Plastics in the Marine Environment:

the implications for seafood

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Plastics and microplastics

Plastic production has risen steadily since the mid-1950s

Plastics degrade in the marine environment forming micro and nanoplastics

Public awareness has increased significantly

Plastics and microplastics

Much of the plastic we use ends up in the sea

clothes
tyres
microbeads

Larger items degrade in the sea:

bags
bottles
fishing nets

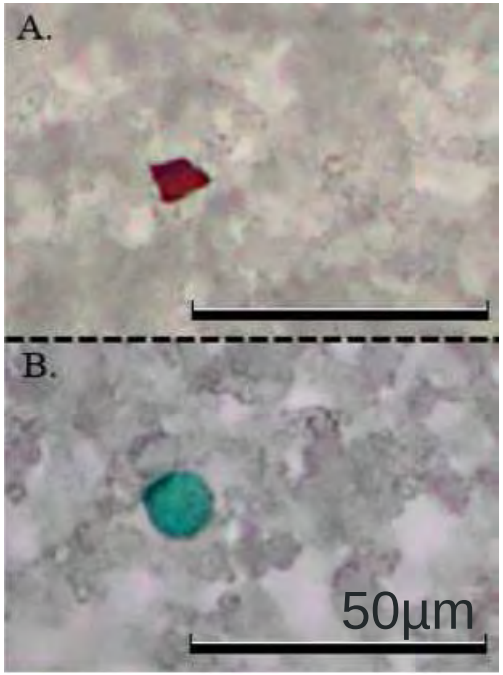
Plastics

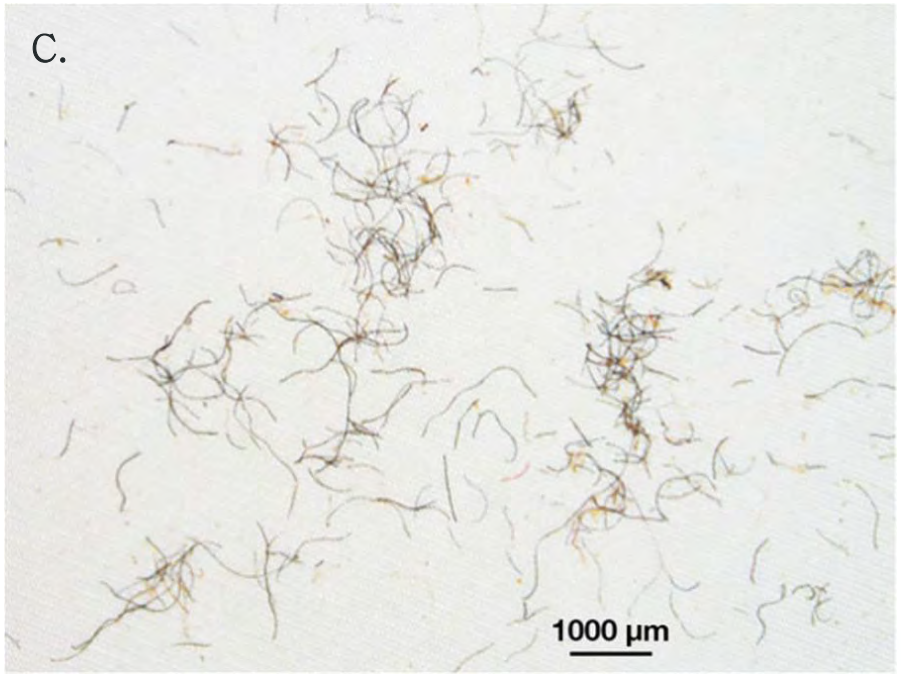
Polymer type	Examples of uses
Low density polyethylene (LDPE)	Plastic carrier bags, general packaging, squeeze bottles, netting, drinking straws
High density polyethylene (HDPE)	Kitchenware, jerry cans, toys, fishing nets, microbeads
Polypropylene (PP)	Carpets, twine, clothing, structural foam, automotive parts
Polystyrene (PS)	Vending cups, food containers
Polyamide (nylon) (PA)	Textiles, fishing line, netting, car parts
Polyester (PES)	Textiles, films
Acrylic (AC)	Textiles, paints
Polyoxymethylene (POM)	Car parts, housing parts, food conveyors
Polyvinyl alcohol (PVA)	Papermaking, textiles, coatings
Polyvinyl chloride (PVC)	Packaging, cling film, cable insulation
Poly methylacrylate (PMA)	Safety glass, coatings
Polyethylene terephthalate (PET)	Food packaging, bottles

