



Towards a Clean Litter-Free European
Marine Environment through Scientific Evidence
Innovative Tools and Good Governance

Sailing on a Clean Sea

navigating our way to a sea without marine litter

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What is marine litter?

‘Any persistent, manufactured or processed solid material disposed of or abandoned in the marine and coastal environment’ (UNEP 2005)

- Plastics and rubber
- Metal
- Glass
- Other manufactured materials



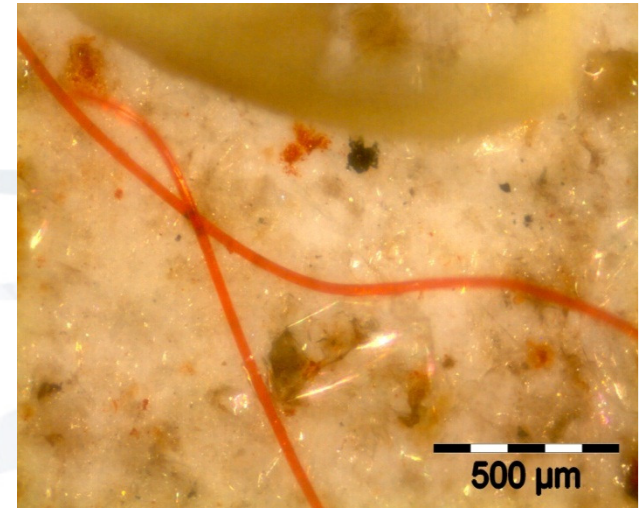
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Macro litter



Micro litter <5 mm



Microplastics in the North Sea (IVM)



Northern Fulmar stomach contents

Van Franeker et al. Environ Poll. 2011



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Litter comes from populated areas...



