



Plastics & MPs in Marine Environment: Progress and Challenge

Juying Wang

Marine Debris and Microplastics Research Center
National Marine Environmental Monitoring Center
MEE

Qingdao
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jywang@nmemc.org.cn



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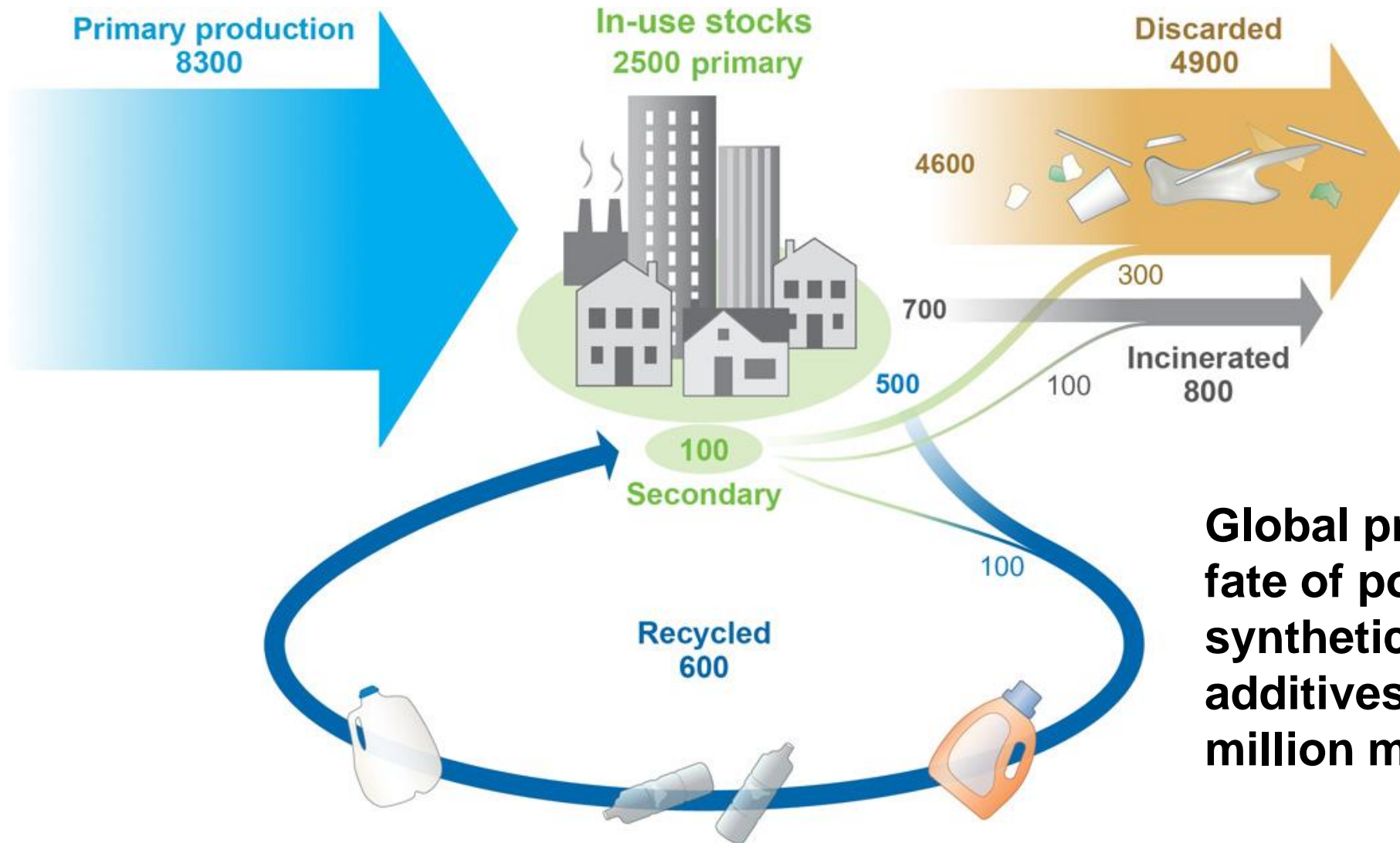
03 Challenge



01

Background

1 Global Production



Global production, use, and fate of polymer resins, synthetic fibers, and additives (1950 to 2015; in million metric tons).

PLASTICS

Of this waste, 9% has been recycled, 12% incinerated, and 79% has accumulated in landfills or the natural environment.

8,300 Mt

Virgin plastics
produced to date

6,300 Mt

Plastic waste
generated in 2015

12,000 Mt

Plastic waste in
landfills by 2050

40%

Increase in production
over next 10 yrs

3 Global Production

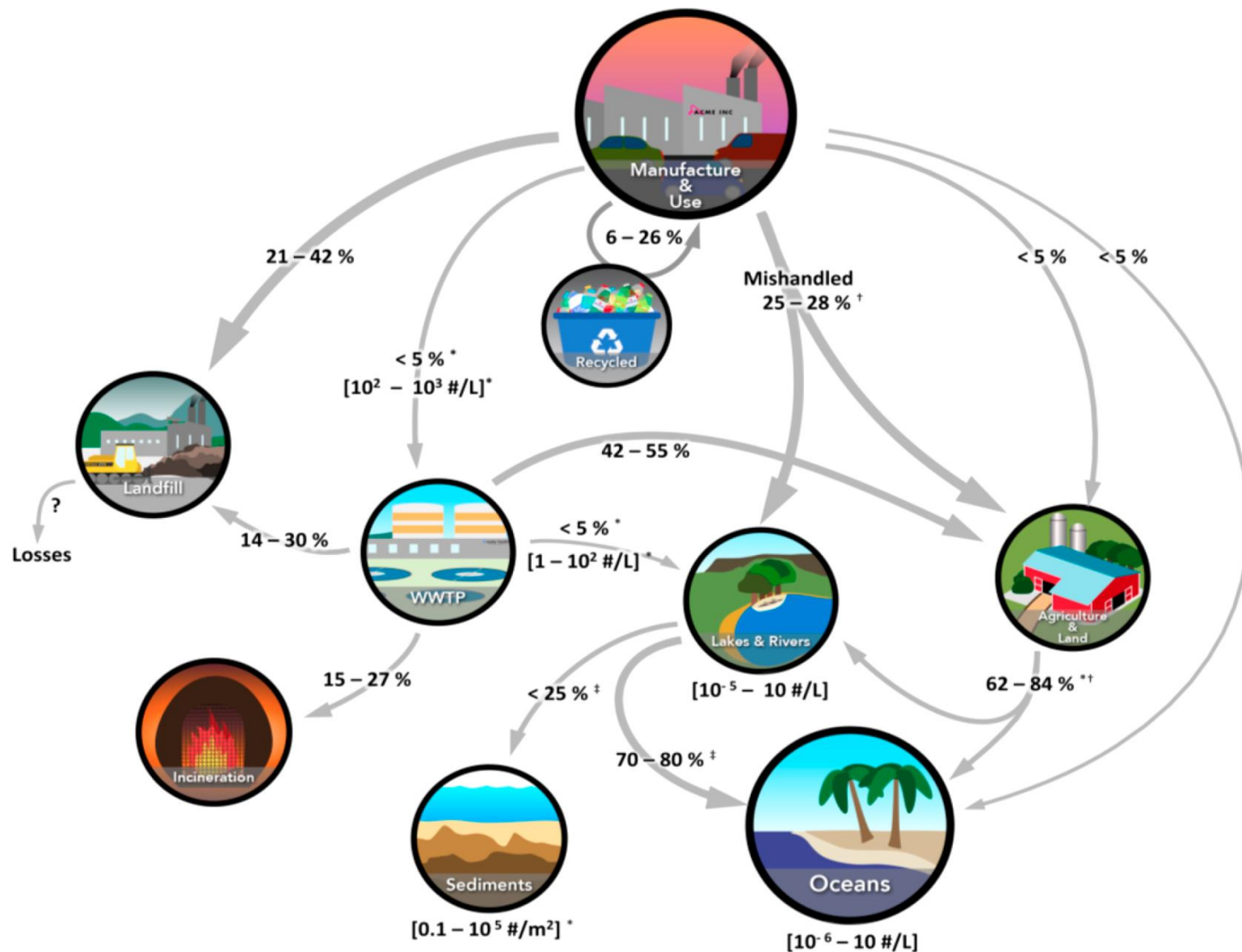
Estimates of plastic loading and transport pathways in the environment aggregated from reports in the literature

