

Marine Litter: An Uprising Problem

Christopher K. Pham

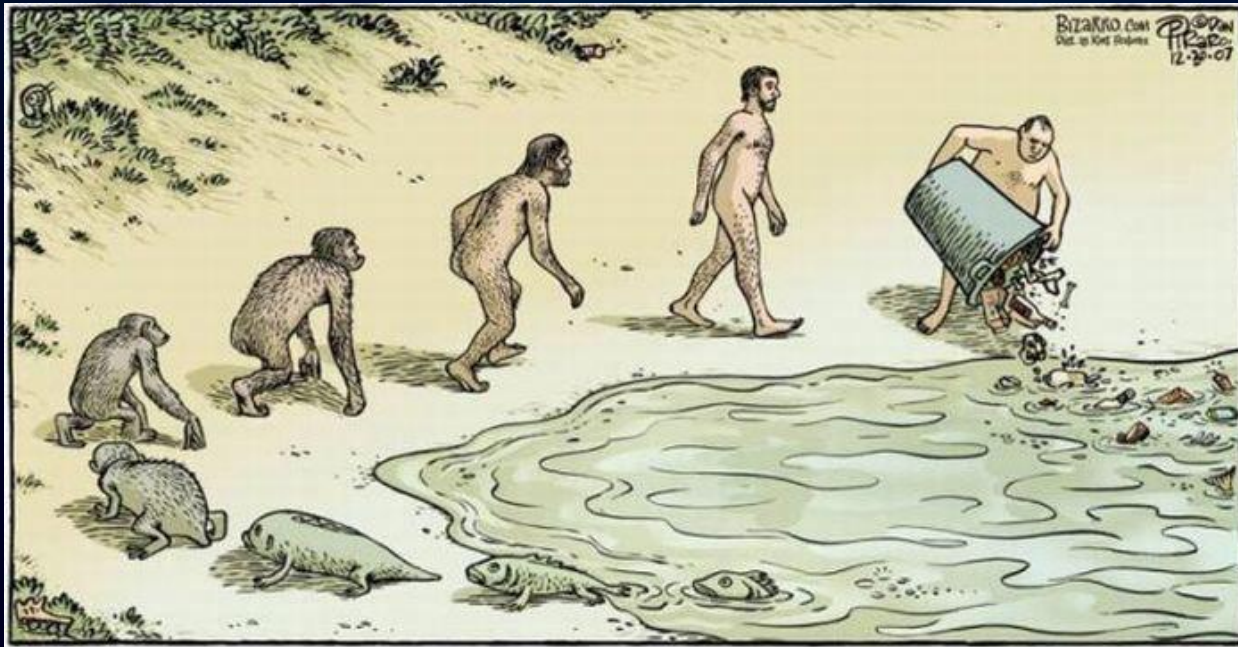
MARE – Marine and Environmental Sciences Centre, Department of Oceanography and Fisheries, University of the Azores



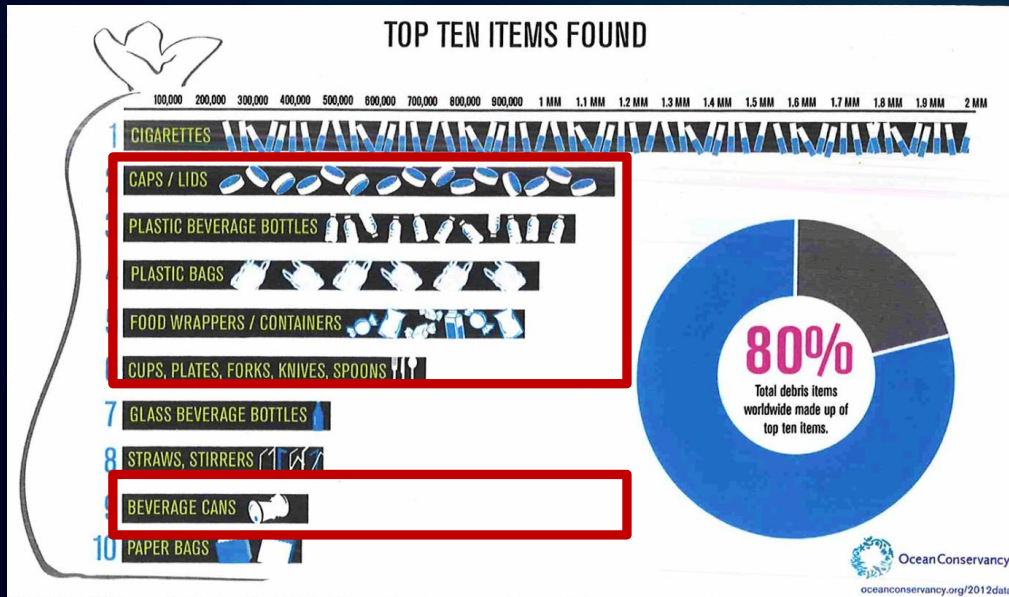
Definition

Defined by the United Nations Environment Program (UNEP):

“Any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment.”



