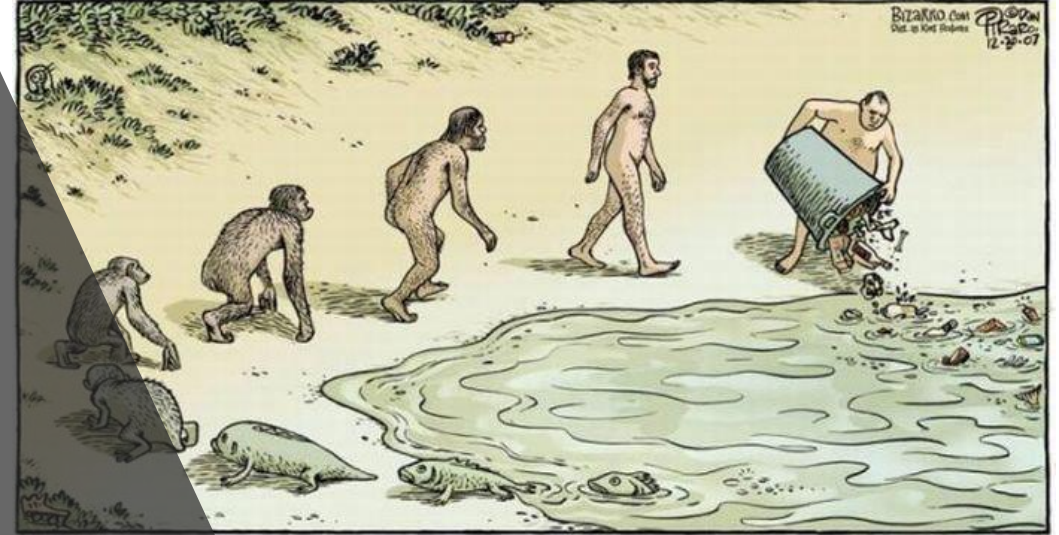


Cefas Marine Litter Activities

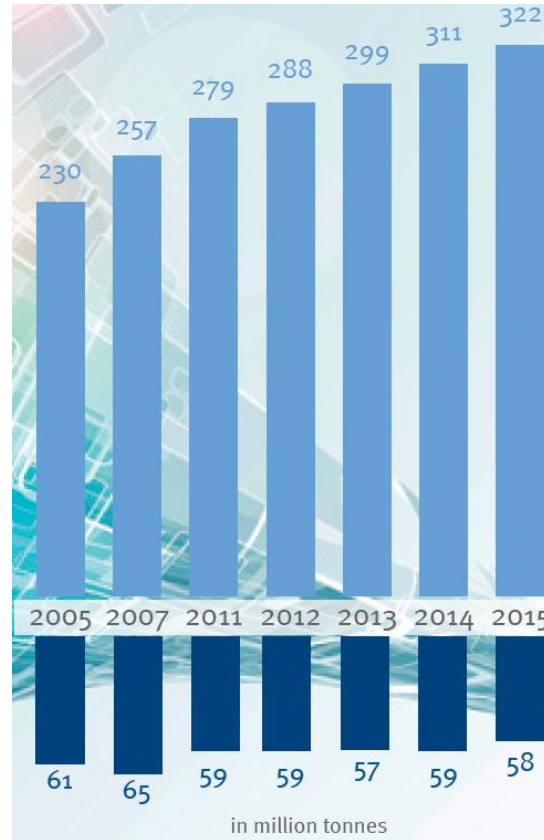
LC/SG 40+LP/SG 11 - Science Day 2017

Thursday, 30th March 2017

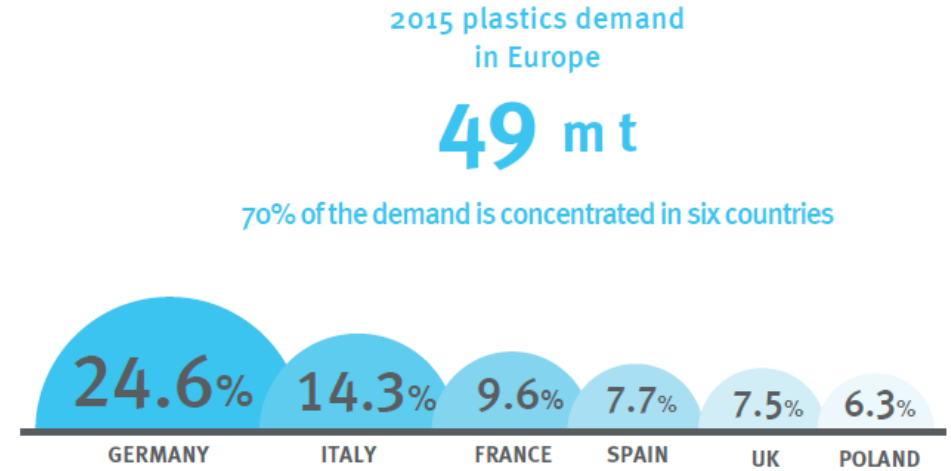
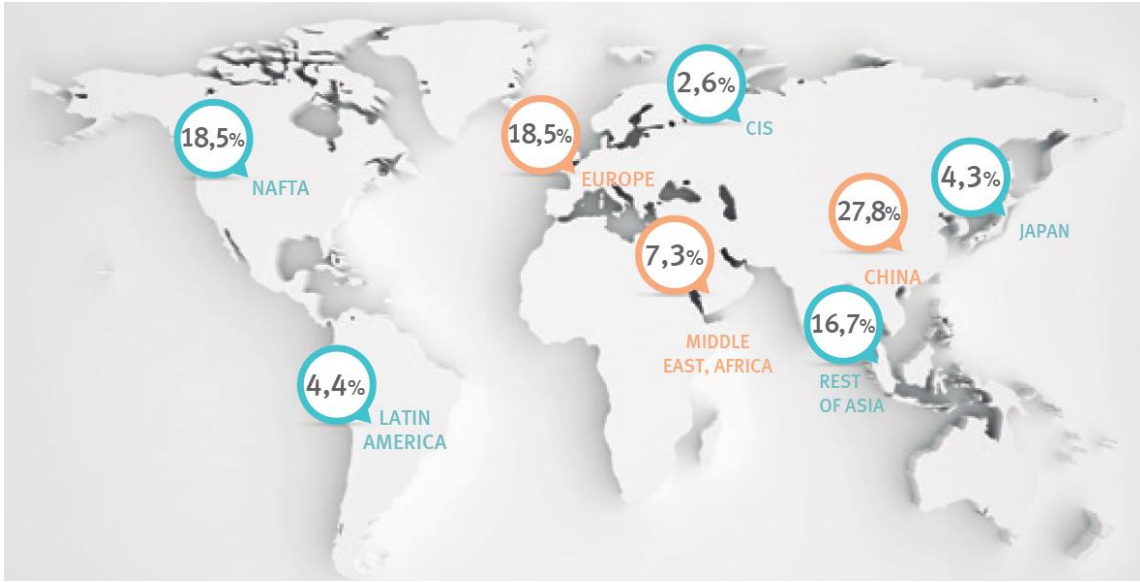
Thomas Maes, Cefas



Cefas



PLASTIC PRODUCTION



PLASTIC PRODUCTION HOTSPOTS

Total demand
49 m t

AGRICULTURE
3.3%



ELECTRICAL &
ELECTRONIC
5.8%



AUTOMOTIVE
8.9%



BUILDING &
CONSTRUCTION
19.7%



PACKAGING

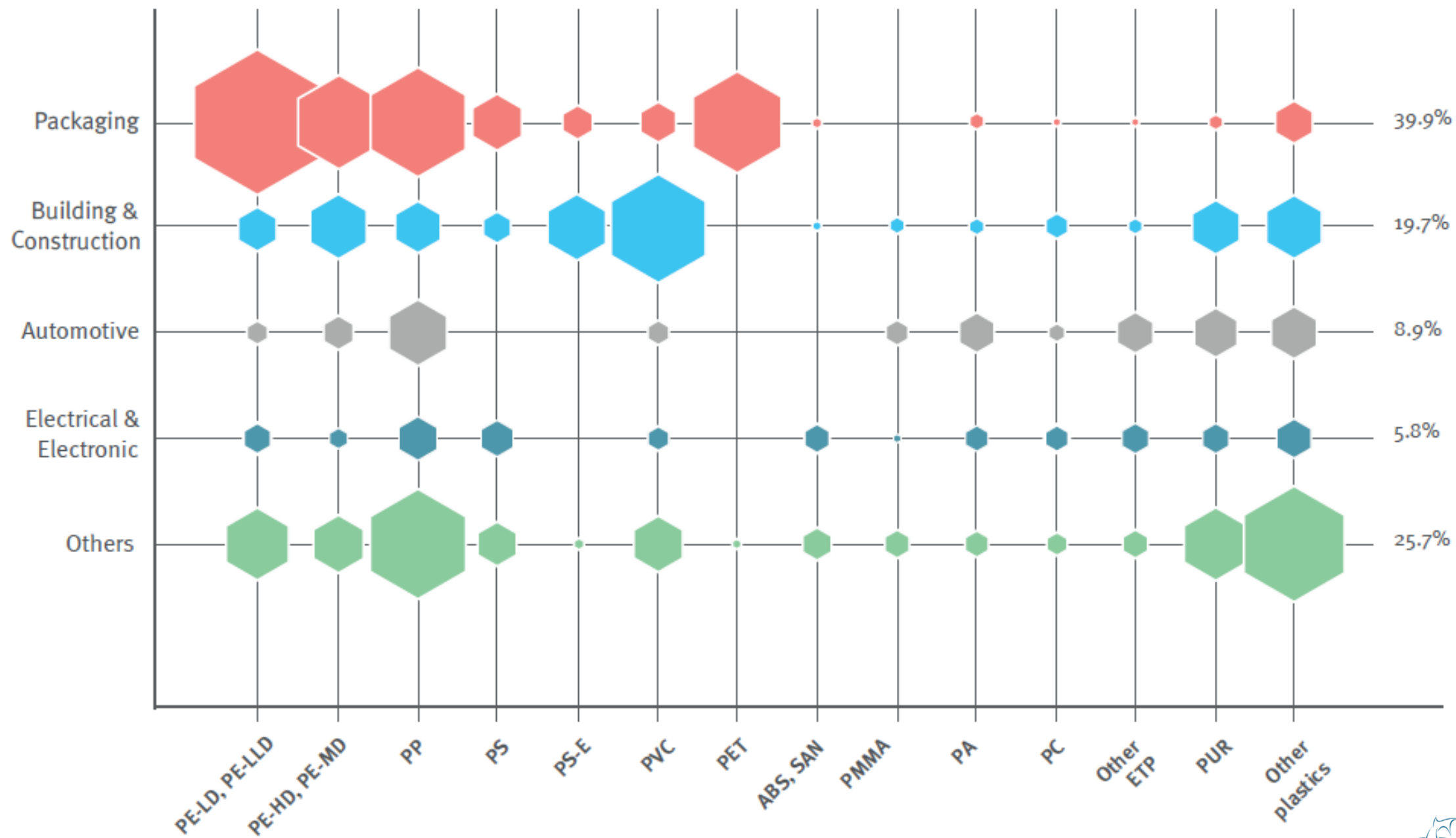
39.9%



OTHERS
22.4%

Consumer
and household
goods, furniture,
sport, health
and safety, etc.





