MICRO-PLASTICHE

MACRO-PROBLEMI

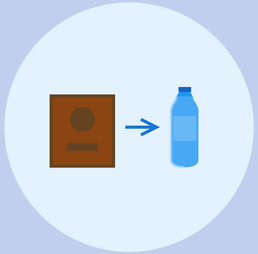


Giusto Lo Bue

UNIVERSITÀ
DI PAVIA

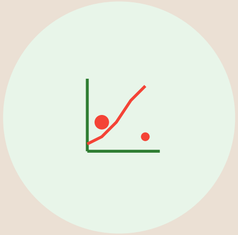
giusto.lobue01@universitadipavia.it
giustolobue@gmail.com

SOROPTIMIST INTERNATIONAL



1. Come siamo arrivati alla crisi attuale?

Da materiale rivoluzionario a sfida globale.



2. Stato dell’arte: le plastiche in ambiente.

Conoscenze attuali, dati e preoccupazioni.

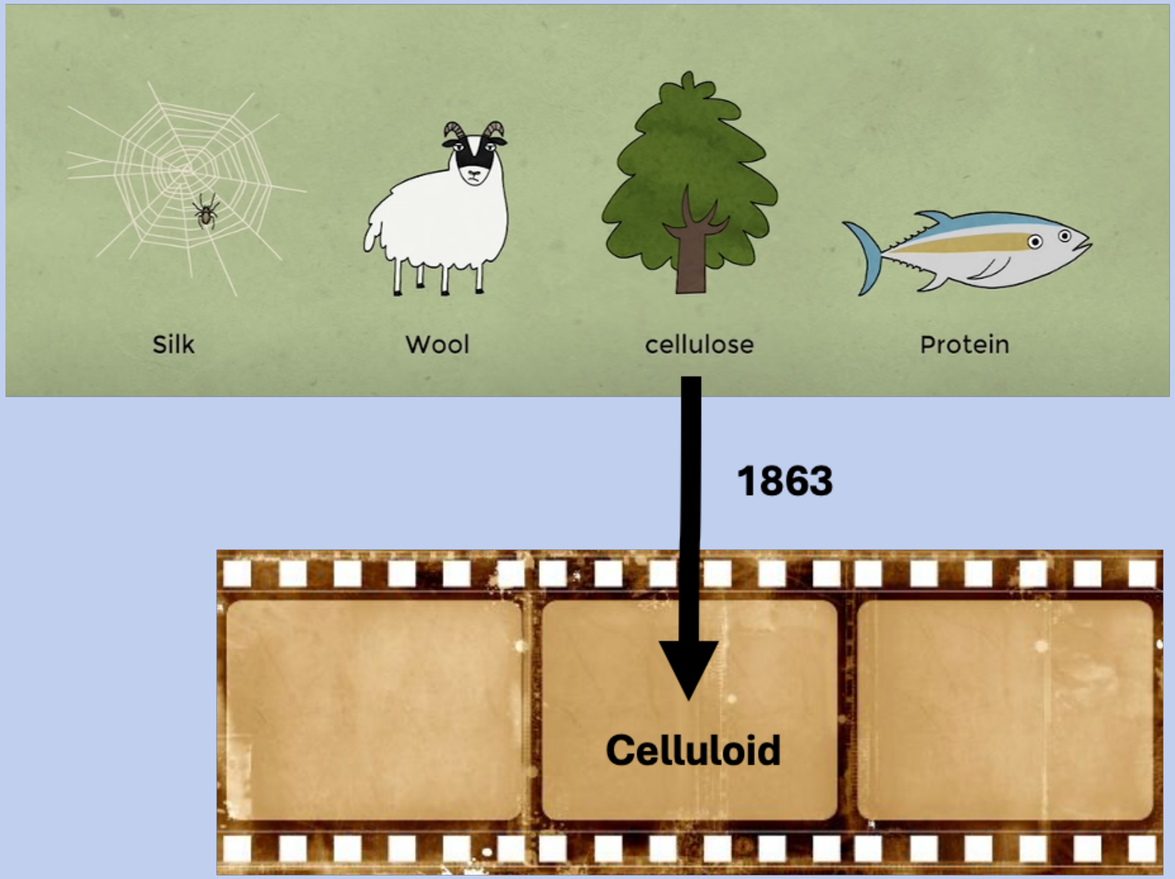


3. La nostra ricerca:

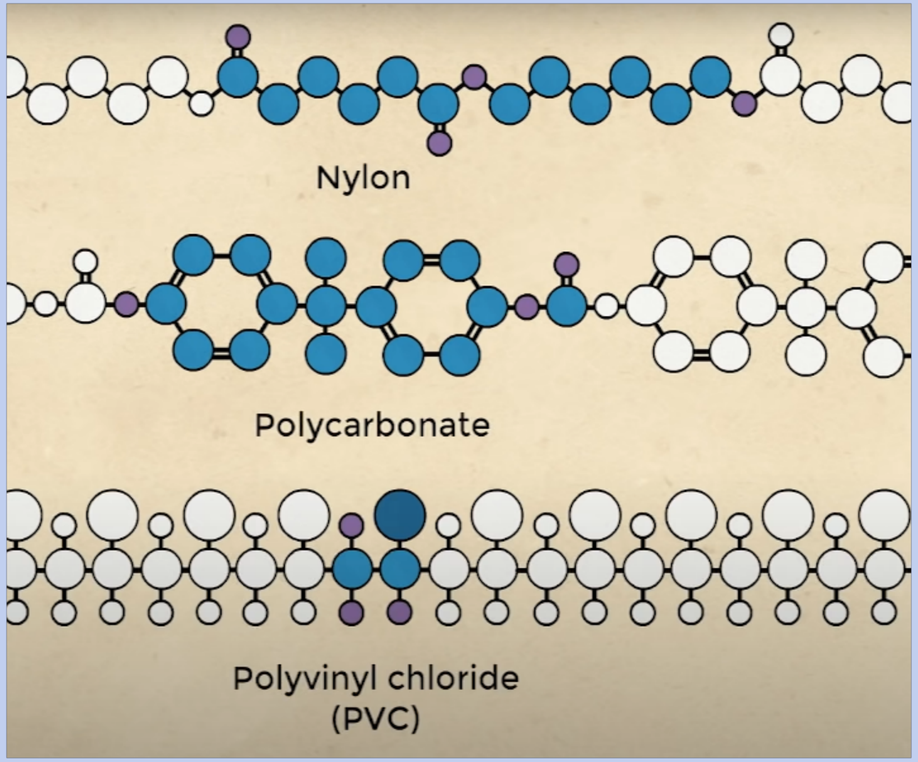
Microplastiche negli habitat creati da bio-costruttori marini.

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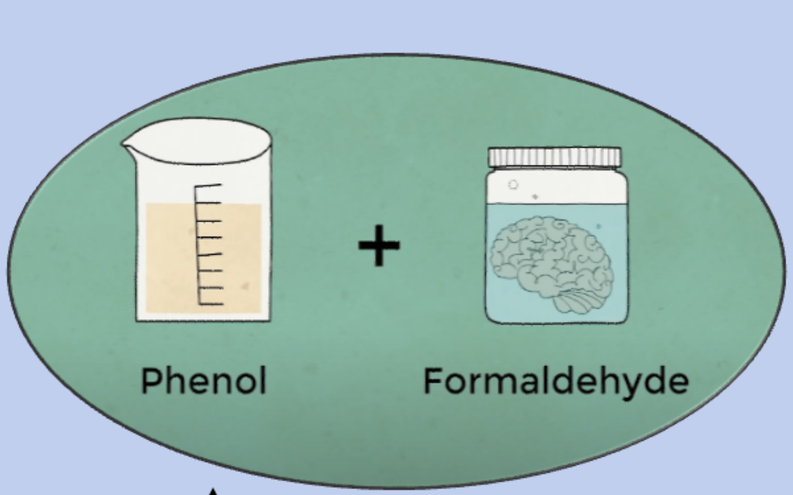
Polymers are repetition of monomers.
Synthetic (produced in laboratory) are inspired to natural ones

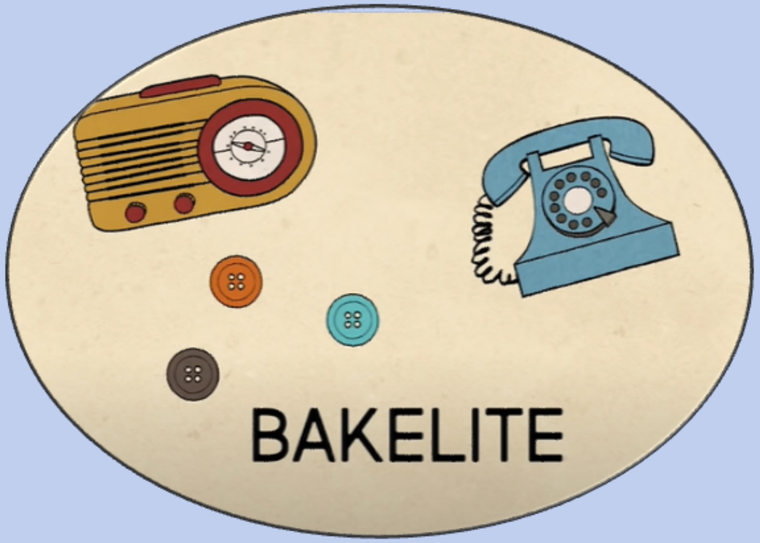


Illustrations by Sharon Colman

1. Come siamo arrivati alla crisi attuale?

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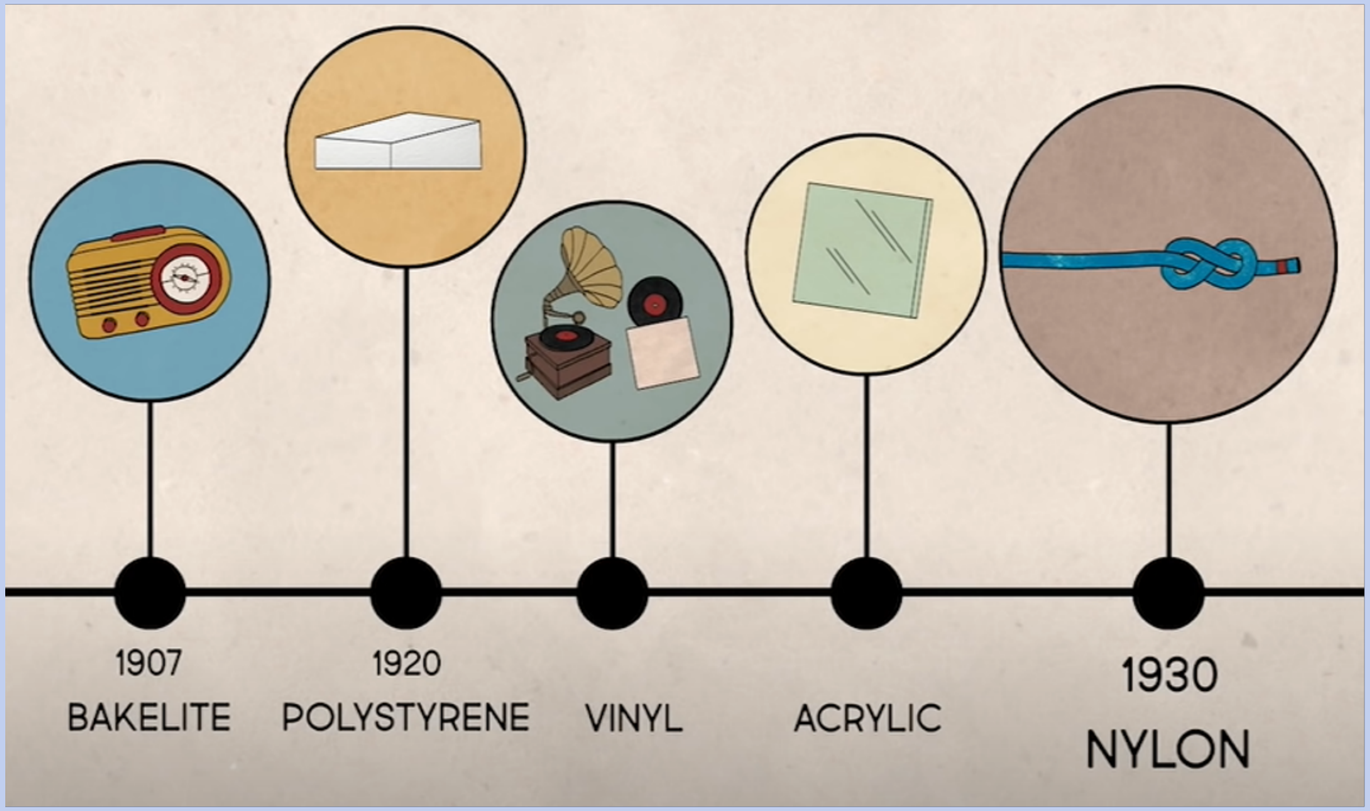




Petroleum and chemical industries began forming strategic alliances, giving rise to industrial giants (Dow Chemicals, ExxonMobil, DuPont, and BASF) - companies that still dominate the production of raw plastic resins today.

1. Come siamo arrivati alla crisi attuale?

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Ethylene was one of the most abundant by-products, and the British company Imperial Chemical Industries (ICI) was the first to transform it into plastic material.



1. Come siamo arrivati alla crisi attuale?

Da materiale rivoluzionario a sfida globale.







Figure 5–38. The first million-dollar order for plastics was for the M-52 trench mortar fuze. Many molders produced these parts in very high volume.

https://americanhistory.si.edu/collections/object/nmah_1200996

1. Come siamo arrivati alla crisi attuale?

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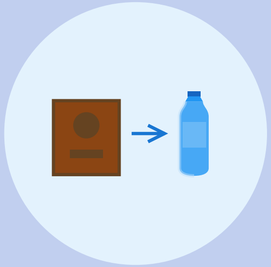




- Plastic materials have effectively exceptional physical characteristics.

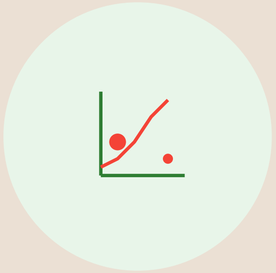
- Extremely slow or absent biological degradation

If paired with a long-term usage, can be the most eco-friendly common used material at a global scale.



1. Come siamo arrivati alla crisi attuale?

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2. Stato dell’arte: le plastiche in ambiente.

Conoscenze attuali, dati e preoccupazioni.



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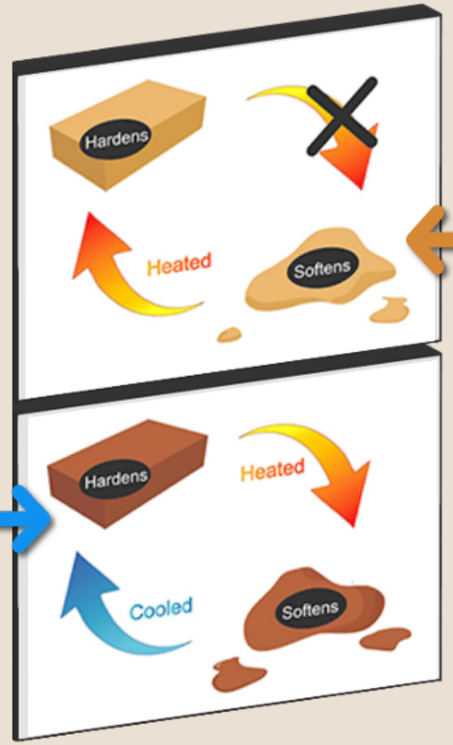
2. Stato dell’arte: le plastiche in ambiente.

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Thermoplastics

Plastics that can be melted when heated and hardened when cooled. These characteristics, which lend the material its name, are **reversible**

Polyethylene,
Polypropylene, etc..



Thermosets

Plastics that undergo a chemical change when heated, creating a three dimensional network. The process is **irreversible**: once formed these plastic cannot be re-melted

Polyurethane, epoxy resins, silicone, etc..

https://plasticseurope.org/wp-content/uploads/2021/10/2018-Plastics-the-facts.pdf

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Synthetic Polymers: structure essentially comprises the multiple repetition of units (monomers).

