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Life in Plastic, it's Fantastic?

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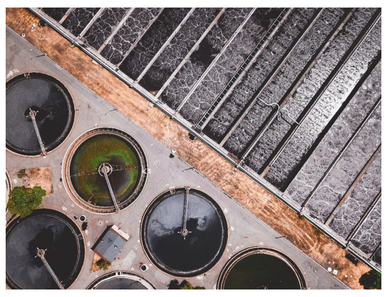
PLASTIC POLLUTION IN WATER





Annual global plastic production has **increased** from 2.1 million tonnes in 1950 to **368 million tonnes** in 2019[1]

Accumulation of plastic in the environment **caused by**:

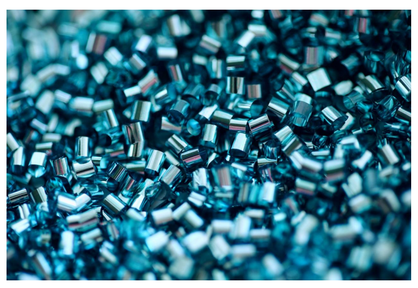
- low **degradation** rate of plastics
- **mismanagement** of plastic **waste** i.e. disposal and unsustainable use[2]

- Due to environmental conditions larger plastic items **fragment** into smaller particles i.e. from macro-plastics to **microplastics**[3]
- A major issue with mega- and macro-sized plastics is **entanglement** with aquatic mammals, turtles, fish and birds[4]

- Microplastics are prevalent in both **freshwater** and marine environments[5]
- Freshwater ecosystems provide a multitude of **essential functions** and services (i.e. food and water)
- We need to understand their effects as a **pollutant** on ecosystems and **human health**

MICROPLASTICS

"Microplastics are any synthetic solid particle or polymeric matrix, with regular or irregular shape and with size ranging from 1 µm to 5 mm, of either primary or secondary manufacturing origin, which are insoluble in water"[6]

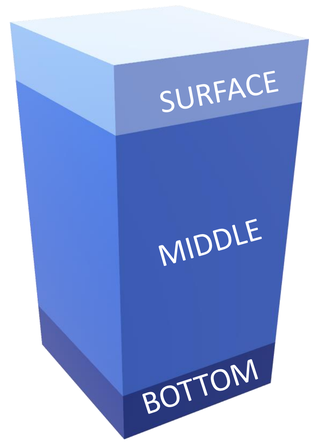


Primary microplastics
< 5 mm by design[3]

Secondary microplastics
Caused by fragmentation[3]

MICROPLASTICS IN FRESHWATER

- Microplastics differ from other suspended pollutants
- They can exist in different forms in aqueous media i.e. **dissolved**, **colloidal**, or macroscopic **suspended** matter[7]
- The **variety** of **microplastic** morphologies, polymer types, and size affect density and/or hydrophobicity
- Lighter microplastics will float on the **surface** whereas denser microplastics will settle at the **bottom** and accumulate in the sediment phase[8]
- Microplastic **behaviour** and **transport** need to be understood to mitigate impact on freshwater ecosystems and services



Simplified water column

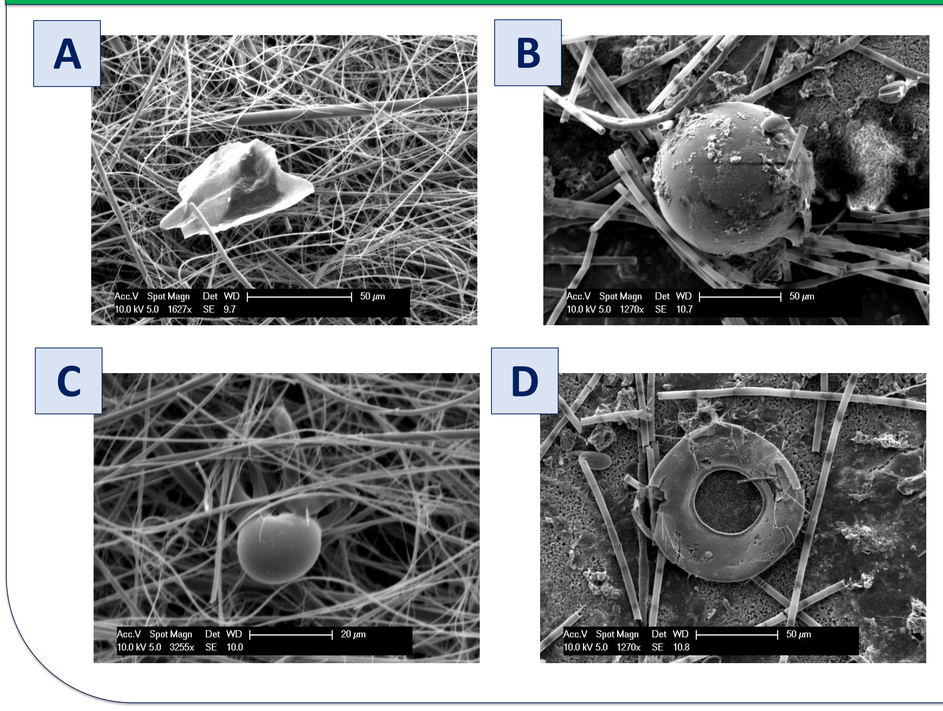
The aim of this research is to evaluate methodologies to better understand plastic pollution and impact on freshwaters and services

Assess limitations with identification and quantification of microplastics → Develop guidance for optimising identification across environmental freshwater media → Develop techniques for quantifying microplastic concentrations *in situ* → Determine how environmental conditions and degradation impact microplastic identification

RESEARCH GAPS

- Type, morphology, size, and density of the polymer is not always reported
- Extrapolation and reporting of units (e.g. particles L^{-1}, particles m^{-3}, or particles km^{-2})
- False positive and negative microplastic detection
- Identification issues – mislabelling of microplastics
- Developing a series of sequential steps for analysis
- Measure/detect microplastics in flow
- Degradation of microplastics in the environment
- Potential for cascade pollution

PRELIMINARY RESULTS: SCANNING ELECTRON MICROSCOPY



Contaminating samples with microplastics during processing can lead to **false positives** (**A**). Distinguishing between **non-microplastics** and microplastics can be challenging (**B&C**). Processing steps are important to remove unwanted **organic material** as it can interfere with later analysis (**D**).

Food Water Waste

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