Methodology versus Data Comparability in Microplastic Research

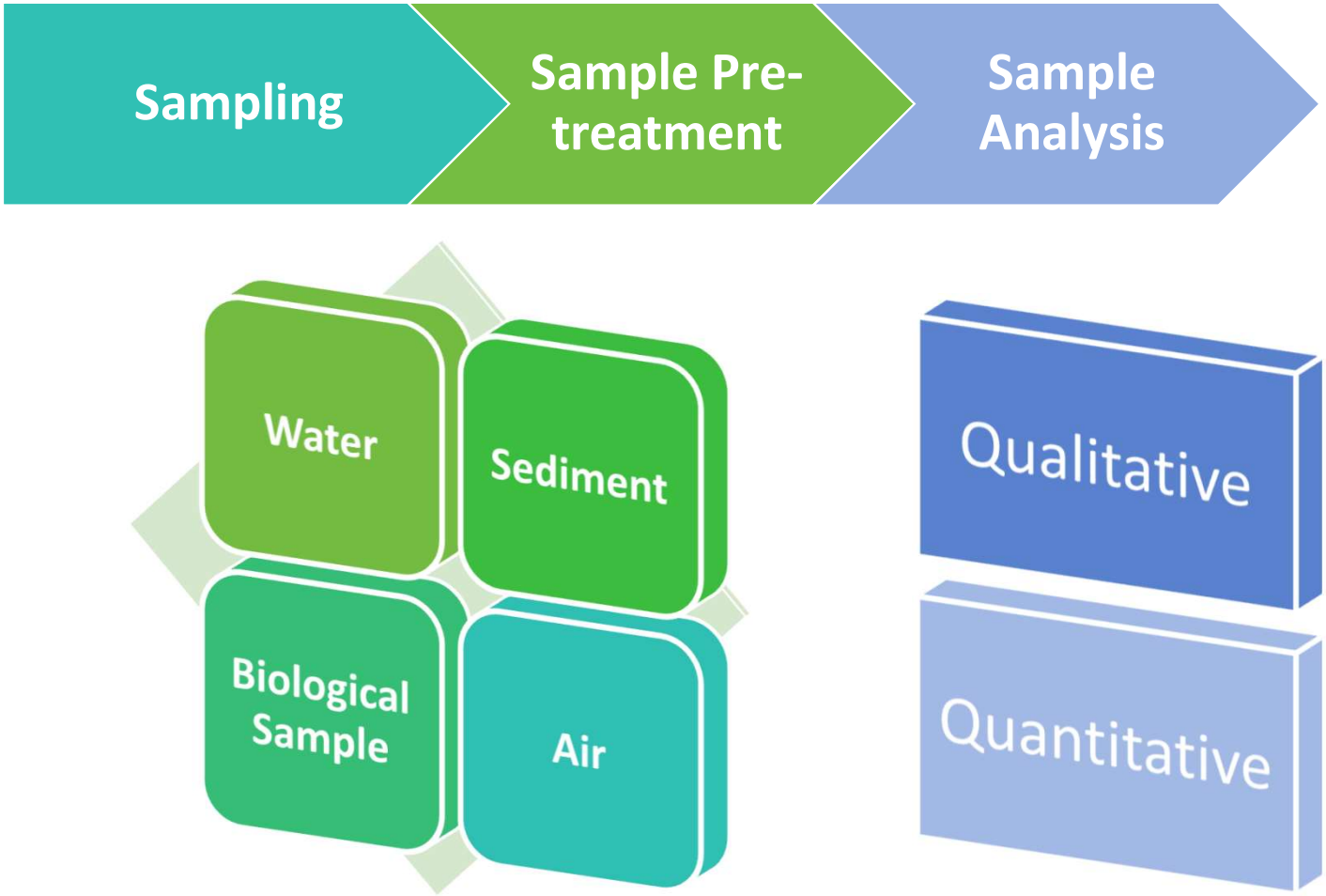
Chengjun Sun[1], Jinfeng Ding[1], Jingxi Li[1], Wenxi Zhang[2], Fenghua Jiang[1], Wei Cao[1], Fenglei Gao[3]

[1]First Institute of Oceanography, Ministry of Natural Resources, China. E-mail: csun@fio.org.cn
[2] No. 58 High School of Shandong Province, Qingdao, China.
[3] Qingdao Institute of Marine Geology

