

# Are we swimming in a plastic soup?

**Martina Capriotti**

Marine Biologist

Research Scientist at University of Connecticut

National Geographic Explorer





It's still a problem...  
even if media don't  
talk about it anymore



# PLASTIC: A USEFUL MATERIAL...?



- Durable
- malleable
- low cost
- safe
- light
- technical gear
- protective equipment

**Plastic save our lives during COVID pandemic**





# USE OF PLASTIC

Plastic wastes:

9% has been recycled

12% incinerated

79% dumped in landfill and environment



the environmental costs



# SOURCES

- Storms
- River
- Floods
- Direct input (coastal or maritime)
- Illegal or not protected landfill
- Mismanagement of solid waste

(1.7% to 4.6% plastic waste end up to the sea in coastal countries)



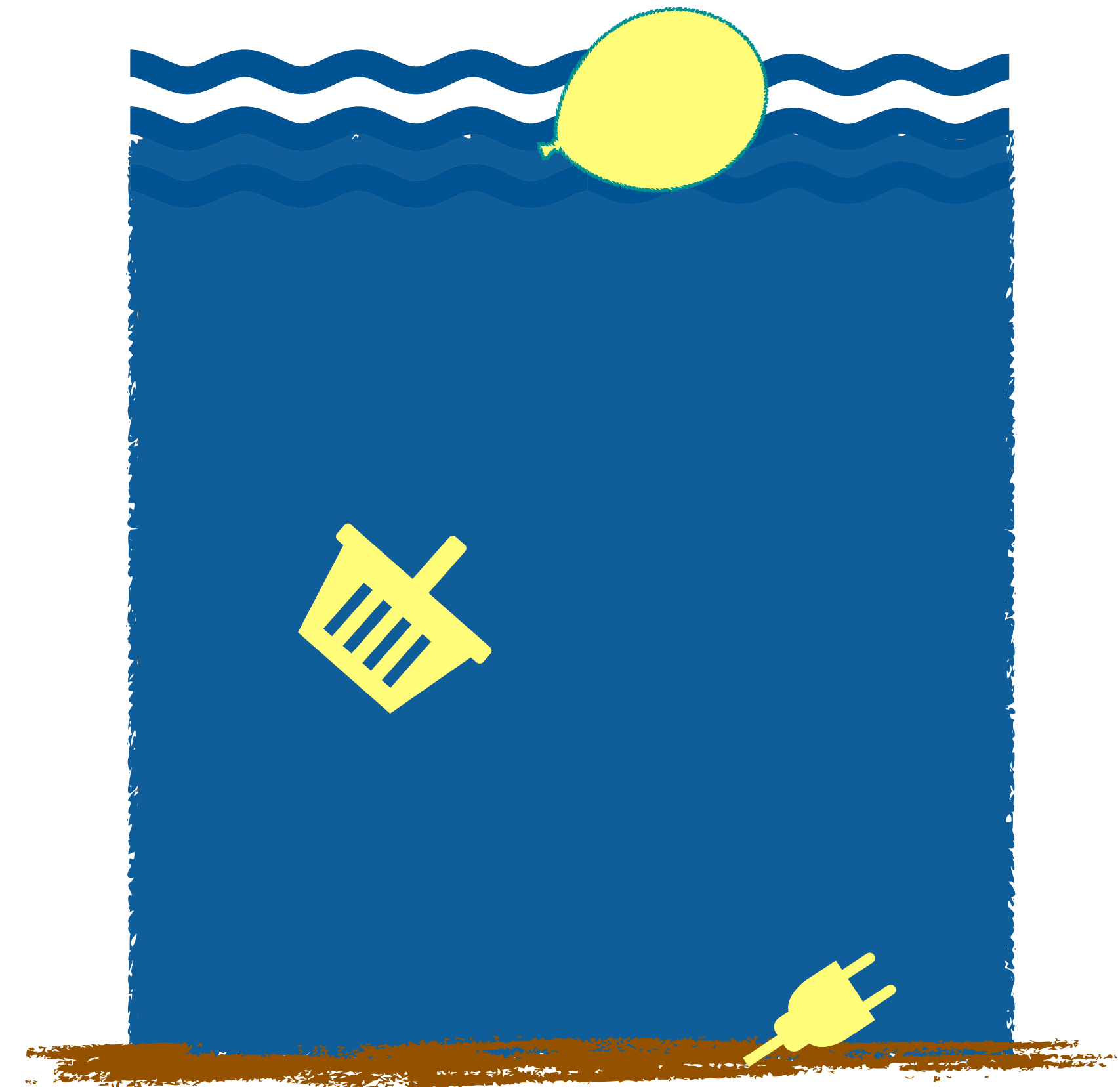
80% land source

**IMO - MARPOL**  
**International Convention for the Prevention of Pollution from Ships**



# GARBAGE IN THE SEA

- 15% floats
- 15 % water column
- 70% sea bed



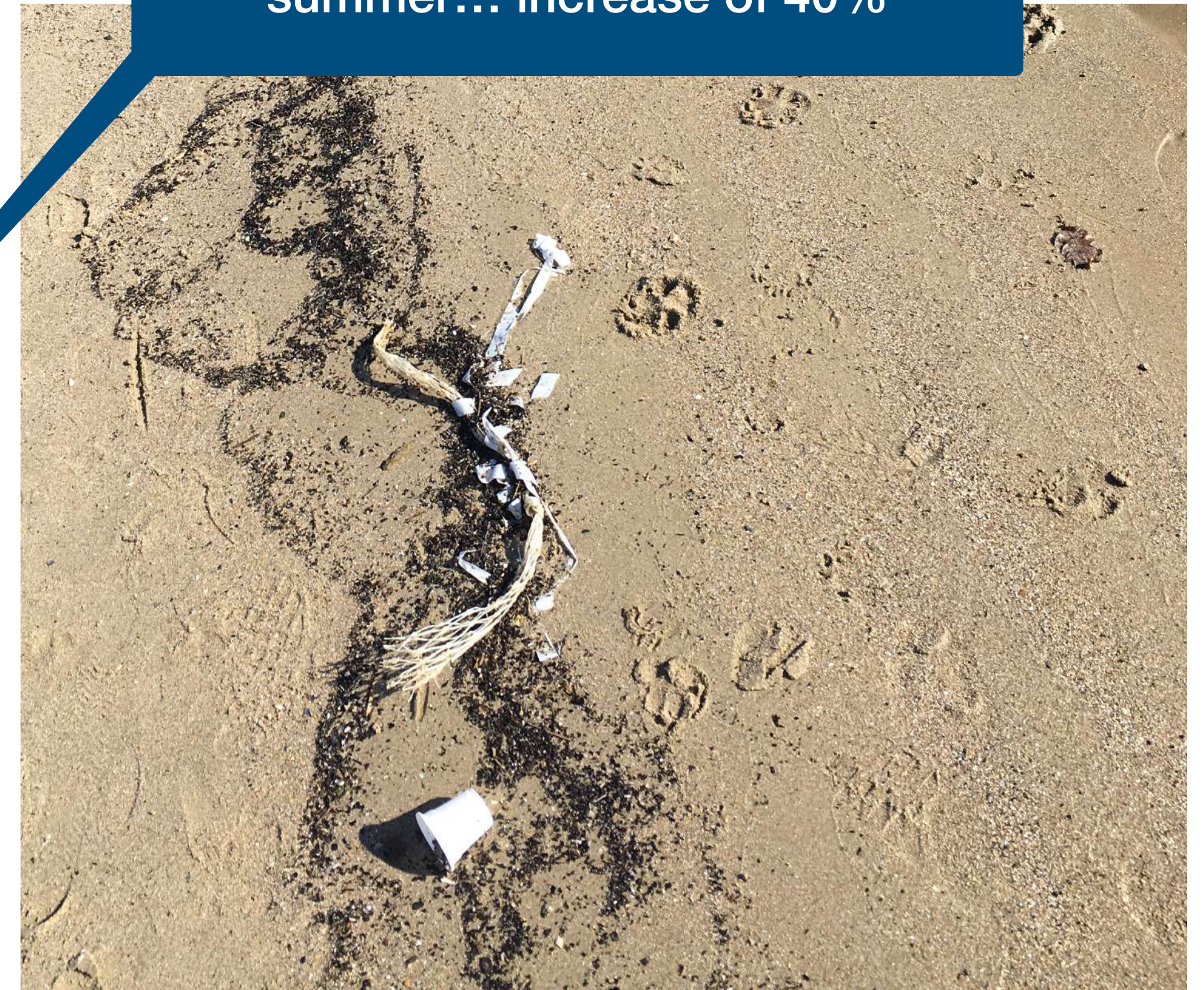


# STRANDED PLASTIC

- Recreational activities on the beach
- Sea transportation

**Single-Use Plastic and fishing gear  
80% of stranded Marine Litter**

summer... increase of 40%





# SINKING PLASTIC

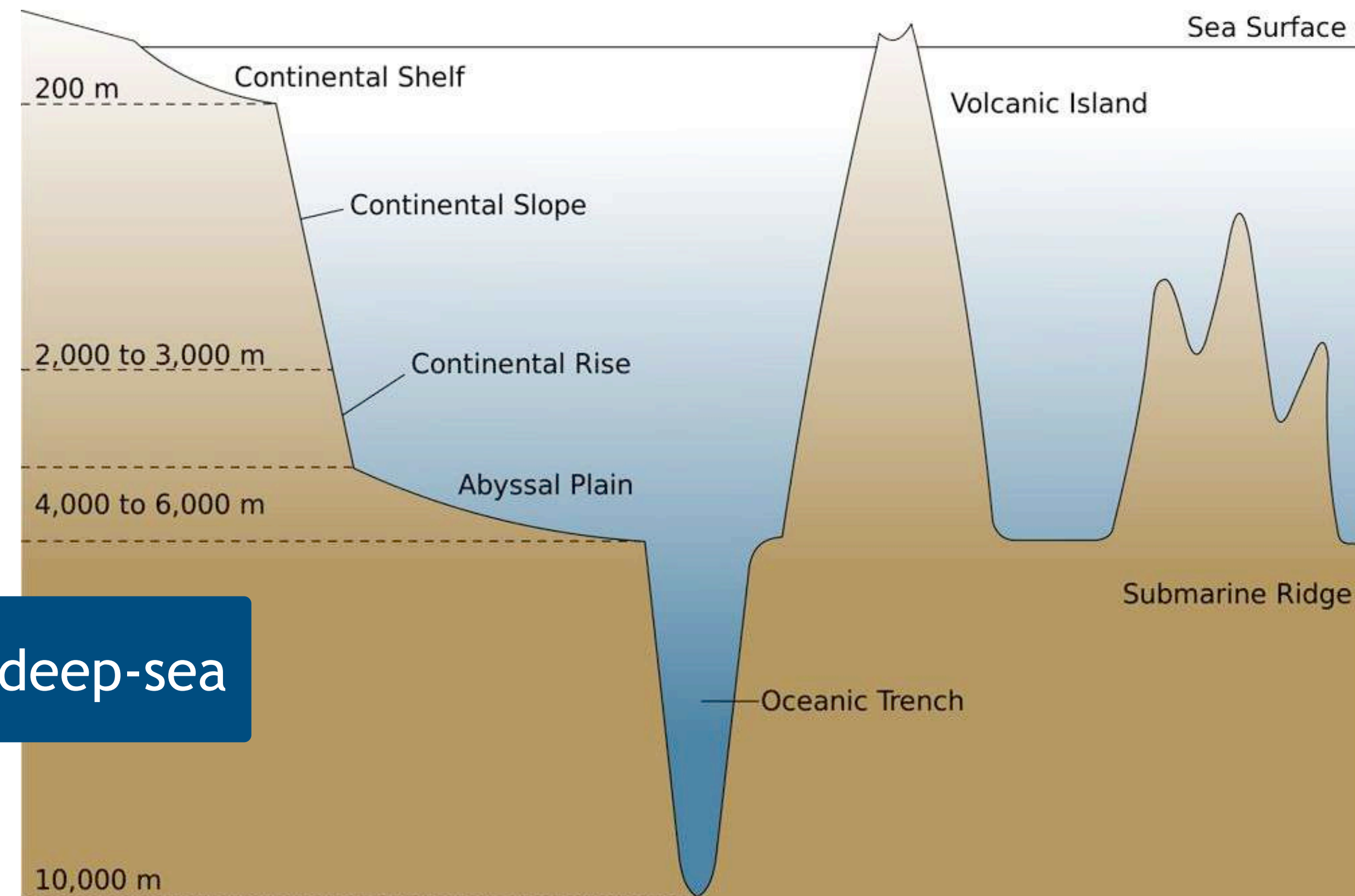
Plastic is 90% of trash in benthic trawl