Additives: additives to improve plastic processability, properties, and performance (flame retardants, plasticizers, etc..).

Copolymers: many polymers are produced from more than one species of monomer (ABS: Acrylonitrile-Butadiene-Styrene).

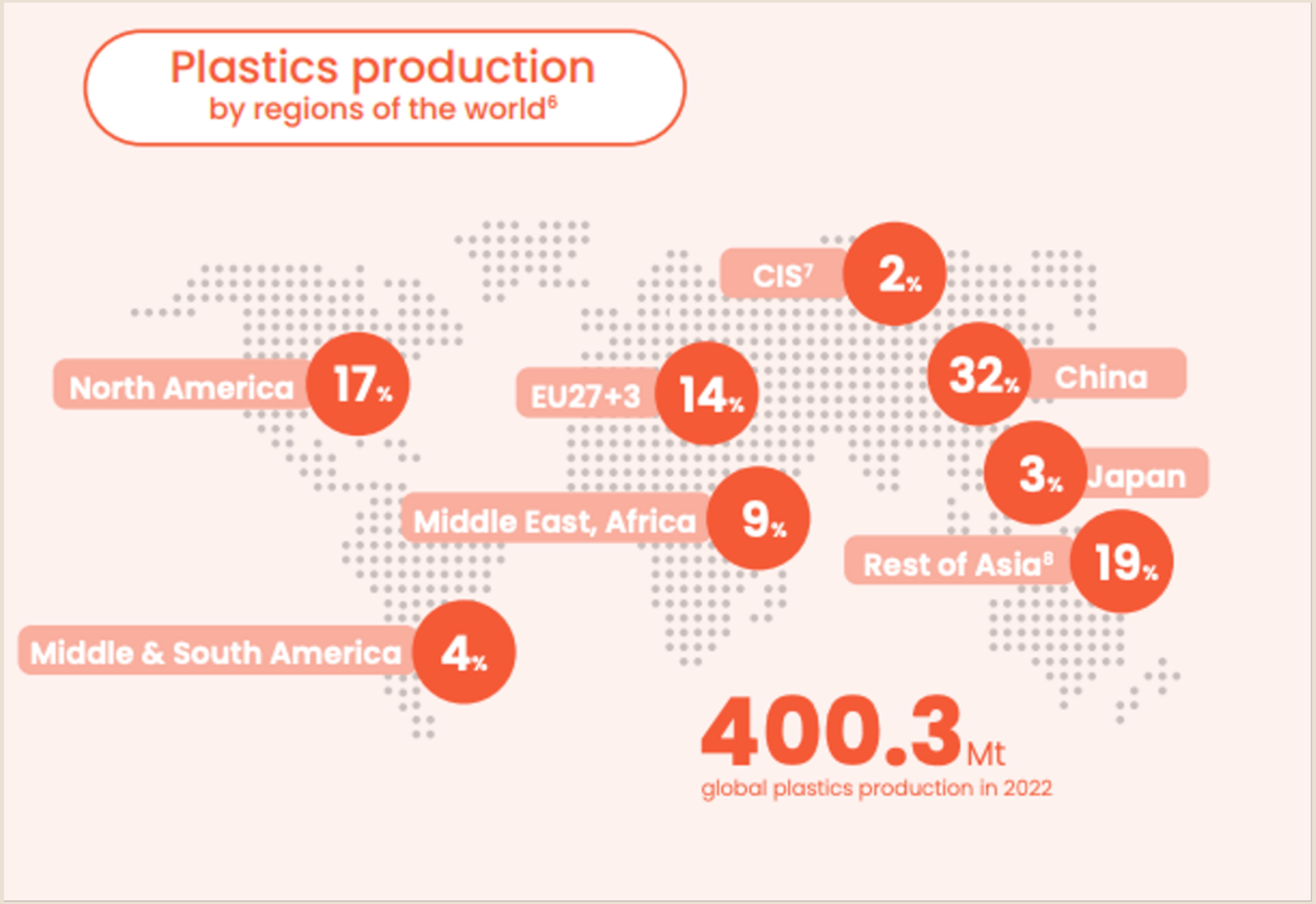
Composites: consists of two components: the polymer matrix and non-polymeric reinforcement. (Typical of thermosets)

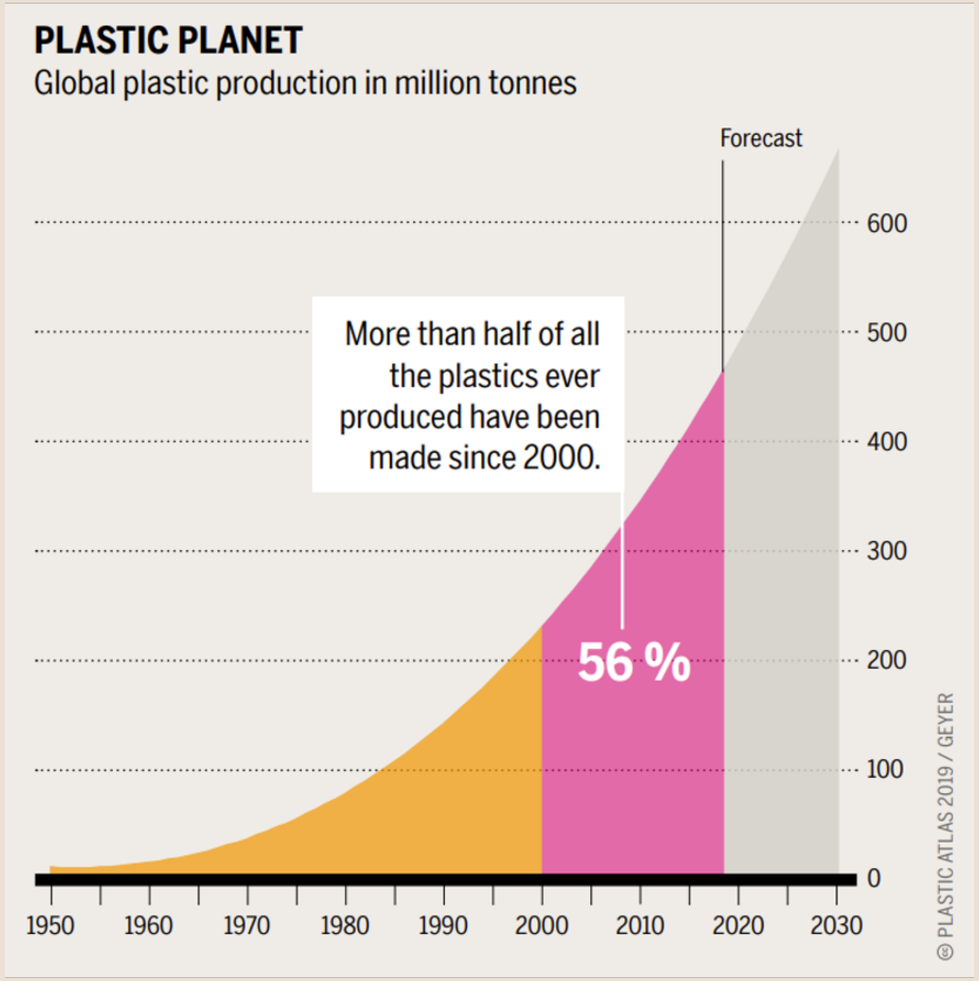
Symbol	Polymer type	Examples of applications
1	PET polyethylene terephthalate	Soft drink and water bottles, salad trays.
2	HDPE high density polyethylene	Milk bottles, shampoo bottles, toys, houseware.
3	PVC polyvinyl chloride	Window frames, floor coverings, pipes, cable insulation.
4	LDPE low density polyethylene	Carrier bags, bin liners, packaging films.
5	PP polypropylene	Microwave-proof containers, automotive parts, food packaging.
6	PS polystyrene	Yoghurt pots, insulating packaging and building materials, plastic cutlery, protective packaging for consumer goods.
7	PUR polyurethane	Building insulation, pillows and mattresses, insulating foams.
7	other	Hub caps (ABS); optical fibres (PBT); eyeglasses lenses (PC); touch screens (PMMA); cable coating in telecommunications (PTFE); other applications in aerospace, medical implants, surgical devices, membranes, valves and seals, protective coatings, etc.

https://www.europarl.europa.eu/RegData/etudes/BRIE/2017/603940/EPRS_BRI(2017)603940_EN.pdf

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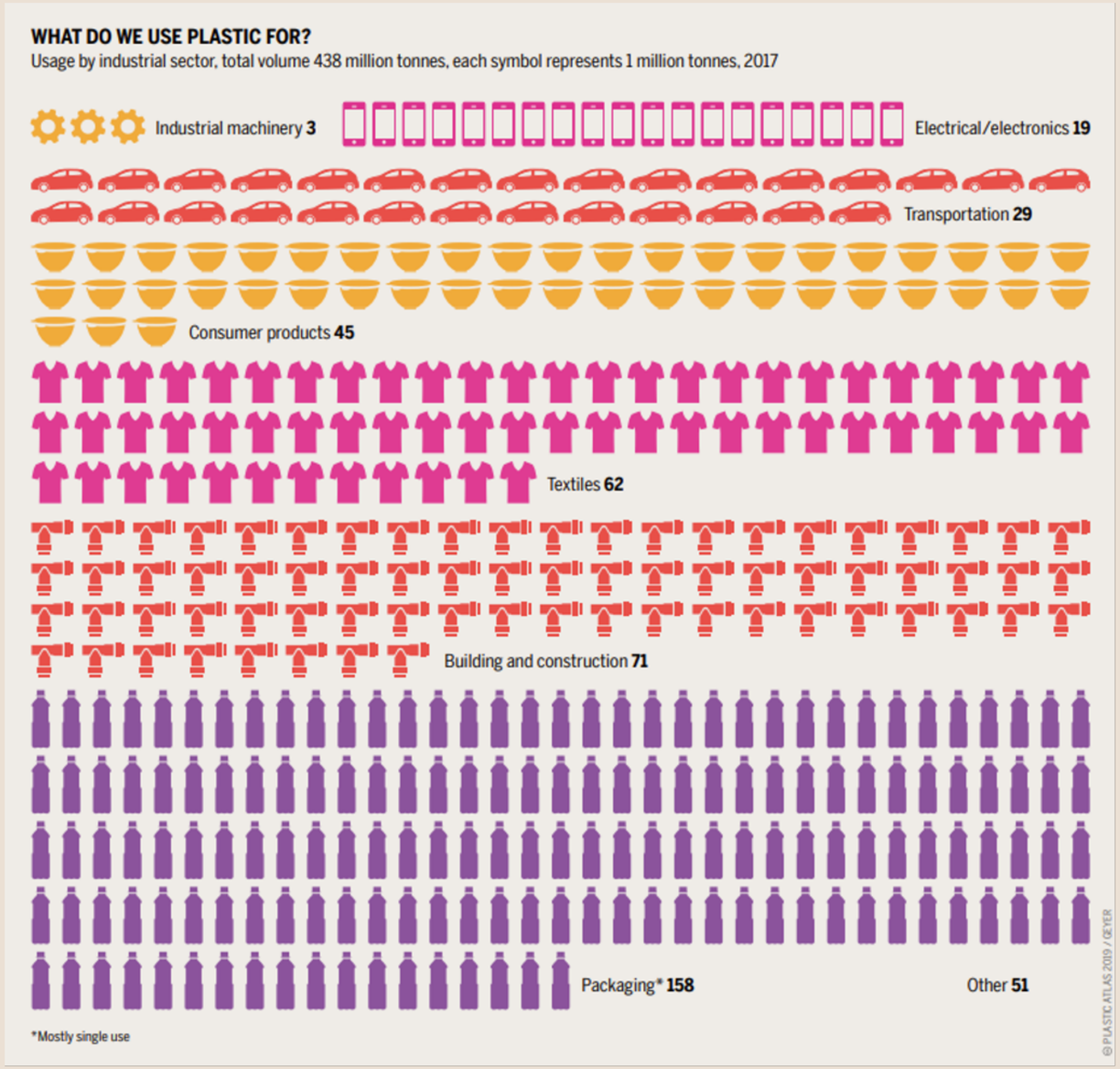




https://plasticseurope.org/knowledge-hub/

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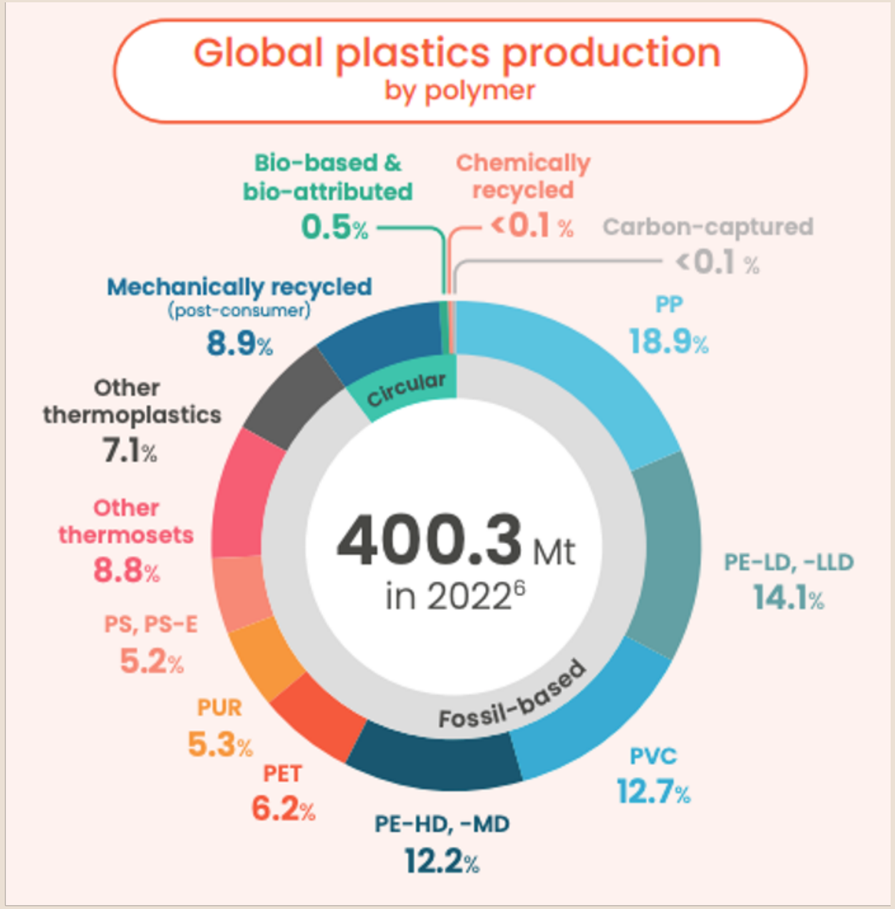
Conoscenze attuali, dati e preoccupazioni.



2. Stato dell’arte: le plastiche in ambiente.

Conoscenze attuali, dati e preoccupazioni.

