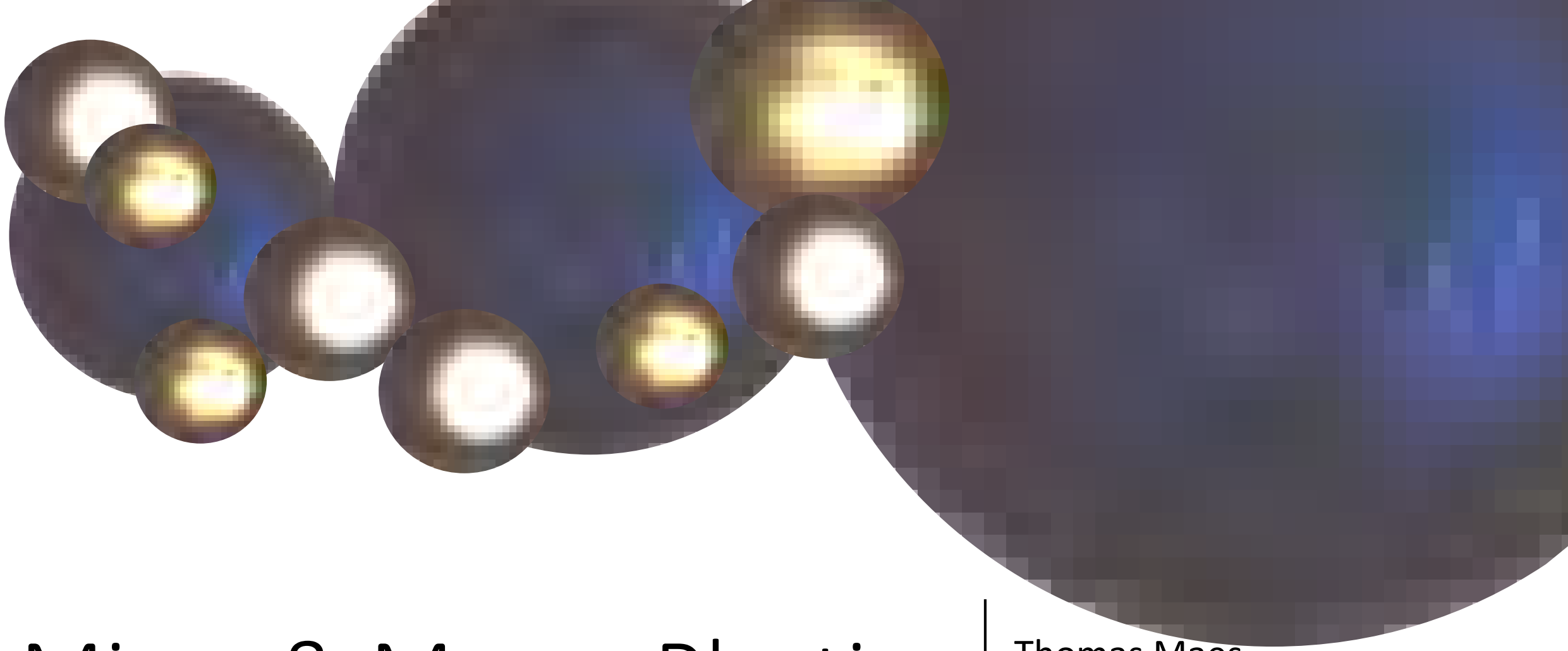


Micro & Macro Plastic:

Where do we go from here?

Thomas Maes

RSC Workshop

17 October 2017

Cefas

Marine Litter

- Human-made solid material
- Global, cross-sector & trans-boundary issue
- **Land**/Sea based sources
- Waste management issue
- Increase in scale, and variety of materials, with population growth and globalisation of trade

Cefas

- Mainly Plastics
- Many shapes and sizes
- Depleting the capacity of the world's oceans
- Social, economic and ecological harm
- Entanglement & ingestion
- Cumulative effects

Macro & Microplastics

International initiatives

- UN SDG14
- UN Clean Seas & GPML
- UNEA3
- GGGI
- G7/G20
- Our Ocean
- OSPAR RAP & Common Indicators
- EU MSFD D10

RESEARCH NEEDS

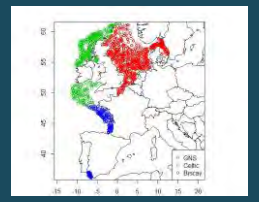
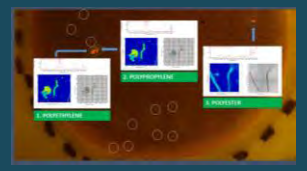
- **Monitoring & Modelling**
  - Distribution and abundance
  - Sources and types
  - Spatial and temporal trends
  - Hotspots
- **Standardised, cheap and simple methods** for sorting and enumerating plastic fragments
- Ecological, environmental and socio-economic **impacts**
- Biological and ecosystem **effects** e.g. toxicity, productivity and biodiversity
- The relevance of co ingestion of **plastics, microbes, polymer additives and POPs**.
- **Bioaccumulation** and trophic transfer
- Knowledge of the **fragmentation rates and mechanisms**
  - effects of aging
  - physico-chemical properties
  - retention rates
  - microplastic particle generation
  - relative importance of various sources
  - particle size distribution
- **Risk assessments and socio economics**
  - Food chain
  - Human dietary intake
  - Industries e.g. aquaculture
- **Measures and methods for reducing/removing**