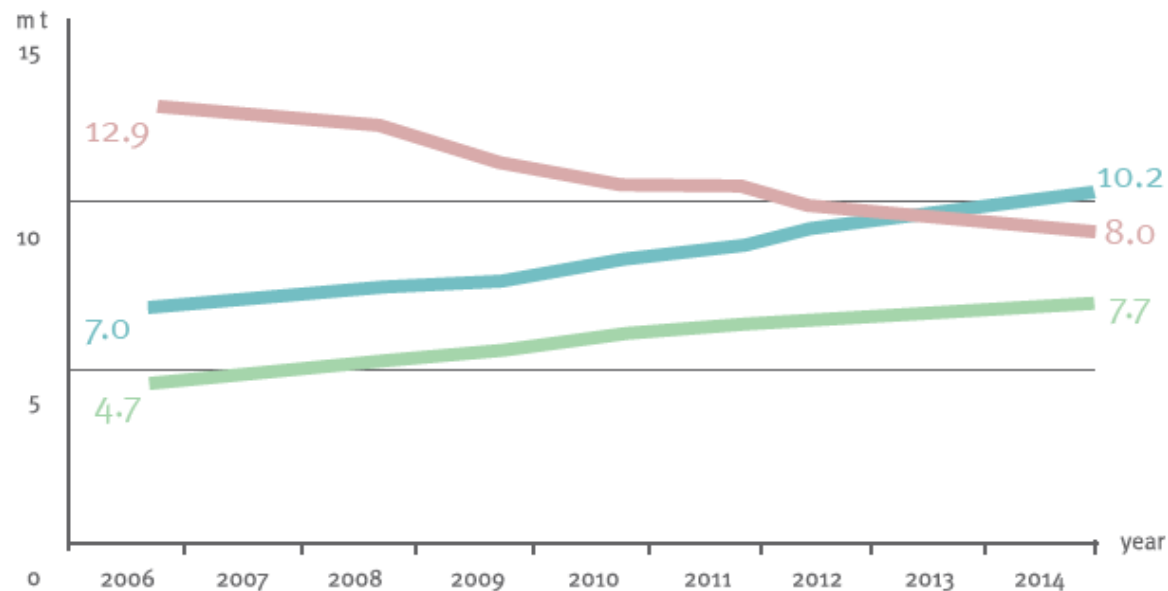
PLASTIC WASTE MANAGEMENT EUROPE

Recycling 29.7%

Energy recovery 39.5%

Landfill 30.8%

2006-2014 waste treatment evolution:



