MARINE PLASTISPHERE

HITCHHIKERS AND THEIR LUGGAGE

DR JOÃO FRIAS

Photos by Maksym Kaharlytskyi and Giulia Carbonaro

Ollscoil Teicneolaíochta an Atlantaigh
Atlantic Technological University

MARINE AND FRESHWATER RESEARCH CENTRE
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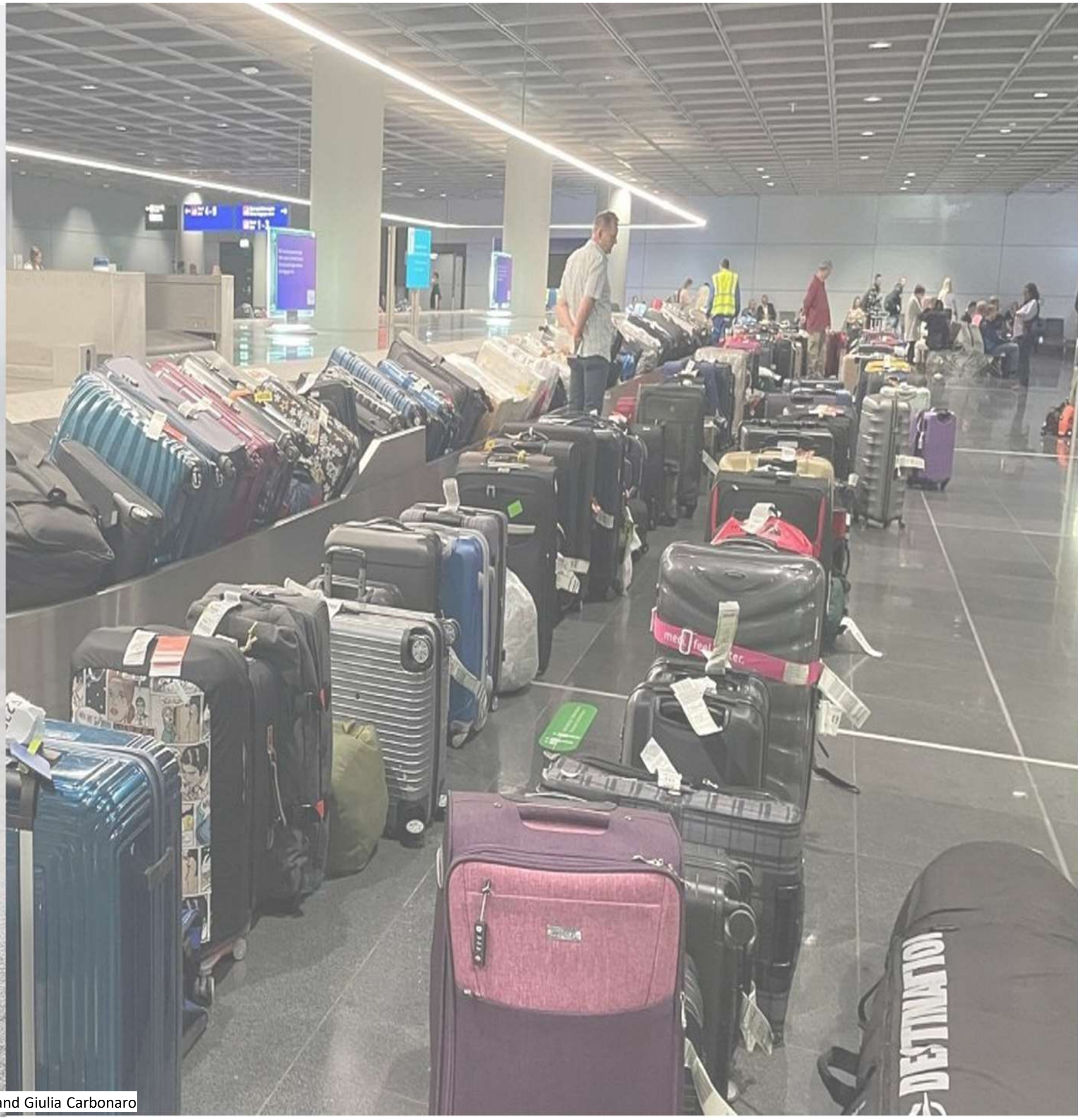

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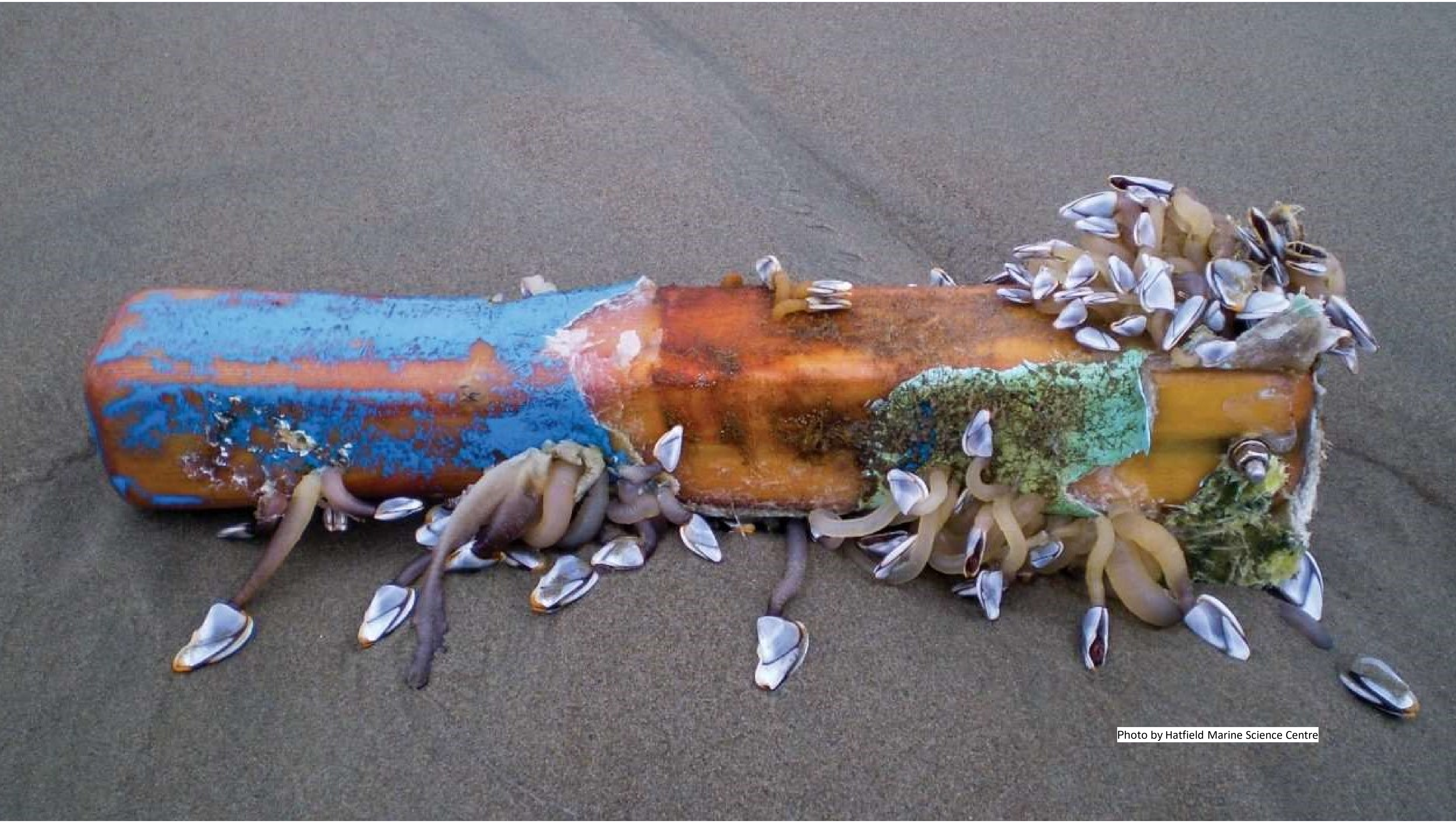
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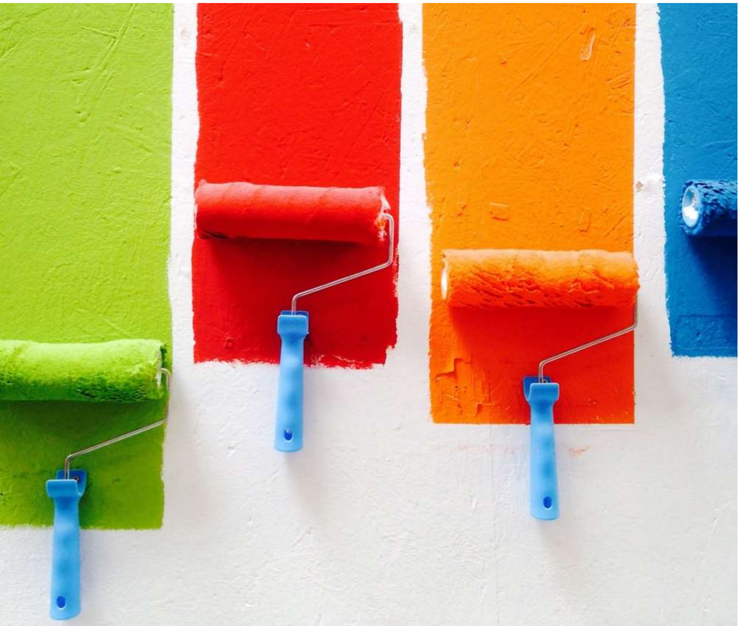
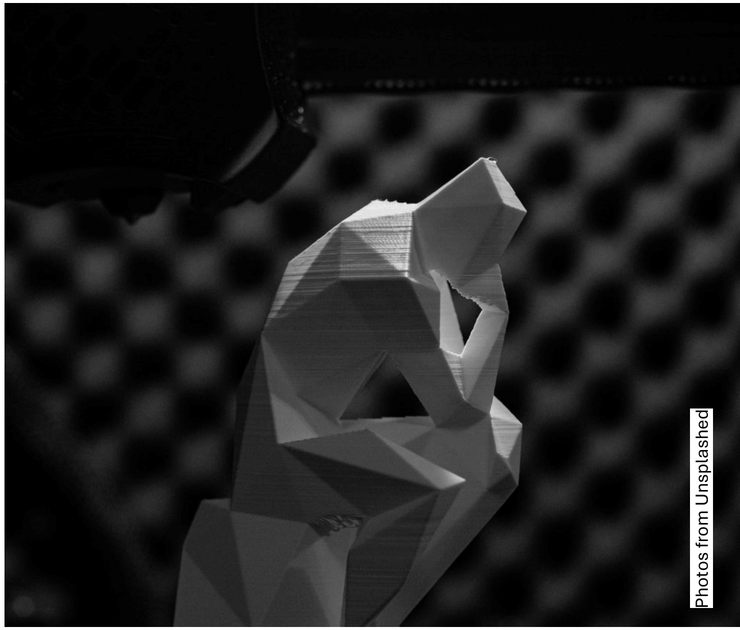




Photos from Unsplashed

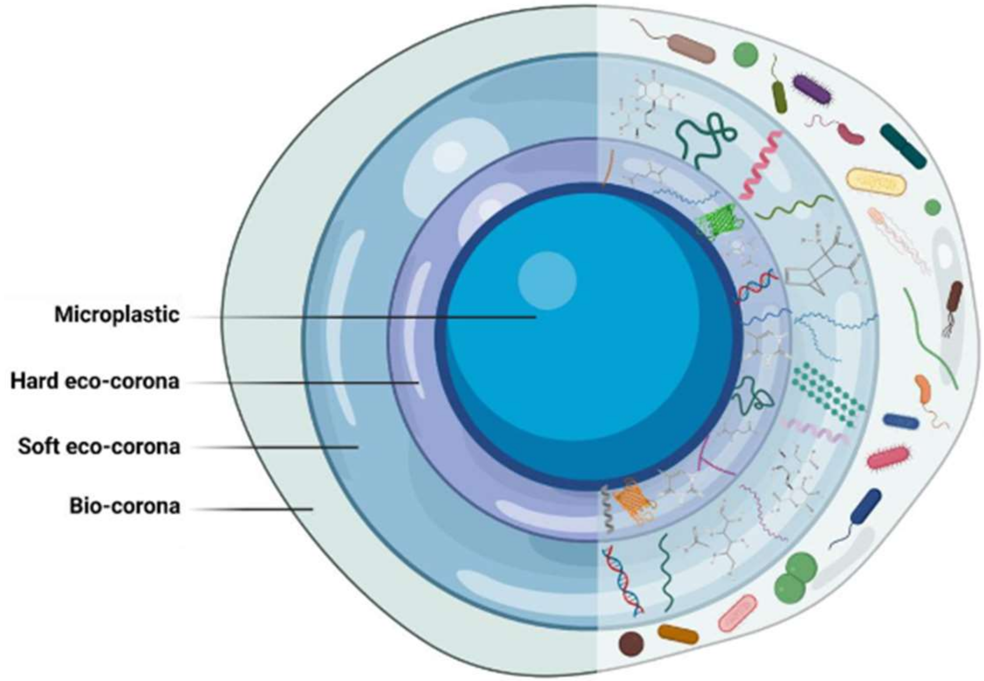

Essential

Non-
essential
TRIP
HÖRMANN

Understanding the bigger picture

Chris Jordan, 2009. Image depicts 2.4 million pieces of plastic, equal to the estimated number of pounds of plastic pollution that enter the world's oceans every hour. All the plastics in this image were collected from the Pacific Ocean.

OUTLINE



Tom de Kanter, 2022
https://doi.org/10.13140/RG.2.2.34896.99846

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PERSPECTIVES FOR FUTURE WORK IN RESEARCH AND POLICY

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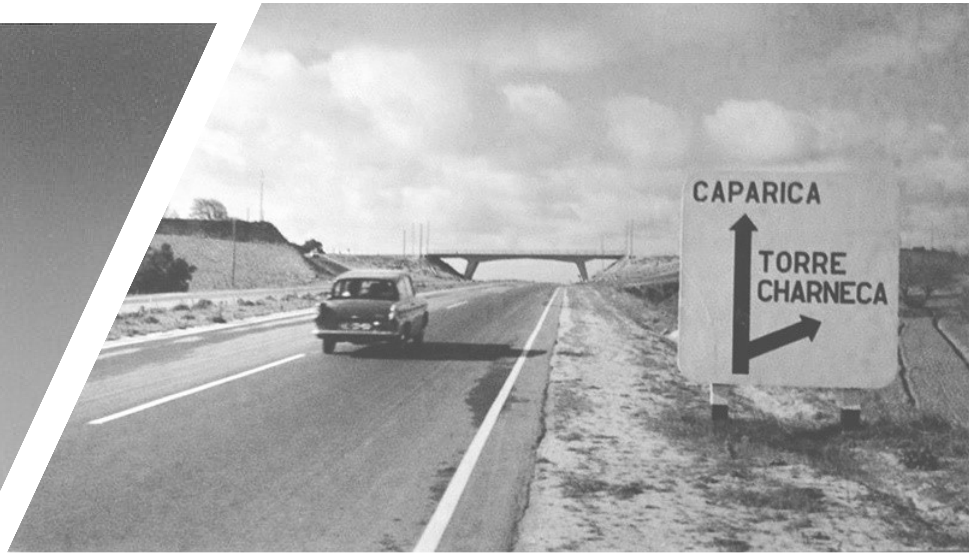
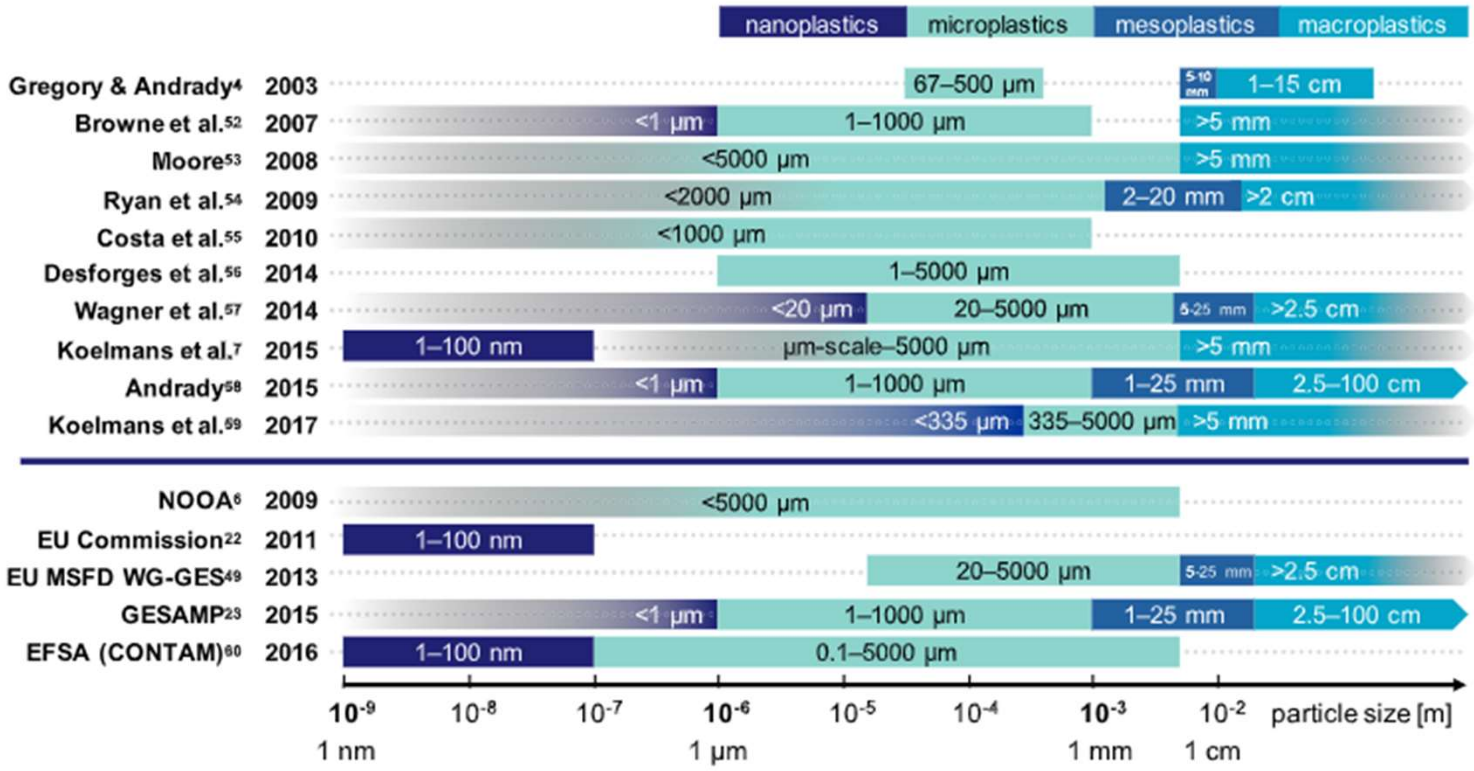
MY DIVE INTO PLASTICS