Plastic is the dominant litter material found in the marine environment



Plastic Production

Mass production started in 1950s



Throwaway Living

DISPOSABLE ITEMS CUT DOWN HOUSEHOLD CHORES

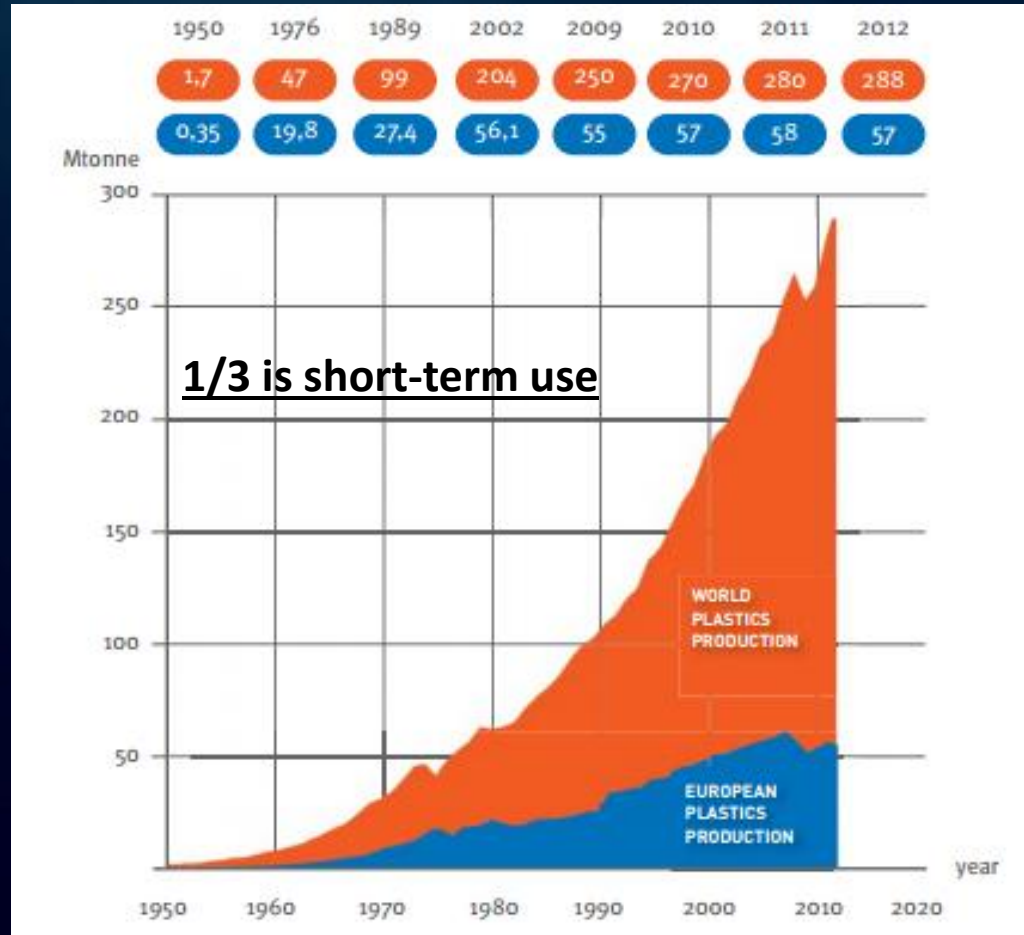
The objects flying through the air in this picture would take 40 hours to clean—except that no housewife need bother. They are all meant to be thrown away after use. Many are new; others, such as paper plates and towels, have been around a long time but are now being made more attractive.

At the bottom of the picture, to the left of a New York City Department of Sanitation trash can, are some throwaway vases and flowers, popcorn that pops in its own pan. Moving clockwise around the photograph come assorted frozen food containers,

a checkered paper napkin, a disposable diaper (seriously suggested as one reason for a rise in the U.S. birth rate) and, behind it, a baby's bib. At top are throwaway water wings, foil pans, paper tablecloth, guest towels and a sectional plate. At right is an all-purpose bucket and, scattered throughout the picture, paper cups for beer and highballs. In the basket are throwaway draperies, ash trays, garbage bags, hot pads, mats and a feeding dish for dogs. At the base of the basket are two items for hunters to throw away: disposable gone and duck decoys.