LESS THAN 0.5%

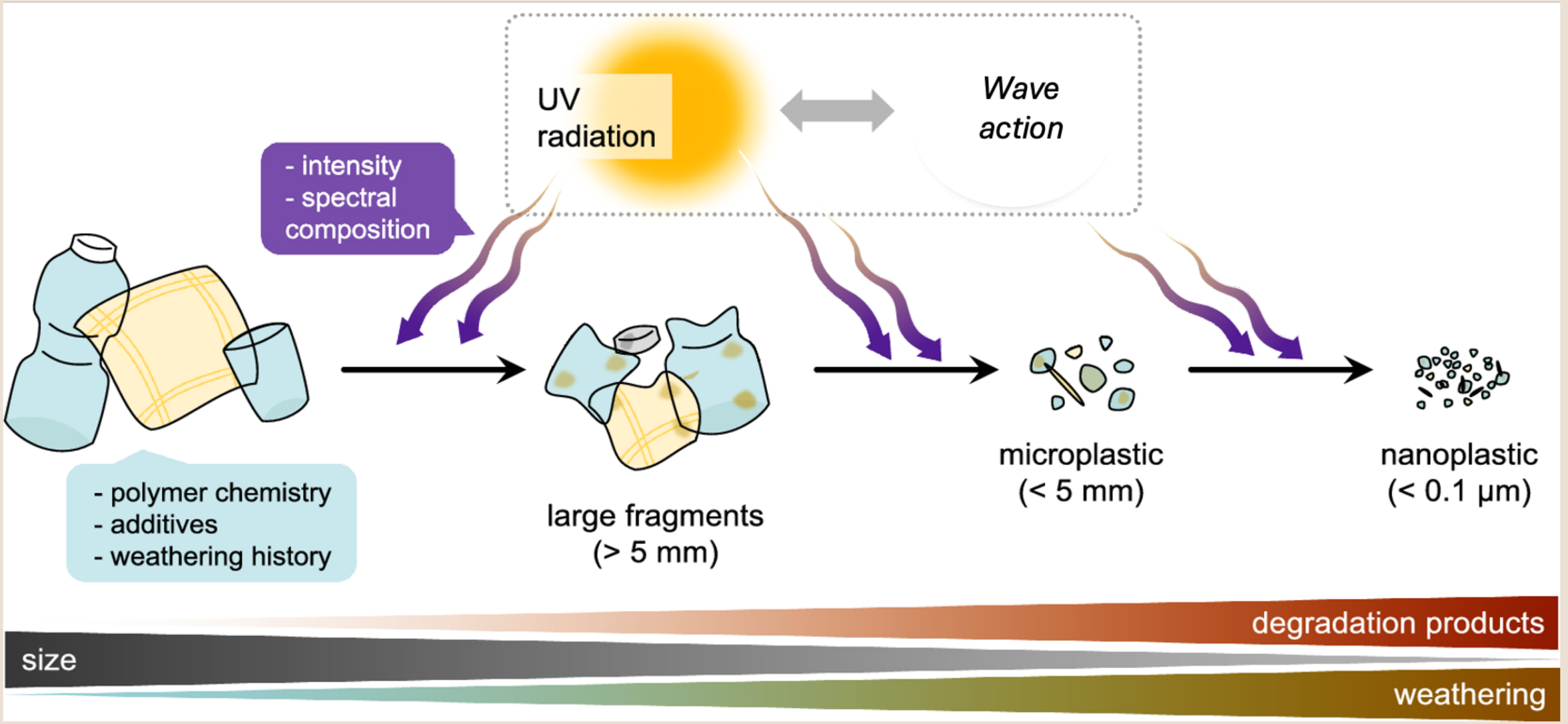




* Lebreton et al., 2017, Schmidt et al., 2017, Mai et al., 2020, Roebroek et al., 2020, Meijer et al., 2021.

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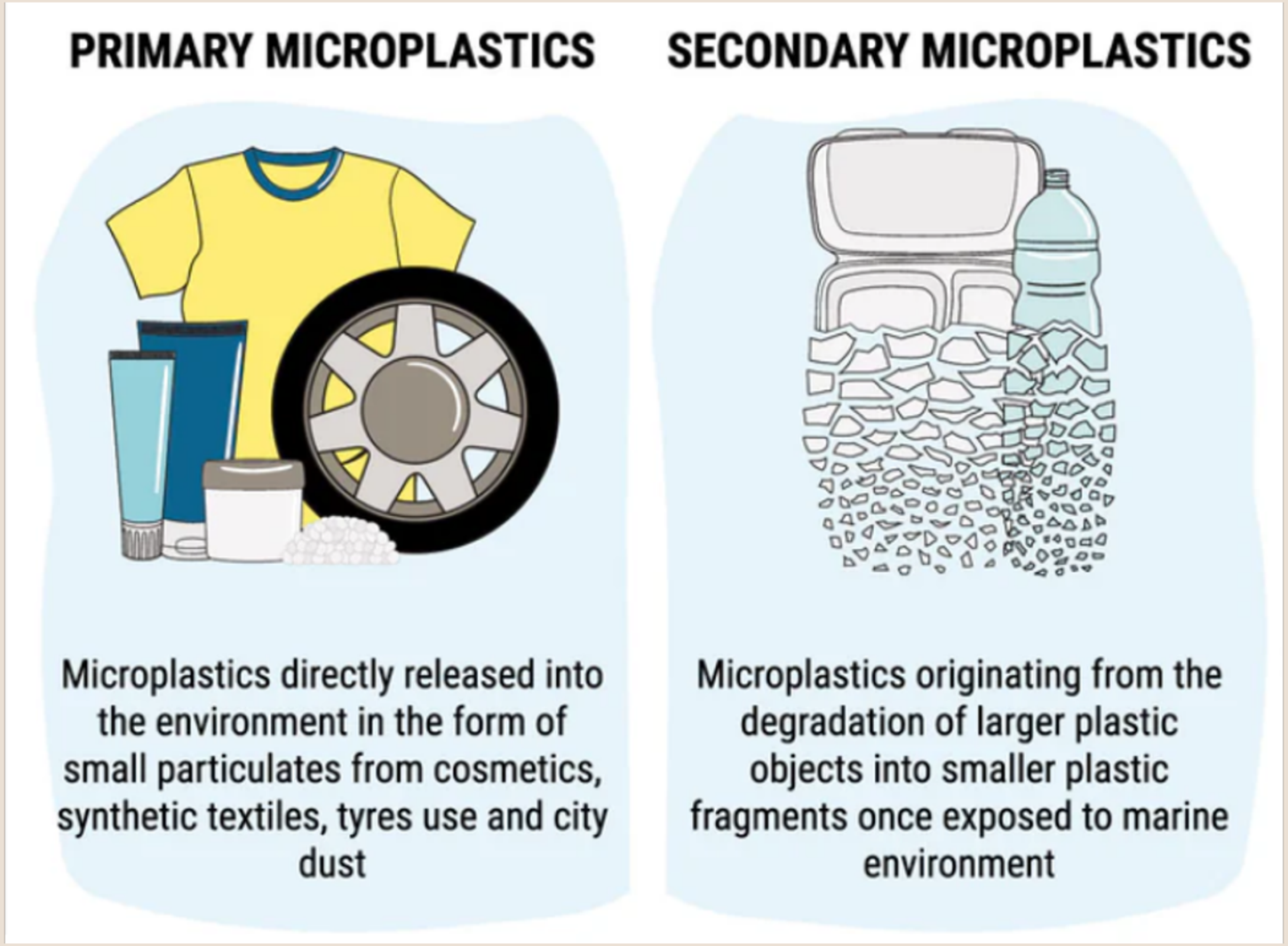
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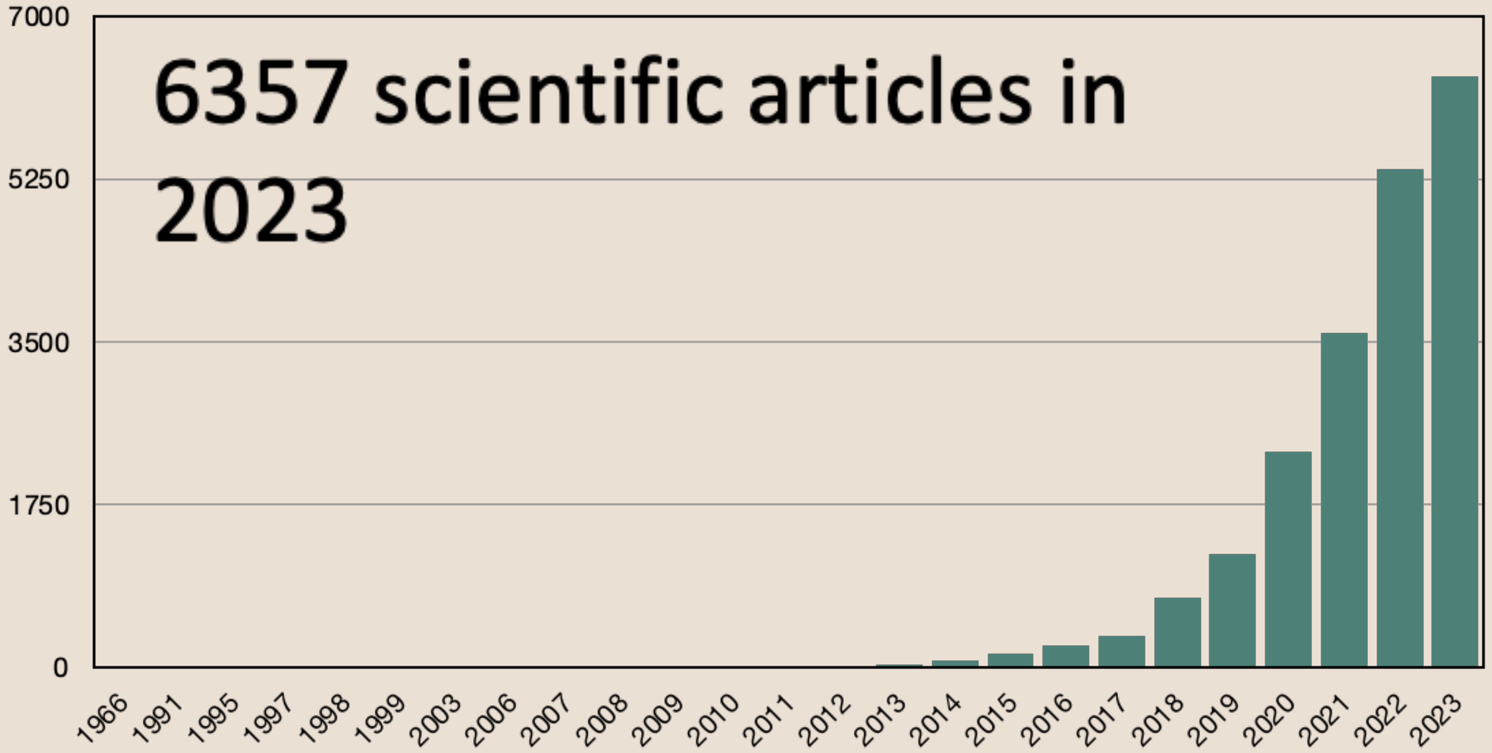
Conoscenze attuali, dati e preoccupazioni.

- **ECHA (European Chemical Agency):** Microplastics are solid plastic particles composed of mixtures of polymers and functional additives. They may also contain residual impurities.



2. Stato dell’arte: le plastiche in ambiente.

Conoscenze attuali, dati e preoccupazioni.



Data acquired from Scopus on 11 December 2023 using the search term “microplastic” and querying the environmental sciences field.

- First record of plastic ingestion from wildlife is from 1960s.

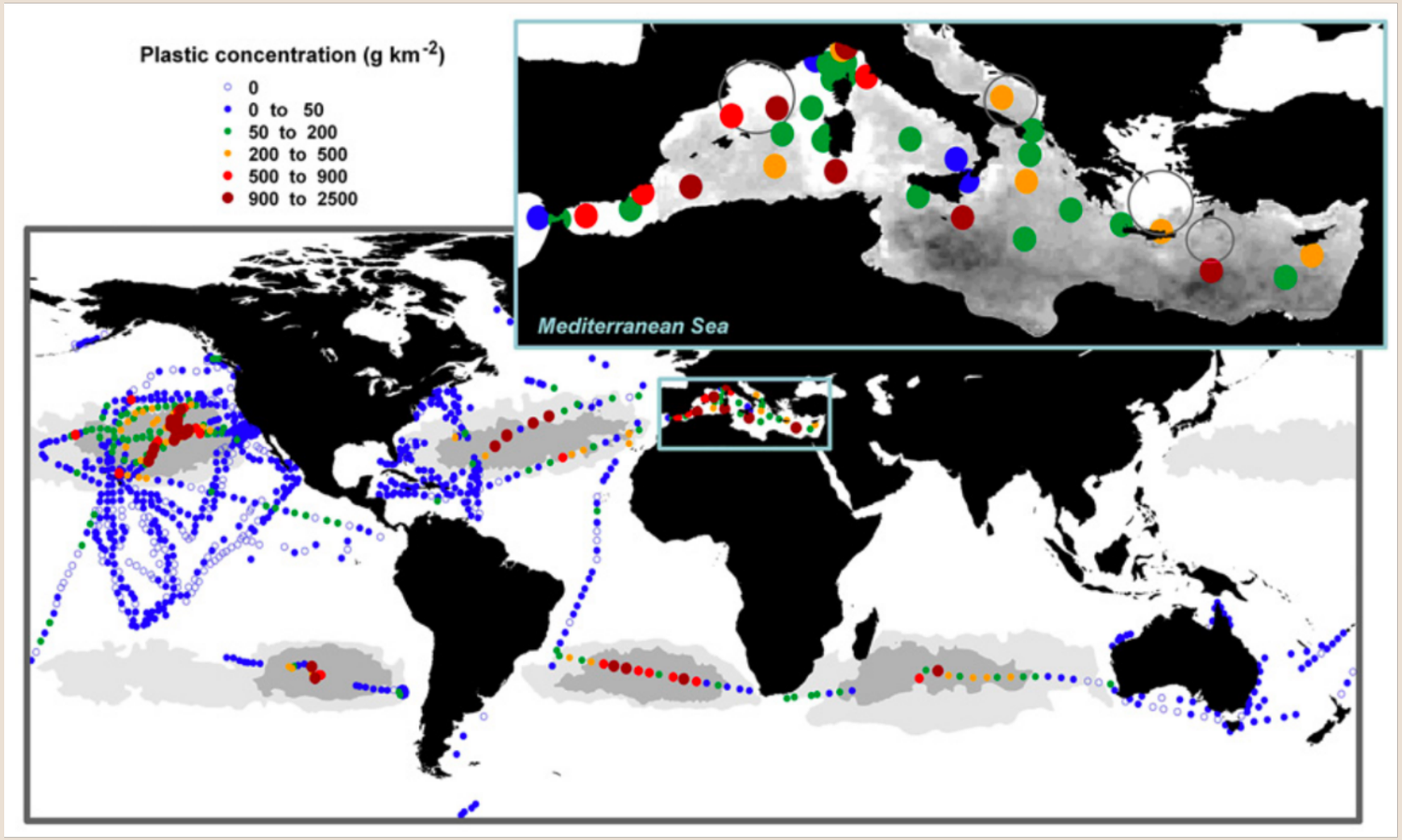
- From 70s microplastic and plastic have been reported on the sea surface.

Main focuses are:
- Impact on life
- abundance as a floating debris

https://www.scopus.com/search/form.uri?display=advanced

2. Stato dell’arte: le plastiche in ambiente.

Conoscenze attuali, dati e preoccupazioni.