MY DIVE INTO PLASTICS

CONCEPTS

MICROPLASTICS



Hartmann et al., 2019
https://doi.org/10.1021/acs.est.8b05297

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Are We Speaking the Same Language? Recommendations for a Definition and Categorization Framework for Plastic Debris

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BACK

CLOSE WINDOW

CONCEPTS

MICROPLASTICS

FIRST COINED BY PROF. RICHARD THOMPSON IN A 2004 PUBLICATION ADDRESSING THE PLASTIC BALANCE IN THE OCEAN, DESCRIBING **MICROSCOPIC PIECES OF PLASTIC** IN MARINE SEDIMENTS AND IN THE WATER COLUMN.

Thompson et al., 2004
https://doi.org/10.1126/science.1094559

BREVIA

Lost at Sea: Where Is All the Plastic?

Richard C. Thompson,[1*] Ylva Olsen,[1] Richard P. Mitchell,[1] Anthony Davis,[1] Steven J. Rowland,[1] Anthony W. G. John,[2] Daniel McGonigle,[3] Andrea E. Russell[3]

Millions of metric tons of plastic are produced annually. Countless large items of plastic debris are accumulating in marine habitats worldwide and may persist for centuries (1–4). Here we show that microscopic plastic fragments and fibers (Fig. 1A) are also widespread in the oceans and have accumulated in the pelagic zone and sedimentary habitats. The fragments appear to have resulted from degradation of larger items. Plastics of this size are ingested by marine organisms, but the environmental consequences of this contamination are still unknown.

Over the past 40 years, large items of plastic debris have frequently been recorded in habitats from the poles to the equator (1–4). Smaller fragments, probably also plastic, have been reported (5) but have received far less attention. Most plastics are resistant to biodegradation, but will break down gradually through mechanical action (6). Many "biodegradable" plastics are composites with materials such as starch that biodegrade, leaving behind numerous, nondegradable, plastic fragments (6). Some cleaning agents also contain abrasive plastic fragments (2). Hence, there is considerable potential for large-scale accumulation of microscopic plastic debris.

To quantify the abundance of microplastics, we collected sediment from beaches and from estuarine and subtidal sediments around Plymouth, UK (Fig. 1B). Less dense particles were separated by flotation. Those that differed in appearance to natural particulate material (Fig. 1A) were removed and identified with Fourier Transform infrared (FT-IR) spectroscopy (7). Some were of natural origin and others could not be identified, but about one third were synthetic polymers (Fig. 1C). These polymers were present in most samples (23 out of 30), but were significantly more abundant in subtidal sediment (Fig. 1D). Nine polymers were conclusively identified: acrylic, alkyd, poly (ethylene:propylene), polyamide (nylon), polyester, polyethylene, polymethylacrylate, polypropylene, and polyvinyl-alcohol. These have a wide range of uses, including clothing, packaging, and rope, suggesting that the fragments resulted from the breakdown of larger items.

To assess the extent of contamination, a further 17 beaches were examined (Fig. 1B). Similar fibers were found, demonstrating that microscopic plastics are common in sedimentary habitats. To assess long-term trends in abundance, we examined plankton samples collected regularly since the 1960s along routes between Aberdeen and the Shetlands (315 km) and from Sule Skerry to Iceland (850 km) (7) (Fig. 1B). We found plastic archived among the plankton in samples back to the 1960s, but with a significant increase in abundance over time (Fig. 1E). We found similar types of polymer in the water column as in sediments, suggesting that polymer density was not a major factor influencing distribution.

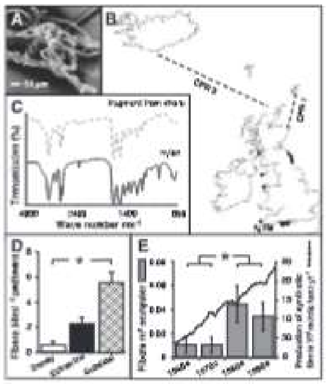

Fig. 1. (A) One of numerous fragments found among marine sediments and identified as plastic by FT-IR spectroscopy. (B) Sampling locations in the northeast Atlantic. Six sites near Plymouth (□) were used to compare the abundance of microplastic among habitats. Similar fragments (●) were found on other shores. Routes sampled by Continuous Plankton Recorder (CPR 1 and 2) were used to assess changes in microplastic abundance since 1960. (C) FT-IR spectra of a microscopic fragment matched that of nylon. (D) Microplastics were more abundant in subtidal habitats than on sandy beaches (*, $F_{2,3} = 13.26$, $P < 0.05$), but abundance was consistent among sites within habitat types. (E) Microscopic plastic in CPR samples revealed a significant increase in abundance when samples from the 1960s and 1970s were compared to those from the 1980s and 1990s (*, $F_{3,3} = 14.42$, $P < 0.05$). Approximate global production of synthetic fibers is overlain for comparison. Microplastics were also less abundant along oceanic route CPR 1 than along CPR 2 ($F_{1,24} = 5.18$, $P < 0.05$).

It was only possible to quantify fragments that differed in appearance from sediment grains or plankton. Some fragments were granular, but most were fibrous, ~20 μm in diameter, and brightly colored. We believe that these probably represent only a small proportion of the microscopic plastic in the environment, and methods are now needed to quantify the full spectrum of material present. The consequences of this contamination are yet to be established. Large plastic items can cause suffocation and entanglement and disrupt digestion in birds, fish, and mammals (3). To determine the potential for microscopic plastics to be ingested, we kept amphipods (detritivores), lugworms (deposit feeders), and barnacles (filter feeders) in aquaria with small quantities of microscopic plastics. All three species ingested plastics within a few days (7) (fig. S1).

Our findings demonstrate the broad spatial extent and accumulation of this type of contamination. Given the rapid increase in plastic production (Fig. 1E), the longevity of plastic, and the disposable nature of plastic items (2, 3), this contamination is likely to increase. There is the potential for plastics to adsorb, release, and transport chemicals (3, 4). However, it remains to be shown whether toxic substances can pass from plastics to the food chain. More work is needed to establish whether there are any environmental consequences of this debris.

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5. J. B. Colton, F. D. Knapp, B. R. Burns, Science 185, 491 (1974).
6. P. P. Klemchuck, Polym. Degrad. Stab. 27, 183 (1990).
7. Materials and methods are available as supporting material on Science Online.
8. We thank C. Hoare, R. Ticehurst, G. Mardell, and F. Riverback for help with sample collection and analysis. Supported by the Leverhulme Trust, UK.

Supporting Online Material
www.sciencemag.org/cgi/content/full/304/5672/838/DC1
Materials and Methods
Fig. S1
References and Notes

10 December 2003; accepted 10 February 2004

[1]University of Plymouth, PL4 8AA, UK. [2]Sir Alister Hardy Foundation for Ocean Science, Plymouth, PL1 2PB, UK. [3]University of Southampton, SO17 1BJ, UK.

*To whom correspondence should be addressed. E-mail: rcthompson@plymouth.ac.uk

CONCEPTS

MICROPLASTICS

THE CONCEPT WAS FURTHER EXPANDED IN 2009, WITH A PUBLICATION OF A REPORT FROM THE NOAA MARINE DEBRIS PROGRAMME, WHERE AN **UPPER LIMIT** TO THE TERM WAS USED, AND **MICROPLASTICS** WERE KNOWN AS "**PLASTIC PARTICLES SMALLER THAN 5 MM**".

Arthur et al., 2009
https://marinedebris.noaa.gov/microplastics/proceedings-second-research-workshop-microplastic-marine-debris

CONCEPTS

MICROPLASTICS

Marine Pollution Bulletin 62 (2011) 2588–2597

Contents lists available at SciVerse ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Review

Microplastics as contaminants in the marine environment: A review

Matthew Cole [a,*], Pennie Lindeque [a], Claudia Halsband [b], Tamara S. Galloway [c]

[a] Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth PL1 3DH, UK
[b] Akvaplan-niva AS, FRAM – High North Research Centre for Climate and the Environment, N-9296 Tromsø, Norway
[c] College of Life and Environmental Sciences: Biosciences, Hatherly Laboratories, University of Exeter, Prince of Wales Road, Exeter EX4 4PS, UK

ARTICLE INFO

Keywords:
Microplastics
Marine litter
Plastic debris
Priority pollutant

ABSTRACT

Since the mass production of plastics began in the 1940s, microplastic contamination of the marine environment has been a growing problem. Here, a review of the literature has been conducted with the following objectives: (1) to summarise the properties, nomenclature and sources of microplastics; (2) to discuss the routes by which microplastics enter the marine environment; (3) to evaluate the methods by which microplastics are detected in the marine environment; (4) to assess spatial and temporal trends of microplastic abundance; and (5) to discuss the environmental impact of microplastics. Microplastics are both abundant and widespread within the marine environment, found in their highest concentrations along coastlines and within mid-ocean gyres. Ingestion of microplastics has been demonstrated in a range of marine organisms, a process which may facilitate the transfer of chemical additives or hydrophobic waterborne pollutants to biota. We conclude by highlighting key future research areas for scientists and policymakers.

Contents

Cole et al 2011
https://doi.org/10.1016/j.marpolbul.2011.09.025

Environmental Science & Technology

Feature

Cite This: Environ. Sci. Technol. 2019, 53, 1039−1047

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Are We Speaking the Same Language? Recommendations for a Definition and Categorization Framework for Plastic Debris

Nanna B. Hartmann,*,† Thorsten Hüffer,*,‡ Richard C. Thompson,§ Martin Hassellöv,‖ Anja Verschoor,⊥ Anders E. Daugaard,# Sinja Rist,† Therese Karlsson,‖ Nicole Brennholt,¶ Matthew Cole,∇ Maria P. Herrling,○ Maren C. Hess,◆ Natalia P. Ivleva,◇ Amy L. Lusher,▲ and Martin Wagner*,▼

†Department of Environmental Engineering, Technical University of Denmark, Bygningstorvet B115, Kgs. Lyngby 2800, Denmark
‡Department of Environmental Geosciences, Environmental Science Research Network, and Research Platform Plastics in the Environment and Society (PLENTY), University of Vienna, Althanstrasse 14, Vienna 1090, Austria
§School of Biological and Marine Sciences, University of Plymouth, Plymouth PL4 8AA, United Kingdom
‖Department of Marine Sciences, University of Gothenburg, Kristineberg 566, Fiskebäckskil 45178, Sweden
⊥National Institute for Public Health and the Environment, Antonie van Leeuwenhoeklaan 9, Bilthoven 3721 MA, The Netherlands
#Department of Chemical and Biochemical Engineering, Danish Polymer Centre, Technical University of Denmark, Søltofts Plads B227, Kgs. Lyngby 2800, Denmark
¶Department Biochemistry and Ecotoxicology, Federal Institute of Hydrology, Am Mainzer Tor 1, Koblenz 56068, Germany
∇Marine Ecology & Biodiversity, Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth PL1 3DH, United Kingdom
○Oviva Switzerland AG, Hauptstrasse 192, Aesch 4147, Switzerland
◆Department of Water Management and Water Protection, North Rhine Westphalia State Agency for Nature, Environment and Consumer Protection, Postfach 101052, Recklinghausen 45610, Germany
◇Institute of Hydrochemistry, Chair of Analytical Chemistry and Water Chemistry, Technical University of Munich, Marchioninistr. 17, Munich 81377, Germany
▲Norwegian Institute for Water Research (NIVA), Oslo 0349, Norway
▼Department of Biology, Norwegian University of Science and Technology (NTNU), Trondheim 7491, Norway

ABSTRACT: The accumulation of plastic litter in natural environments is a global issue. Concerns over potential negative impacts on the economy, wildlife, and human health provide strong incentives for improving the sustainable use of plastics. Despite the many voices raised on the issue, we lack a consensus on how to define and categorize plastic debris. This is evident for microplastics, where inconsistent size classes are used and where the materials to be included are under debate. While this is inherent in an emerging research field, an ambiguous terminology results in confusion and miscommunication that may compromise progress in research and mitigation measures. Therefore, we need to be explicit on what exactly we consider plastic debris. Thus, we critically discuss the advantages and disadvantages of a unified terminology, propose a definition and categorization framework, and highlight areas of uncertainty. Going beyond size classes, our framework includes physicochemical properties (polymer composition, solid state, solubility) as defining criteria and size, shape, color, and origin as classifiers for categorization. Acknowledging the rapid evolution of our knowledge on plastic pollution, our framework will promote consensus building within the scientific and regulatory community based on a solid scientific foundation.

Hartmann et al., 2019
https://doi.org/10.1021/acs.est.8b05297

Marine Pollution Bulletin 138 (2019) 145–147

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Focus

Microplastics: Finding a consensus on the definition

J.P.G.L. Frias*, Roisin Nash

Marine and Freshwater Research Centre (MFRC), Galway-Mayo Institute of Technology (GMIT), Dublin Rd., Galway, H91 T8NW, Ireland

ARTICLE INFO

Keywords:
Marine anthropogenic litter
Marine strategy framework directive
Pollution
Monitoring
Definition
Policy

ABSTRACT

Polymer science is one of the most revolutionary research areas of the last century, instigated by the discovery of Bakelite, the first synthetic plastic. Plastic, once a revolutionary material, has gradually become a global environmental threat with ubiquitous distribution.

The term '*microplastics*' coined in 2004, is used to describe the smaller plastic particles recorded, however there is still no all-inclusive definition that accurately encompasses all criteria that could potentially describe what a microplastic is.

Here, the authors focus on the currently reported methods for describing and identifying microplastics and propose a new definition that incorporates all the important descriptive properties of microplastics. This definition not only focuses on size and origin, but also considers physical and chemical defining properties. While this manuscript may promote debate, it aims to reach a consensus on a definition for microplastics which can be useful for research, reporting and legislative purposes.

The discovery of Bakelite, the first synthetic plastic, in 1907, revolutionised polymer science and modern life, by introducing several polymers and plastic formulations to our daily lives, many of which are still available in the market nowadays (Shashoua, 2008). Plastic materials are extremely versatile due to their low density, low thermal and electric conductivity, resistance to corrosion, which allow these materials to serve as a water and oxygen barrier, while their low price also contributes for their easy and widespread manufacture, where they are used in a wide range of applications from food packaging to medical and technological applications.

However, what was and is still described as a revolutionary material has slowly become a global environmental threat with ubiquitous distribution in marine and freshwater ecosystems (Bergman et al., 2015; Wagner et al., 2018; Zeng et al., 2018). The natural occurring environmental conditions within these ecosystems, particularly ocean current dynamics, solar radiation, abrasion and interactions with vessels and organisms, cause plastic items to slowly degrade and fragment into smaller particles commonly known as *microplastics*.

