Microplastics in the environment: implications for the microbial world

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Plastics in our environment

- Estimated **311 million tonnes** of plastic items were produced in 2014.
- Expected to total **33 billion tonnes by 2050**.
- Majority is single-use plastics. E.g. bottles, bags.
- Only 9% globally is recycled — value depends on crude oil value.
- Majority ends up in landfill, or entering the environment.
- Pervasive.
- Earth, water and air all affected.
Types of Microplastic

- 100 µm – 5 mm
- 1º microplastics
  - Made for purpose:
    - e.g. microbeads
- 2º microplastics
  - Breakdown products of larger plastic items
    - fibres – nets/clothes
    - fragments of larger items
  - Continued breakdown into nanoplastics
Prediction of **count densities** (pieces km$^{-2}$)

Current estimates:

> 5 trillion pieces

> 250,000 tonnes

Prediction of **weight densities** (g km$^{-2}$)
Water column

Plastic smog

Beach debris

5 x PE
5 x PP
1 x PE:PP
Sources of Freshwater and Marine Microplastic
• Wastewater effluent:
  • Domestic/industrial and personal cleaning products
  • Clothing
  • Industrial processes
  • Synthetic carpet cleaning
  • Fragmentation of larger items
Terrestrial Microplastic Sources: Food production and waste
Potential Impacts

- Reduced biomass
- Endocrine disruption
- Physical damage
- Accumulation and concentration of other chemicals
- Facilitate uptake of chemical contaminants
- Bioaccumulation of chemicals and trophic transfer – food safety
- Ecosystem disruption through loss of key species
Microbial World

- Ecosystem function – nutrient cycling
- Microbiome composition – organism health
- Biosecurity risks – marine microrrafting
- Wastewater treatment efficiency
- Horizontal Gene Transfer – Virulence and AMR
Microplastics in New Zealand’s Ecosystems: the levels, the impacts and the potential solutions

- Microbiologists
- Molecular biologists
- Environmental chemists
- Microbiologists
- Marine biologists
- Polymer chemists
- Freshwater ecologists
- Ecotoxicologists
- Marine modellers
- Social scientists

Working together with a large number of stakeholders including: industry, iwi, communities, regional and national government, NGOs.
Impacts of plastics on New Zealand’s plastispheres...and hopefully some solutions!

- Ecosystem function – community development
- Microbiome composition – organism health
- Marine microrafting – biosecurity & WWTP
- Differences between plastic type and age
- Microbial degradation of plastic

- Marine system and Wastewater Treatment Plants
- Marinas: Nelson, Christchurch, Auckland
- WWTP: Christchurch
- Plastics: 5
- Virgin and aged plastics
- Sampling over time
Ahakoa he iti hoki te mokoroa, nāna i kakati te kahikatea.

Although the grub is but little, yet it gnaws through the big white pine tree

*(Podocarpus dacrydioides)*.