Cefas

Monitoring

- BEACH
- FLOATING/WATERCOLUMN
- SEAFLOOR
- MICROPLASTICS (WATER/SEDIMENT/BIOTA)
- IMPACT

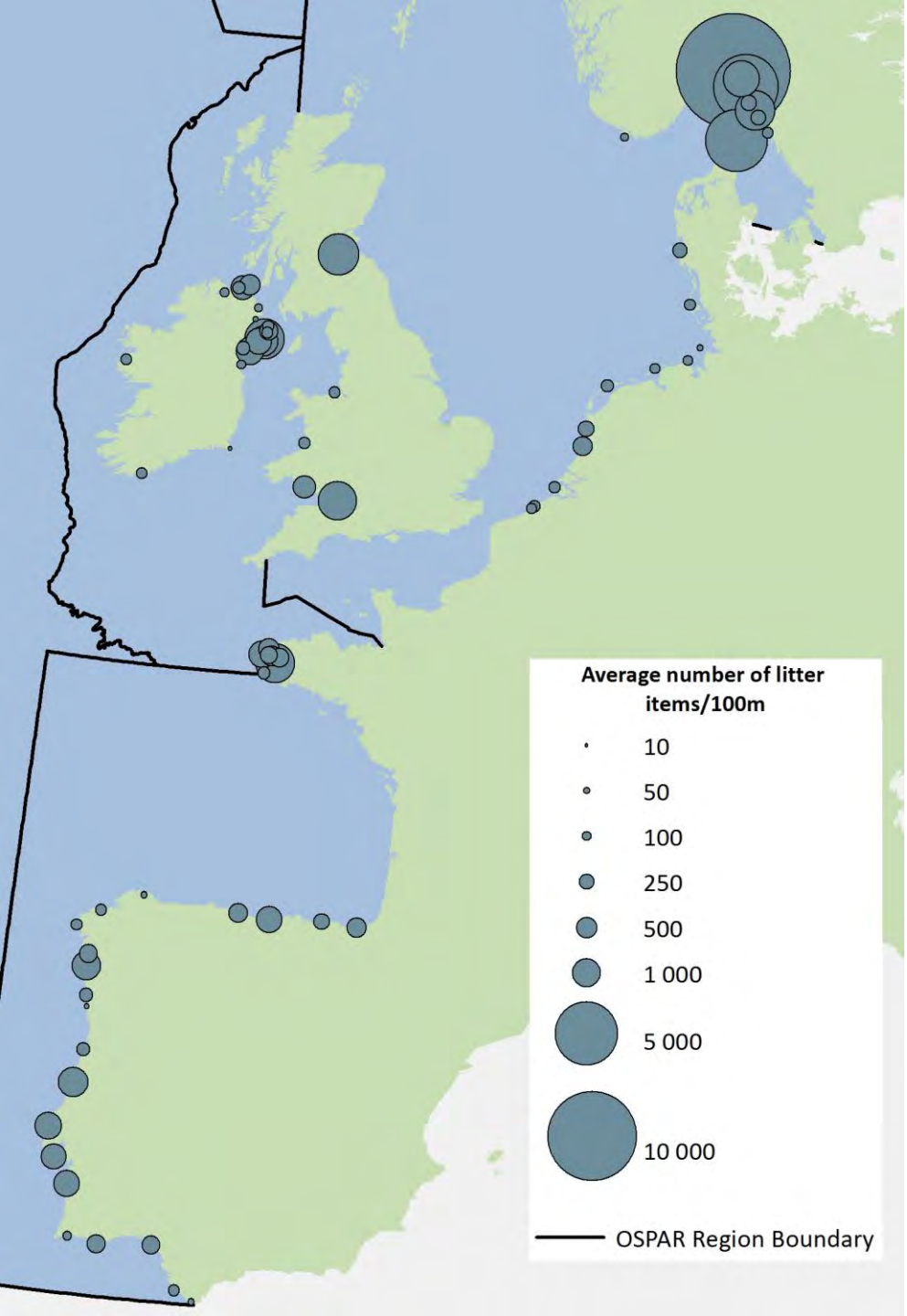


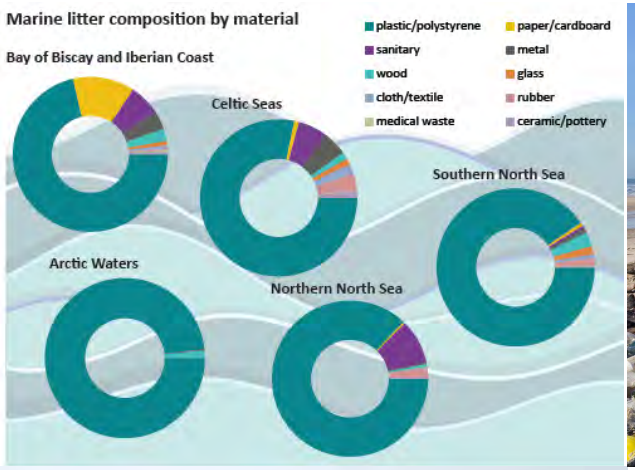

Cefas

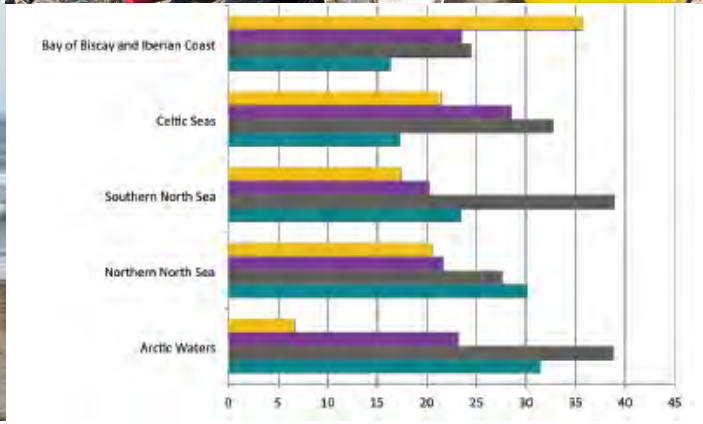
MARINE LITTER MONITORING
Targeted VS Opportunistic

Cefas



OSPAR BEACH LITTER MONITORING – BEACH CLEANS





https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/marine-litter/beach-litter/

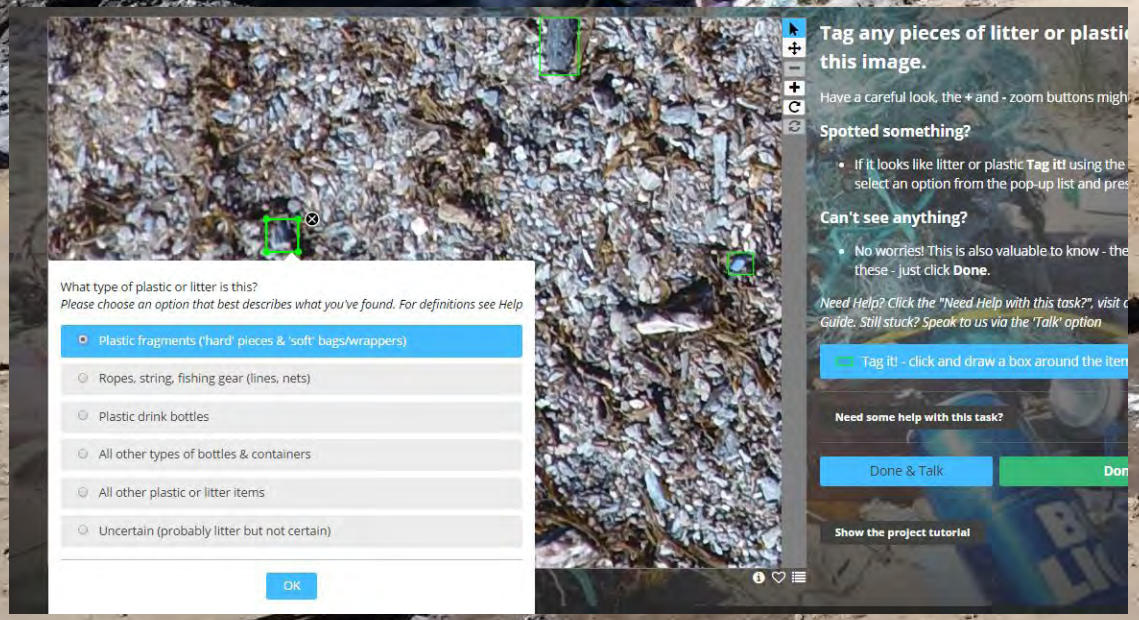
Marine Conservation Society

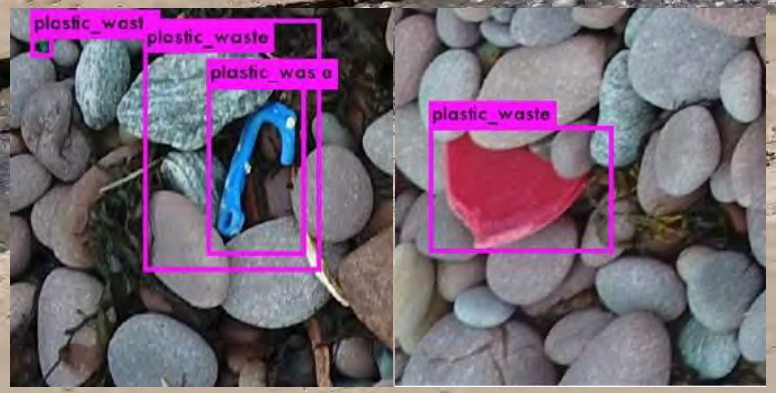
Cefas

The Plastic Tide

https://www.theplastictide.com/

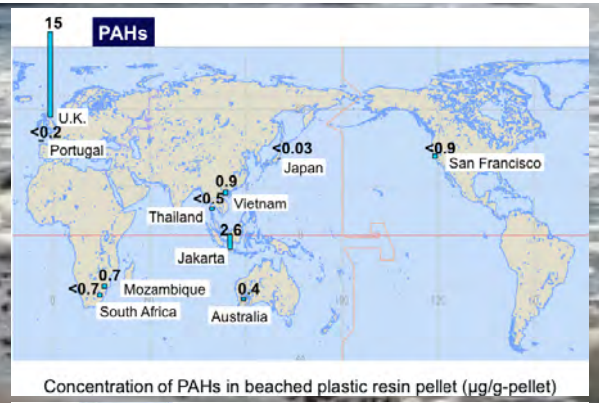
BEACH LITTER MONITORING – UAV



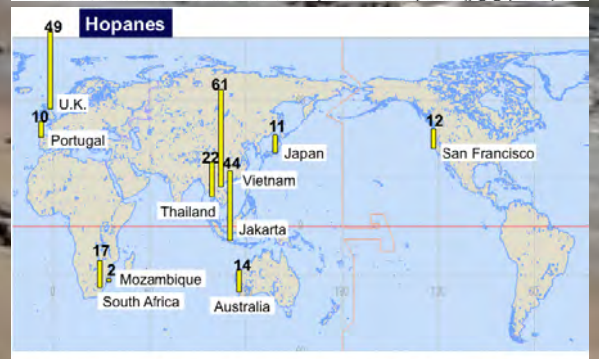


Cefas

INTERNATIONAL PELLET WATCH



Concentration of PAHs in beached plastic resin pellet (μg/g-pellet)



Concentration of Hopanes in beached plastic resin pellet (μg/g-pellet)

Arch Environ Contam Toxicol. 2017;73(2):196-206.

Polycyclic Aromatic Hydrocarbons (PAHs) and Hopanes in Plastic Resin Pellets as Markers of Oil Pollution via International Pellet Watch Monitoring.

Yeo BG[1], Takada H[2], Hosoda J[1], Kondo A[1], Yamashita R[1], Saha M[1,3], Maes T[4].

