Summer 2018

The Effects of depth on microplastics distribution and ingestion by a biological indicator species: Mytilus galloprovincialis

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Background

- Microplastics, plastics smaller than 5mm in length, have been observed in virtually every marine environment.
- Microplastics can be ingested by organisms ranging from plankton to large marine mammals, causing deleterious effects such as gastrointestinal blockage and leaching harmful chemicals into body tissue (Fossi et al. 2014, Desforges et al. 2015, Davidson and Dudas 2016, Terepocki et al. 2017, Nelms et al. 2018).
- In the water column, some microplastics have been observed to distribute in patterns of exponential decay with increasing depth, thereby creating differential levels of bioavailability as a function of the relative positions of organisms in the water column (Kukulka et al. 2012, Reisser et al. 2015, Kooi et al. 2016).
- These vertical distribution patterns have only been observed in gyres and open ocean environments, and further study is needed in other marine habitats to better understand how these patterns affect distributions on a global scale.

Objectives

1. Characterize the depth profile of microplastics in Puget Sound, and
2. Directly link this distribution to patterns of plastics ingestion by an indicator species, *Mytilus galloprovincialis*.

Methods

- *Mytillus galloprovincialis* samples grown on subtidal, vertical culture lines were obtained from an aquaculture facility in Totten Inlet. Individuals were sampled at 1, 3, and 5 m depths.
- Water samples were obtained from the same location. Samples were taken from 0 (surface), 1, 3, and 5 m depths.
- For processing, 35% hydrogen peroxide was used to dissolve organic matter. Salt floatation was used to suspend and a series of sieves used to isolate microplastics for visual inspection.
- Microplastics 5 mm – 500 µm were cataloged using a dissecting scope under 40 X magnification. Microplastics < 500 µm were cataloged using fluorescent confocal microscopy.

Results

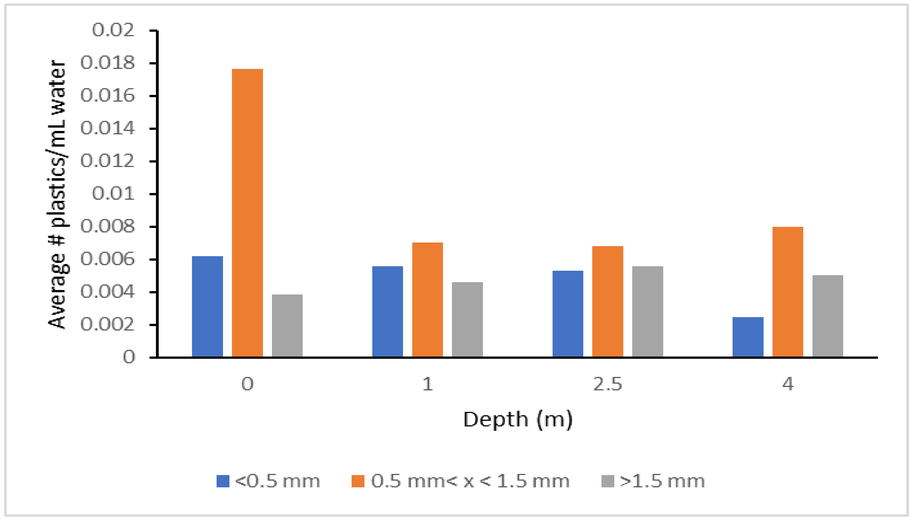

Figure 1. Average numerical concentrations of microplastic filaments per mL of water sample at each depth category, separated into three size classes (<0.5 mm, between 0.5 and 1.5 mm, and >1.5 mm

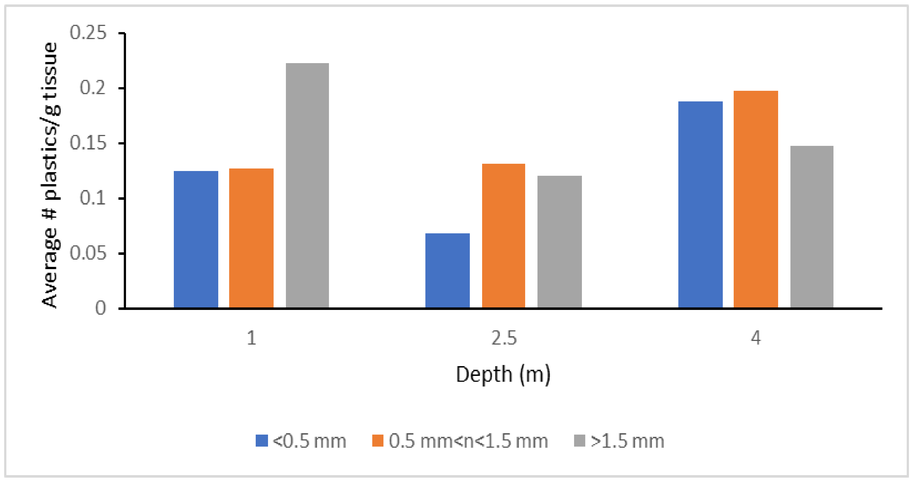

Figure 2. Average numerical concentrations of microplastic filaments per gram of mussel tissue from each depth category, separated into three size classes (<0.5 mm, between 0.5 and 1.5 mm, and >1.5 mm).