Thompson et al. (2004) initially coined the term microplastics to describe the accumulation of microscopic pieces of plastic in marine sediments and in the water column of European waters. In 2009, Arthur et al., proposed an upper size limit to the initial term and microplastics where known as "*plastic particles smaller than 5 mm*". This definition was further refined in 2011, when Cole et al. (2011) distinguished microplastics, according to their origin, into primary (produced to be of microscopic dimensions) or secondary (resulting from degradation and fragmentation processes in the environment). The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), defines microplastics as '*plastic particles < 5 mm in diameter, which include particles in the nano-size range (1 nm)*' (GESAMP, 2015, 2016) and it helped further spreading the definition worldwide.

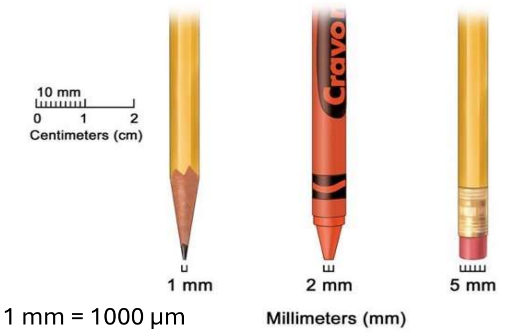
Over the last decade, the focus on the microplastic issue as a novel pollutant has seen a large increase in investments at a global scale, in this novel research field. Projects range from exploring sources and pathways (Mahon et al., 2017) establishing baselines in areas potentially impacted (Maes et al., 2017); establishing a consensus on standardised methodologies (Frias et al., 2018) identifying worldwide hotspots for microplastic accumulation (Eriksen et al., 2014; Jambeck et al., 2015; Lebreton et al., 2018), and exploration of ecosystem and potential impacts on both habitats and species (Rochman, 2018). The output of such projects has resulted in an exponential increase of microplastics literature (Bergman et al., 2015; Zeng et al., 2018), and increased attention of the media worldwide highlighting issues or the plastics pollution problem. Microplastic bans in the form of microbeads or others have been introduced in several countries (e.g. U.S.A. (California), U.K., Canada, New Zealand). In addition, several other countries are following suit and are in the process of drafting bills on microplastics (e.g. Ireland, Italy, India, Taiwan, South Korea). Its global dimension has resulted in microplastics being reviewed in relation to international policy and the global environmental pollution problem (Bergman et al., 2015).

Frias and Nash., 2019
https://doi.org/10.1016/j.marpolbul.2018.11.022

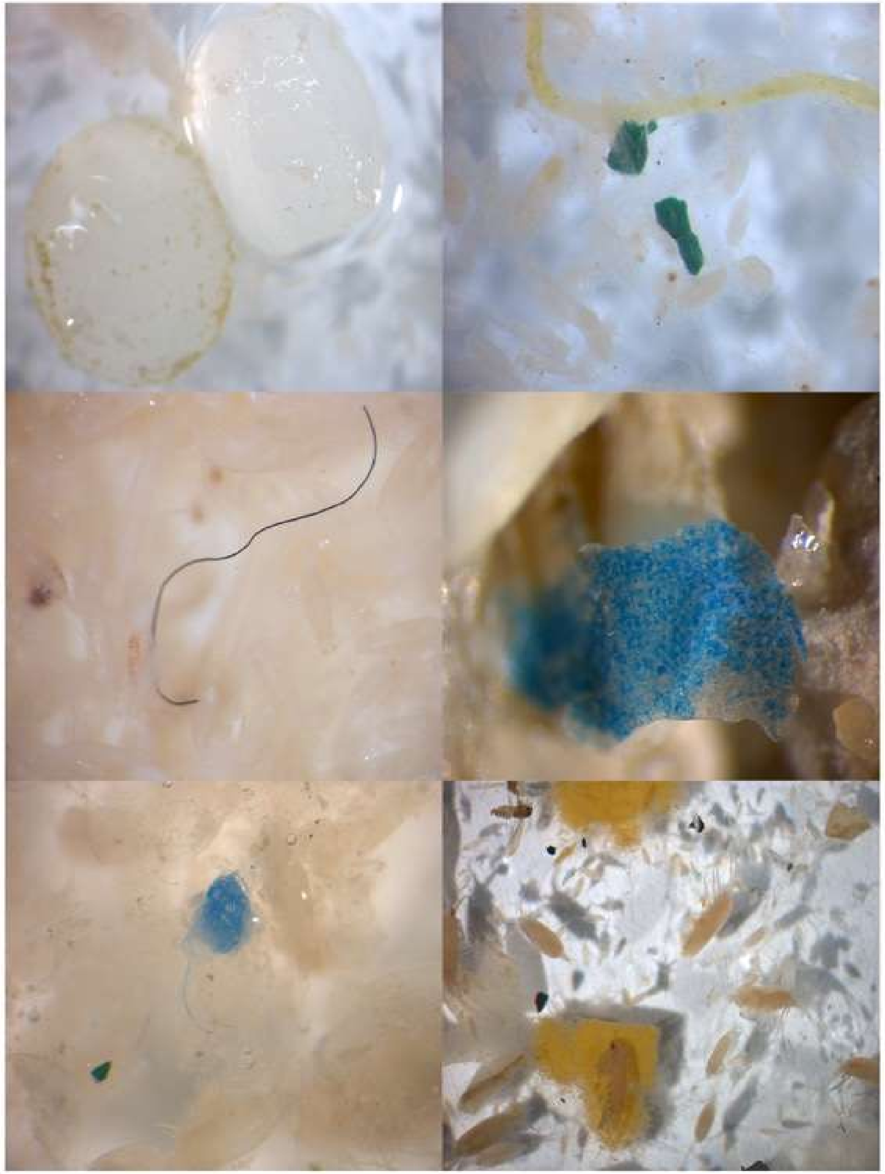
MICROPLASTICS

ANY SYNTHETIC, **SOLID** *PARTICLE* OR *POLYMERIC MATRIX* WITH:

- REGULAR OR IRREGULAR **SHAPE**;
- A **SIZE** RANGING FROM 1 μM TO 5 MM;
- OF EITHER PRIMARY OR SECONDARY **ORIGIN**;
- WHICH IS **INSOLUBLE IN WATER**



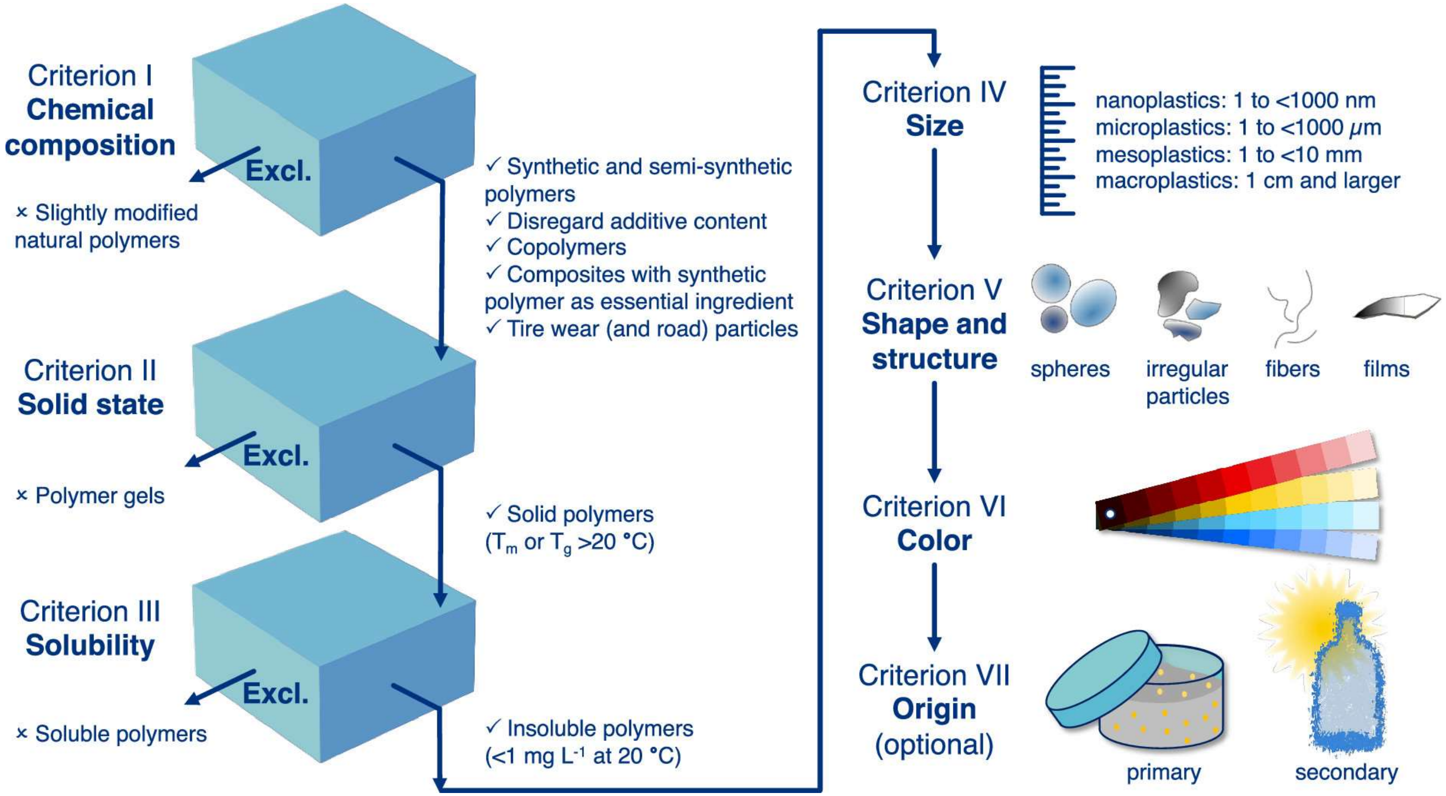
Frias and Nash, 2019
https://doi.org/10.1016/j.marpolbul.2018.11.022



Photos by João Frias and Teresa Winslow

CONCEPTS

MICROPLASTICS



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[†]Department of Environmental Engineering, Technical University of Denmark, Bygningstorvet B115, Kgs. Lyngby 2800, Denmark
[‡]Department of Environmental Geosciences, Environmental Science Research Network, and Research Platform Plastics in the Environment and Society (PLENTY), University of Vienna, Althanstrasse 14, Vienna 1090, Austria
[§]School of Biological and Marine Sciences, University of Plymouth, Plymouth PL4 8AA, United Kingdom
[∥]Department of Marine Sciences, University of Gothenburg, Kristineberg 566, Fiskebäckskil 45178, Sweden
[⊥]National Institute for Public Health and the Environment, Antonie van Leeuwenhoeklaan 9, Bilthoven 3721 MA, The Netherlands
[#]Department of Chemical and Biochemical Engineering, Danish Polymer Centre, Technical University of Denmark, Søltofts Plads B227, Kgs. Lyngby 2800, Denmark
[¶]Department Biochemistry and Ecotoxicology, Federal Institute of Hydrology, Am Mainzer Tor 1, Koblenz 56068, Germany
[∇]Marine Ecology & Biodiversity, Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth PL1 3DH, United Kingdom
[○]Ovivo Switzerland AG, Hauptstrasse 192, Aesch 4147, Switzerland
[◆]Department of Water Management and Water Protection, North Rhine Westphalia State Agency for Nature, Environment and Consumer Protection, Postfach 101052, Recklinghausen 45610, Germany
[◊]Institute of Hydrochemistry, Chair of Analytical Chemistry and Water Chemistry, Technical University of Munich, Marchioninistr. 17, Munich 81377, Germany
[▲]Norwegian Institute for Water Research (NIVA), Oslo 0349, Norway
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Hartmann et al., 2019
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BACK

CLOSE WINDOW

CONCEPTS

MICROPLASTICS

3.1 microplastic MP

material consisting of a solid polymer containing particles, to which additives or other substances may have been added, and where a weight fraction of ≥1% particles have: a) all sizes 100 nm ≤ × ≤ 5 mm,
b) for fibres, a length of 300 nm ≤ × ≤ 15 mm and a length/diameter ratio >3

Note 1 to entry: Polymers that occur in nature that have not been chemically modified (other than by hydrolysis) are excluded, as are polymers that are (bio) degradable.
[SOURCE:ECHA, ANNEX XV Restriction Report - Microplastics, 22 August 2019, par 1.2.2.1, modified on lower size recommended dimensions, by Commission Recommendation C/2022/3689 of 10 June 2022 on the definition of nanomaterial (OJ C 229, 14.6.2022, p. 1), modified — "≥1% w/w" was changed to "a weight fraction of ≥1 %"; additional information has been given as a note to entry.]

3.1 large microplastic

any solid plastic particle insoluble in water with any dimension between 1 mm and 5 mm
Note 1 to entry: Microplastics may show various shapes.
Note 2 to entry: Typically, a large microplastics object represents an item consisting of plastics or a part of an end-user product or a fragment of the respective item.
[SOURCE:ISO/TR 21960:2020, 3.10, modified — term number in Note 1 to entry was removed.]

3.2 microplastic

any solid plastic particle insoluble in water with dimension between 1 μm and 1 000 μm (= 1 mm)
Note 1 to entry: Primary microplastics object represents a particle intentionally added to end-user products for example cosmetic means, coatings, paints etc. Secondary microplastics object can also result as a fragment of the respective item.
Note 2 to entry: Microplastics have regular and irregular shapes (see ISO 9276-6:2008).
Note 3 to entry: The defined dimension is related to the longest length of the particle.
[SOURCE:ISO/TR 21960:2020, 3.9, modified — Note 1 to entry was removed, all other Notes to entry were changed.]

CONCEPTS

MICROPLASTICS

UNEP/PP/INC.1/6

Annex

Glossary of key terms

I. Terms used in Environment Assembly resolution 5/14 that have definitions adopted or endorsed by an intergovernmental process

Environmentally sound waste management means taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes.[1]

Impact means any effect caused by a proposed activity on the environment, including on human health and safety, flora, fauna, soil, air, water, climate, landscape and historical monuments or other physical structures or the interaction among those factors. It also includes effects on cultural heritage or socioeconomic conditions resulting from alterations to those factors.[2]

Microplastics refers to plastic particles less than 5 millimetres in diameter, including nano-sized particles.[3]

UNITED NATIONS

UNEP/PP/INC.1/6

United Nations Environment Programme

UNEP

Distr.: General
8 September 2022

Original: English

Intergovernmental negotiating committee to develop an international legally binding instrument on plastic pollution, including in the marine environment
First session
Punta del Este, Uruguay, 28 November–2 December 2022
Item 4 of the provisional agenda*

Preparation of an international legally binding instrument on plastic pollution, including in the marine environment

Glossary of key terms

Microplastics refers to plastic particles less than 5 millimetres in diameter, including nano-sized particles.[3]

CONCEPTS

PLASTISPHERE

THE **MICROBIAL COMMUNITY ATTACHED TO PLASTIC** THAT IS **DISTINCT** FROM THE COMMUNITIES IN THE **SURROUNDING ENVIRONMENT**