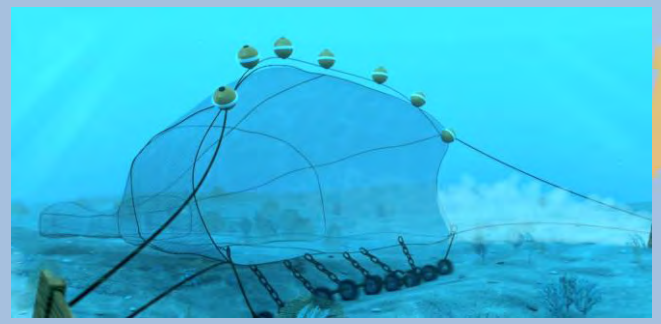
DOI:10.1007/s00244-017-0423-8

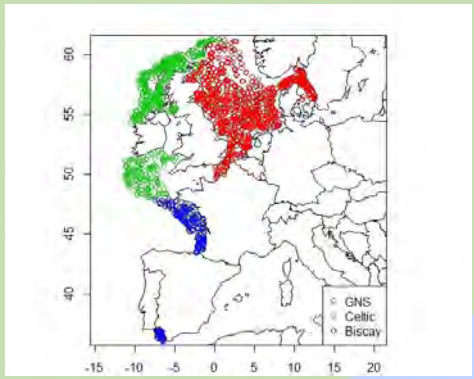
International Pellet Watch Japan

http://www.pelletwatch.org/

Cefas

SEAFLOOR LITTER – FISH STOCK SURVEYS



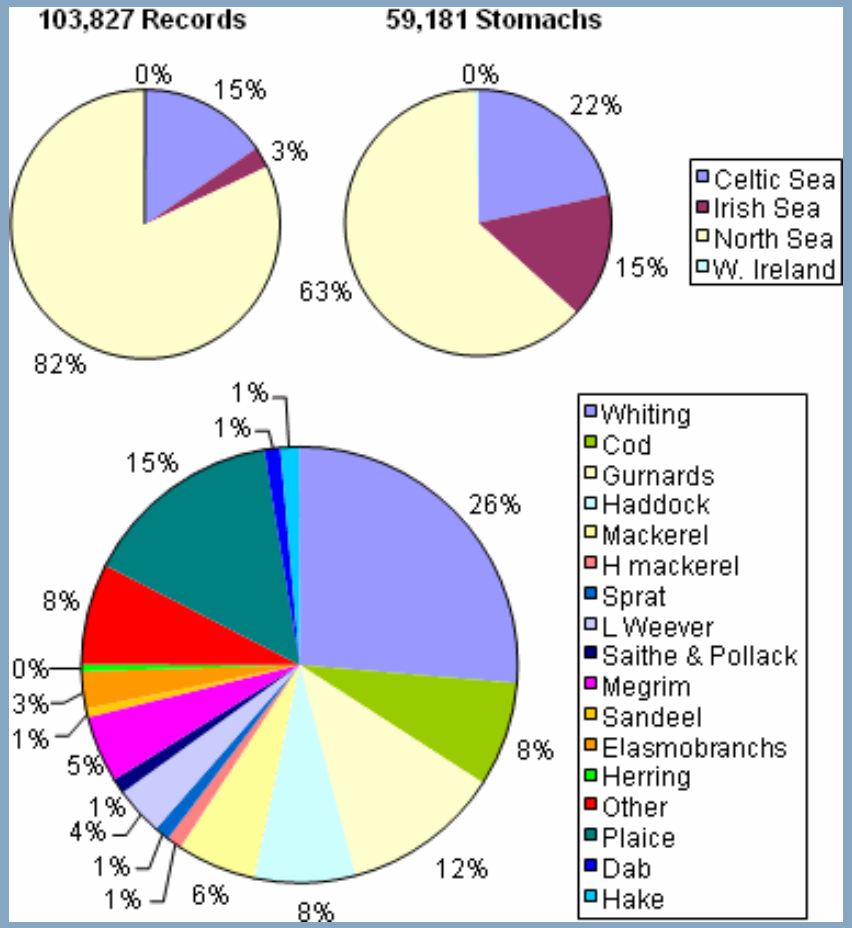


Total Litter per km^2

- 0,0 - 16,5
- 16,5 - 33,0
- 33,0 - 49,6
- 49,6 - 66,1
- 66,1 - 82,7
- 82,7 - 99,2
- 99,2 - 115,7
- 115,7 - 132,3
- 132,3 - 150

CEFAS – 25 year seafloor litter data

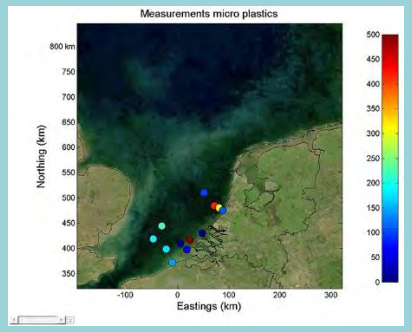
PLASTIC INGESTION - Integrated Database and Portal for Fish Stomach Records (DAPSTOM)



https://www.cefas.co.uk/cefas-data-hub/fish-stomach-records/

Cefas

MICROPLASTIC SAMPLING – FISHERIES SURVEYS



Floating microplastic: **0 - 1.5 microplastic/m^3** - fragments
Microplastics in sediments: **0 - 3,146 particles/kg DW** - fibers & spheres

Hotspots:
Estuaries
High organic carbon content.

Recommendations:
Sediment monitoring
Standardization of monitoring methods

Maes et al. (2017). Microplastics Baseline Surveys at the Water Surface and in Sediments of the North-East Atlantic . *Frontiers in Marine Science*

MICROPLASTIC SEDIMENT – HAZARDOUS SUBSTANCES MONITORING

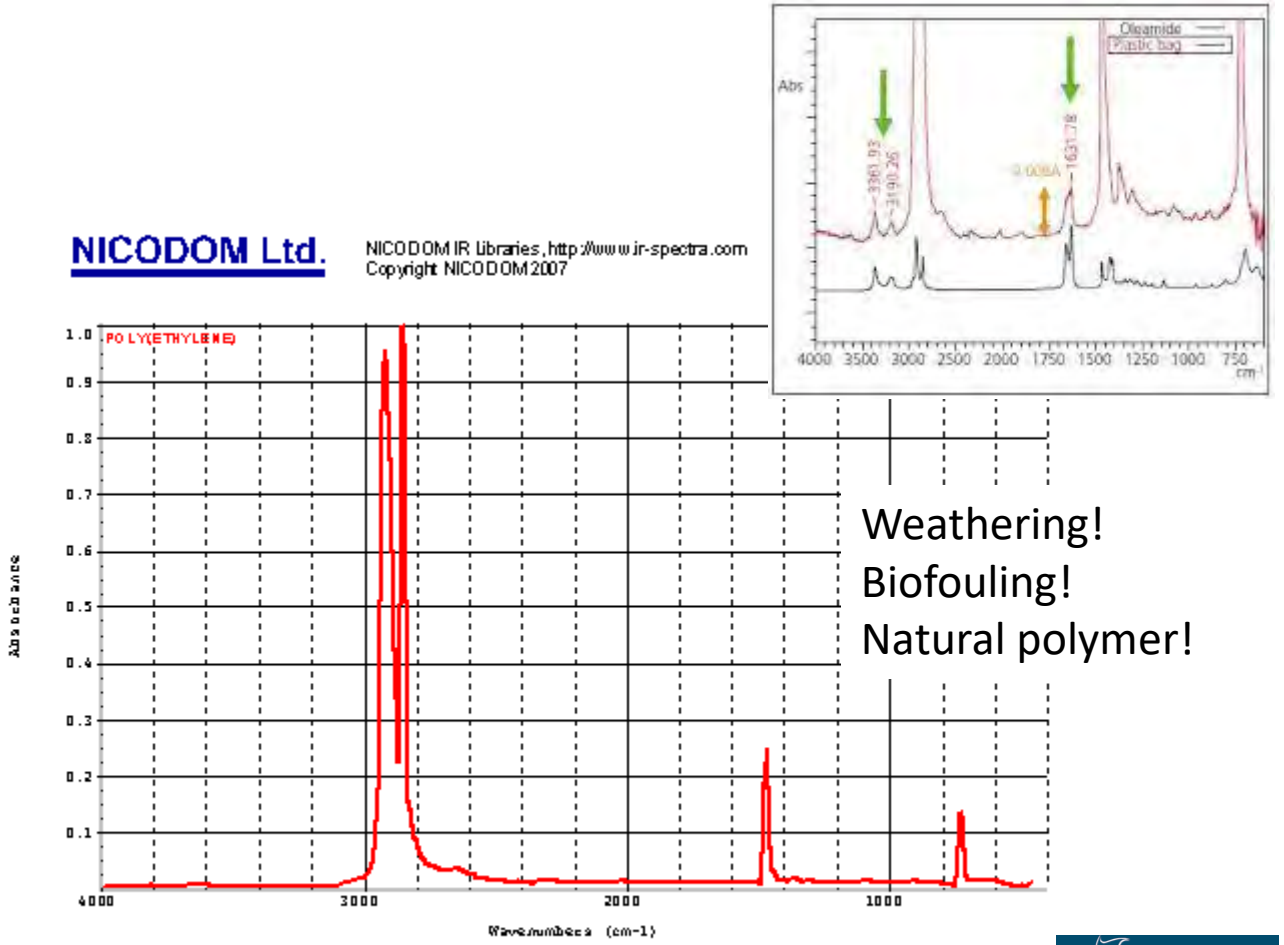
VISUAL

Shape, colour, size, …

Mismatches!