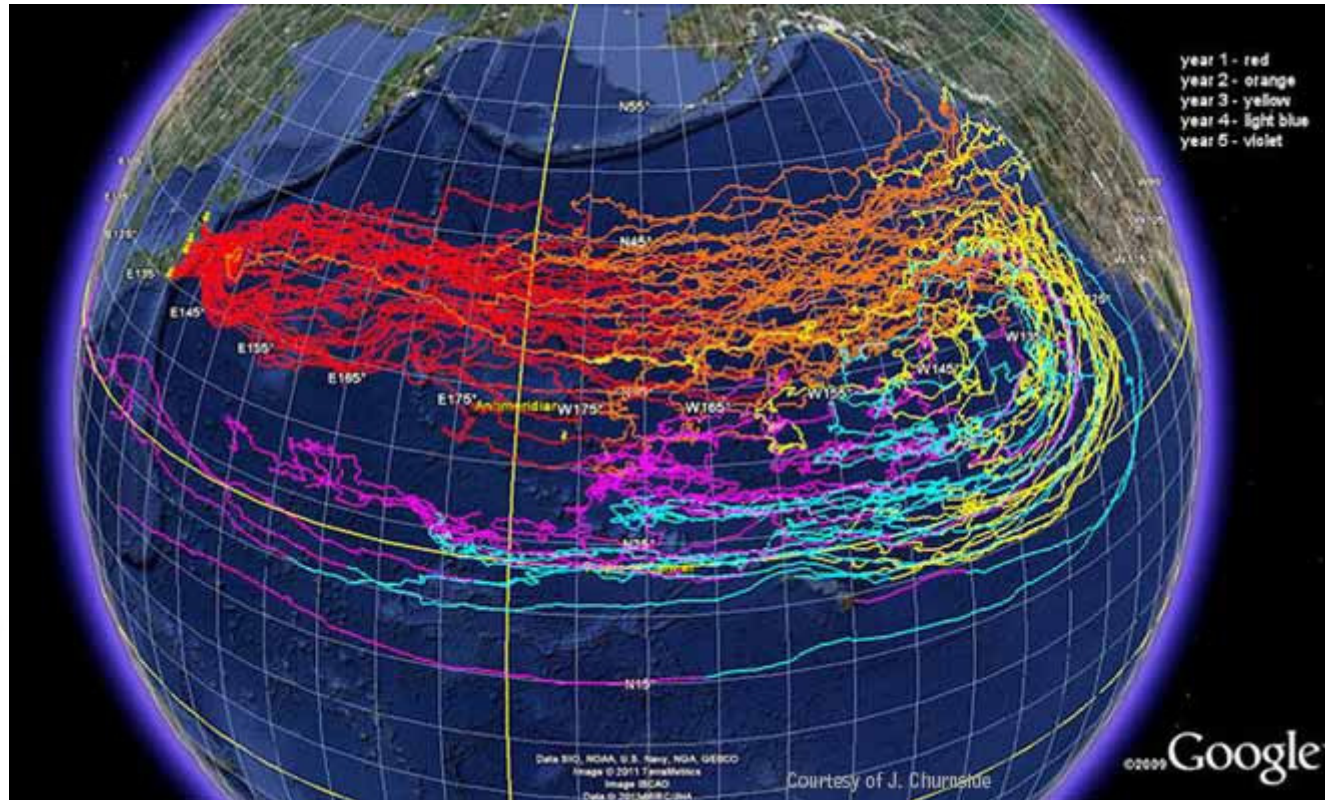








Natural disasters, e.g. tsunami

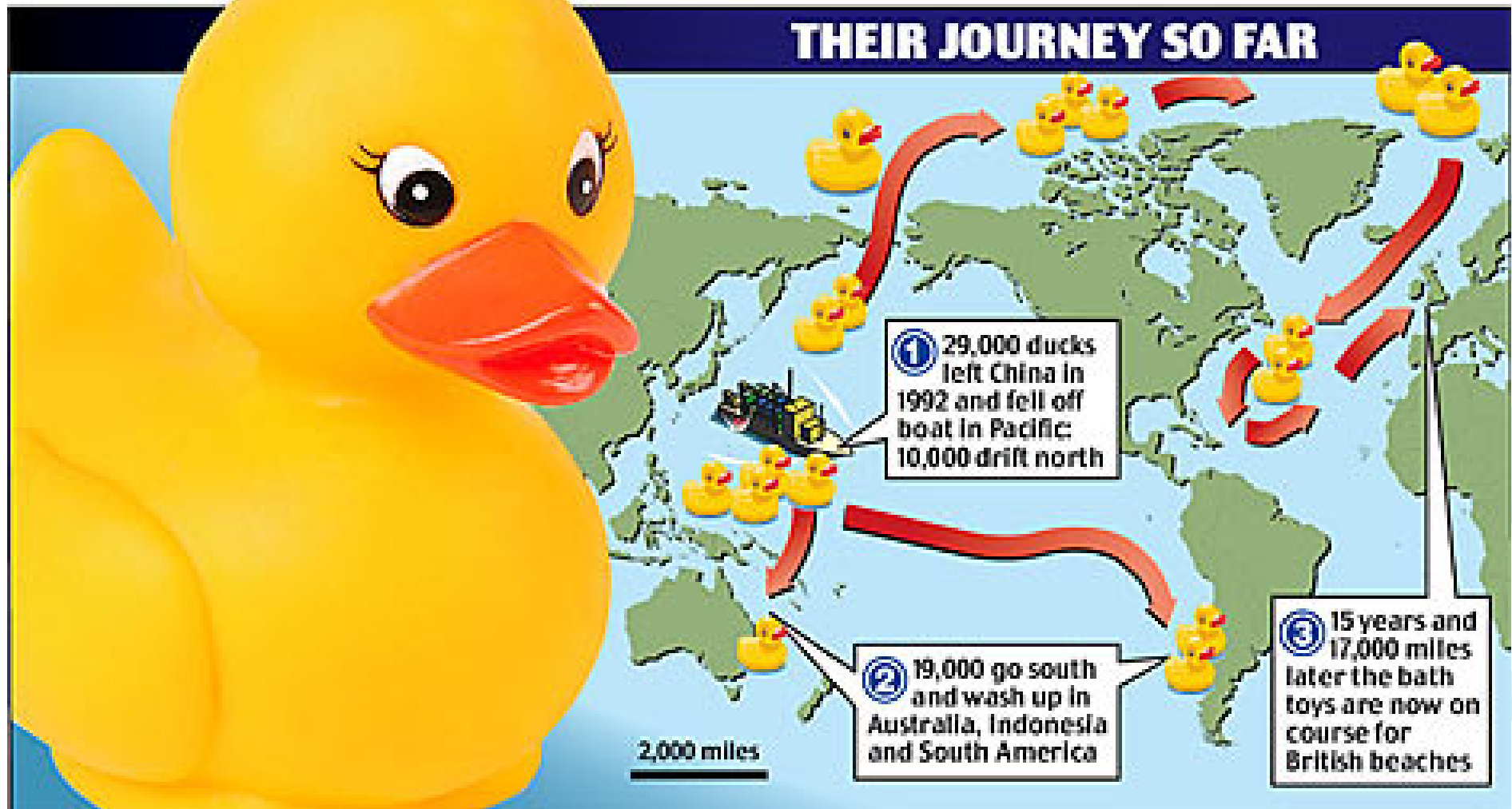


NOAA has run a model using OSCURS (Ocean Surface Current Simulator). Year 1 = red; Year 2 = orange; Year 3 = yellow; Year 4 = light blue; Year 5 = violet. By 2016 the debris will have circled back towards Hawaii

