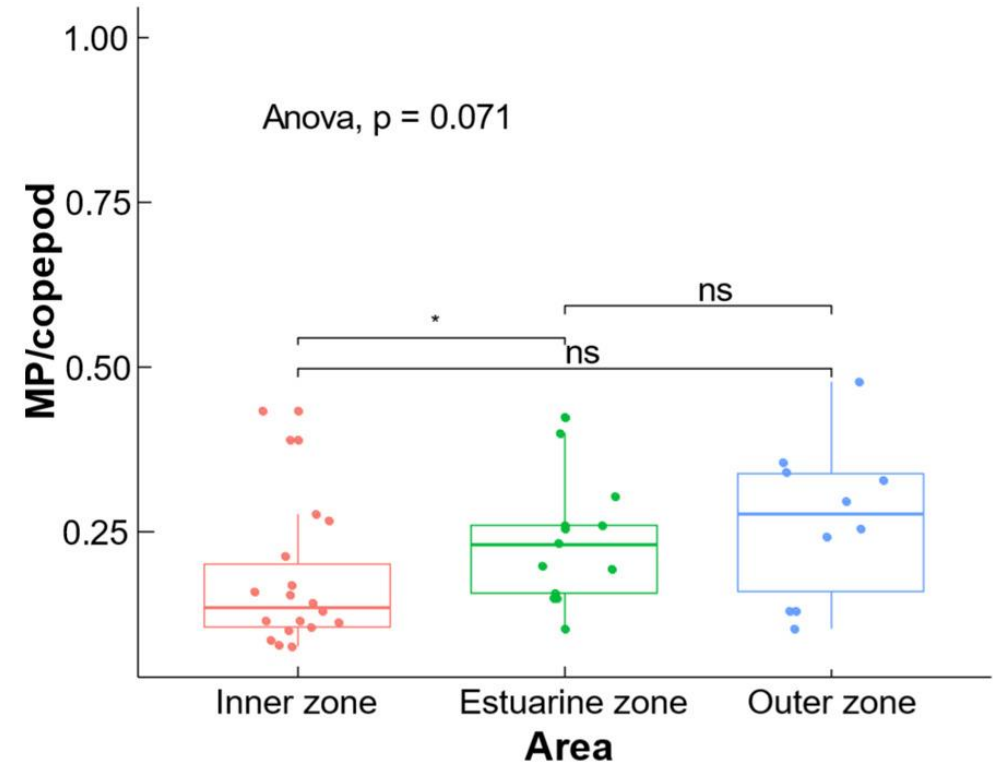
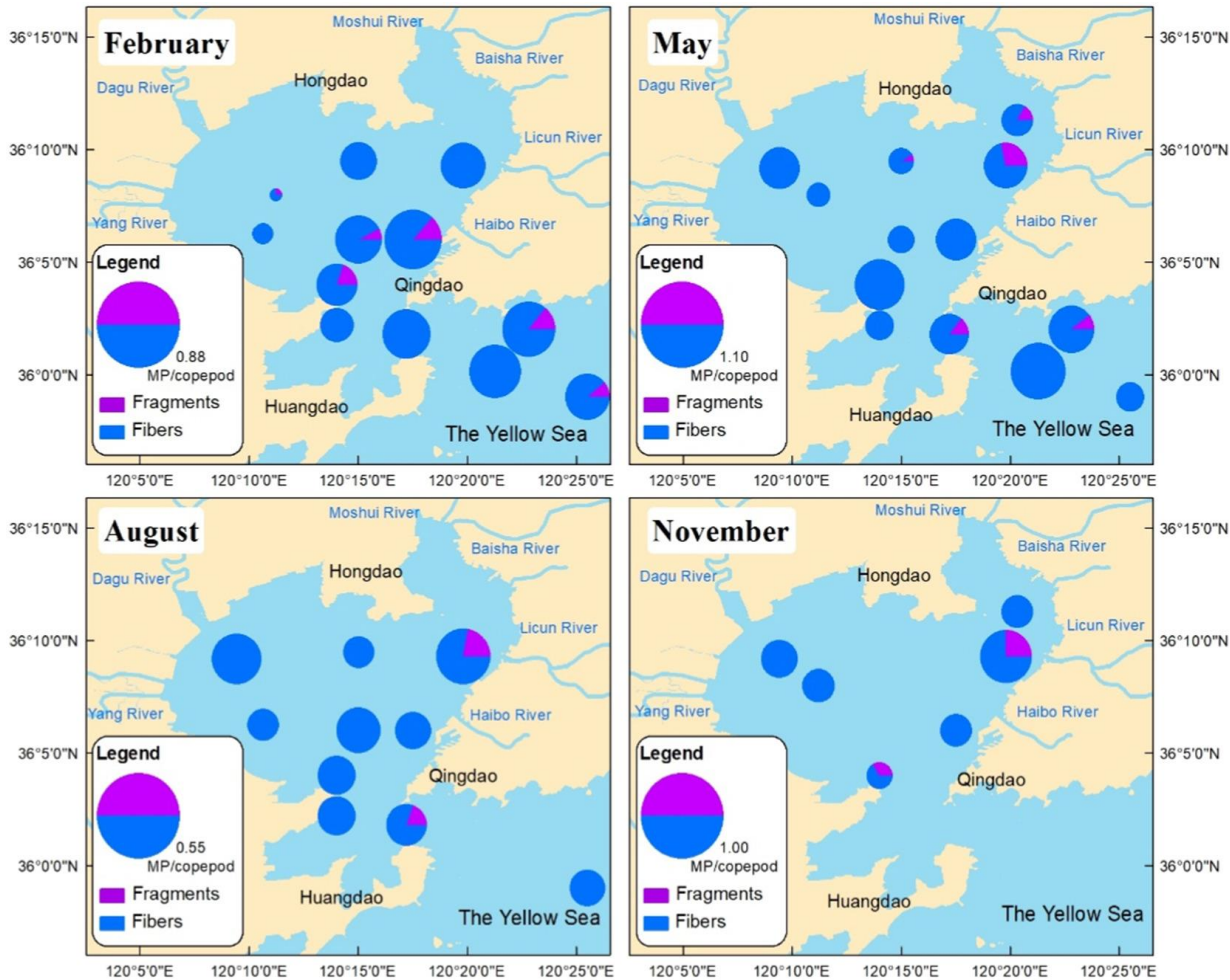
● Chemical composition of MPs in copepods in Jiaozhou Bay