SPECTROSCOPY

FTIR, Raman



Weathering!
Biofouling!
Natural polymer!

Cefas

IFR Institute of Food Research

UEA University of East Anglia

Cefas

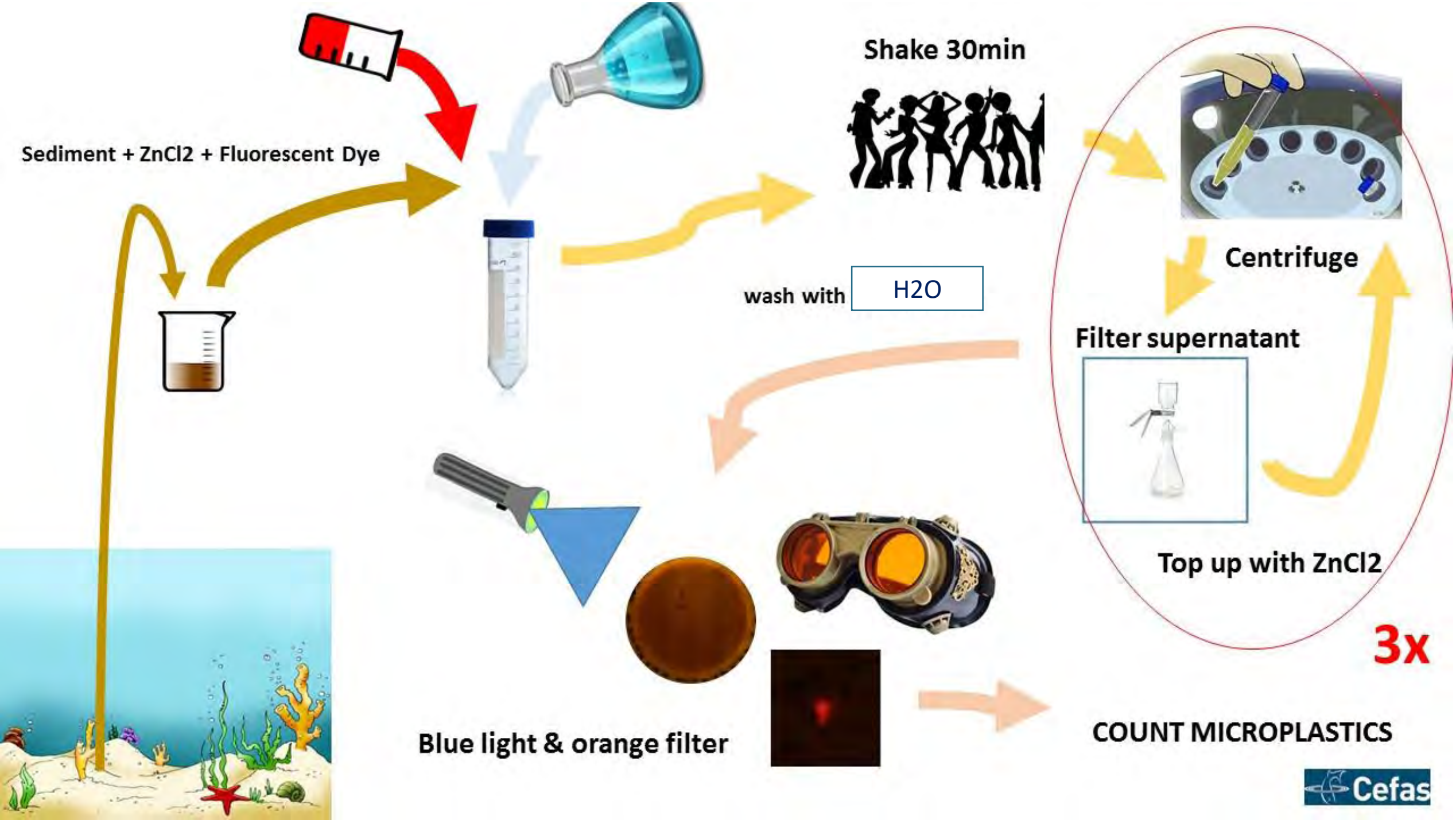
CRIME SCENE

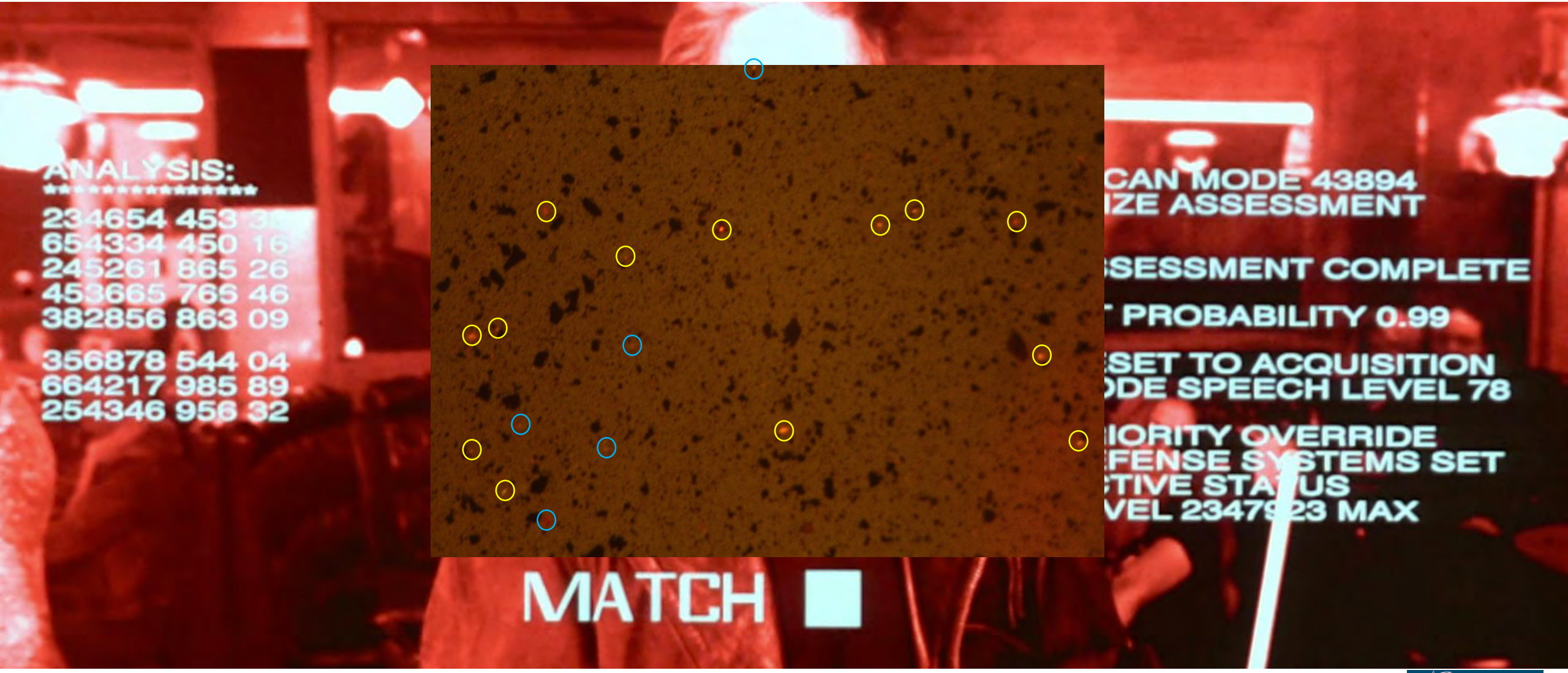
Maes, T. et al. A rapid-screening approach to detect and quantify microplastics based on fluorescent tagging with Nile Red. Sci. Rep. 7, 44501; doi: 10.1038/srep44501 (2017). http://www.nature.com/articles/srep44501