Microplastics and nanoplastics

Microplastics: < 5 mm

Nanoplastics: <100 nm





A, B, Hermsen et al. 2017; C, Shreya Sonar (Patagonia, 2017)

Microplastics: our concerns

The marine ecosystem

and the sea as a source of food

Microplastics in seafood

Our overall exposure

Microplastics: our concerns

Direct effects

Indirect effects

Nano effects

Physical

Chemical

Microbiological

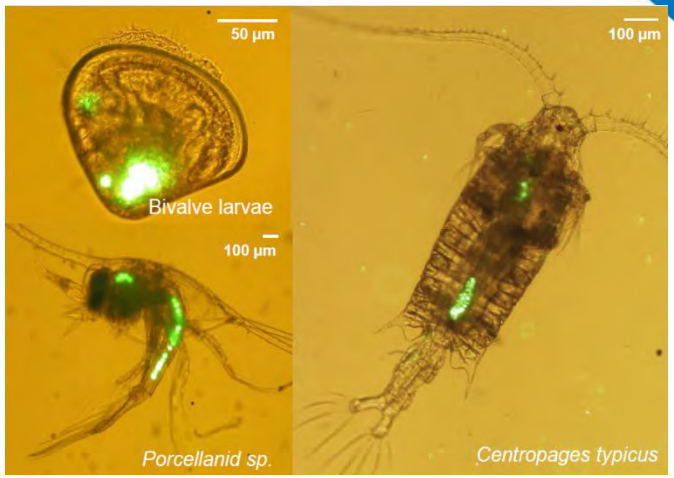
Microplastic effects

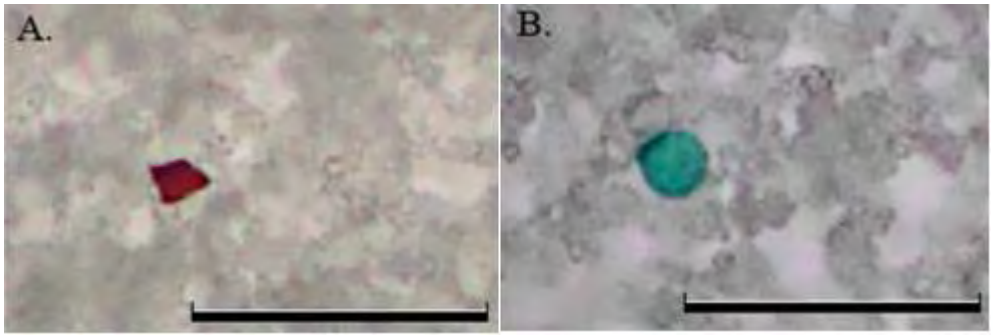
Direct effects

Sub-lethal effects on plankton

Found in the stomachs of fish, seabirds, marine mammals

Evidence they may cross into organs if <150µm





Cole et al. 2013; A, B: Hermsen et al. 2017

Microplastic effects

Indirect chemical effects

Present from manufacturing process

Adsorption from marine environment, due to hydrophobic nature

Concentration (up to $x10^6$)

PAHs, PCBs, OC pesticides, polybrominated compounds, endocrine disruptors, metals

EFSA: Exposure is minor compared to ordinary exposure to BPA and PCBs including dioxins