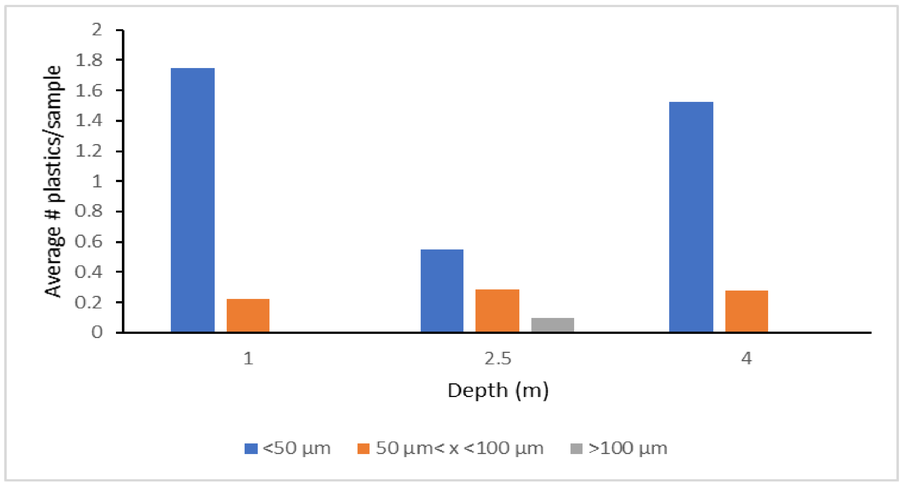

Figure 3. Average numerical concentrations of microplastic fragments per sample from each depth category, separated into three size classes (<50 µm, between 50 and 100 µm, and >100 µm).

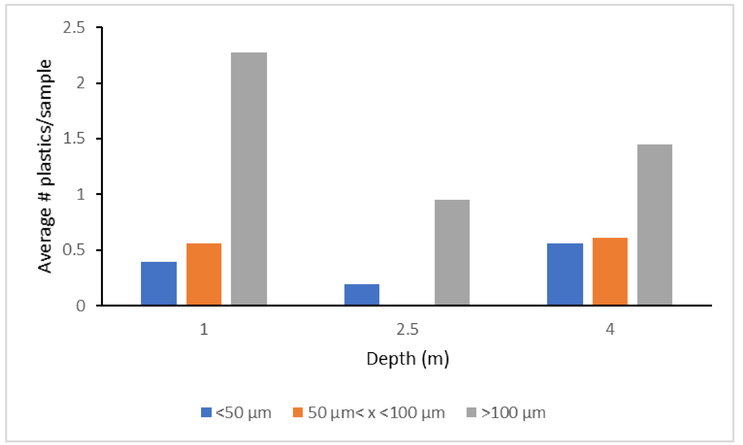

Figure 4. Average numerical concentrations of microplastic filaments per sample from each depth category, separated into three size classes (<50 µm, between 50 and 100 µm, and >100 µm).

Conclusions

- Both water samples and mussel samples contained 99% filaments and 1% fragments across all size and type classes for plastics measuring >500 µm.
- Microplastics measuring >500 µm were distributed similarly from 0-4 m depths in water samples, and this pattern was reflected in mussel samples as well.
- So far, no pattern of distribution for microplastics <500 µm has been observed in mussel samples.

Future Directions

- Finish microscopy for analysis of microplastics <500 µm.
- Perform statistics to analyze
  - The effects of depth on the distribution of numerical concentrations of microplastics >500 µm and <500 µm, respectively, from both water and mussel samples.
  - The comparison of numerical concentrations of microplastics measuring >500 µm and <500 µm, respectively, across 1-4 m depths between water and mussel samples.
- Investigate water samples from lower depths

Acknowledgements

I would like to thank Peter Hodum, Joel Elliott, and everyone in the Hodum lab for their helpful support and advice throughout this research process. I would also like to thank the Mellam Family Foundation and the University of Puget Sound for granting the funds that made this research possible.