CONTINUED

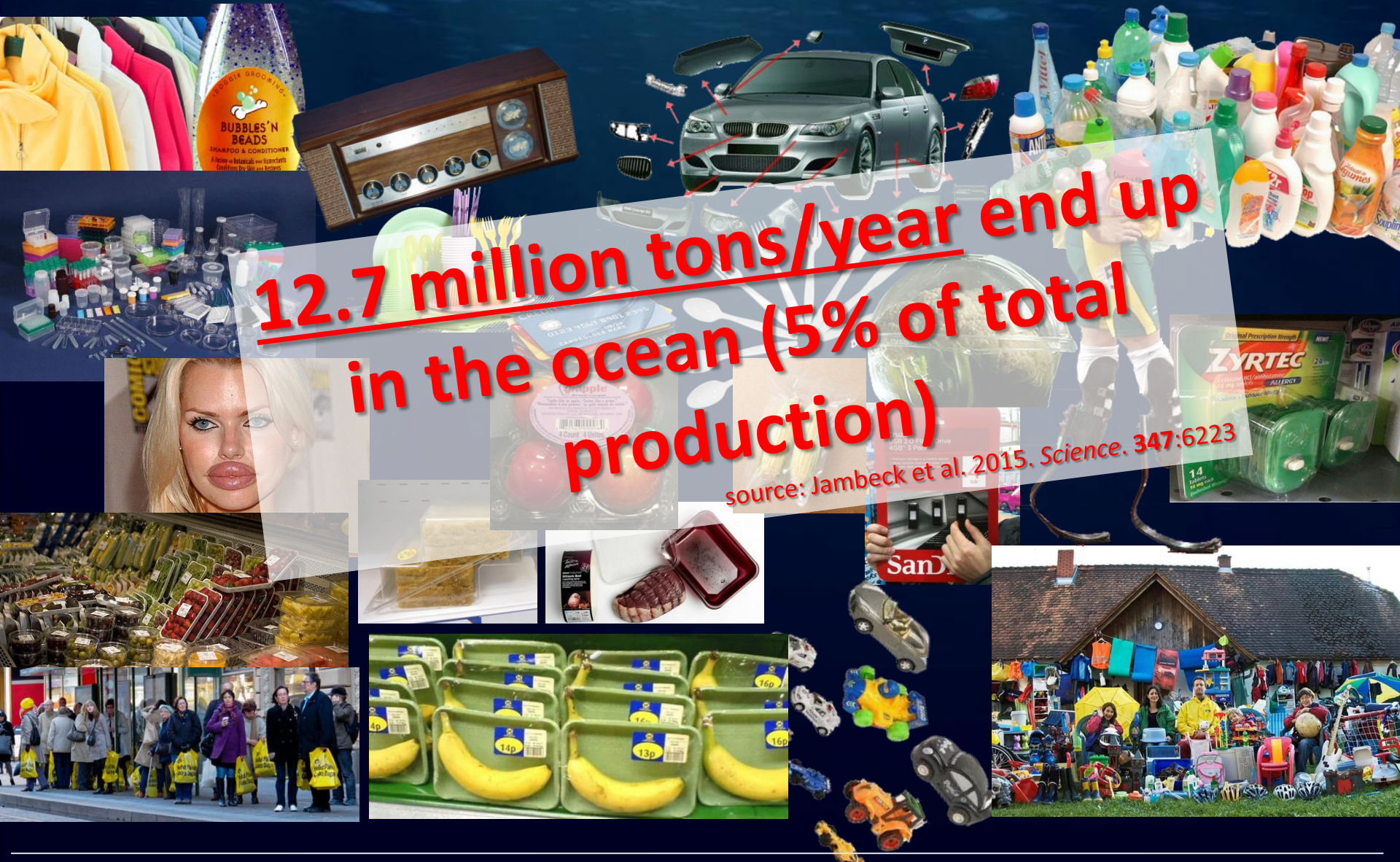
LIFE magazine, 1955



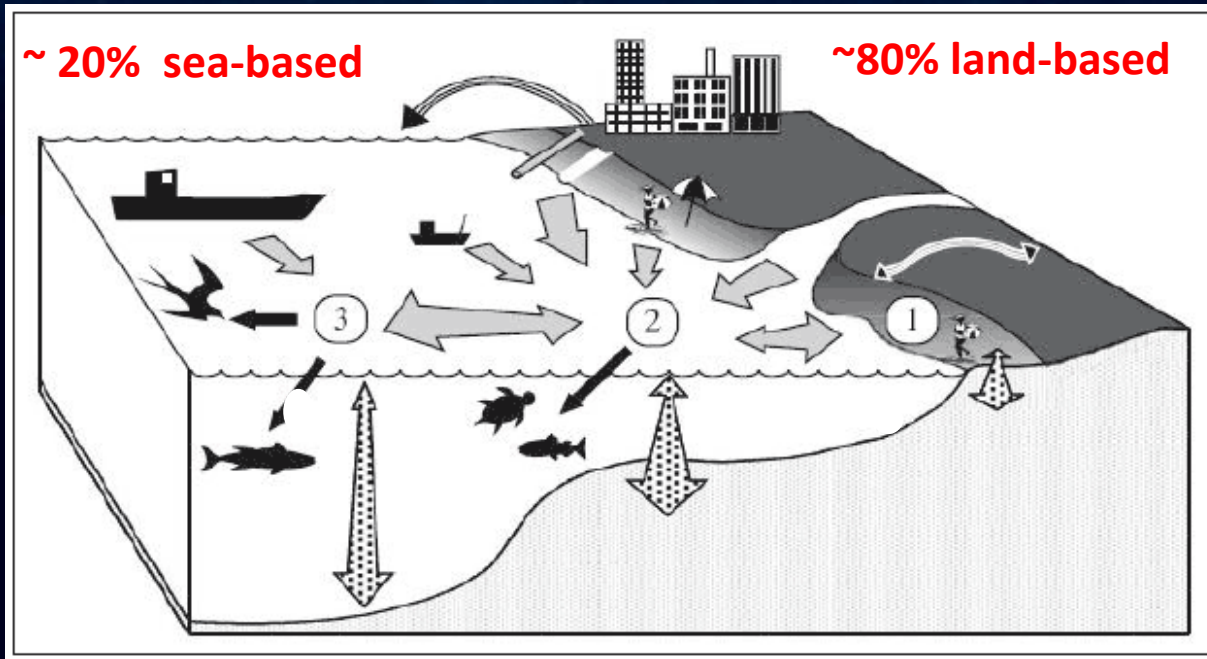
A PLASTIC PLANET

**12.7 million tons/year end up
in the ocean (5% of total
production)**

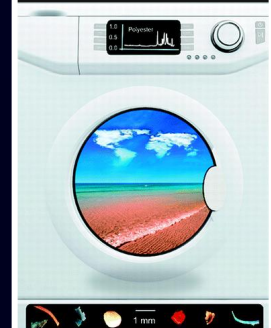
source: Jambeck et al. 2015. Science. 347:6223



How does it get into the ocean?