Zettler, Mincer and Amaral-Zettler, 2013
https://doi.org/10.1021/es401288x

European MARINE BOARD
Advancing Seas & Ocean Science

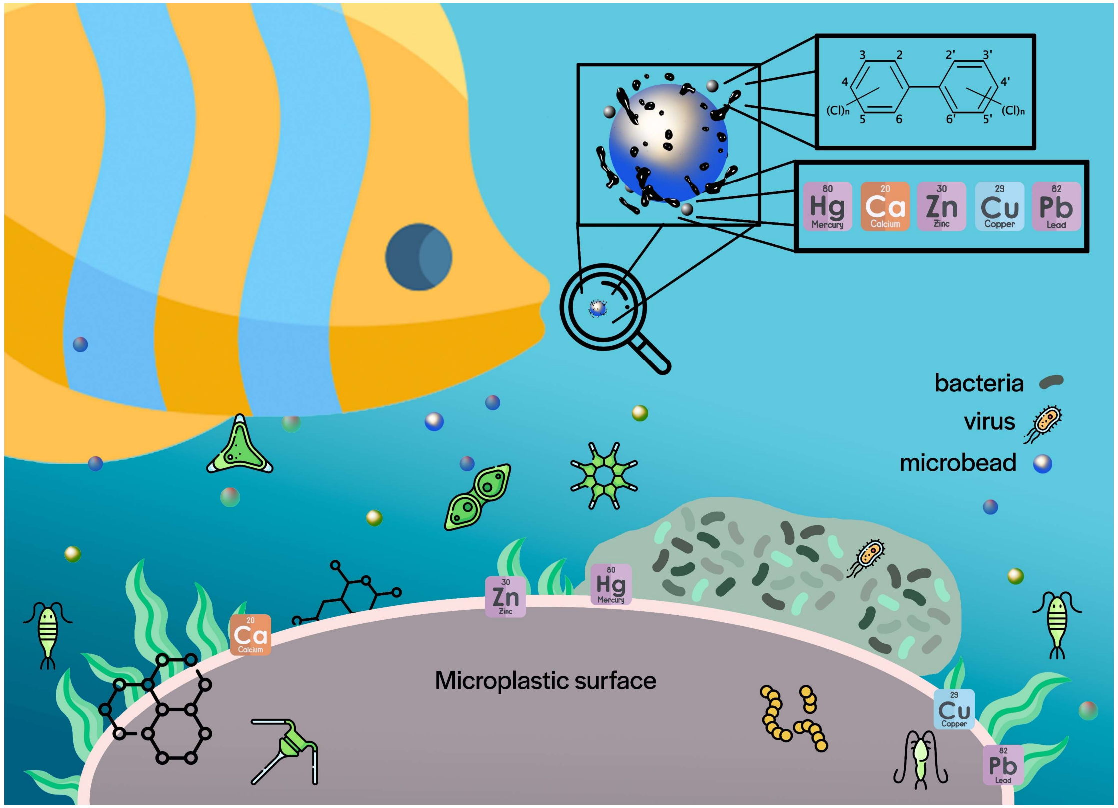
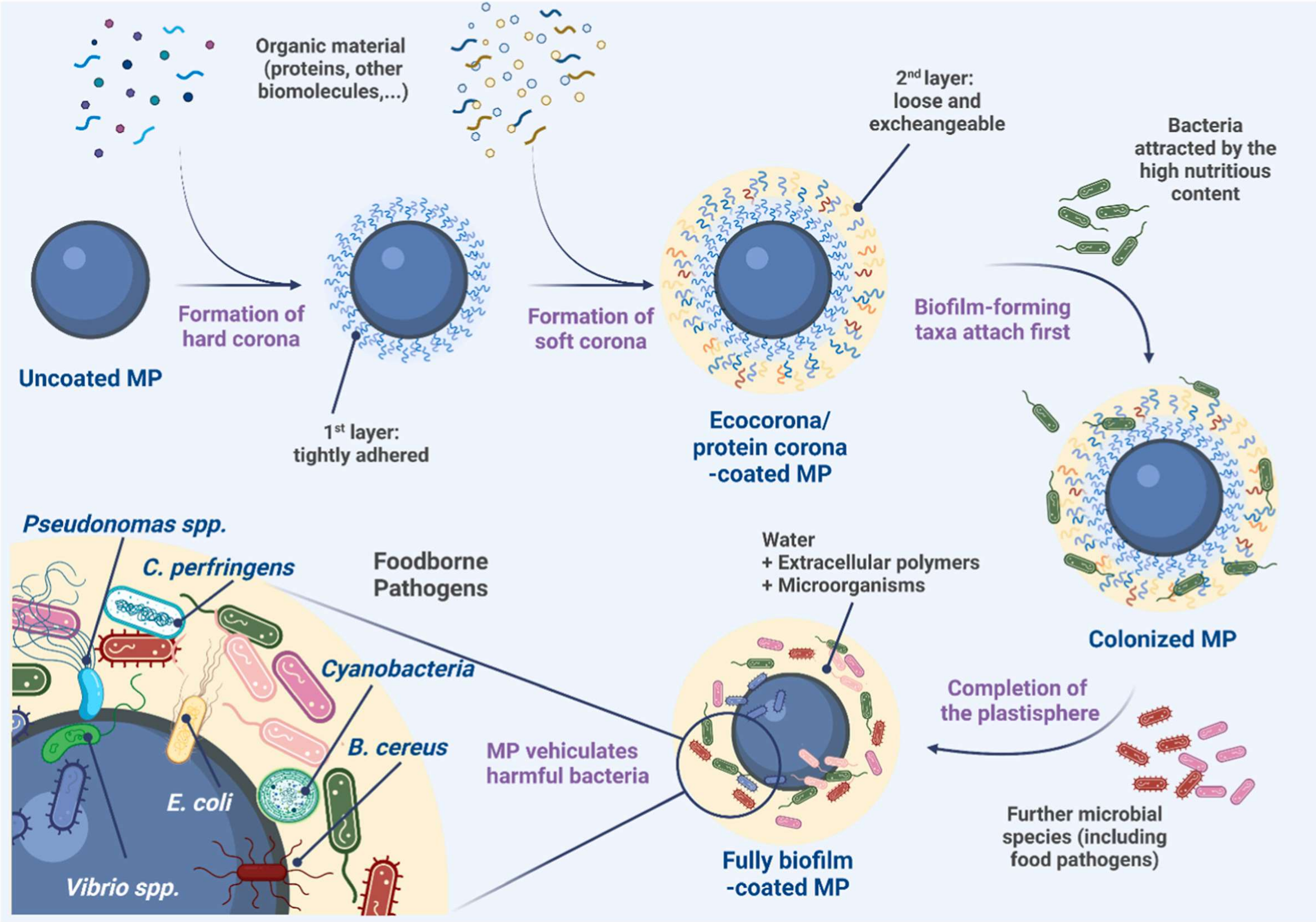


Image part of the Navigating the Future series from the EMB NFVI 2024

CONCEPTS

PLASTISPHERE



Travelli et al., 2022
https://doi.org/10.1016/j.tifs.2022.08.021

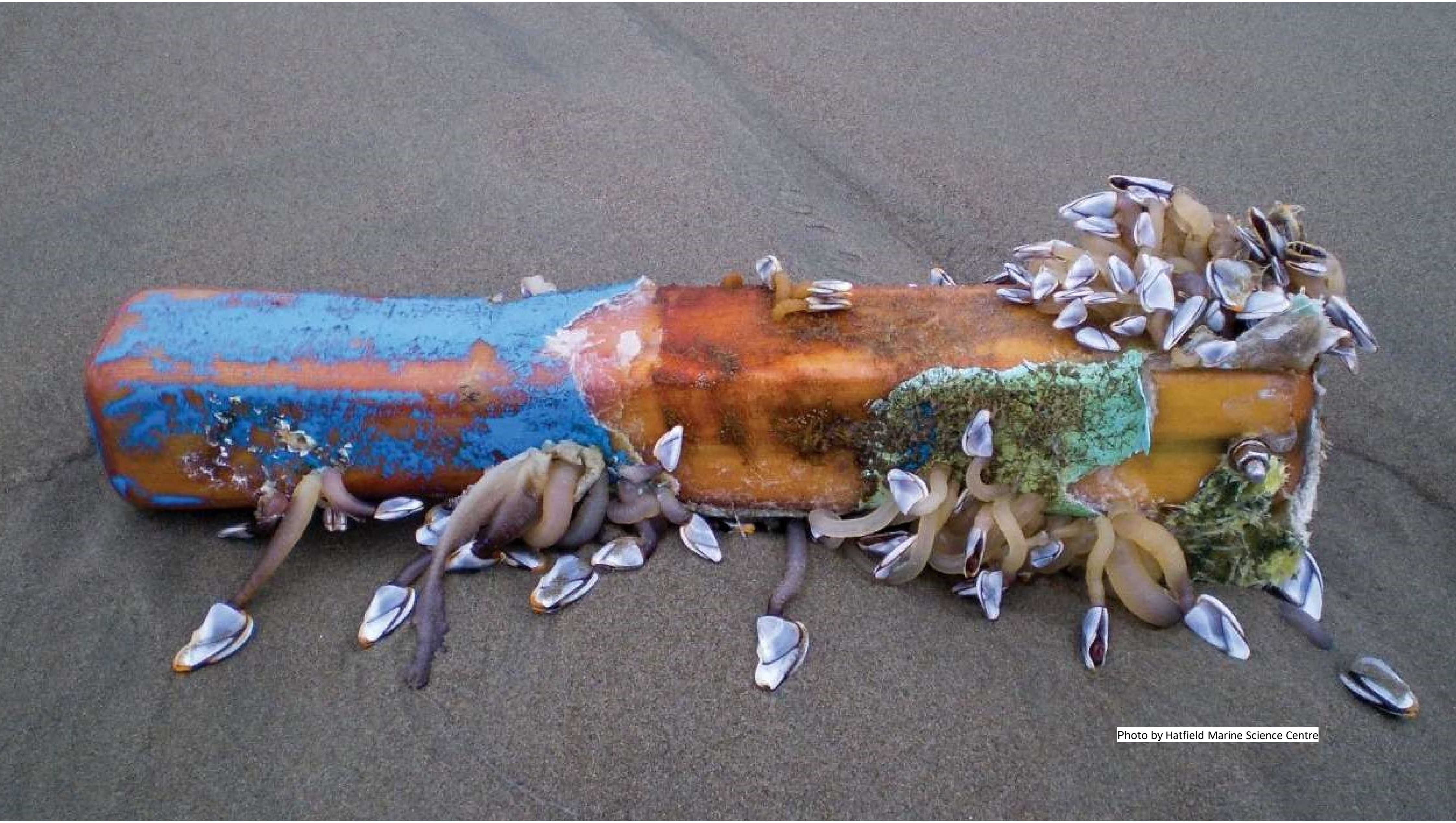
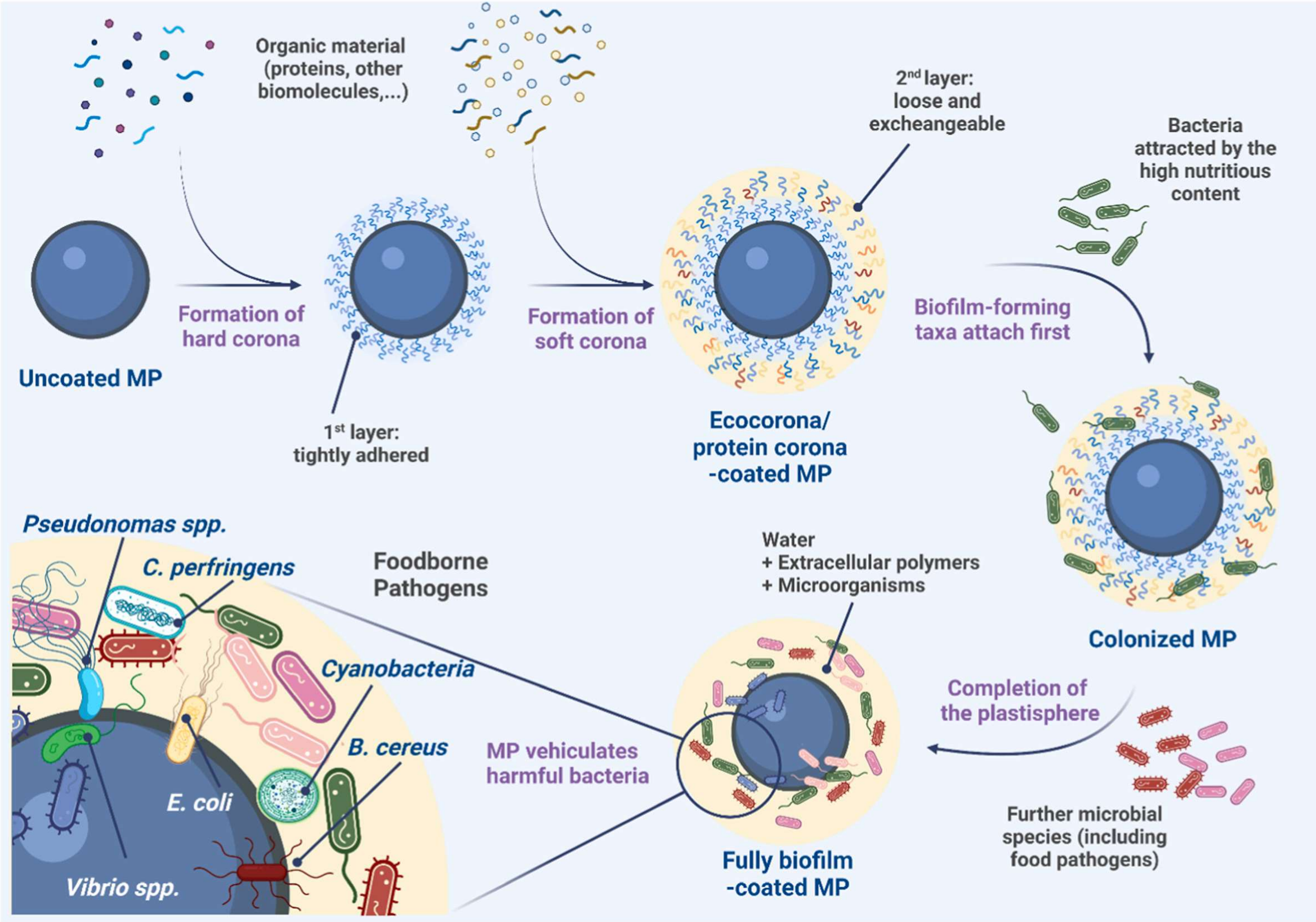


Photo by Hatfield Marine Science Centre

CONCEPTS

PLASTISPHERE

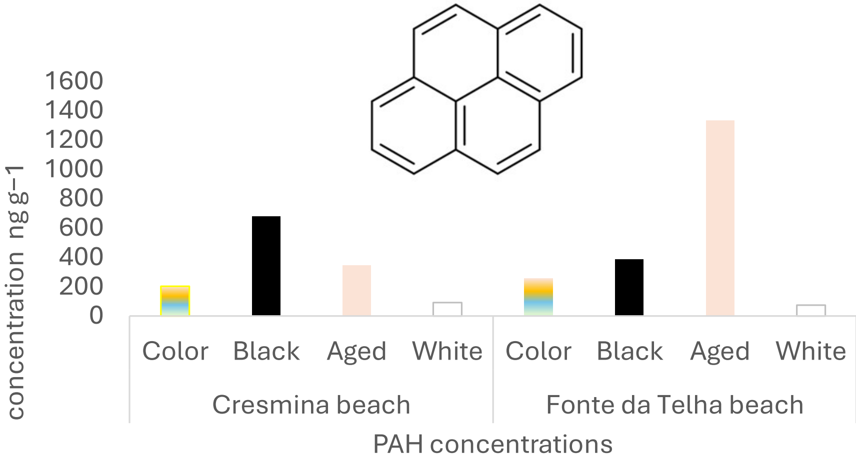


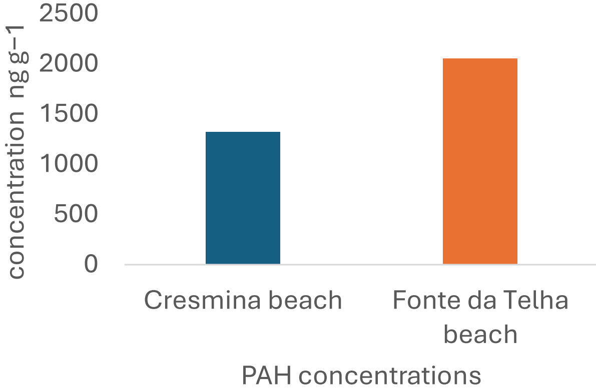
Travelli et al., 2022
https://doi.org/10.1016/j.tifs.2022.08.021

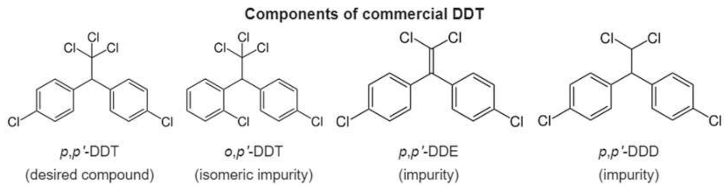
PLASTICS AND POLLUTANTS

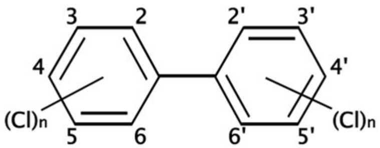
Photo by João Frias

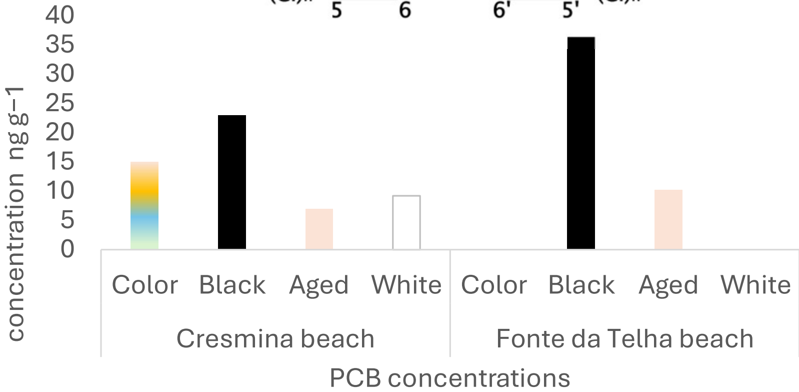
Bay of Biscay
FRANCE
EUROPE
ANDORRA
Tagus River
PORTUGAL
SPAIN
ATLANTIC OCEAN
MEDITERRANEAN SEA
ALGERIA
MOROCCO
AFRICA
0 100 200 mi
0 100 200 km
© Encyclopædia Britannica, Inc.