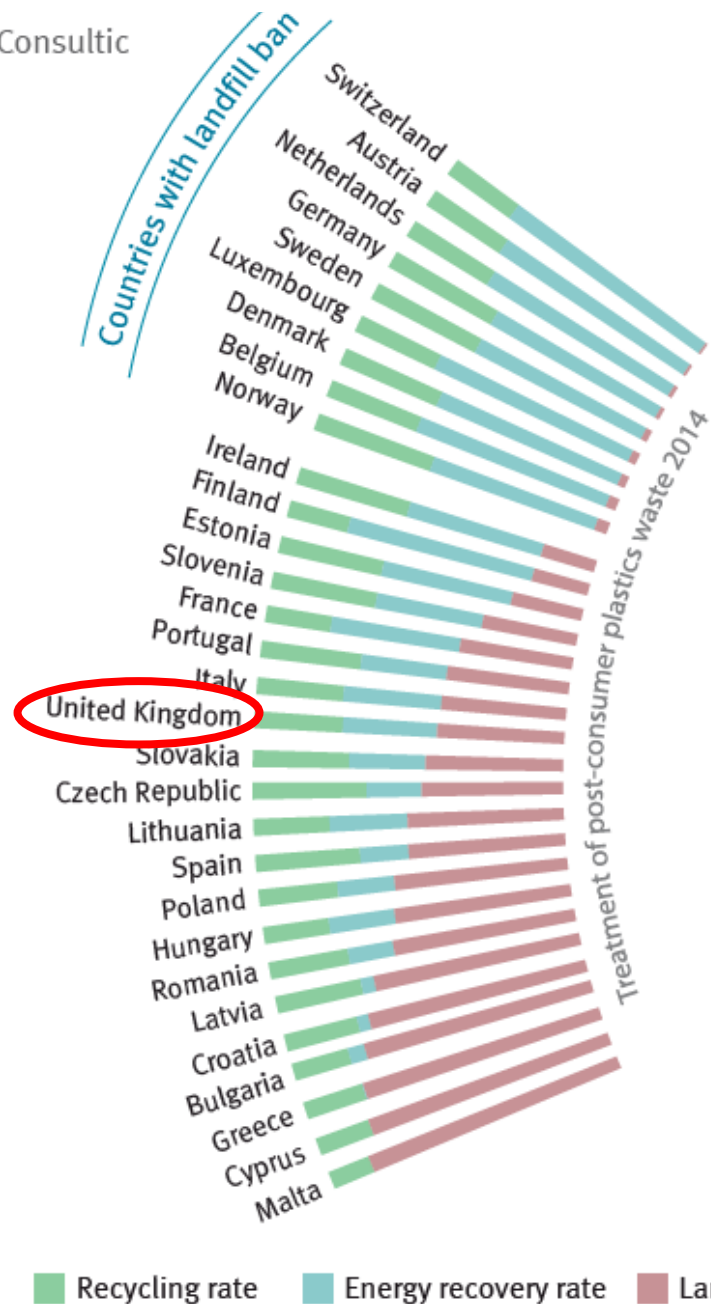
+ 64 % Recycling

+ 46 % Energy recovery

- 38 % Landfill

Source: Consultic

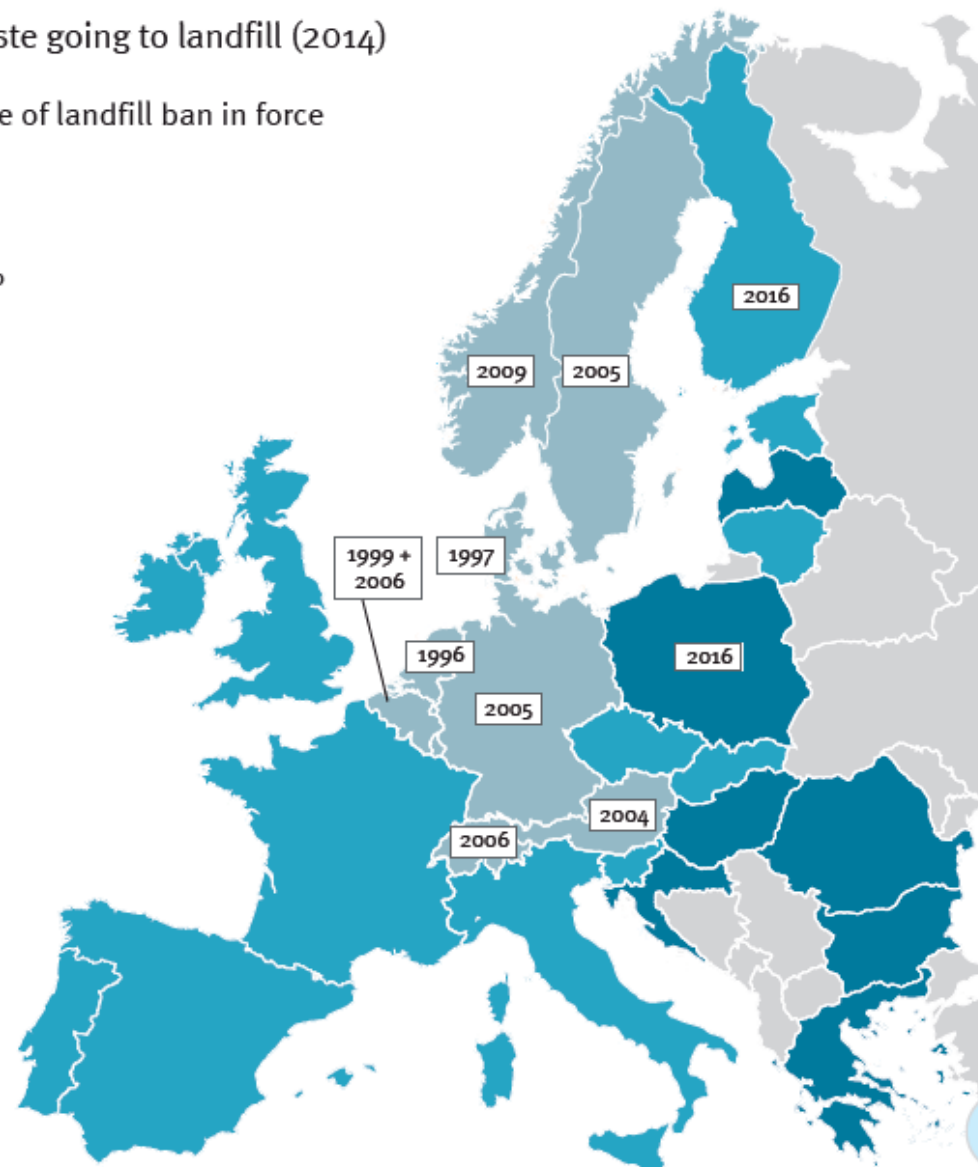
Source: Consultic



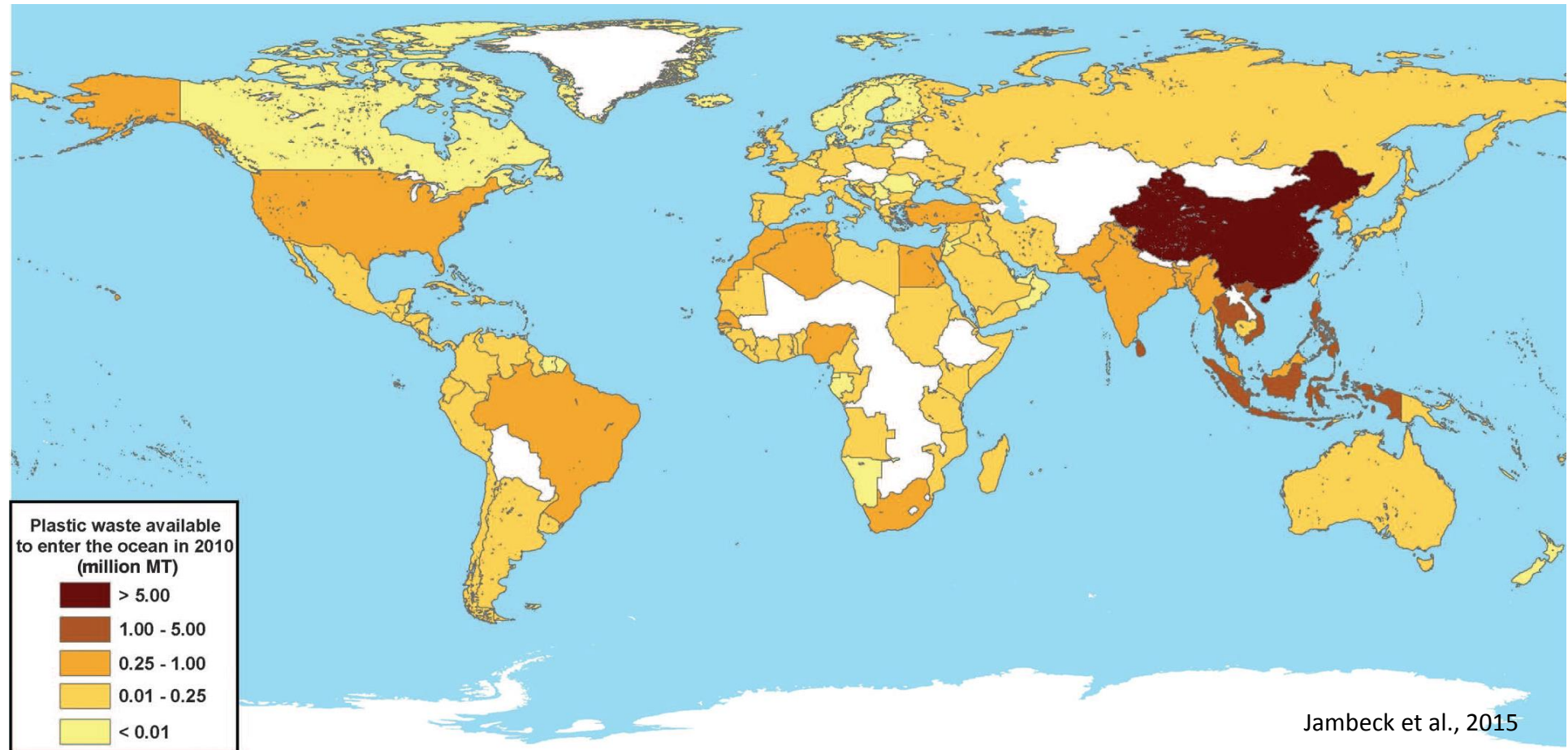
Plastics waste going to landfill (2014)

□ Date of landfill ban in force

■ > 50%
■ 10% - 50%
■ < 10%



Global Plastic Waste Inputs



- **275 million metric tons (MT) of plastic waste was generated in 192 coastal countries in 2010, with 4.8 to 12.7 million MT entering the ocean.**
- Without improvements predicted to increase by an order of magnitude by 2025
- Currently 150 million MT of plastic in oceans based on estimated leakage per year since 1950

MARINE LITTER SOURCES

- **Land-based Sources:** Littering, Dumping, Poor Waste Management Practices, Untreated Sewage and Storm Water Discharges, Riverine Inputs, Industrial Facilities, Tourism, Extreme Natural Events
- **Ocean-based Sources:** Fishing Vessels, Cargo Ships, Stationary Platforms, Fish Farming Installations, Pleasure Crafts and Other Vessels



Socio-Economic Impacts of Marine Litter

Damage to people, property and livelihood can be grouped into the following general categories:

- Fishing boats and gear
- Fish & Shellfish stocks
- Safety risks for people at sea
- Damage to intakes
- Blocked waterways
- Aesthetic value
- Tourism revenues
- Contamination of beaches
- Contamination of harbours
- Health hazards to people
- ...

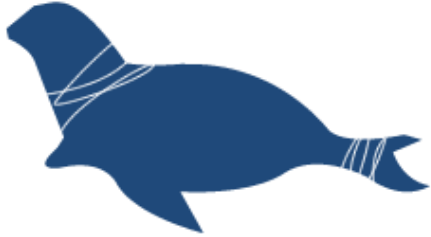


IMPACTS OF MARINE DEBRIS



INGESTION

Animals mistakenly eat plastic and other debris.



ENTANGLEMENT & GHOSTFISHING

Marine life gets caught and killed in ghost nets, trapped in derelict gear, and entangled in plastic bands and other marine debris.



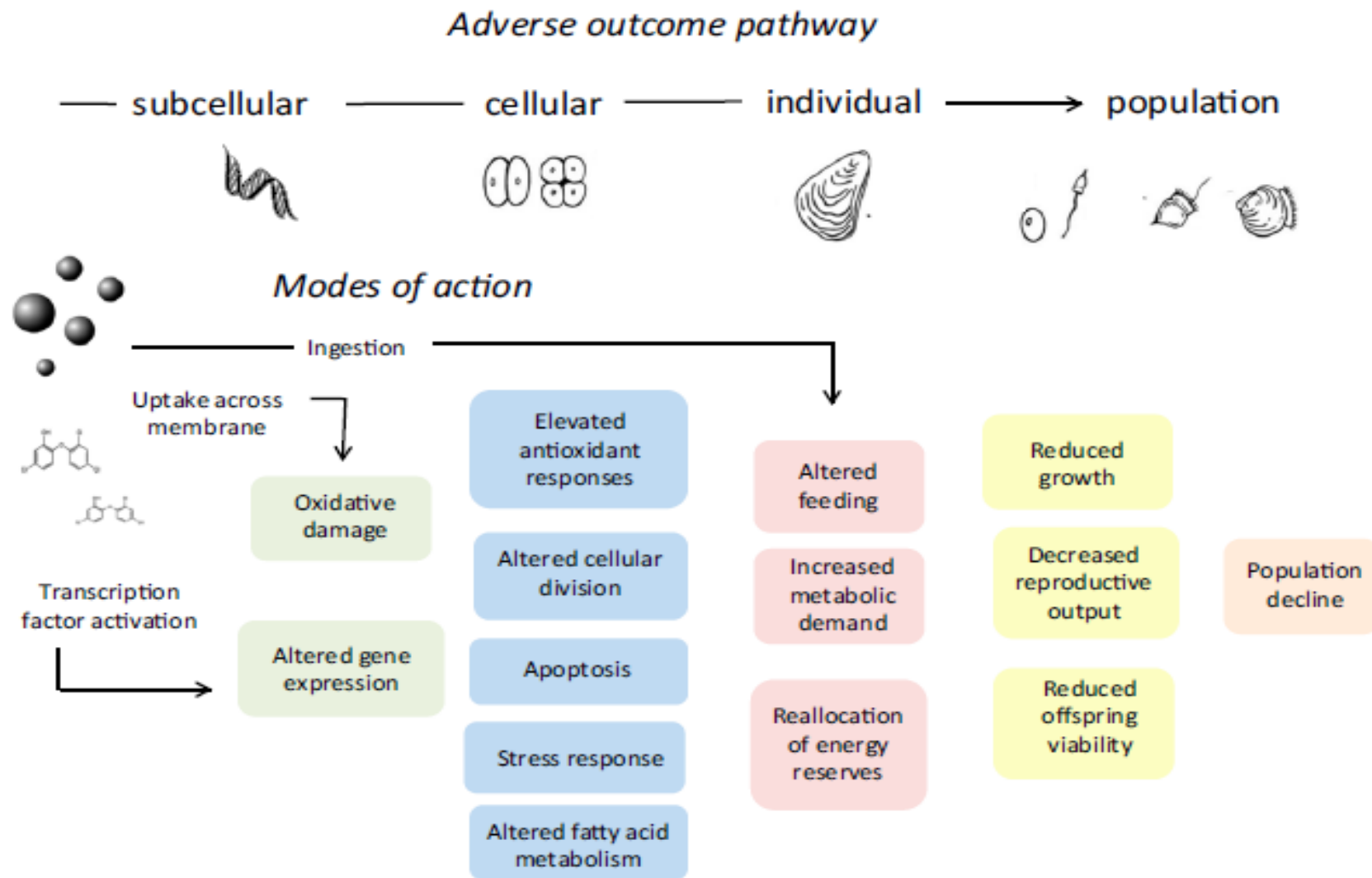
HABITAT DAMAGE

Heavy marine debris crushes sensitive habitat, such as coral reefs and sea grass.



NON-NATIVE SPECIES

Marine debris transports alien and invasive species from one region to another.



Tentative Adverse Outcome Pathway scheme for microplastics exposure of aquatic species showing potential pathways linking ingestion, uptake across membranes, and chemical release with adverse outcomes of growth inhibition and reproductive decline (Galloway and Lewis, 2016).