Microplastic effects

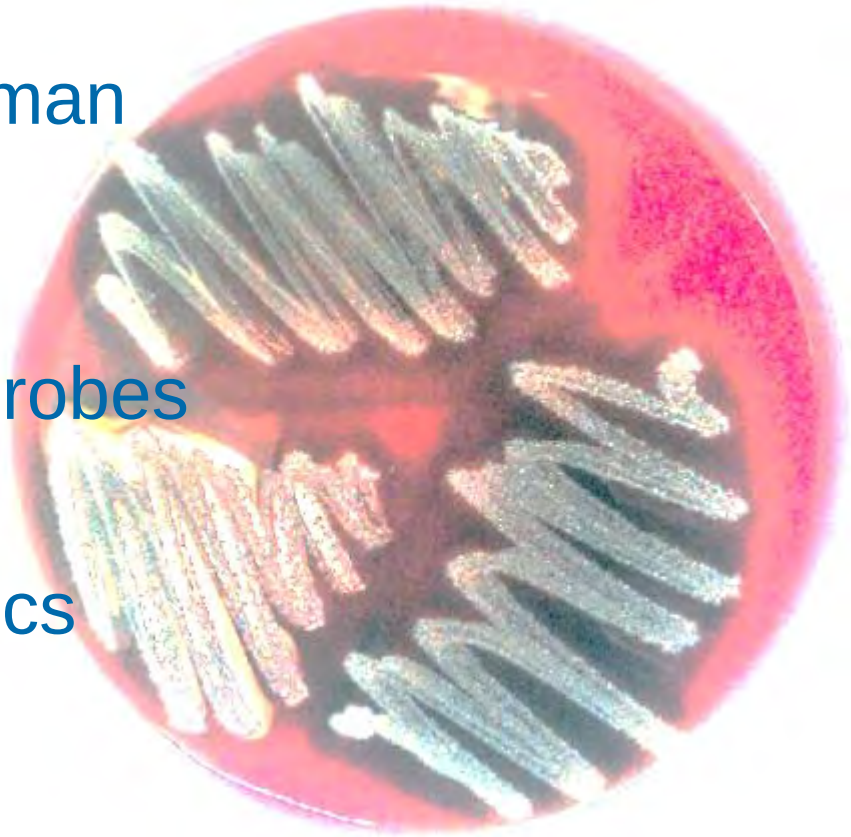
Microbiological effects

Microorganisms including human pathogens can colonise microplastics

Gene exchange between microbes associated with microplastics

Vectors for adsorbed antibiotics

Vector for the fish pathogen *Aeromonas salmonicida*



Nanoplastic effects

Nanoplastics can enter cells.

Some engineered nanomaterials have shown toxic effects (inflammation, liver and kidney effects, secondary genotoxic effects).

Introducing nanoplastics into molluscs, sea urchins, chickens and human cell lines demonstrated a variety of harmful effects.

Toxicity effects on humans are unknown.

Analytical methods need to be developed.

Occurrence data in food is absent.

Plastics and seafood

Marine organisms are exposed to microplastics and ingest them

Microplastics can enter the human food chain via the food we eat

Much of the research on microplastics in seafood has focused on shellfish

Exposure to microplastics

Top mussel consumers (older Belgian citizens): **11,000** particles/person/year

Average UK consumer: **125** particles/person/yr

Household dust ingested during meals: **14,000–68,000** particles/person/year

Potential reputational risk for the industry

Characterising the risk

Risk matrix

Information matrix
To map our level of understanding of the various microplastic risks

What information is currently available?
How robust?
Known hazards
Mitigation measures
Information gaps
Ongoing research

Risk / information matrix

	Physical hazard of plastic microparticles
Current information	MP/NP are ubiquitous in the aquatic / marine environment. Variable sizes, densities and shapes.
Known issues, hazards, risks	Transfer to marine organisms in all trophic levels, including seafood species. Size and shape effects. Presence of MP in the gut of several species confirmed. Presence of MP & NP in organs following transport across the gut. Lab trials confirm they are physical stressors with effects on health.
Mitigation measures	Removal of plastics; marine clean-up schemes; onshore and marine waste management; depuration of molluscs and crustaceans
Information & knowledge gaps	How widespread the MP/NP are; no standard testing methods for identification, enumeration and characterisation; no way to remove NPs from marine environment
Current research	Efforts to standardise testing methods

Risk / information matrix

The micro/ nanoparticles	Physical Chemical Microbiological
The marine environment; impacts on marine life	Physical Environmental
Sources of ingestion by humans	Seafood: molluscs / crustaceans / finfish Food & drink: water / beer / honey / salt / other proteins Other sources: inhaled air / house dust deposition / packaging / textiles
Consumer perception	Awareness Perception
Regulation	Food Environmental

Characterising the risk

We can only partially characterise the risk associated with microplastics.

Seafish will assess current knowledge and ongoing research.

Seafish aim to publish guidance on how businesses can mitigate risk

Thank you

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