Cózar et al 2015

Annual Plastic Input:

4.8 to 12.7 million tons

Observed Floating Plastic:

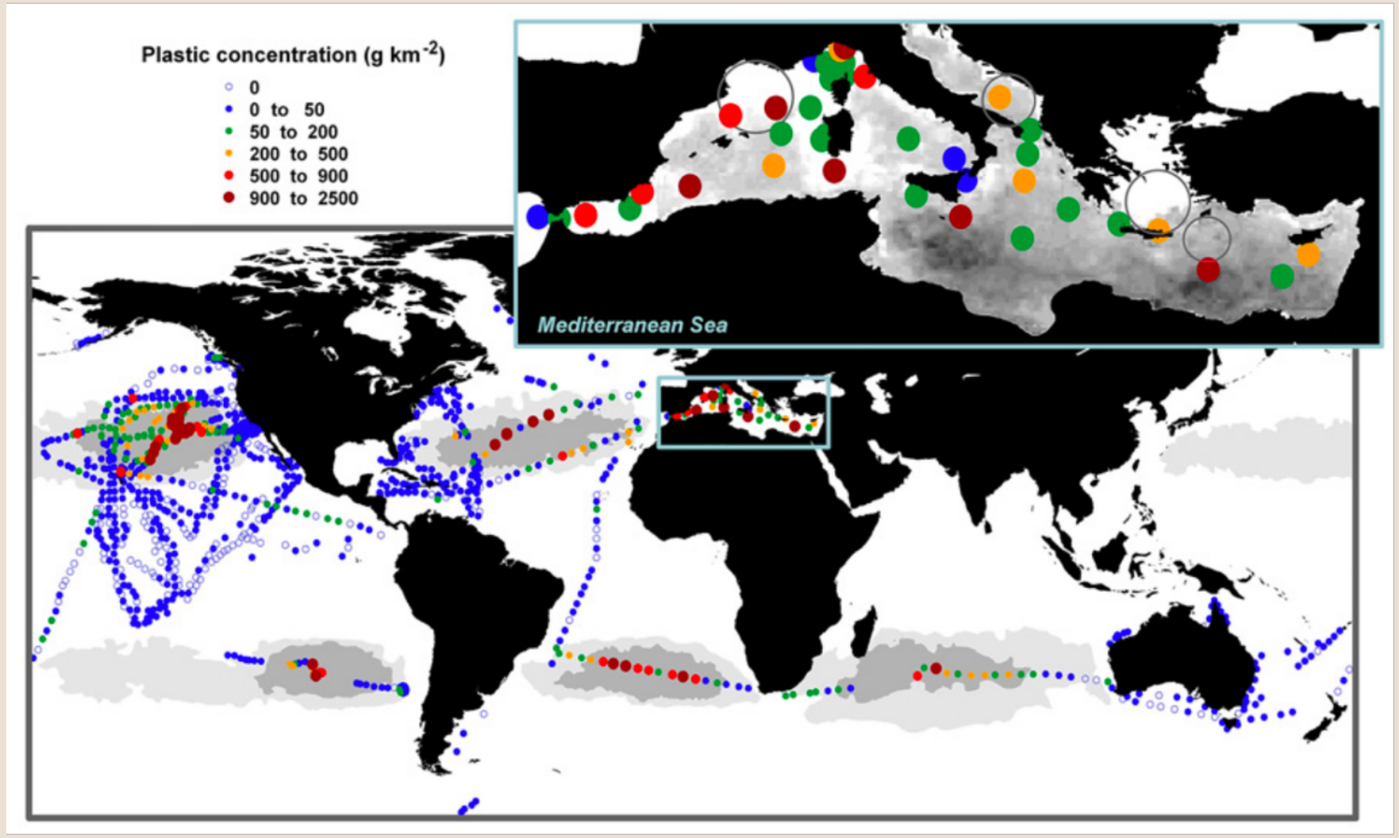
Global: 7000 to 35000 tons

Mediterranean Sea: 1000 to 3000 tons

Jambeck et al. 2015

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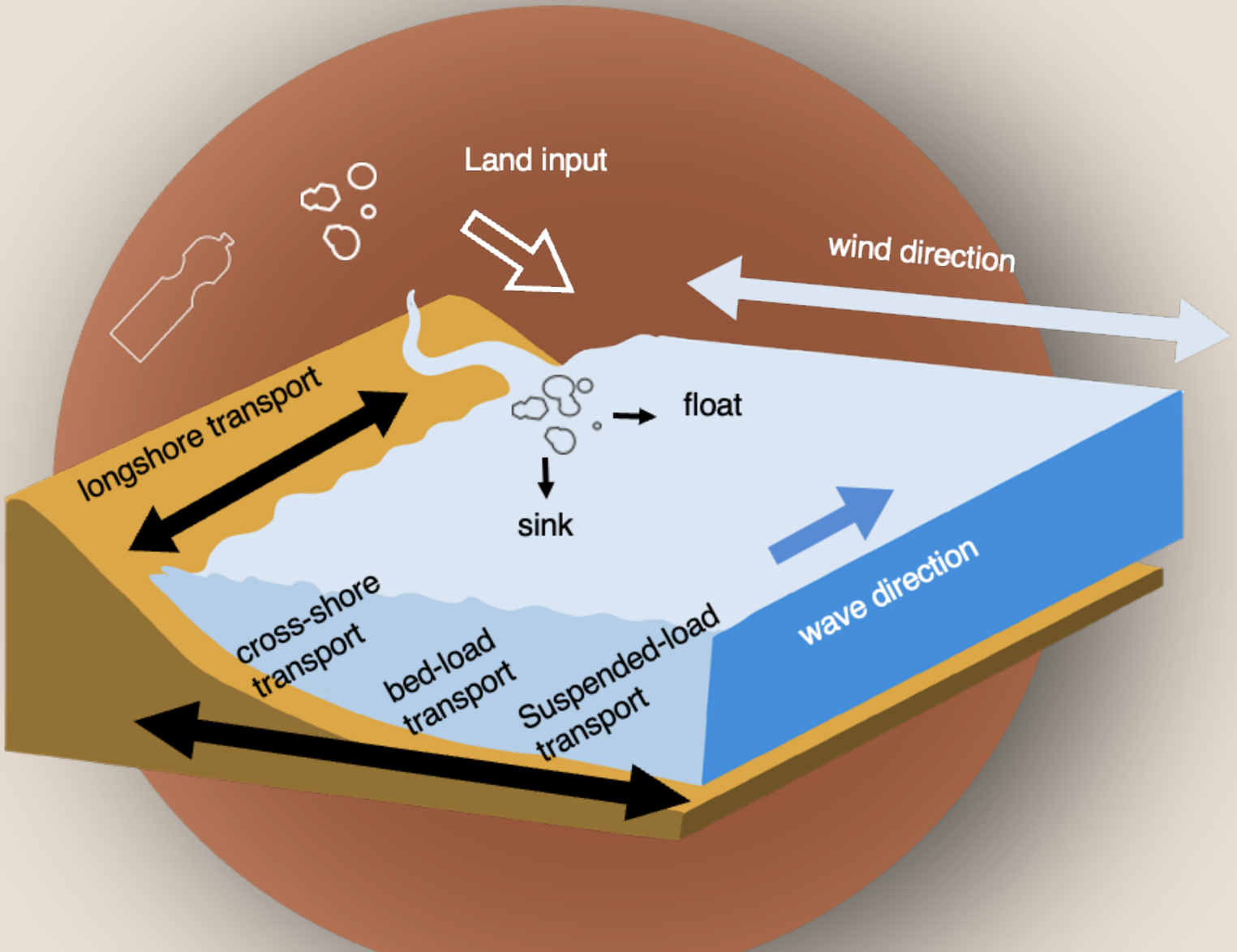
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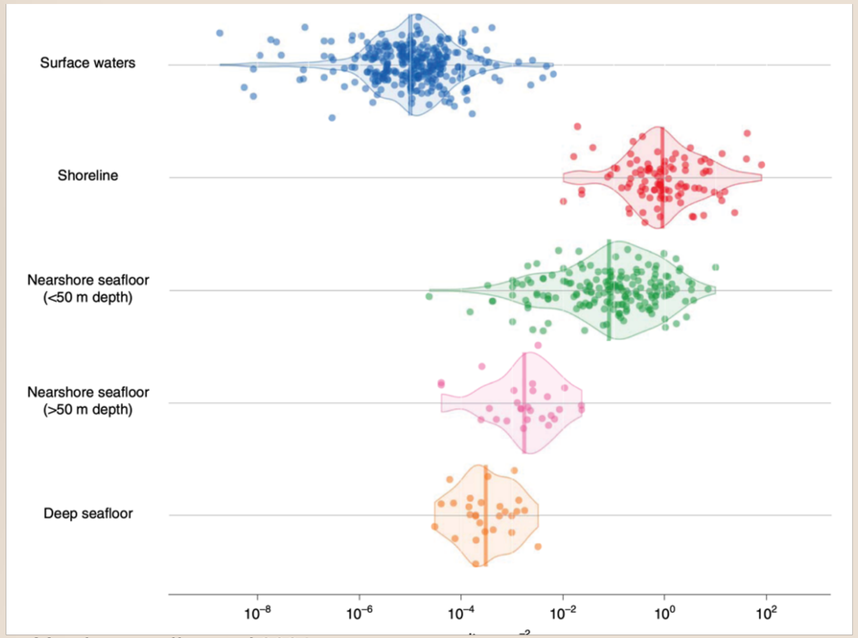
Jambeck et al. 2015

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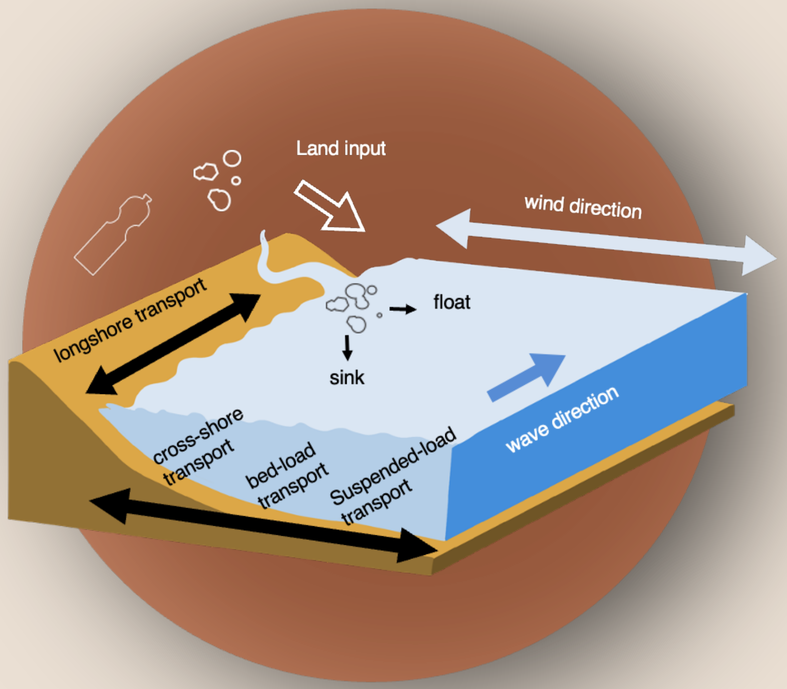
- Deposition within shore sediments

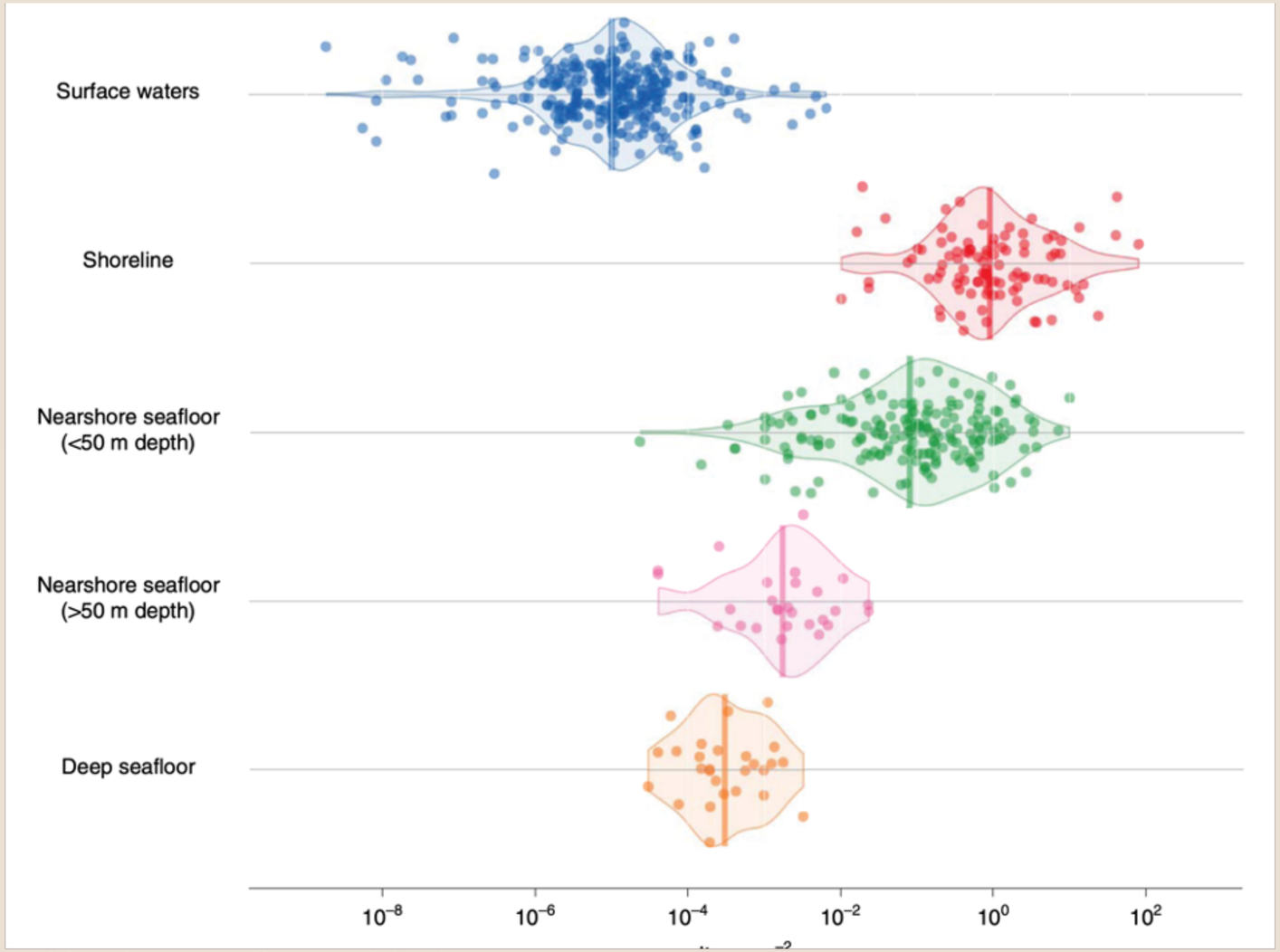


Morales-caselles et al 2021

2. Stato dell’arte: le plastiche in ambiente.

Conoscenze attuali, dati e preoccupazioni.





Morales-caselles et al 2021

2. Stato dell’arte: le plastiche in ambiente.

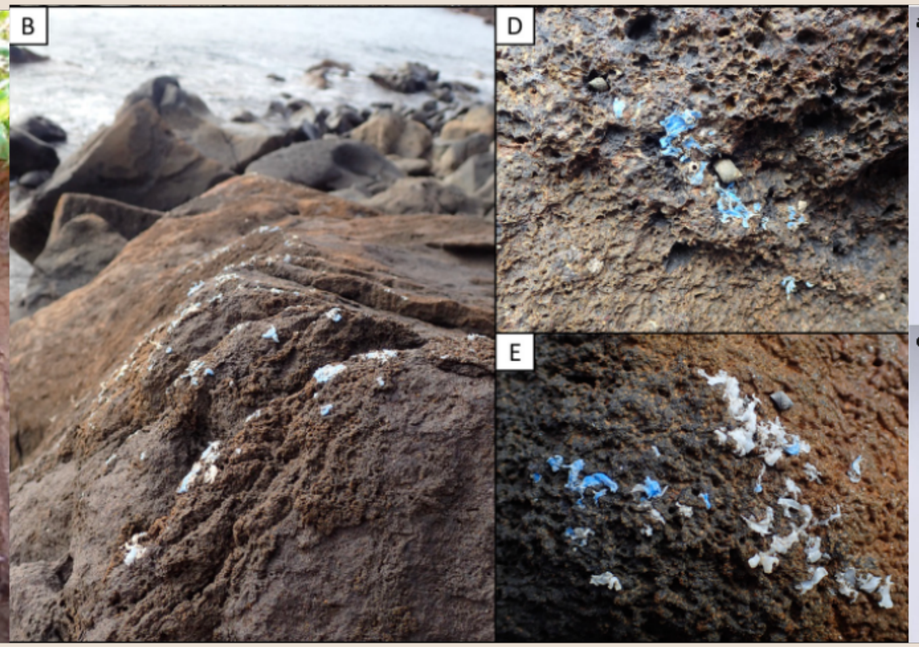
Conoscenze attuali, dati e preoccupazioni.