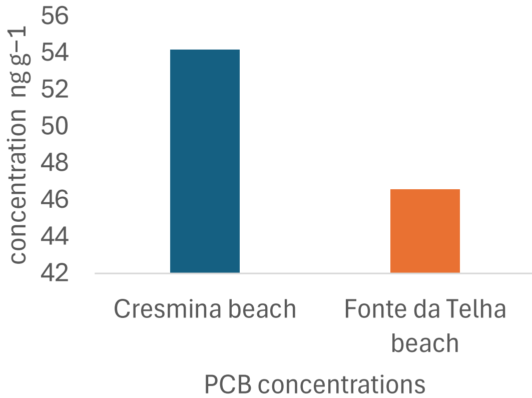


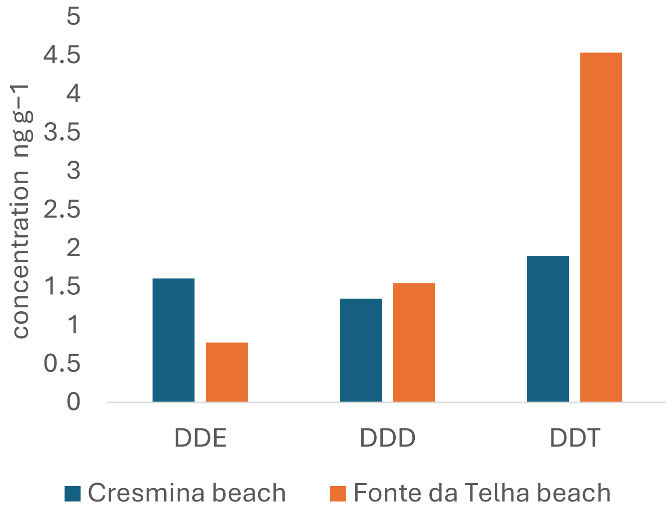












Frias, Sobral and Ferreira, 2010

https://doi.org/10.1016/j.marpolbul.2010.07.030

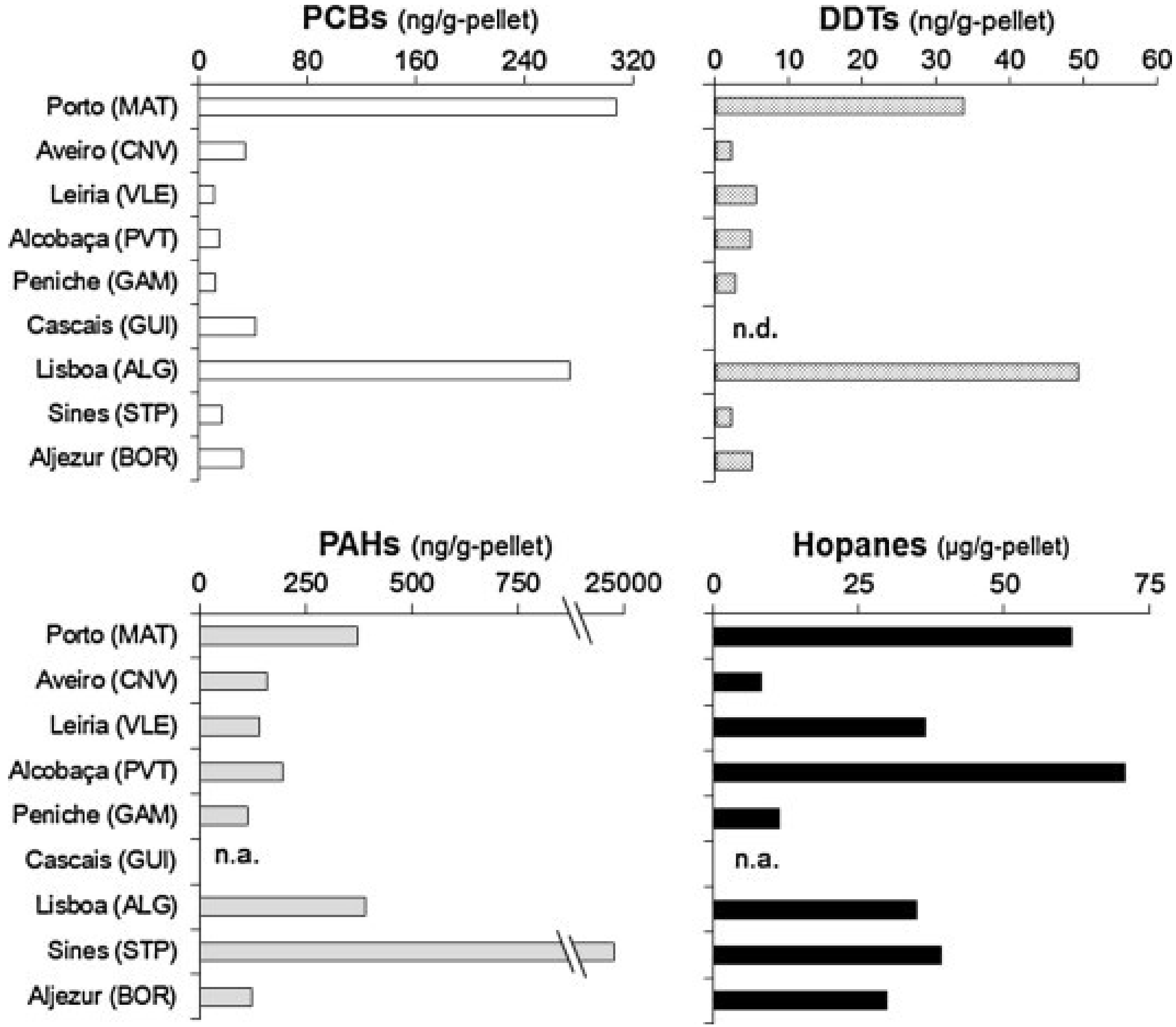
PLASTICS AND POLLUTANTS

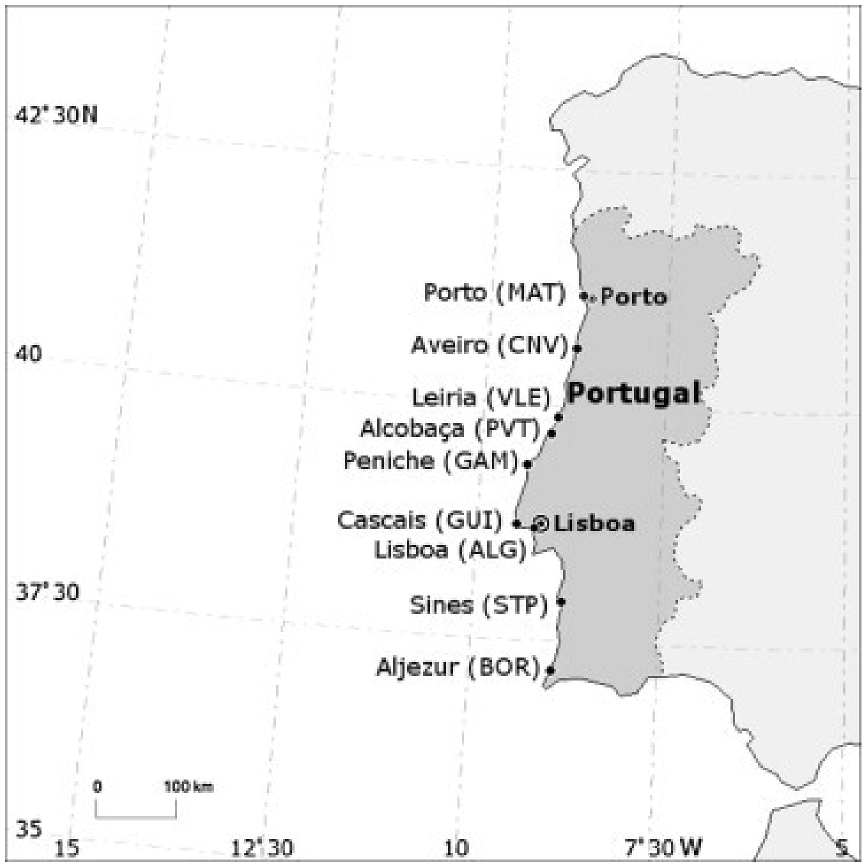

Photo by João Frias

International Pellet Watch

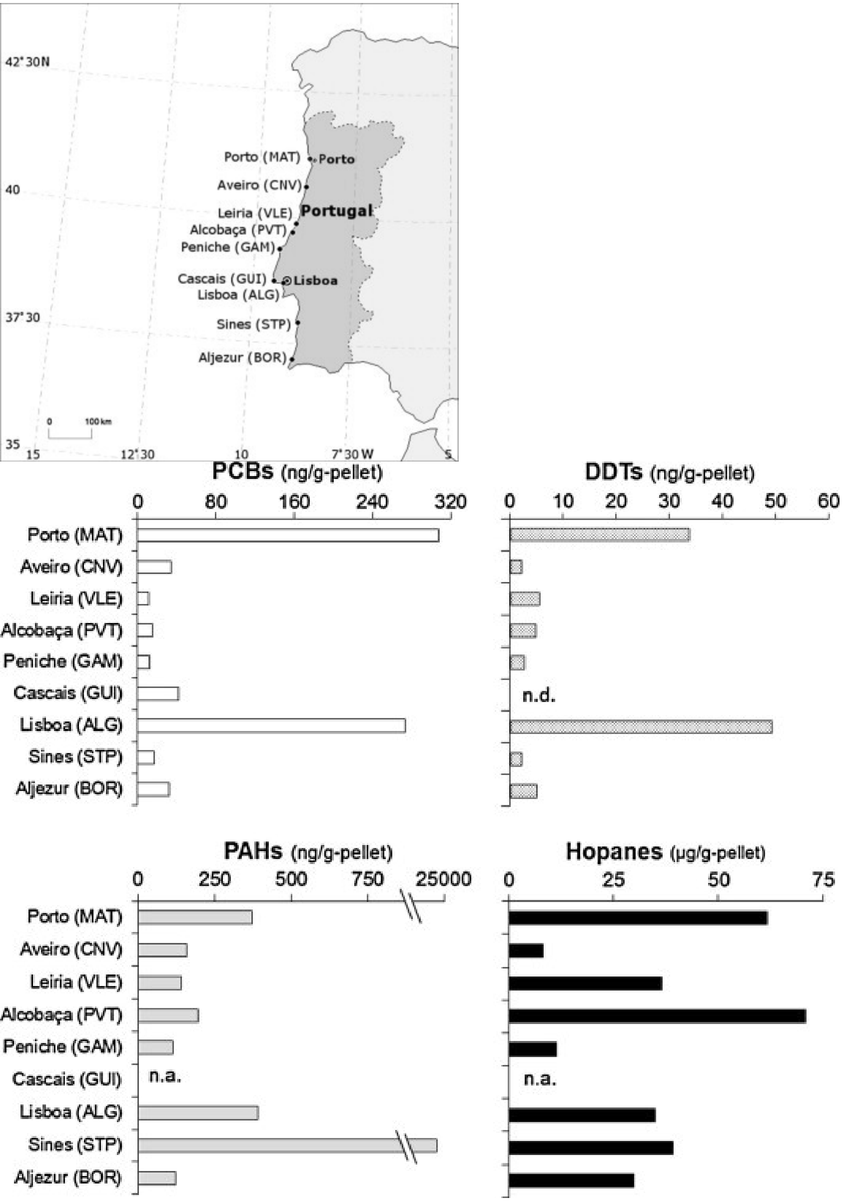
http://pelletwatch.org/


Photos by International Pellet Watch





Mizukawa et al, 2013
https://doi.org/10.1016/j.marpolbul.2013.02.008



Mizukawa et al, 2013
https://doi.org/10.1016/j.marpolbul.2013.02.008

Journal of Environmental Science and Health, Part B
Pesticides, Food Contaminants, and Agricultural Wastes
ISSN: 0360-1234 (Print) 1532-4109 (Online) Journal homepage: http://www.tandfonline.com/loi/lesb20

Occurrence of persistent organic pollutants in sediments and biota from Portugal versus European incidence: A critical overview

Cláudia Ribeiro, Ana Rita Ribeiro & Maria Elizabeth Tiritan

Location	Matrix	Substance	Concentration
Minho River	Sediment	tPAHs	3.71 ng g^{-1}
Douro River	Sediment	tPAHs	58.98-156.45 ng g^{-1}
Aveiro delta	Sediment	tPAHs	16.13 – 347.13 ng g^{-1}
Aveiro delta	Sediment	$\sum_{13}$PCBs	~4.0 – 62.0 ng g^{-1}
Tejo River	Mussels	PCBs	0.192 – 4.233 ng g^{-1}
Tejo River	Sediment	PCBs	0.326 – 52.3 ng g^{-1}
Sado River	Sediment	tDDT	5.0 – 60.0 ng g^{-1}
Sado River	Sediment	PCBs	1.0 – 25.0 ng g^{-1}
South Coast	Mussels	PAHs	220.1 ng g^{-1}

Table compiled from Ribeiro, Ribeiro and Tiritan, 2015
http://dx.doi.org/10.1080/03601234.2015.1108793

FACT:

PERSISTENT ORGANIC POLLUTANTS ACCUMULATE IN ENVIRONMENTAL PELLETS

(AND IN ENVIRONMENTAL PLASTICS)

AT HIGHER CONCENTRATIONS THAN THE SURROUNDING ENVIRONMENT

(SEDIMENT AND ORGANISMS)

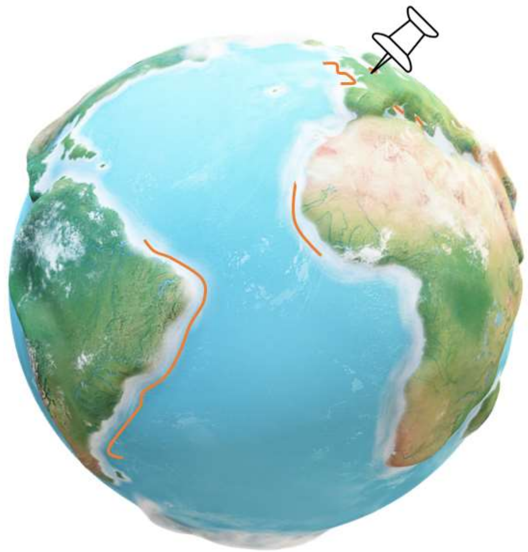
WHAT ELSE IS THERE WITH BIOFILM?

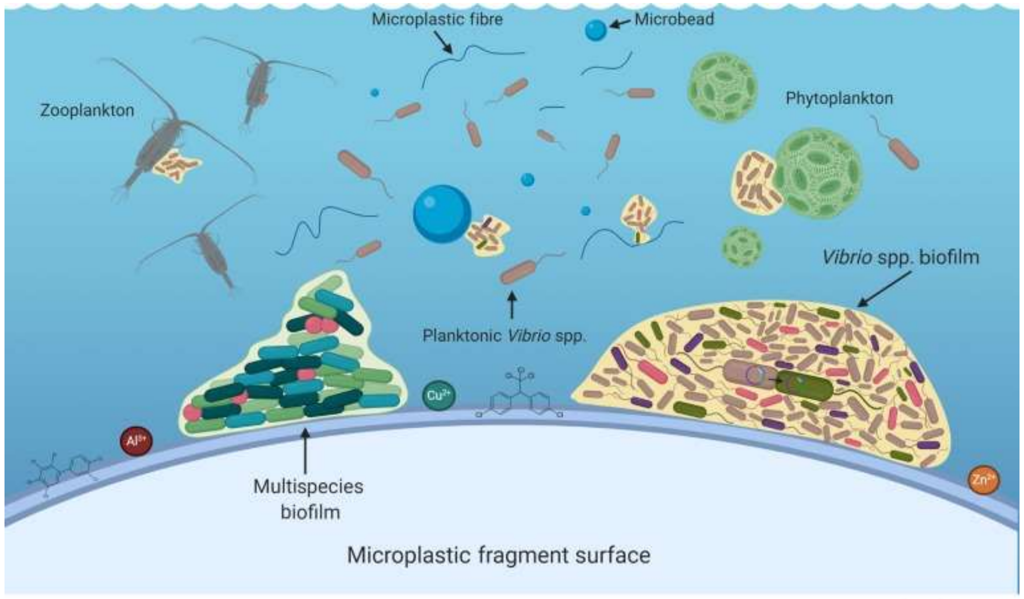
WHAT ELSE IS THERE WITH BIOFILM?