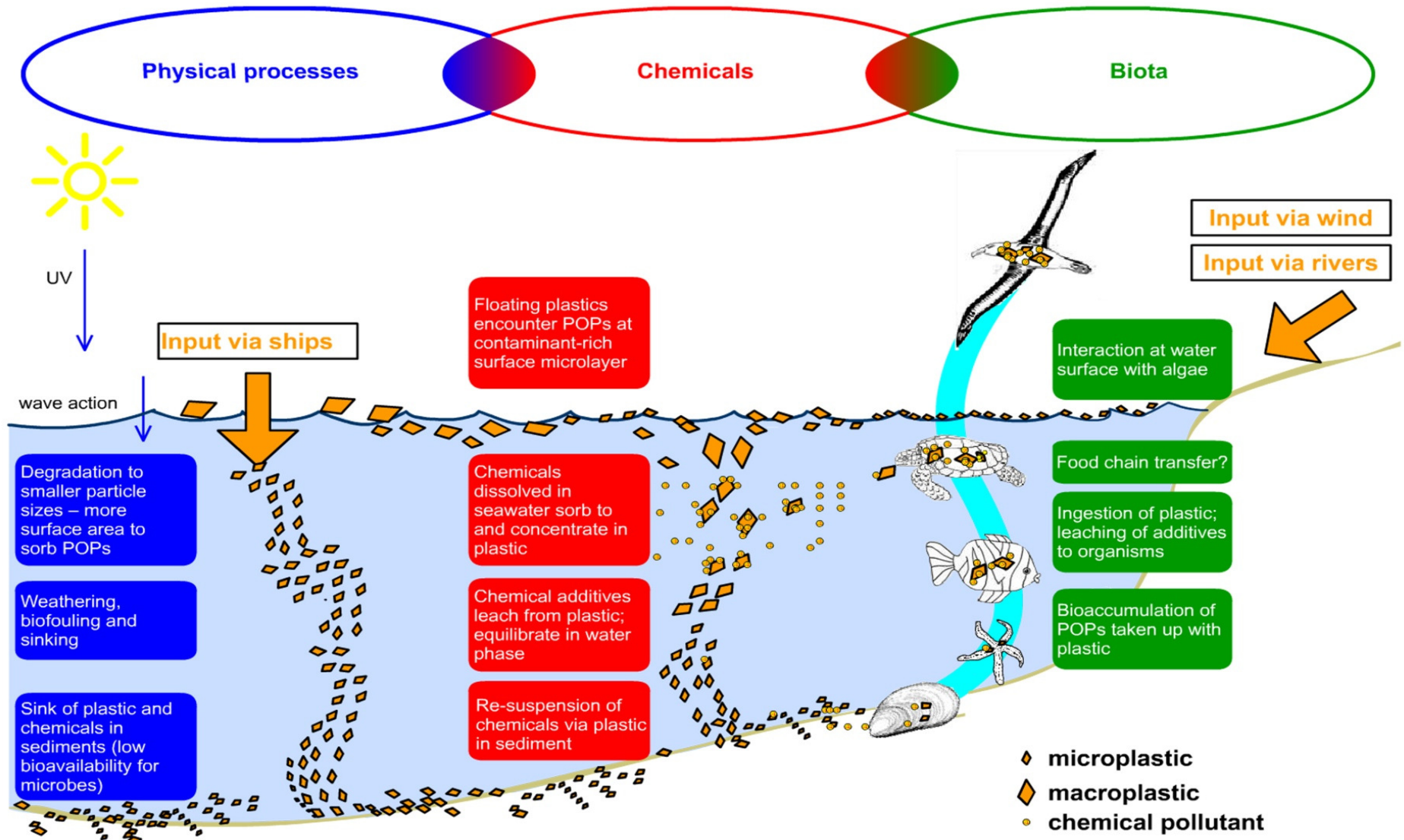
Accidents



29,000 bath toys spill, 1992, Pacific Ocean



Multiple routes of marine litter to the sea

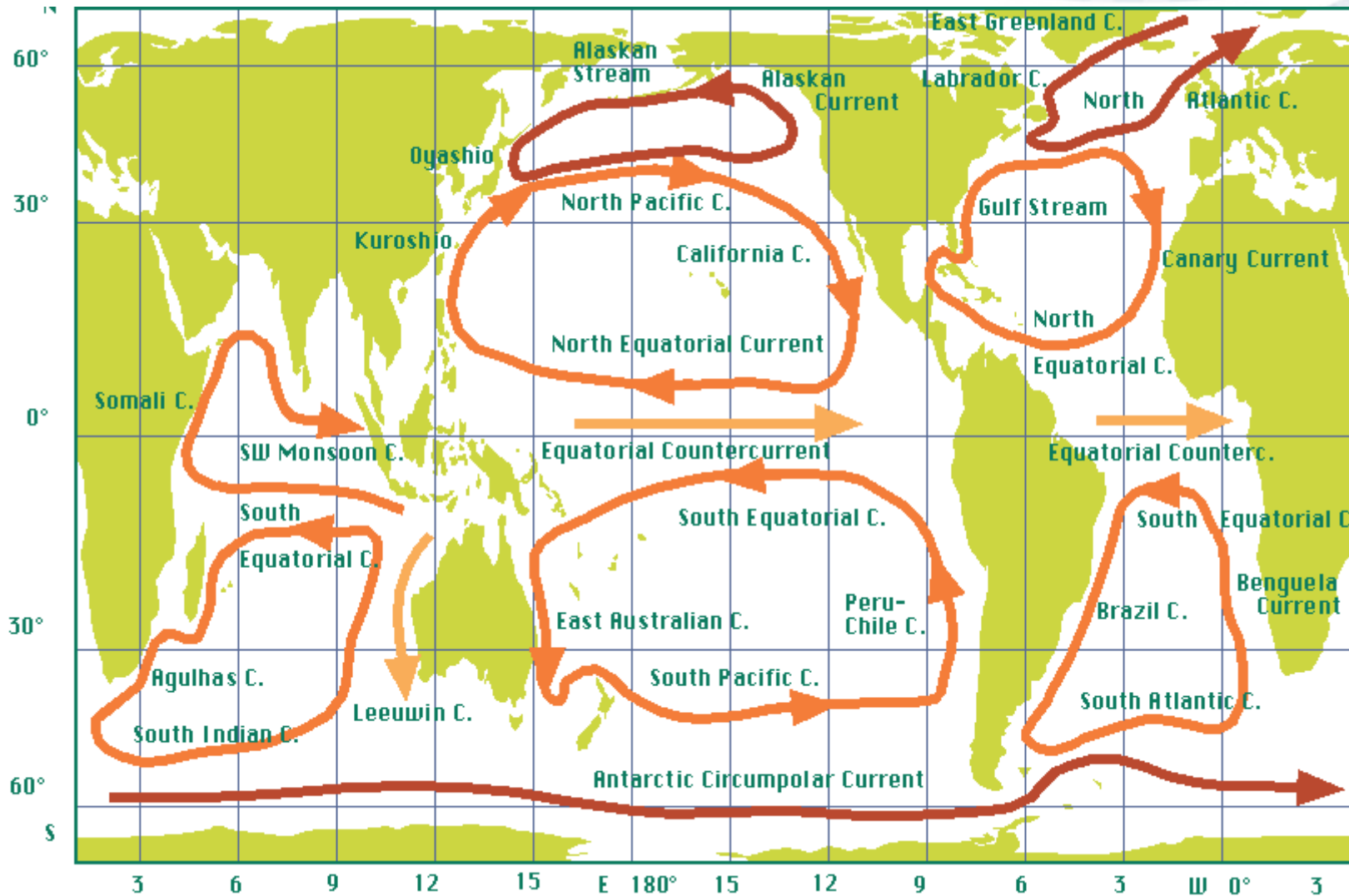