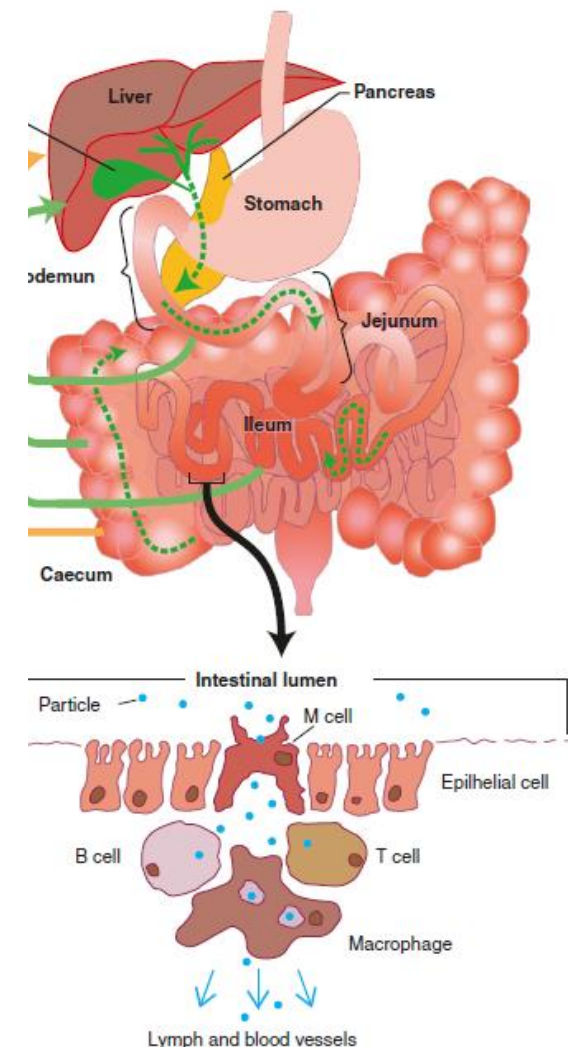
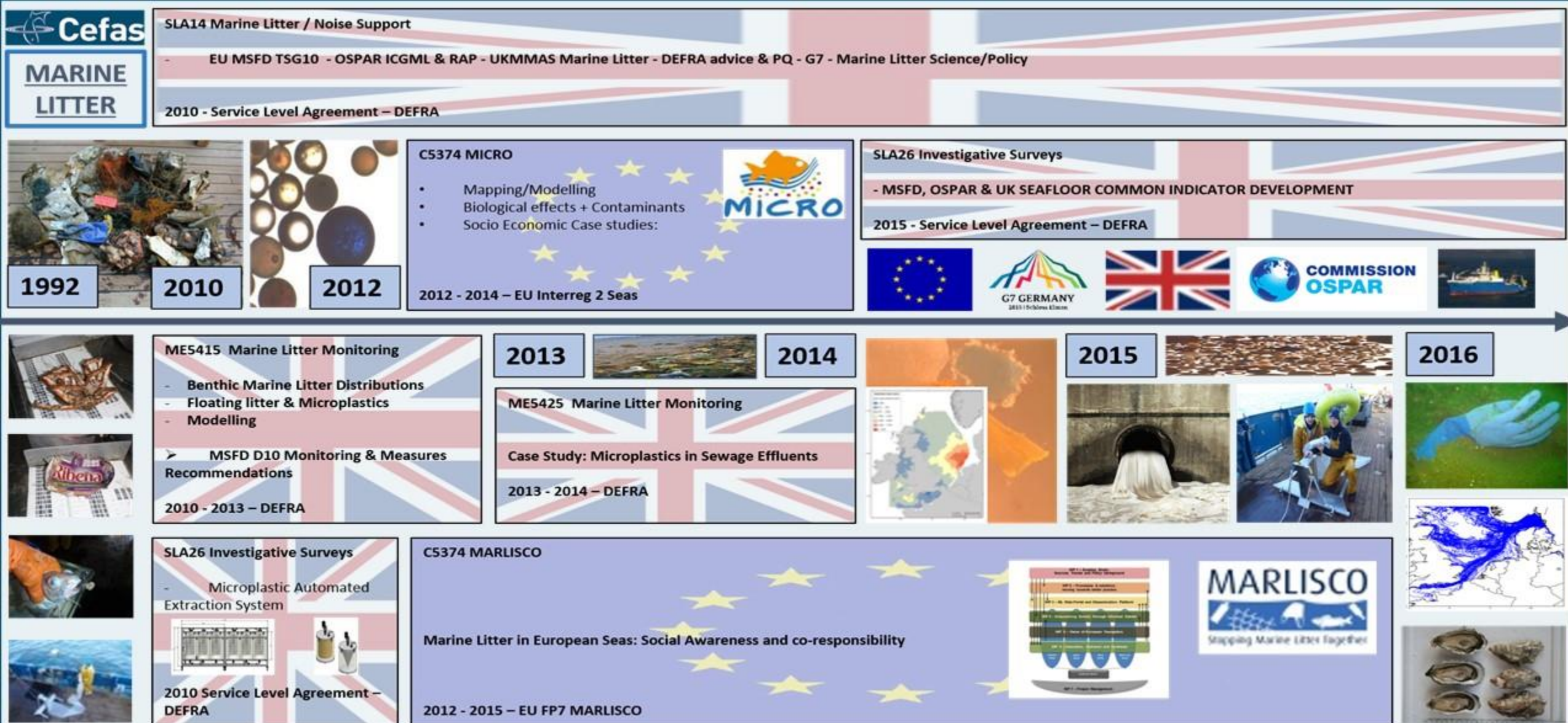
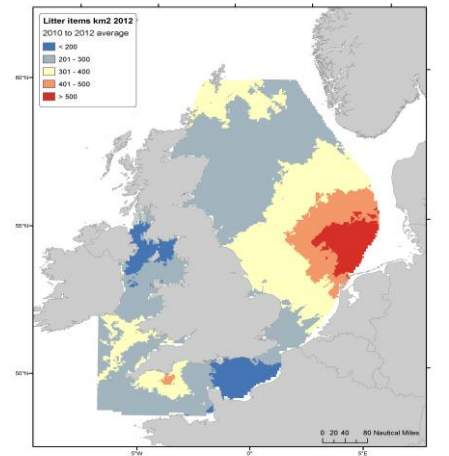
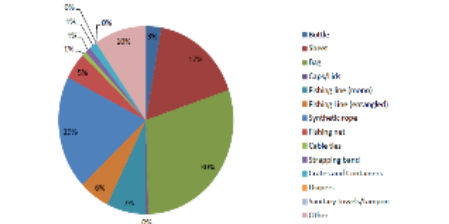
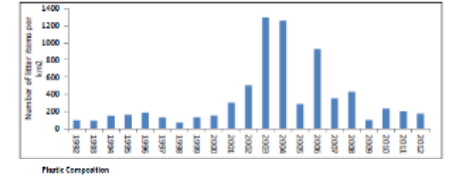


Fig. 13.1 A diagram illustrating a proposed recirculation pathway for polymer nanoparticles (ammonium palmitoyl glycol chitosan) after oral administration. The nanoparticles are taken up into the blood from the gut through M cells, and from there through the lymphatic system (shown in yellow) and into the liver and gall bladder. Particles are then re-released into the gut together with bile (shown in green) before excretion in faeces and urine. Adapted from Garrett et al. (2012)



Cefas

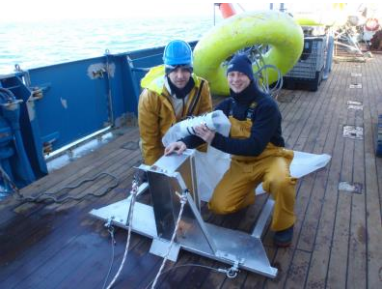






MICROPLASTIC

SOURCES & FATE



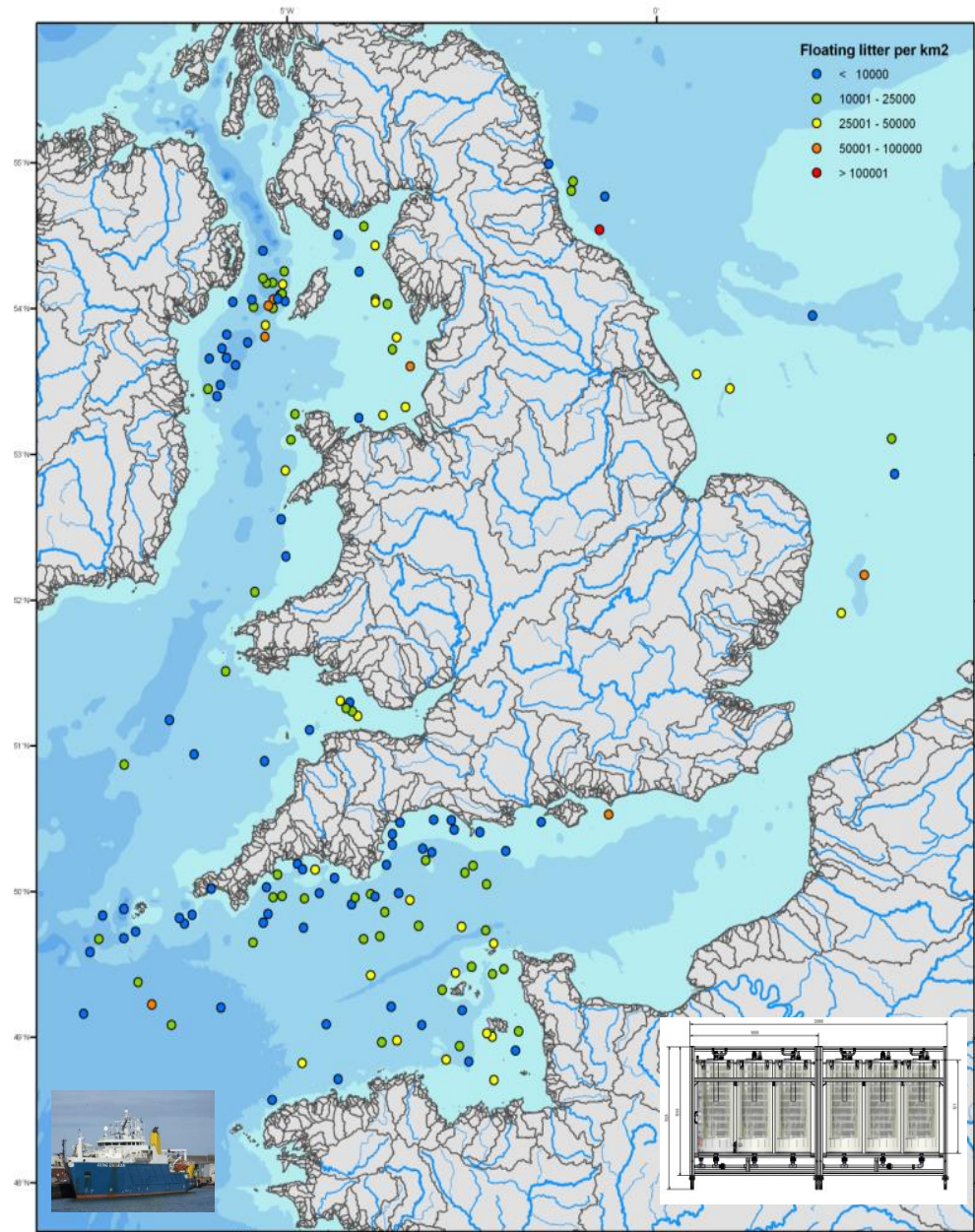
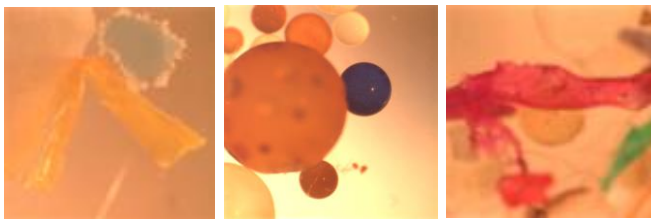
MICROPLASTIC CASE STUDY