Anthropocene geological marker



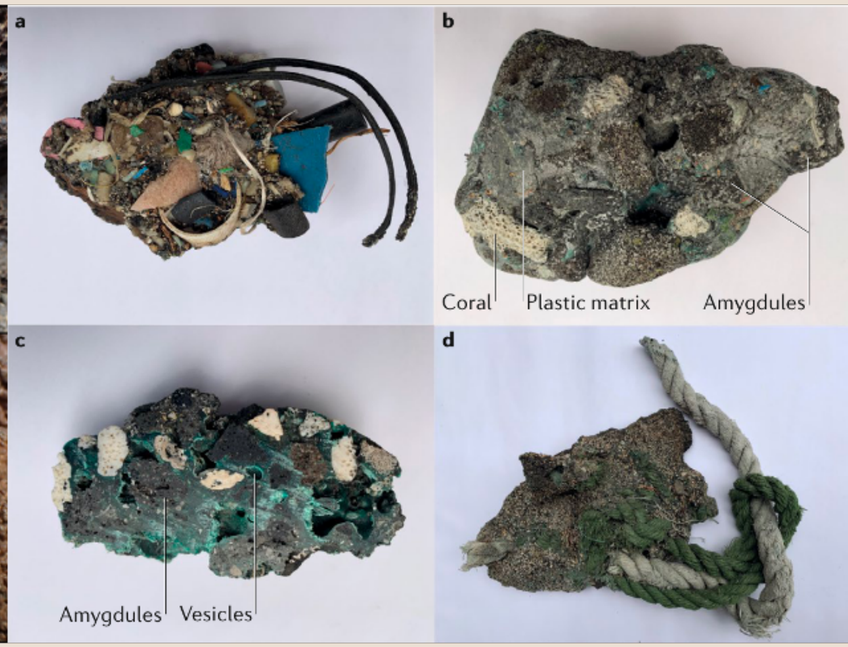
Zalasiewicz et al. 2016

‘Plasticrust’



Gestoso et al. 2019

‘Plastiglomerate’



Corcoran & Jazvac 2020

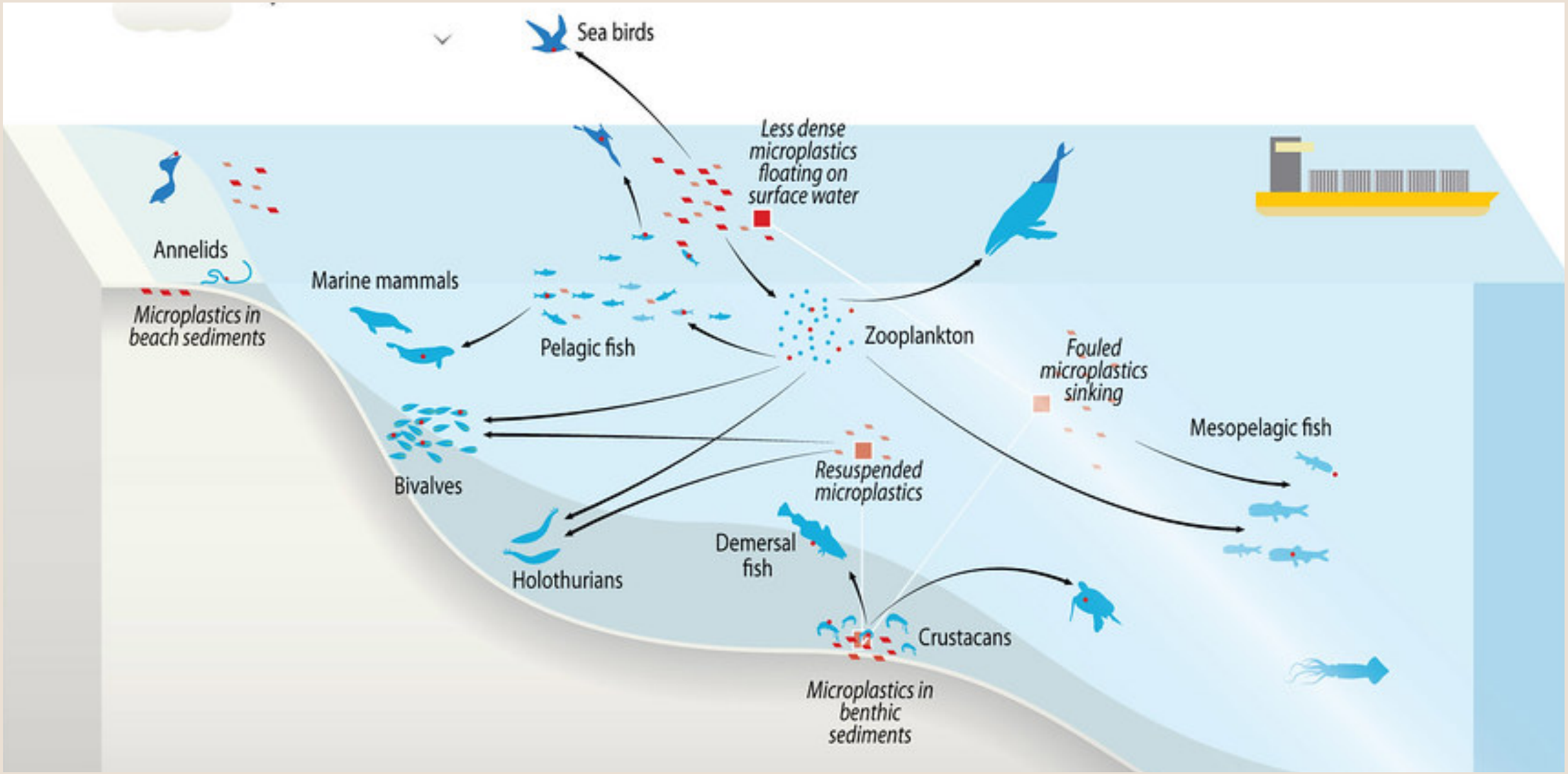
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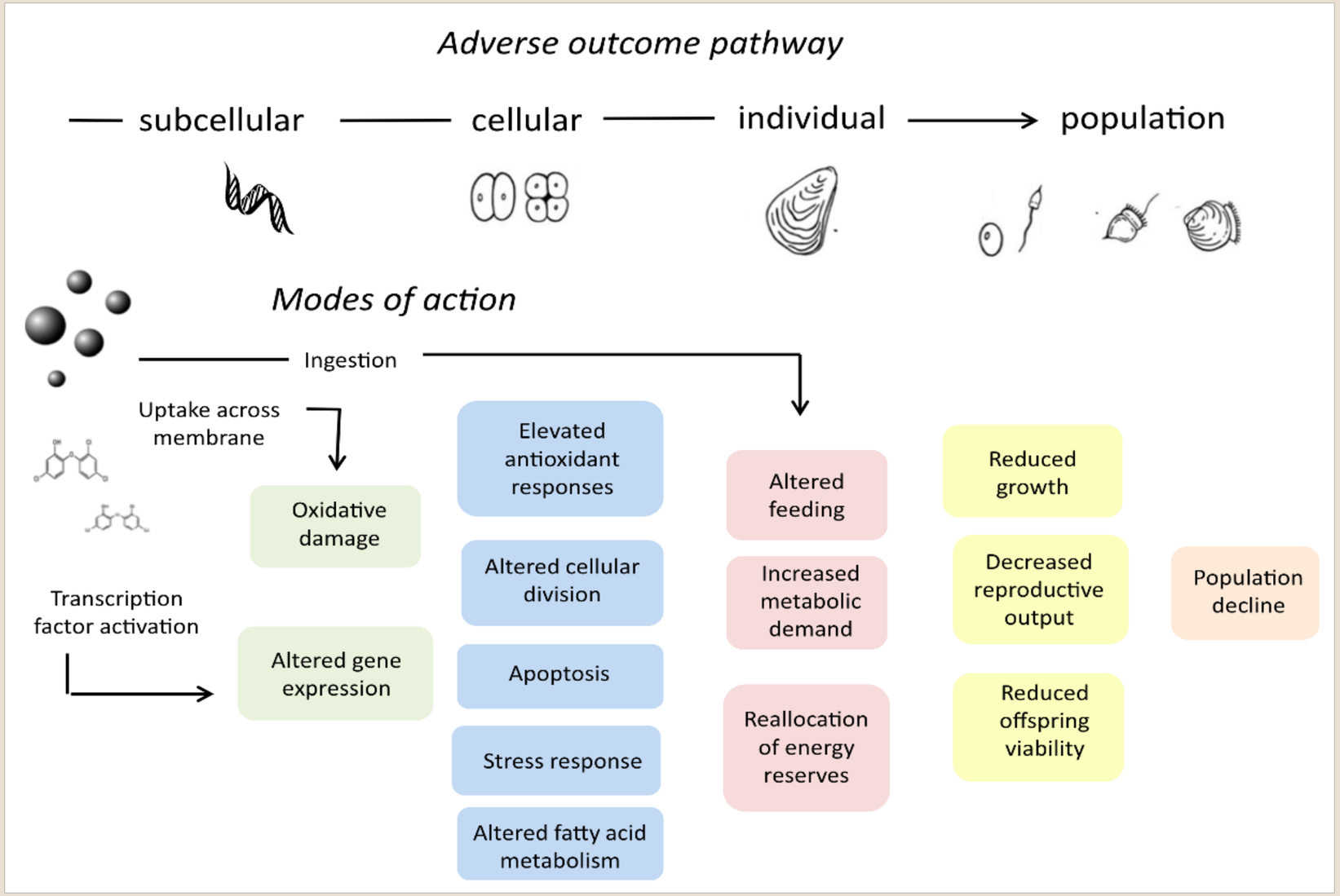
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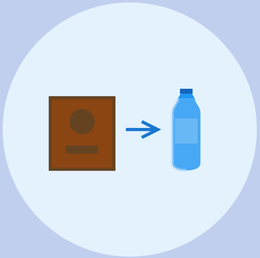


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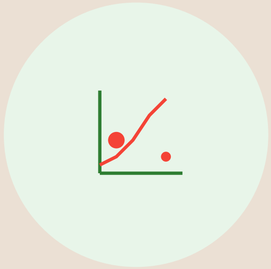


Galloway et al. 2016



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3. La nostra ricerca:

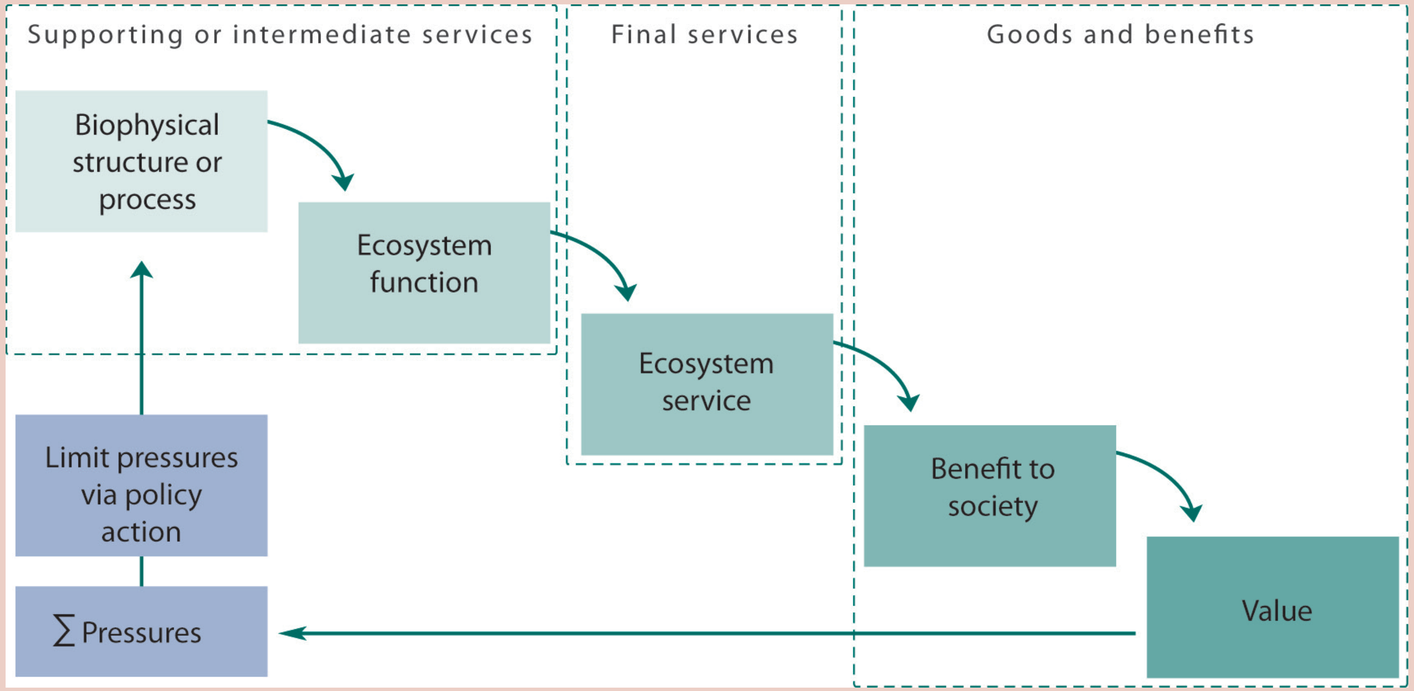
Microplastiche negli habitat creati da bio-costruttori marini.

3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.

Servizi ecosistemici:





De Valck et al., 2023

3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.

I servizi ecosistemici dipendono spesso da ingegneri ecosistemici







3. La nostra ricerca:

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La creazione di protezioni agglutinate avviene tramite la raccolta di particelle di sedimento dall'ambiente.

È una caratteristica diffusa in diversi fila:

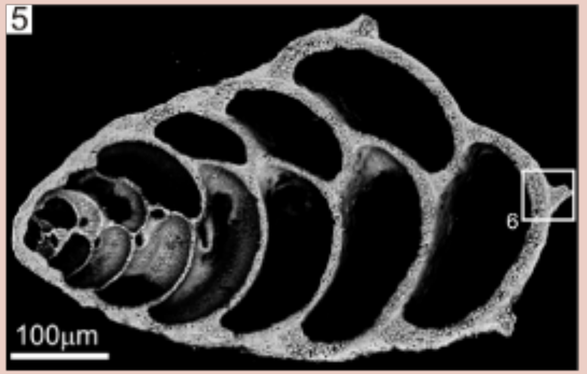
Marine worms (Polychaete)



Trichopteran (insects)



Foraminifera (Protista)



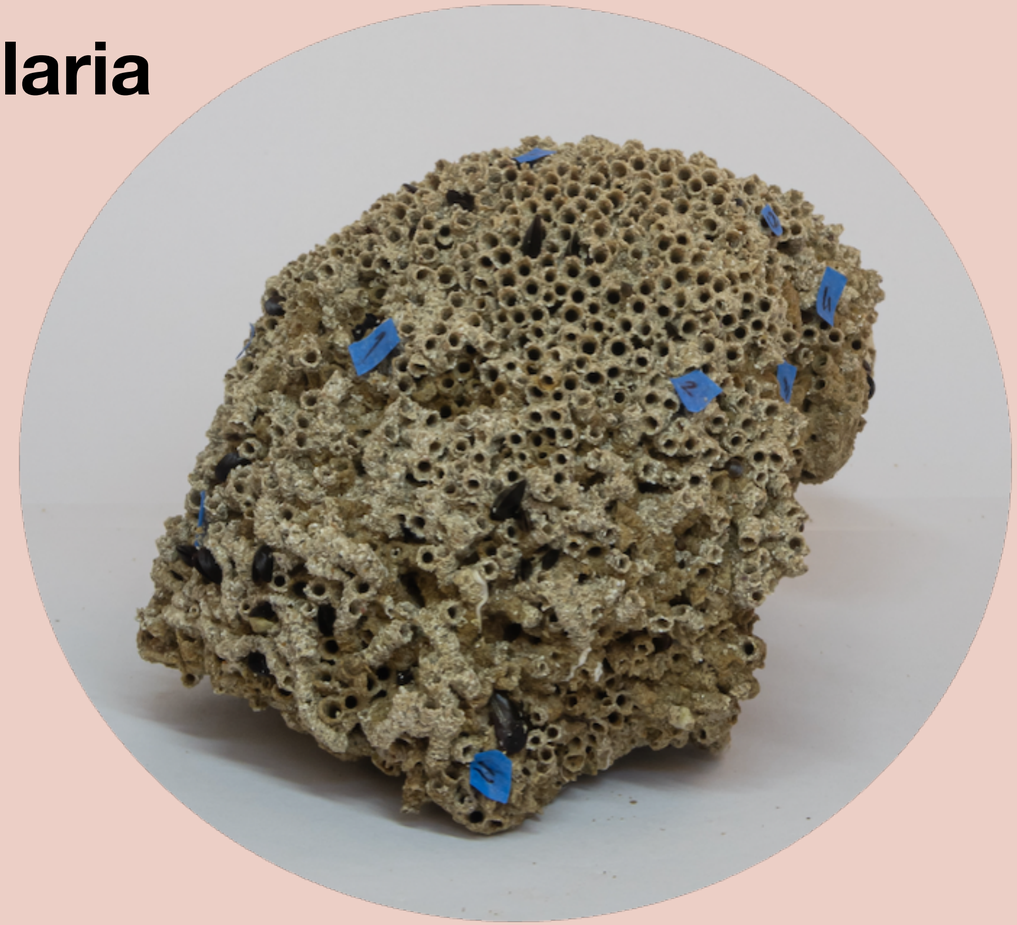
Mancin et al 2022

3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.