Outline

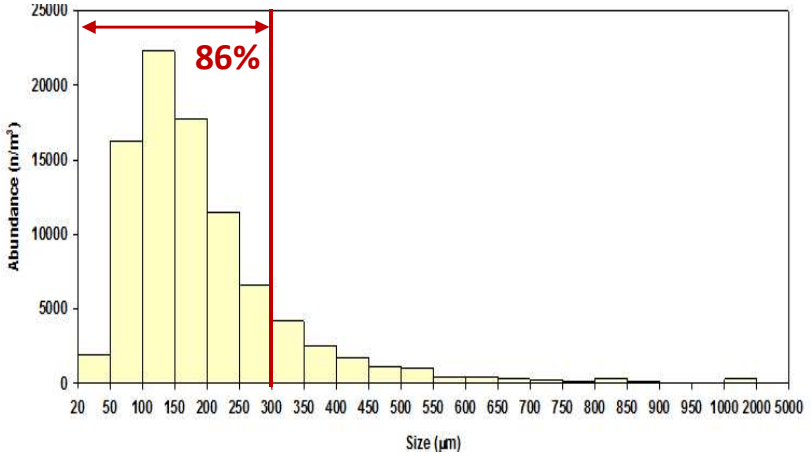
- ☐ Water microplastic analysis
- ☐ Bivalve microplastic analysis
- ☐ Findings and suggestions
- ☐ Acknowledgments

Microplastic Monitoring Workflow

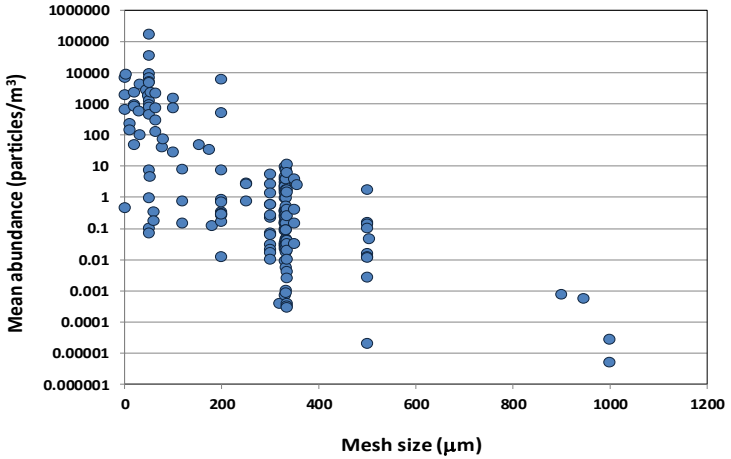


Microplastic size distribution in the North Pacific

North Pacific MP size distribution (20-5000 μm MP)



Song et al. *Environ. Sci. Technol.* , 2018



Shim, et al., 2022


Marine Pollution Bulletin 146 (2019) 462–465

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Baseline

A novel method enabling the accurate quantification of microplastics in the water column of deep ocean

Kai Liu, Feng Zhang, Zhangyu Song, Changxing Zong, Nian Wei, Daoji Li*

State Key Laboratory of Estuarine and Coastal Research, East China Normal University, 500 Dongchuan Road, Shanghai 200062, China

> 8 m³ water sample

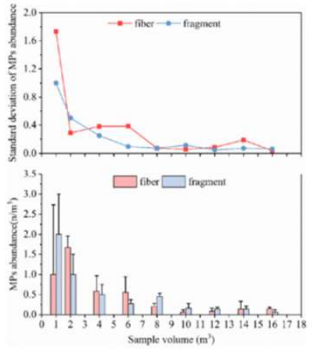


Fig. 2. Relationship between sample volume and MP abundance in the present study.

Table 2. Detailed Summaries (Sampling Methods, Sampled Depth, and Size) of MPs from Water Columns From the Literature and the Present Study