- January to March 2011
- 151 locations
- Ubiquitous presence of litter in water column and surface
- In total 3597 items collected
- 12000 items per km²
- Higher concentrations inshore close to estuaries
- Mainly fragments (63%) and pieces of thin films (14%) (>333um)
- Mostly between 1.00mm to 2.79mm
- White (33%), transparent (29%) and black (19%) coloured

TYPE	Black/Grey	Blue/Green	Brown/Tan	Orange/Pink/Red	Transparent/Translucent	White	Yellow
Fragment	485	239	55	53	597	764	89
Pellet	141	16	6	4	66	97	26
Line	13	52	1	43	13	36	1
Thin Film	49	39	7	9	365	41	6
Foam	7	1	5	1	2	262	8

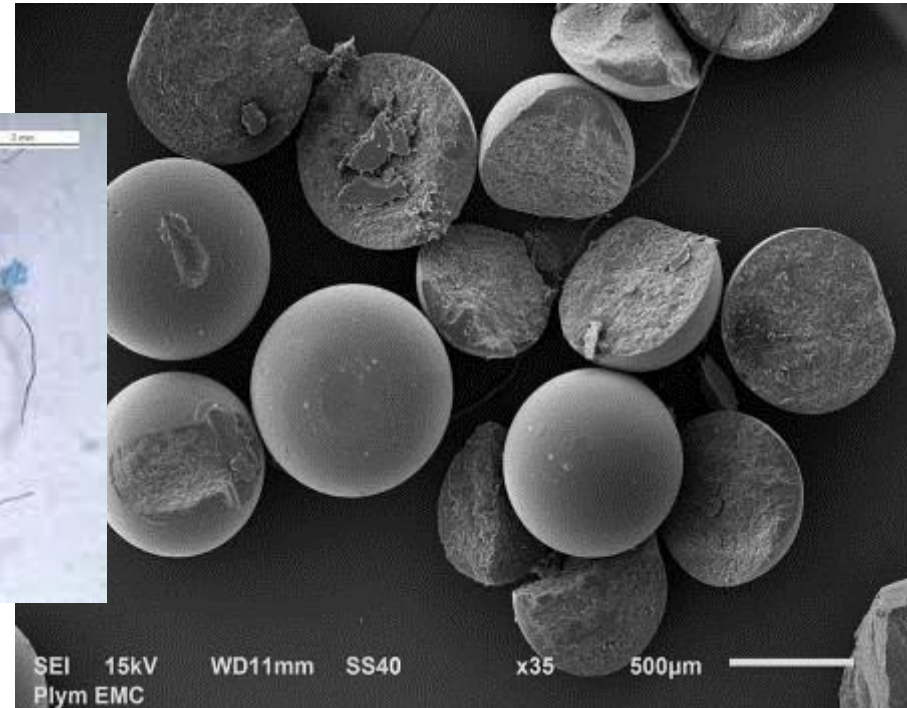
Number of Microplastics in UK waters

Mean	19237 items/km ²
Median	11881 items/km ²
Max	156624 items/km ²



Microplastics in UK Sewage Treatment Waters

>80% Removal Efficiency

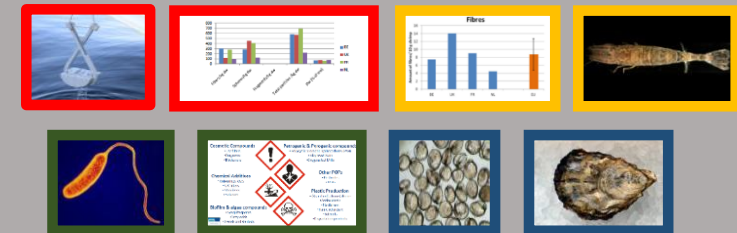
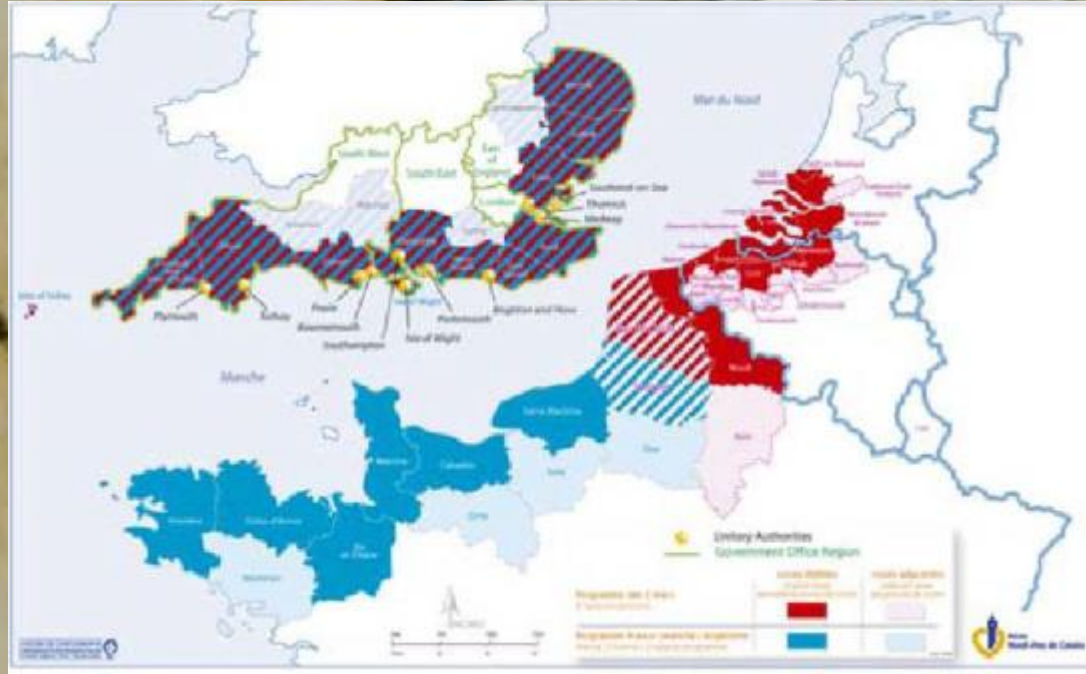




MICRO Interreg IV A 2 Seas MicroPlastics - Is it a threat for the 2 Seas Area?



- **Modelling & Prediction**
- **Monitoring:** sampling at Sea surface, Water column, Sediment, Shrimp & Mussels
 - 8 microplastic fibres/shrimp
 - 500 microplastic particles/kg DW sediment
- **Chemical & Bacterial Analysis of Microplastics**
- **Impacts** were observed on major physiological functions such as **digestion, immunity, reproduction and growth** when exposed to high concentrations in lab conditions
- **Socio-Economic:** Between £1,5 million and £500 million potential costs to Oyster and Mussel aquaculture in UK
- Potential **Impacted Areas:**
 - ☐ Hampshire & Isle of Wight region in oyster sector
 - ☐ Dorset region in mussel sector
 - ☐ Devon and Norfolk in terms of tourism



