What are microplastics and how do they impact on marine and human life?

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Le génie
au service de la société :
Inspiring a Cleaner World

OUR MISSION

To promote educational campaign about plastic pollution in the ocean and how engineers and all of us can help to solve this social problem.

Outline

What are Microplastics?

Source of Microplastics

Why is this important?

Impact of microplastics on marine life

Impacts of microplastics on health

What should be done

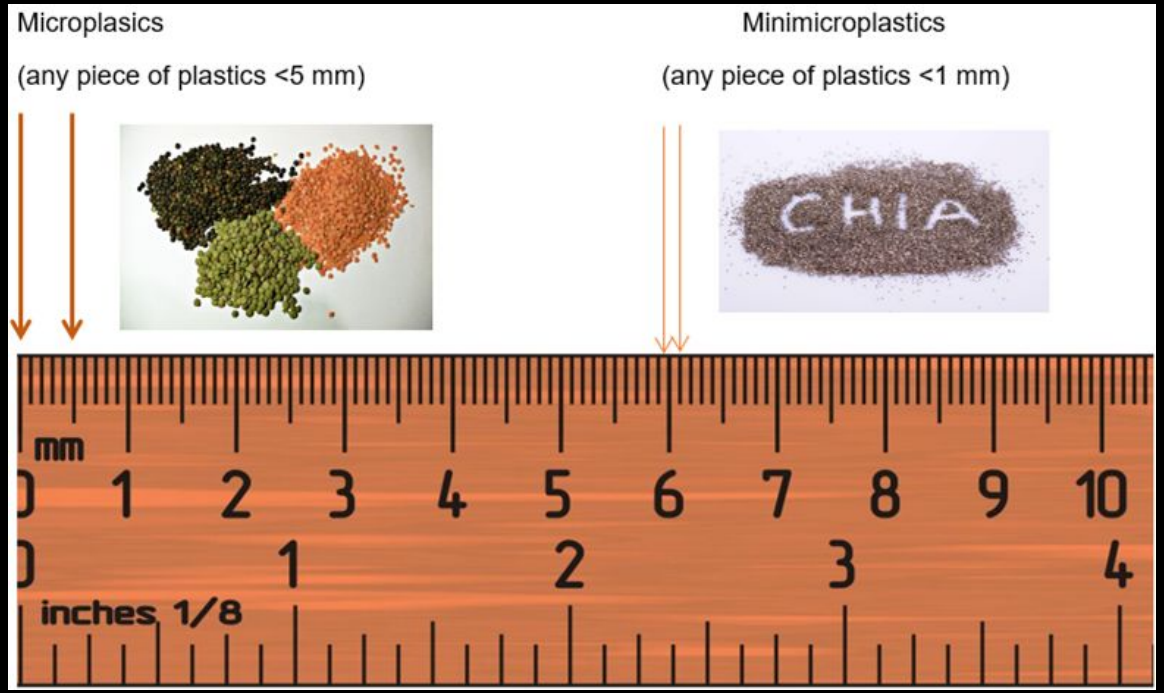
What are Microplastics

- Plastic is a completely human created material.
- Plastic productions have raised exponentially, with estimation of 400 million ton in 2017, and approximately about 8 million metric tons dumped into oceans annually.
- This amount is projected to amplify 10 times by the end of 2025.

- The term "microplastics" was introduced in 2004 by Professor Richard Thompson.
- Plastics are very durable, and they are never dissolved in water. Instead, they break down to small pieces known as microplastics (MPs)