area division	sampling regions	methods	depth (m)	volume/sample (L)	mesh size of nets[a] or filters (sieves)[b] (μm)	MP abundance (n/m³)	MPs size (mm)
Coastal seas	Bohai sea, China[25]	CTD sampler	0–30	5	5[b]	0–23,000	0.10–3.00 (mostly)[c]
	South China Sea, China[26]	CTD sampler/plexiglass water sampler	10–40	5	0.45[b]	200–45,200	0.02–0.33(mostly)[c]
	Sumba coastal waters, Indonesia[27]	CTD sampler	5–300	10	0.45[b]	0–120	0.30–1.00(mostly)[c]
	Baltic Sea, Russia[28]	Modified submersible pump	0.5–91	2500–3500	174[b]	32.20 (mean) ± 50.40 (SD)	0.17–1.00(mostly)[c]
	Korean coastal waters[29]	submersible pump	3–58	100	20[b]	10–2000	0.02–5.00
	HAUSGARTEN observatory[18]	in situ filtration device	1–5350	218–561	32[b]	0–1287	0.01–0.15
Pelagic ocean	Arctic Central Basin[10]	CTD sampler	8–4369	7–48	250[b]; 1.20[b]	0–375	0.25–5.00
	Mariana Trench[12]	CTD sampler/lander system	2673–10,903	35–180	0.22[b]; 0.30[b]	2060–13,510	1.00–3.00(mostly)[c]
	West Pacific and East Indian Ocean (present study)	in situ filtration device	2–4000	10,000	60[b]; 1.60[b]	0.2–3.5	0.03–6.33

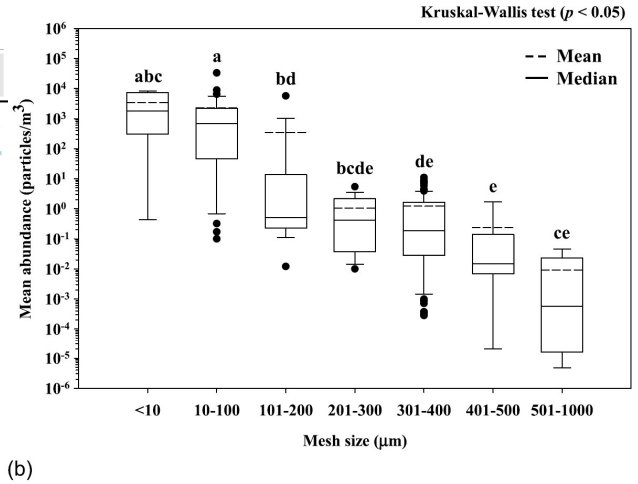
[a]Mesh size of the net used in the reference. [b]Mesh size of the filter or sieve used in the filtering process. [c]Only the size range of MPs was included in the literature.

Larger volumn better representation, non-linear relationship

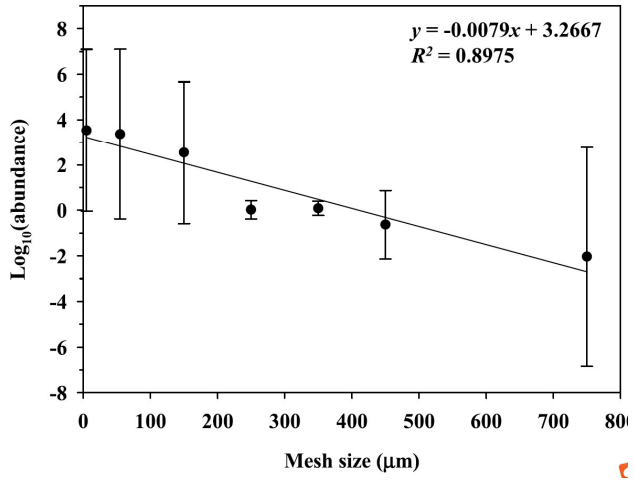
Sampling Methods Lead to Different Results


Environmental Pollution

Toward a long-term monitoring program for seawater plastic pollution in the north Pacific Ocean: Review and global comparison

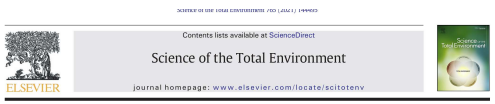


(b)



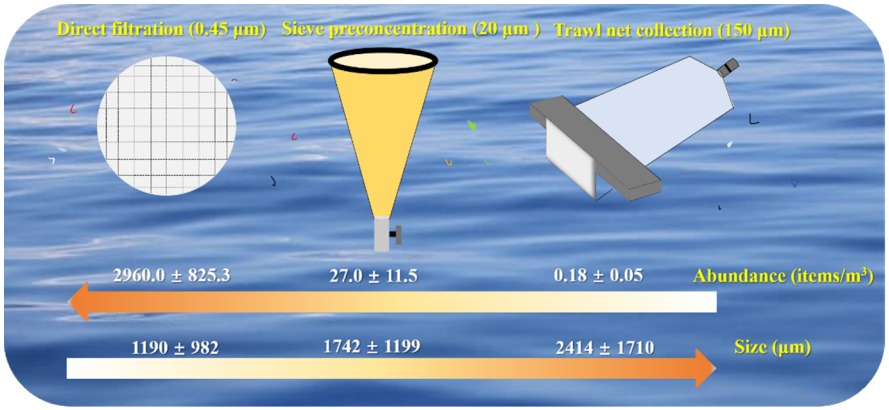
Average abundance of microplastics in seawater of the world

Shim et al. 2022, *Environ. Pollut.* 311: 119911


Science of the Total Environment

Comparative study of three sampling methods for microplastics analysis in seawater

Yifan Zheng, Jingxi Li, Chengjun Sun, Wei Cao, Menghui Wang, Fenghua Jiang, Peng Ju



The abundance and size of microplastics are significantly affected by the pore size of the filter.