Trawling only sandy bottom

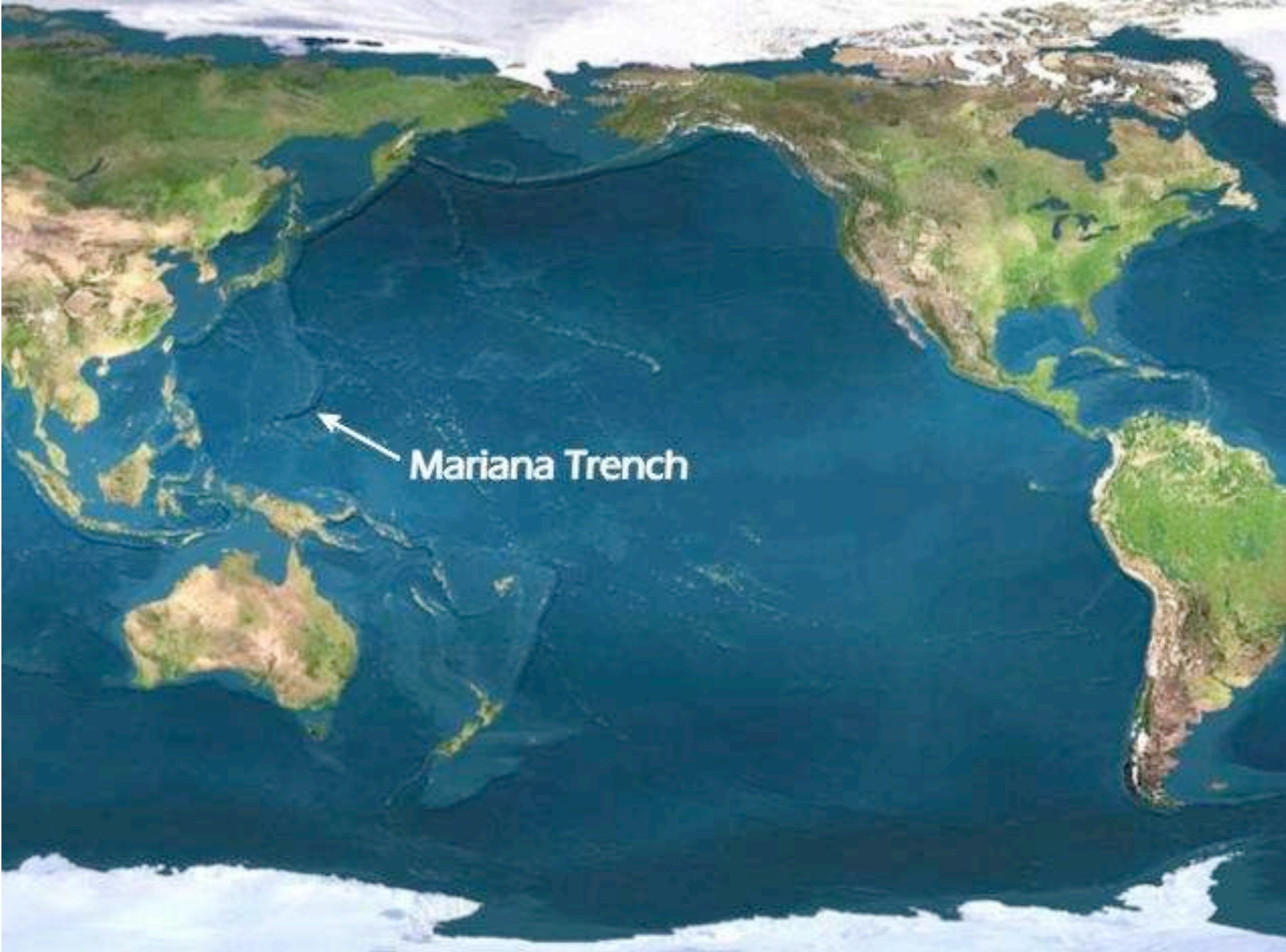
Sampling method could bring to underestimate the amount

Deep-sea not easily accessible

Almost half of the planet surface is deep-sea







# Plastic in Mariana trench

-10.898 mt

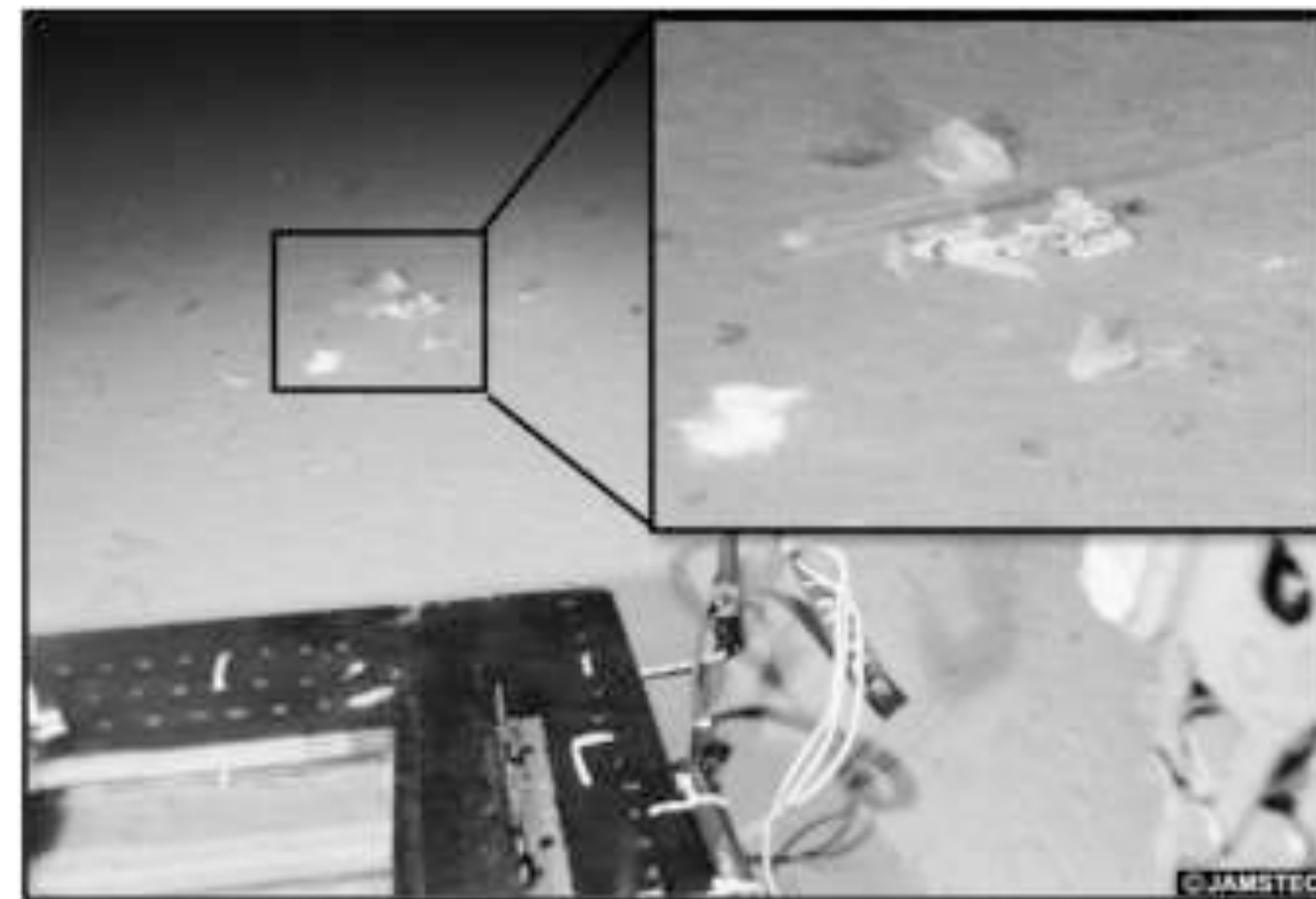
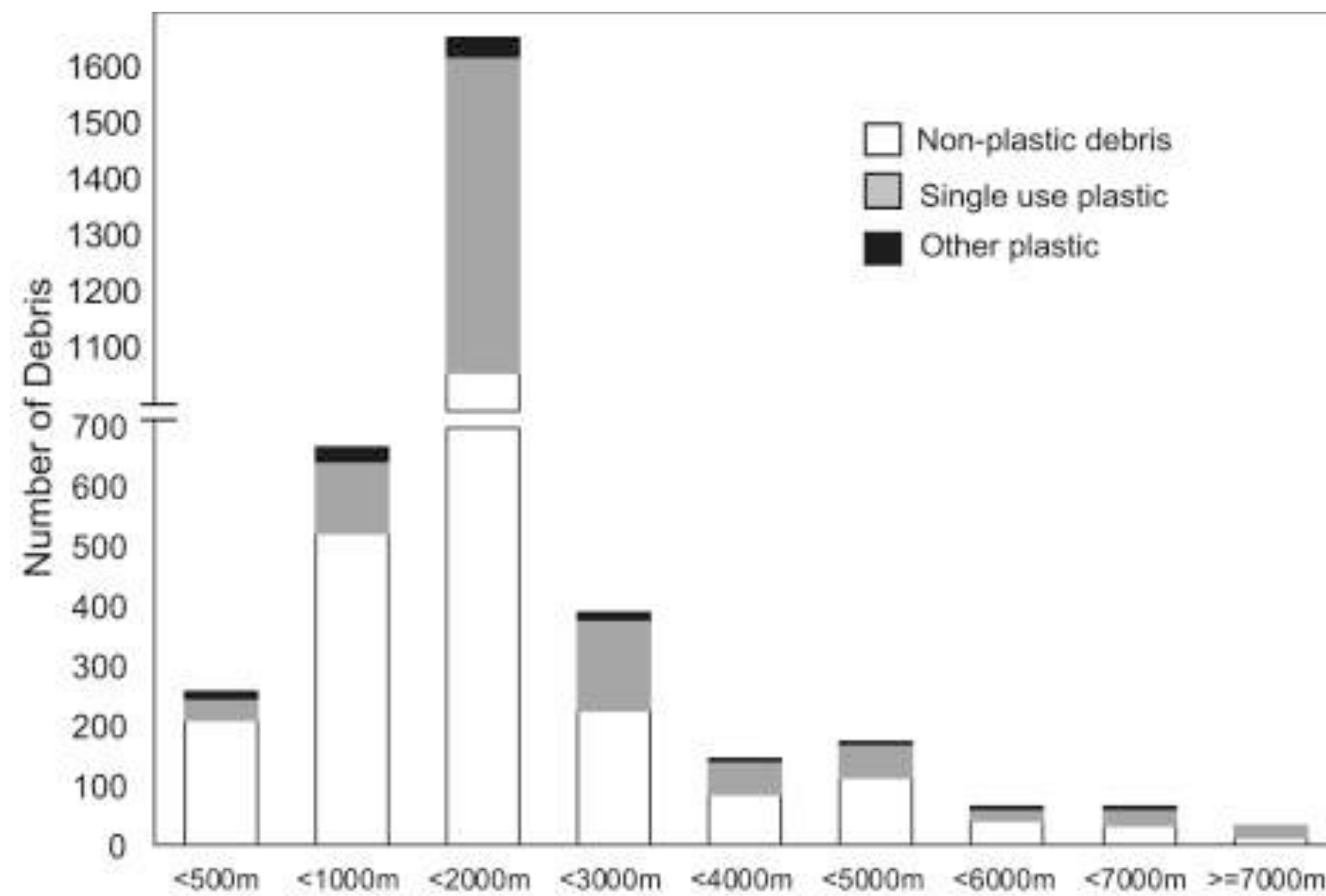


PHOTO ID:KAIKO0073ASC0153Hp05-09

- More than 33% of debris was plastics
- 89% of macroplastic was SUP



# Highest density of marine litter is on the bottom of Messina Straits

About 200items/10mt

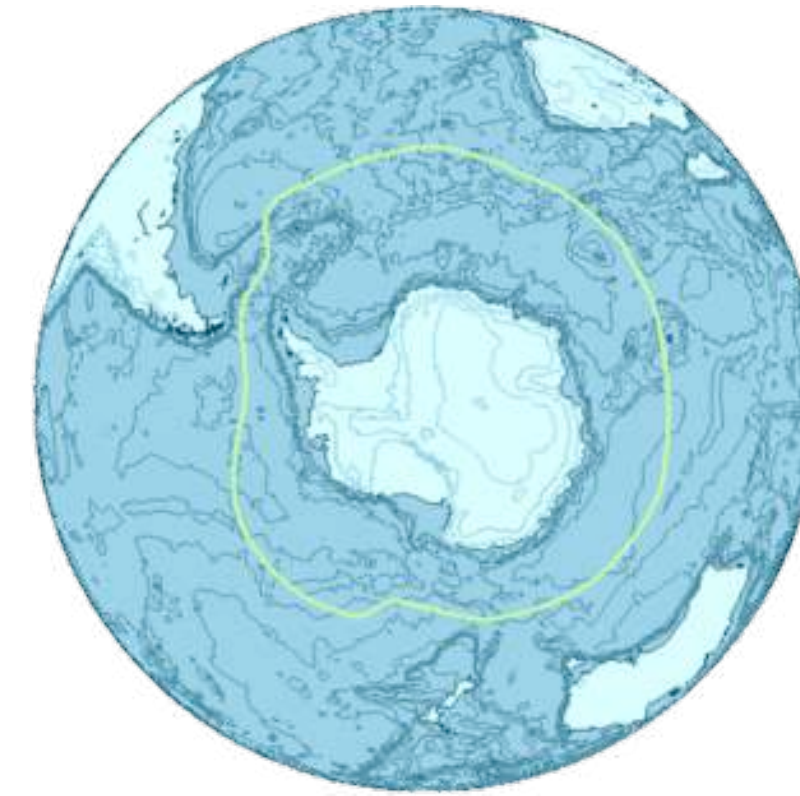


Seafloor characteristics, distribution and composition of marine litter. (a) Seafloor types and (b), categories of marine litter for each transect (location in Fig. 1). The size of the pie charts in (b) is proportional to litter abundance ( $D$  = total litter density and  $D(h)$  = litter density of heavy items, both expressed as items/10 m). (c) Overall composition of marine litter observed along all ROV dives in the Messina Strait canyons. The map in (b) was generated with QGIS Version 2.18 (<https://www.qgis.org/it/site>). The satellite imagery was obtained from the Bing Aerial maps, using the QGIS OpenLayers plug-in (<https://github.com/sourcepole/qgis-openlayers-plugin>).



# FLOATING PLASTIC

Wind and currents as mean of transport



A common fate of plastic marine debris in the Southern Ocean. Fur seal (a) and elephant seal (b) entangled in drift plastic. Images copyright British Antarctic Survey.