Alimi et al, 2018, EST

*Estimates for microplastics only

†Values divided between two compartments

‡Best estimates in the absence of data in literature





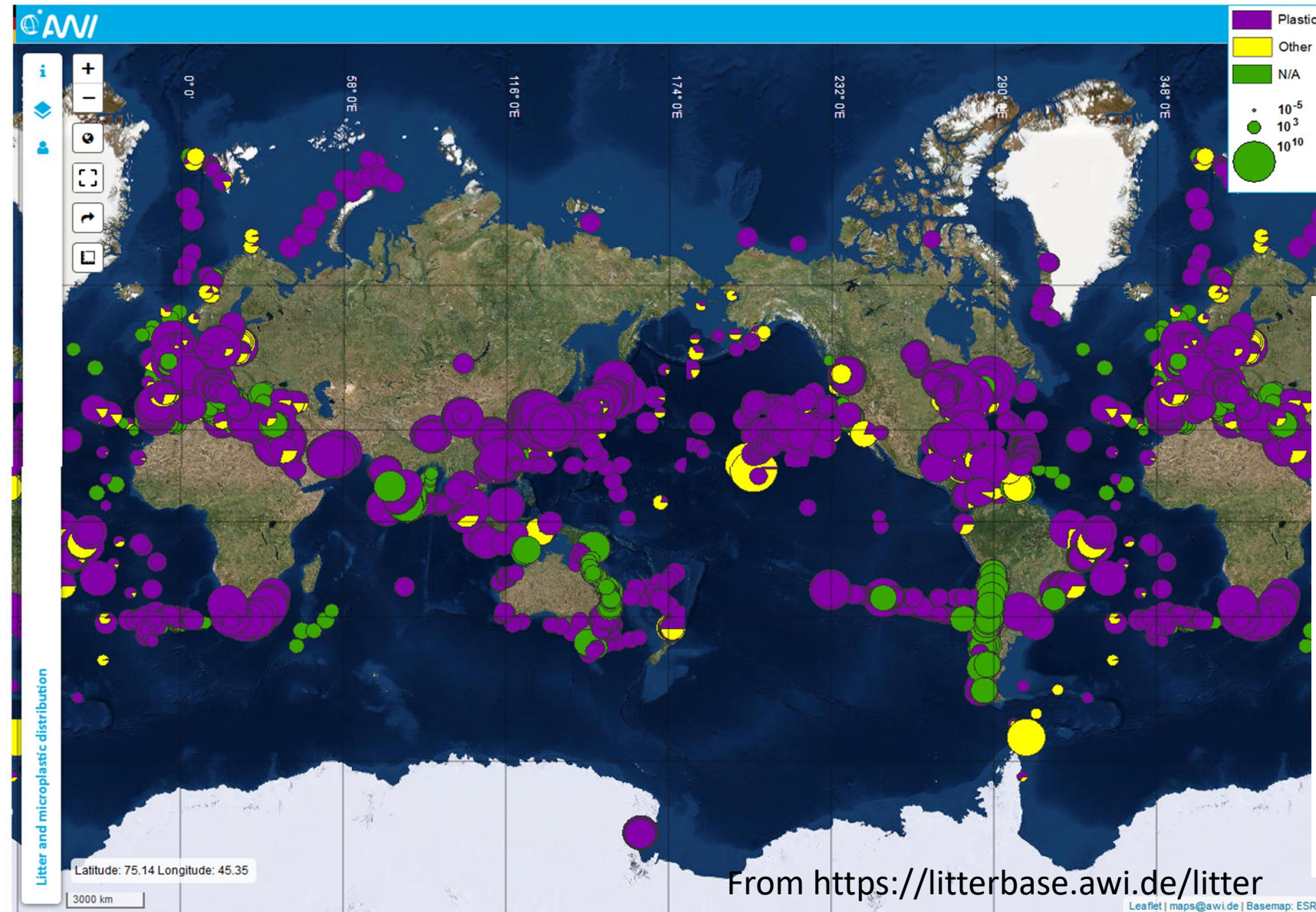
02

Distribution & Abundance

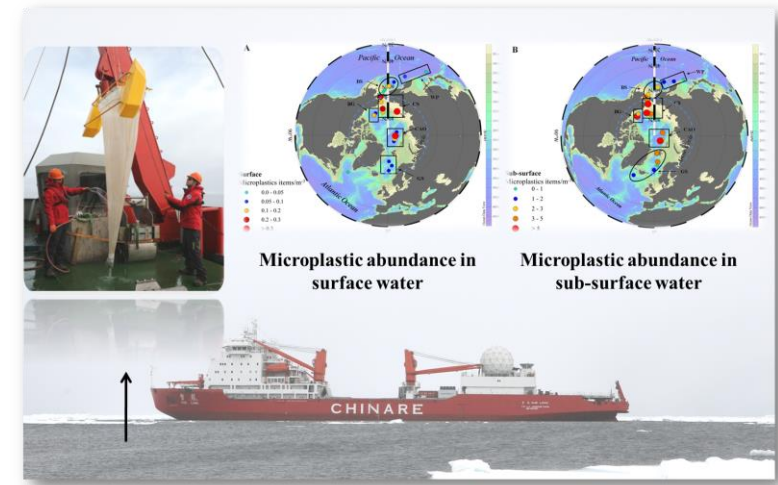
Litters in Marine Environ

61 - 87 % plastics

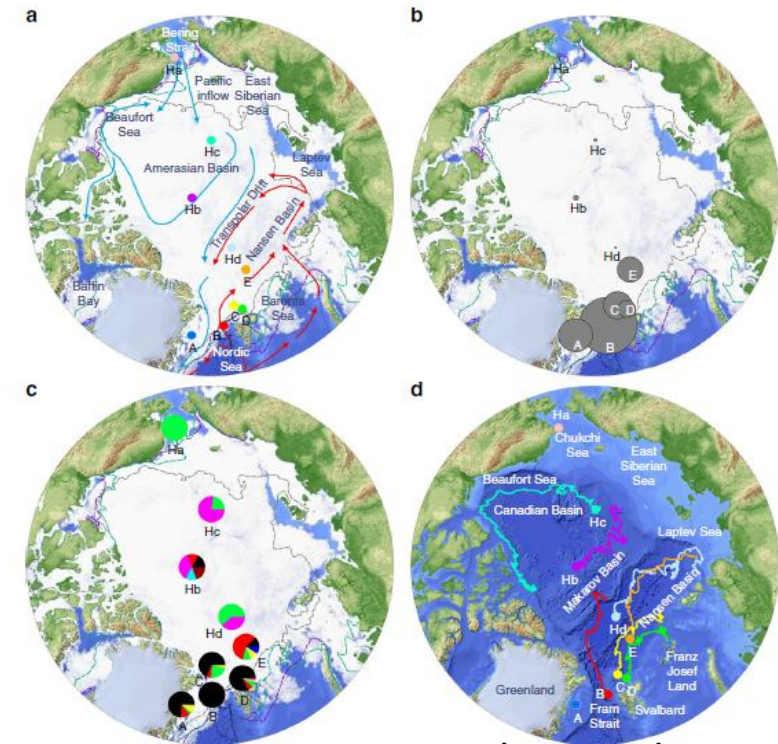
Distribution of litter types in different realms (916 publications)



From <https://litterbase.awi.de/litter>



Mu et al., 2019



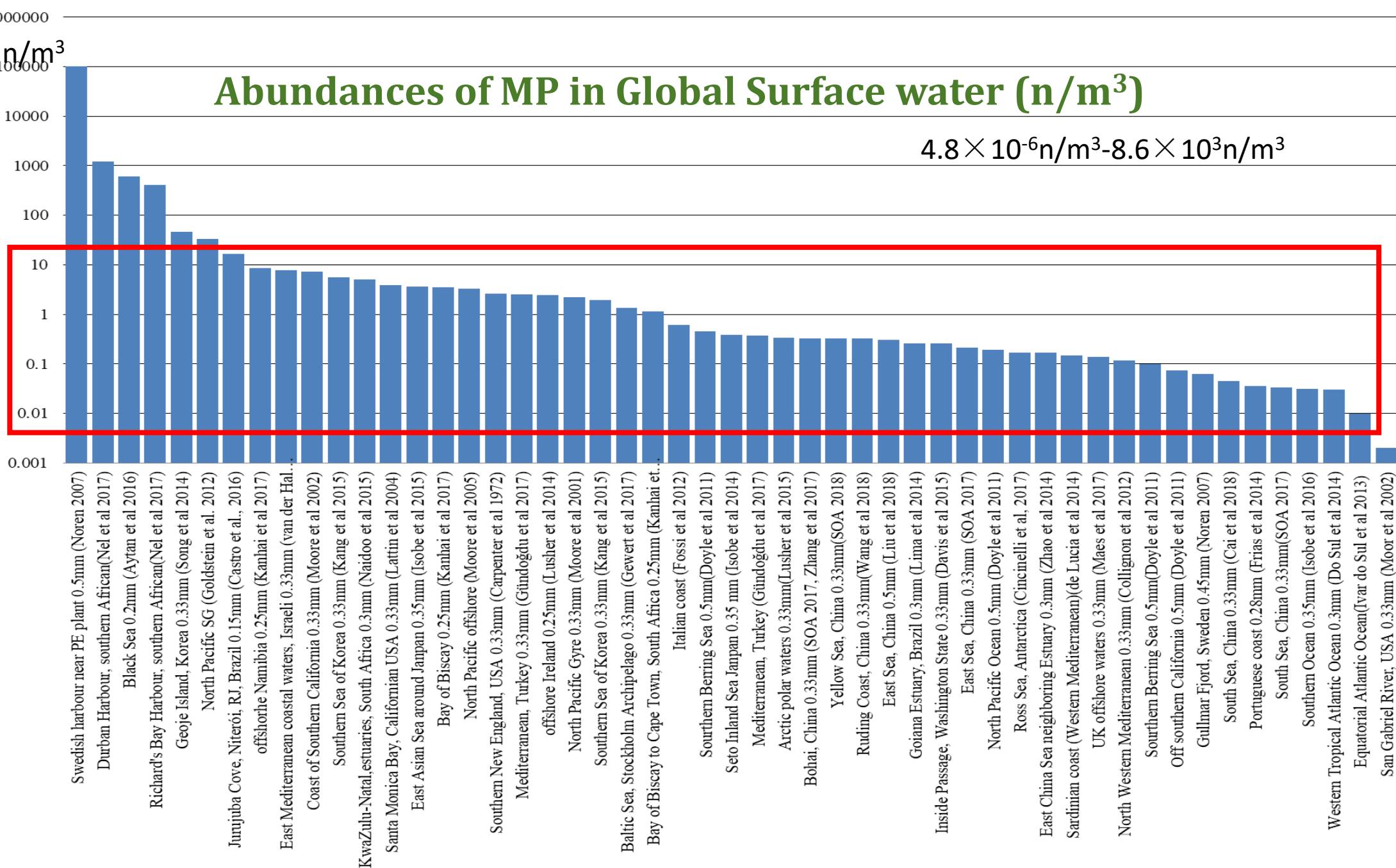
Peeken et al., 2018

ND-102,550 n/m³

Abundances of MP in Global Surface water (n/m³)