Genere: Sabellaria





Bioconstructions result from the activity of reef-builders: benthic colonial sessile organisms.

Sabellariids builds bioconstructions formed by a myriad of arenaceous packed tubes made up of sand particles mobilized from waves.

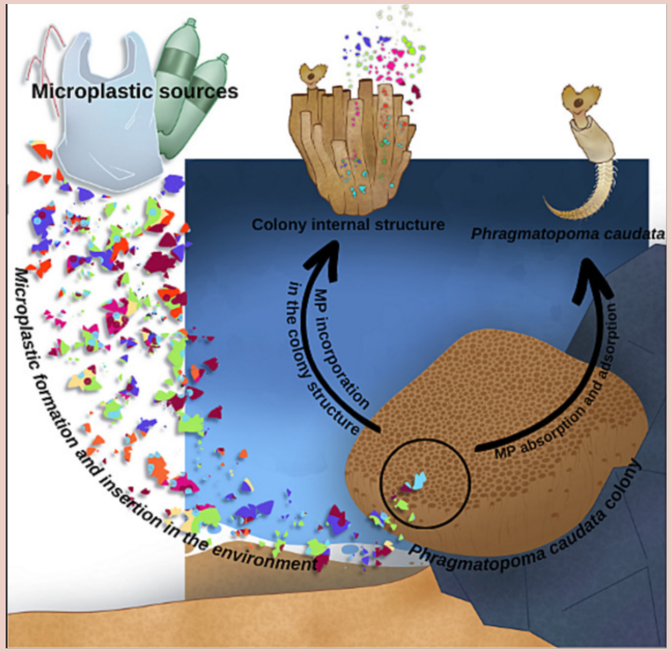


- Sustaining biodiversity
- Protecting from coastal erosion

3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.

‘Plasticagglutinated’ reefs by the sedentary polychaete *Sabellaria spinulosa* (Leuckart 1849) in the Adriatic Sea: Microplastic uptake, accumulation and associated risk.



da Costa et al (2021, 2023).

Does this structures accumulate microplastics?

3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.

1. Quantificazione in ambiente

2. Esperimenti in laboratorio → 3.1 Effetti sui singoli vermi

+

3.2 Effetti sul processo biocostruttivo

3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.



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Campione di biocostruzione

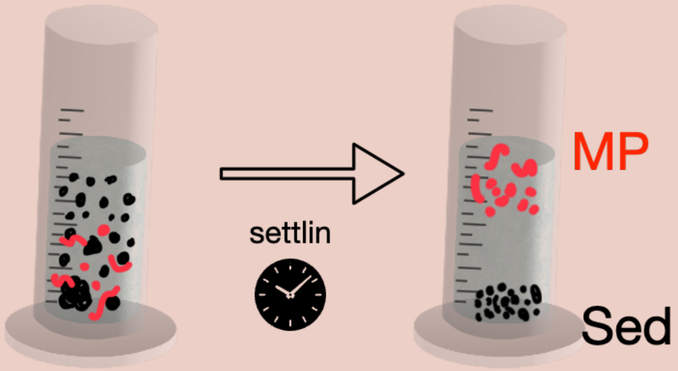
Approccio comparativo

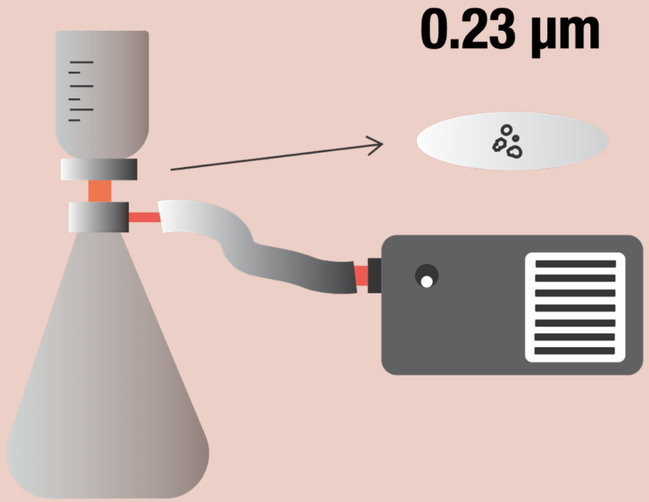


Campione di Sedimento

3. La nostra ricerca:

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QUANTITATIVE



- Size
- Color
- Physical response
- Morphology
- Fluorescence (395nm)

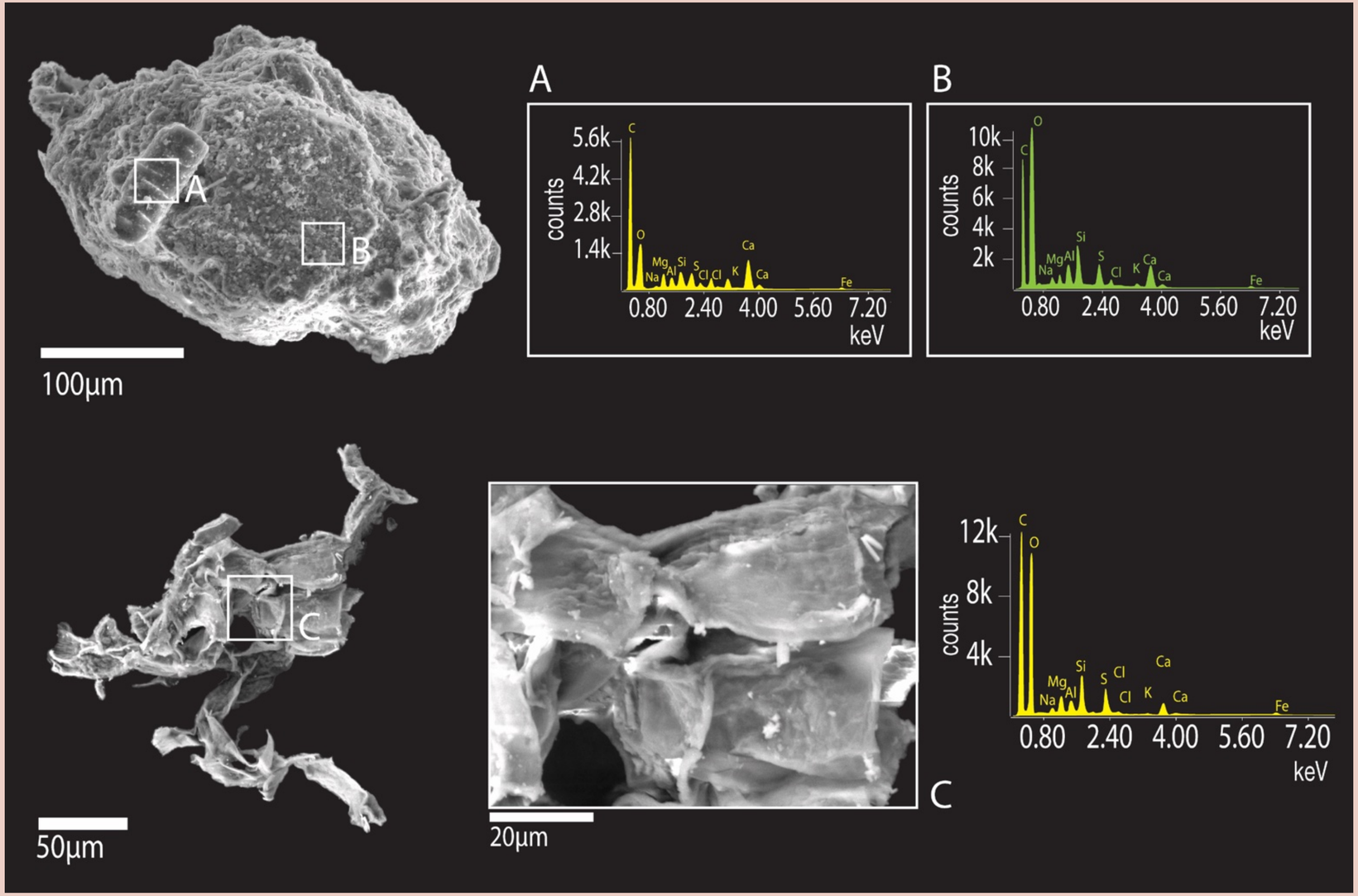
QUALITATIVE



- Particle type
- Polymer identification
- Additives and co-polymers

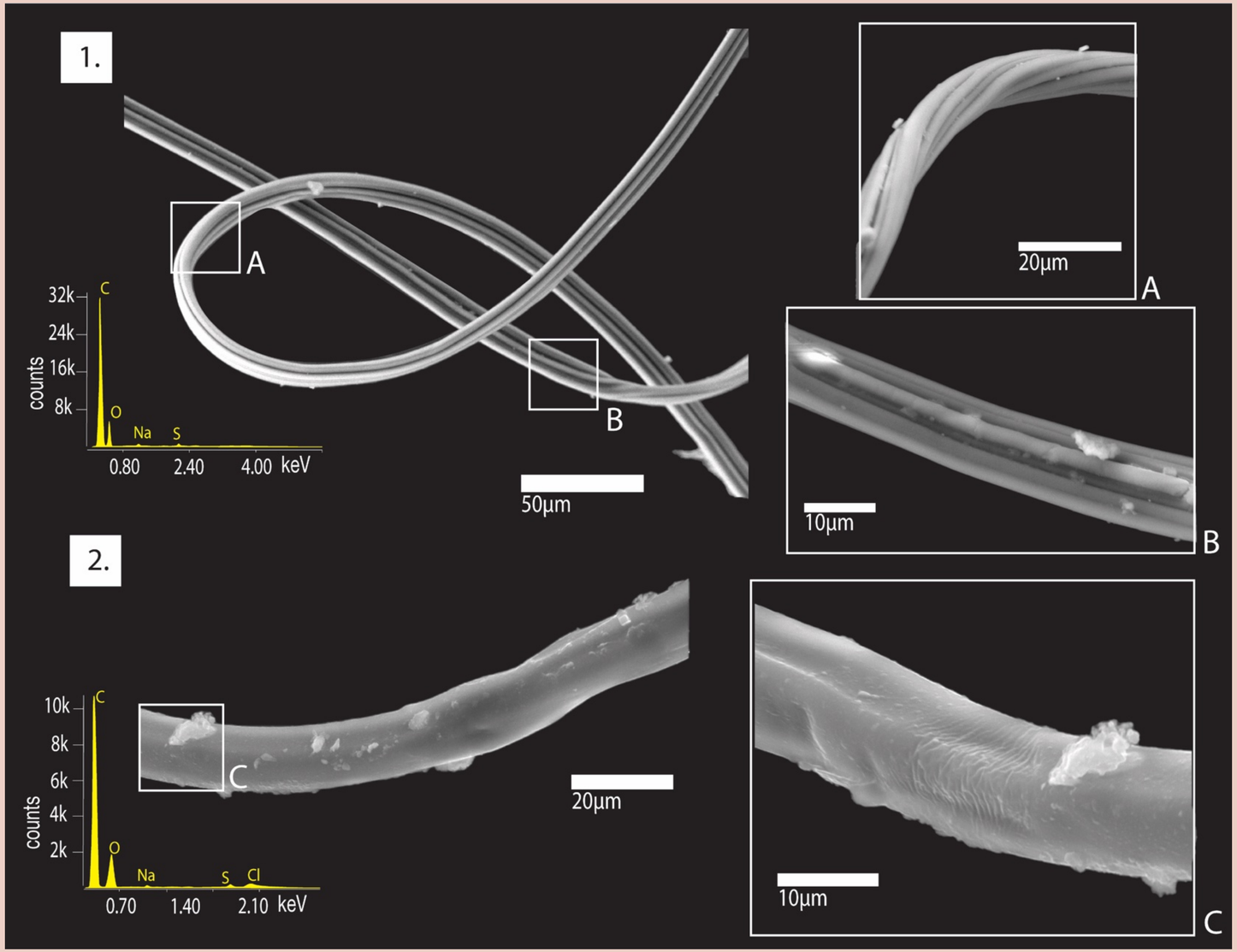
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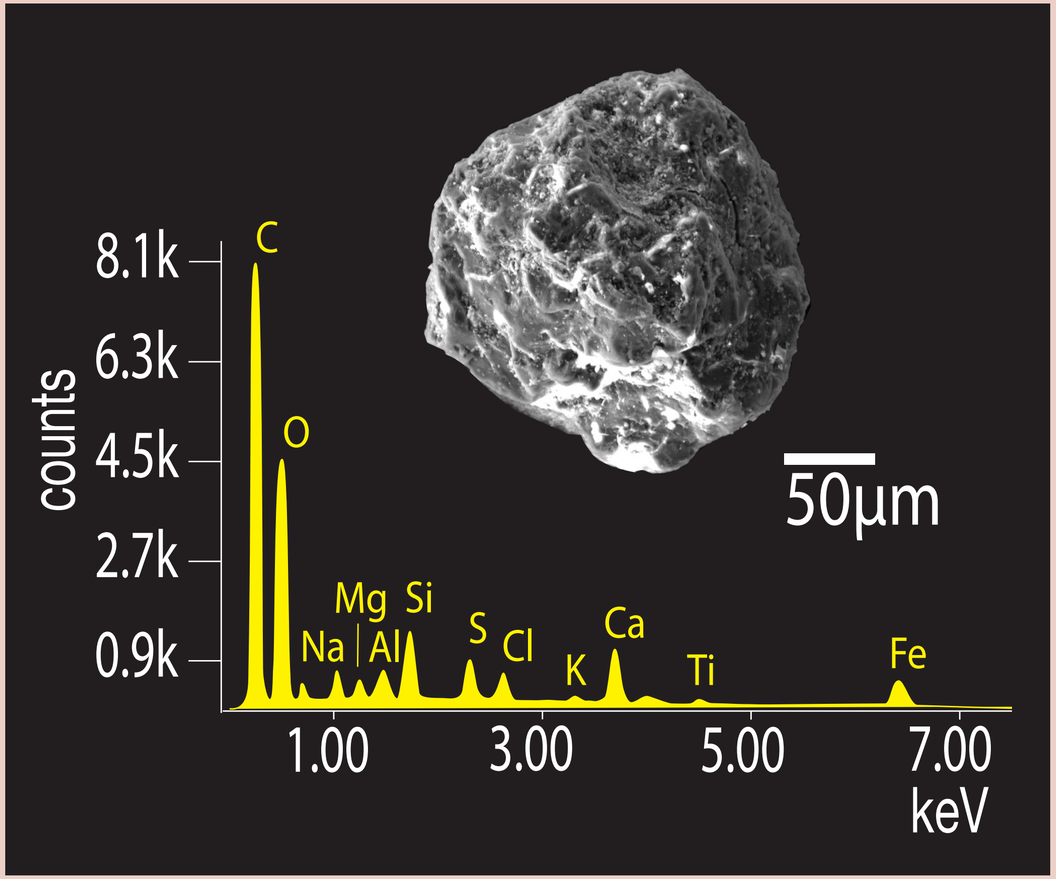
Microplastiche negli habitat creati da bio-costruttori marini.