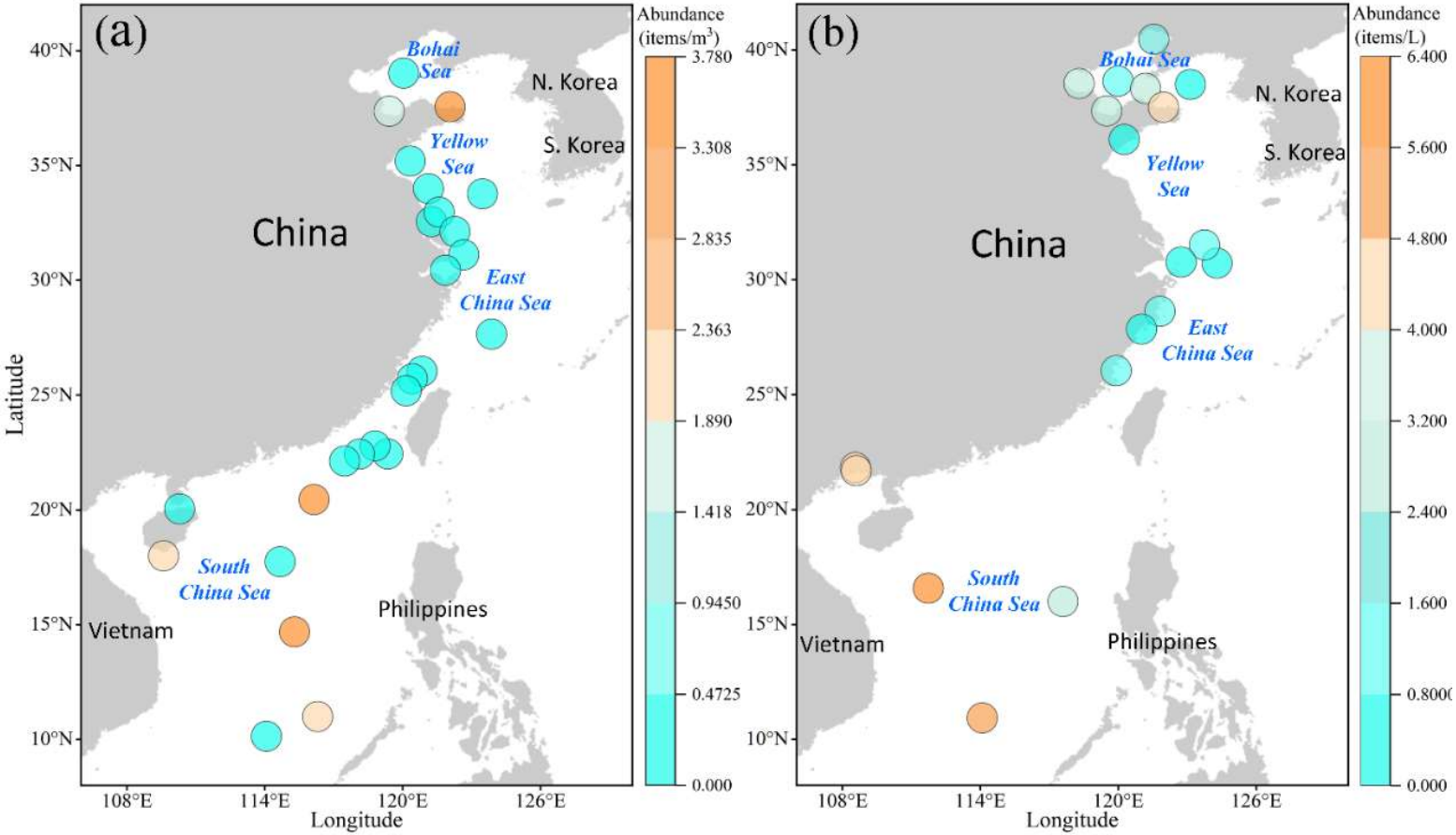
- The smaller the sampling mesh size, the higher microplastic abundance
- Orders of magnitude difference depending on sampling methods

