Identifying microplastic polymers using FTIR spectrometry from surface waters in the Pacific Northwest

Hannia Larino, Julie Masura*

UW TACOMA

BACKGROUND

- Microplastics are identified as synthetic polymers that are < 5 mm in length (NOOA 2023).
- Researchers estimate that there are approximately 15 to 51 trillion microplastic particles in the ocean (Van Sebille 2015).
- Much of the research in the Northwest focuses on quantifying the concentration of MPs in different regions of the waterways as well as comparing how spatial and temporal factors influence the concentrations (Mahoney 2017; Hall 2021; Harris 2022; Moats 2019).
- Minimal research studies investigate the polymer composition present in their samples.
- Understanding the polymer compositions present in our waterways can help understand the source of the MP pollutants. In addition, knowing the chemical composition of the MP polymers can guide ecotoxicologists in future studies investigating the physiological impacts MPs have on aquatic biota.

In this research study, we used Fourier-Transformed Infrared spectroscopy (FTIR) to analyze polymer composition from surface waters in the Pacific Northwest.

METHODS

> Samples were collected using a manta net.

> Contents from the net were sieved between 0.33 and 5 mm and stored in a glass jar at 4°C until processed in the lab

> Polymers were extracted using wet peroxide oxidation following NOOA's water sample extraction protocol (Masura et al. 2015).

> FTIR was used to scan plastics from water samples (figure 1).

> PerkinElmer Spectrum IR software was used to capture wavelengths between 4,000 to 650 cm-1.

> PerkinElmer Polymer Libraries were used to align scans to known polymer spectrums.

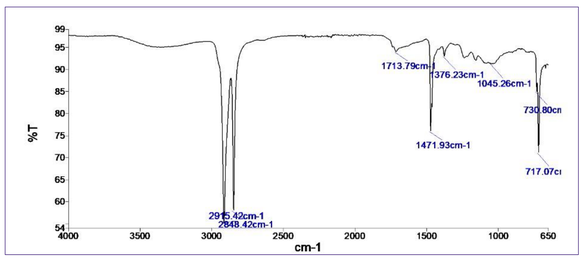

Figure 1. Spectrum of a high-density polyethylene microplastic taken using FTIR spectrometry.

FIELD SITES

Figure 2 A B C. Maps of the field sites where the surface water samples were taken from. Station number corresponds to time scale with 1 being taken 1st and 5 taken last.

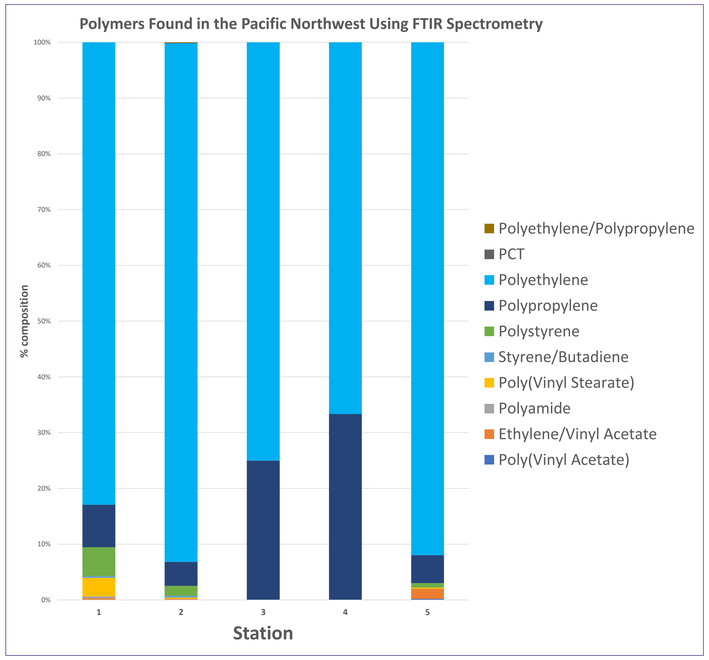

Figure 3. Synthetic polymers found in 5 unique sites throughout the Puget Sound waterways. Polymers with forward slash (/) are copolymers. PCT = Poly (1,4-Cyclohexanedimethylene terephthalate).

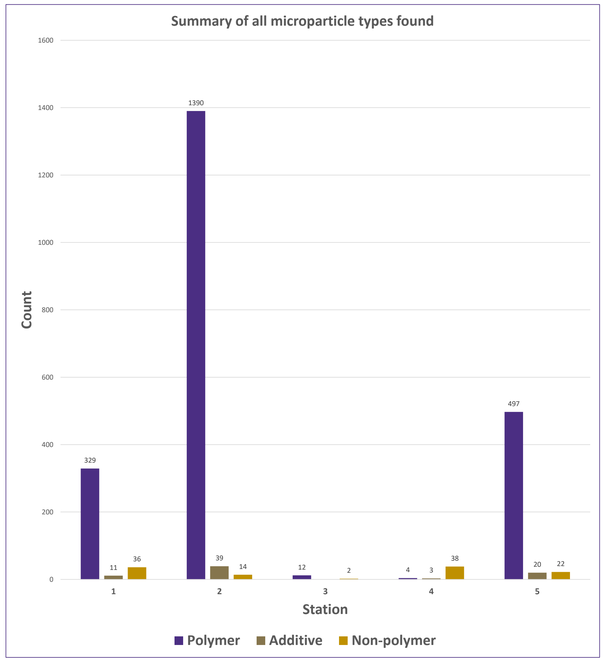

Figure 4. Summary of composition of microparticles obtained from surface water samples.

RESULTS

> MPs were found in all 5 sites.

> The most common morphology found was fragment.

> Black and transparent were the most abundant colors.

> The most common length in our samples were in the 1-2.5 and < 1 mm range.

> Water samples were composed of polymers, plastic additives, and non-polymers.

> Stations adjacent to highly populated places had the highest MP concentrations overall.

> The most abundant polymers found in our samples were polyethylene and polypropylene.

DISCUSSION

> The results show that MP pollutants in 5 regions of the Pacific Northwest derive from single-use plastic polymers. Particularly polyethylene and polypropylene polymers. These results are consistent with previous research findings.

> These results can be used to influence policies aiming to reduce plastic pollution in the ocean.

> Future research should investigate how these polymers influence the physiology and ecology of biota that are endemic to surface waters. In addition, future research can also investigate the influence that plastic additives may have on aquatic life.

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*Capstone research advisor

REFERENCES