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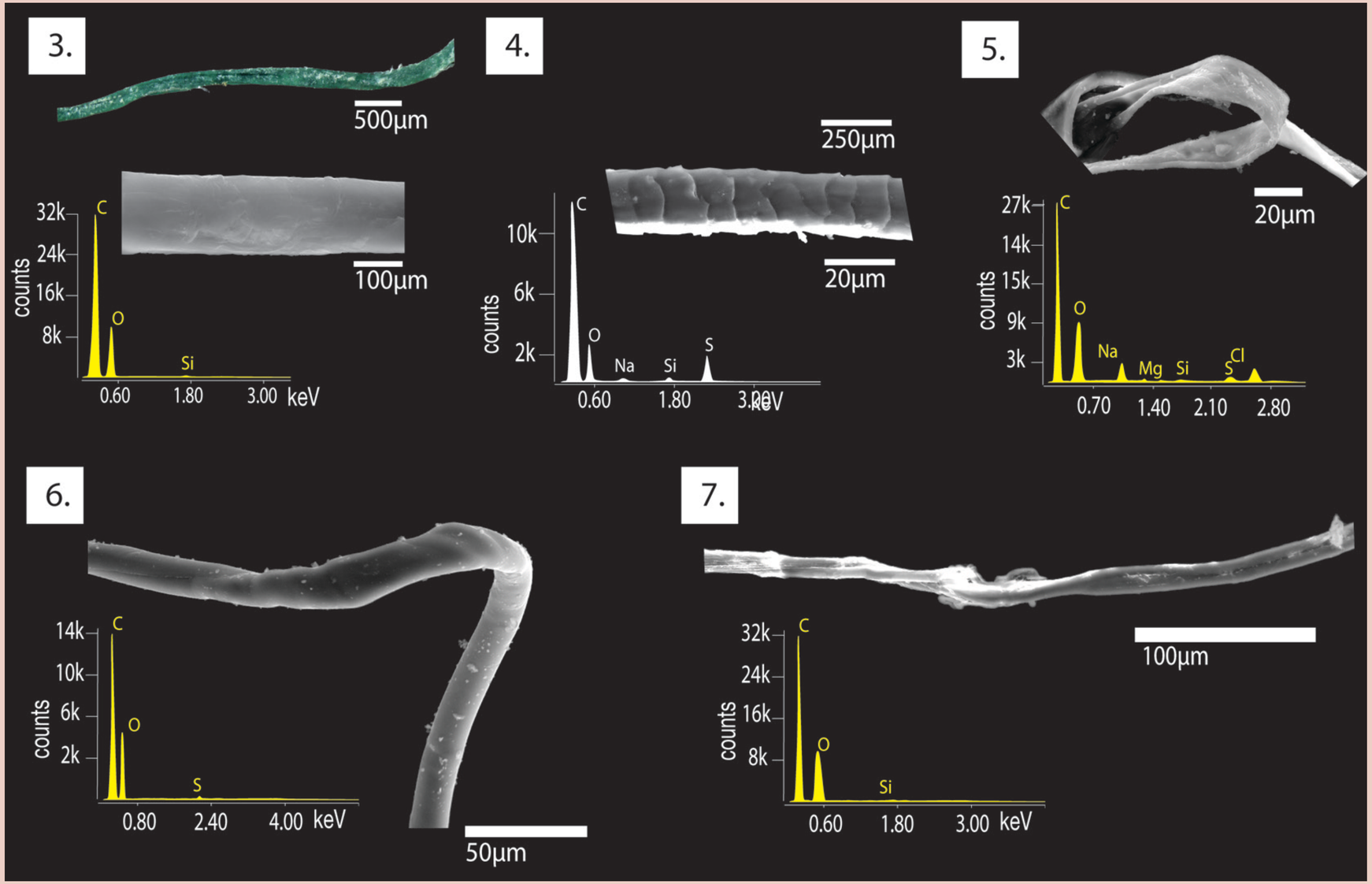
Microplastiche negli habitat creati da bio-costruttori marini.





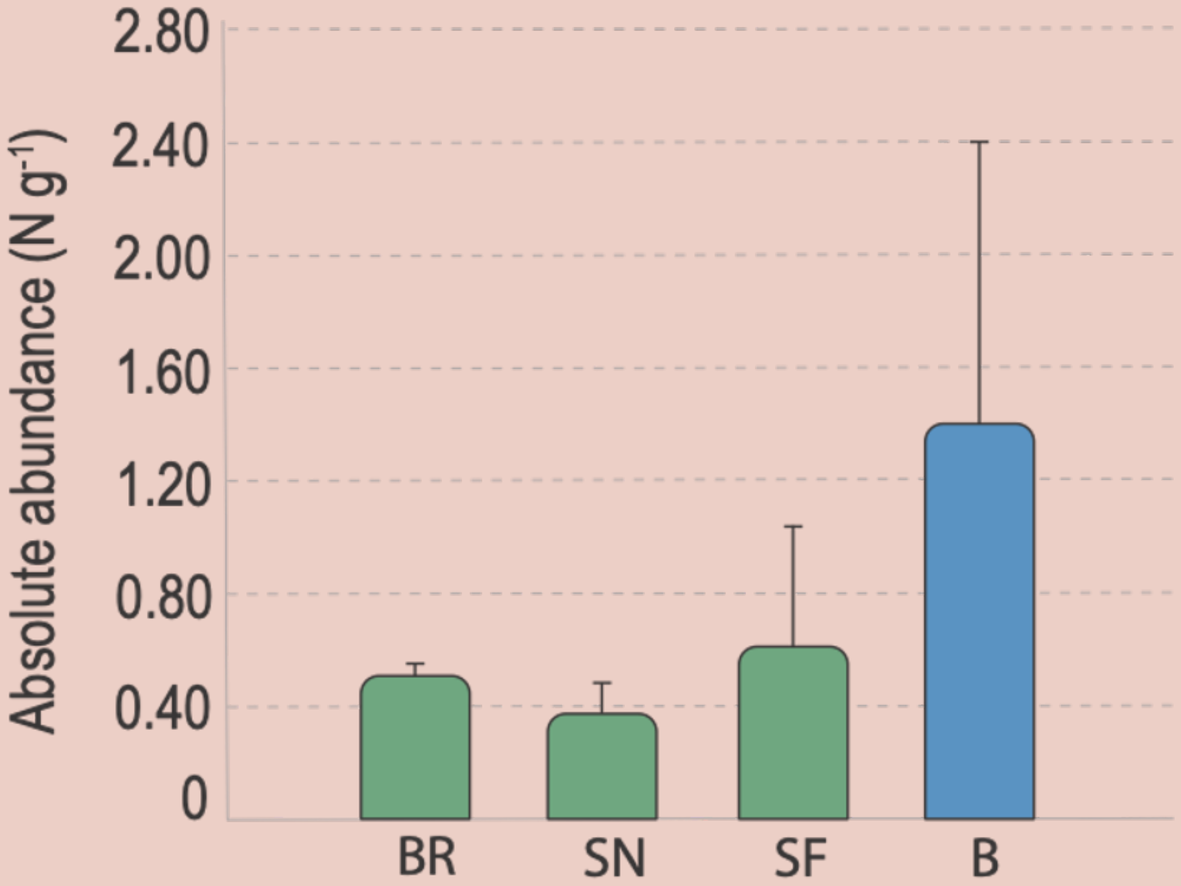
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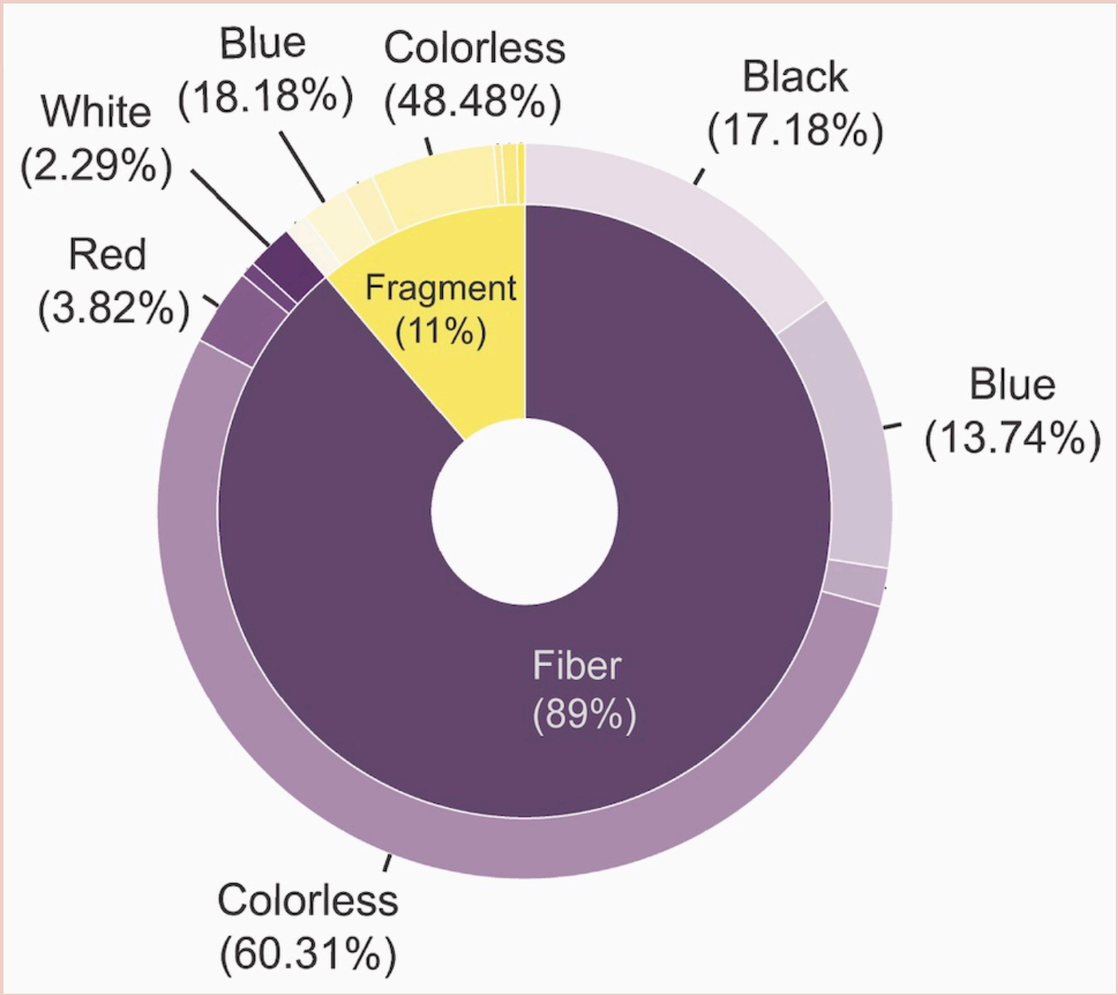
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Microplastiche negli habitat creati da bio-costruttori marini.