- A total of 11 polymers were detected in copepods in Jiaozhou Bay
- **Polyester and cellophane** dominated across all four seasons
- **No significant differences** in Chemical composition of MPs in copepods among the seasons ($p > 0.05$)

Results and discussion

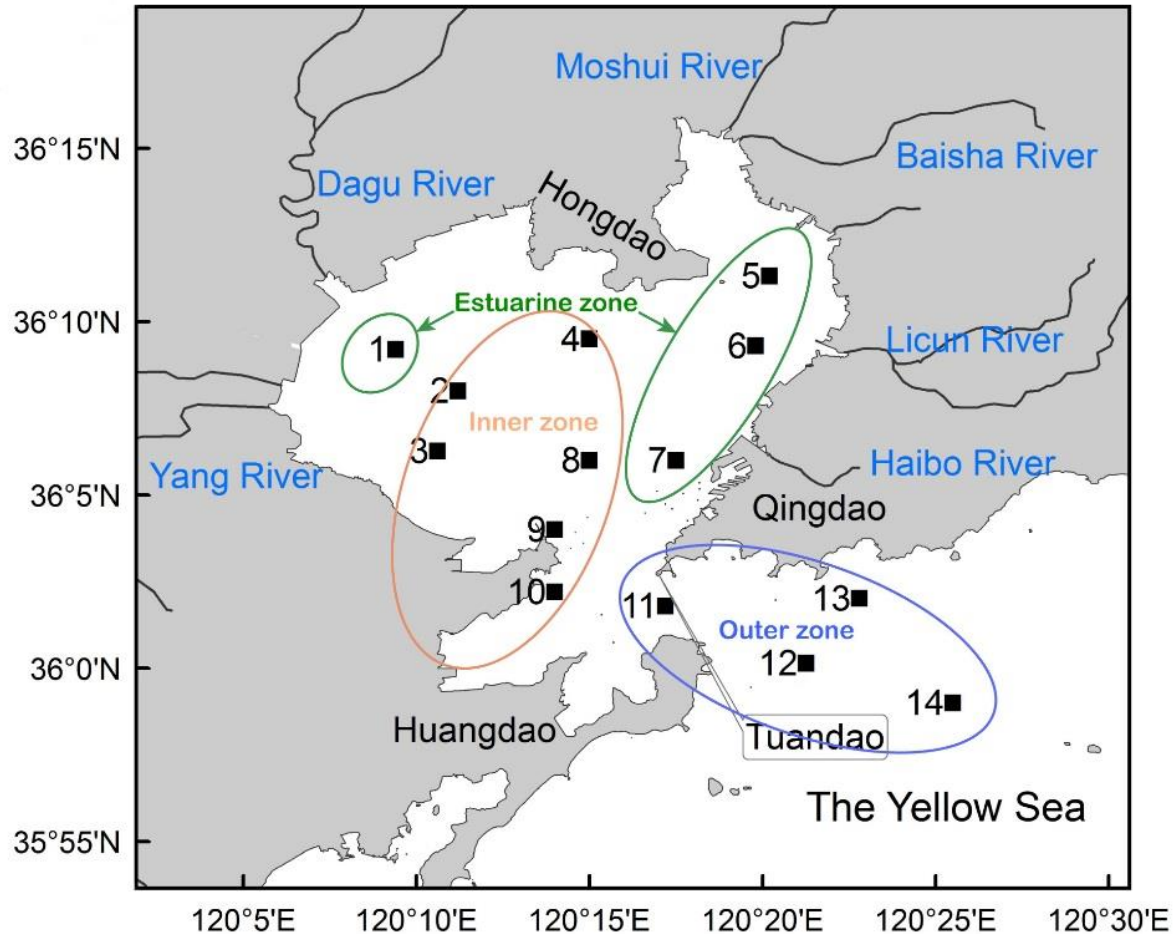
- **Spatial distribution: MP/copepod in different areas of Jiaozhou Bay.**