Zheng, et al., STOTEN, 2021

Results Comparability from Different Methods

Trawling

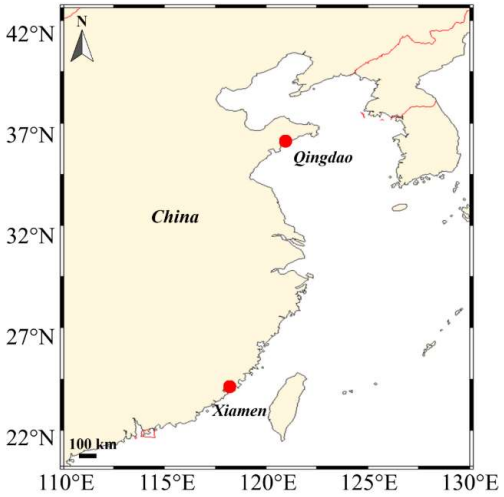
Bulk sampling

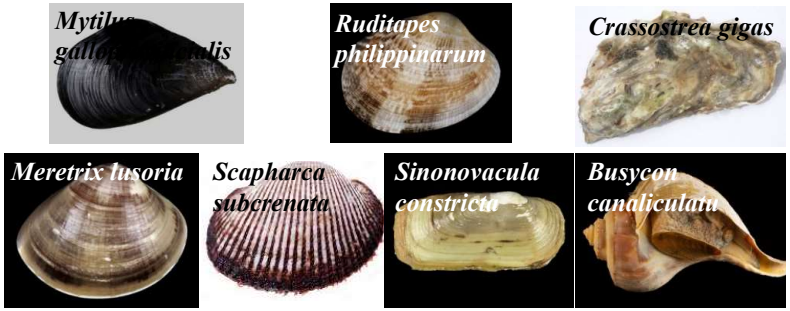


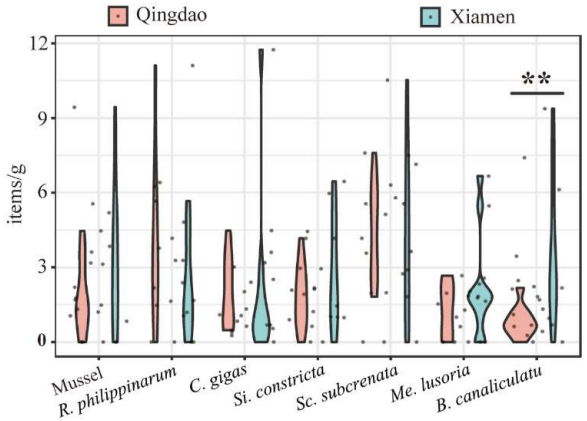
Distribution of microplastic abundance based on (a) trawl samples and (b) bulk water samples

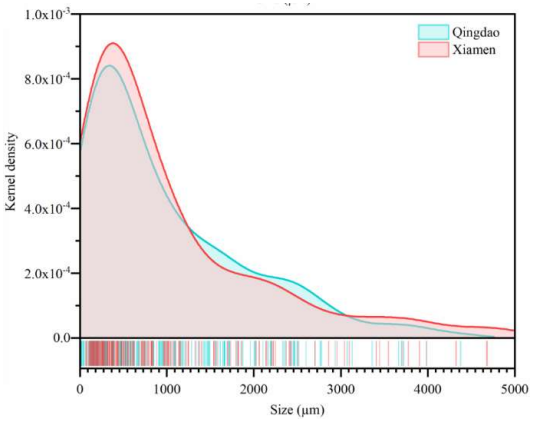
Gao, et al., Journal of Ocean University of China 2023, 22, 1326–1340

