Micro & Macro Plastic: Where do we go from here?

Thomas Maes
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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
• 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**
Monitoring

- BEACH
- FLOATING/WATERCOLUMN
- SEAFLOOR
- MICROPLASTICS (WATER/SEDIMENT/BIOTA)
- IMPACT
MARINE LITTER MONITORING
Targeted VS Opportunistic
OSPAR BEACH LITTER MONITORING – BEACH CLEANS


Marine Conservation Society
The Plastic Tide

BEACH LITTER MONITORING – UAV

https://www.theplastictide.com/
Polycyclic Aromatic Hydrocarbons (PAHs) and Hopanes in Plastic Resin Pellets as Markers of Oil Pollution via International Pellet Watch Monitoring.
Yeo BG¹, Takada H², Hosoda J¹, Kondo A¹, Yamashita R¹, Saha M¹,³, Maes T⁴.
DOI:10.1007/s00244-017-0423-8

http://www.pelletwatch.org/
SEAFLOOR LITTER – FISH STOCK SURVEYS

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/
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!
http://www.nature.com/articles/srep44501
Sediment + ZnCl₂ + Fluorescent Dye → Shake 30min

Centrifuge

Filter supernatant

Top up with ZnCl₂

COUNT MICROPLASTICS

Blue light & orange filter

wash with H₂O
RESEARCH & DEVELOPMENT
INTERREG VB ATLANTIC AREA

➢ CLEANATLANTIC – 3yr – 18 partners
➢ OCEANWISE – 3yr – 15 partners
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 practices for beach marine litter clean up aimed at local authorities
➢ 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

OSPAR Action 49 on Mitigation of EPS impacts in the marine environment
Better products
Better systems
Better legislation
A Better World Starts With You

Be part of the solution

Life Without Plastic
Trash is for Tossers
Zero Waste Life
REFUSE & REDUCE

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
REUSE & RECYCLE

Most common materials

Thermoplastics
- Polyethylene (PE)
- Polypropylene (PP)
- Polyvinyl-chloride (PVC)
- Polystyrene (PS)
- Polyethylene Terephthalate (PET)
- Expanded polystyrene (EPS)
- SAN
- Polycarbonate (PC)
- Polymethyl methacrylate (PMMA)
- Polymides (PA)
- Thermoplastic elastomers (TPE)
- Fluoropolymers
- PEEK
- Etc.

Thermosets
- Polyurethane (PUR)
- Polyester
- Epoxy resins
- Vinyl ester
- Silicone
- Phenolic resins
- Acrylic resins
- Urea-formaldehyde
- Phenol-formaldehyde
- Melamine resin
- Etc.

PLASTICS SHAPE THE FUTURE
REBUILD & RETHINK
THE PLANET

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

Plastic 4 to 6%
40% Packaging
Historic packaging

1/4L oil + 1L water + 1L water + 1L water = 1L bottled drinking water
Creative packaging

“Bio-plastics”
Biodegradable plastics
Bio-based plastics
Sources of primary microplastics:
- Plastic pellets
- Industrial abrasives
- 3D printing powders
- PCPs

Sources of secondary microplastics:
- Emissions from traffic
- Textiles
- Macroplastics
  - Dust from vehicle tyres and road markings
  - Washing fibres
  - Fragmentation

Wastewater treatment:

Waterways:

Water body:

(Cefas modified from the original by Peter J. Kershaw (UNEP 2016).)
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.

Plastic waste is broken down into tiny pieces of secondary microplastics because of UV-radiation, wind, waves and ingestion by animals.

Microplastic added to other products
4 - Cosmetics
50

Some particles will sink to the seabed

Painting and maintenance of ships and leisure boats
650

Loss from plastic production
400

Zooplankton, fish and benthic animals can feed on microplastics
310

Painting and maintenance of buildings, constructions and roads

Washing of textiles
110

May accumulate in the food chain

May cause internal injuries and false sense of fullness

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
MICHELIN
VISIONARY CONCEPT
PERMANENT STRUCTURE
AIRLESS RECYCLED RECYCLABLE
ON DEMAND TREAD
3D PRINTED
RENEWABLE
BIO DEGRADABLE
Textile & yarn improvements, protective softeners, washing machines & products, ...
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.

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

THE END
THANK YOU FOR YOUR ATTENTION

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

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