Cefas

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

Cefas


Sediment + ZnCl2 + Fluorescent Dye
Shake 30min
Centrifuge
wash with
H2O
Filter supernatant
Top up with ZnCl2
3x
Blue light & orange filter
COUNT MICROPLASTICS
Cefas


ANALYSIS:
234654 453
654334 450 16
245261 865 26
453665 765 46
382856 863 09
356878 544 04
664217 985 89
254346 956 32
CAN MODE 43894
ZE ASSESSMENT
SSESSMENT COMPLETE
PROBABILITY 0.99
SET TO ACQUISITION
DE SPEECH LEVEL 78
IORITY OVERRIDE
FENSE SYSTEMS SET
TIVE STATUS
VEL 23479 23 MAX
MATCH

RESEARCH & DEVELOPMENT

Cefas

INTERREG VB ATLANTIC AREA

- CLEANATLANTIC – 3yr – 18 partners
- OCEANWISE – 3yr – 15 partners

Interreg Atlantic Area
European Regional Development Fund

Cefas

CLEANATLANTIC

- Regional characterisation of marine litter in the Atlantic Area
- Stakeholder characterisation and initiatives tackling marine litter in the Atlantic Area
- Review of economic sectors impacted by marine litter in the Atlantic Area
- Scientific and technical basis for data collection/Tools development in relation to needs
- Monitoring the presence of marine litter in the marine environment
- Monitoring the interaction of macro/meso marine litter with fauna in the Atlantic area
- Evaluate the potential harm caused to the marine environment by cigarette filters and cotton buds
- Evaluation of marine litter as transport facilitator and available habitat for nuisance biota (e.g. parasites or non-indigenous species)
- Review on methods and marine litter modelling methodologies
- Software development necessary
- Assessment of the fate of marine litter using models
- Modelling land based sources of marine litter
- Modelling ocean based sources of marine litter
- Marine litter reduction scenarios
- Best practices to reduce inputs from the fishing and port sector
- Fishing for litter in the Atlantic Area
- Reducing abandoned lost and otherwise discarded fishing gears (ALDFG)
- Best practiaces for beach marine litter clean up aimed at local authorities

OCEANWISE

- Stakeholders mapping in the Atlantic area
- Design stakeholder's engagement tools
- Organisation of Stakeholders involvement, meetings and inputs
- Eco-innovation Awards
- Assessment of relevant environmental and socioeconomic insights
- Overview of EPS
- Compilation of database of existing uses of EPS products and applications
- Compilation of database of current available alternatives to EPS products
- Assessment of presence / impact of EPS in the marine environment in the North Atlantic and proximity of potential landmark sources
- State of art on the current solutions to recycle, reuse and repurpose EPS
- Assessment of policies, incentives and producer responsibility schemes with relevance to the subject
- Review of circularity indicators /tools to help evaluate product/application circularity
- Review of models to evaluate and improve product/application circularity
- Circularity assessment of EPS Products & Applications. Wherever feasible, comparison to alternatives
- Testing alternatives EPS for Seafood sector
- Testing alternatives to EPS for general packaging
- Design simple protocols for ensuring comparability
- Ecotoxicology and the marine environment
- Assessment of Biodegradability of alternatives to EPS
- Recommendations on the use of EPS and their alternatives
- New Solutions & Alternatives

Interreg Atlantic Area
European Regional Development Fund

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Better products
Better systems
Better legislation

Cefas

A Better World Starts With You

Be part of the solution

Life Without Plastic

Trash is for Tossers

Zero Waste Life

Cefas

REFUSE & REDUCE

PLASTIC FREE JULY

The Top Four...

things to avoid when taking the **Plastic Free July** challenge

1	PLASTIC STRAWS
2	PLASTIC CUTLERY
3	BOTTLED WATER
4	TAKE AWAY COFFEE CUPS
5	PLASTIC TOOTHBRUSH
6	PLASTIC BAGS
7	TAKE AWAY CONTAINERS
8	PLASTIC WRAPPED TOILET PAPER

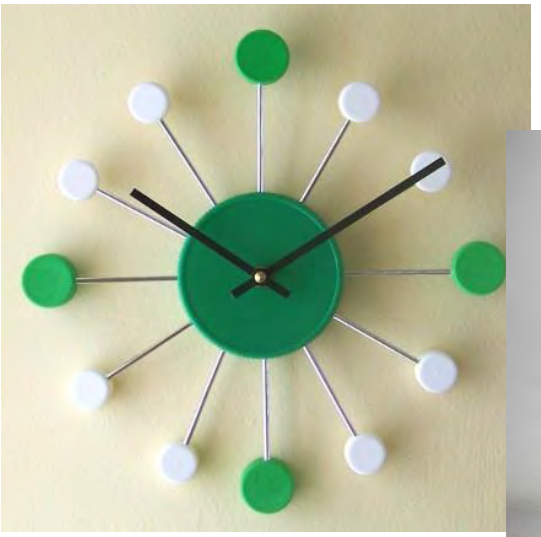
Cefas

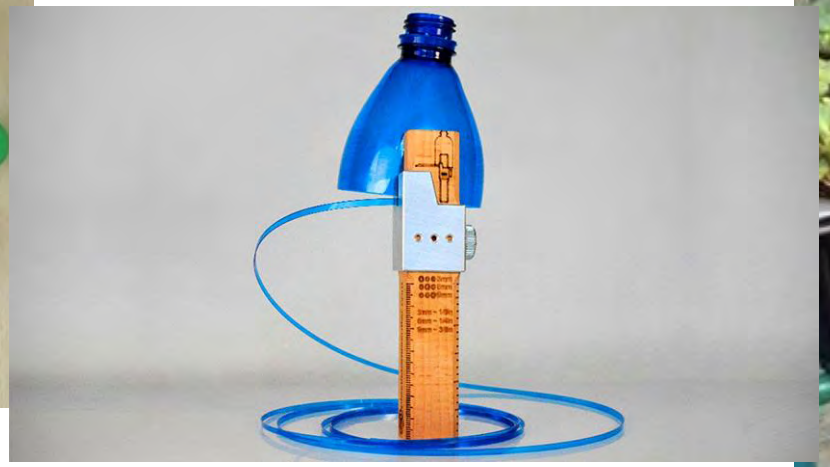

OPTIMALE
DEEK LORES
OPTIONS!
SPROUTED FOODS
LESS WASTE LEAVES A SMALLER CARBON FOOTPRINT
BUY A LITTLE OR BUY A LOT IT'S UP TO YOU
IT'S A GREAT VALUE!
FABULOUS SELECTION LOOK AT ALL YOUR OPTIONS!
HOW TO BUY BULK
1 TAKE A BAG
2 FILL IT WITH AS MUCH PRODUCT AS YOU NEED
3 USE A TWIST TIE TO CLOSE YOUR BAG
4 MAR WITH T


