Mission: Magnifying Microplastic Abundance in Urban Ponds

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INTRODUCTION

The ubiquity of plastic pollution in the world, specifically in bodies of water, has become a global image and topic of conversation. This is due to the popular misconception that bodies of water can store all of the garbage and waste that humans produce until they decompose. As aggregates of different types of pollution became more prevalent in water bodies, scientists not only began to question the ability of these water bodies to store waste, but to sustain it. Therefore, scientists began examining these different types of pollution and the ways in which they decompose. By studying plastic pollution in this way, scientists discovered microplastics. Microplastics are plastics that are less than 5 mm in length and result from artificial manufacturing and the degradation of larger plastic debris.[1] Plastic will break down due to wave action and UV exposure; but it will only break down into smaller fragments of plastic.[2] Microplastics can be easily and unconsciously ingested which can lead to bioaccumulation within one organism and biomagnification through a food chain. Microplastics not only disrupt the digestive and reproductive systems of organisms, but also bind a variety of environmental toxins. Therefore, if microplastics bioaccumulate and biomagnify, there is a very high potential for environmental toxins to do the same.[3]

The United States alone discards plastics at an average rate of 29.6 million tons per year, which contributes to the 8 million metric tons of plastic pollution that winds up in the ocean each year.[4] Urbanized areas contribute the most to plastic production, consumption, and disposal. Therefore, it is believable that where there once was, or is currently, macroplastic pollution, there will also be traces of the microplastic particles. A microplastic survey of urban ponds could lead to an increased awareness of the presence, abundance, and effects of microplastics on the entire world.

QUESTIONS & HYPOTHESES

Q1: Are there microplastics in urban ponds?

H1: There are microplastics in urban ponds.

Q2: Are macroinvertebrates ingesting microplastics?

H2: Macroinvertebrates are ingesting microplastics.

Q3: Does distance from the shoreline affect microplastic abundance?

H3: Microplastic abundance will be greater closer to the shoreline.

Q4: Does microplastic abundance increase as a result of macroplastic litter in ponds?

H4: Microplastic abundance will increase with a greater presence of macroplastic litter.

METHODS

Bulk Water Sampling

- Chose 3 comparable bodies of water in both Prospect Park and Green-Wood Cemetery
- Three, 800 mL replicates collected at each pond and injected with 10 mL of Nile Red
- 500 mL of samples ran through a Buchner vacuum filter using glass fiber filter paper (Whatman grade 934-AH, 90mm diameter, 1.5 um pore)
- UV light shined onto dry filter and viewed under a dissecting microscope
- Number of orange and red fluorescent particles was quantified

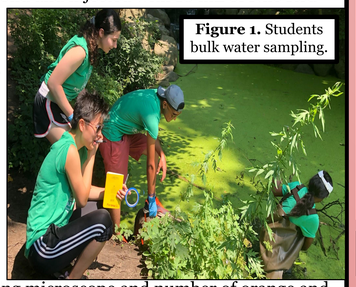

Figure 1. Students bulk water sampling.

Aquatic Midge Sampling

- Dip-netted for macroinvertebrate midges
- Injected samples with 10 mL of Nile Red
- UV light shined onto worms under a dissecting microscope and number of orange and red fluorescent particles was quantified

Bulk Water Sampling at Different Distances From the Shoreline

- Chose 3 comparable bodies of water in both Prospect Park and Green-Wood Cemetery
- Samples taken at 5, 10, and 15 meters from the shoreline of each pond
- 800 mL samples collected and injected with 10 mL of Nile Red
- 500 mL of samples ran through a Buchner vacuum filter using glass fiber filter paper (Whatman grade 934-AH, 90mm diameter, 1.5 um pore)
- UV light shined onto dry filter and viewed under dissecting microscope
- Number of orange and red fluorescent particles was quantified

Surveying Macroplastics

- Collected plastic litter found within the sample sites
- Counted the number of plastics found within the sample site

RESULTS

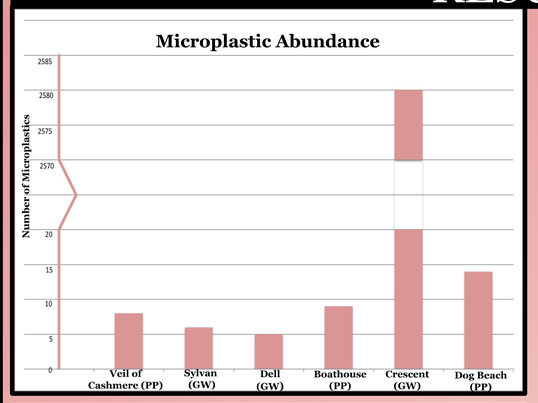

Figure 2. Average microplastic abundance found at each of our surveyed sites.