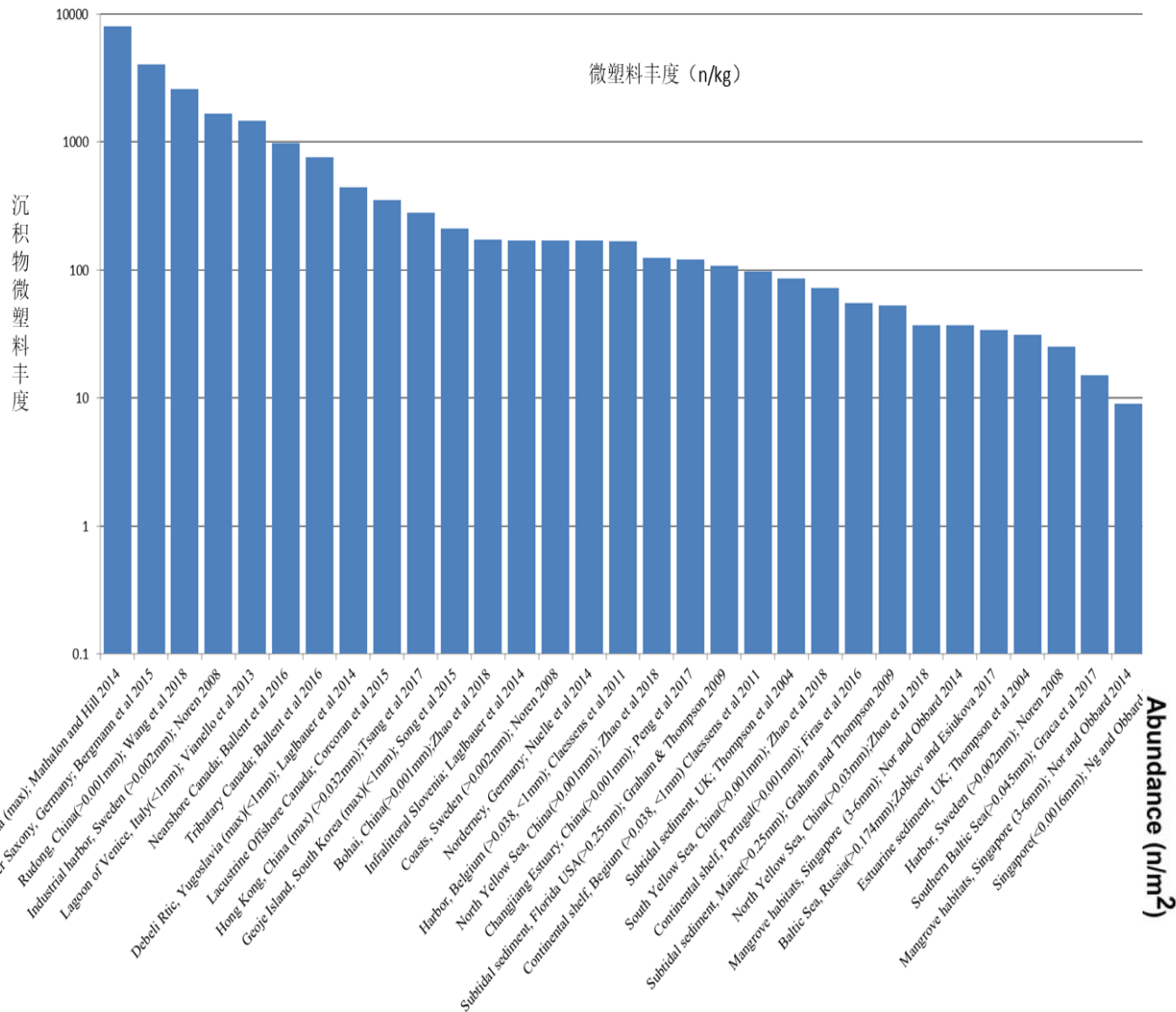
$4.8 \times 10^{-6} \text{ n/m}^3 - 8.6 \times 10^3 \text{ n/m}^3$

海表微塑料丰度 (个/m³)



采样点位、网眼及文献

MP abundance in global sediment (n/kg)

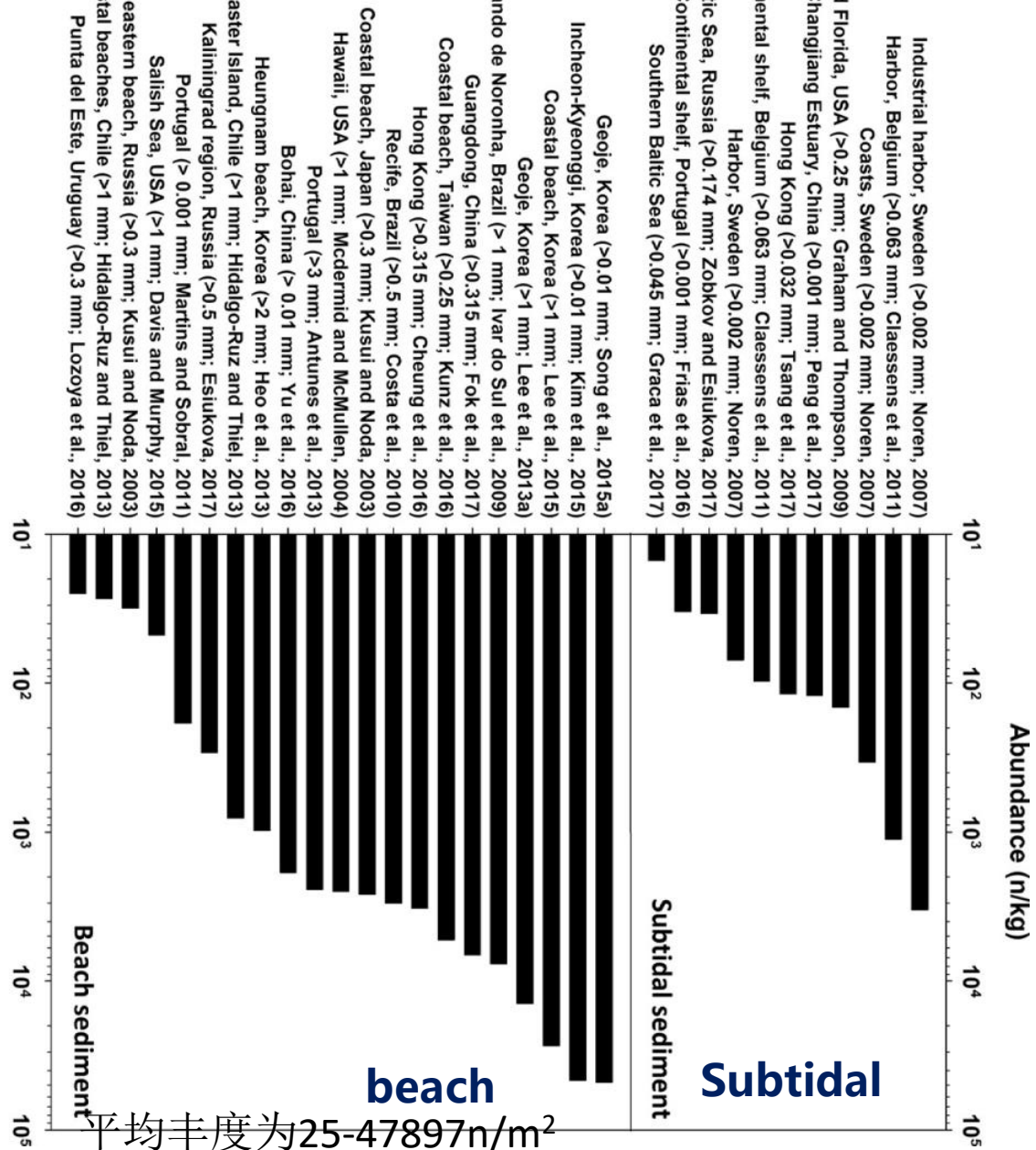


subtidal

Location (mesh/filter size; Reference)