CASE STUDY

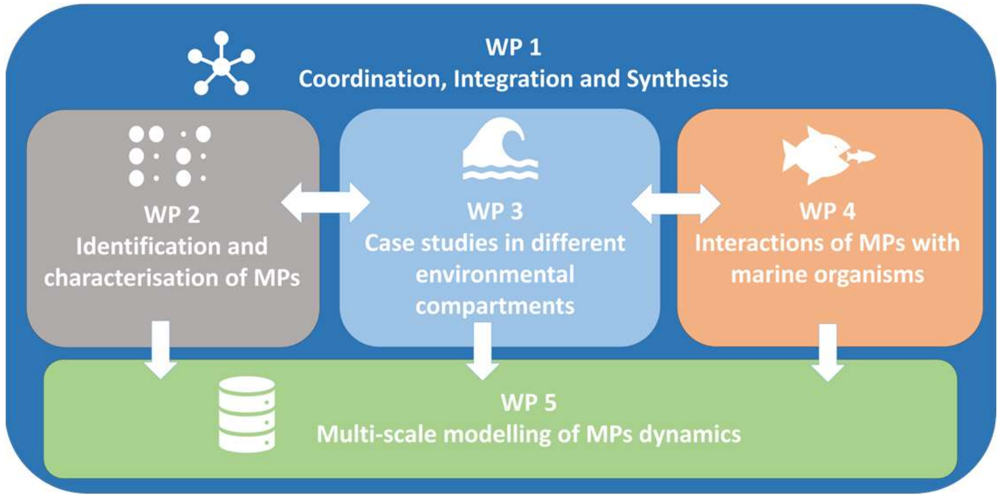
AIMS

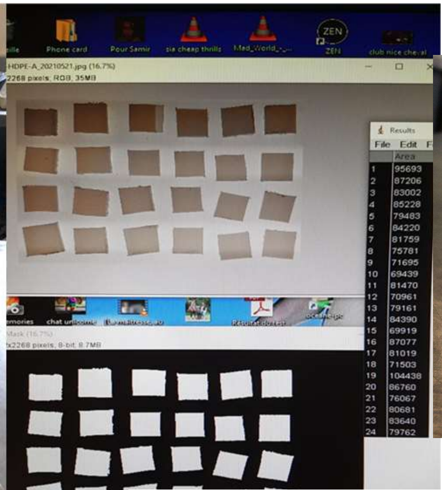
TO OVERCOME KNOWLEDGE GAPS ON **WEATHERING** AND **BIOFOULING** AND HOW THESE PROCESSES INFLUENCE **FRAGMENTATION, DISTRIBUTION AND DISPERSAL** OF MICROPLASTICS IN THE MARINE ENVIRONMENT

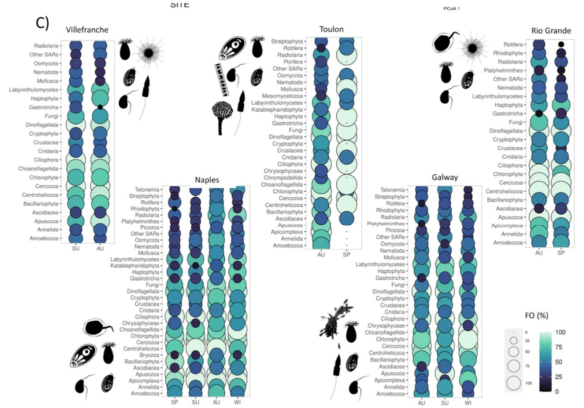


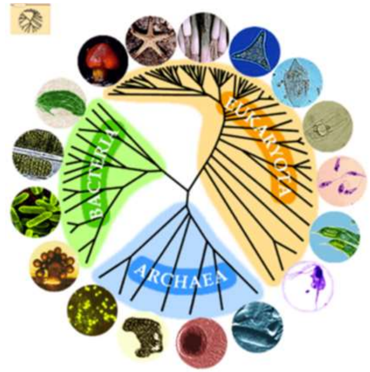


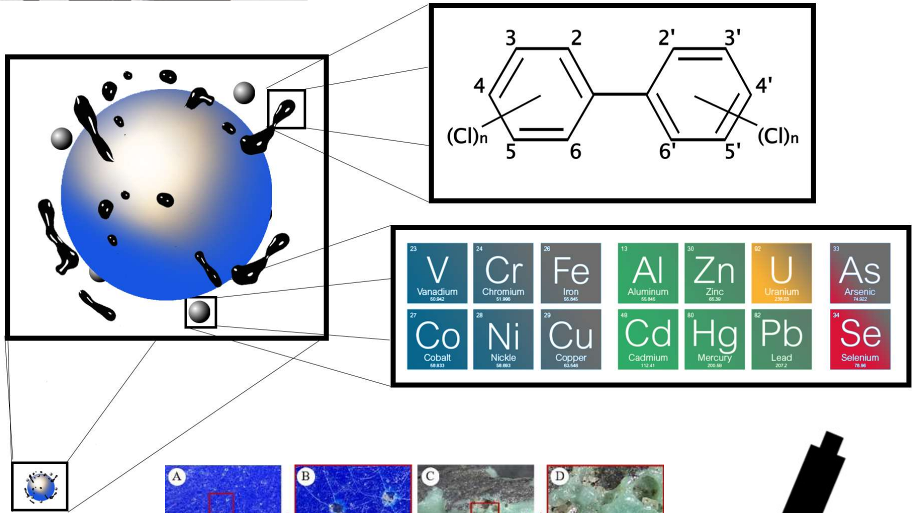
Trends in Microbiology

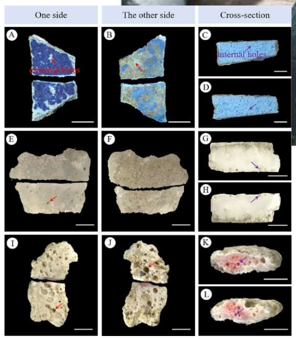


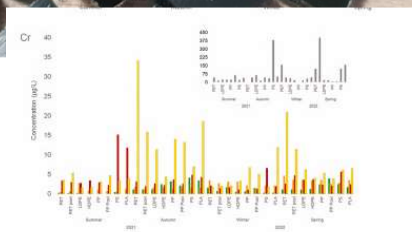


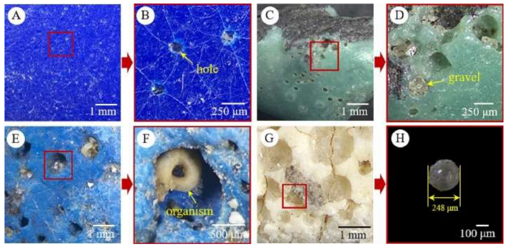

C)
Villefranche
Toulon
Rio Grande
Naples
Galway
FO (%)

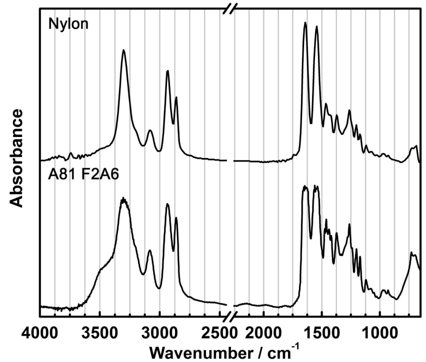

BACTERIA
EUKARYOTA
ARCHAEA


3
2
2'
3'
4
4'
(Cl)n
(Cl)n
5
6
6'
5'
V Vanadium
Cr Chromium
Fe Iron
Al Aluminum
Zn Zinc
U Uranium
As Arsenic
Co Cobalt
Ni Nickle
Cu Copper
Cd Cadmium
Hg Mercury
Pb Lead
Se Selenium

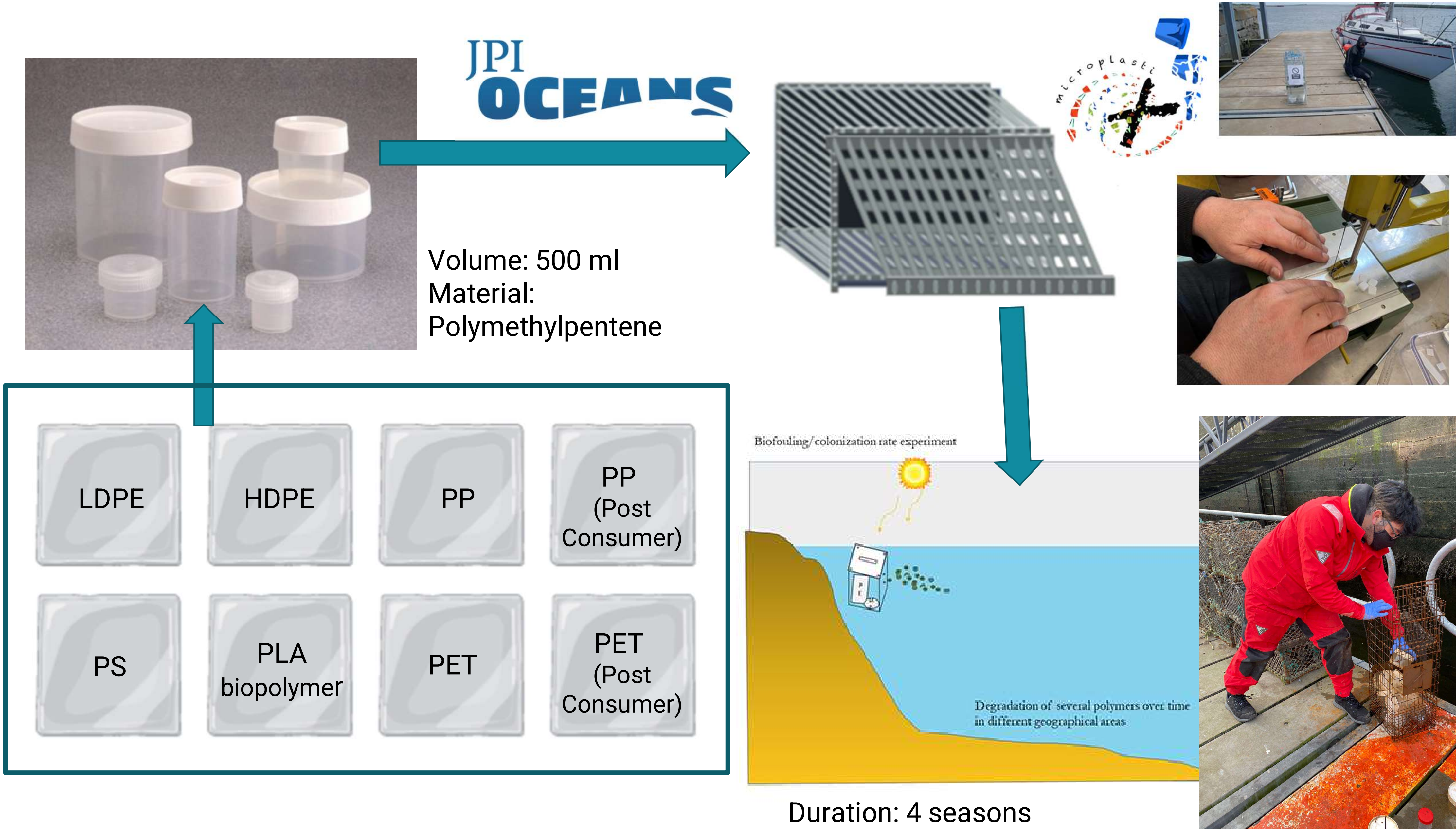

One side
The other side
Cross-section


Cr

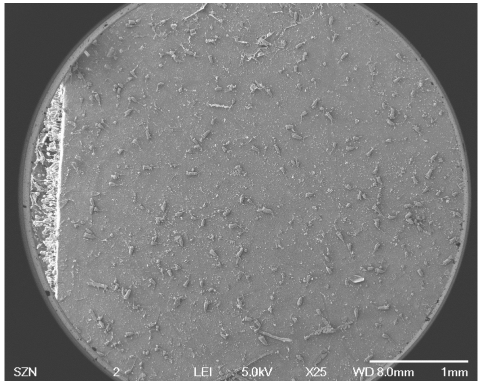

A
B
C
D
E
F
G
H
hole
gravel
organism
1 mm
250 μm
500 μm
248 μm
100 μm

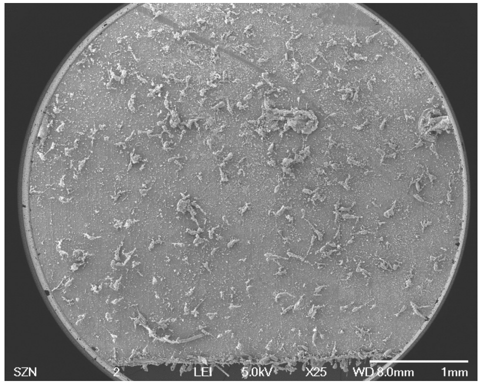

Nylon
A81 F2A6
Absorbance
4000
3500
3000
2500
2000
1500
1000
Wavenumber / cm-1

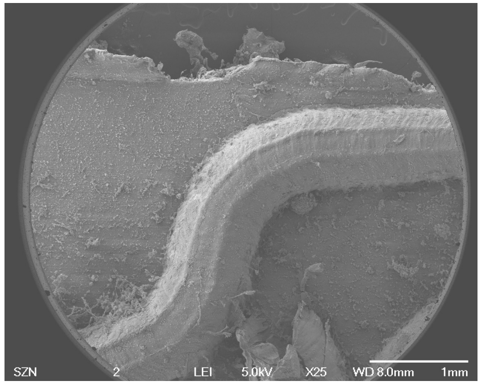

microplastiX
"Integrated approach on the fate of microplastics towards healthy marine ecosystems"
1
Port of Galway (Ireland)
53°16´08´´N - 9°02´55´´W
2
Ares harbour (Spain)
43°25´20´´N - 8°14´22´´W
3
Port of Toulon (France)
43°04´60´´N - 5°54´00´´W
4
Villefranche (France)
43°41´47´´N - 7°18´33´´W
5
Bay of Naples (Italy)
40°49´59´´N - 14°15´11´´W
6
Federal Univ. Rio Grande (Brazil)
JPI OCEANS

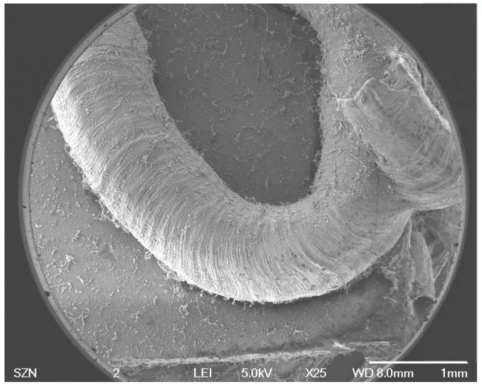

JPI OCEANS
Volume: 500 ml
Material: Polymethylpentene
LDPE
HDPE
PP
PP (Post Consumer)
PS
PLA biopolymer
PET
PET (Post Consumer)
Biofouling/colonization rate experiment
Degradation of several polymers over time in different geographical areas
Duration: 4 seasons


Ollscoil
Teicneolaíochta
an Atlantaigh
Atlantic
Technological
University

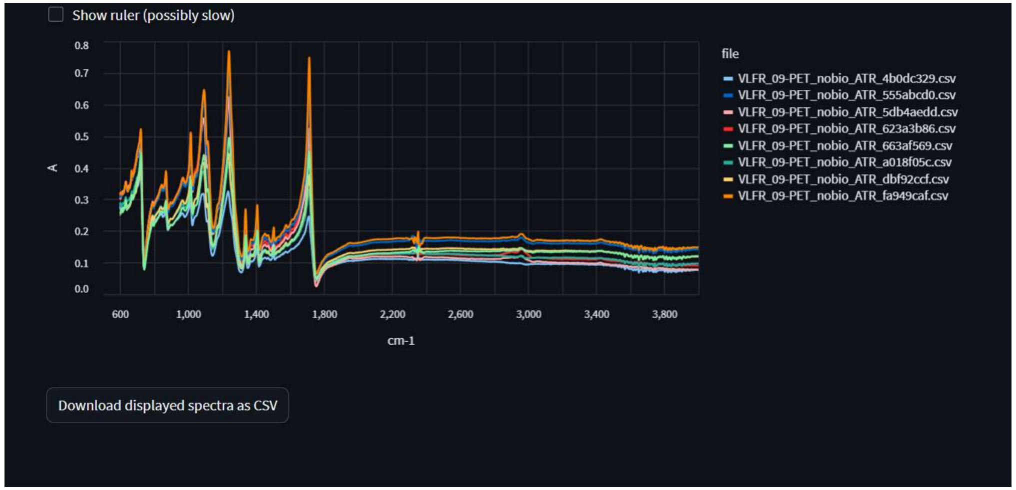


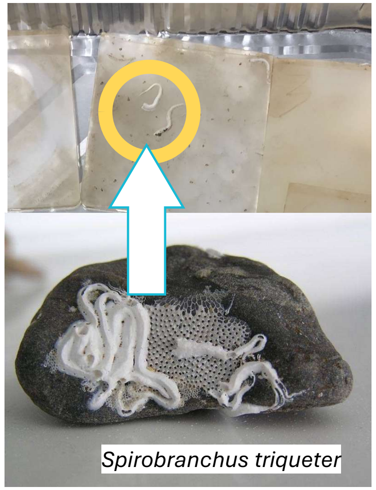


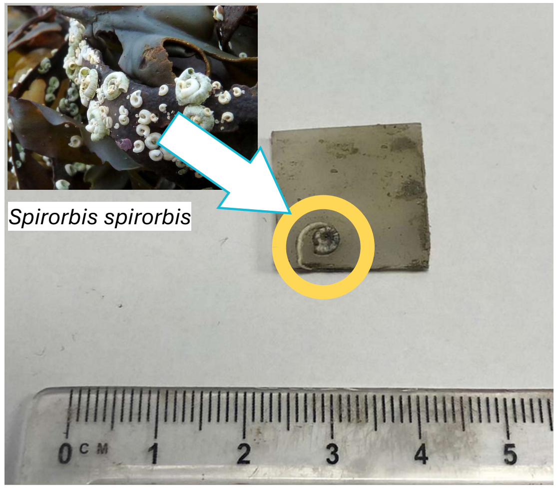




Above: time affecting plastics in the Mediterranean (SZN, Naples, Italy. Cassotti et al.)
Below: spectral database over time from IPF, Germany; biofouling of organisms in Galway, Ireland