Marine Environmental Research

Volume 70, Issue 2, August 2010, Pages 250-252



Short communication

## Macroplastics at sea around Antarctica

David K.A. Barnes <sup>a</sup> ✉, Adam Walters <sup>b</sup>, Leandra Gonçalves <sup>b</sup>





# GARBAGE PATCHES

nature

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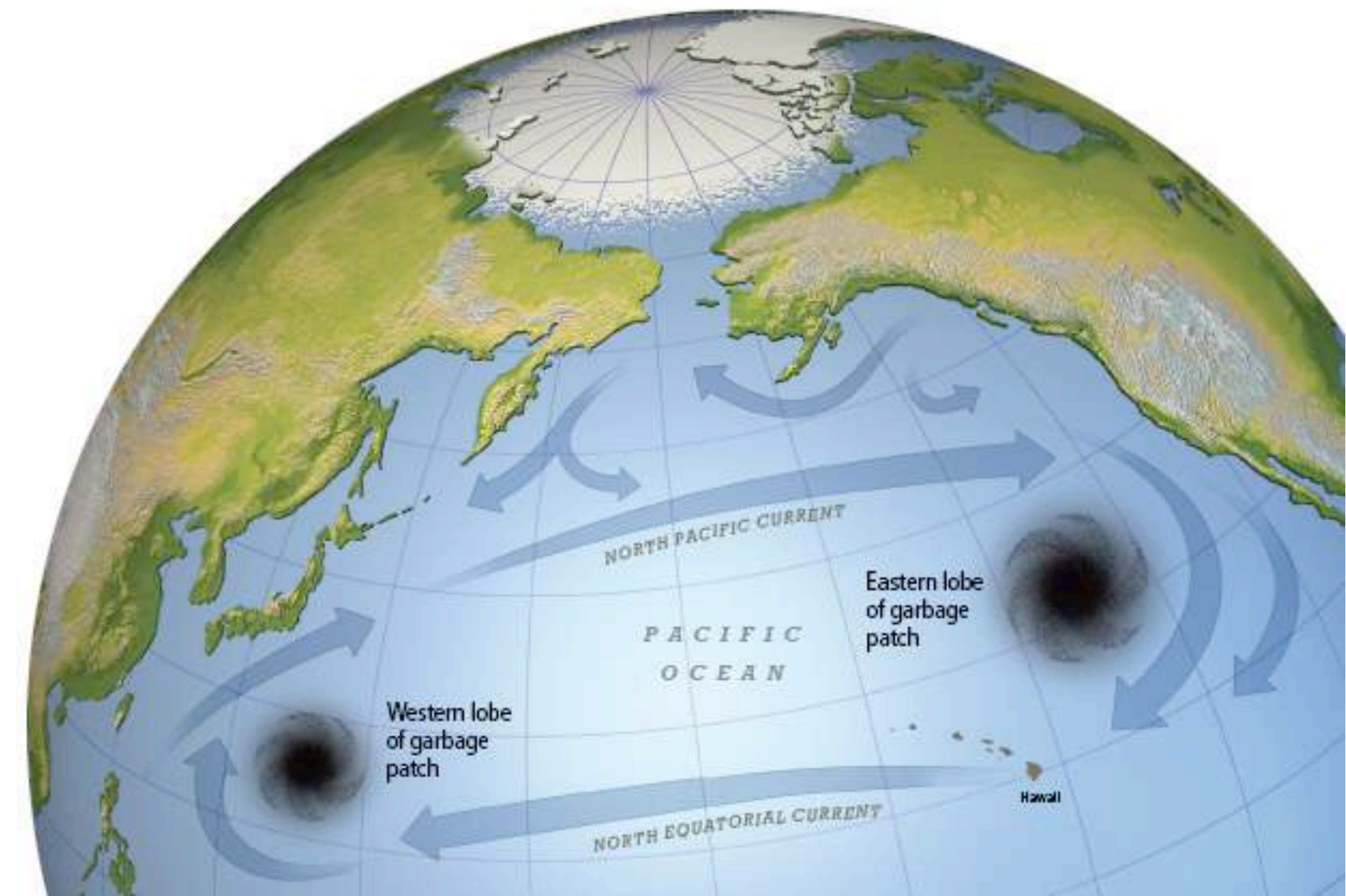
[nature](#) > [letters](#) > [article](#)

Published: 26 January 1973

## Man-made Objects on the Surface of the Central North Pacific Ocean

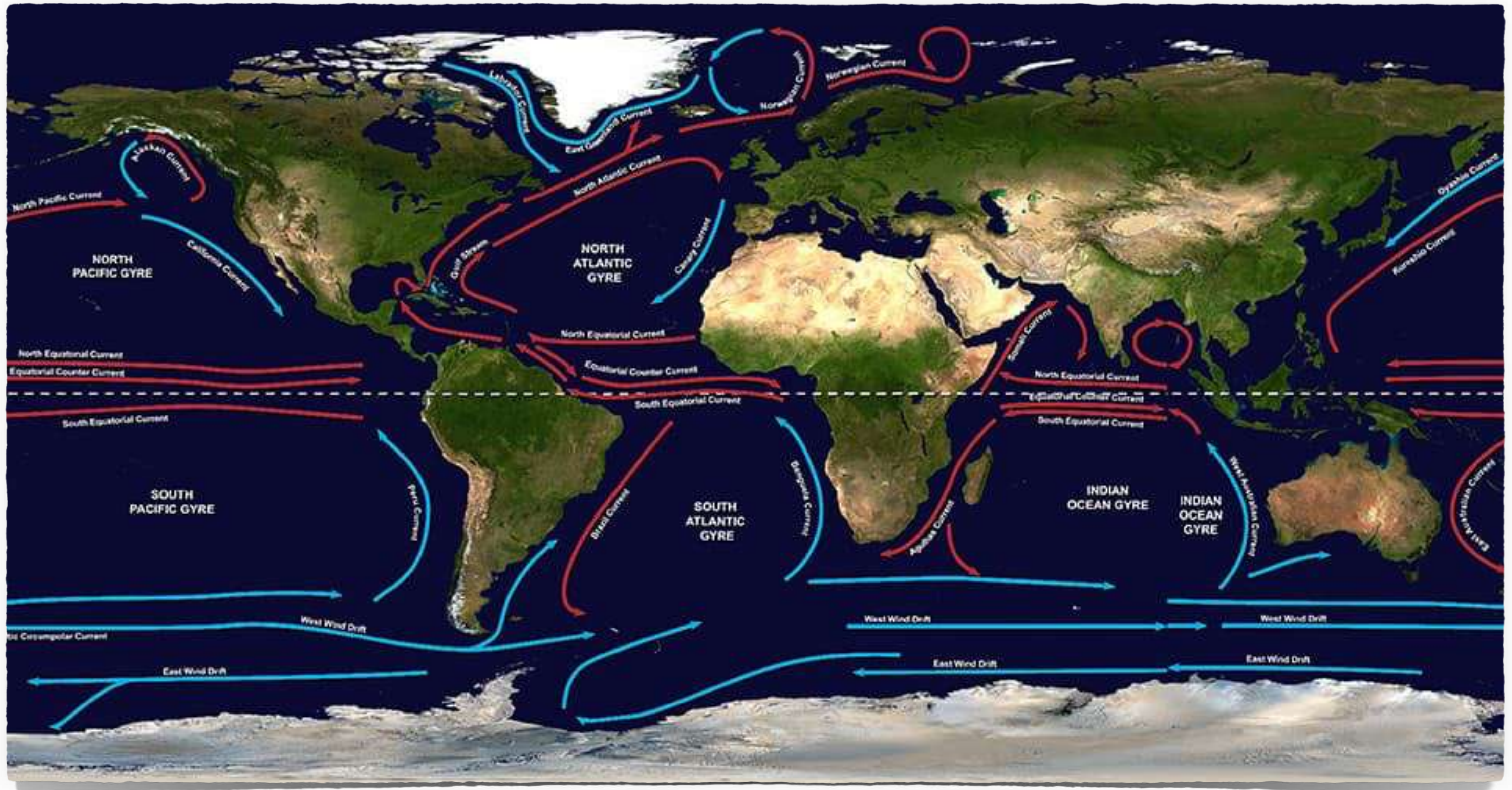
E. L. VENRICK, T. W. BACKMAN, W. C. BARTRAM, C. J. PLATT, M. S. THORNHILL & R. E. YATES

*Nature* 241, 271(1973) | [Cite this article](#)





# Ocean circulation





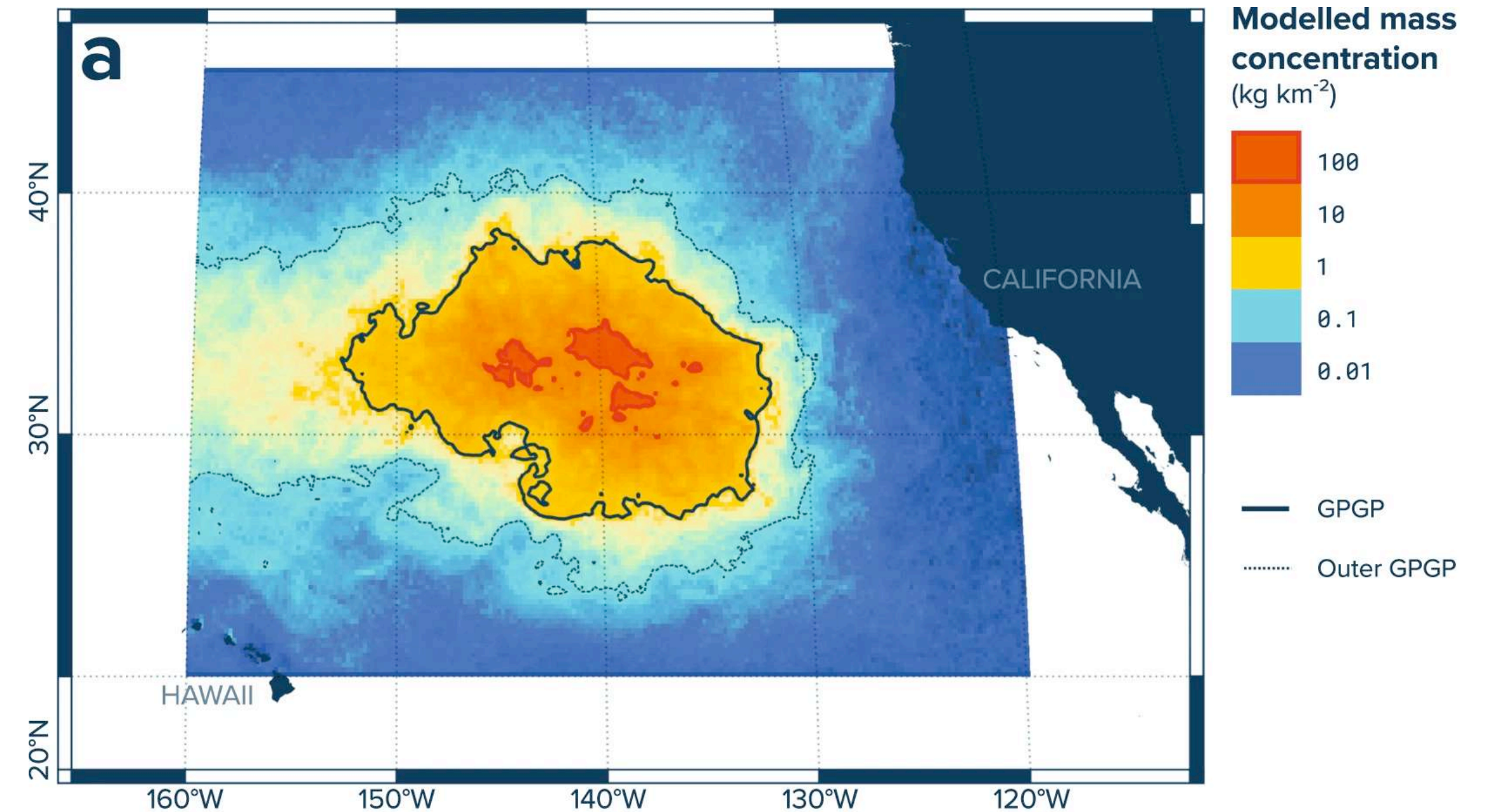
# Great Pacific Garbage Patch

- 1.6 million km<sup>2</sup>
- Italy=302.073
- Multi-vessel and aircraft surveys, predicted at least **79 (45-129)** thousand tonnes of ocean plastic are floating inside the area
- 1.8trillion

99.9% plastic

46% fishing net

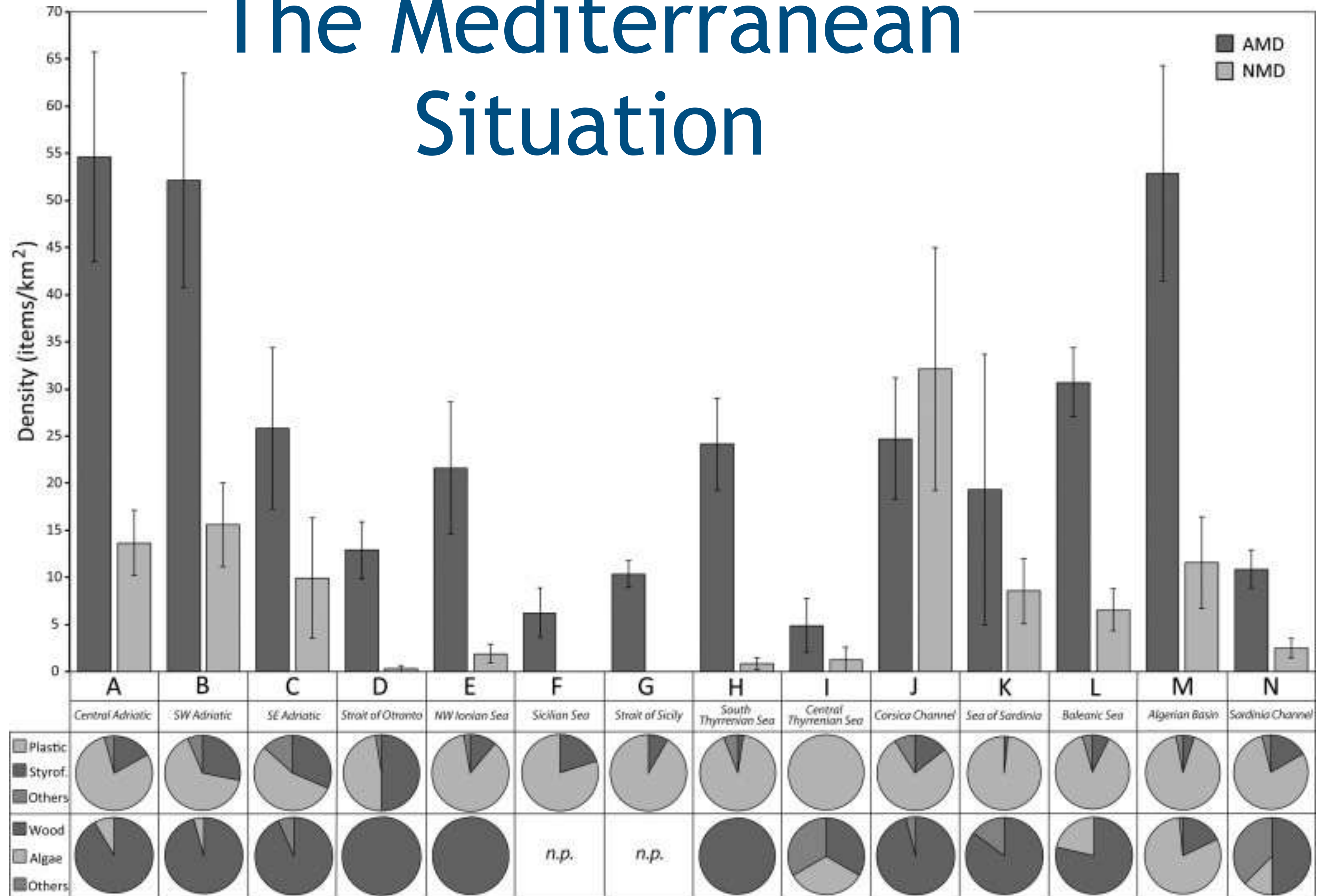
Microplastics 94% of the 1.8 trillion pieces