The MP/copepod in the **estuarine zone** was **significantly higher** than the inner zone ($p < 0.05$)

Results and discussion

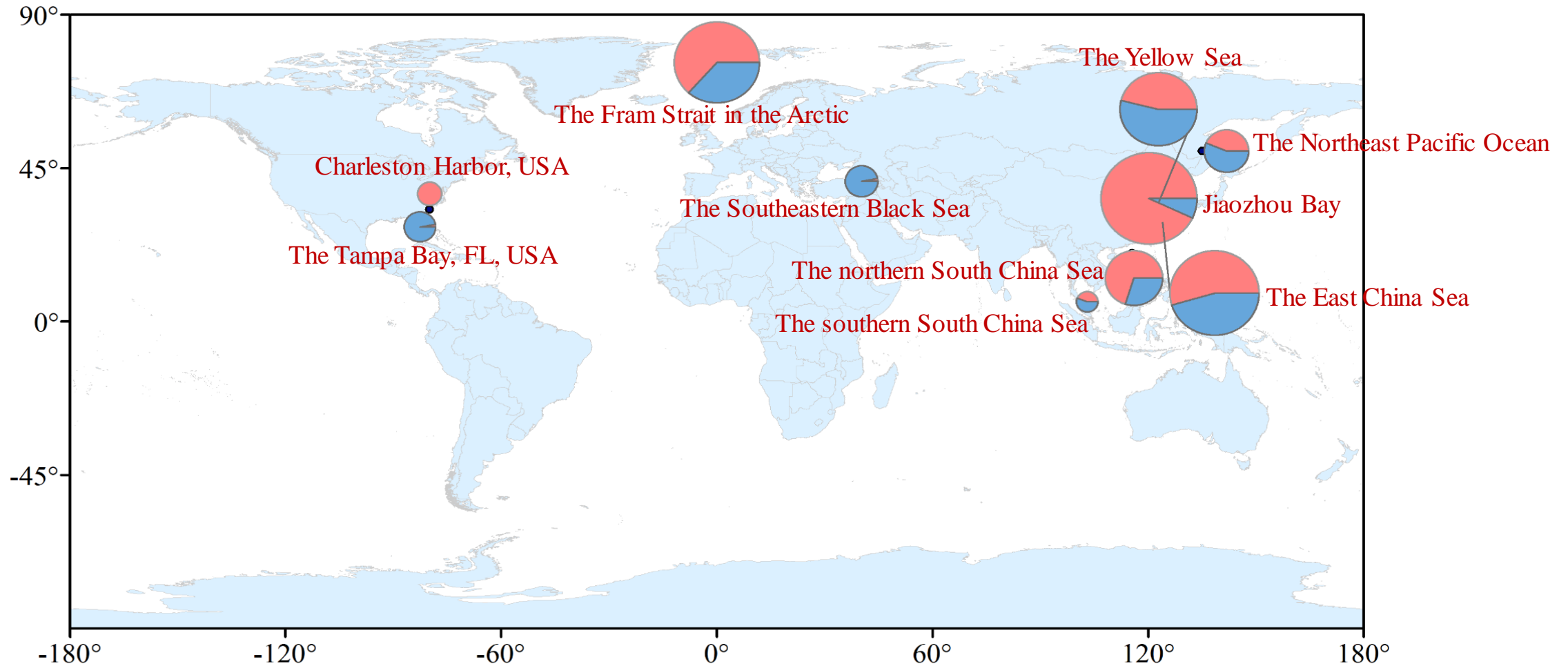
- **Comparison on MP/copepod in different areas of Jiaozhou Bay.**



- More intensive human activity in coastal areas
- The emission of MPs from rivers and wastewater treatment plants (WWTPs) may be a pivotal factor influencing the MP concentrations in Jiaozhou Bay
- The potential risk of MPs to the marine food web via copepods is **more serious in coastal areas** than in the open sea.