Size categories for pieces of plastic

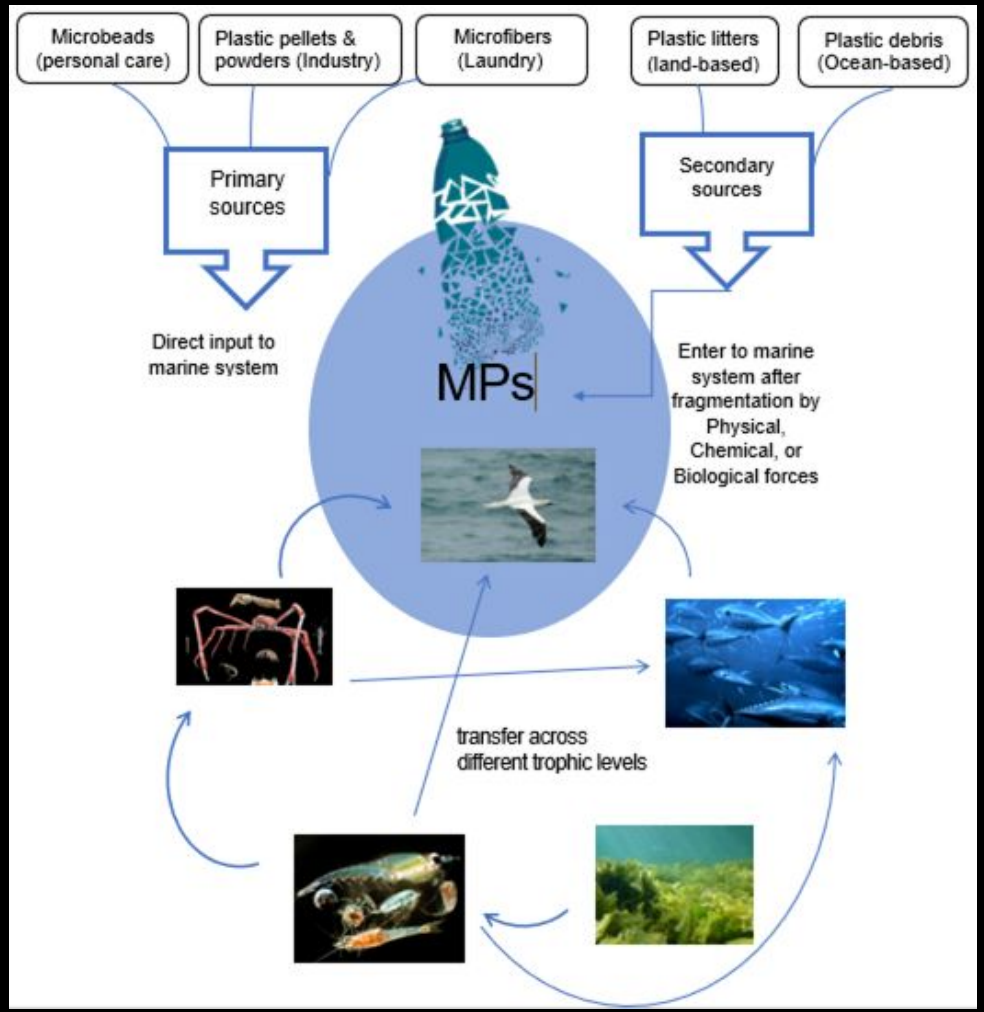
Microplastic (<5 mm–1 mm) Minimicroplastic (<1 mm–1 μm) Nanoplastic (<1 μm)