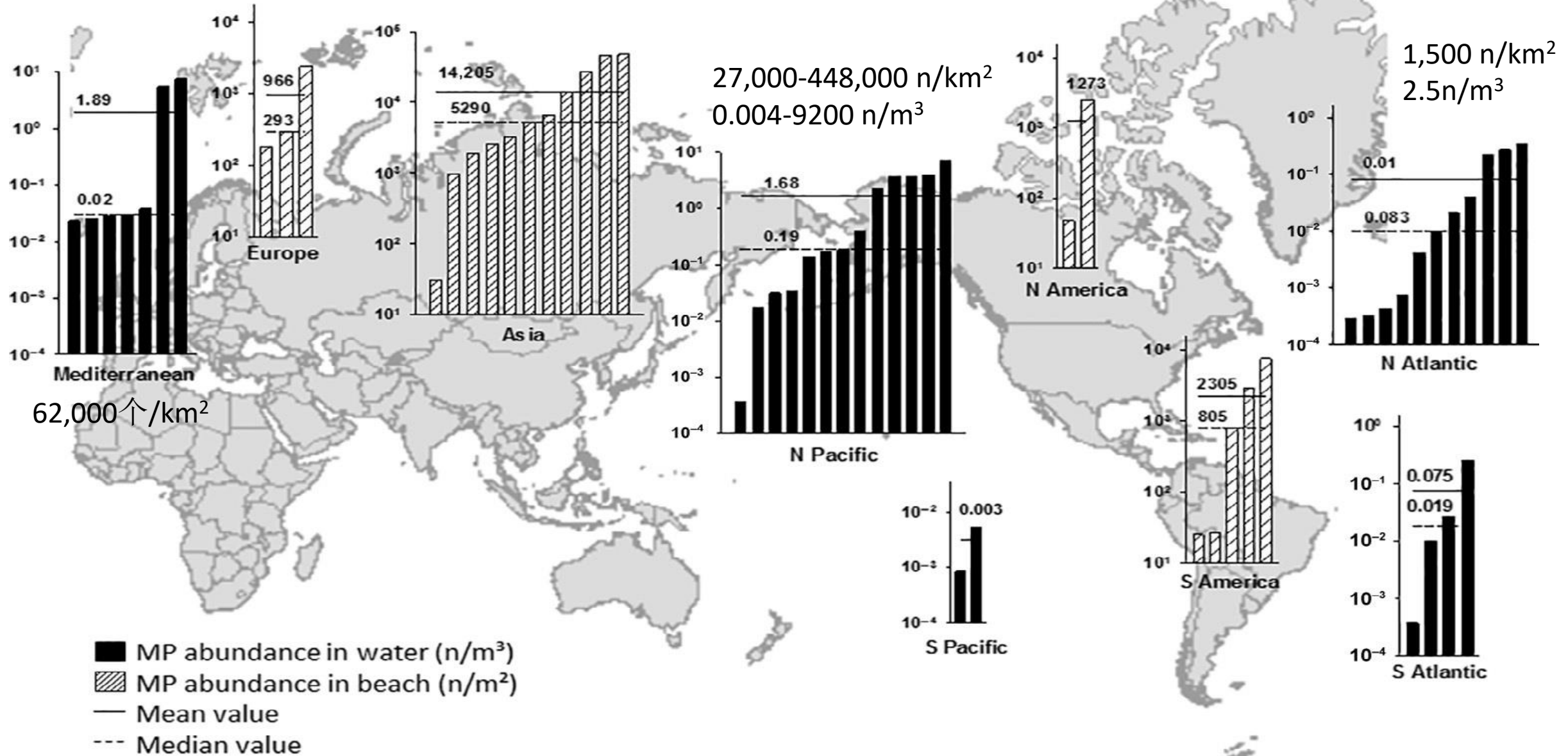
Source: Won Joon Shim et al, 2018

62100 n/kg



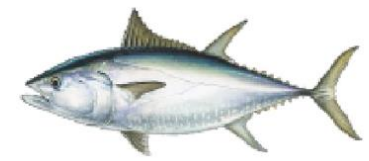
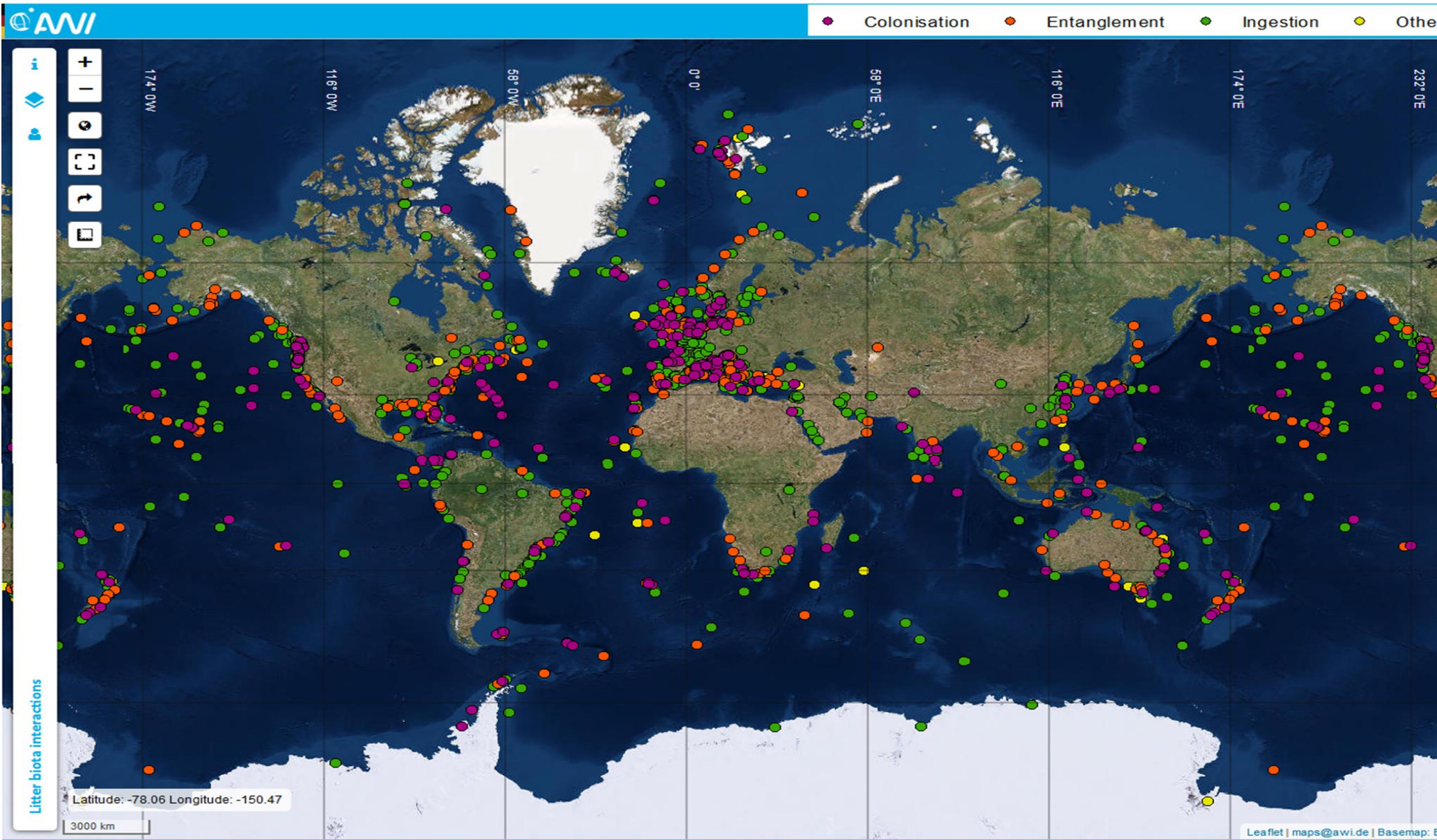
MPs distribution in global ocean

Source: Won Joon Shim et al, 2018



2,249 species are affected by litter (1,188 publications)

UNEP, 2014



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)

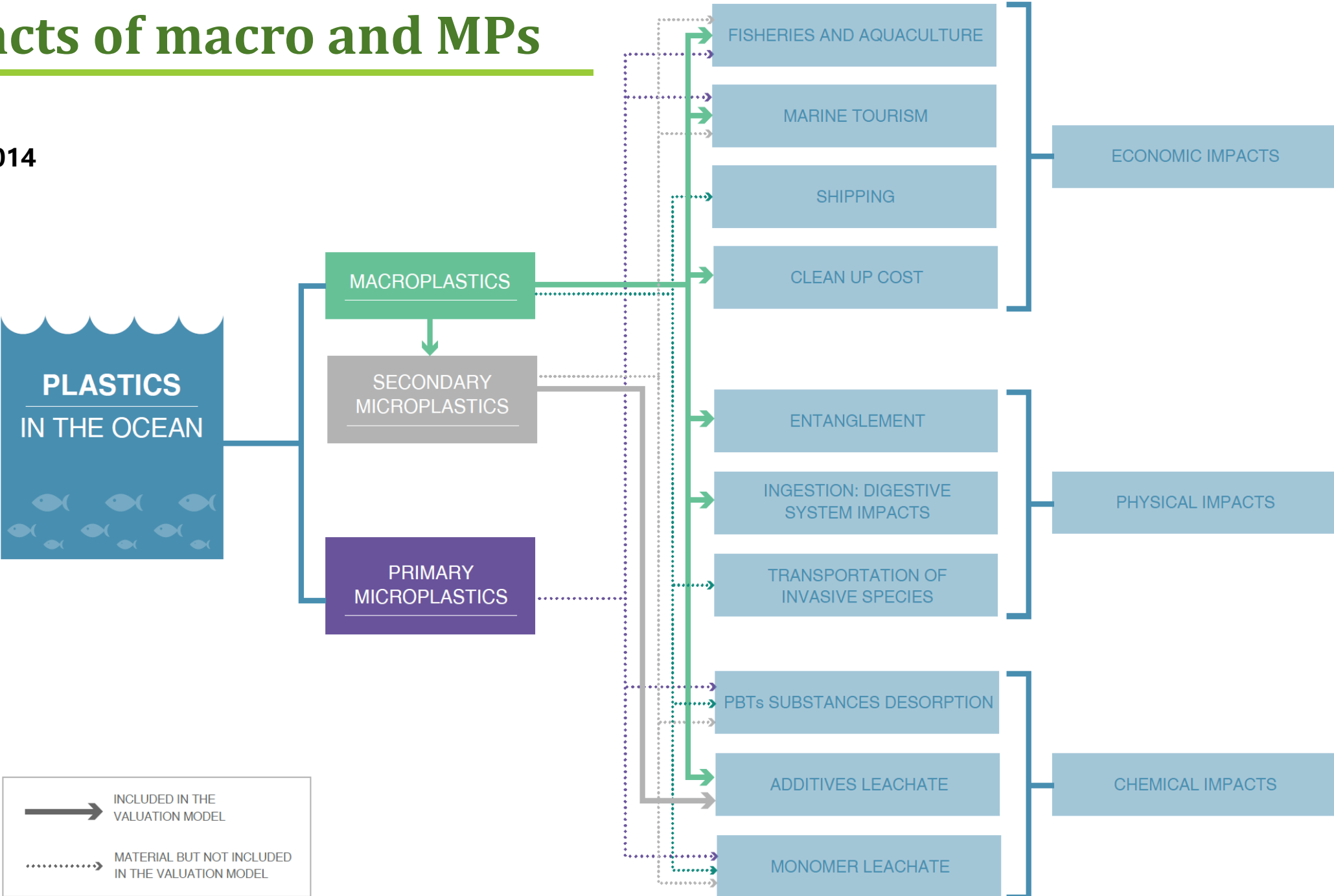


Sperm whale
(*Physeter microcephalus*)
76.92% (10/13)