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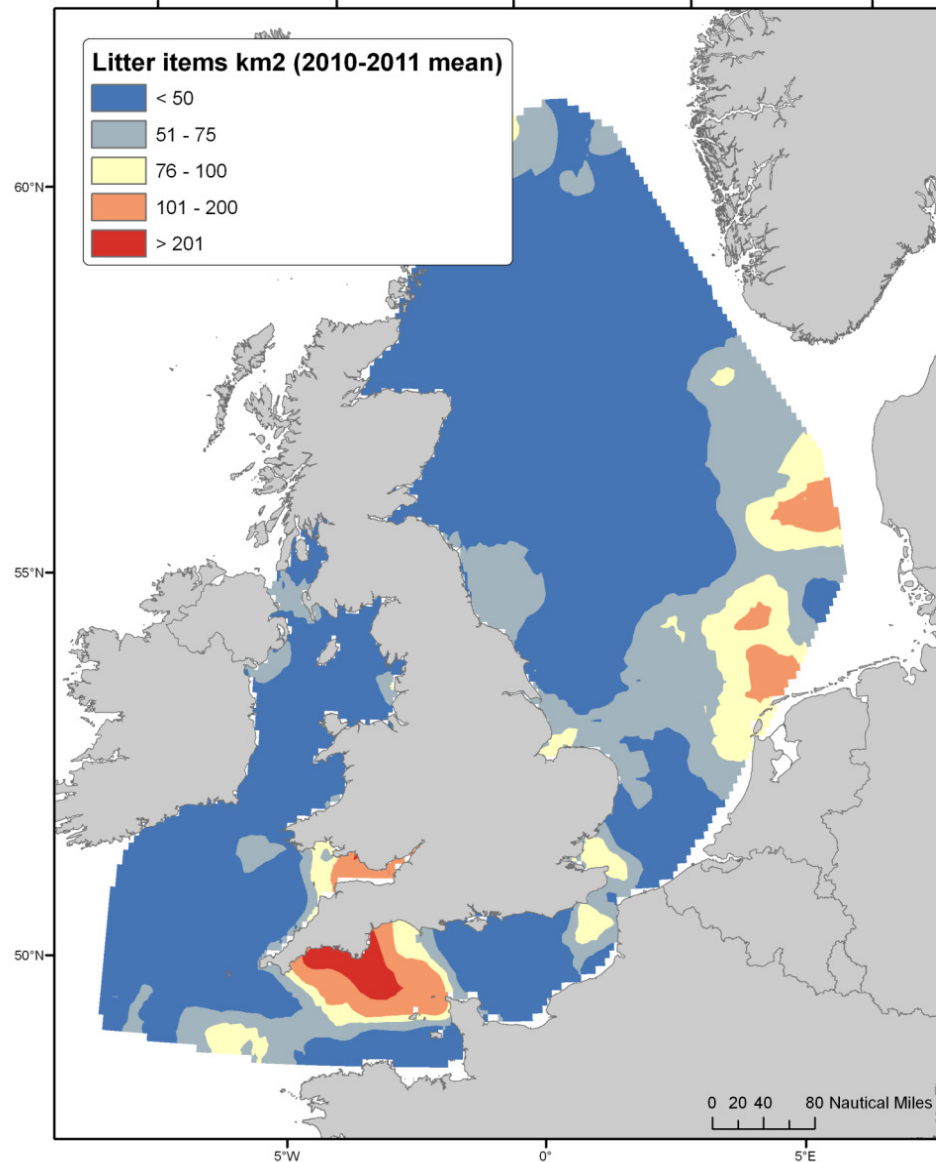


Litter on the move

Captain Charles Moore



Distribution of litter on the sea bed



Thomas Maes
Cefas (UK)