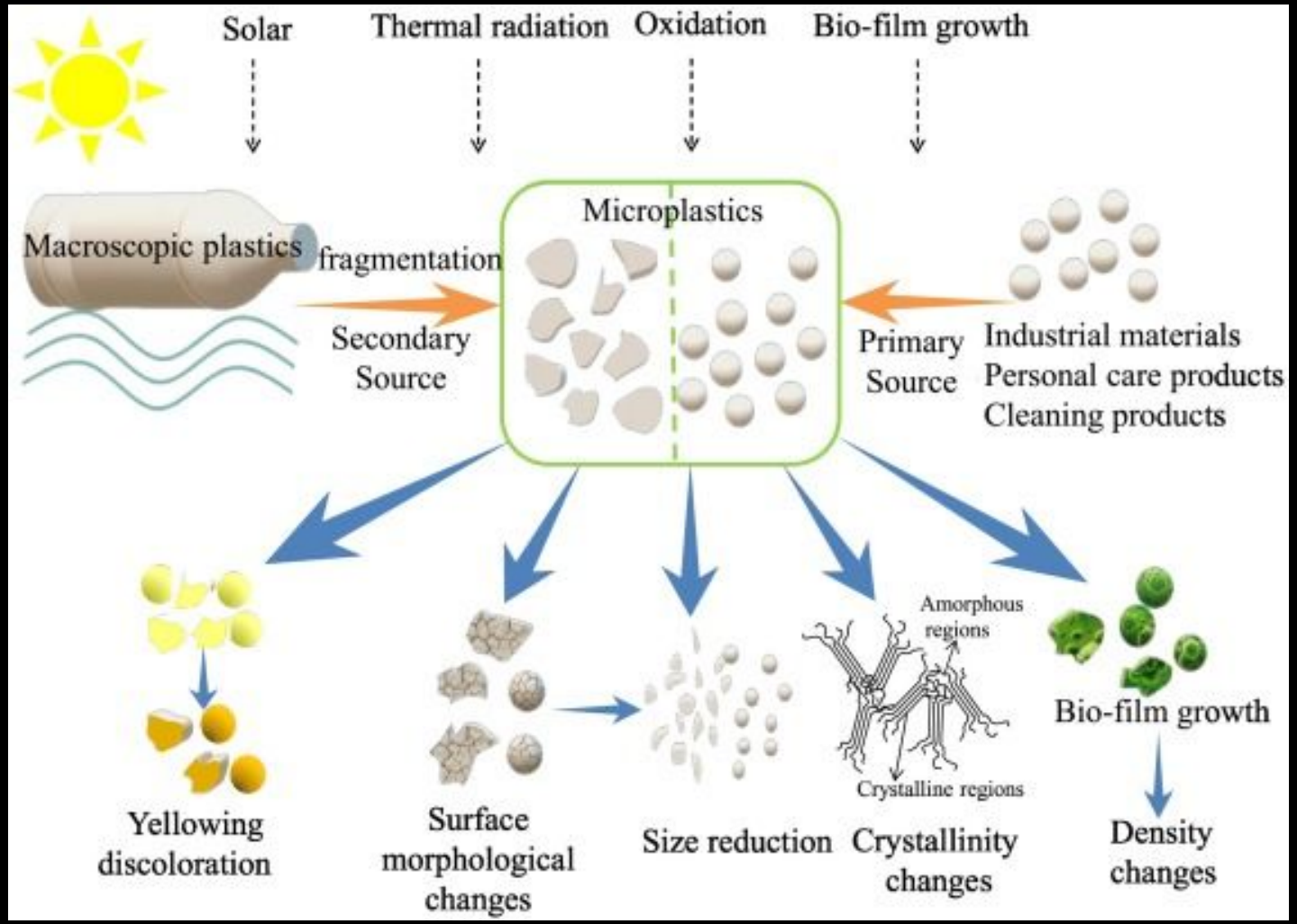


Source of MPs

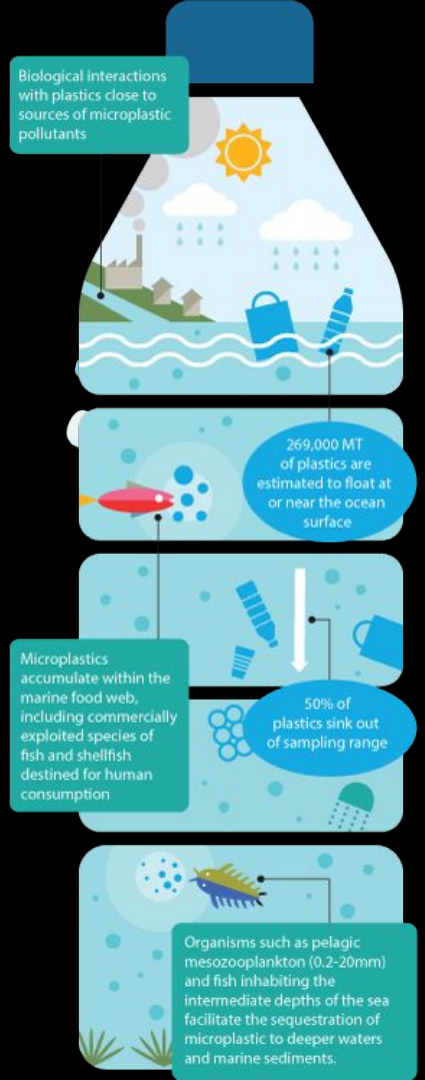
1.45 million tons of primary MPs are dumped into oceans annually