Ryan et al. 2009. Phil. Trans. R. Soc. B



Distributed across the marine realm

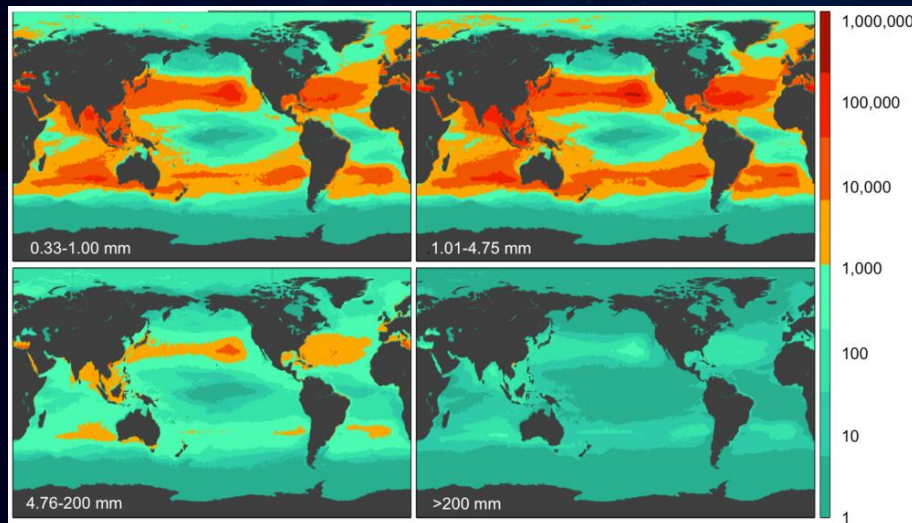
- **Coastal environment**: combination of different materials that differ in size and composition
- **Ocean surface**: fragments and whole items of floating plastic trash.
- **Water column**: mostly plastic fragments, small enough to be suspended by ocean currents
- **Ocean floor (down to 7200m)**: dominated by larger material, such as fishing gear and beverage containers but also microplastics.





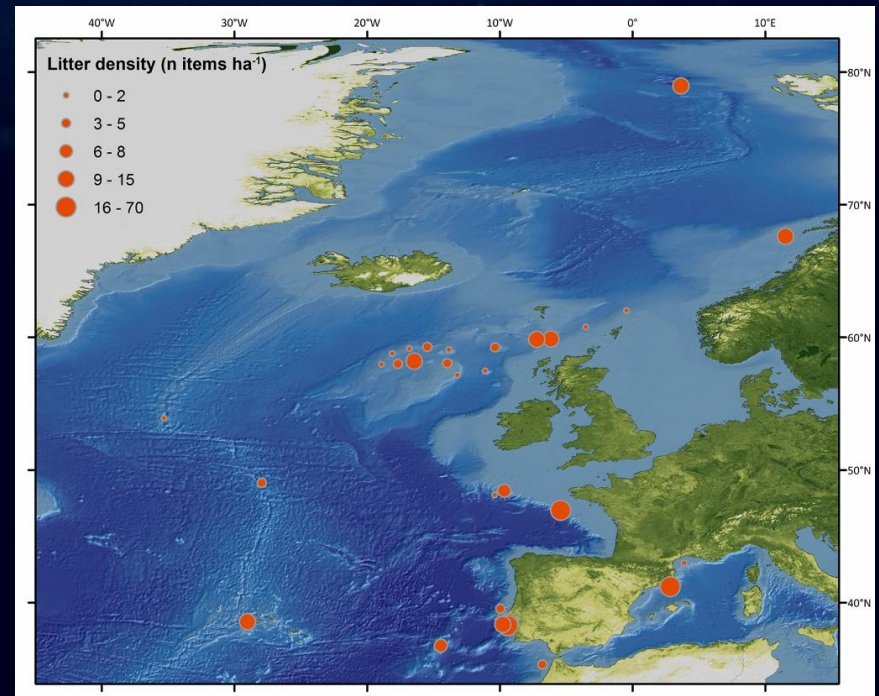
Few locations are free of marine litter

SURFACE



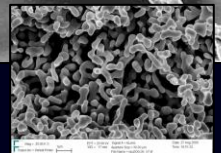
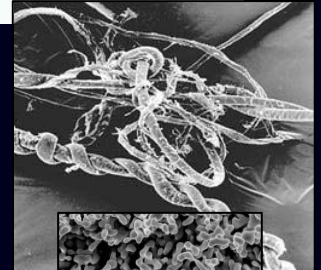
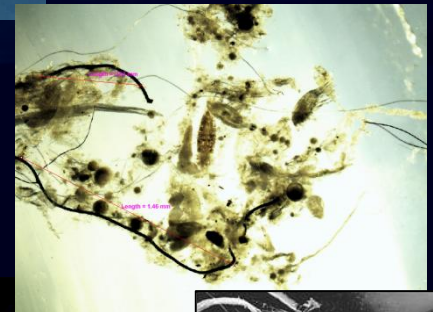
Eriksen et al. 2014. Plos One