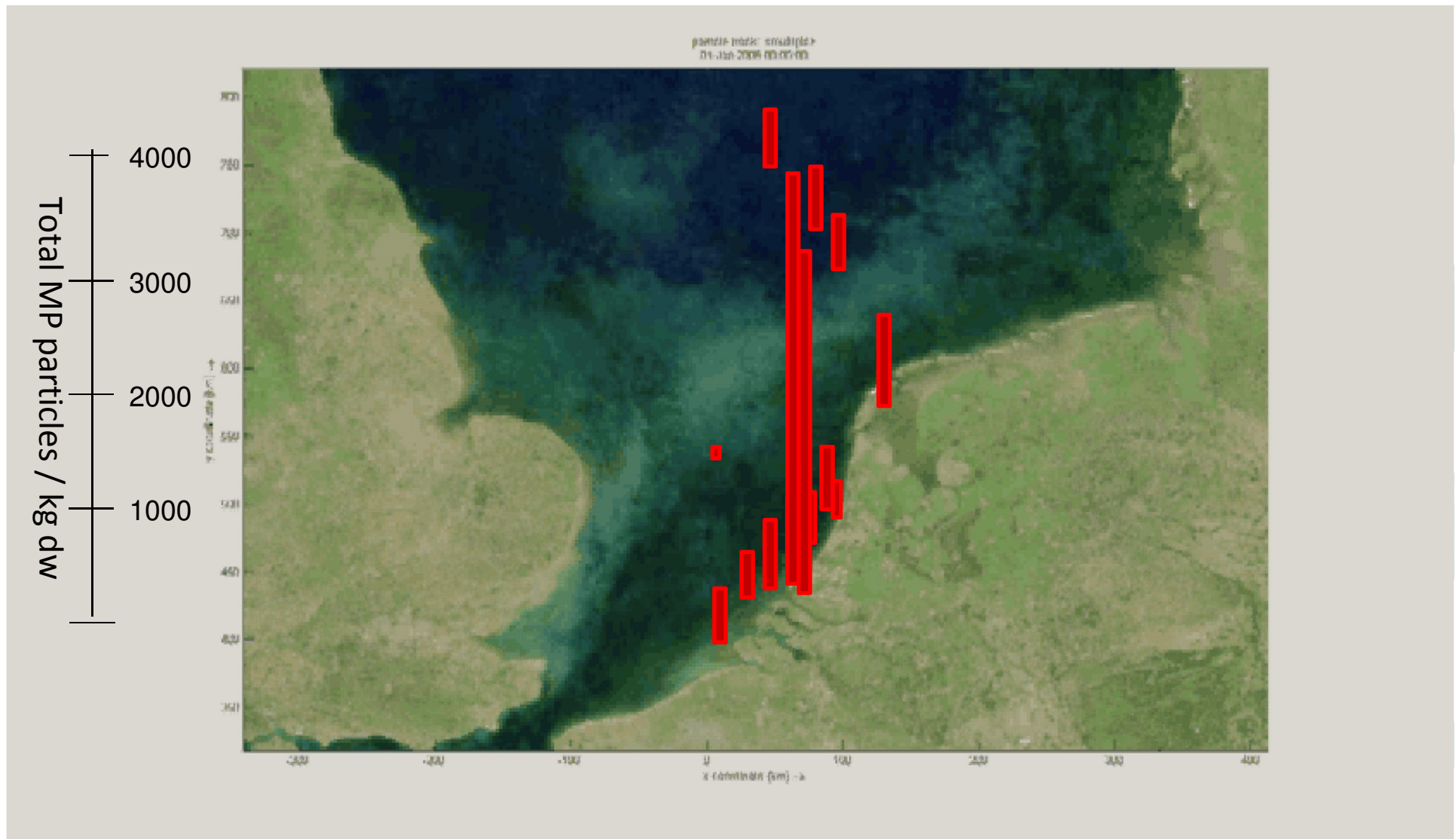


Microplastics in seawater



Net mesh	Microplastics / m ³	Location	Ref
280 µm	0.04 - 0.05	shipping routes UK, 10 m depth	Thompson et al. 2004
80 µm	150-2400	Swedish coast, sea surface	Norén 2008
0.5-2 mm	102,000	Swedish harbour near PE plant, sea surface	Norén 2008
10-500 µm	200-1000	Skaggerak, Norwegian S coast, sea surface	Norén & Naustoll 2011
333 µm	0.2-1.6	Doggerbank, sea surface	Leslie, 2012

Microplastic concentrations in North Sea sediments



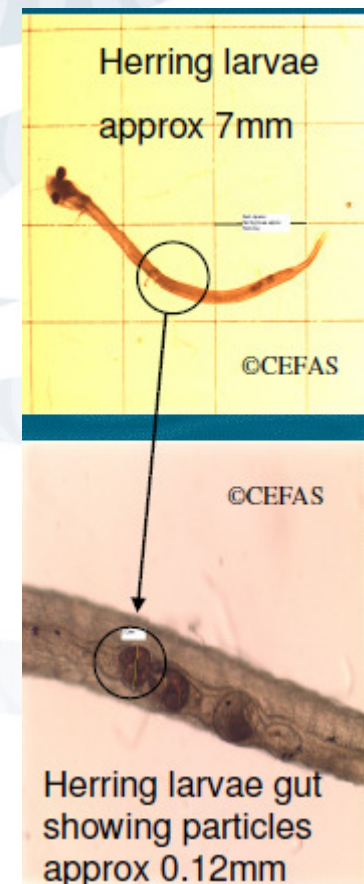
Entanglement/ingestion



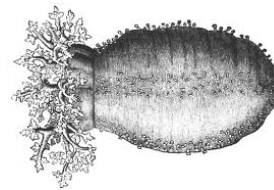
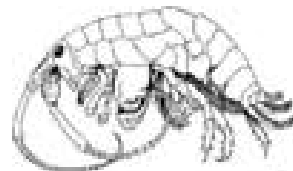
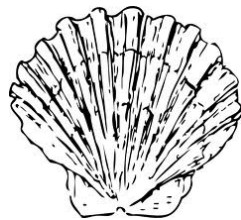
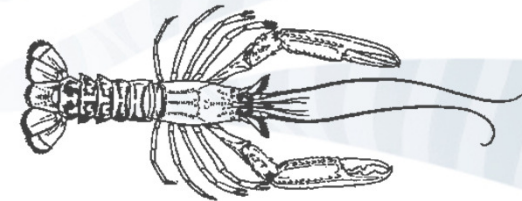
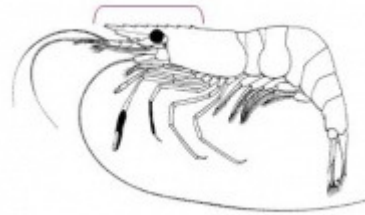
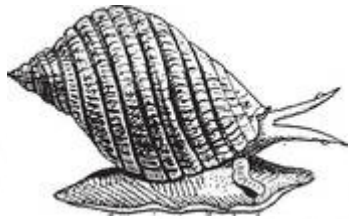
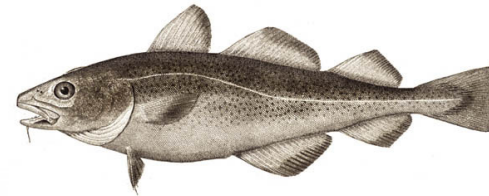
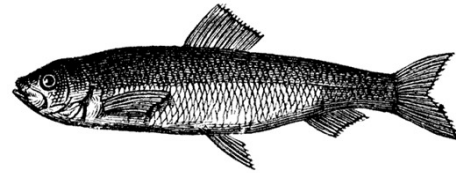
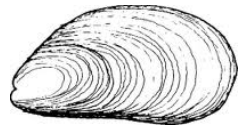
Ingestion of small fragments