Cefas

REUSE & RECYCLE

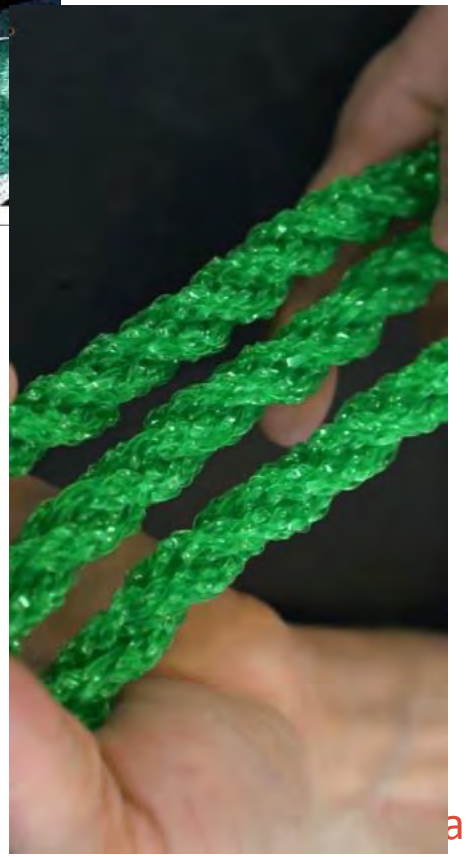
Cefas

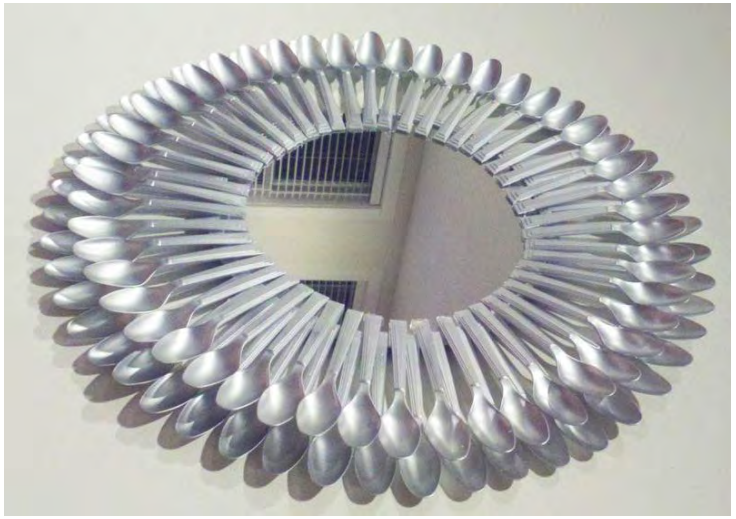




Cefas

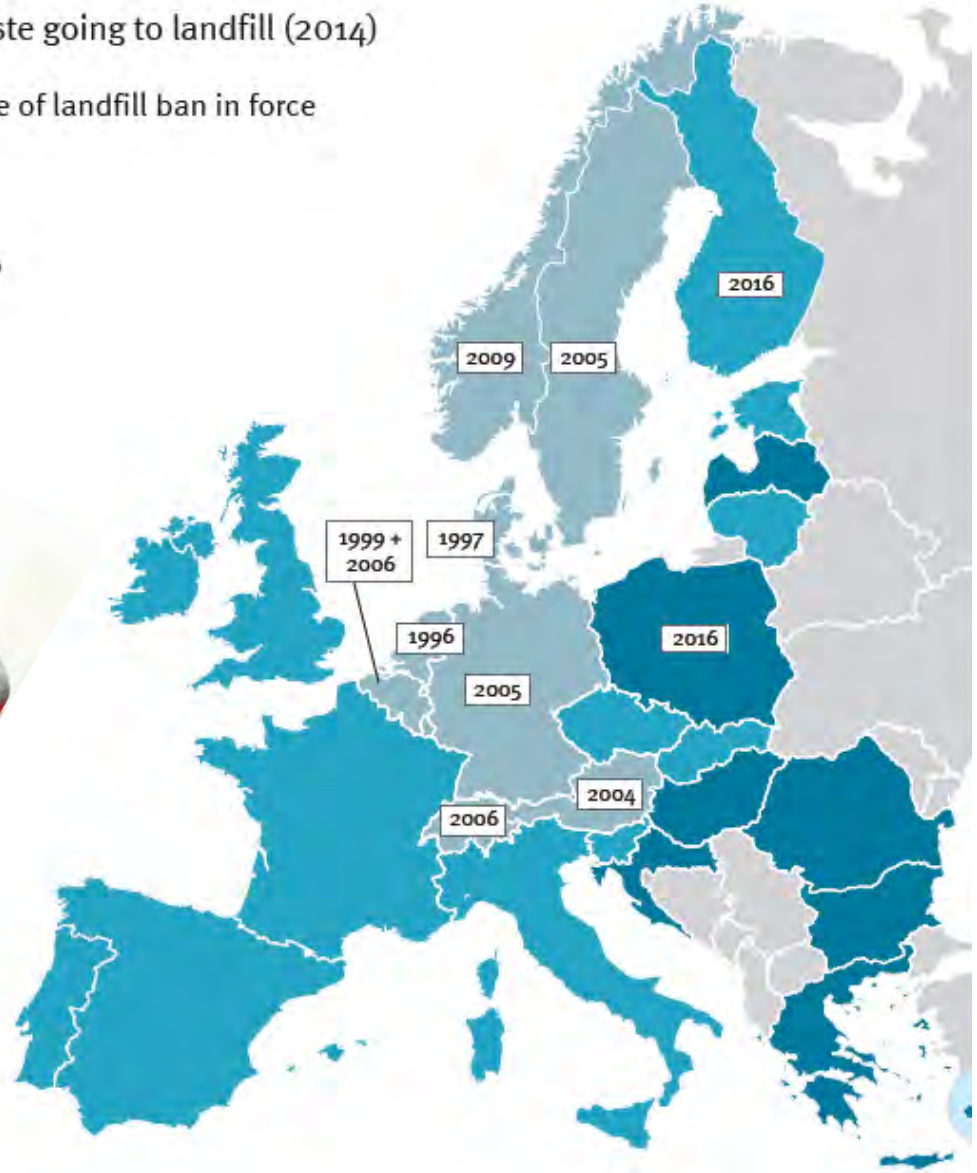
Caixa feita com tiras finas de PET





Cefas

Source: Consultic



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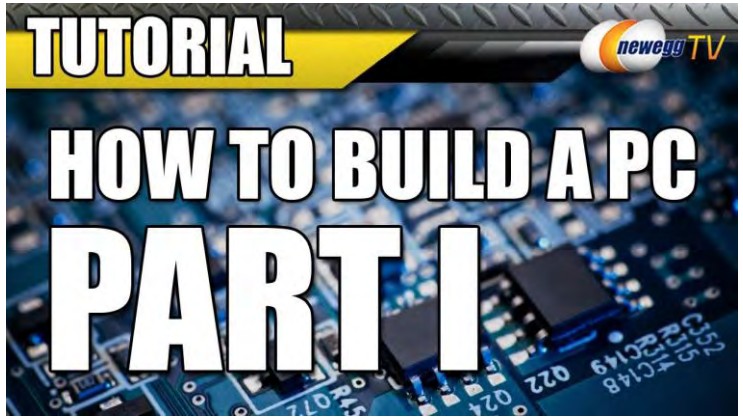
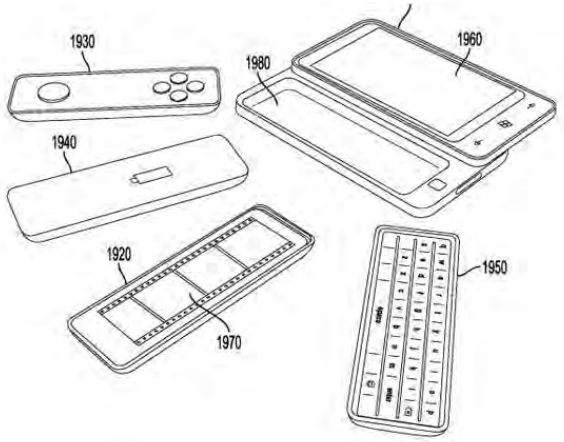
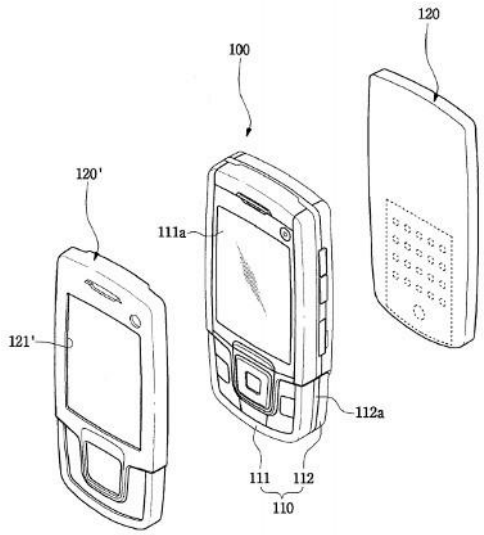