35 % laundering
28 % Car Tire
2 % personal care





https://www.sciencedirect.com/science/article/abs/pii/S0025326X19302036

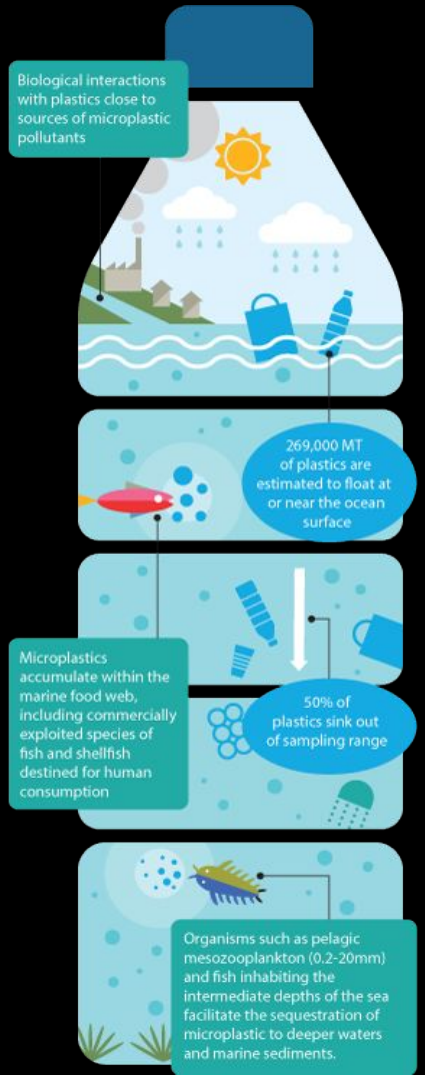


Why is this concerning?

- Over 300 million tonnes of plastics are manufactured per year, and around 50% of plastics are single used items.
- Approximately, 8 million tons of plastics end up in the oceans annually,
- "Every single piece of plastic ever made still exists, and will continue existing for at least 500 years. To put that in context, if Leonardo da Vinci had drunk water from a plastic bottle when he was painting the Mona Lisa, that bottle would not have fully decomposed yet" by Diego Gonzaga
- Yet, majority of large plastics have not stayed long enough in the ocean to be degrade to small size, thus there are large quantity of larger sized plastics available.
- Once they entered the ocean, they start to break down to small fractures that it can no longer be detected easily.

https://www.pml.ac.uk/Research/Research_topics/Facing_the_challenge_of_new_pollutants/Marine_plastics?related=3&page=2

To be con...



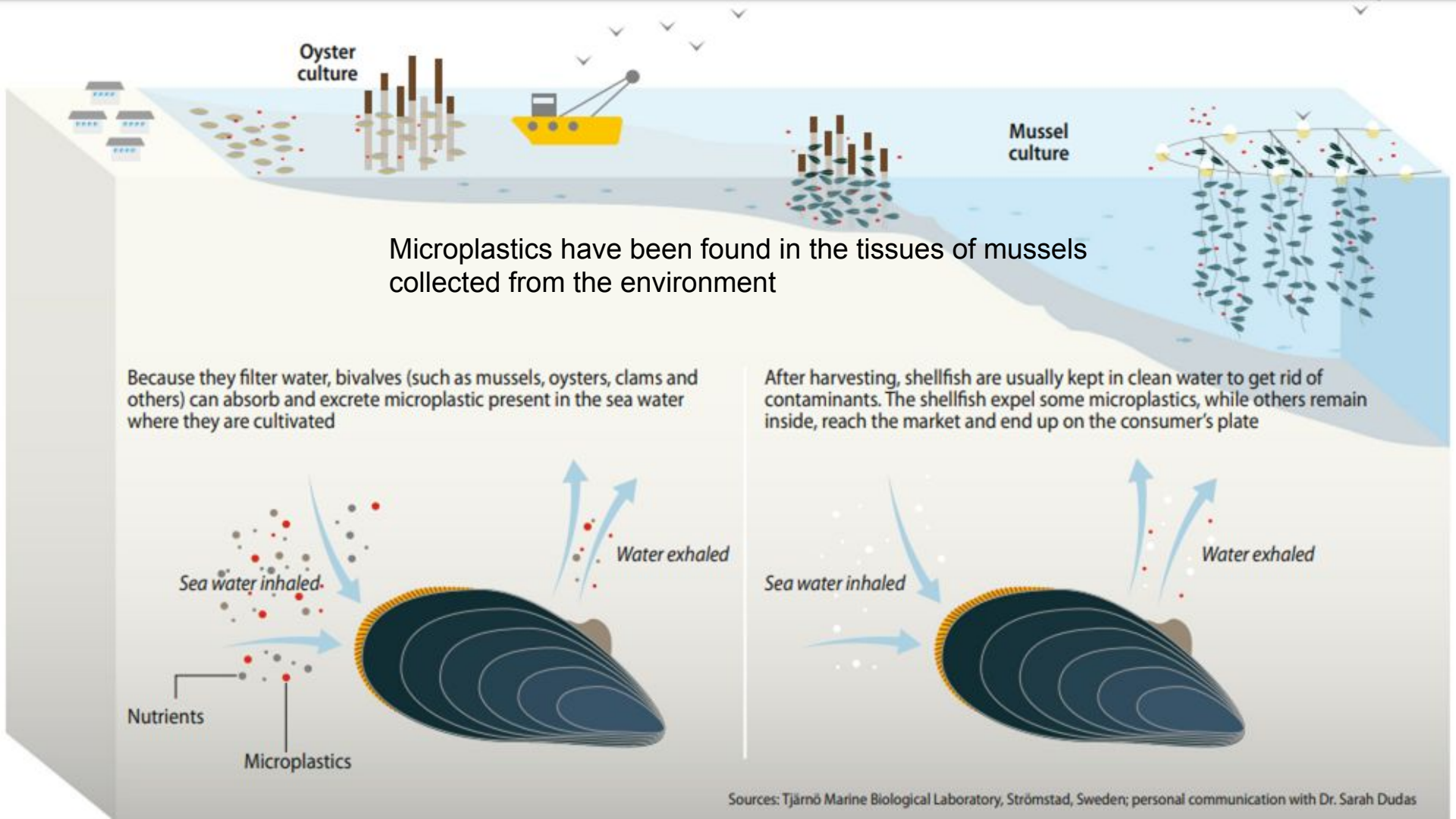
- Then buoyant MPs degrades to smaller size and become the host to grow biofilm, leading to increase the density of Mps, thereby resulting in sinking.
- Once MPs reach a suitably small size, they are ingested by marine life unintentionally and translocate to their tissues or they are excreted and return back to the ocean.
- MPs transfer across the food web, threatening the food safety and human health.
- MPs are able to adsorb other chemicals may exist in the ocean such as pesticides, pharmaceutical products, other industrial products and transferred them along the food chain.
- MPs have been persistently found in the marine ecosystem throughout the world and along the water column from the surface to the seabed.

