EVALUATING MICRO- AND MACRO-PLASTIC CONCENTRATIONS ON NJ COASTAL BEACHES

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Abstract

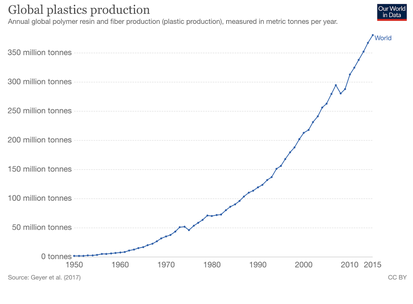
Over the past decade, increasing amounts of microplastic debris have built up in the marine environment, becoming an emerging issue. It is known that many organisms, including humans, that interact with bodies of water consume microplastics unintentionally, though its impact on health is not well understood. To quantify the magnitude of this issue and track the proliferation of microplastics, measurements were made in a preliminary attempt to quantify microplastic concentration in a number of New Jersey beaches. Two sampling protocols were used – one taken from the National Oceanic and Atmospheric Association (NOAA) Marine Debris Program and the other from the Save Coastal Wildlife Foundation for deep and surface level sampling respectively. Both sampling methods yielded the highest concentrations of macroplastics at the Long Branch site. The greatest microplastic concentration was found at the Asbury Park site using the surface sampling method, however, there was no detectable amount using the deep sampling protocol. Although no definitive conclusions can be made, it is hoped that this preliminary study raises awareness to this important and serious environmental issue.

What are Microplastics?

- Small plastic pieces less than 5.0mm long
- Microplastics result from the breakdown of larger pieces of plastic over time
- Some sources include toothpastes, face washes, and soaps which contain microbeads
- The impact on the environment and human health are not yet clearly known and are currently being studied

The Microplastic Epidemic

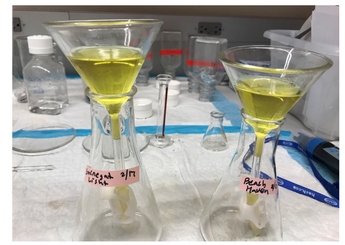
- Since 1950, the production of plastic has increased at an extraordinary rate of over 200-fold per year.
- It is estimated that over 8.3 billion metric tons of plastic have been produced since 1950 of which approximately half is discarded as waste and only 9% of the plastic is recycled.
- Microplastics raise concerns because of their long half-life; many of them take over over 400 years to degrade.
- It is projected that if current trajectories do not change, there will be more plastic than fish in the ocean by the year 2050.
- This poses a major problem because sea animals can ingest the plastics, become entangled and trapped in larger sized plastics.
- Ultimately, it impacts humans who consume contaminated seafood. With the production of plastic, it is expected to continue rapidly rise in the coming years.



Methods and Materials

The two sampling methods used in this study come from the National Oceanic Atmospheric Administration (NOAA) and the Save Coastal Wildlife Foundation. The former method allows for deep collection by selecting a damp or wet area of sand and digging into the sand about 4in deep. The second sampling method from the Save Coastal Wildlife Foundation involves surface collection of a 1m^2 square of beach sand and sieving through the top layers of the sand.

The methodology used in the microplastic analysis from both sampling methods is from NOAA. First, large pieces of plastic were removed from the samples. A dense NaCl solution (d=1.15 g/mL) was added to the sediment sample. Microplastics with lower densities may be separated through density differentiation in the NaCl solution. Further steps call for collecting the floating solids from the solution through a 0.3mm sieve. The floating solids were then treated with a WPO solution, containing hydrogen peroxide and an Fe(II) solution to eradicate and react any organic material that may have been previously collected with the microplastics. Salt was added to this solution and placed in a density separator where the microplastics again were expected to float. The isolated microplastics and macroplastics were massed and calculated as a percentage of the dry weight of the sample.



Results

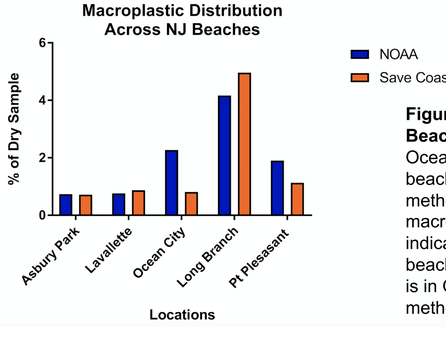


Figure 1: Macroplastic Distribution Across NJ Beaches. Data shows that with an exception to Ocean City, the macroplastic concentration in beach sand is consistent for both sampling methods. Both methods show the greatest macroplastic contamination in Long Branch, NJ, indicating a high density of plastic and unkept beach areas. The lowest concentration by mass is in Ocean City for the Save Coastal Wildlife method and Asbury Park for the NOAA method.

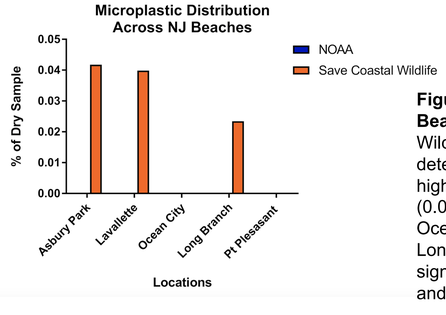


Figure 2: Microplastic Distribution Across NJ Beaches. Data shows that the Save Coastal Wildlife method results in a much higher and detectable amount of microplastics, with the highest density occurring at Asbury Park (0.042%), and the lowest, with a value of zero in Ocean City and Point Pleasant. Lavallette and Long Branch also demonstrated to have significantly high levels of microplastics, 0.04% and 0.023%, respectively.

Limitations

- Constraints in time and different locations of group members affected the group's ability to effectively collect samples.
- Collection of samples had to be modified from originally collecting water samples, to collecting sediment samples as there was insufficient funding.
- Because small samples from each beach were taken, they cannot accurately represent the actual micro and macro plastic distribution along these beaches. More trials of each beach would need to be conducted to gain confidence in our results.

Conclusion

- The data from this study show that micro- and macroplastics are indeed common in representative NJ beaches.
- Figure 1 shows that macroplastics, which are easier to detect, were found in all of the beaches explored.
- Both sampling methods yielded similar macroplastic concentrations, demonstrating the reliability of the procedures.
- While the Save Coastal Wildlife Foundation method detected discernable amounts of microplastics at a number of locations, the lack of microplastic findings using the NOAA method suggests that it lacks sensitivity in comparison to the other methodology.
- The microplastic analysis showed that Asbury Park had the largest microplastic contamination with comparable but lower amounts in Lavallette, followed by Long Branch.
- As this study is preliminary, more studies would be needed to firmly quantify the concentration levels of the microplastics at these sites.

Future Directions

- While beach cleanups and government bans on plastic are currently starting to be implemented across the world, they do little to combat the damaging effect of tiny microplastics already present in many marine environments.
- In recent years, wastewater treatment technology has been found to successfully remove many microplastics from wastewater. Membrane bioreactors have been the most successful out of these water treatments.
- Future improvements of such filters, the use of microorganisms to degrade plastics, and biodegradable alternatives are all potential solutions to the microplastic epidemic
- With the growing AI industry, there could potentially be a combining of robotics and AI to form "smart" robots that can both detect and cleanup water on there own, without outside assistance.

Acknowledgements

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