From <https://litterbase.awi.de/litter>

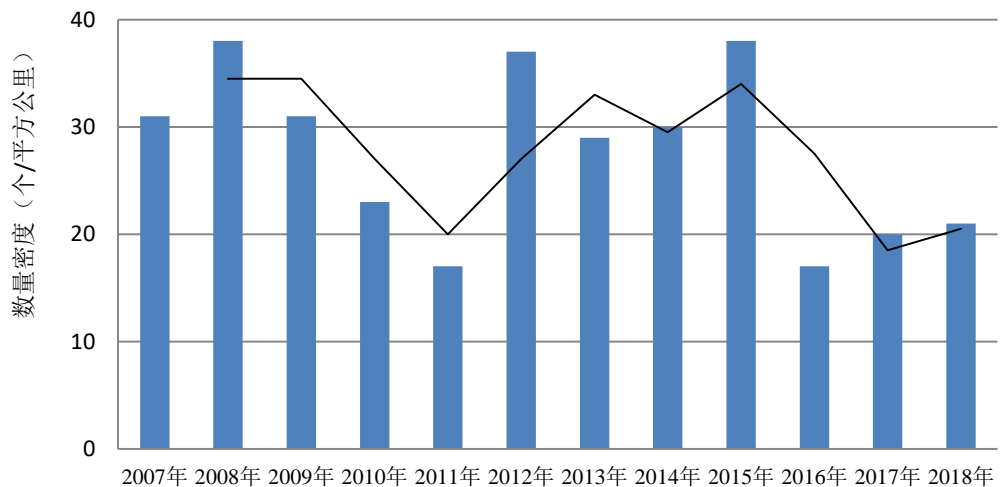
Impacts of macro and MPs

UNEP, 2014

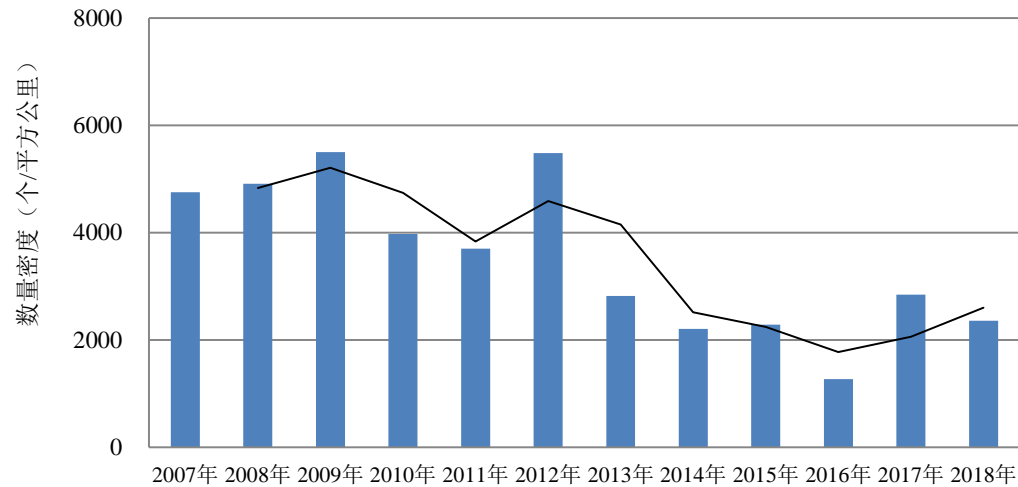


我国07-18年间海洋垃圾变化趋势图

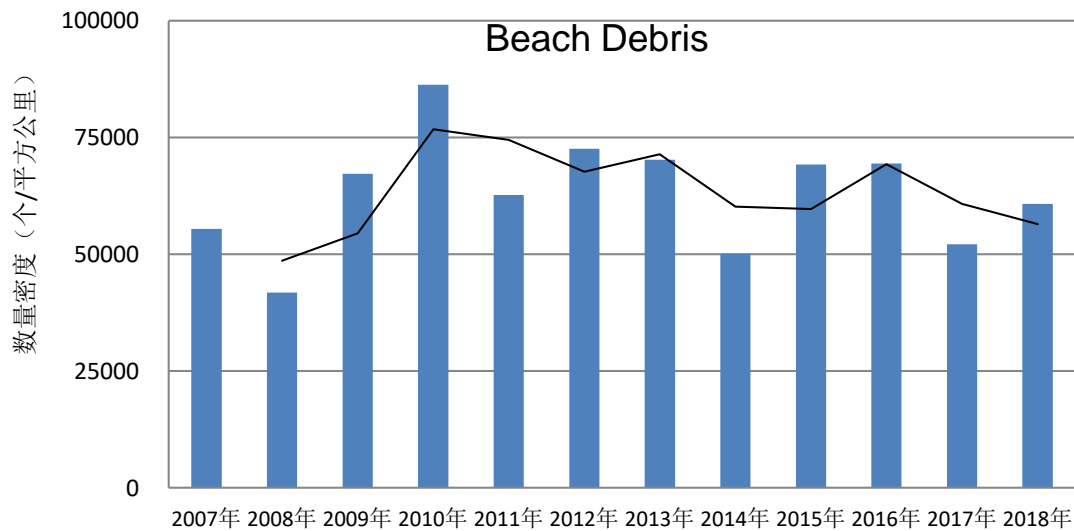
Macro Floating Debris



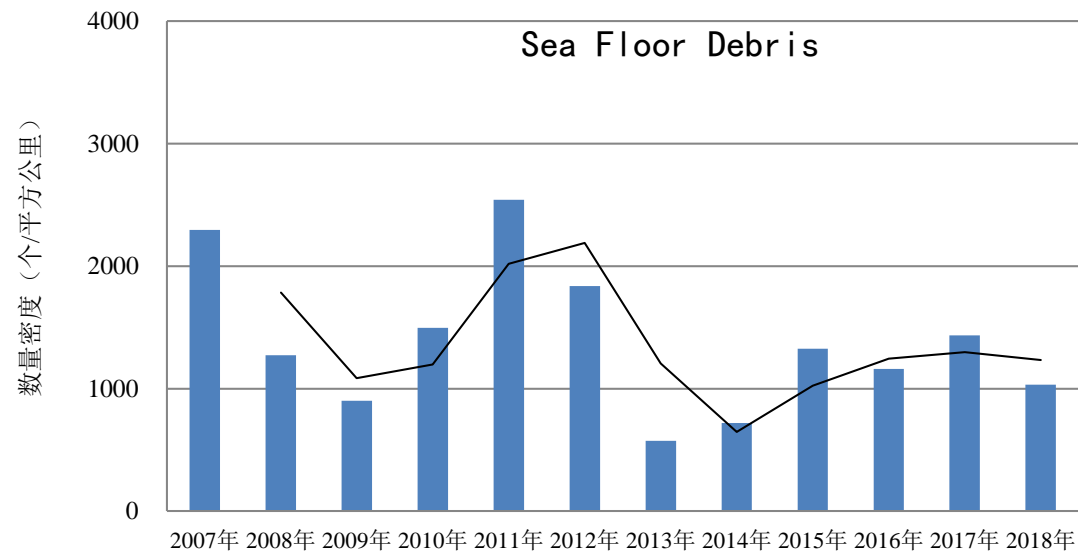