# The Mediterranean Situation

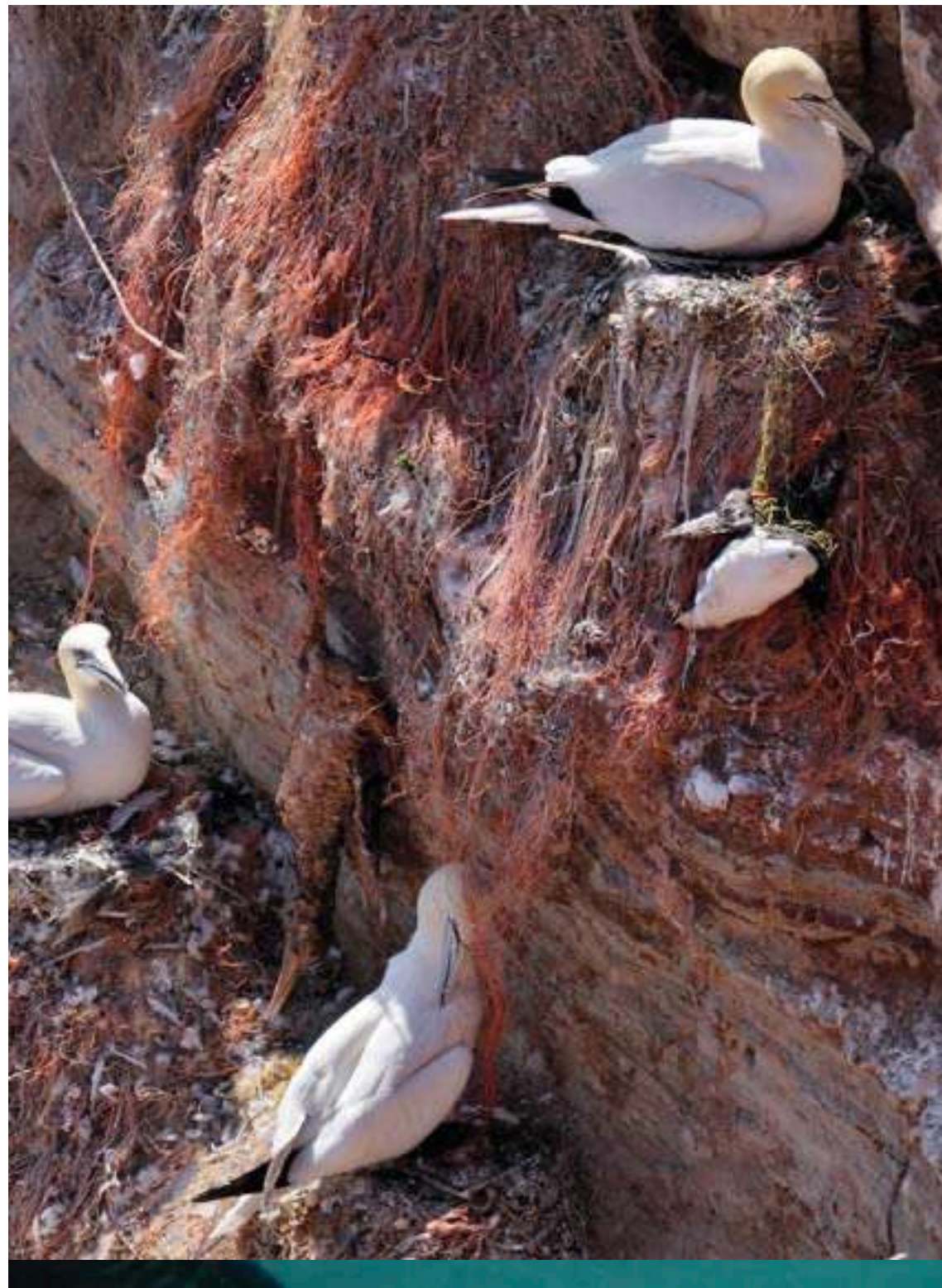
- More than 62million litter items are floating in open waters
- 24.9 items/km<sup>2</sup>
- Densely populated coast
- high maritime traffic
- semi-enclosed basin
- low water exchange
- limited tidal flow





Effects on marine life





**Entanglement**  
is a threat for at least 243 marine species  
is responsible for more known mortalities  
([Gall and Thompson, 2015](#)).



monofilament lines, ropes and  
other fishing related gear



# ENTANGLEMENT

#CutPlasticRing

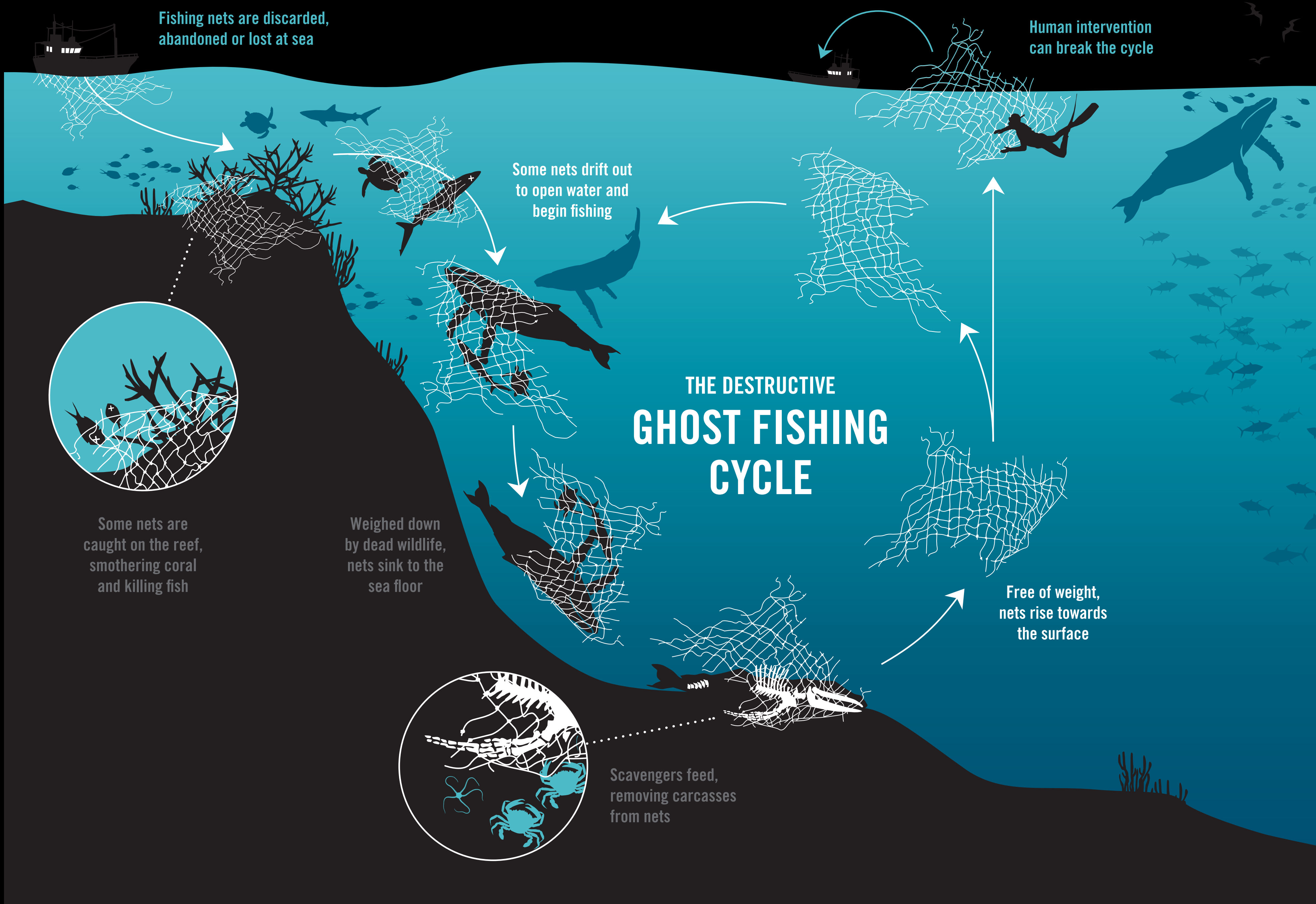




# GHOST FISHING









# SUFFOCATION

The visual similarity between plastic bags and jellyfish can cause confusion even in the absence of chemical stimuli associated with food sources.



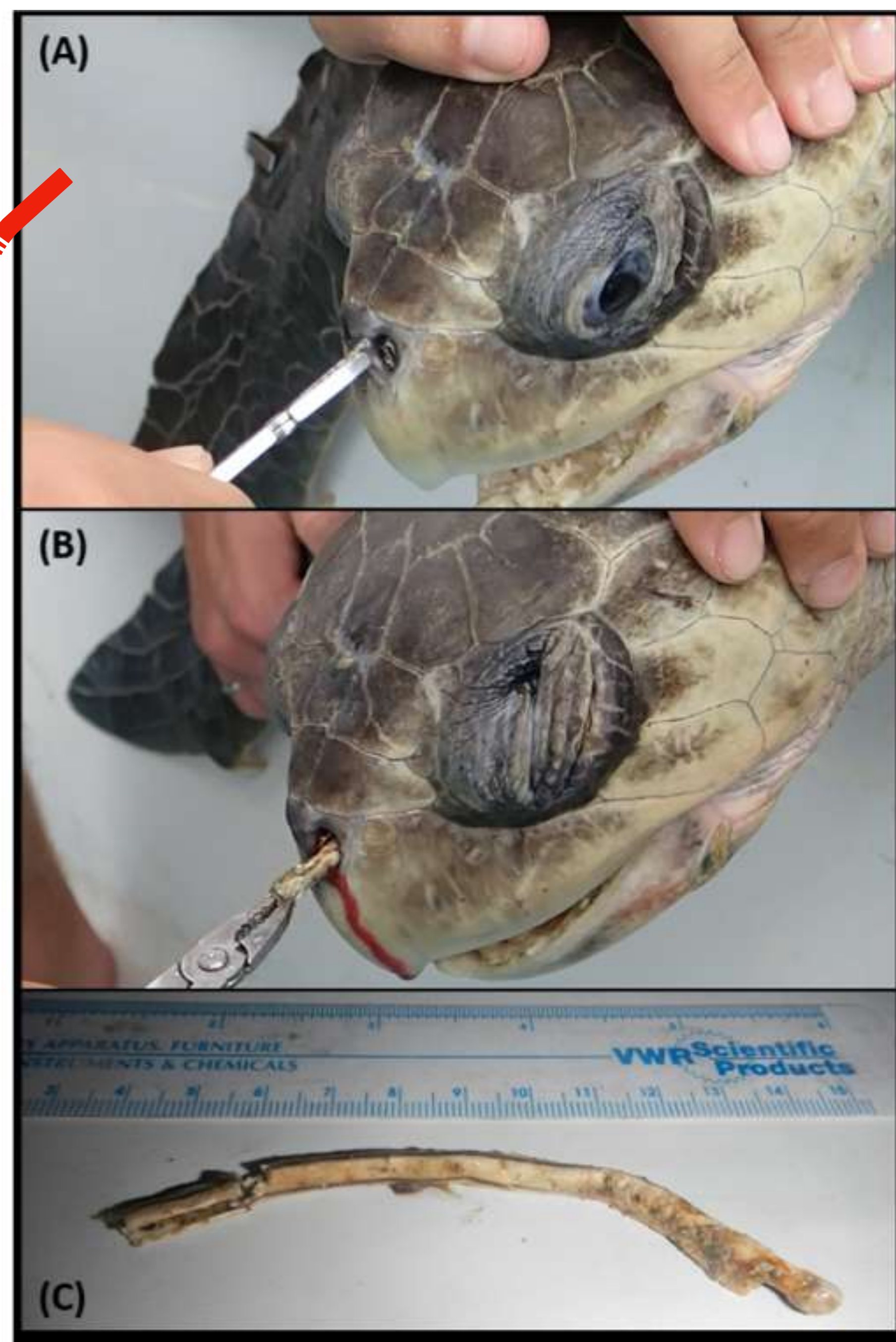
They use visual characteristics to select their food







Silver croaker, *Plagioscion squamosissimus*, found dead in the waters of Marajó Bay, Amazon estuary, presenting evidence of suffocation by a plastic bag (Andrades et al., 2021)



(A) Plastic straw in the left nostril of an olive ridley sea turtle. (B) Removal of the straw (C) The straw next to a ruler for scale. (Robinson and Figueiras, 2015)





# INGESTION





# MICROPLASTICS



**“plastic particles  
<5mm and >0.1 $\mu$ m”**

NOAA at the International Microplastic Workshop  
Washington, 2008 - Arthur et al., 2009