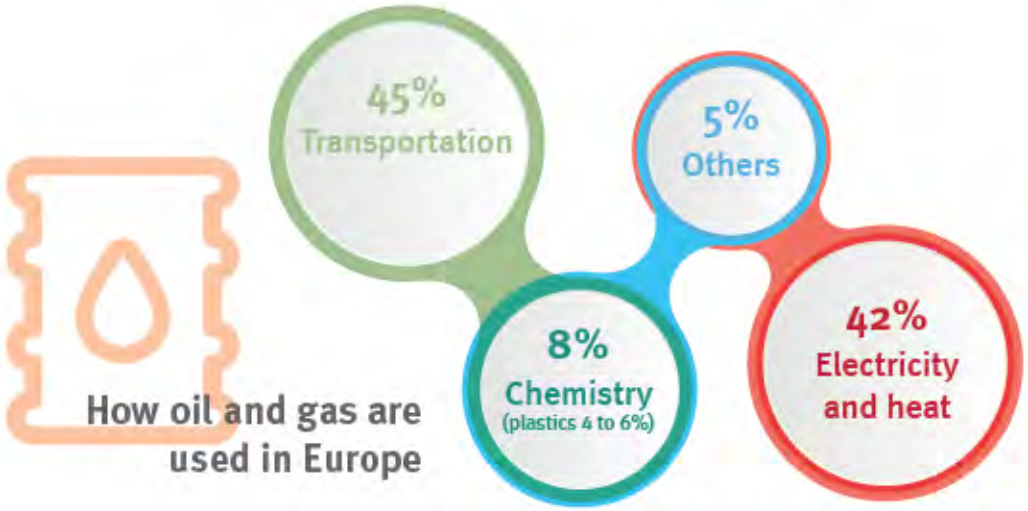
REBUILD & RETHINK

Cefas

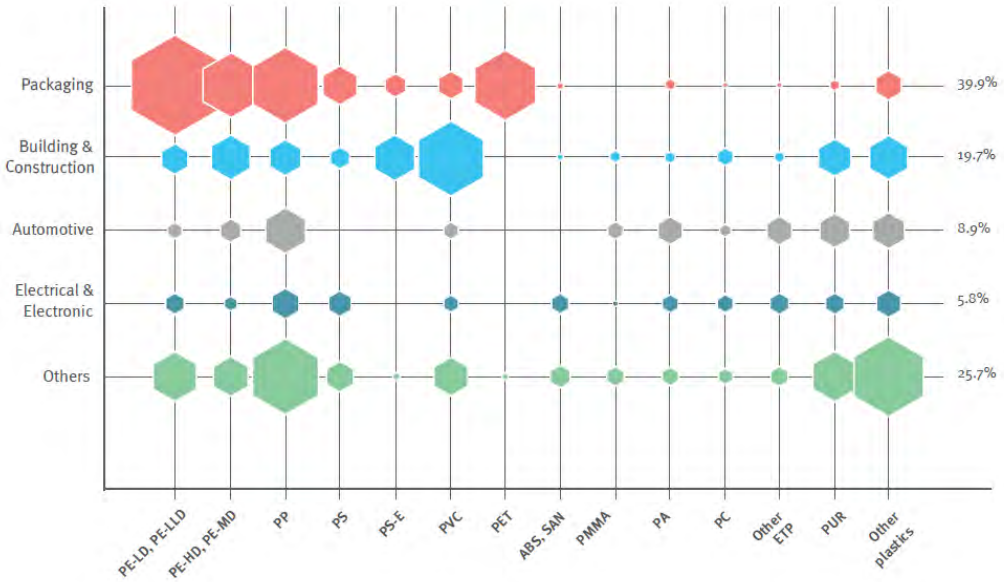
THE TIME HAS COME TO REBUILD OUR SOCIETY &
OUR ECONOMY ON PRINCIPLES THAT SERVE **THE PLANET**