Fish larvae



Microplastic uptake by North Sea marine organisms



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Microplastics: adverse effects observed

Marine species	Microplastic exposure and effect	Reference
Blue mussel <i>Mytilus edulis</i>	Absorption of 1-80 µm MPs Granulocytoma formation (inflammation) Increase in SB haemocytes, Decrease in lysosome stability	Koehler & von Moos, 2010
Blue mussel <i>Mytilus edulis</i>	Exposure to 10, 30 90 µm MPs Indications for selective uptake of 10 µm MPs Reduced clearance rate	Van Cauwenberghe, 2012
Blue mussel <i>Mytilus edulis</i>	Exposure to/absorption of 30 nm PS causes reduced valve opening and filtering activity	Wegner et al. 2012
Phytoplankton <i>Scenedesmus</i>	Adsorption of 20 nm PS Hindered algal photosynthesis and promotion of algal ROS indicative of oxidative stress	Bhattacharya et al. 2010
Carp species <i>Carassius carassius</i>	Absorption of 24 nm NPs Food chain transport of NPs affects behaviour and fat metabolism	Cedervall et al. 2012



Microplastics effects on mammals

Species	MP exposure and effect	Reference
Human lymph and circulatory system	Absorption of PE particles taken up in lymph and circulatory system from gastro-intestinal tract	Hussain et al. 2001
Human placenta (<i>ex vivo</i>)	Fluorescent 50, 80, 240 and 500 nm PS particles Particles up to 240 nm were taken up by the placenta	Wick et al. 2010
Rat	535, 202 and 64 nm PS Lung inflammation and enzyme activities were affected, with increasing severity as particle size decreased	Brown et al. 2001
Human airway smooth muscle cell	Fluorescent 40 nm PS particles decreased cell contractility	Berntsen et al. 2010
Human endothelial cells (blood vessels)	Carboxyl PS latex beads in sizes of 20-500 nm were tested. 20 nm PS particles induced cellular damage through apoptosis and necrosis	Fröhlich et al. 2010







“The Future We Want” UNEP 2012:

**Calling on all countries to
develop a global action plan to combat marine litter and
pollution.”**



FP7 Ocean for Tomorrow Program

Marine Strategy Framework Directive

MSFD Descriptor 10:

“Properties and quantities of marine litter do not cause harm to the coastal and marine environment”

- Honolulu Declaration, Rio +20 Earth Summit, UNEP/GESAMP, IMO, OSPAR, etc.