SEAFLOOR

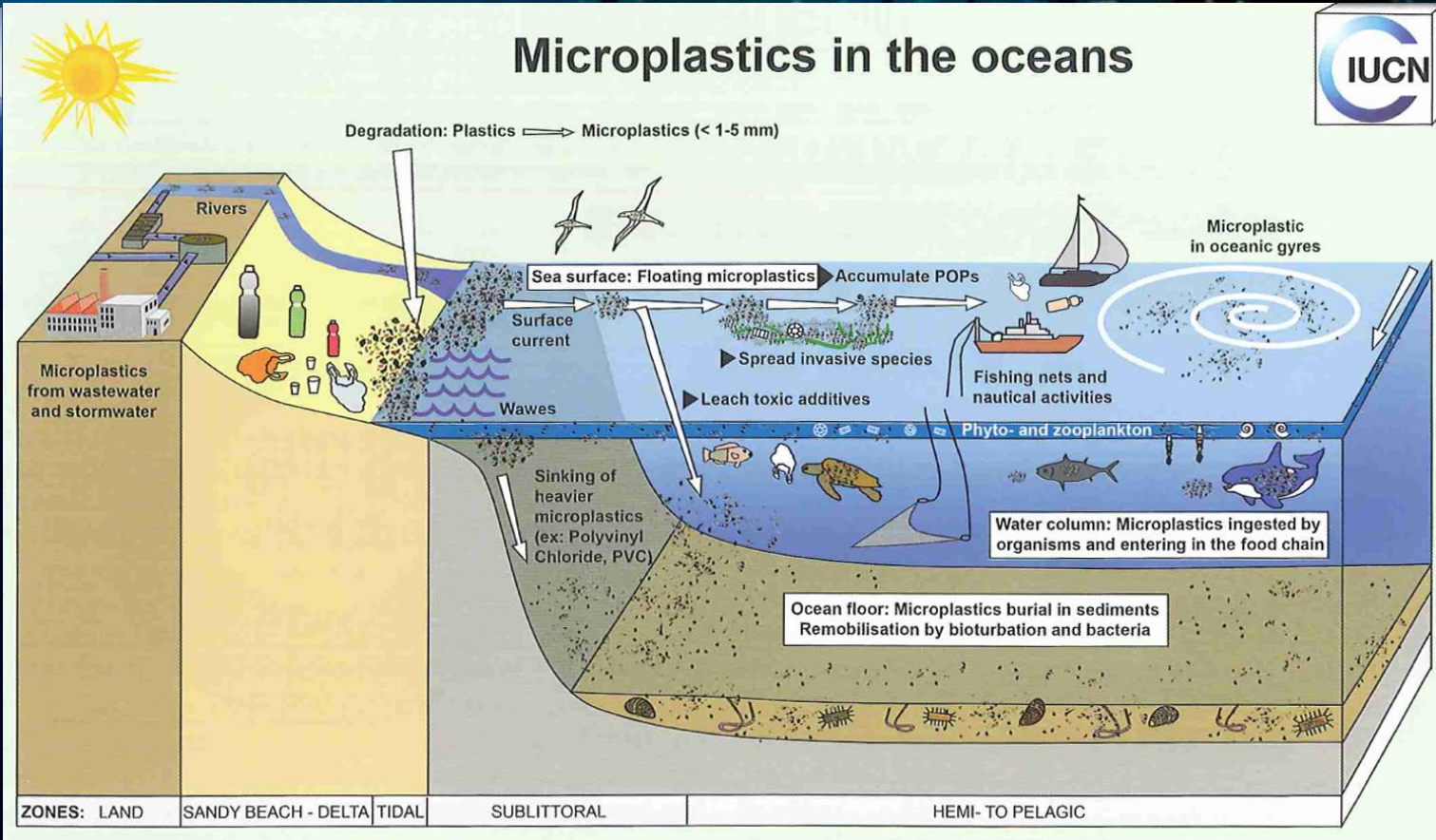


Pham et al. 2014. Plos One

Size of marine litter is highly variable



MICROPLASTIC (<5mm)



Thevenon et al. 2015

MICROPLASTIC:

Great Pacific Garbage Patch: an island of plastic?