<http://www.ilvo.vlaanderen.be/micro>



Van Cauwenberghe et al., 2015



Lusher et al., 2012



©5Gyres



Van Franeker et al., 2010



£££

LABORATORY



Coles et al., 2013



FIELD



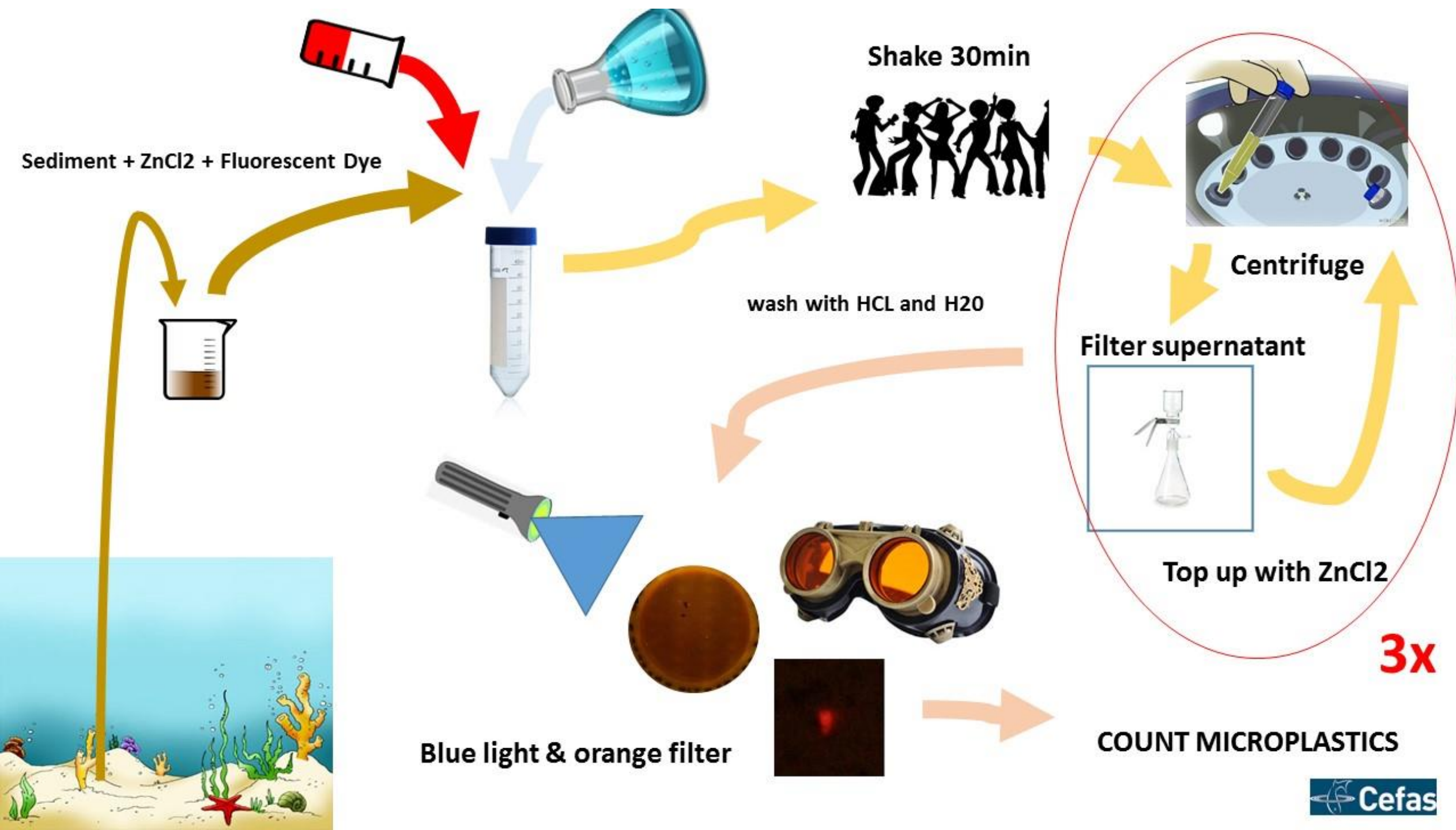
Shining a light on microplastics

Fluorescent Microplastic Tagging



CRIME SCENE INVESTIGATION

Thomas Maes, Rebecca Jessop, Niklaus Wellner and Andrew G. Mayes

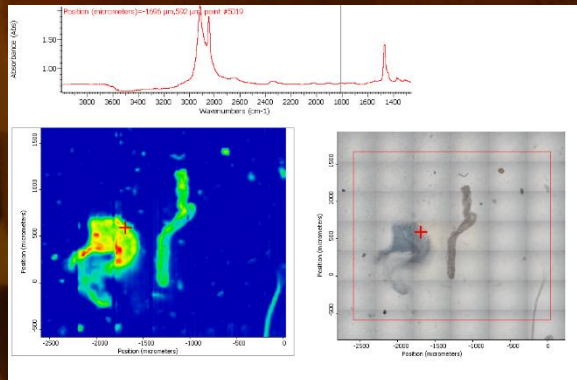




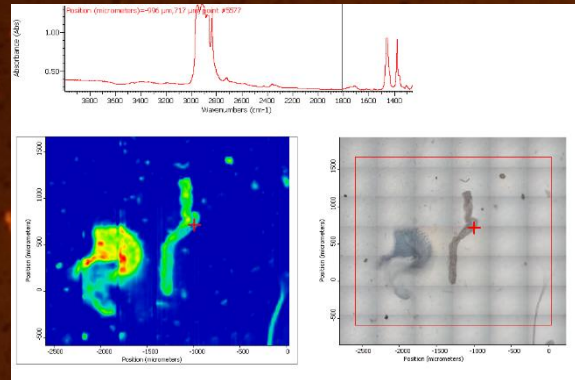
Maes, T. et al. A rapid-screening approach to detect and quantify microplastics based on fluorescent tagging with Nile Red. *Sci. Rep.* 7, 44501; doi: 10.1038/srep44501 (2017).