Impacts on Marine Life

- Microplastics have been investigated in 2004, and, since then about 19,100 researches have been conducted on MPs.
- The latest UN report documented over 800 animal species contaminated with plastic via ingestion or entanglement
- MPs are accessible everywhere throughout the aquatic system and they can be taken by a wide range of marine creatures in various means
- Large animals like whale, turtle, and seabird can mistaken the large piece of plastics for something to eat.

Impacts on Marine Life

mortality, suffocation or physical damage to the digestive tract


Oyster culture
Mussel culture
Microplastics have been found in the tissues of mussels collected from the environment
Because they filter water, bivalves (such as mussels, oysters, clams and others) can absorb and excrete microplastic present in the sea water where they are cultivated
Sea water inhaled
Water exhaled
Nutrients
Microplastics
After harvesting, shellfish are usually kept in clean water to get rid of contaminants. The shellfish expel some microplastics, while others remain inside, reach the market and end up on the consumer's plate
Sea water inhaled
Water exhaled
Sources: Tjärnö Marine Biological Laboratory, Strömstad, Sweden; personal communication with Dr. Sarah Dudas

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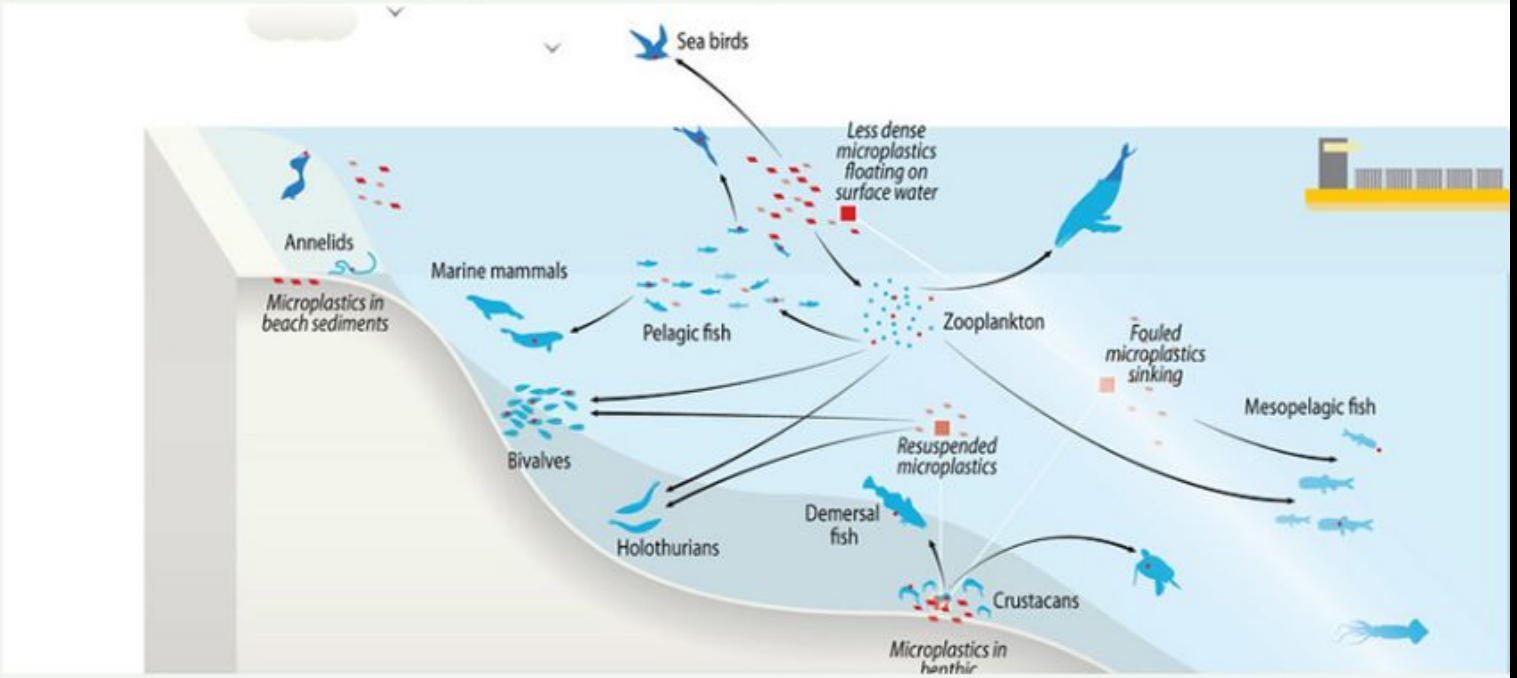
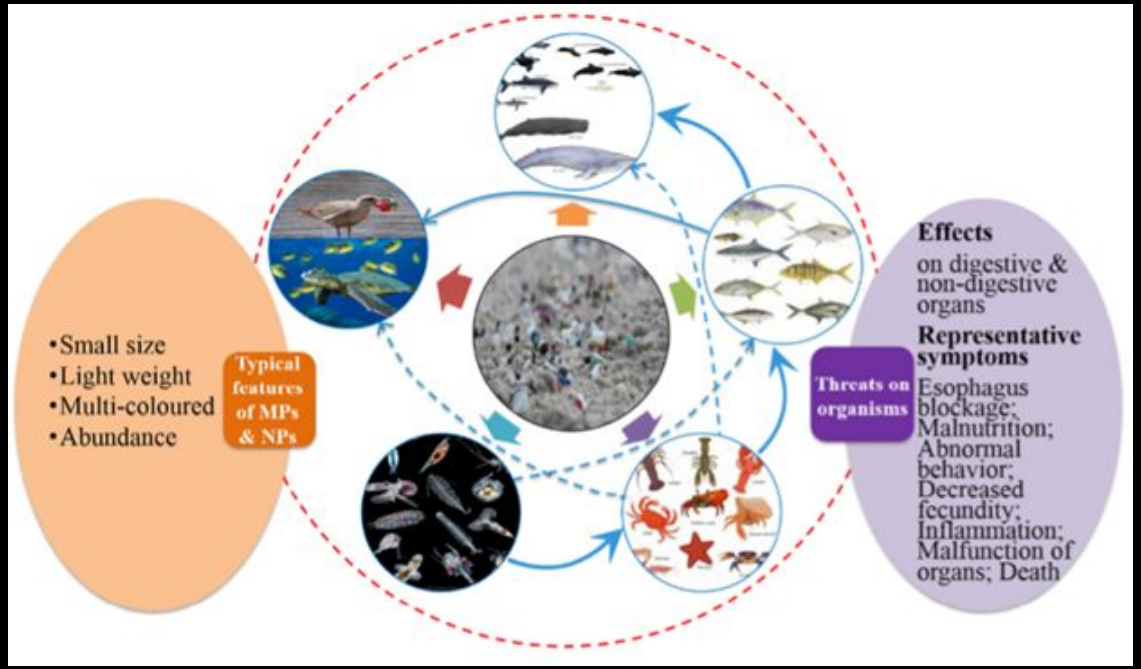


How plastics enter the food web

Download

Impacts on Marine Life



MPs (0.1 > 10μm) are ingested via passive water filtration, and they are transferred throughout the circulatory system, causing systemic exposure, leading to significant health disorders