Meso Floating Debris



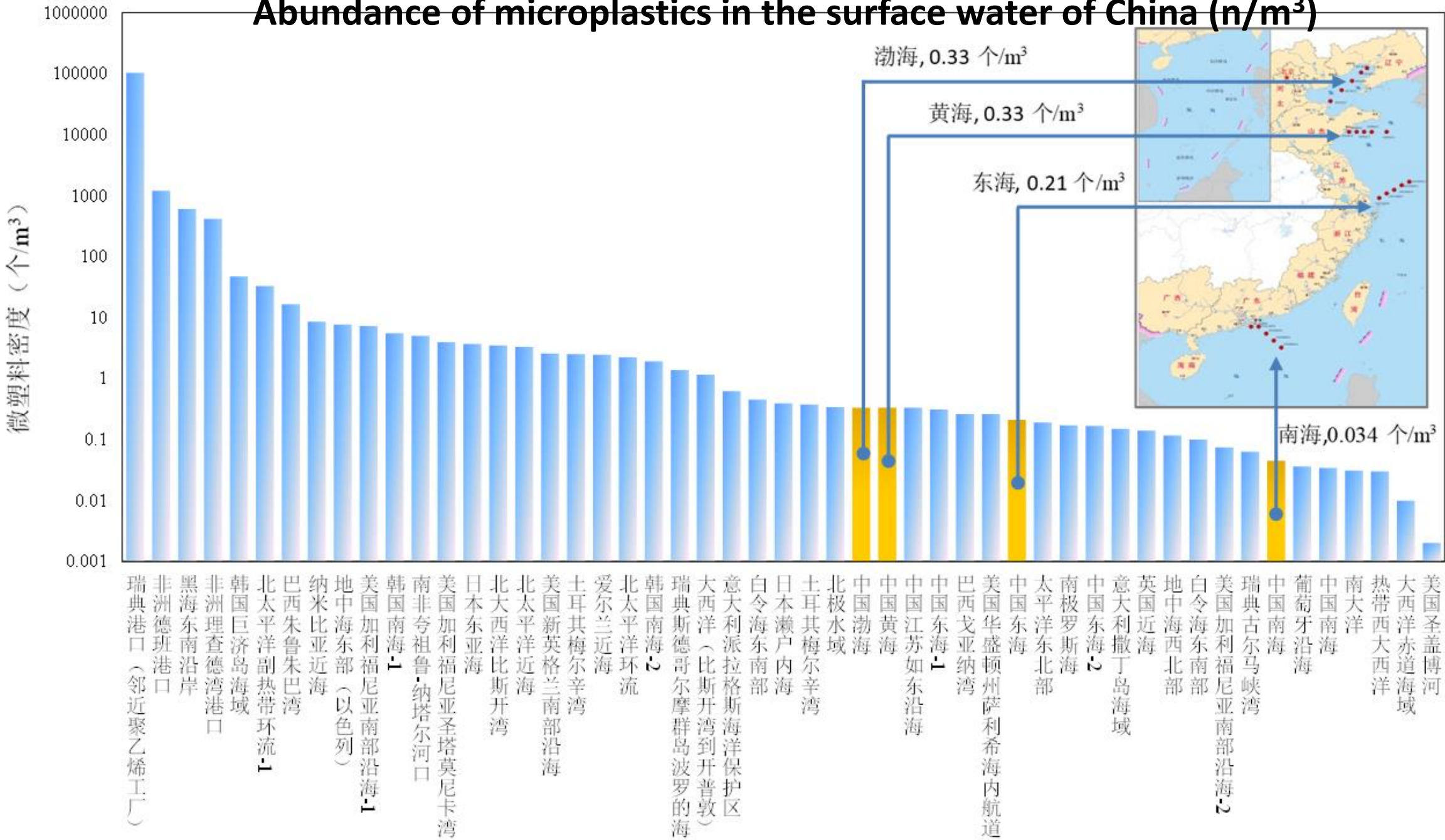
Beach Debris



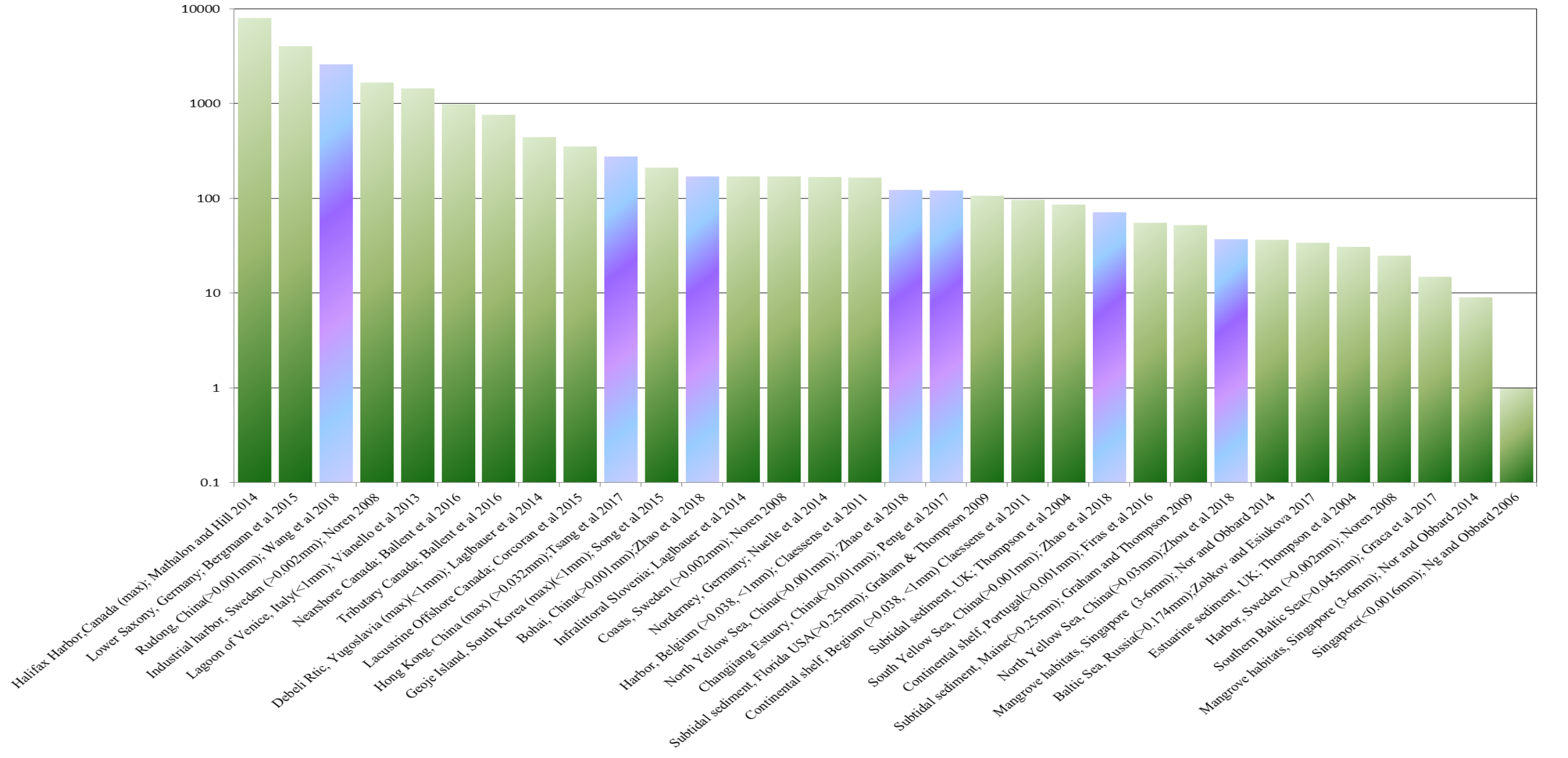
Sea Floor Debris



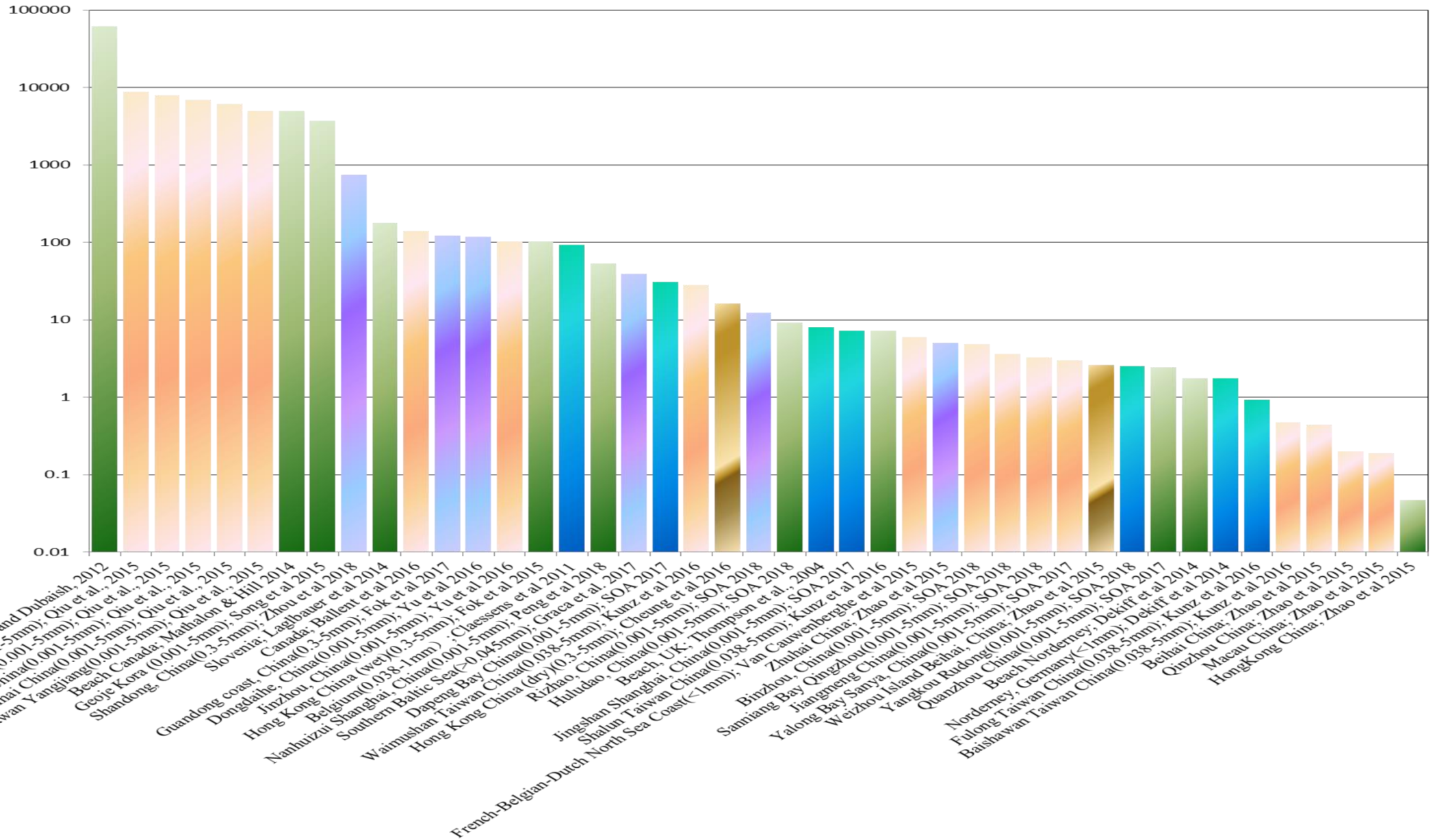
Abundance of microplastics in the surface water of China (n/m³)