Cefas

Food Packaging

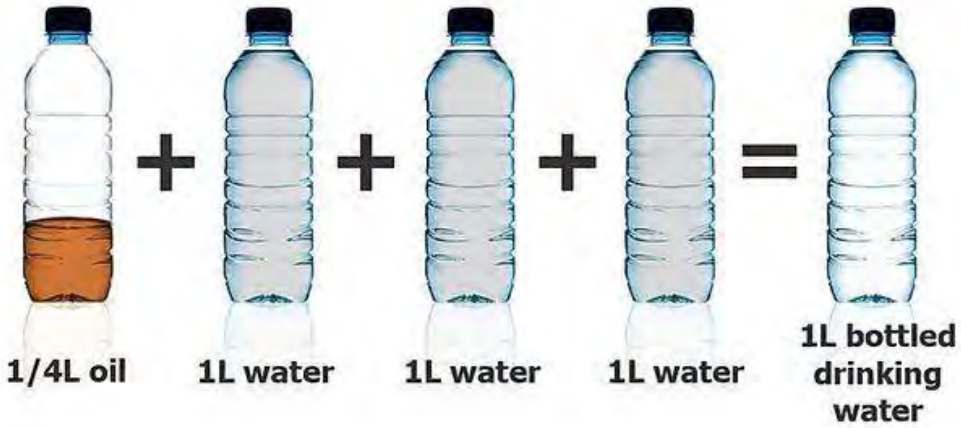


Plastic 4 to 6%
40% Packaging



Cefas

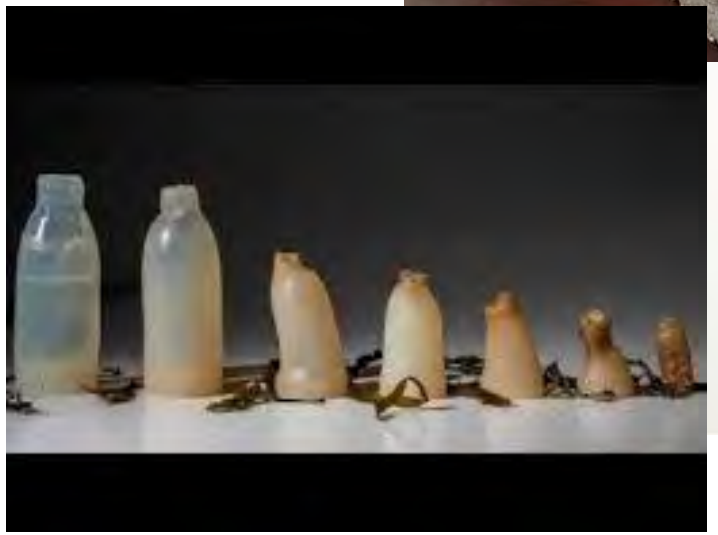
Historic packaging



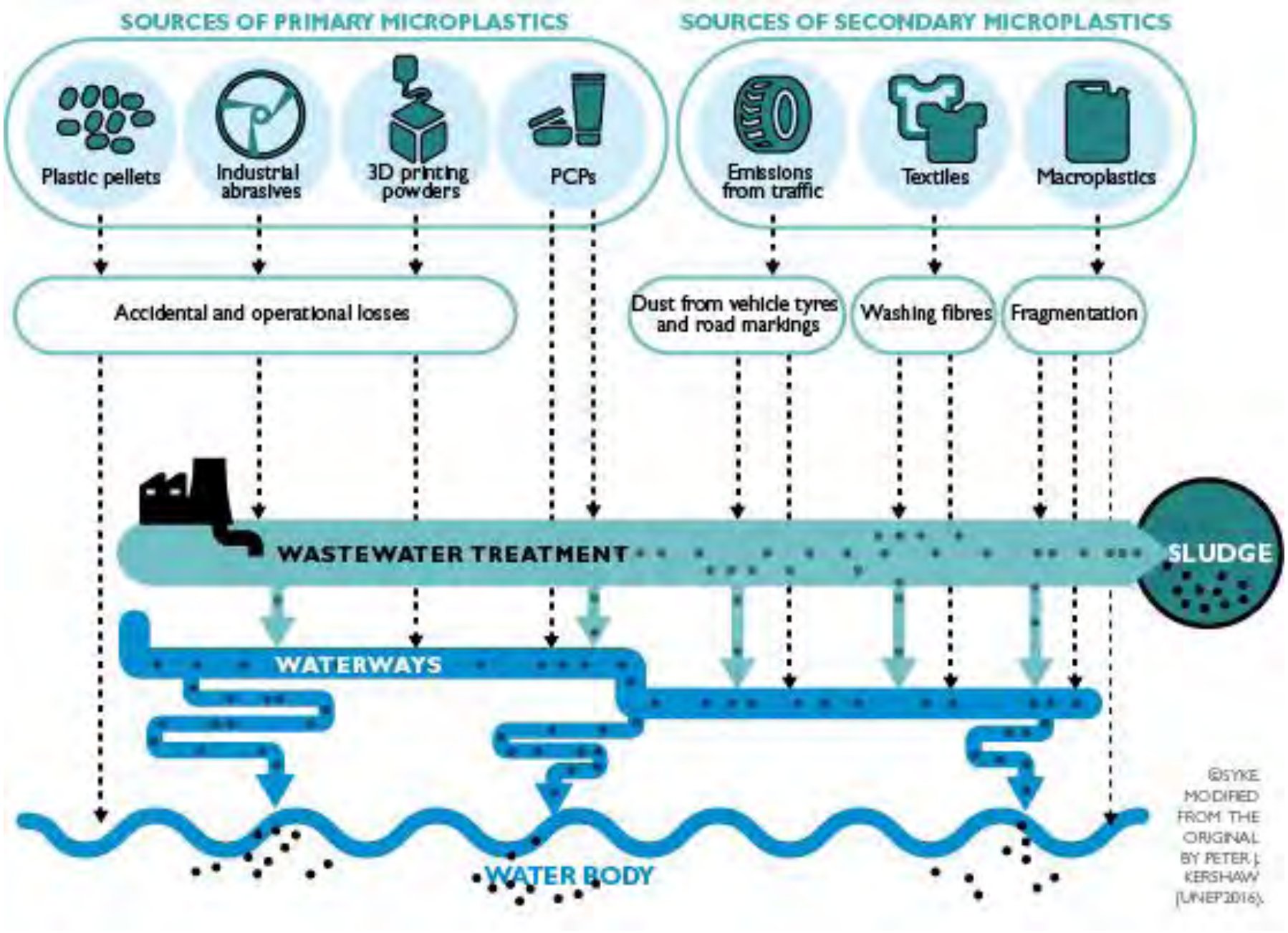
COURTESY: CONSUMER REPORTS

Creative packaging

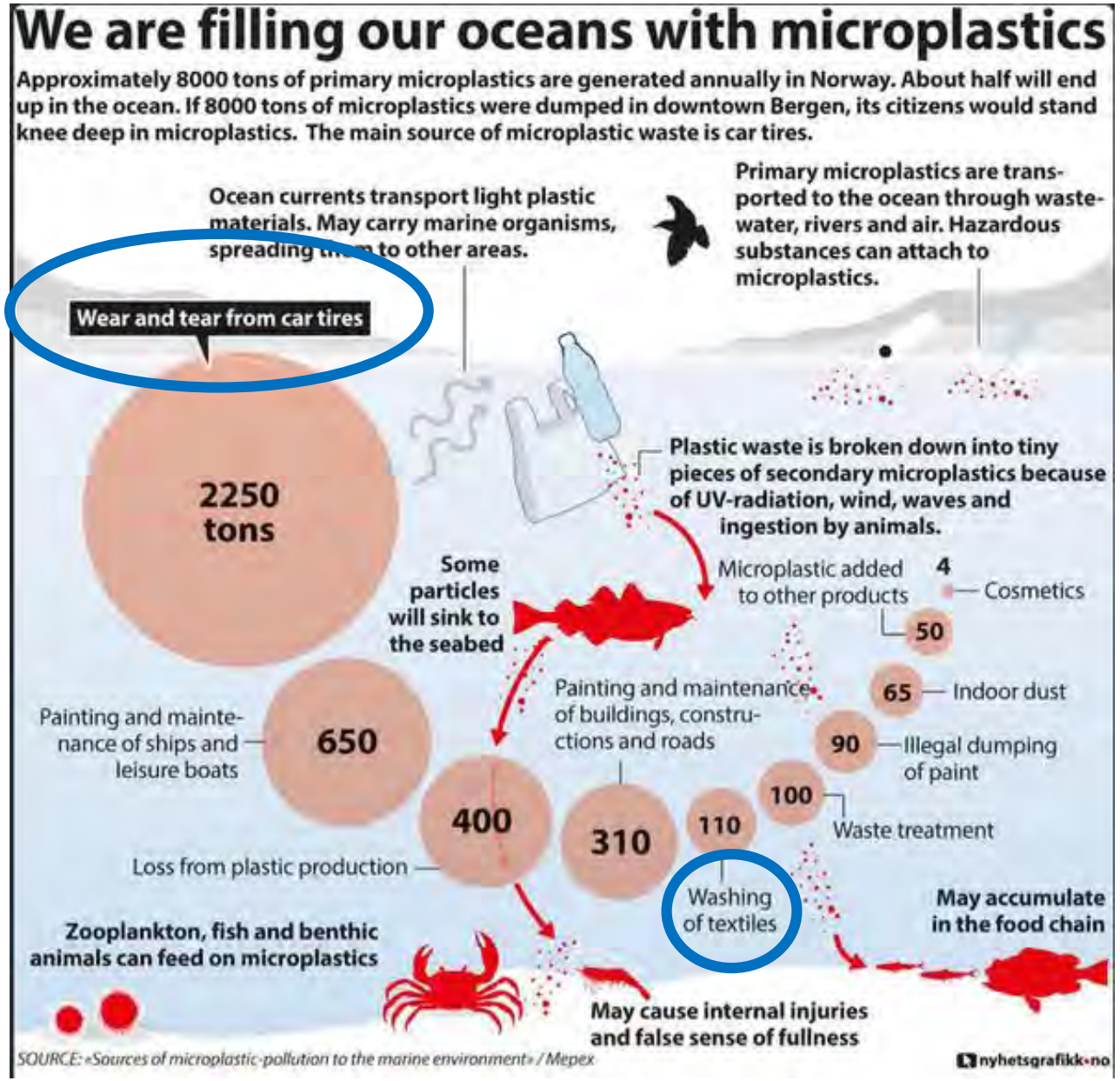
“Bio-plastics”
Biodegradable plastics
Bio-based plastics



Cefas


SOURCES OF PRIMARY MICROPLASTICS
SOURCES OF SECONDARY MICROPLASTICS
Plastic pellets
Industrial abrasives
3D printing powders
PCPs
Emissions from traffic
Textiles
Macroplastics
Accidental and operational losses
Dust from vehicle tyres and road markings
Washing fibres
Fragmentation
WASTEWATER TREATMENT
SLUDGE
WATERWAYS
WATER BODY
©SYKE MODIFIED FROM THE ORIGINAL BY PETER J. KERSHAW (UNEP 2016).

Cefas


We are filling our oceans with microplastics
Approximately 8000 tons of primary microplastics are generated annually in Norway. About half will end up in the ocean. If 8000 tons of microplastics were dumped in downtown Bergen, its citizens would stand knee deep in microplastics. The main source of microplastic waste is car tires.
Ocean currents transport light plastic materials. May carry marine organisms, spreading them to other areas.
Primary microplastics are transported to the ocean through wastewater, rivers and air. Hazardous substances can attach to microplastics.
Wear and tear from car tires
2250 tons
Plastic waste is broken down into tiny pieces of secondary microplastics because of UV-radiation, wind, waves and ingestion by animals.
Some particles will sink to the seabed
Microplastic added to other products
4
Cosmetics
50
65
Indoor dust
Painting and maintenance of buildings, constructions and roads
Painting and maintenance of ships and leisure boats
650
90
Illegal dumping of paint
100
Waste treatment
400
310
110
Loss from plastic production
Washing of textiles
May accumulate in the food chain
Zooplankton, fish and benthic animals can feed on microplastics
May cause internal injuries and false sense of fullness
SOURCE: «Sources of microplastic-pollution to the marine environment» / Mepex
nyhetsgrafikk.no


Marine pollution
Sources of microplastics washed into the sea
Marine coatings 3.7%
Personal care products 2%
Plastic pellets 0.3%
Road markings 7%
City dust 24%
Tyres 28%
Synthetic textiles 35%
Source: IUCN

Cefas

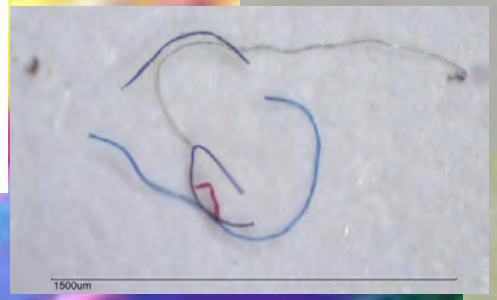
Cefas

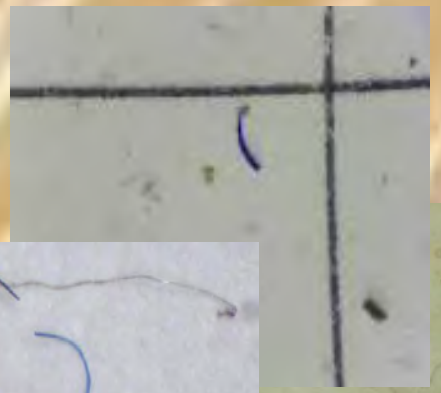

MICHELIN
MICHELIN
VISIONARY
CONCEPT


MICHELIN
PERMANENT
STRUCTURE
AIRLESS
RECYCLED
RECYCLABLE
Cefas


MICHELIN
ON DEMAND
TREAD
3D PRINTED
RENEWABLE
BIODEGRADABLE

Textile & yarn improvements, protective softeners, washing machines & products, …





rozalia project
for a clean ocean

Cefas

THE END

THANK YOU FOR YOUR ATTENTION

CONTACT:
THOMAS MAES
CEFAS
THOMAS.MAES@CEFAS.CO.UK

WANT TO FIND OUT MORE?

CEFAS WEBPAGE: http://www.cefas.co.uk/
TWITTER: @SEAMOHT
FACEBOOK GROUP:
www.facebook.com/groups/marlite
FACEBOOK PAGE:
www.facebook.com/MICROPLASTIC

Cefas