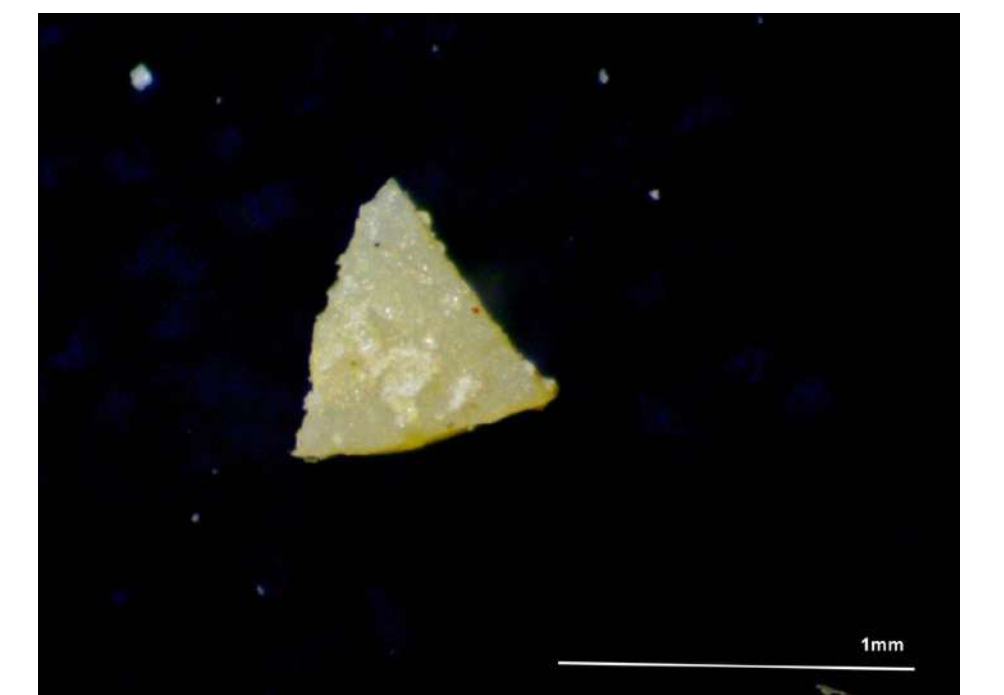


# Primary



# Secondary

## Microfibers





# Primary MP in the ocean

98% from land-based activities  
2% from activities at sea

laundrying  
tyres abrasion

66% through road runoff  
25% through wastewater treatment systems  
7% wind transfer





# Primary MP in the ocean the nurdles

- Pre-production pellets-beads-nurdles
- 2-5mm; regular shape
- produced by polymeric industries or recycling facilities
- transportation through train, truck or ship
- land and maritime accidents





# X-press Pearl vessel accident Sri Lanka 2021



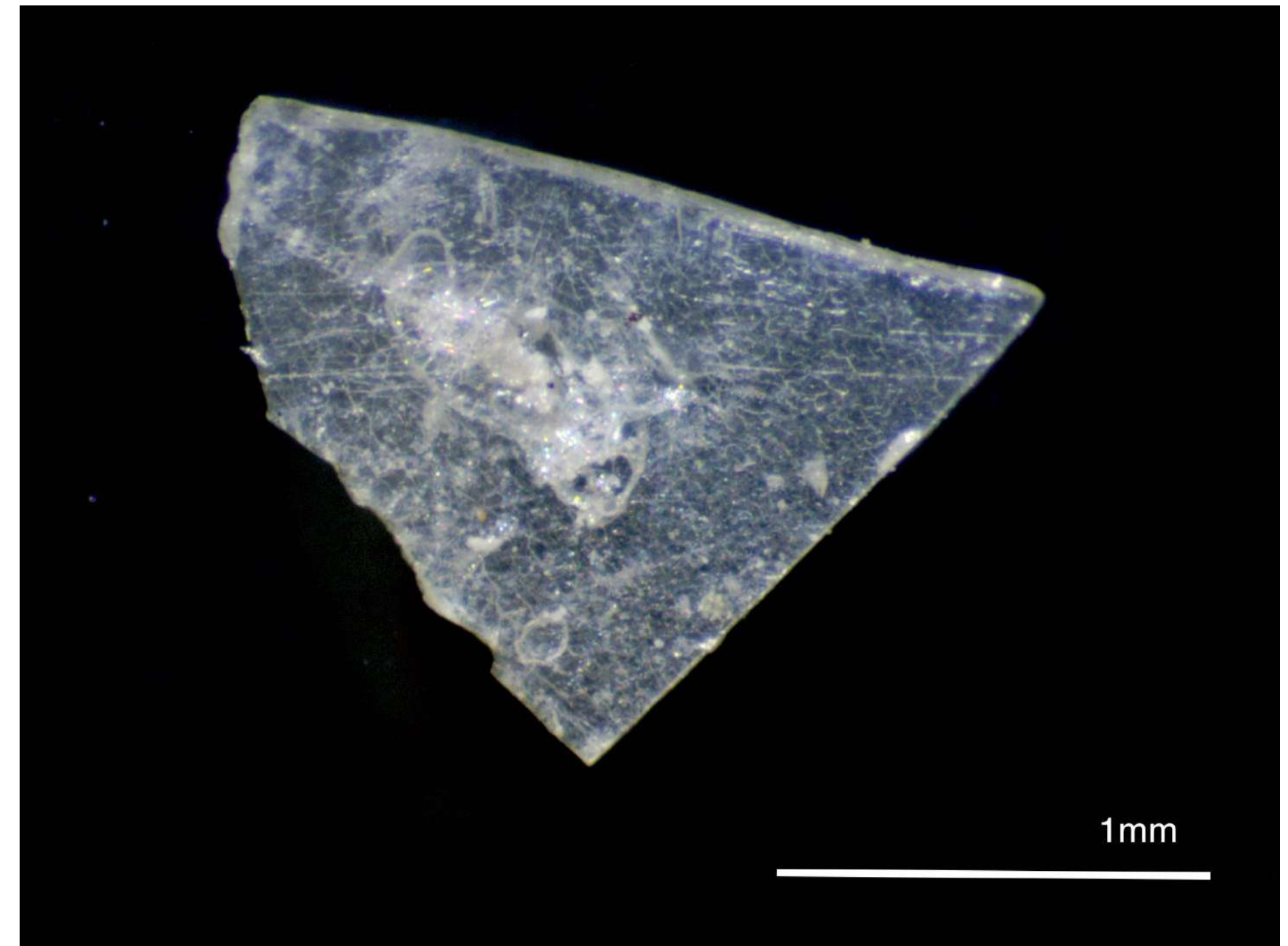
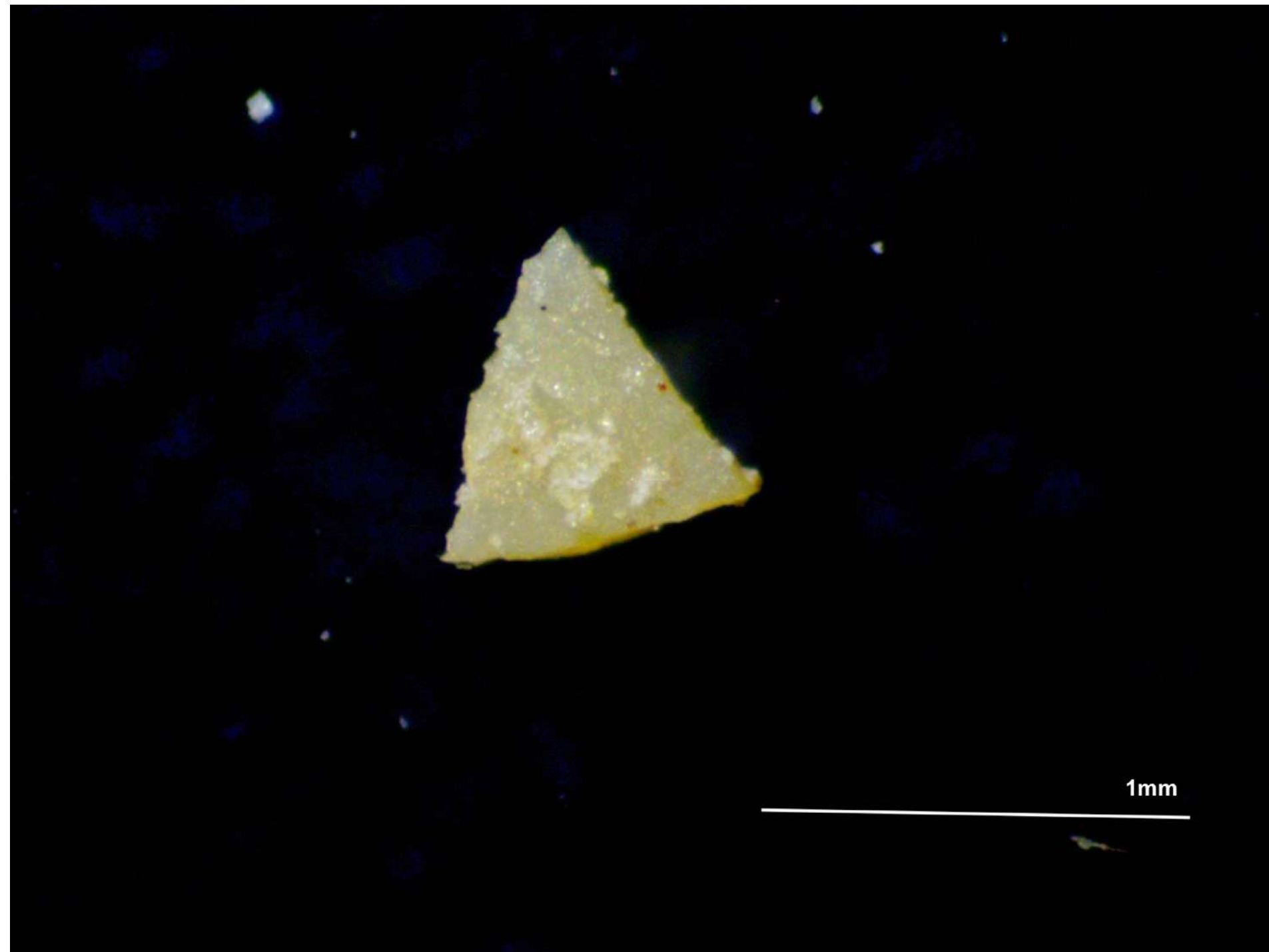
nitric acid  
caustic soda  
methanol  
epoxy resins  
plastic pellets