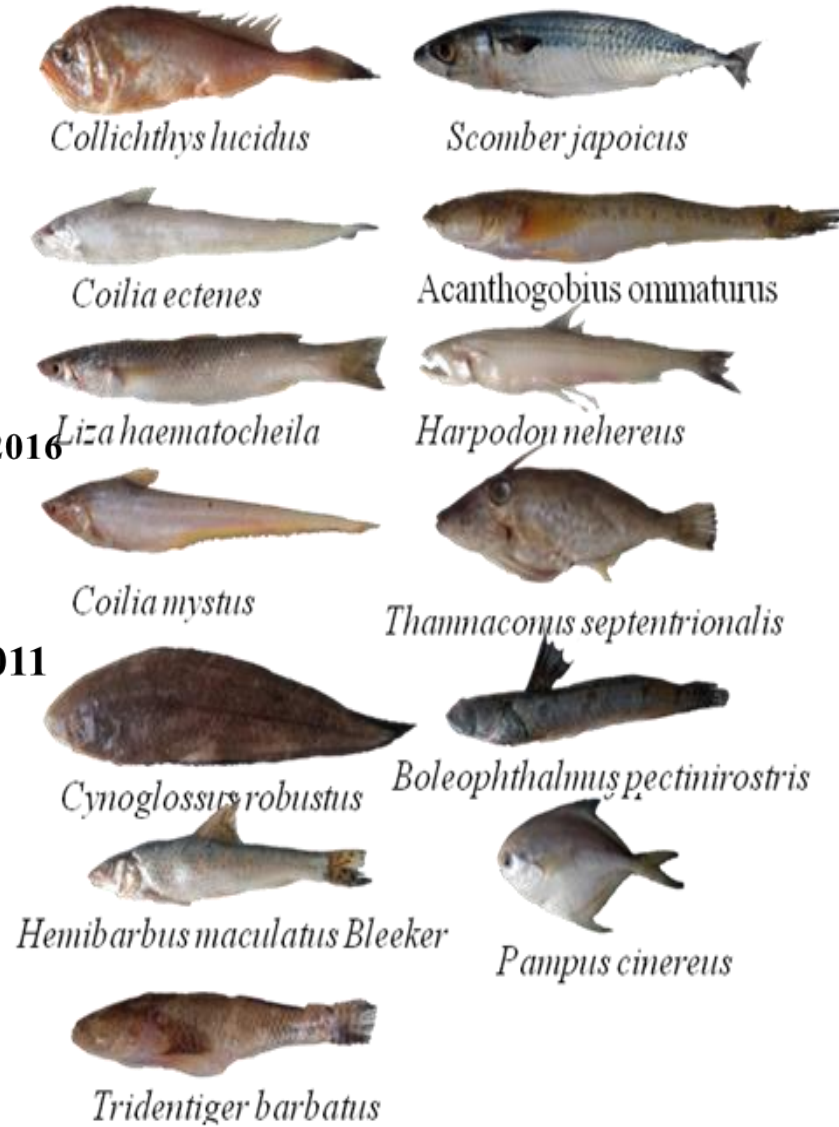
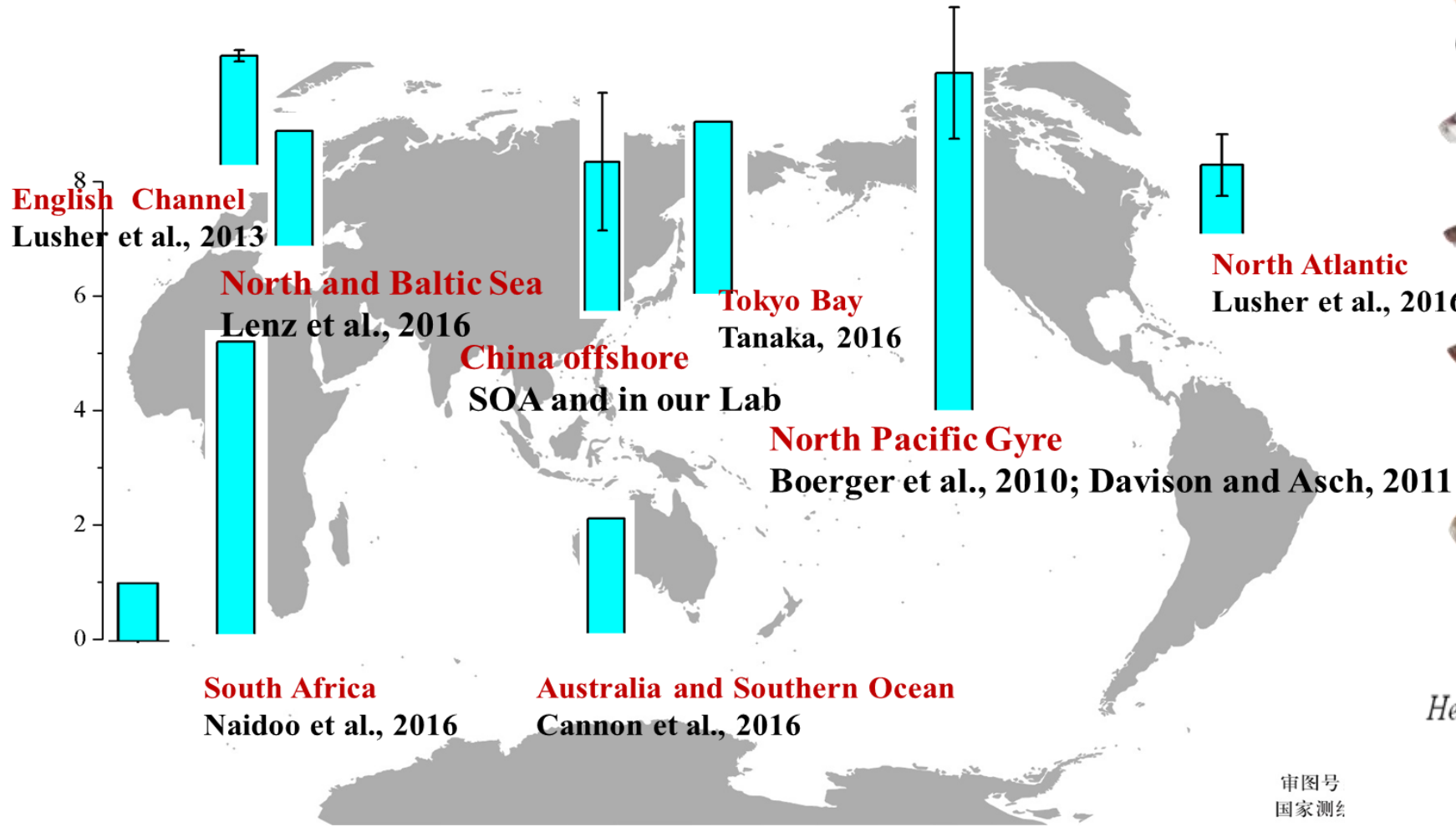
Abundance of microplastics in subtidal sediment of China (n/kg)



Abundance of microplastics in beach sediment of China (n/kg)



Data summary of microplastics ingestion by fish





03

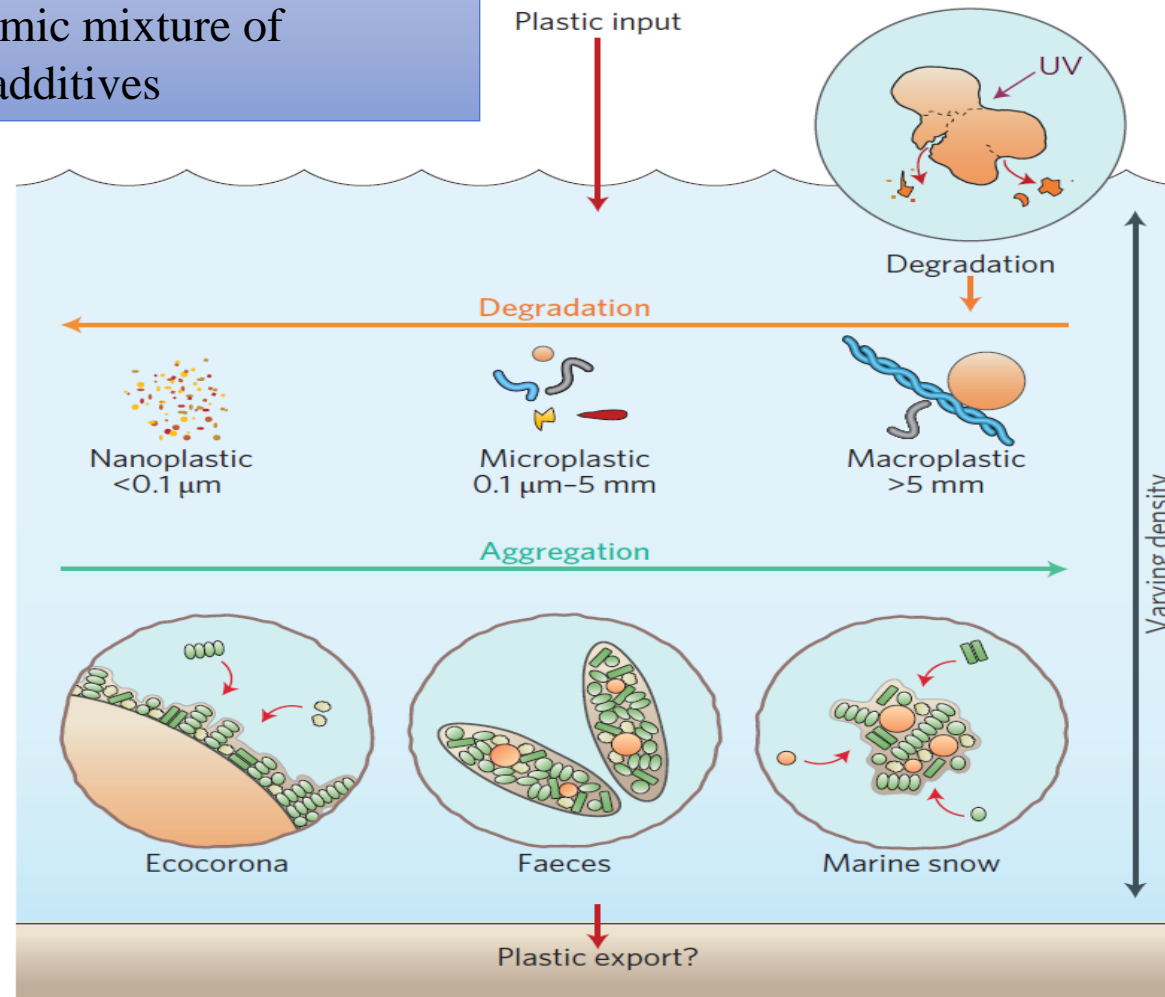
Challenges

Challenges — MPs

complex, dynamic mixture of polymers and additives

- Inhomogeneous
- Different sizes
- Different shapes
- Different densities

- Fragmentation
- Aging at surface
- Bio-mineralization



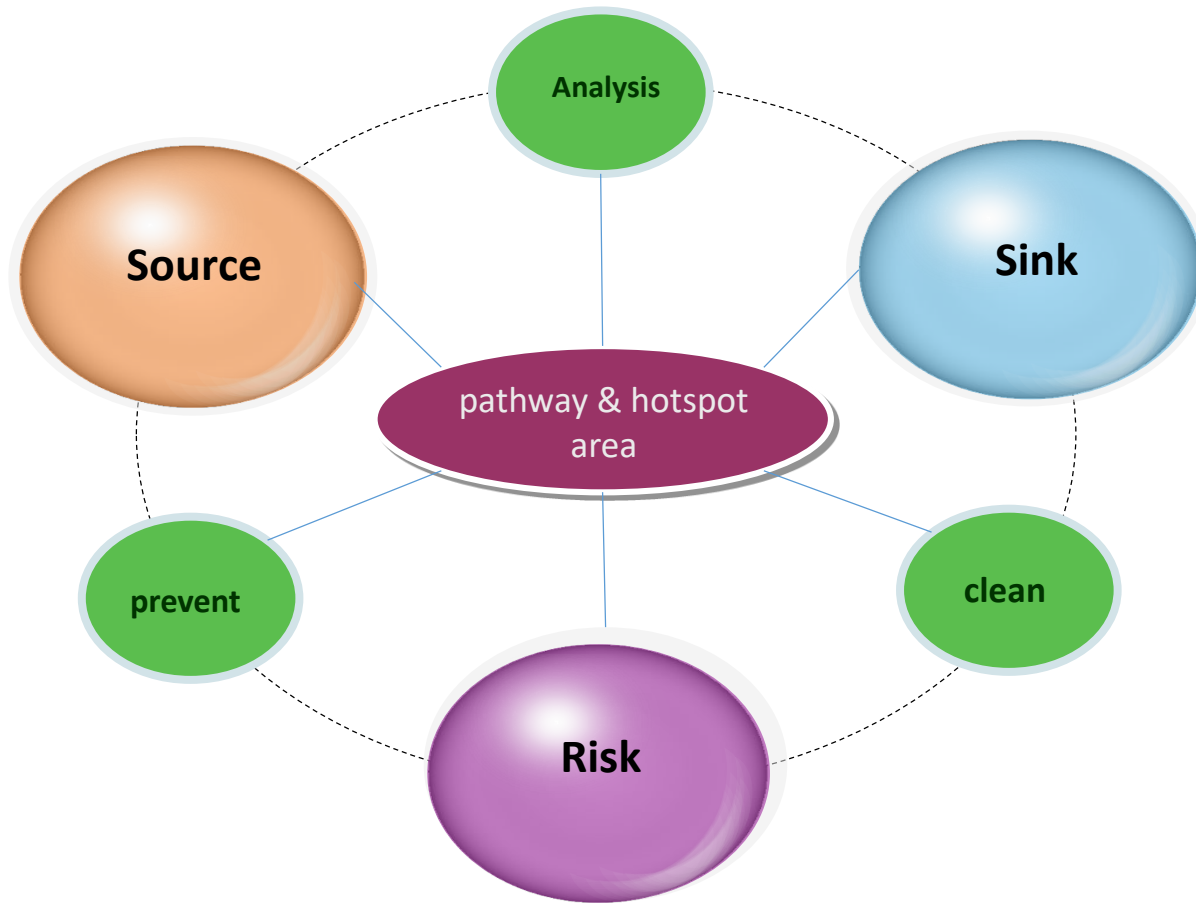
Ubiquitous
Persistent
Cross-boundary

organic material and contaminants can successively bind to form an 'ecocorona' increasing the density and surface charge of particles and changing their bioavailability and toxicity.