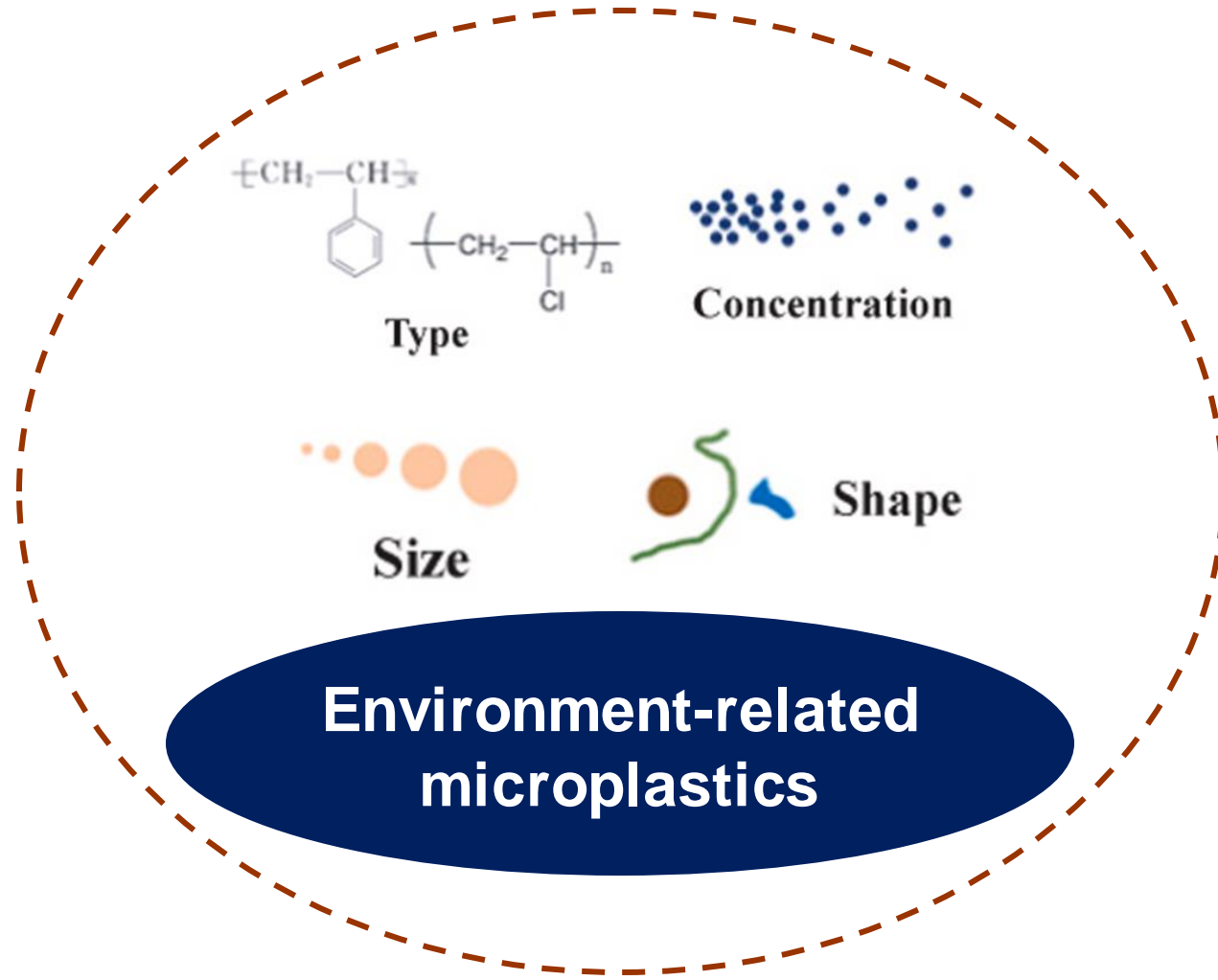
Further research

- **Comparison of different sea areas on a larger scale**



➤ **Reveal a close link between **human activities** and the retention of MPs in the natural copepod community**

Further research



To better assess the ecological risks of MPs, **prey-size environmental MPs** should be collected simultaneously in future studies.

Thank you!

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