# MICROPLASTIC CLASSIFICATION

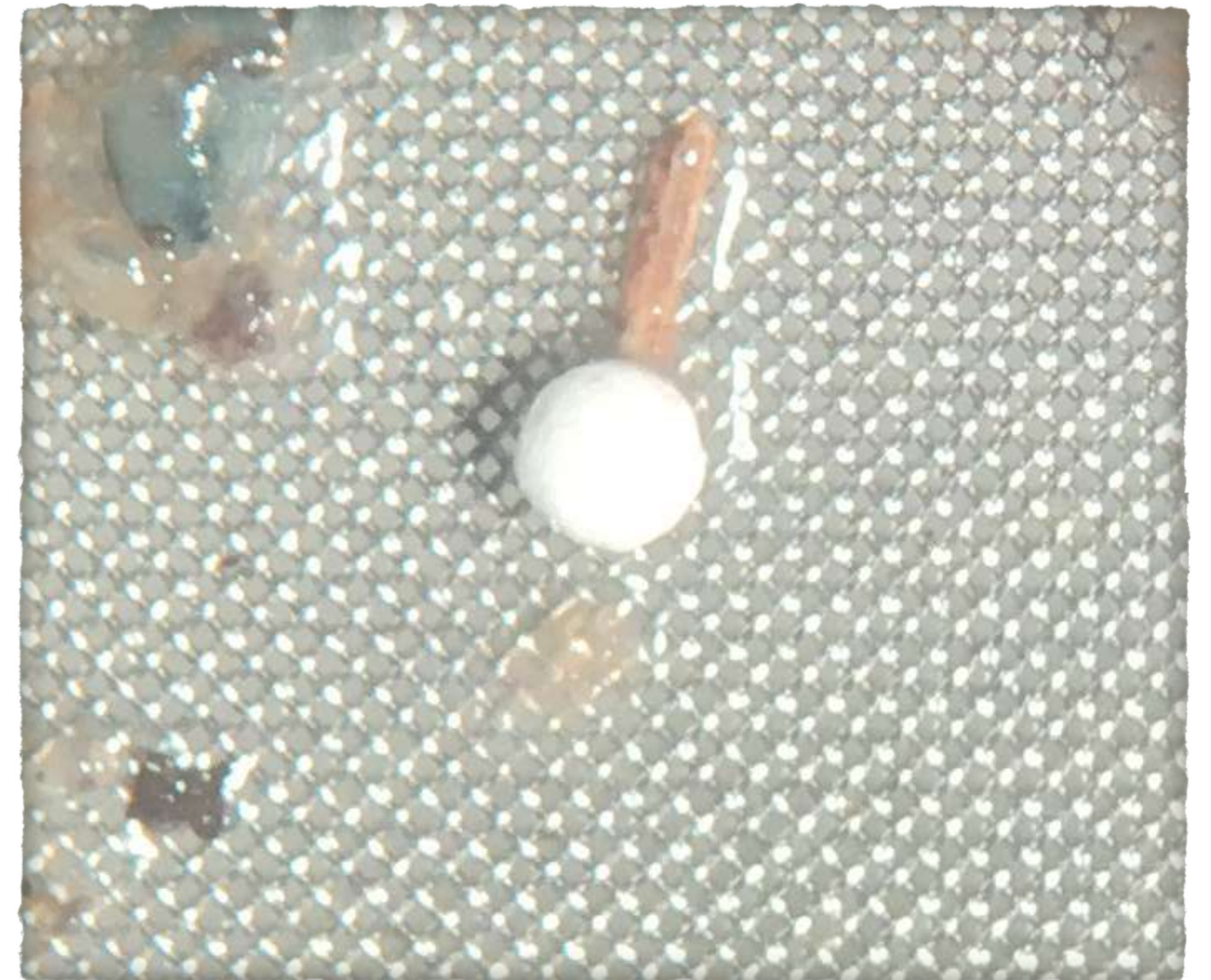
## Fragments





# MICROPLASTIC CLASSIFICATION

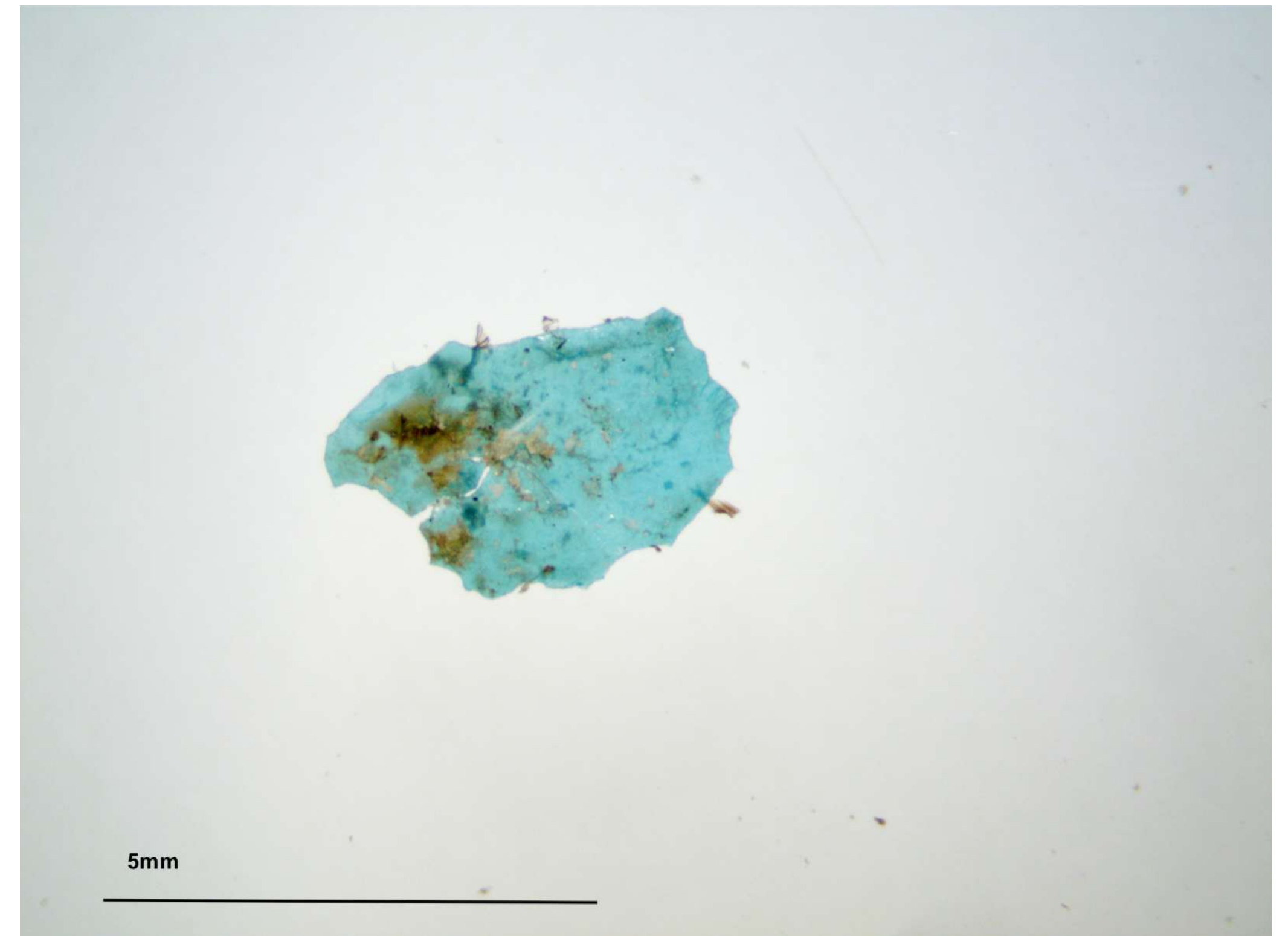
## Pellets and spheres





# MICROPLASTIC CLASSIFICATION

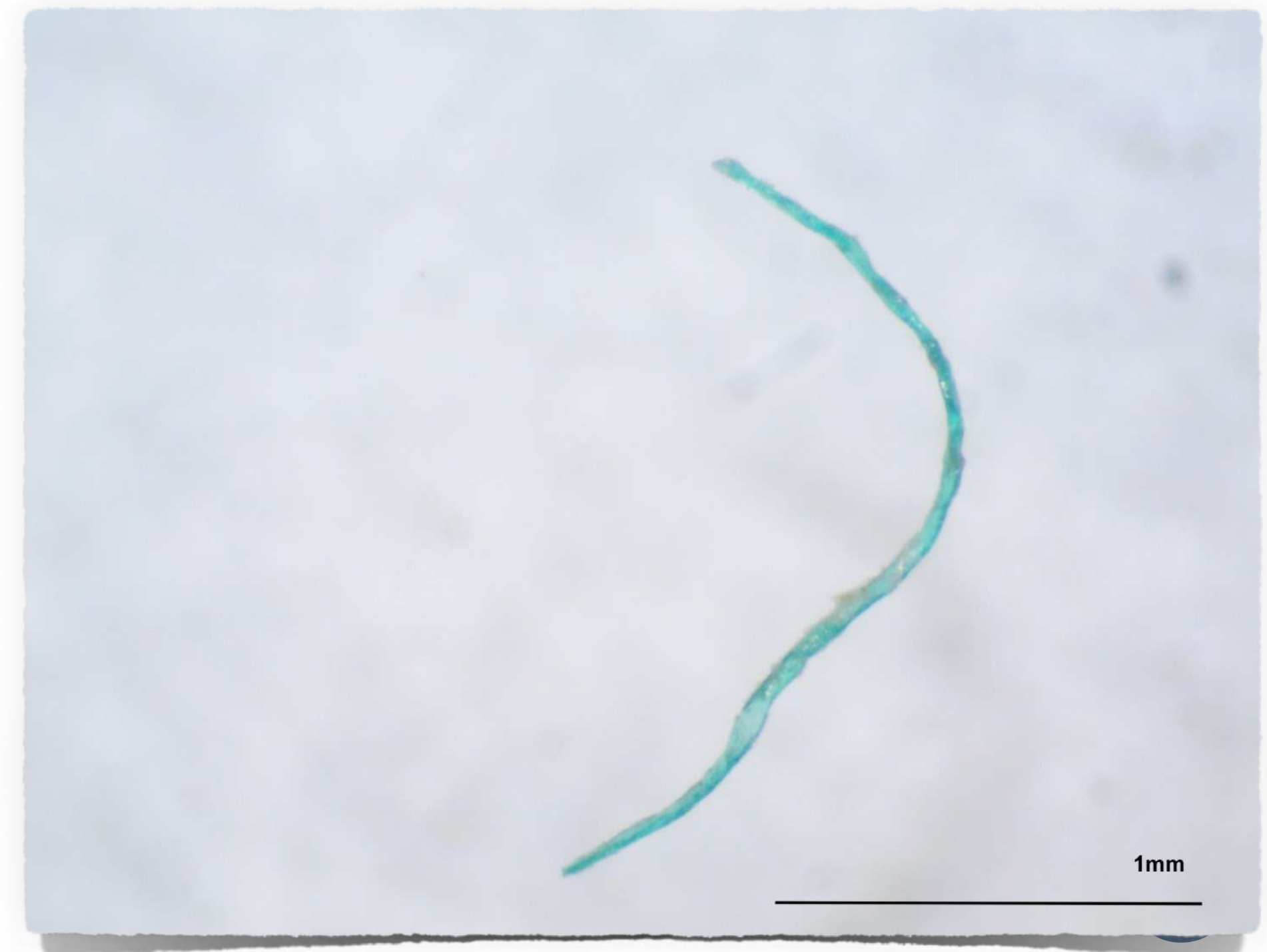
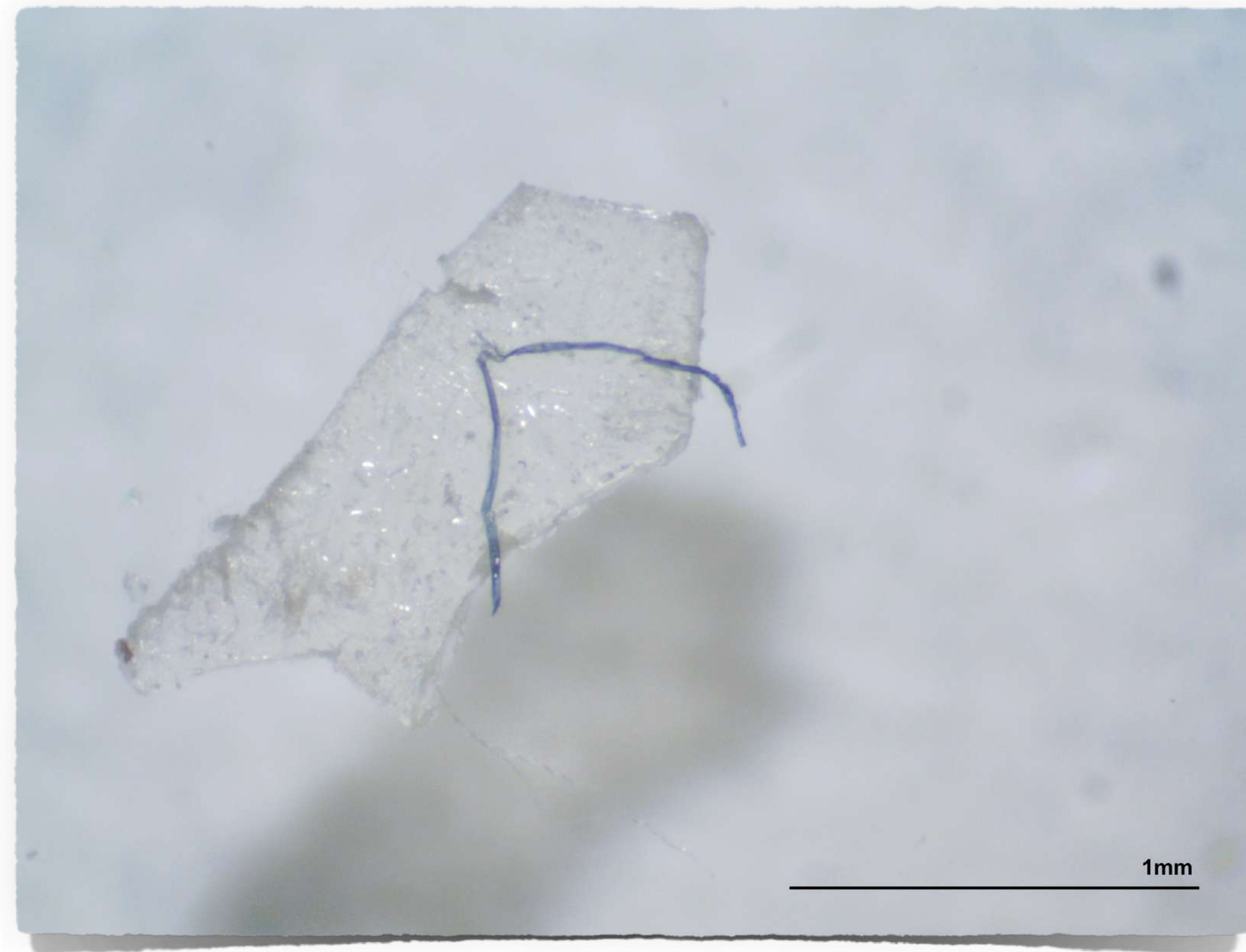
## Film





# MICROPLASTIC CLASSIFICATION

## Filaments and microfibers





# Microfiber released from washing machine



The number of microfibers released from a typical 5 kg wash load of polyester fabrics was estimated to be over 6,000,000 depending on the type of detergent used. The usage of a softener during washes reduces the number of microfibres released of more than 35%