Galloway et al, 2017

Schematic illustration of the dynamic changes experienced by MPs in the water column

Gaps — MPs



Scientific Considerations

1. Develop practical method

- harmonize monitoring method, SOP
- flux of plastic and distribution
- identify pathways & accumulation areas

2. Impact & Risk assessment

- Ecological Risk
- Human health
- Impact on economics

3. Prevent & clean at source

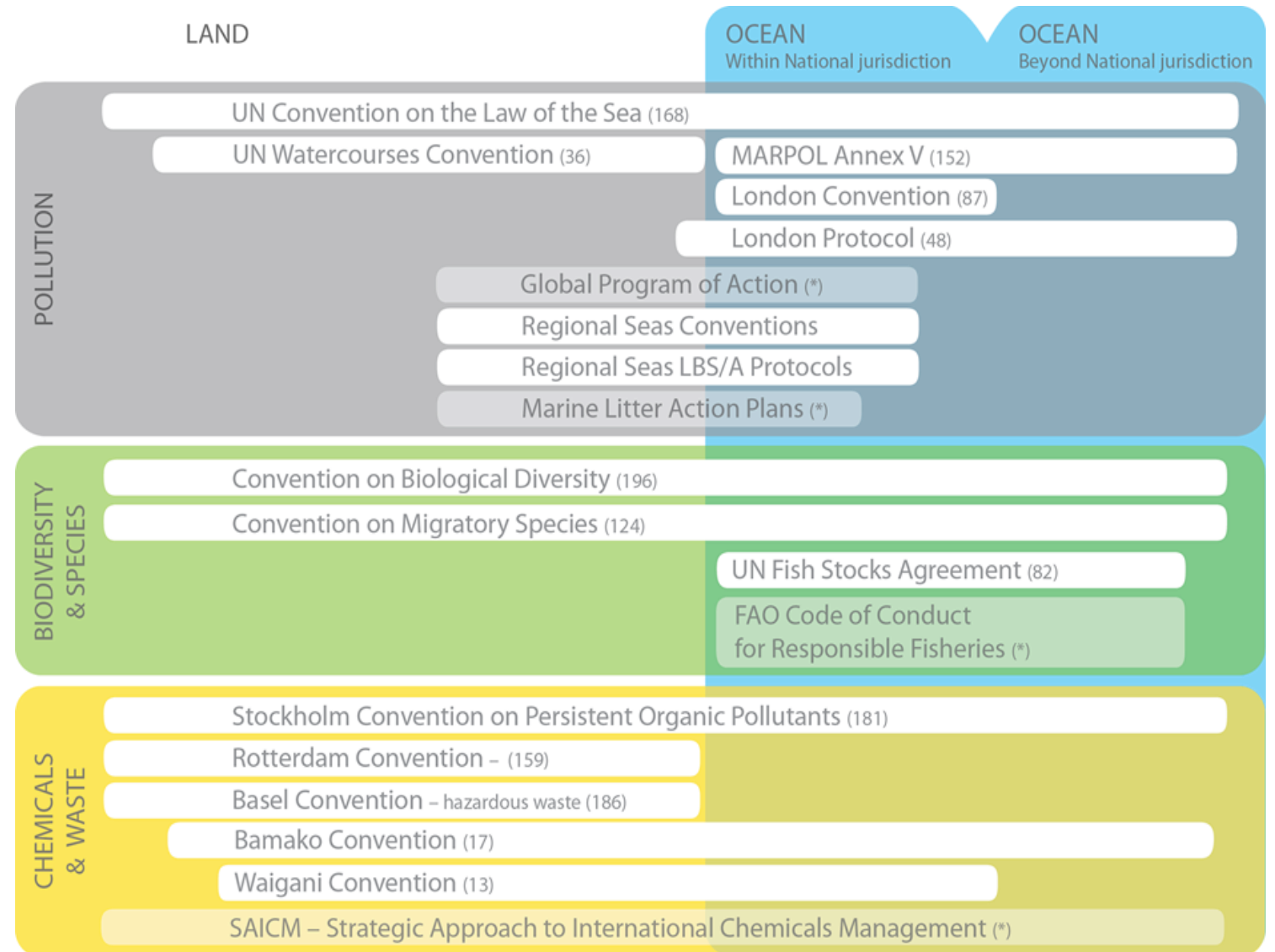
- innovative method in WWTPs
- innovative containment barrier for rivers
- Contingency plans

Challenge & Gap \neq No **Action** !

- However, these points **should not be taken as a plea for downscaling** the attention to plastic debris in the environment.
- As the risks are **uncertain** and the concerns are **considerable**, plastics have rightly become an **emerging political issue**.
- A common way to act upon the uncertainties and ignorance (i.e., lack of knowledge) regarding potential effects of plastic debris is to recognize it as a high-potential risk requiring **urgent action**.

International Legal Framework

Current governance strategies and approaches provide a fragmented approach that does not adequately address marine litter and microplastics



Holistic Approaches to Address the Marine Plastics Challenge



- Science & Civil Society
- Science & Industry
- Science & Public Authorities



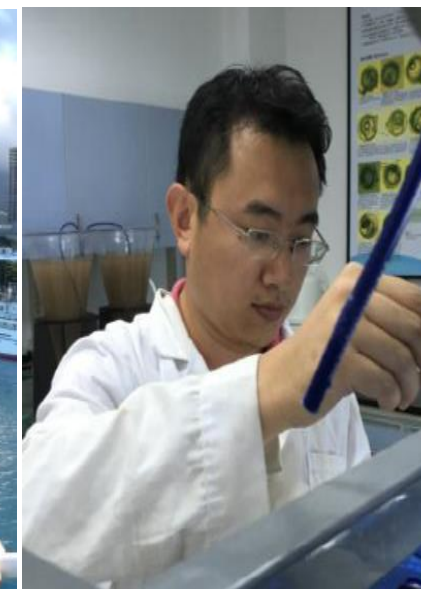
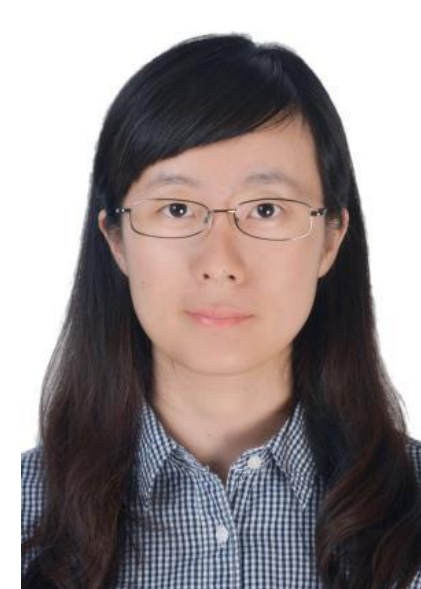
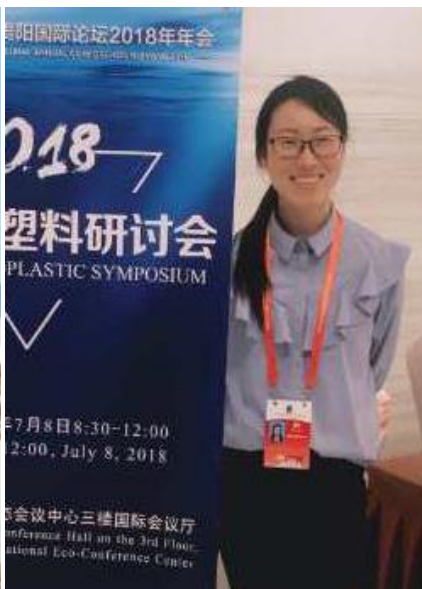
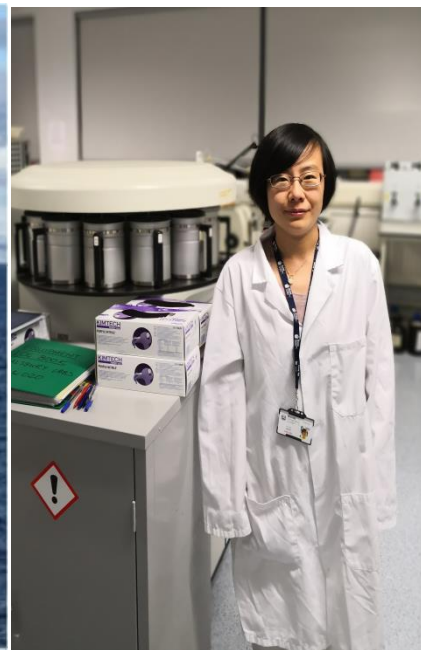
Cooperation Science,
Industry, Civil Society & Public
Authorities

- Development and applying Innovative Methods (Science & Industry)
- Foster exploitation of project result considering the device value and solution obtained (Science & Industry & Stakeholders)
- Cost-effective analysis and business models (Science & Industry & Stakeholders)
- Engage stakeholders & deliver “lessons learned” to policy platforms and society (Science & Industry & Civil Society & Stakeholders)
- Societal Responsibility (Science & Industry & Civil Society & Stakeholders)

No single solution will stop marine plastic pollution!



Marine Debris & Microplastics Research Center





Thanks for your attention!