<http://www.nature.com/articles/srep44501>

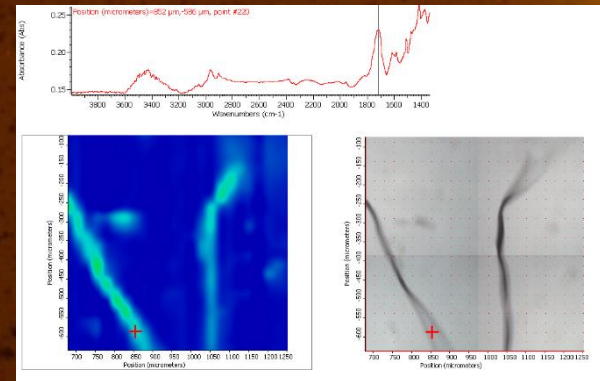
1. POLYETHYLENE



2. POLYPROPYLENE



3. POLYESTER



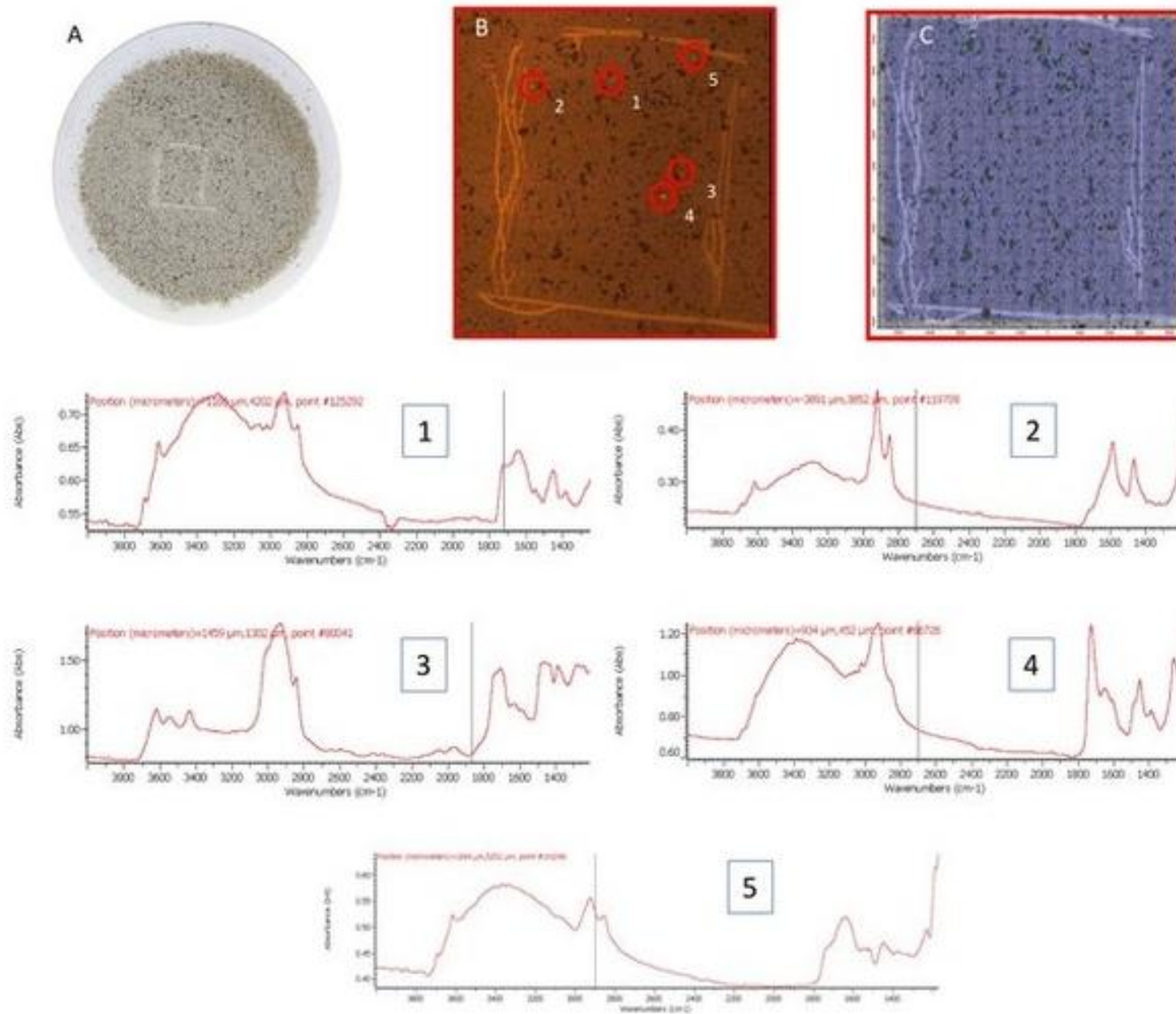
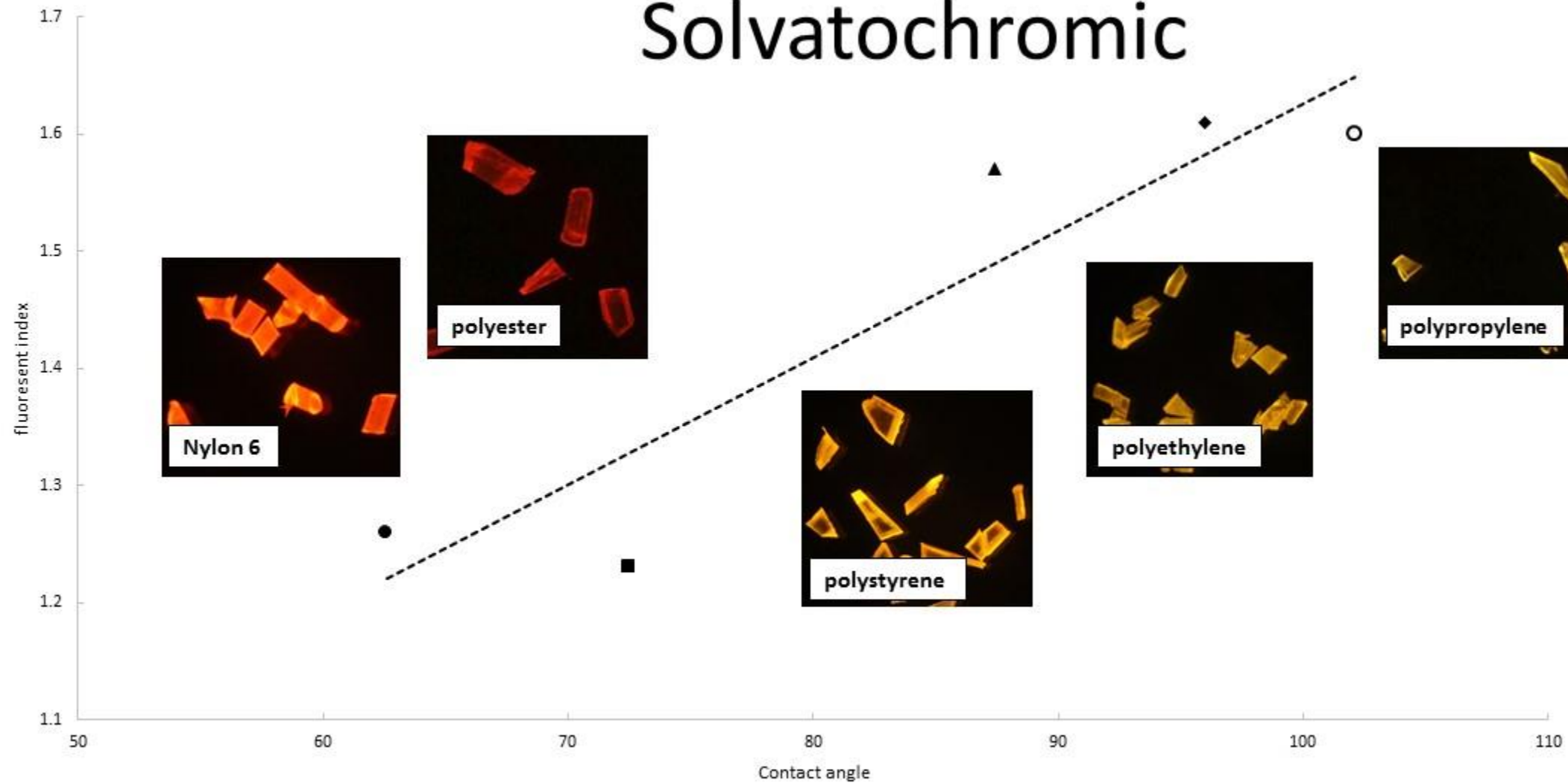
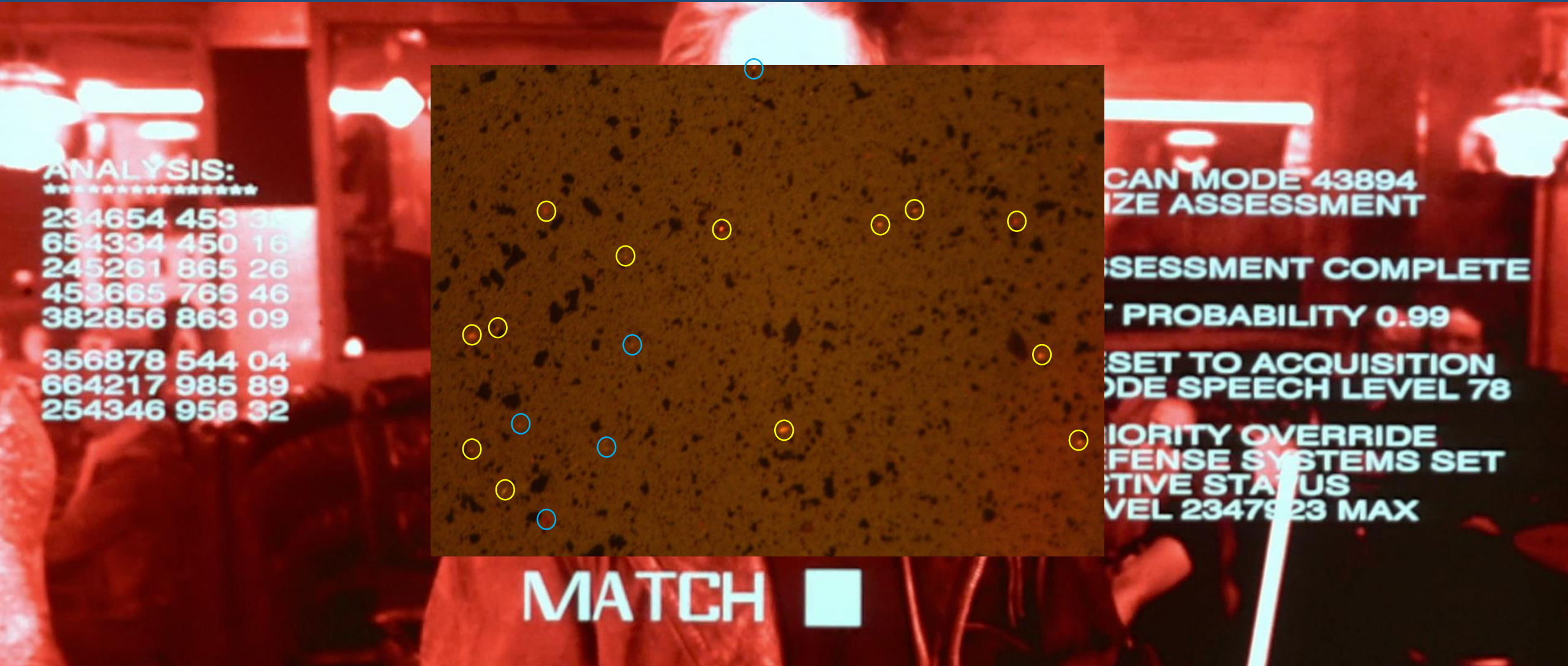


Image of the filter in white light showing (A) the scribed area; (B) expansion of the scribed area under blue light, photographed through an orange filter, reconstructed from tiled images showing the bright fluorescent objects identified, (C) tiled white-light image from the IR microscope overlaid with a C-H filtered IR spectral map to highlight organic material and below, IR spectra from the 5 locations ringed and numbered in panel (B).

Solvatochromic



AUTOMATED IMAGE RECOGNITION



SOLUTIONS



defra

Department for Environment
Food and Rural Affairs



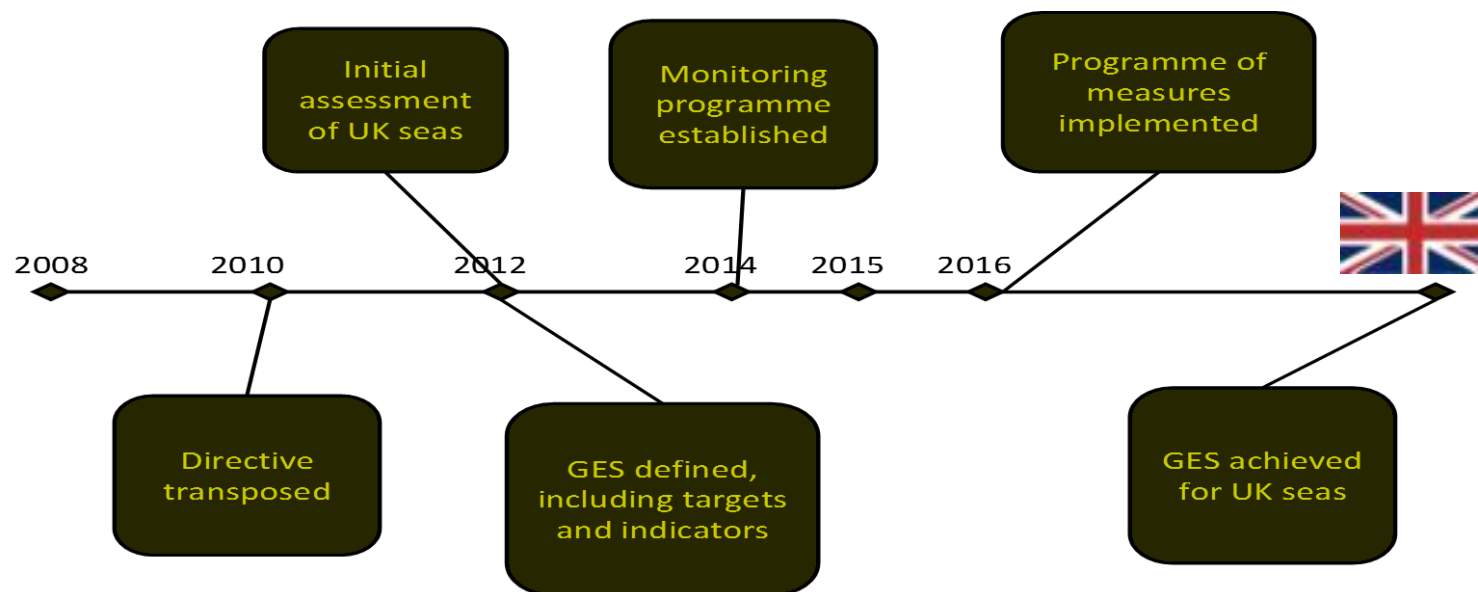


The Marine Strategy Framework Directive

DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June 2008

10 DESCRIPTORS:

1. Biological diversity
2. Non-indigenous species
3. Commercial fish and shellfish stock
4. Marine food webs
5. Eutrophication
6. Sea-floor integrity
7. Hydrographical conditions
8. Concentrations of contaminants
9. Contaminants in seafood
10. **Marine litter**
11. Introduction of energy (noise)