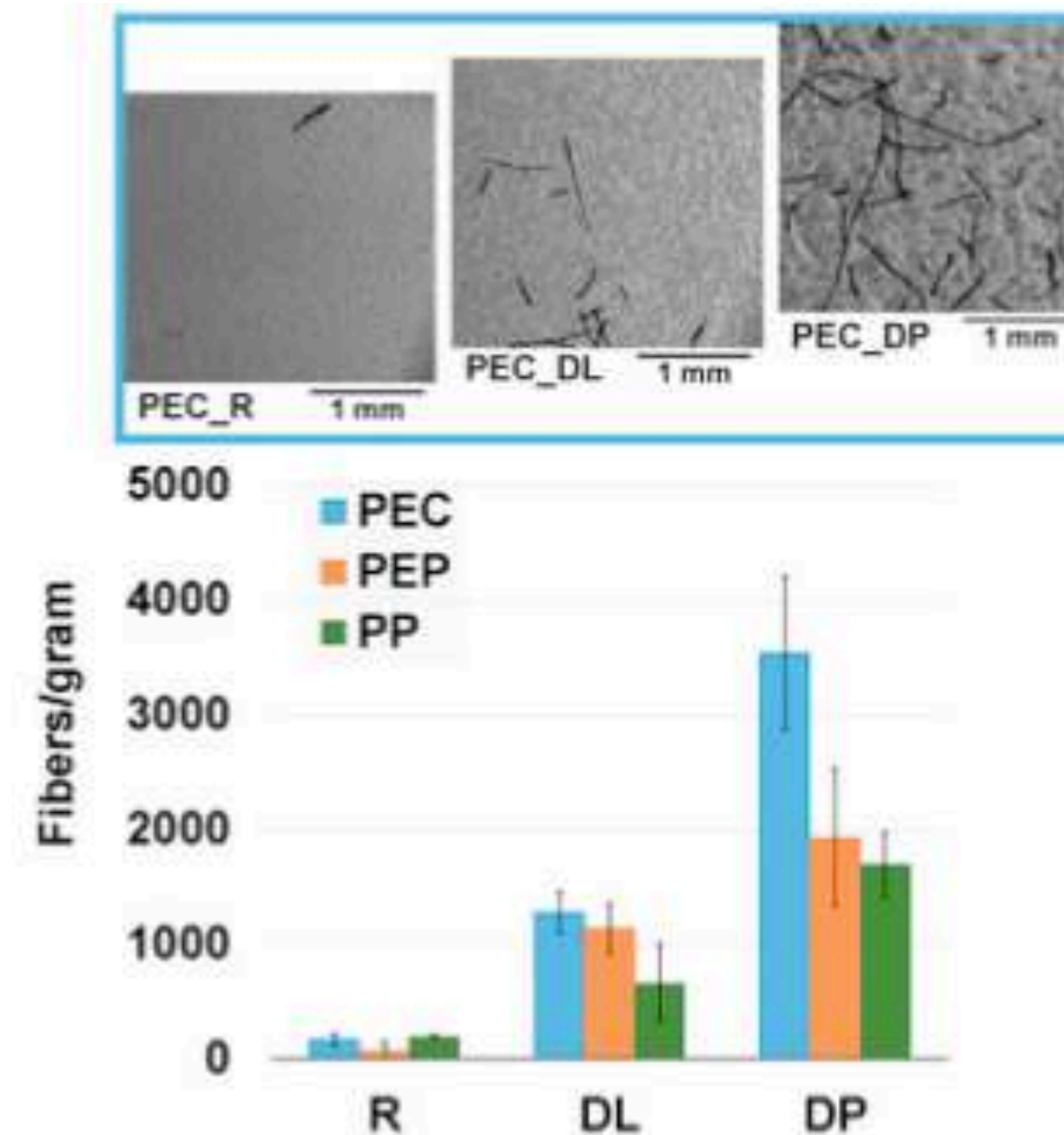
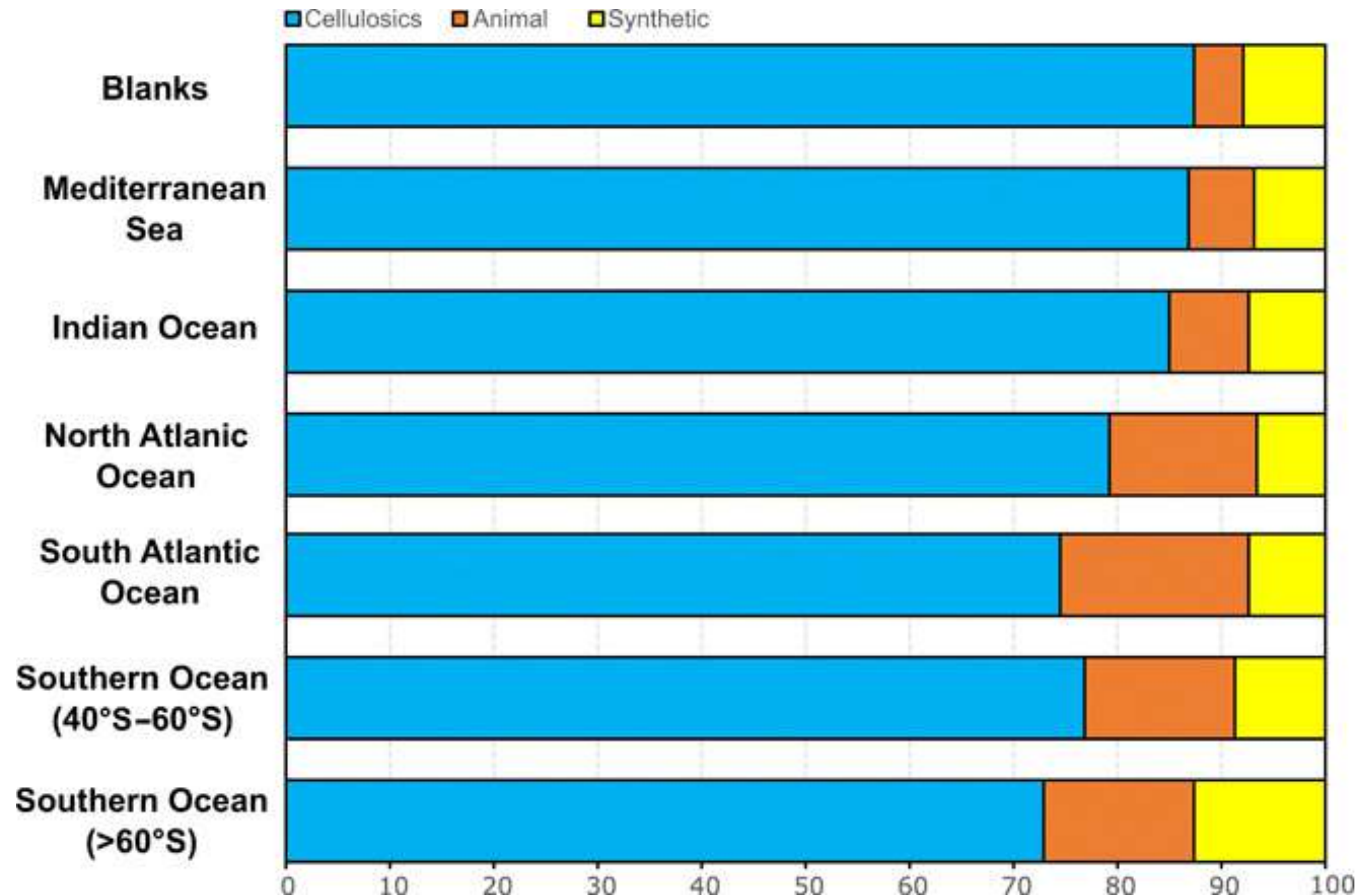


Fig. 3. Number of fibres per gram of fabric ( $N_a \pm SD$ ) released from woven and knitted polyester (PEC and PEP, respectively) and woven polypropylene fabrics (PP), during domestic washing simulations performed with water (R), liquid detergent (DL) and powder detergent (DP). In the upper part of the figure, SEM images of the filters collected by simulating washings of PEC with water, liquid detergent and powder detergent, are reported (false-colour SEM images).



# Microfibers in oceanic surface waters

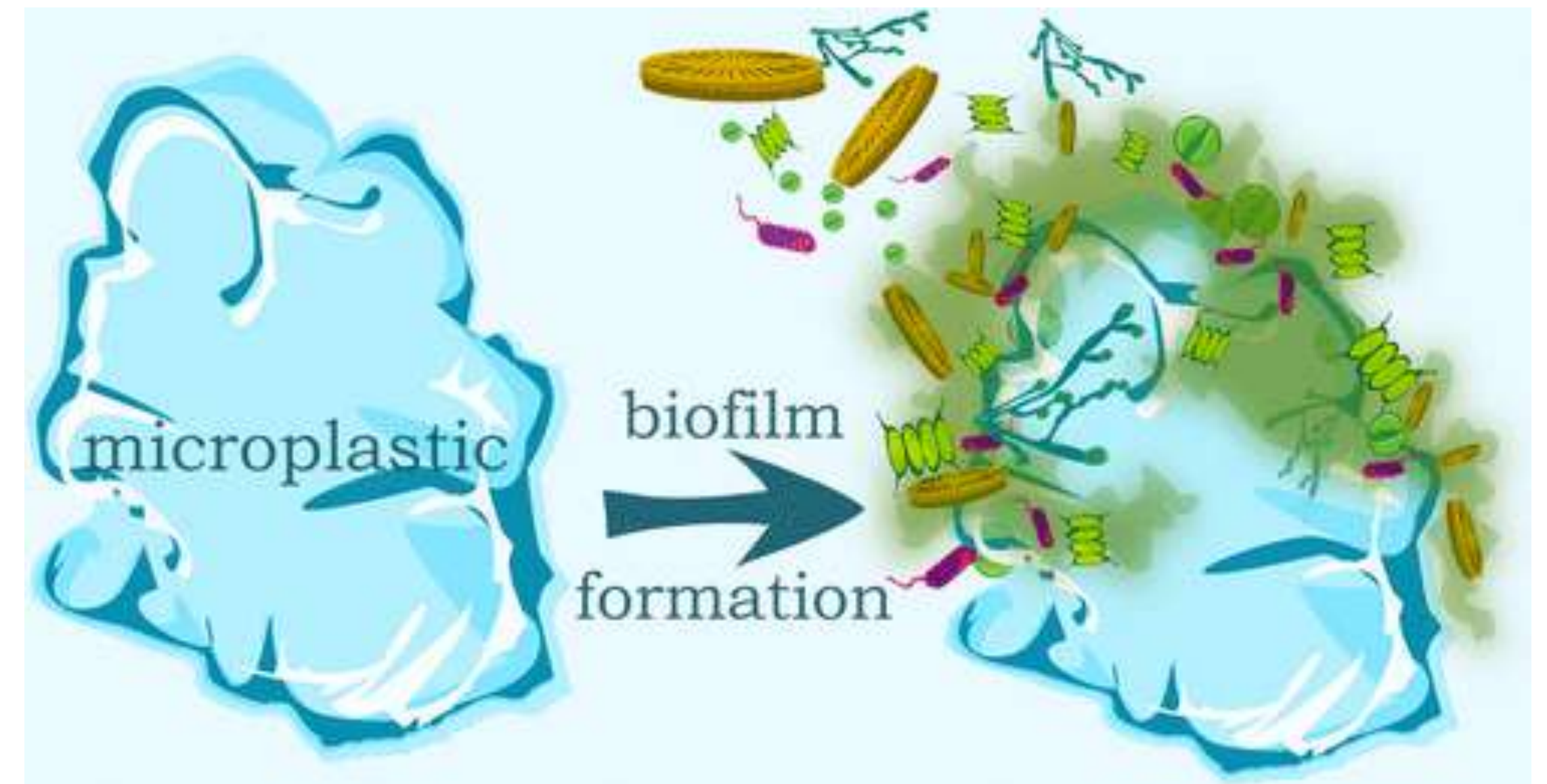
NATURAL vs SYNTHETIC





# Eco-corona

- molecules in seawater cover the surface of MP (high hydrophobicity)
- Organic contaminants in the water as well
- Conditioning film



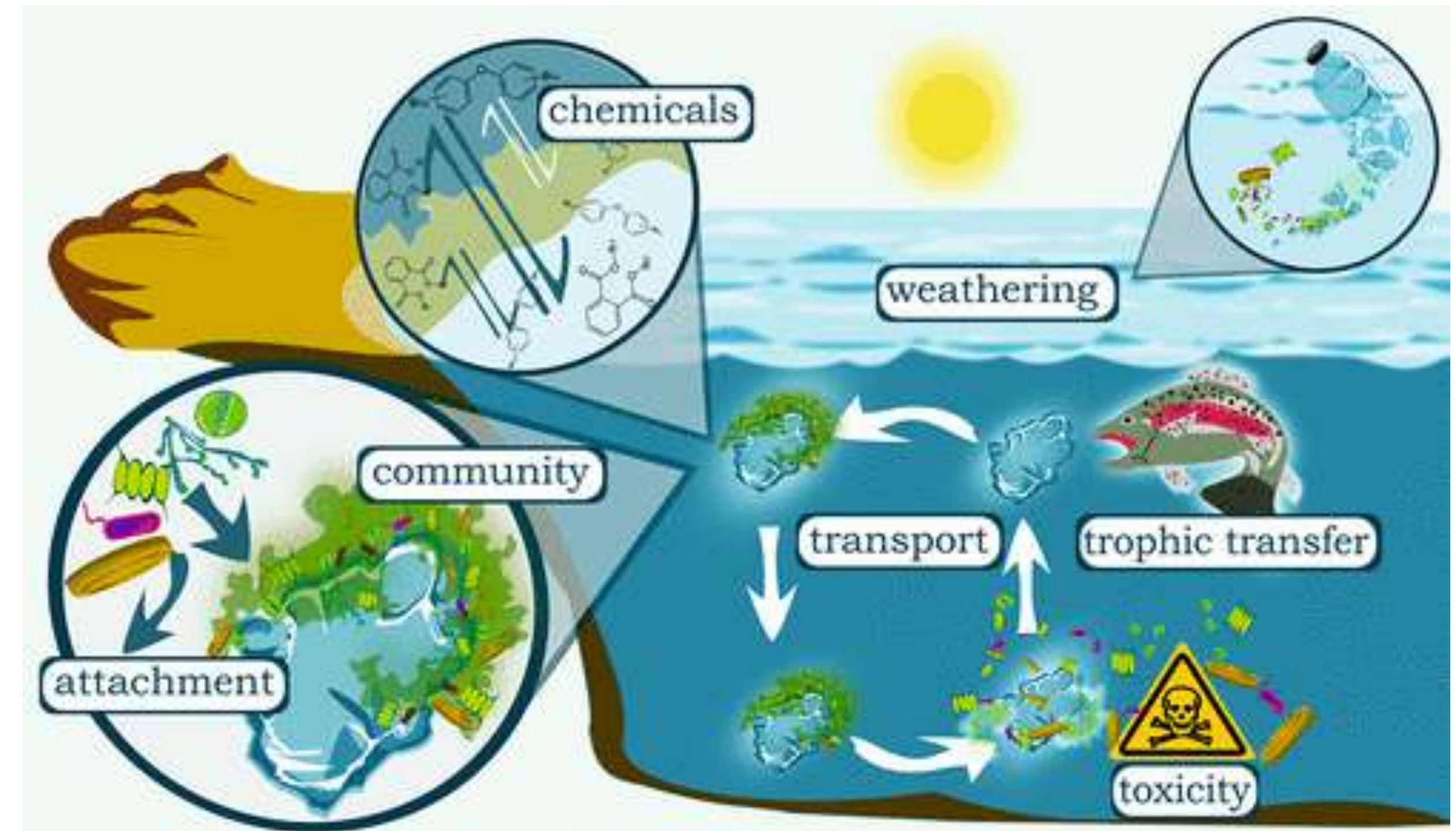
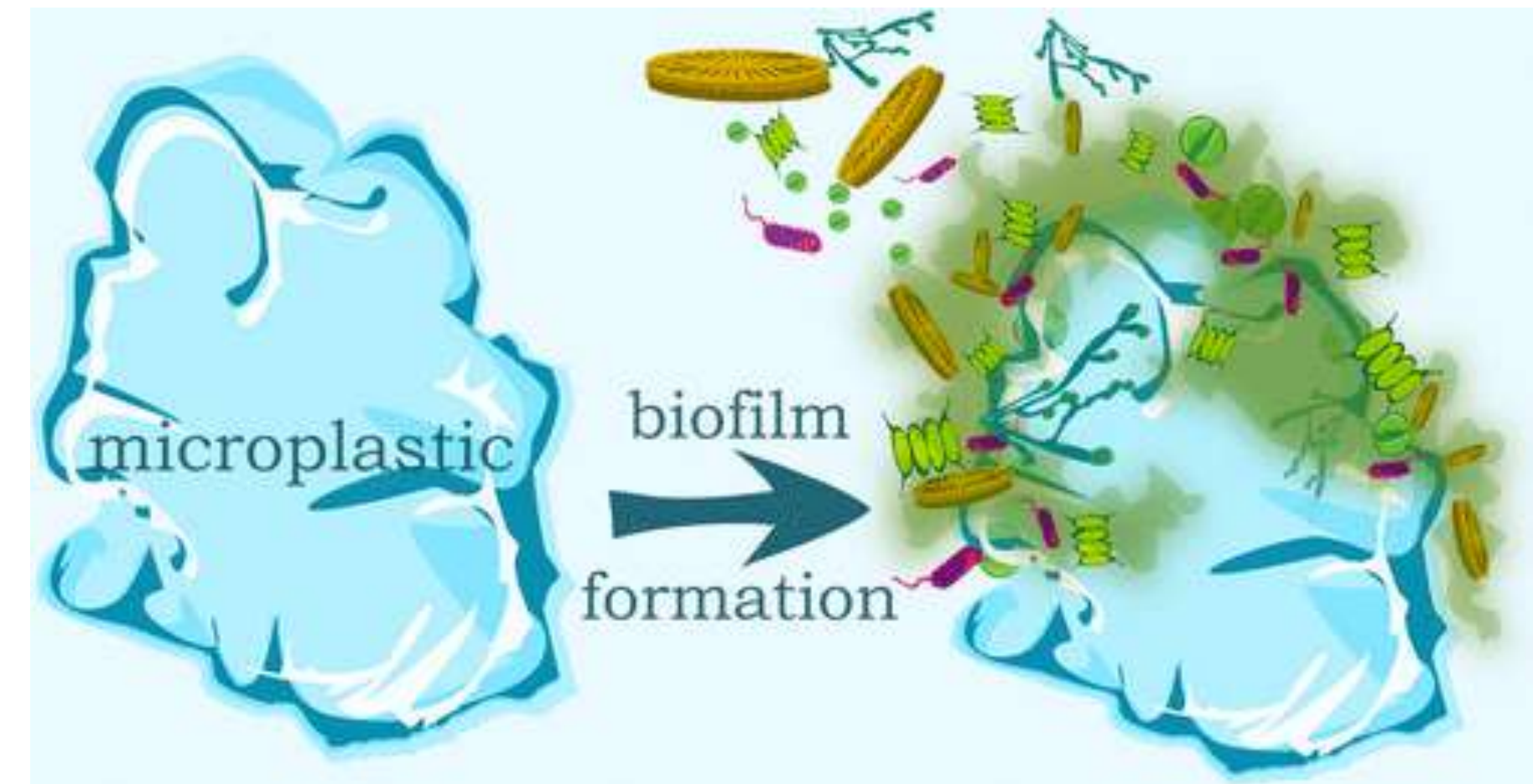
within seconds