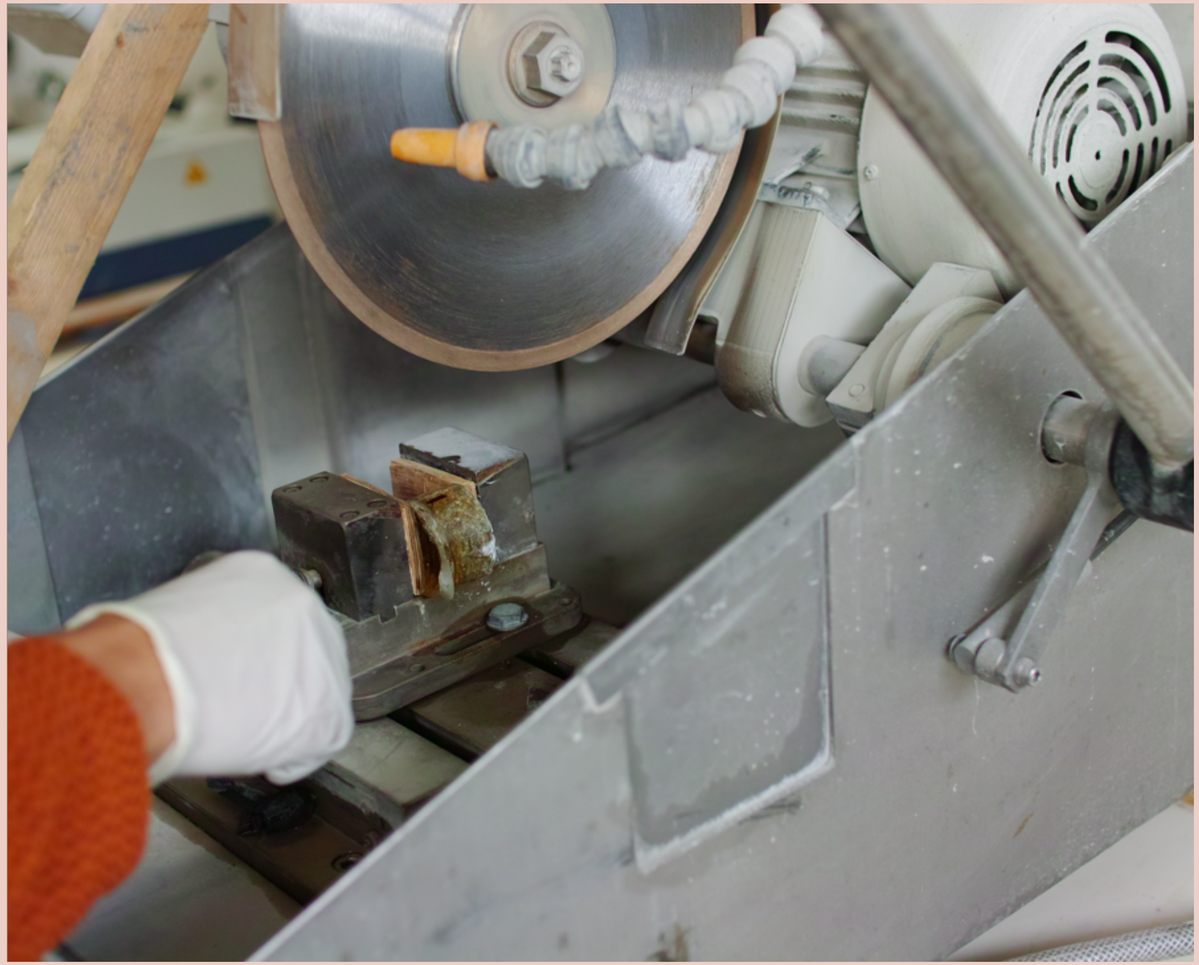




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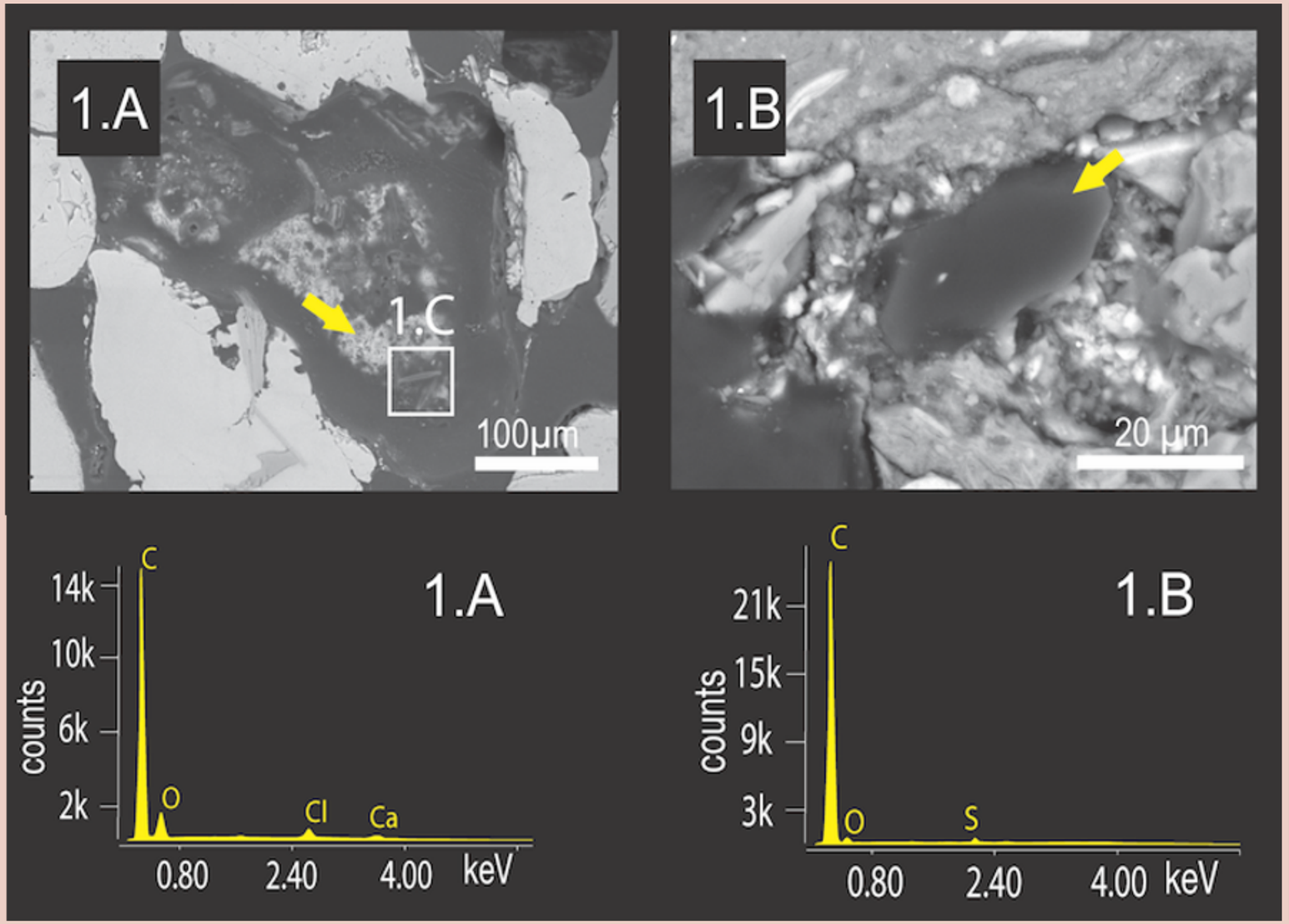
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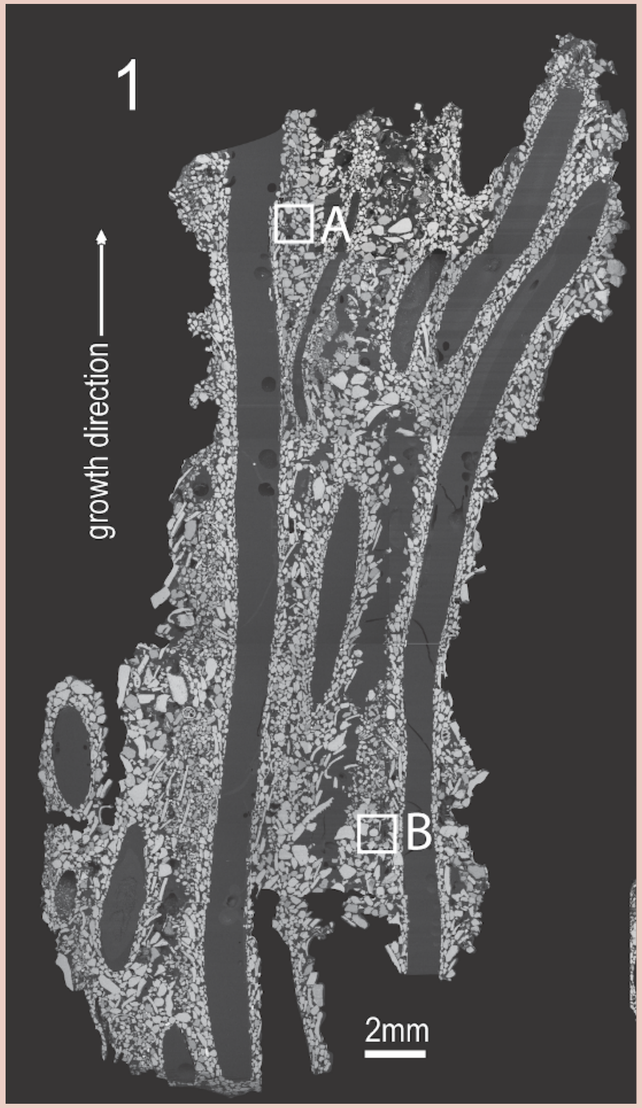




3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.





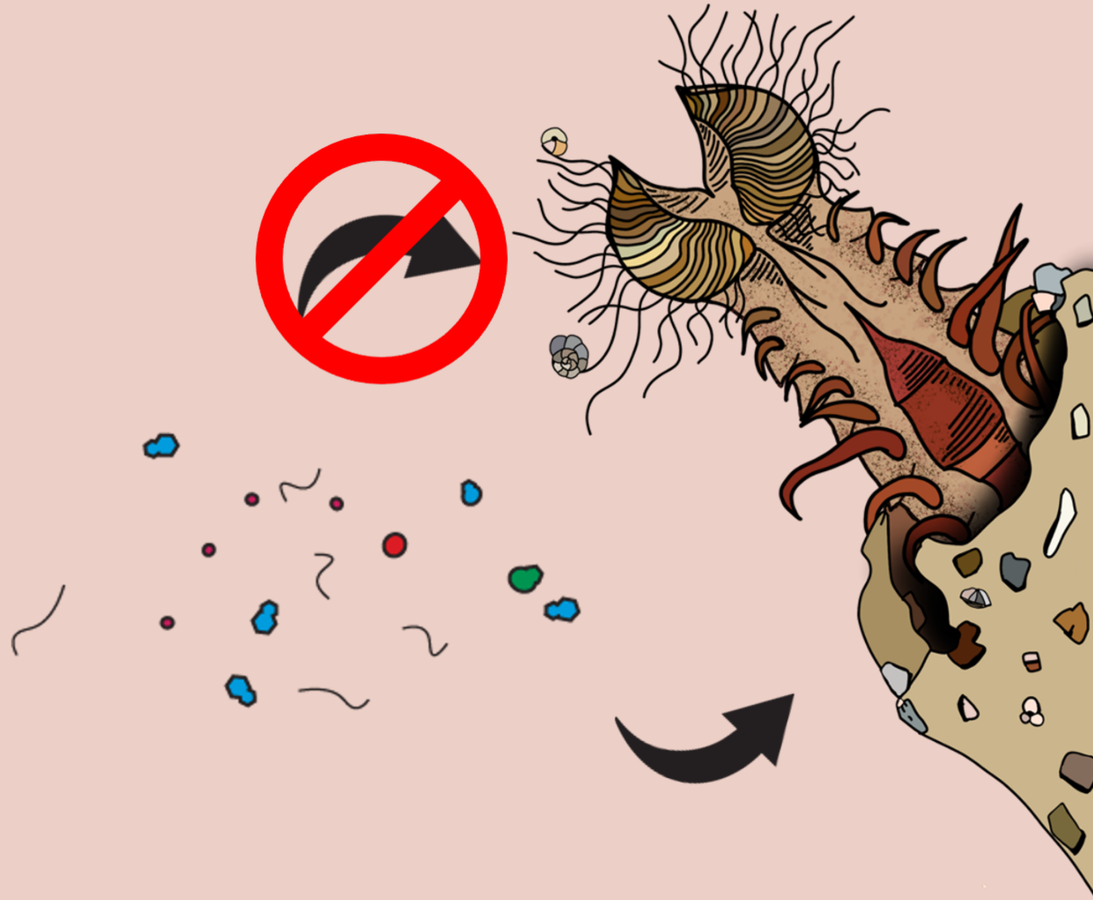
3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.

- Le microplastiche sono ritrovate nella biocostruzione in abbondanze paragonabili o maggiori al sedimento.

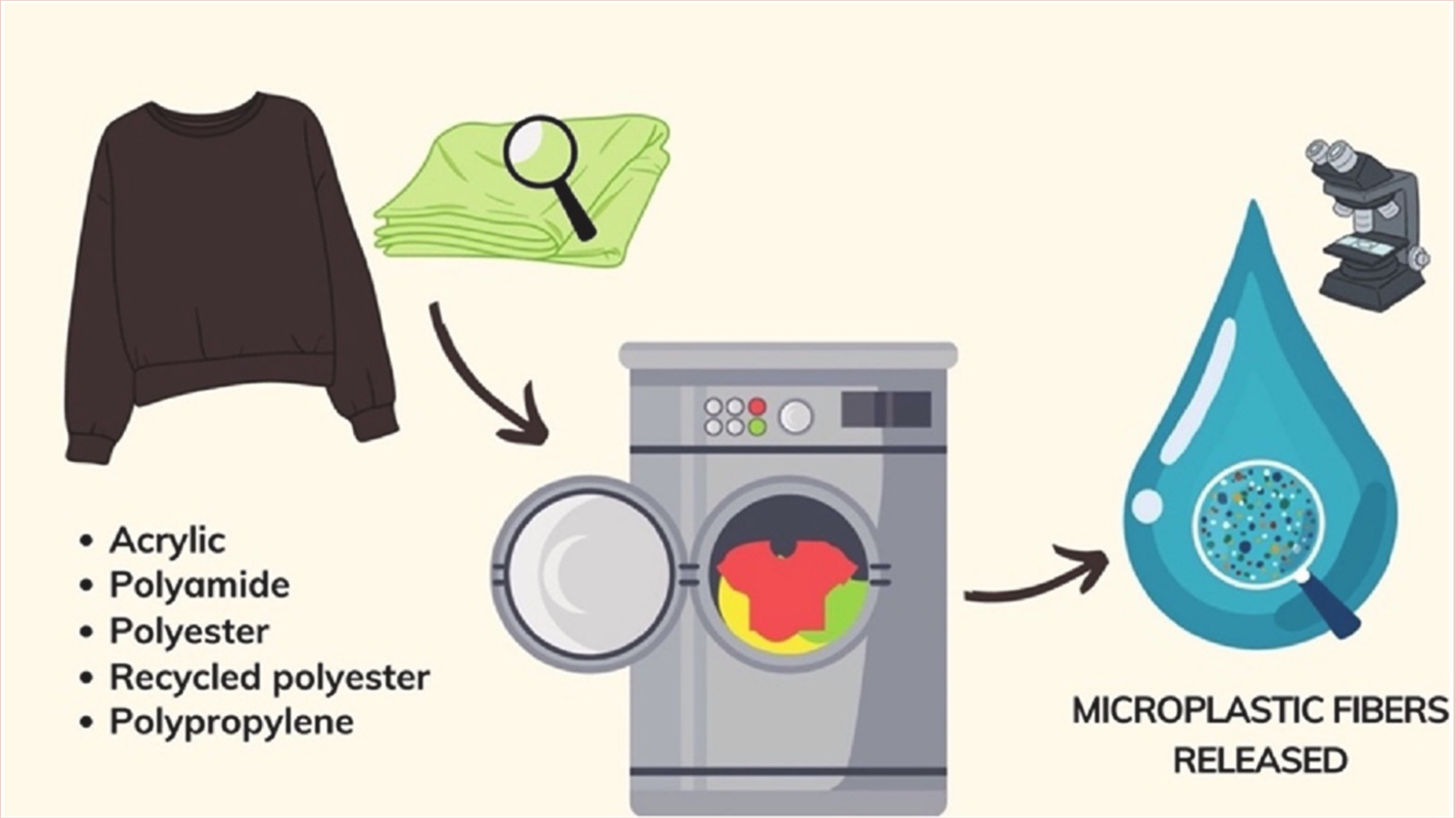
- Le microplastiche che troviamo sono principalmente fibre.

- L’accumulo avviene nello spazio tra un tubo ed un altro.



3. La nostra ricerca:

Microplastiche negli habitat creati da bio-costruttori marini.



3. La nostra ricerca:

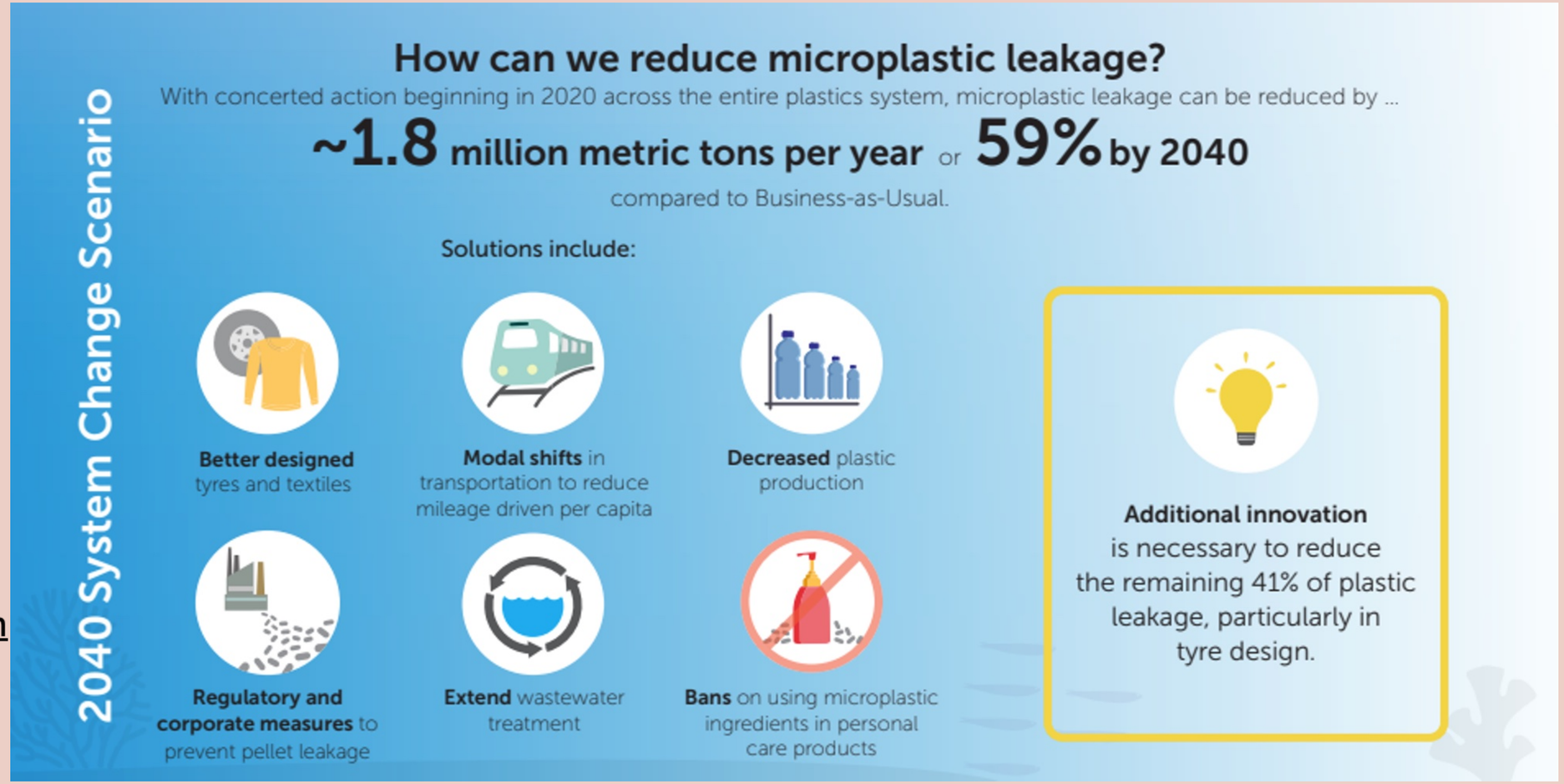
Microplastiche negli habitat creati da bio-costruttori marini.

- Is there an effect on bioconstructions integrity?

- What are possible consequence for this habitat?

Potential solution to the plastic crisis?

On 12 May 2021, the European Commission adopted the EU Action Plan: "Towards a Zero Pollution for Air, Water and Soil"



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MICRO-PLASTICHE

MACRO-PROBLEMI



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Grazie!

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