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The CleanSea Project

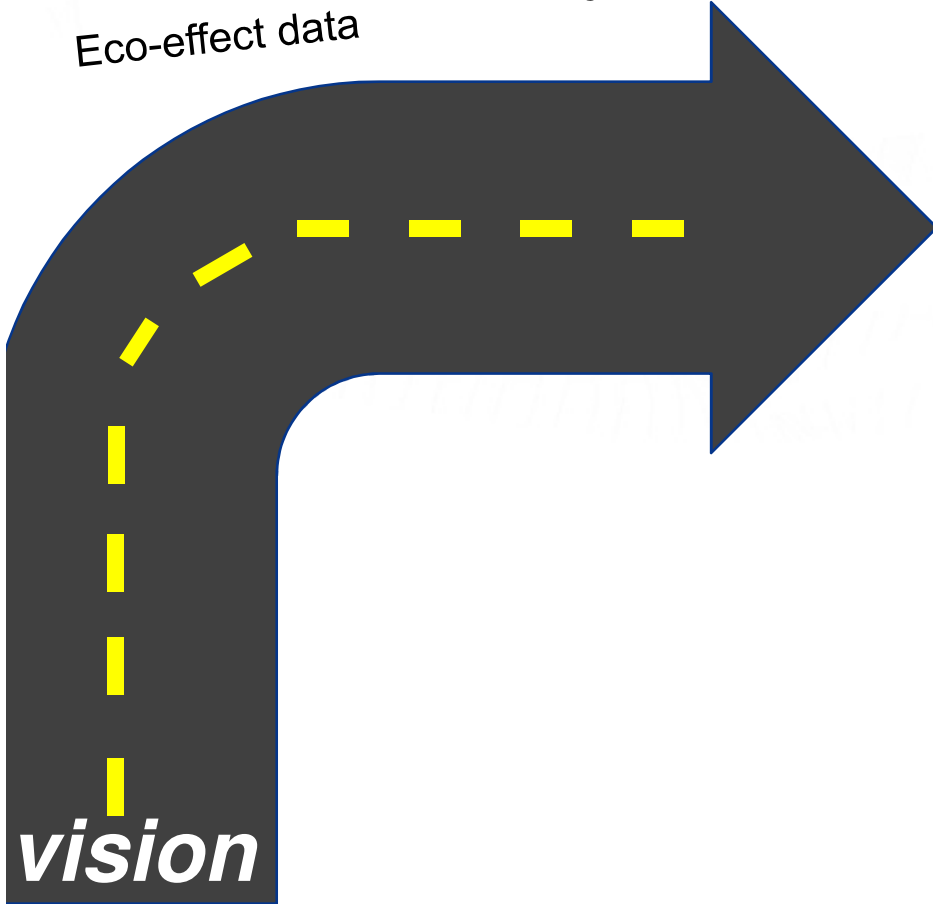


4 Marine Regions



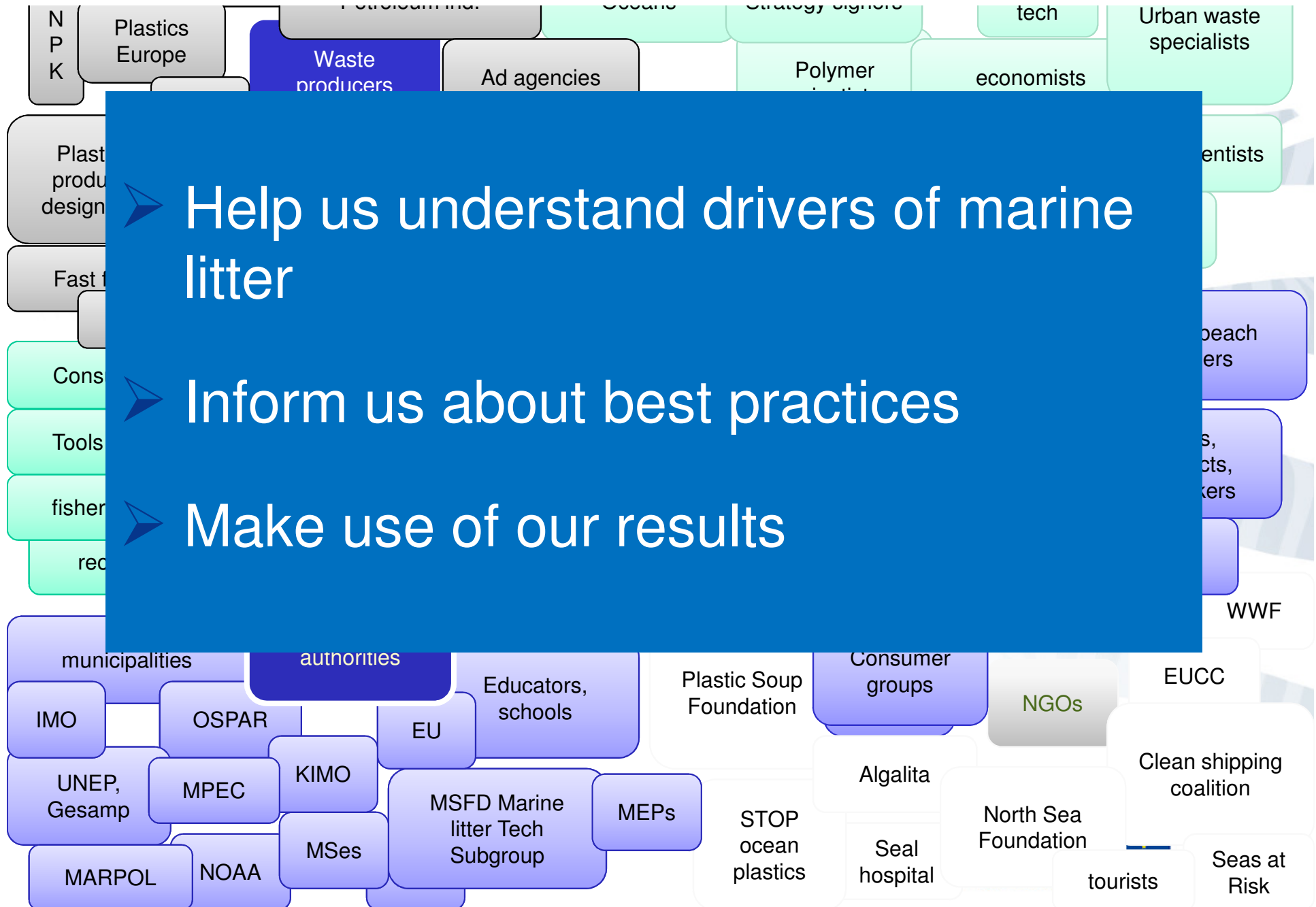
Overarching Goal of CleanSea Project

Improved methods
Monitoring tools
Litter field concentrations
Eco-effect data
Best practices
Identify drivers of marine litter
Policy options
Management measures



**Roadmap to
'good
environmental
status' for marine
litter in 2020**

Stakeholder Platform



The solutions to marine litter involve everyone.

- All sectors
- Regulatory bodies
- Local - international governments
- Scientists
- Industrial designers
- Consumers
- Civil society



