Microplastics in Faunal Tissue of Marine Organisms

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Abstract

Microplastics are fragments of plastic less than 5mm in size and include microbeads used in consumer and commercial products, fibers from polyester clothing, and plastics which have photodegraded or otherwise fractured into tiny bits. They are prevalent in marine environments. Due to their small size, they can be ingested by a variety of organisms. Our study investigates the presence of microplastics in faunal tissue of five types of marine organisms; clams, shrimp, oysters, mussels and small fish. Microplastics were identified in all organisms sampled.

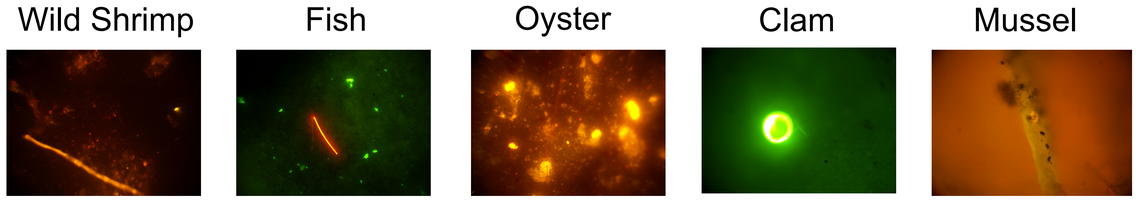
Introduction

Over 300 million metric tons of plastic are produced each year, of which 10- 20 million tons end up in oceans. Only 23% of plastic is recycled annually and the remaining plastic is left to photodegrade into decreasingly smaller fragments. Plastic waste accumulating in marine environments disrupts food webs because organisms confuse plastic beads for eggs, and fibers and fragments for zooplankton, and the unintentional filtering of plastics by filter feeders such as oysters, clams and mussels which ingest plastics by sieving water through their gills. The consumption of these plastics by these organisms have been studied in our research.

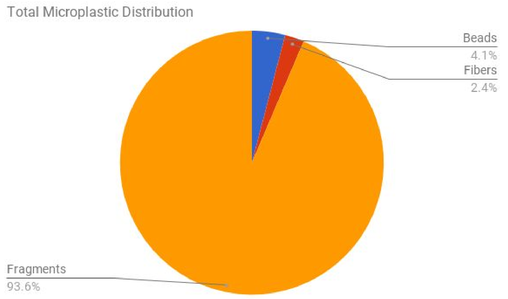
Methods

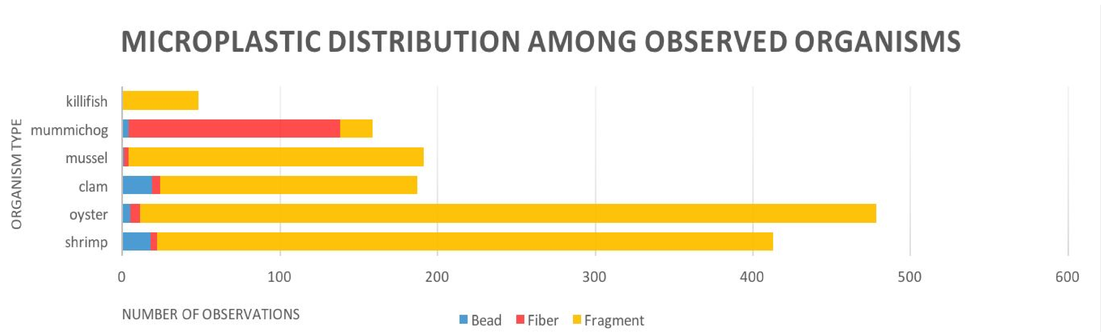
- Digestive tracts were extracted from organisms
- Filtration and oxidation methods were applied to remove organic matter
- Samples were filtered and stained with Nile Red
- UV microscopy enabled visual identification of plastic material
- Plastic particles were categorized as: beads, fragments, or fibers
- 16 random field of view counts were made for each sample (4 per quarter) to estimate how many plastics were on the slide
- A scanning electron microscope (SEM) was employed for further identification of plastics
- FT-IR spectroscopy confirmed and identified type of plastics present in samples

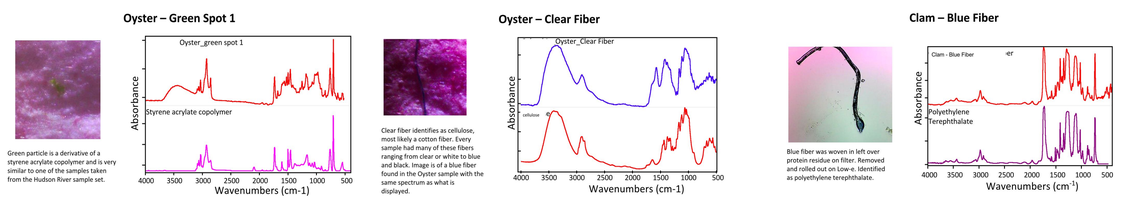
Results

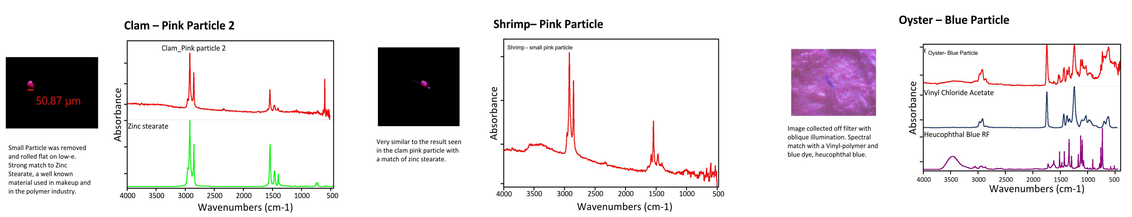


- Microplastics were observed in all organisms sampled through staining and UV fluorescence microscopy
- Plastic fragments comprised 93% of all the particles counted in our samples.
- Observationally, wild shrimp from Ecuador contained mostly plastic fibers.
- FT-IR analysis confirmed and identified the types of plastics found in three of our samples.
- Fragments were more abundant than beads or fibers.
- FT-IR spectroscopic analysis confirmed plastic types.









Conclusions

- FT-IR spectroscopy confirmed the identification methods for plastics, further supporting our hypothesis.
- Based on the origins of the organisms sampled, we can infer microplastics are globally prevalent.
- As seen from the sum our quantitative data, photodegradation of larger plastics over time is the primary source of microplastic pollution.
- The presence of microplastics in the digestive tracts of these marine organisms suggest that plastics are being mistaken for food at one point in the food web.
- By conducting these studies, we hope to raise awareness of the results of ubiquitous use of plastics and the "throw-away" societal mind-set.

Future Work

- Begin analysis of the SSFRP collection of fish and organisms collected from Piermont Marsh to identify trends in time and species specific characteristics
- Continue to sample shellfish sold to consumers
- Continue to take water samples each year from Piermont Marsh to collect data of microplastics found in the local environment of the marsh
- Sample gut content of organisms at higher trophic levels such as porgy, and striped sea bass from local fisheries.
- Continue to improve and refine protocols
- Employ FT-IR spectroscopic analysis on samples to confirm and identify types of plastics and identify trends

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