# Plastisphere

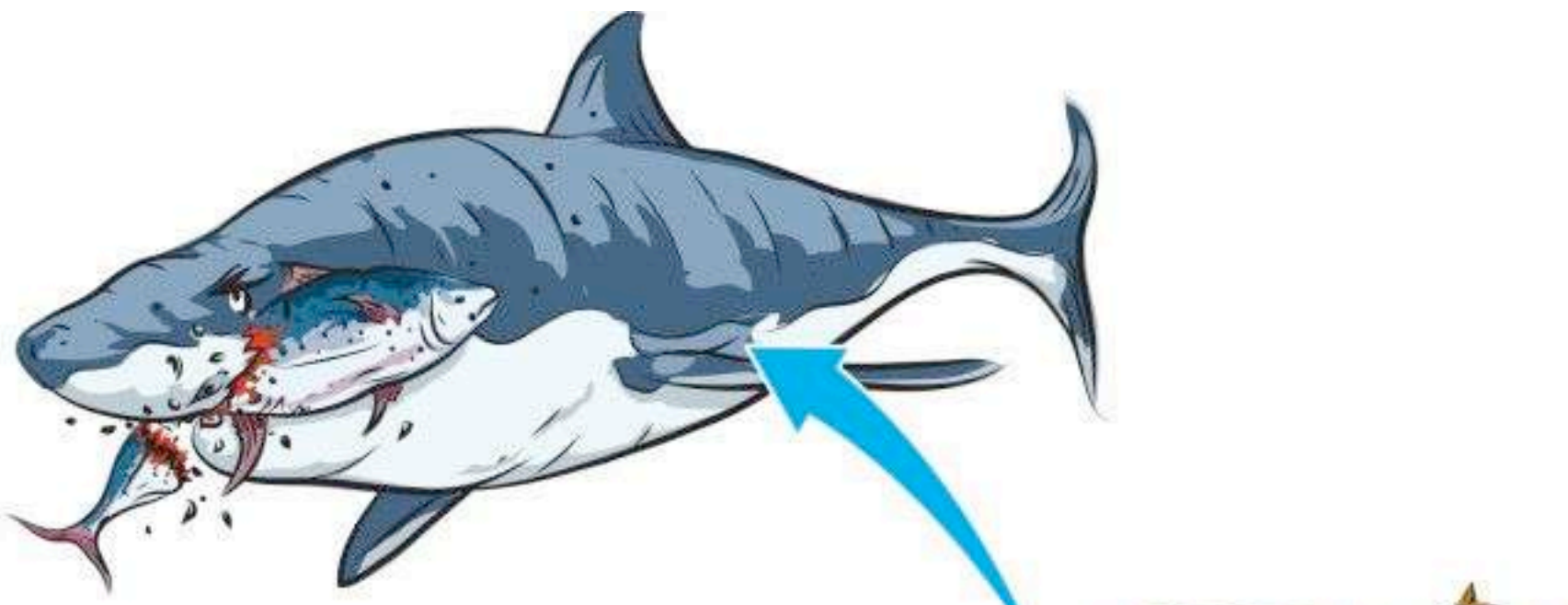
- New micro-habitat
- Microorganisms colonizing MP
- Weight changes mediate vertical transport
- Great palatability 🍷
- Enhanced ingestion and transfer along the food web

Rummel et al., 2017

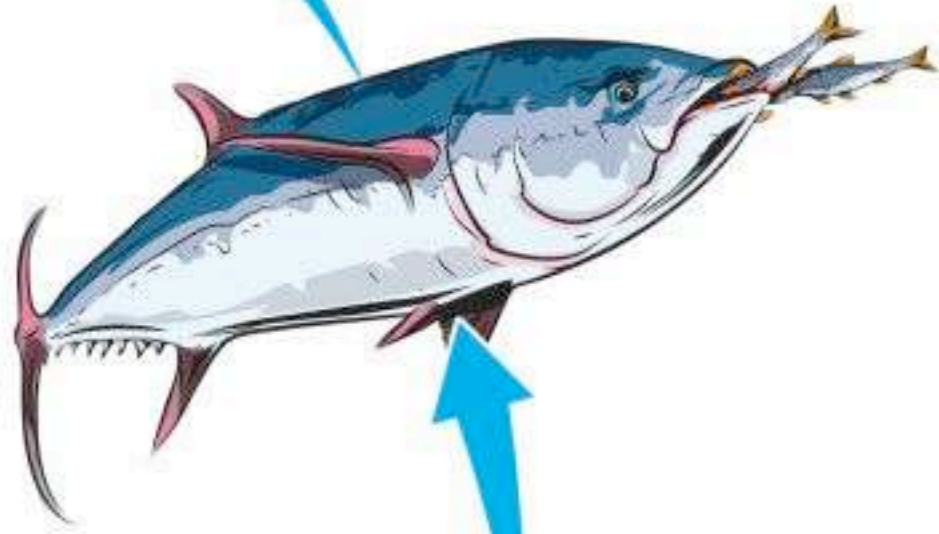




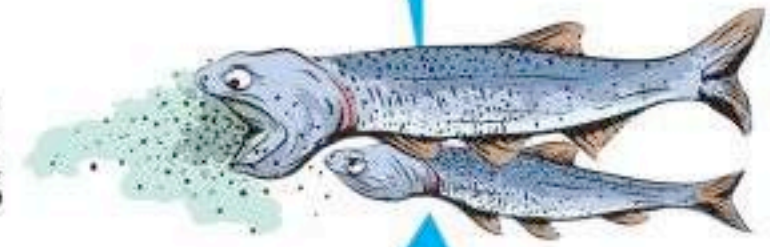
**QUATERNARY  
CONSUMERS**



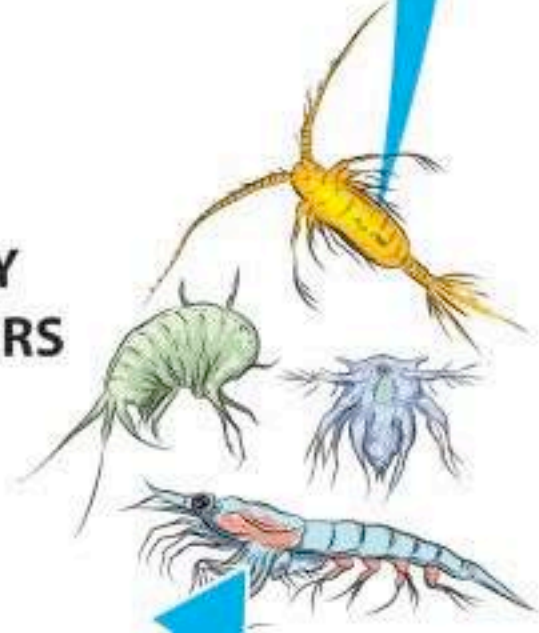
**TERTIARY  
CONSUMERS**



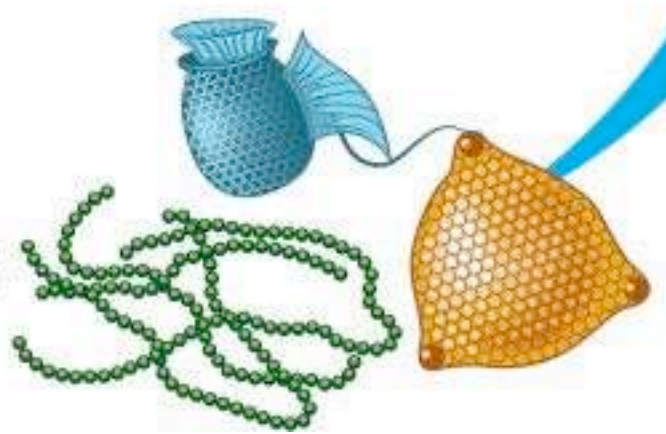
**SECONDARY  
CONSUMERS**



**PRIMARY  
CONSUMERS**



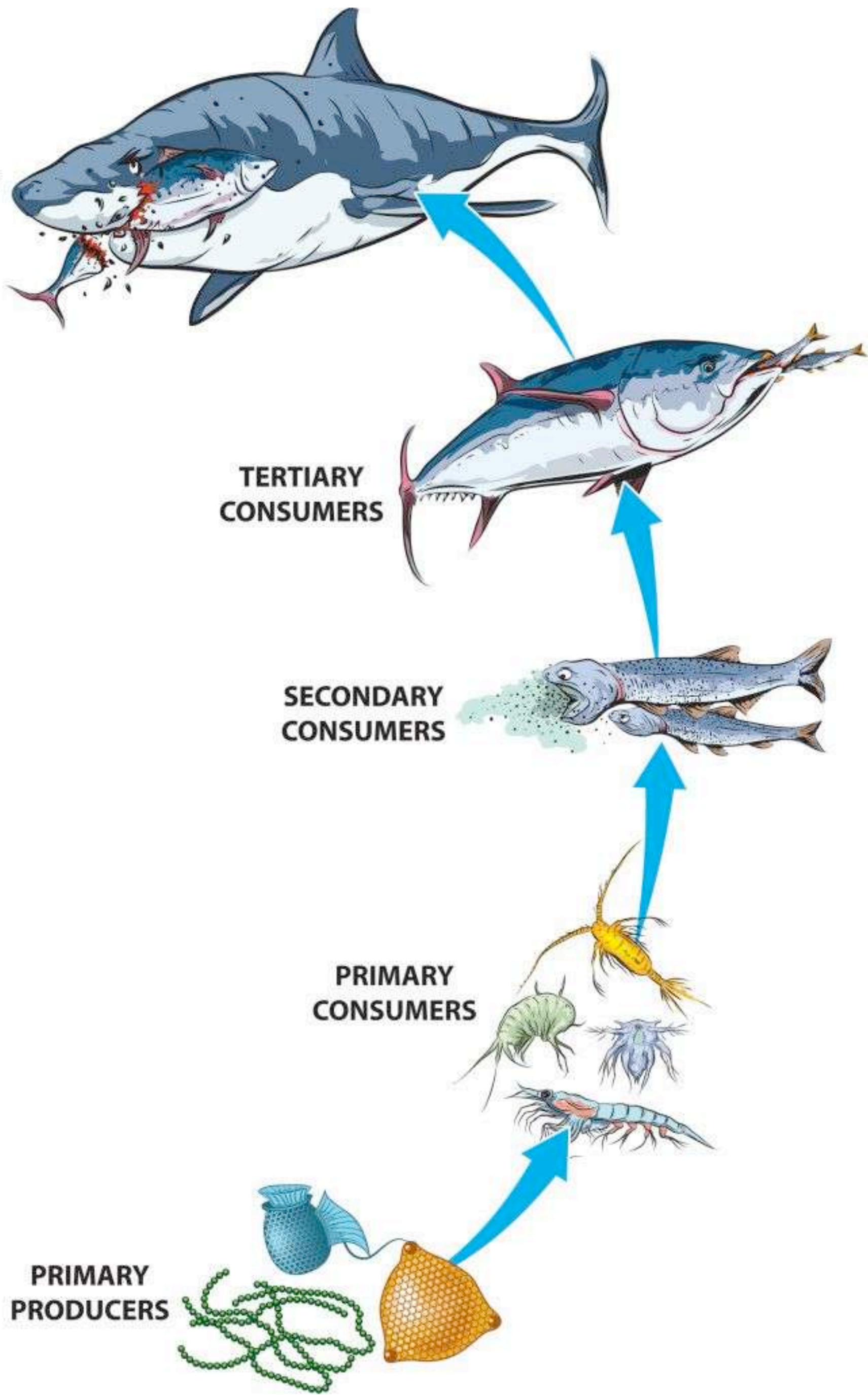
**PRIMARY  
PRODUCERS**



**NO BIOACCUMULATION  
NO BIOMAGNIFICATION**



QUATERNARY  
CONSUMERS



TERTIARY  
CONSUMERS

SECONDARY  
CONSUMERS

PRIMARY  
CONSUMERS

PRIMARY  
PRODUCERS

# Food safety







Thanks for  
your attention

Martina Capriotti

[martina.capriotti12@gmail.com](mailto:martina.capriotti12@gmail.com)  
IG @martinacapriotti12  
TW @12Martina\_C