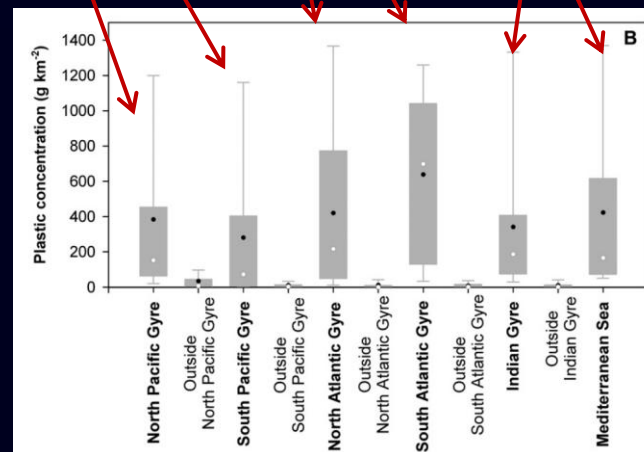
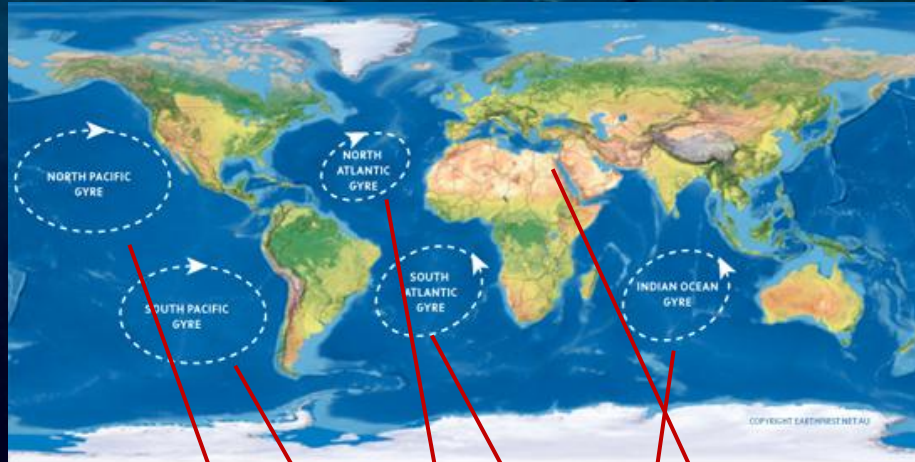


MICROPLASTIC:

Great Pacific Garbage Patch: an island of plastic?

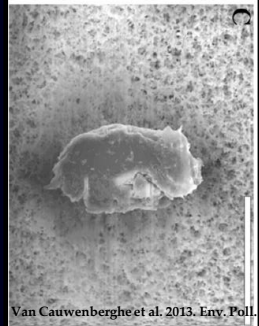
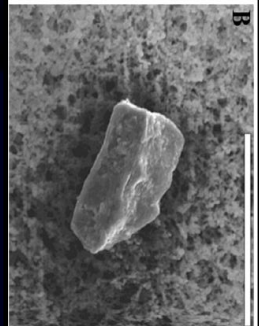


MICROPLASTICS IN THE OPEN SEA



Cozár et al. 2015. Plos One

MICROPLASTIC IN THE DEEP SEA



Van Cauwenberghe et al. 2013. *Env. Poll.*

Environmental Pollution 182 (2013) 495–499

Contents lists available at ScienceDirect

Environmental Pollution

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

ELSEVIER

Short communication

Microplastic pollution in deep-sea sediments

Lisbeth Van Cauwenberghe^{a,*}, Ann Vanreusel^b, Jan Mees^{b,c}, Colin R. Janssen^a

^aLaboratory of Environmental Toxicology and Aquatic Ecology, Ghent University, Coupure links 22, 9000 Ghent, Belgium
^bBiology Department, Marine Biology Research Group, Ghent University, Krijgslaan 281/S8, 9000 Ghent, Belgium
^cFlanders Marine Institute (VLIZ), Wandelaarstraat 7, 8400 Oostende, Belgium

CrossMark

ROYAL SOCIETY OPEN SCIENCE

rsos.royalsocietypublishing.org

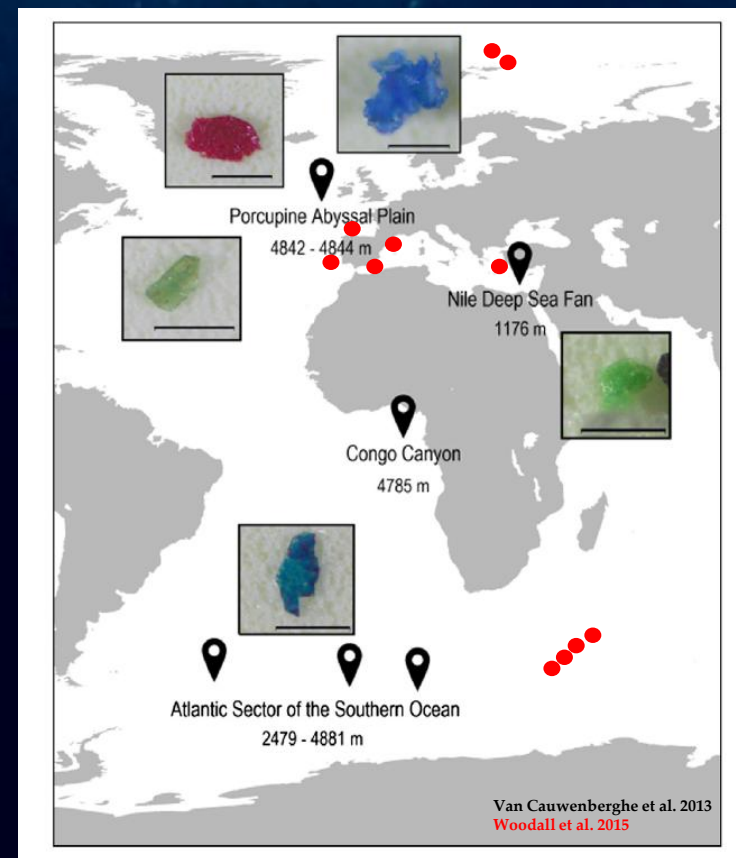
Research

CrossMark

The deep sea is a major sink for microplastic debris

Lucy C. Woodall¹, Anna Sanchez-Vidal², Miquel Canals², Gordon L. J. Paterson¹, Rachel Coppock³, Victoria Sleight³, Antonio Calafat², Alex D. Rogers⁴, Bhavani E. Narayanaswamy⁵ and Richard C. Thompson³

Cite this article: Woodall LC et al. 2014 The deep sea is a major sink for microplastic debris. *R. Soc. open sci.* 1: 140317.