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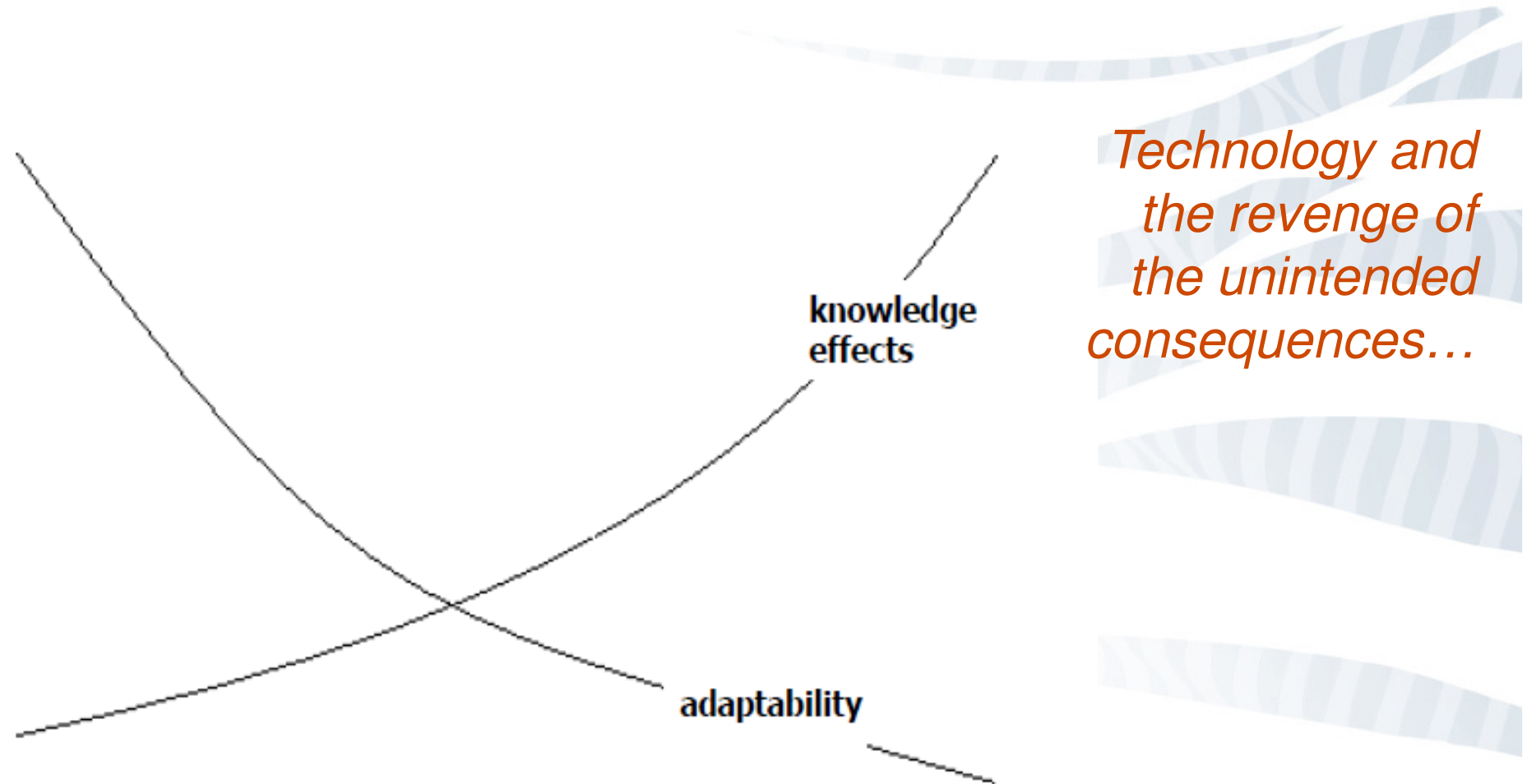
We widely regard nature as an entity separate from society/business/industry/R&D.

Underlying driver of environmental problems like marine litter?



Too much litter.

Policies/technocratic solutions so far insufficient...



Can we transition to a world without waste?



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Lessons learned

- Systematically scrutinise claimed justifications and benefits alongside potential risks.
- Provide long-term monitoring and research into early warnings.
- Reduce 'blind spots' and gaps in scientific knowledge.
- Reduce interdisciplinary obstacles to learning.
- Avoid '*paralysis by analysis*' by acting to reduce potential harm when there are reasonable grounds for concern.

Late lessons from early warnings: the precautionary principle 1896–2000
Harremoës et al. EEA Report 2001

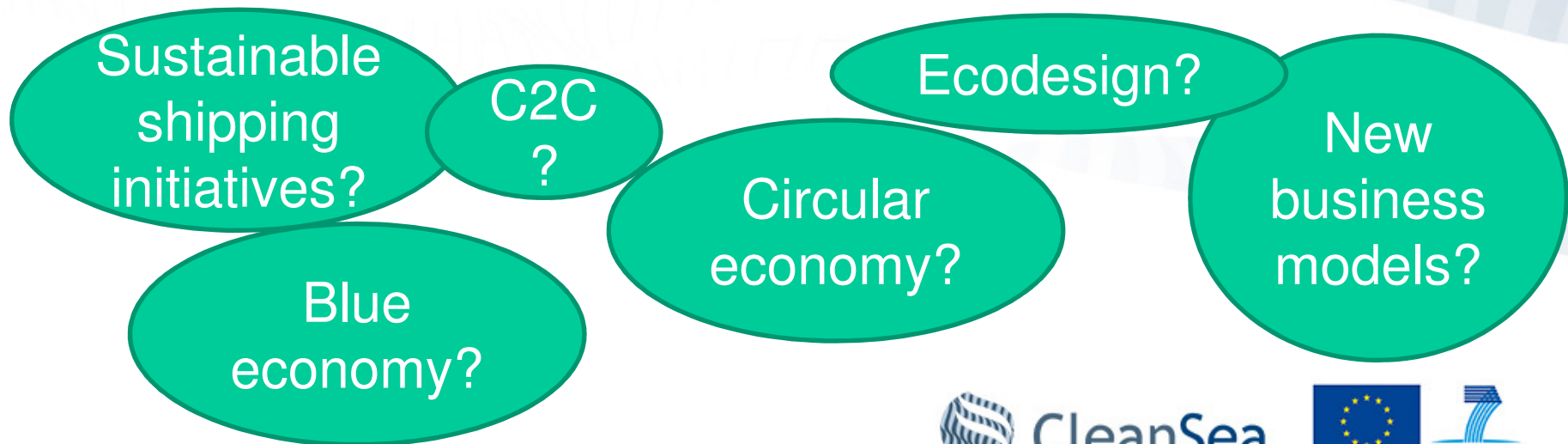


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“hardship and disasters are mere challenges to a boundless human ingenuity”

- Edward Tenner



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Please visit the CleanSea Project website!

www.cleanease-project.eu



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Questions for the audience

- Do you consider marine litter to be an environmental problem?
- Is marine litter an issue that is relevant to the shipping sector?
- Do you notice regional differences in how waste is handled in your sector?
- What could be a factor driving the creation of marine litter in your sector?
- What are some examples of waste management best practises in your sector?