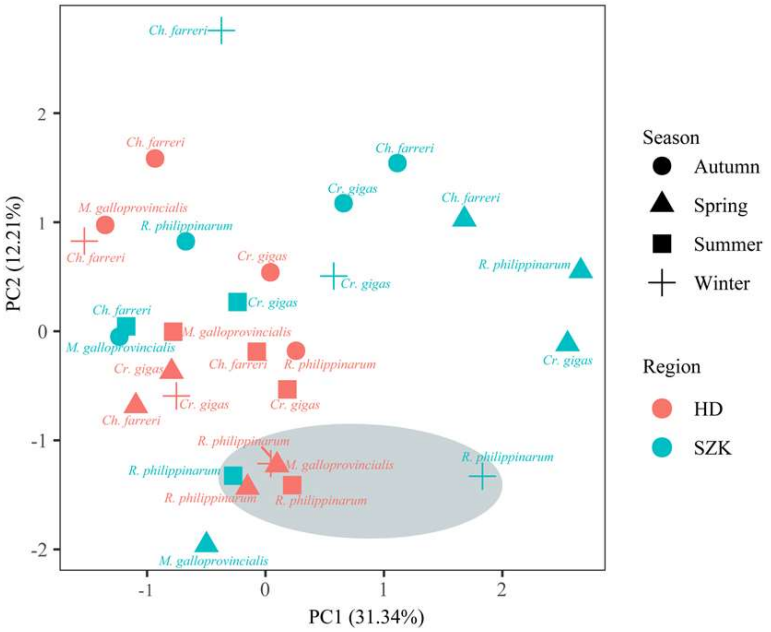
Microplastics in Different Bivalves





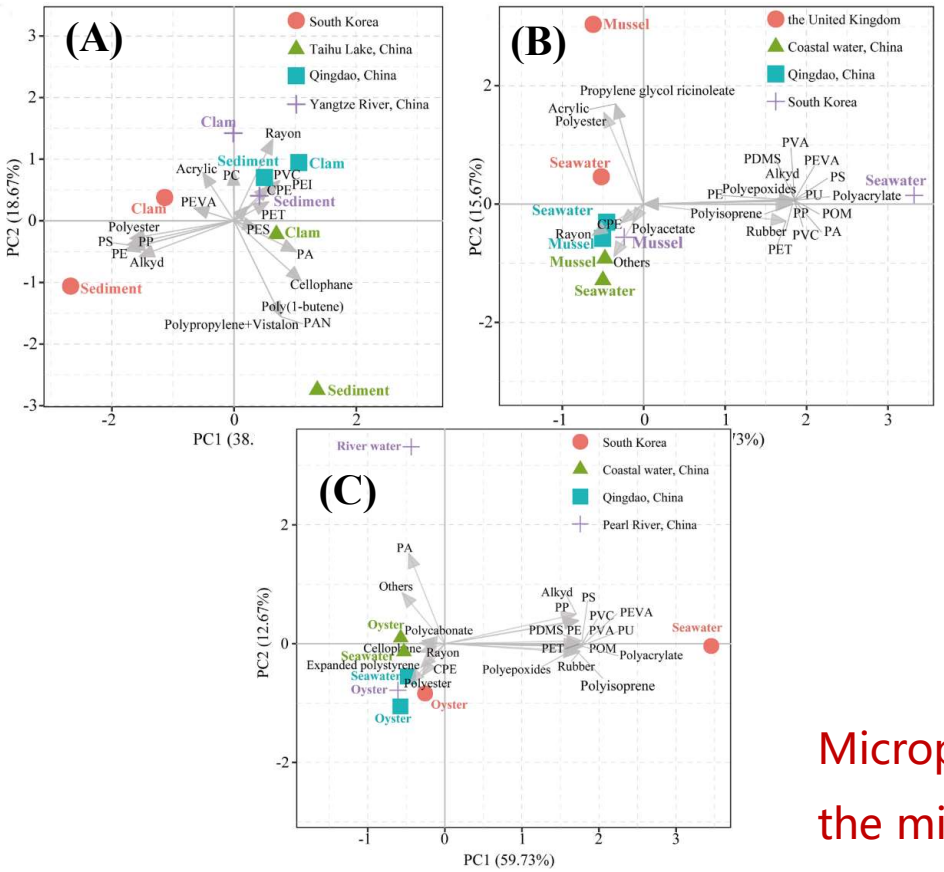


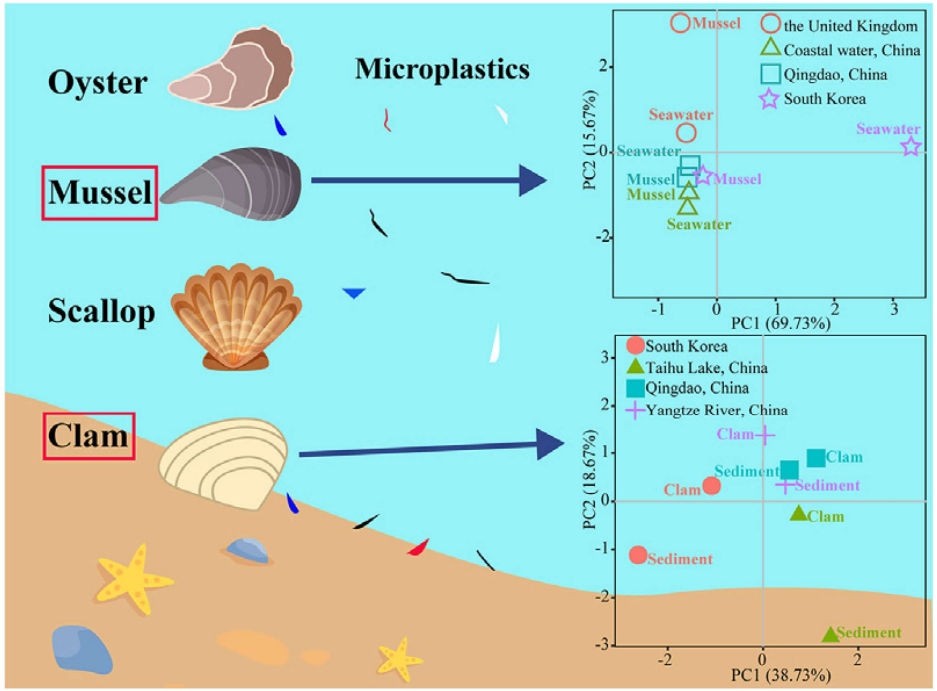




Different location, different abundance, similar sizes, mainly< 500 μm (100–200 μm) , no significant seasonal variation

Microplastics in the Bivalves Reflect MP in their Environment



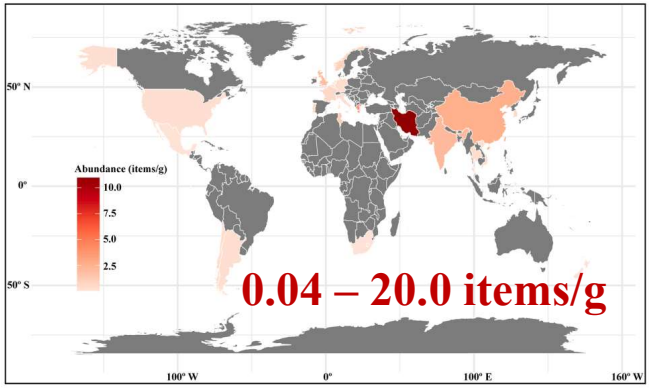


Microplastics in mussels reflect what is in the seawater while the microplastics in the clams reflect what is in the sediment.

(Ding et al., STOTEN, 2021)

Microplastics in Global Bivalves

Microplastic abundance in bivlaves gloablly



(Ding et al., 2022)

Factors affecting the microplastic (MP) abundance in global bivalve mollusks

Bivalve species

Family

Clam — 3.2 ± 4.2

Oyster — 1.3 ± 1.3

Mussel — 1.8 ± 1.4