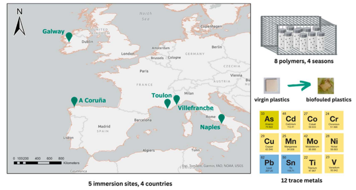




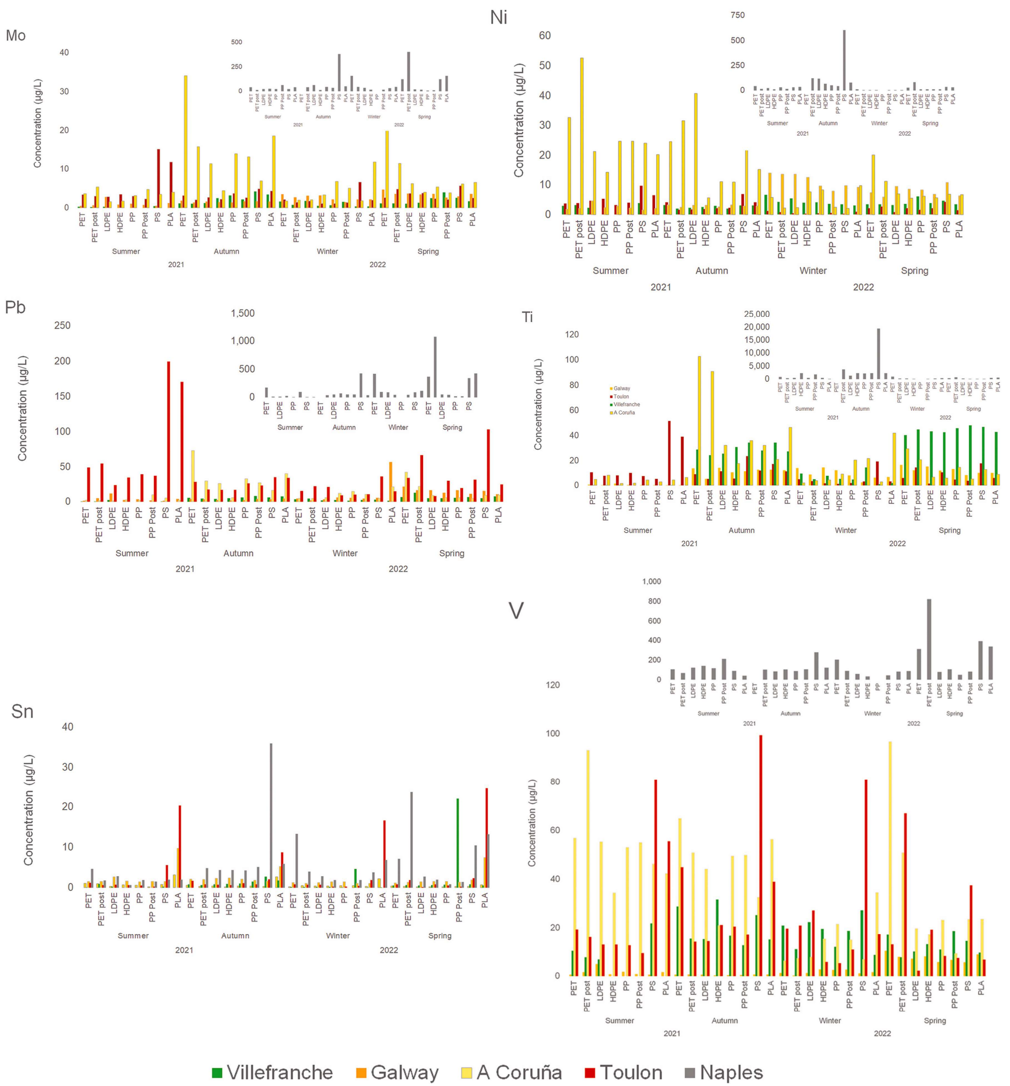


WHAT HAVE WE FOUND?

UNIVERSITÉ DE TOULON



Lenoble et al., 2024
https://doi.org/10.1016/j.envpol.2024.123808



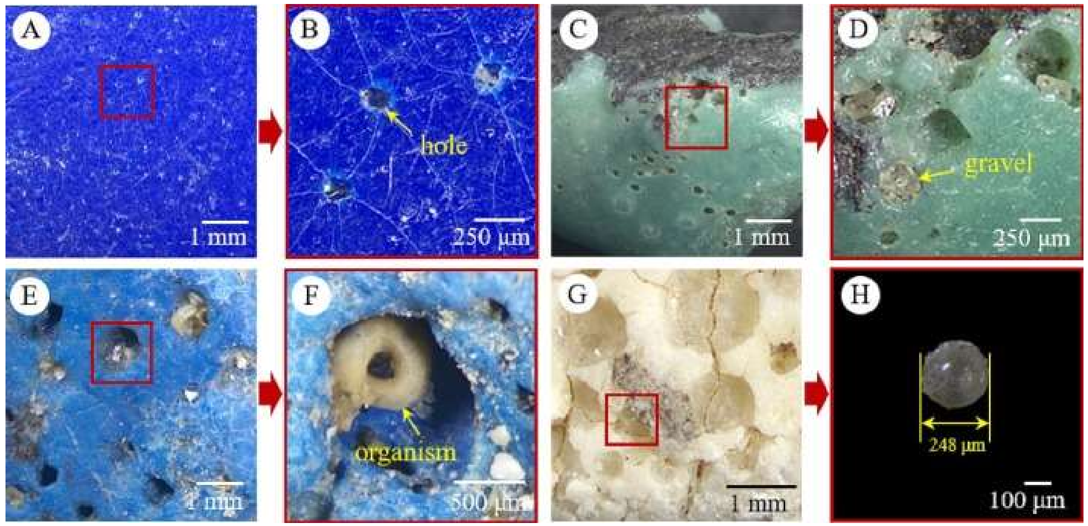
Trace metals accumulate in the biofilm from the surrounding environment

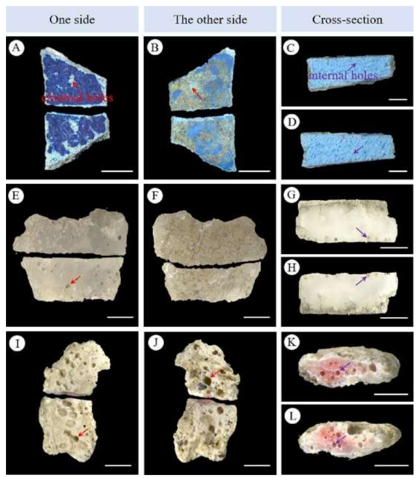
Biopolymers and fossil-fuel based polymers **behave similarly** in metal accumulation

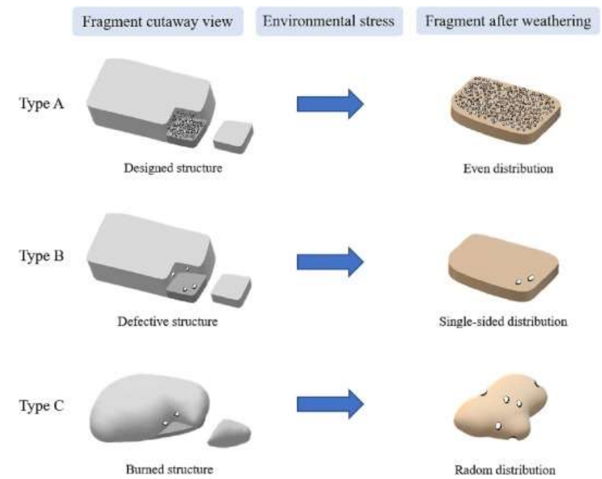
THE PLASTISPHERE DIVERSITY, **AND NOT ITS BIOMASS, INFLUENCE METAL BIOACCUMULATION.**

WHAT HAVE WE FOUND?

Distribution of holes Influences accumulation of species and sand particles, leading to **density** changes that can potentially contribute to the dispersion of plastics to deeper marine layers, either through natural **deposition** or as part of **marine snow**







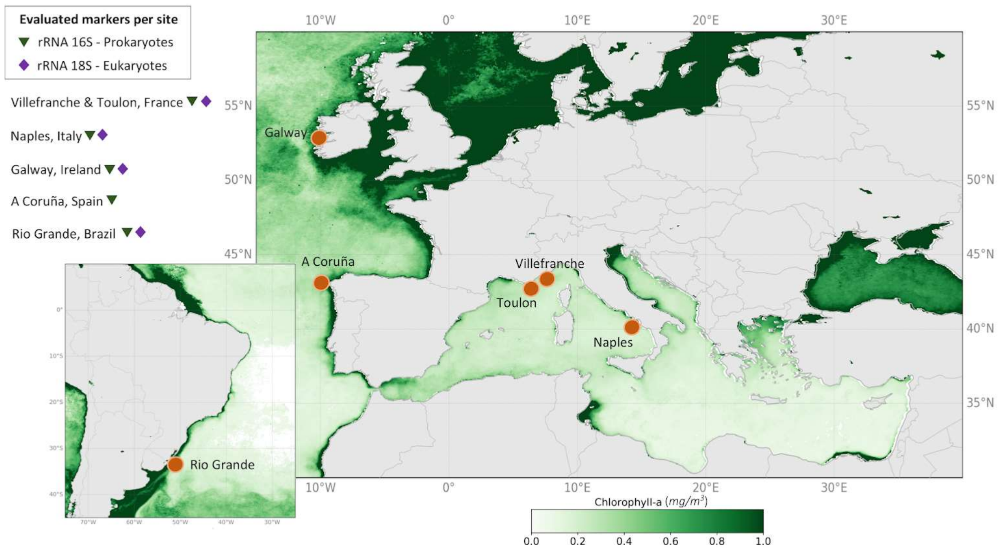
Zheng et al, 2023
https://doi.org/10.1016/j.marpolbul.2023.115180

WHAT HAVE WE FOUND?

Over **550 biofilm samples (rRNA 16S and 18S)** were processed for **viruses, bacteria, fungi and other planktonic organisms**

A wide diversity of organisms were identified with differences **between North and South Atlantic**, and the **Mediterranean Sea**

Toulon and Galway had more **prokaryotes** and **Naples** had more **eukaryotes**



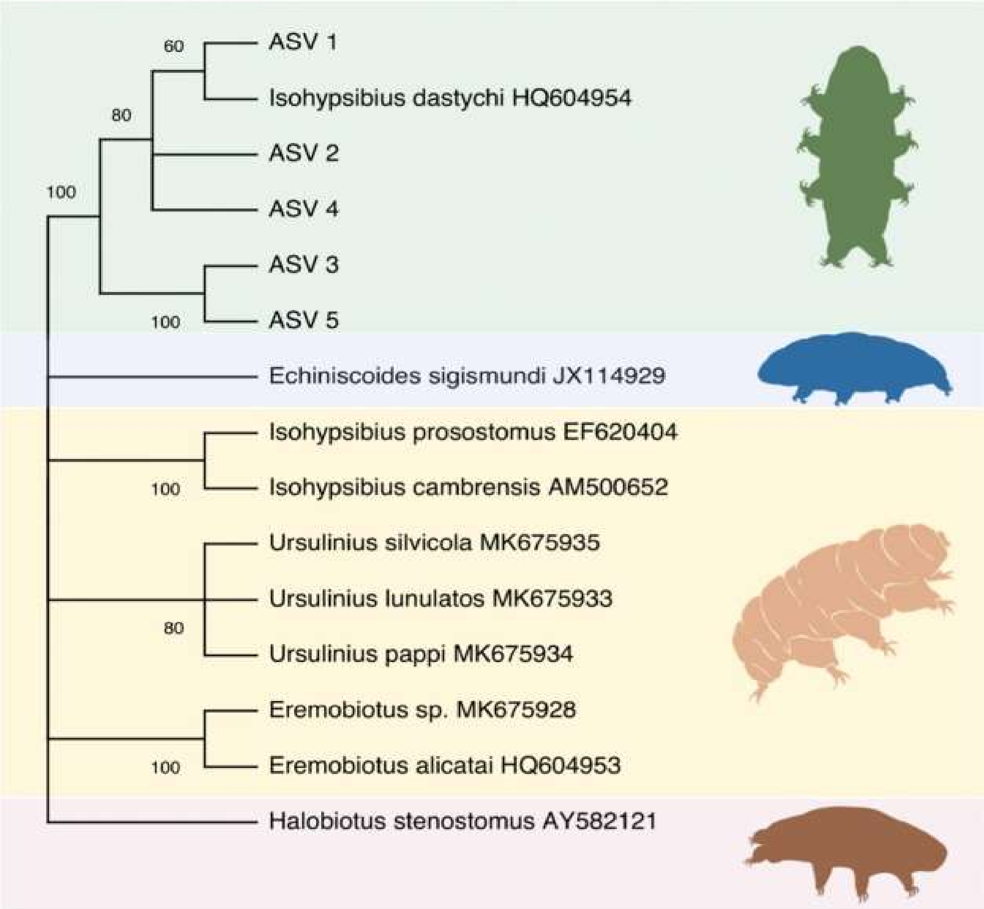
Lacerda et al., *In prep*

Details available soon!

WHAT HAVE WE FOUND?

We have found epiplastic **tardigrades** (water bears) for the **first time in the plastisphere** in **five amplicon sequence variants (ASVs)**

From all the sites explored, they were only found in the **coastal area of Ireland** (Galway)



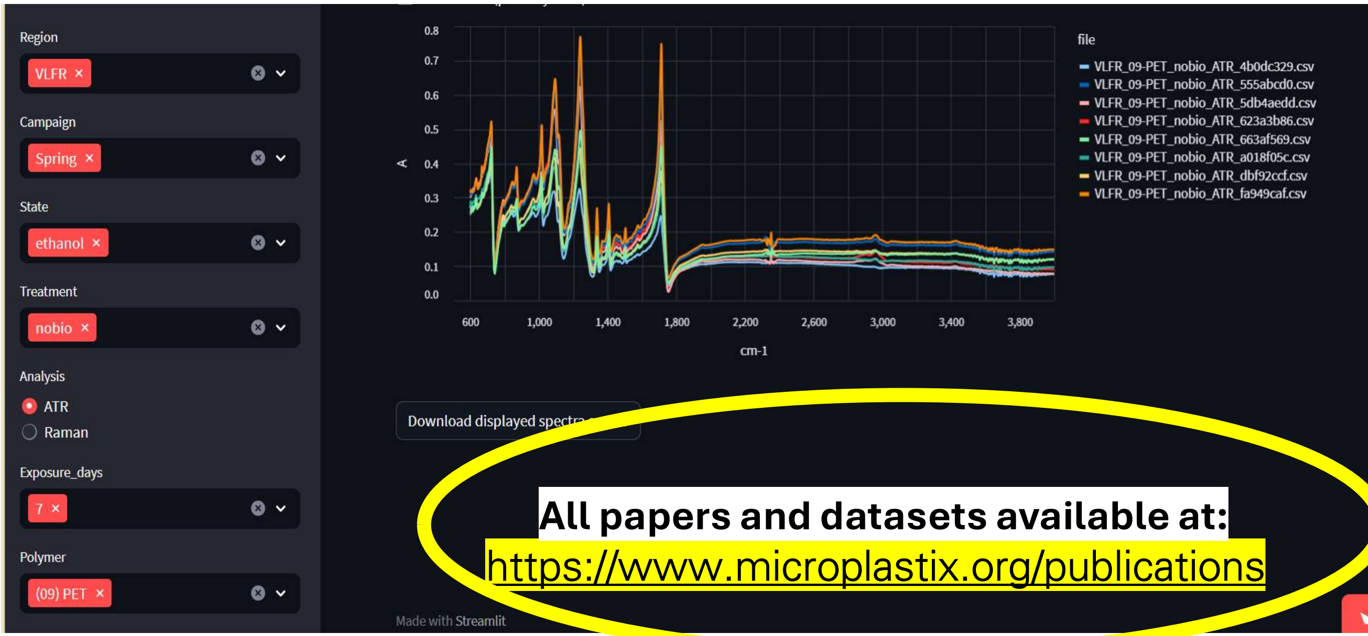
Lacerda, Pedrotti and Frias, 2024
https://doi.org/10.1016/j.marpolbul.2023.115180

WHAT HAVE WE FOUND?