IMPACTS OF MARINE LITTER

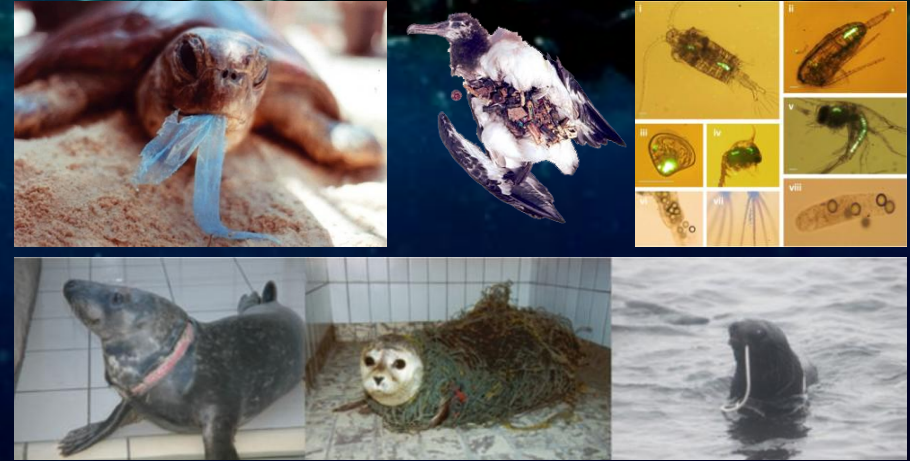


IMPACTS ON MARINE ORGANISMS

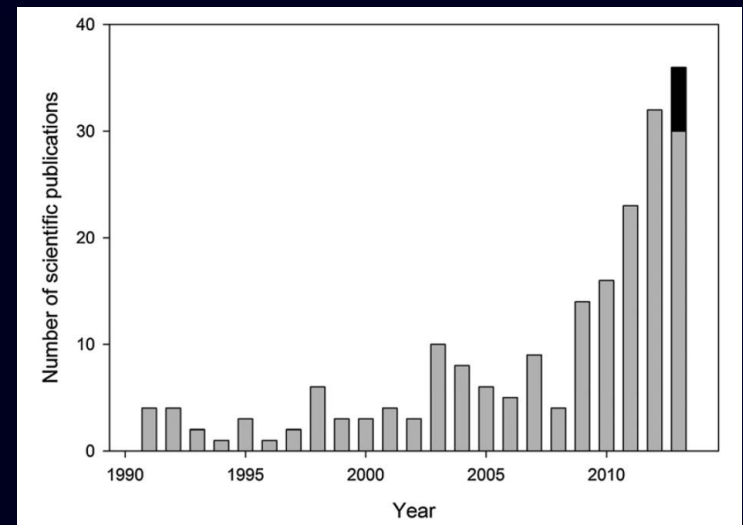
- In 2015 ~700 species reported to be affected (invertebrates → mammals)
- 17% already on IUCN red list (Gall & Thompson, 2015)

• INGESTION OR ENTANGLEMENT

- Entanglement more frequently reported
- Ingestion is frequent but less well documented
- All known species of sea turtle
- 50% of all species of marine mammal and sea bird have ingested or become entangled in marine debris



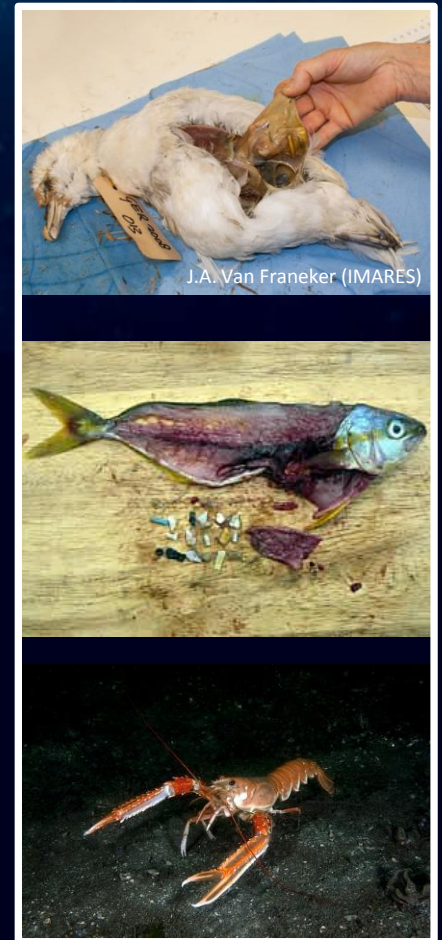
Kuhln et al. 2015



IMPACTS ON MARINE ORGANISMS:

THREATS AT THE POPULATION LEVEL

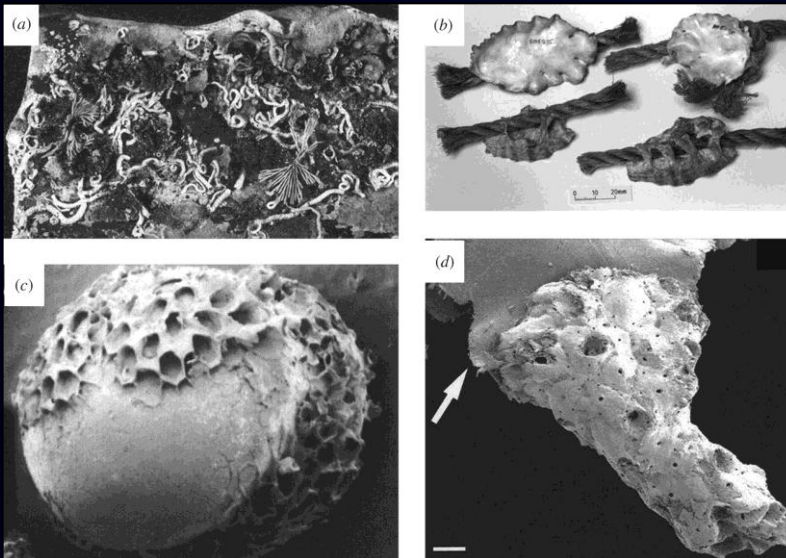
- 95% of northern fulmars (*Fulmarus glacialis*) contain plastic in their stomach (n=1500; van Franeker et al. 2011)
- 36% of commercially important fish sampled in the English Channel had eaten plastic (Lusher et al. 2012).
- 83% of the Norway lobster (*Nephrops norvegicus*) contained plastic filaments (Murray & Cowie 2011)



OTHER ENVIRONMENTAL IMPACTS

Spread of invasive species

The presence of marine litter has approximately doubled the number of different species found in the subtropics (Barnes, 2002. *Nature*).



SOCIO-ECONOMIC IMPACTS

Direct losses

- **Costs of cleaning** (e.g. 10€ million/year in Belgium and Holland (Mouat et al. 2010))
- **Loss of tourism** (e.g. 29€ million/year in S.Korea (Jang et al. 2014))
- **Property damages;**
(e.g. 3\$ million/year in propeller damages for UK harbors)
- In the Asia-Pacific region marine litter costs overall about 1€ billion per year (McIlgorm et a. 2011)



What about indirect losses (e.g. ecosystem services) ???

An underwater photograph showing a diver in the center, surrounded by a dense field of marine litter. The litter includes various pieces of plastic, such as bottles, bags, and fragments, scattered across the seabed. The water is clear, and the scene is illuminated by natural light from above.

Marine Strategy Framework Directive (MSFD)

Descriptor 10: Properties and quantities of marine litter do not cause harm to the coastal and marine environment

1. Litter and its degradation products do not cause harm to marine life and damage to marine habitats.
2. Litter and its degradation products present in, and entering into EU water do not pose direct or indirect risks to human health.
3. Litter and its degradation products present in, and entering into EU waters do not lead to negative socio-economic impacts.

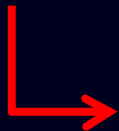
Overriding objective:

Measurable and significant decrease of the total amount of marine litter by 2020



G-7 Leaders' Declaration of the 41st Summit 7-8 June 2015

“ ...We acknowledge that marine litter, in particular plastic litter, poses a global challenge, directly affecting marine and coastal life and ecosystems and potentially also human health. Accordingly, increased effectiveness and intensity of work is required to combat marine litter striving to initiate a global movement. **The G7 commits to priority actions and solutions to combat marine litter** as set out in the annex, stressing the need to address land- and sea-based sources, removal actions, as well as education, research and outreach...”



G7 ACTION PLAN TO COMBAT MARINE LITTER

THANK YOU FOR YOUR ATTENTION

Email: phamchristopher@uac.pt



MSFD MEASURES FOR THE REDUCTION OF MARINE LITTER

The berlin Conference

| TYPES | MEASURES |
|--------------------------|--|
| Sea based litter | Port reception facilities; No-special-fee system (also for marinas); Fishing for Litter; Removal of Abandoned & Lost & Discarded Fishing Gear. |
| Land-based litter | The inclusion of Marine litter as an integrated part of municipal solid waste management; An Improved waste management(Recycling) , including the ban on illegal dumping, especially in tourism hotspots; The Upgrade, redesign and improved maintenance of sewage system, including the storage of wastewater; The establishment of "Guidelines for Management of Coastal Litter"); The transfer of skills/knowledge to Mediterranean countries in the South and East; Education and outreach on marine litter impacts; Incentives/disincentives for littering; Ban smoking on beaches and the Introduction of dissuasive taxes (plastic bags or/ as «tourist tax", etc.) |

MSFD MEASURES FOR THE REDUCTION OF MARINE LITTER

The berlin Conference

| TYPES | MEASURES |
|---------------------------|--|
| Clean-up measures | Compulsory cleaning of inland pathways (rivers, near landfills etc.), beach cleaning by local communities and/or private companies (i.e. of the tourism sector); Incentives for beach cleaning (e.g. awards, like the “Blue flag award”). |
| Production | Smart production (Ban on single-use plastic bags, packaging guidelines, Elimination of certain products (microbeads), use of paper/carton made cotton swabs, extended producer responsibility measures and voluntary agreements with plastic industry for return and restoration integrated management systems |
| Knowledge and data | Standard monitoring programme(s) that consistently describe the litter, their sources and quantities; information sharing around the Mediterranean, |