Scallop — 1.5 ± 1.6

(unit: items/g)

Genera

e.g., *Chlamys* sp., *Pecten* sp.

Using epifaunal and infaunal bivalves monitors MP pollution in water and sediment.

Bivalve sampling

Sample size

e.g.,

Sources

Farmed

Wild

A sample size of at least 50 bivalves is recommended.

MP separation

Digestion solution

e.g., 10% KOH, 30% H_2O_2

Pore size of membrane

e.g., 0.7 μm, 5 μm

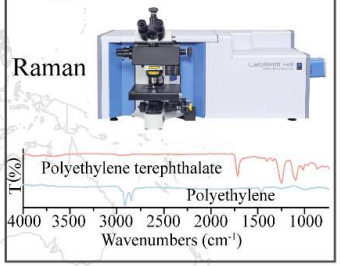
Using 10% KOH as digestion solution and a membrane with a pore size < 5 μm is suggested.

MP identification

Instrumentation

FT-IR

Raman



Consensus is needed for the protocol of the polymer identification process.

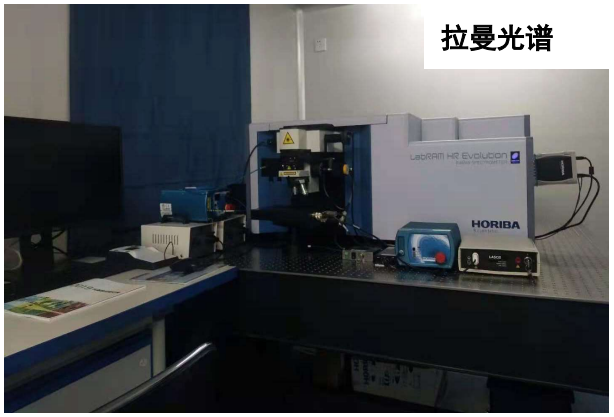
A call for protocol standardization

Same methods give similar results. Trends from different methods are similar.