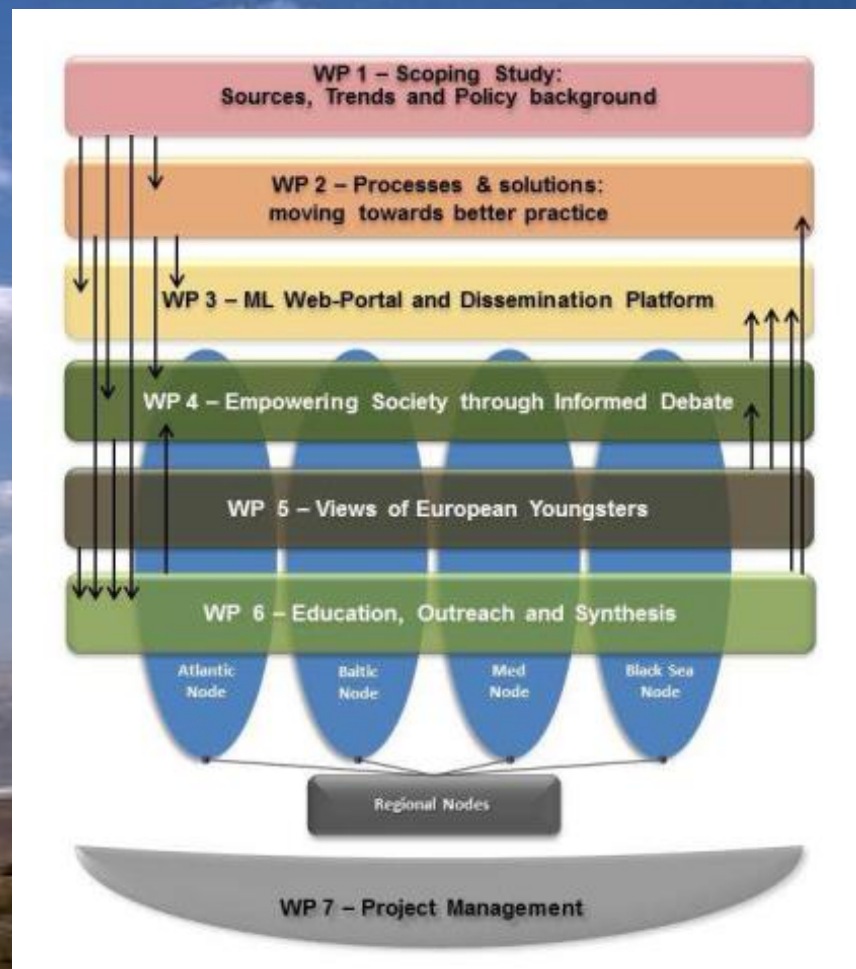
DESCRIPTOR 10: “Properties and quantities of marine litter do not cause harm to the coastal and marine environment”

EU FP7 MARLISCO

Marine Litter in European Seas: Social Awareness and co-responsibility

By developing innovative mechanisms and tools, MARLISCO effectively **engaged, informed and empowered society**, reaching the widest possible audience. Its activities included:

- A **scoping study** of the sources and trends regarding marine litter in each Regional Sea.
- A collection of **best practices** from all partner countries.
- A **survey** on the prevailing perceptions and attitudes of different **stakeholders** regarding marine litter.
- A European **video contest** for youngsters to collect their visions on the issue of marine litter and empower them as agents of change in society.
- **National debates** in 12 partner countries.
- Diversified, tailor-made **national activities** including e-learning, exhibitions, workshops, festivals, clean ups, etc.



MARLISCO – 73 BEST PRACTICES



E.g.:

- Bag It and Bin It - Don't Flush it
- Blue Flag Beaches
- Beach Cleans
- Plastic Bag Fee
- Educational Programmes
- Litter removal schemes by divers
- Fishing for Litter
- Fishing net recycling
- Litter removal in rivers
- Training Seafarers
- ...



OSPAR Regional Action Plan 2014-2021



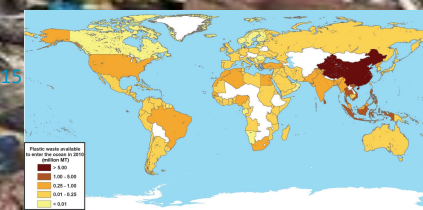
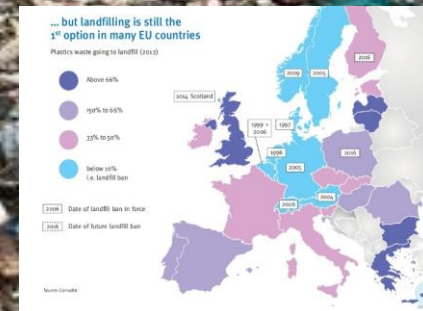
- The OSPAR objective with regard to marine litter is “to substantially **reduce marine litter** in the OSPAR maritime area to levels where properties and quantities do not cause harm to the marine environment” by 2020. In order to achieve this objective the North East Atlantic Environment Strategy also commits to “develop appropriate programmes and measures to reduce amounts of litter in the marine environment and to **stop litter entering** the marine environment, both from sea-based and land-based sources”.
- 3 Levels: **Guidelines/Recommendations/Agreements**
- 4 areas: **Sea-based sources, Land-based sources, Removal Action, Education & Outreach**
- **55 collective and national actions** which aim to address both land based and sea based sources, as well as education and outreach and removal actions
- Key actions:

- Port Reception Facilities
- Waste from fishing industry
- Fines for littering at sea
- Fishing for litter
- Abandoned and lost fishing gear
- Floating litter hotspots

- Education and outreach
- Improved waste management
- Sewage/stormwater run-off
- Reduction of single use items
- Removal of micro plastics/zero pellet loss
- Redesign of harmful products



- improvement of countries' waste systems.
- international development assistance and investments
- national or regional action plans
- Share best practices,
- use of existing platforms and tools for cooperation
- public awareness and education
- prevention
- removal actions
- Support



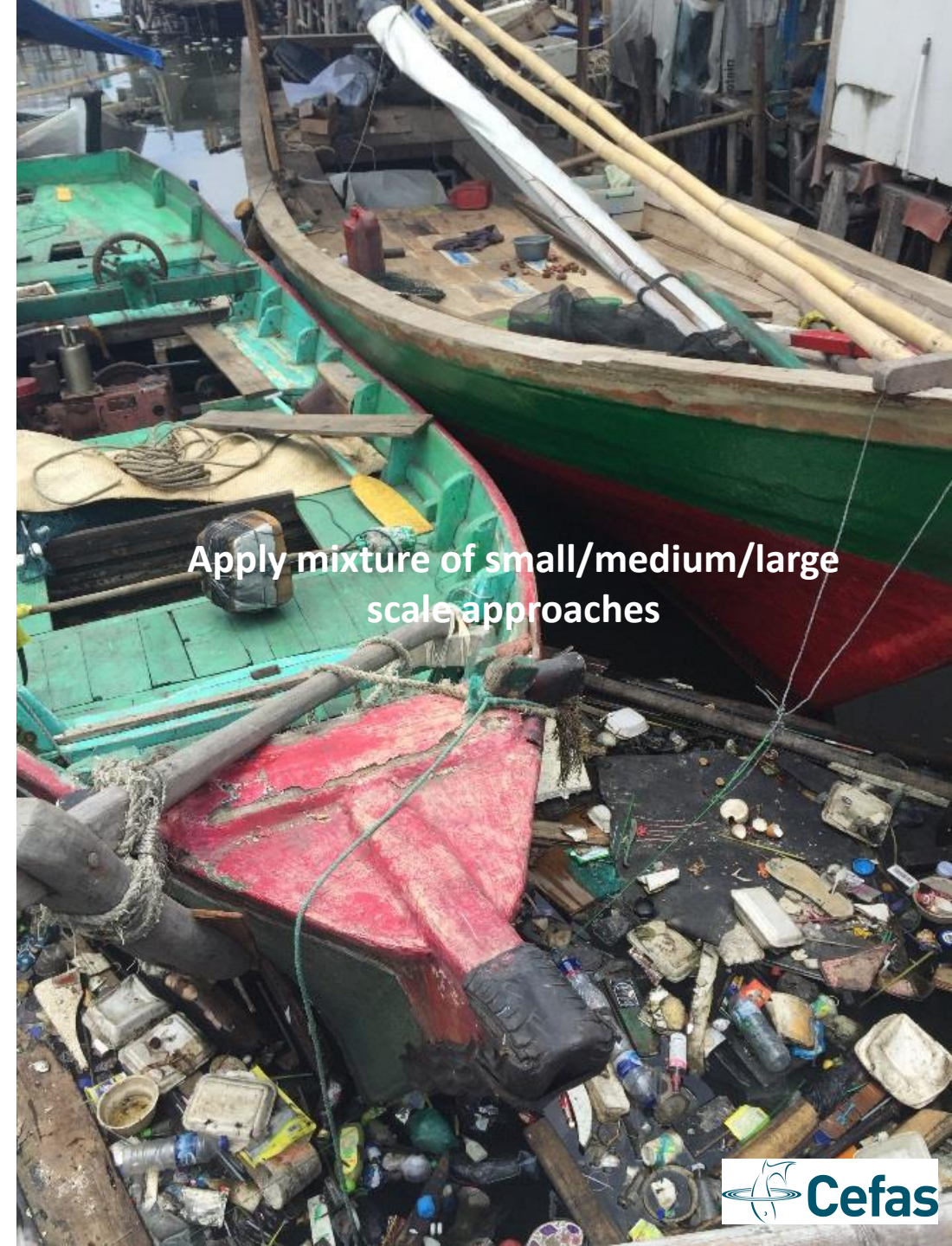
Jambeck et al., 2015

G7 & G20 Marine Litter Action Plan


SOLUTIONS

REDUCE, REUSE, RECYCLE

- Limit marine litter at the source, **stop inputs**
- **Reduce waste** and cut back on the use of plastic, especially single-use plastics e.g. water bottles, straws and cups.
- **Change habits** and products.
- If possible, use **natural materials** rather than synthetics.
- Improve **waste management infrastructure**
- **Awareness** raising at public, industry and governmental level
- **Stakeholder & Public** consultation and buy-in
- Revise and develop regional and national **action plans** on marine litter
- **Legislation**
- **Education & Outreach**
- ...



Apply mixture of small/medium/large scale approaches



The only way to manage the marine litter pollution issue is by limiting the input—changing ways and behaviours that cause marine litter to enter the environment.

THE END

THANK YOU FOR YOUR ATTENTION

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THOMAS.MAES@CEFAS.CO.UK

WANT TO FIND OUT MORE?

CEFAS WEBPAGE: <http://www.cefasc.co.uk/>

TWITTER: @SEAMOHT

FACEBOOK GROUP:

www.facebook.com/groups/marlite

FACEBOOK PAGE:

www.facebook.com/MICROPLASTIC