- cytotoxicity
- Immunotoxicity
- Inflammation

https://doi.org/10.1016/j.scitotenv.2019.134254

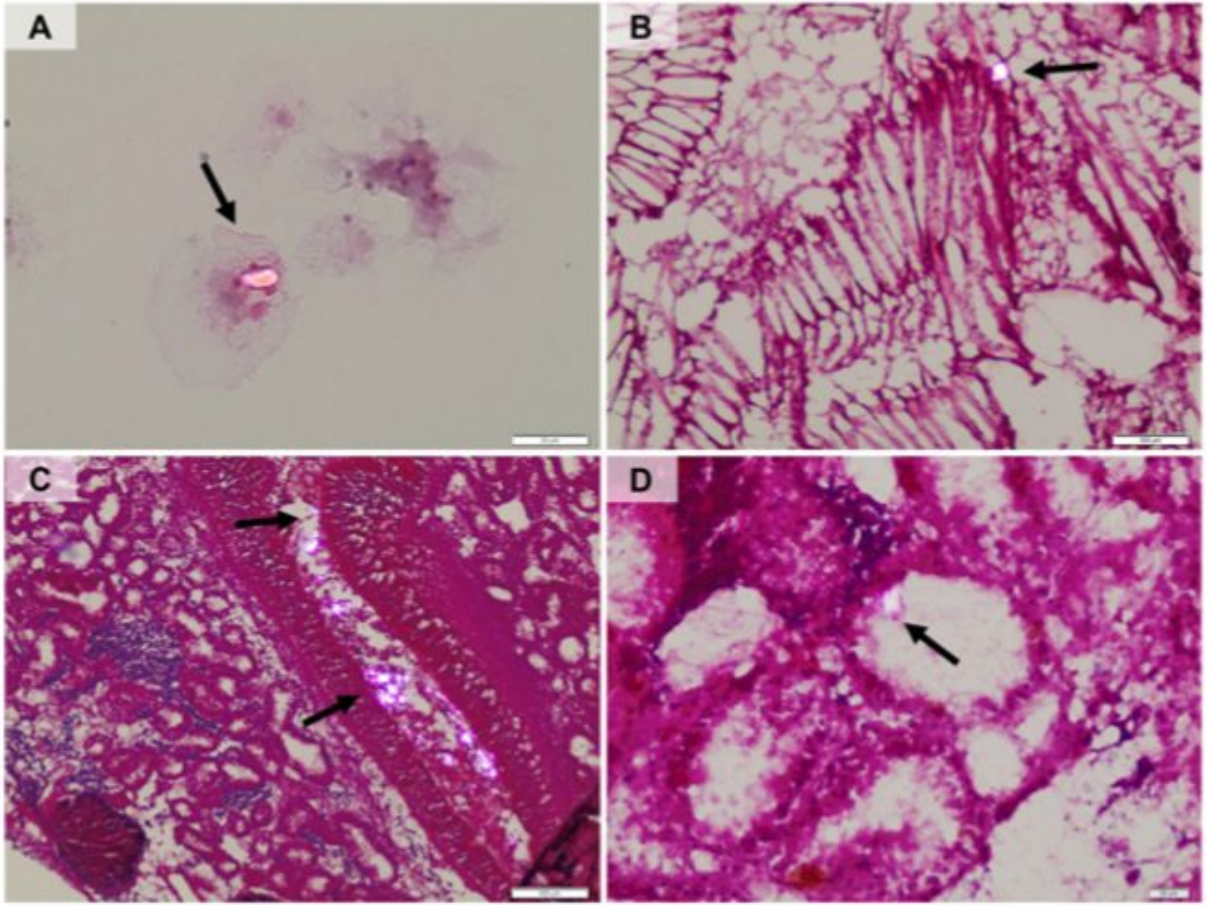
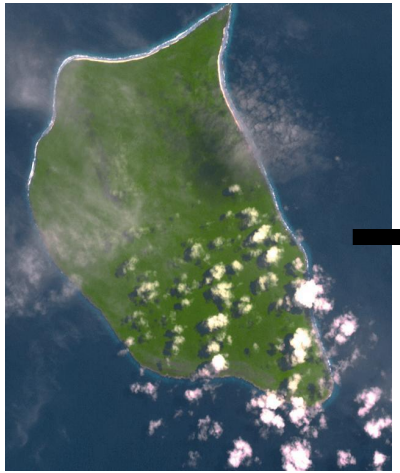
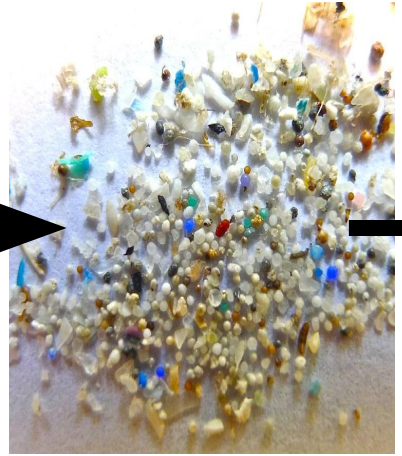


FIGURE 2 | Polarized-light microscopy images showing the presence of microplastic particles in hemolymph **(A)**, gills **(B)**, gut lumen and epithelium **(C)**, digestive tubules **(D)**.