NFDI4Chem

AFTER 60 DAYS UNDERWATER, THE FTIR SPECTROMETRY **DOES NOT RECOGNIZE** THE POLYMER WHEN COMPARED TO THE PRISTINE DATASET

Leibniz-Institut für Polymerforschung Dresden



Lenz et al., 2023
https://microplastix-specdb.streamlit.app/
https://zenodo.org/records/10149551
https://www.nfdi4chem.de/robin-lenz-is-fair4chem-awardee-2024/

NEXT STEPS

PUBLISH PENDING PAPERS

Deep-Sea Research Part I

journal homepage: www.elsevier.com/locate/dsri

Deep sea sediments of the Arctic Central Basin: A potential sink for microplastics

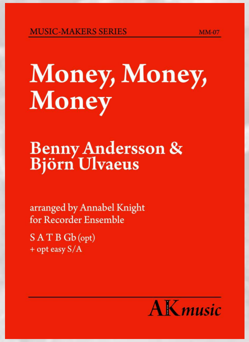
La Daana K. Kanhai, Carina Johansson, J.P.G.L. Frias, Katarina Gardfeldt, Richard C. Thompson, Ian O'Connor

ARTICLE INFO

Keywords:
Microplastics
Marine debris
Arctic Ocean
Sediment
Deep Sea

ABSTRACT

SEEK PARTNERSHIPS AND ADDITIONAL FUNDING FOR ECOTOXICOLOGY STUDIES



RAISE AWARENESS WITHIN THE SCIENTIFIC COMMUNITY AS WELL AS WITH THE RELEVANT STAKEHOLDERS

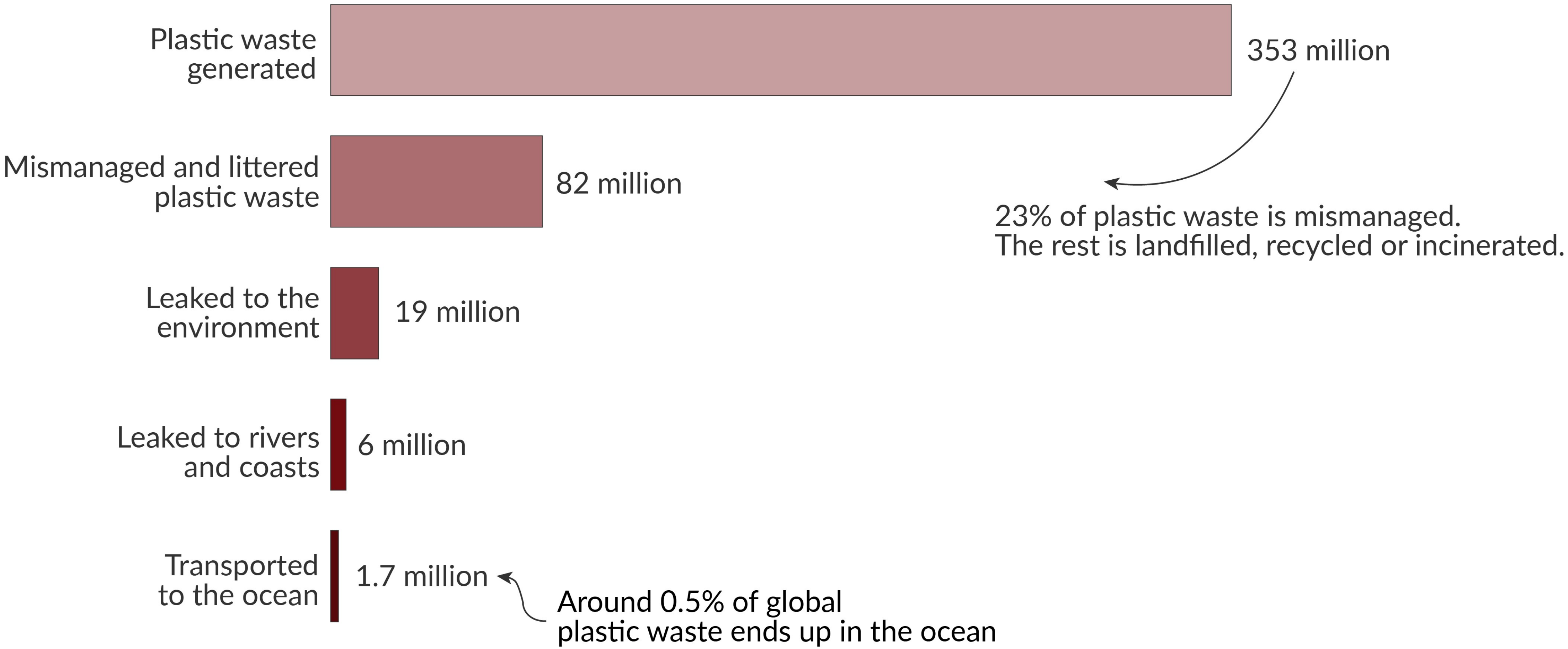
THE SCIENCE WE NEED FOR THE OCEAN WE WANT

MESSAGE IN A BOTTLE?

Photo by Ishan | Unsplash

Around 0.5% of plastic waste ends up in the ocean

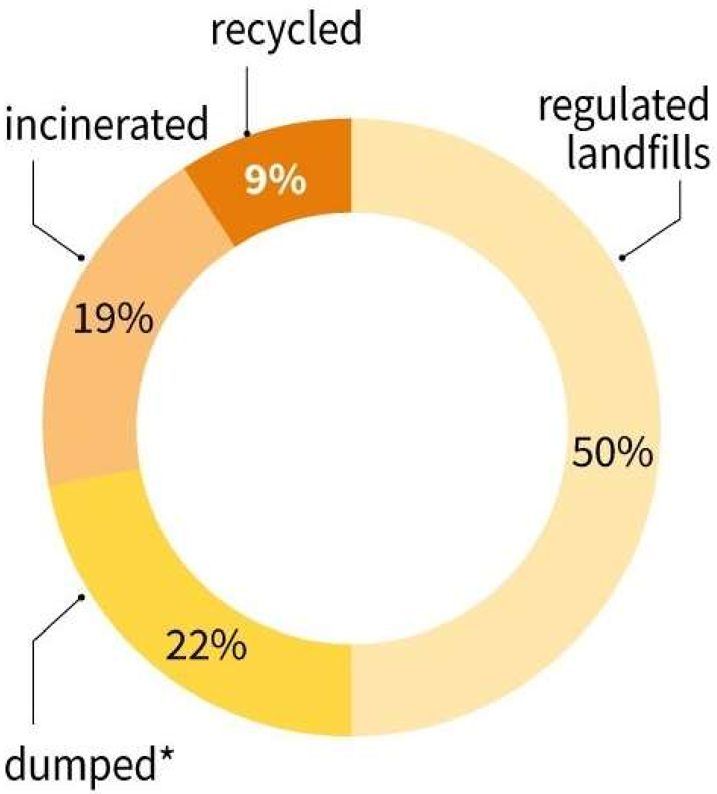
The pathway of global plastic waste to the ocean. Each stage of the chain is measured in million tonnes of plastic per year.



Data source: OECD Global Plastic Outlook (2022).

Plastic waste

353 million tonnes
produced in 2019



*in unregulated landfills, burned in open pits
or leaked into the environment

Source: OECD

AFP

THE SCIENCE WE NEED FOR THE OCEAN WE WANT

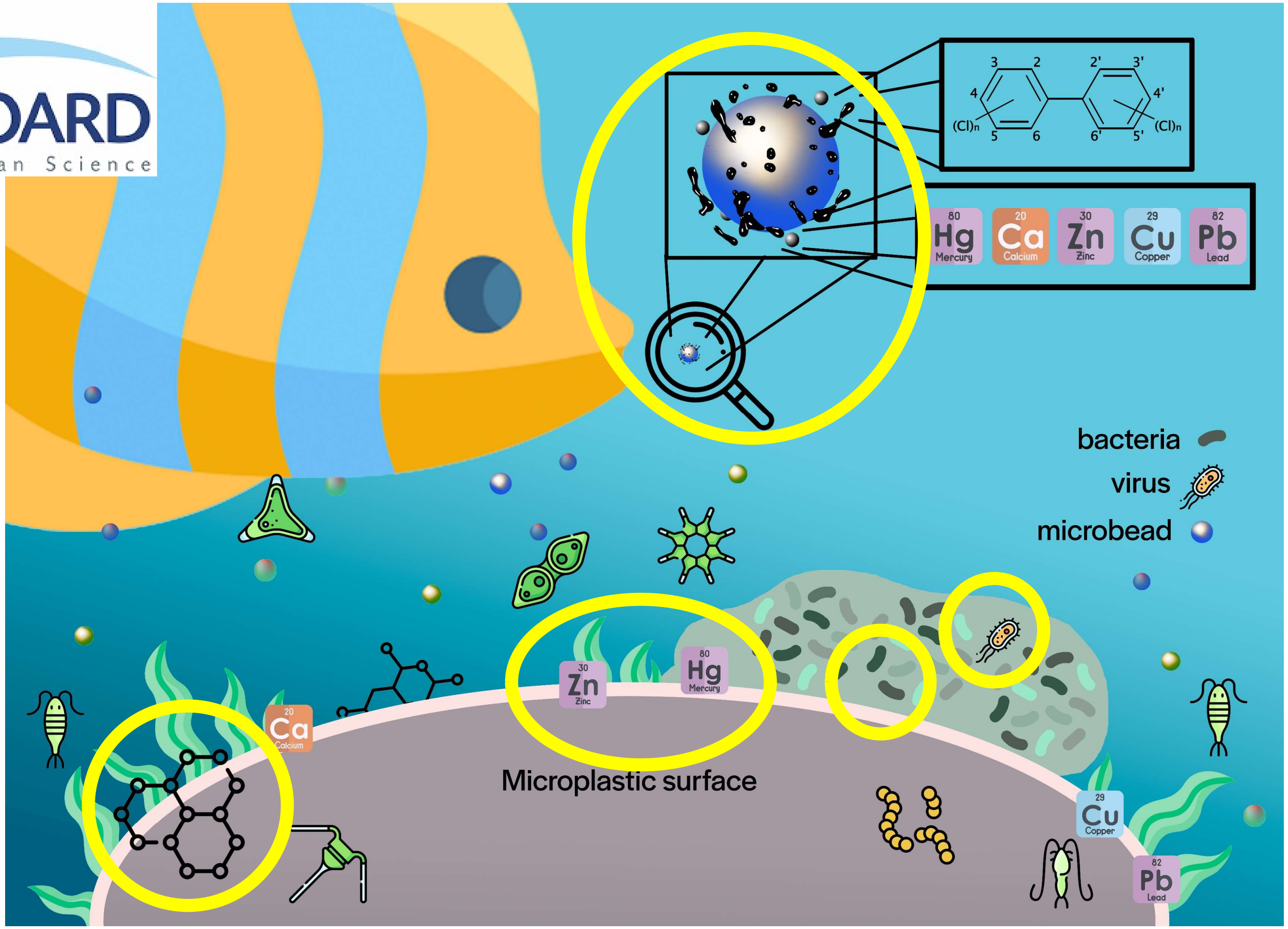


Image part of the Navigating the Future series from the EMB NFVI 2024

ACKNOWLEDGEMENTS OF FUNDING

JPI OCEANS

Foras na Mara
Marine Institute

An Roinn Tithíochta,
Pleanála agus Rialtais Áitiúil
Department of Housing,
Planning and Local Government

Project reference **PBA/PL/20/02**
(MicroplastiX)

Project reference **PDOC/21/04/02**
(Waves of Change)

Contacts

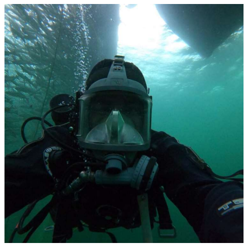
Joao.frias@atu.ie

www.joaofrias.com

@jpglfrias

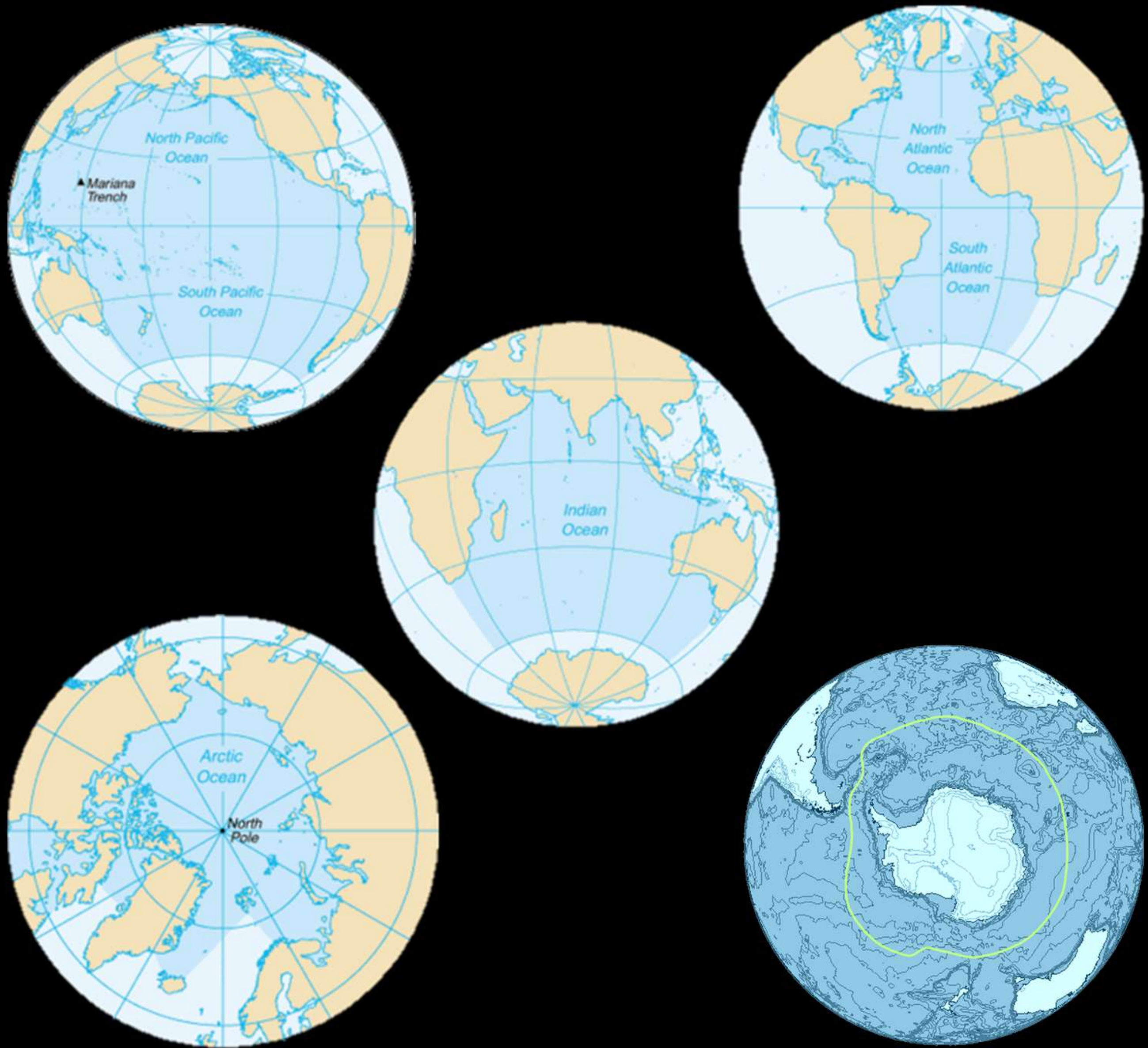
Special thanks to

Captain Brian Sheridan
Galway Harbour Master



Dr Colin Hannon
ATU for diving for this projects

Professor Huahong Shi
East China Normal University


North Pacific Ocean
Mariana Trench
South Pacific Ocean
North Atlantic Ocean
South Atlantic Ocean
Indian Ocean
Arctic Ocean
North Pole

One Ocean


Just because you can't see it, doesn't mean it isn't there
EVERY DISASTER MOVIE BEGINS WITH A SCIENTIST BEING IGNORED
Ferdi Rizkiyanto - 2011


GO RAIBH MILE MAITH AGAT
THANK YOU

From Farm To Plate: Assessing Plastics And Microplastics Across The Value Chain Of Food Systems

frontiers

- Microplastic sources in food systems from agriculture and aquaculture
- Effects of plastic usage in agricultural production on soil and on crops
- Plastic usage in aquaculture and its effects on cultivated species and the surrounding environment
- Alternatives to agricultural plastics and their potential effects on soil, crops, and human health
- Contribution of wastewater sludge to the dispersion and increase of microplastic loadings in agricultural production and marine pollution
- Contamination of foods with microplastics and migration of plastic additives into food via plastic packaging
- Microplastics in processed and unprocessed foods and their potential impacts on human health
- Socioeconomic dimensions of exposure to microplastics through the food supply chain.

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