Acknowledgments



扫描电镜



拉曼光谱

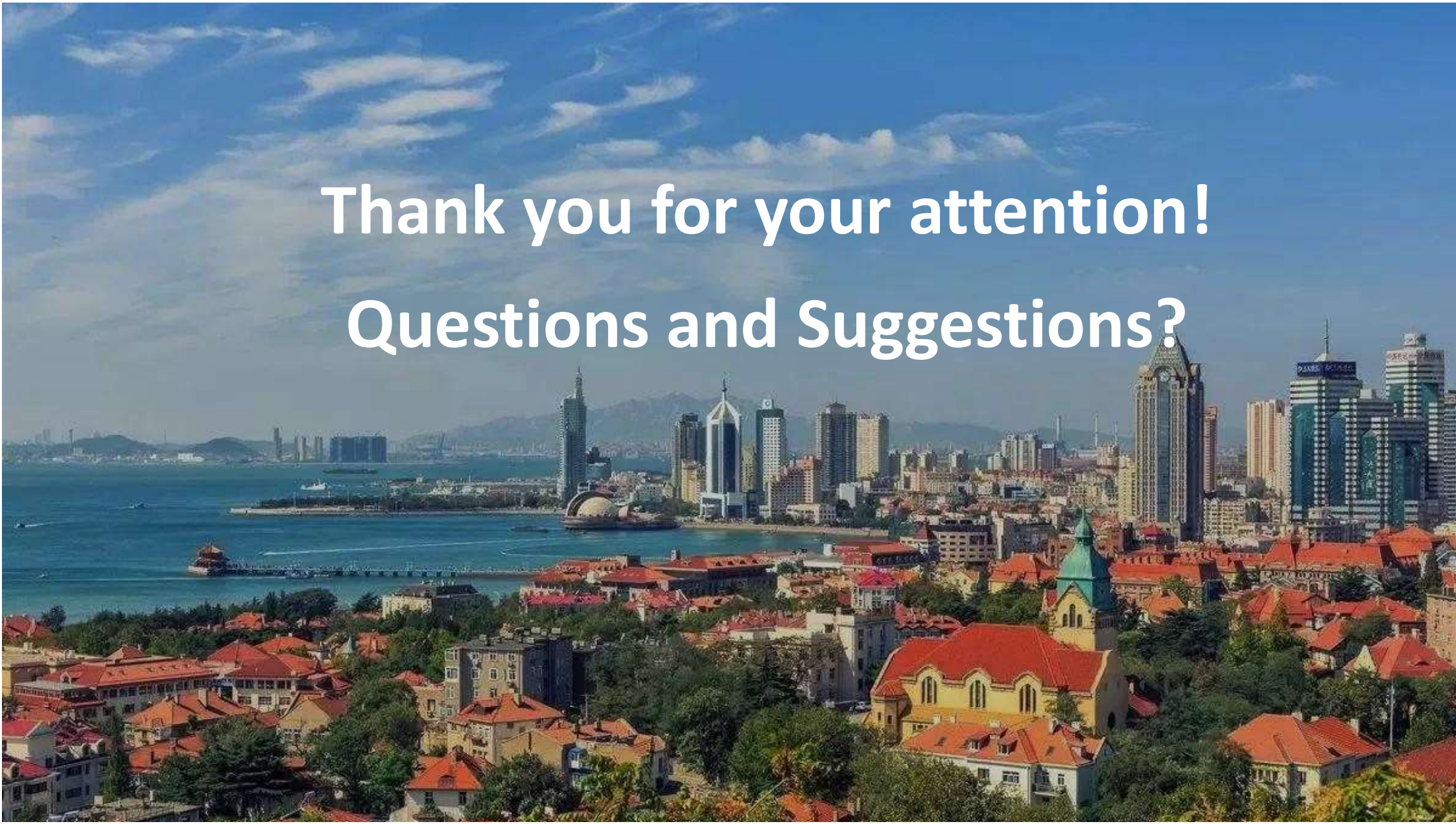








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Thank you for your attention!
Questions and Suggestions?