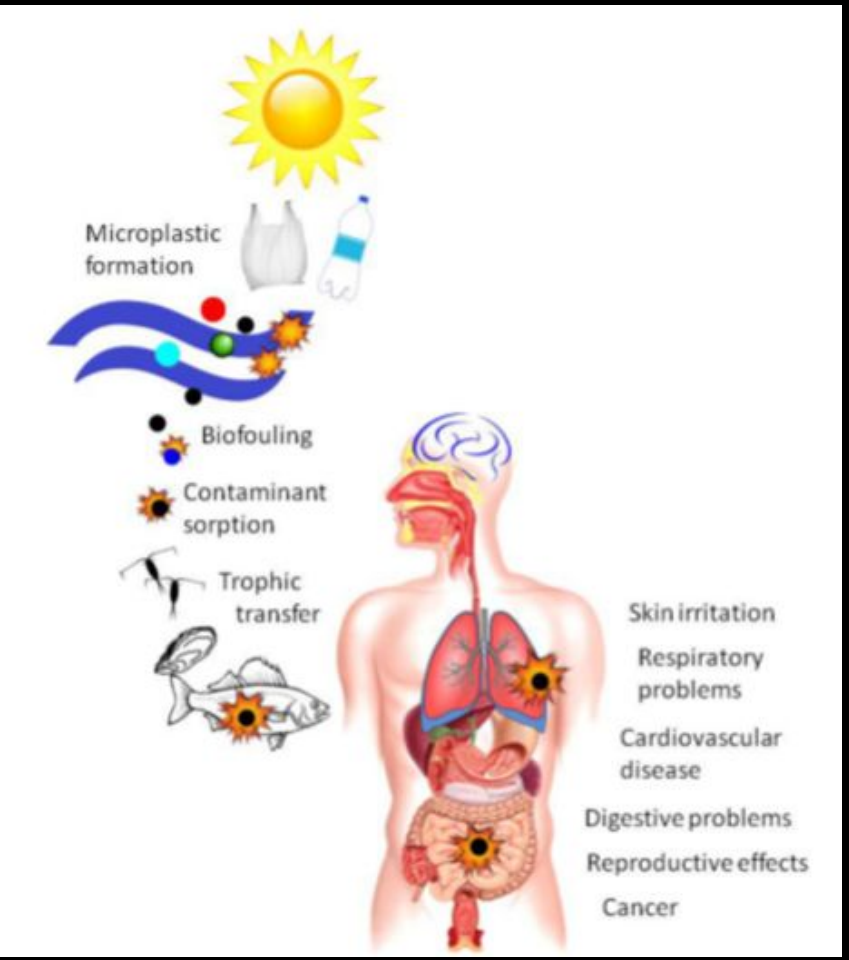
https://doi.org/10.3389/fmars.2018.00103

Impacts on Human Health





Nutritional authorities advise people to double their seafood consumption; however, awareness or concerns about microplastics in seafood could lead consumers to reduce their consumption



Impacts on Human Health

- Global per capita seafood consumption is over 20 kg/year
- It is inevitable that human bodies are exposed to MPs at some level.
- Mammalian systems modeling suggests that MPs at certain size can translocate across living cells, such as muscle cells or nervous cells, to the lymphatic and/or circulatory system, accumulate in secondary organs, and impact the immune system and cell health
- it has been predicted that ingested MPs may cause inflammation in tissue, cellular proliferation, and necrosis and may compromise immune cells.

What should we do?

Avoid using products containing microplastics

Reduce using single-use plastics and recycle properly

Raise awareness about MPs (School-aged & HCC) pollution and support organizations advocates for cleaning the ocean

Society

What should we do?

Improving waste management infrastructure

Enforcing a regulation that bans the use of microbeads

Replacing single used plastics with Eco-Friendly materials

Government

What should we do?

Measuring levels of MPs in seafood and other human consumable products regularly

More research demanded to identify the adverse effects of MPs on human body

Developing techniques to identify the presence of MPs in the human tissue (Ex. Biopsy)

Researchers

Thank you!