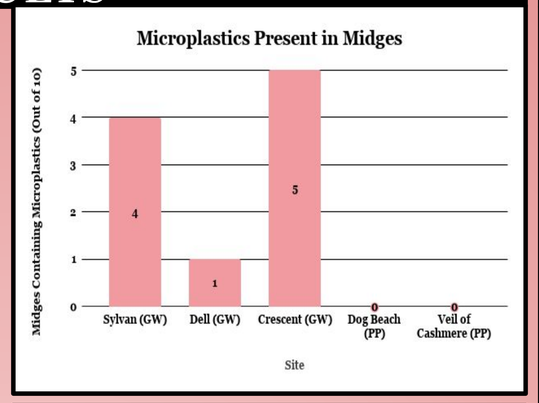

Figure 3. Number of midges from 5 different sample sites found containing microplastics.

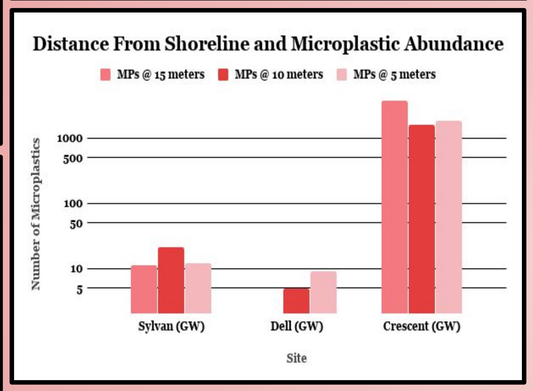

Figure 4. Number of microplastics found at 3 different distances from the shorelines of 3 different ponds.

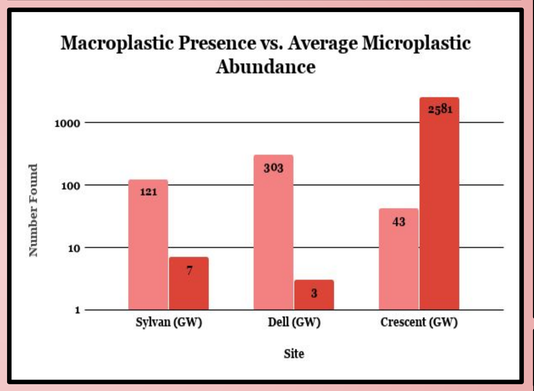

Figure 5. The average number of microplastic particle found compared with the number for macroplastic litter found.

RESEARCH PHOTOS

Figure 6. Wading to take samples.

Figure 7. Replicates taken.

Figure 8. Staining a sample with Nile Red.

Figure 9. Macroplastic litter survey.

Figure 10. Vacuum filtering a sample.

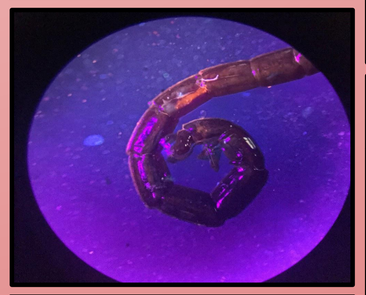

Figure 11. Blood midge containing an ingested microplastic.

DISCUSSION

We found microplastics in every water sample that we took from the ponds in Prospect Park and Green-Wood Cemetery. This data supports our hypothesis that microplastics are present in urban ponds. However, we expected to find a much greater abundance of microplastics in the ponds we surveyed. The average number of microplastic particles found at each of our sites was less than 20, except for Crescent Pond at Green-Wood, which averaged just shy of 2,400 microplastic particles. This discrepancy in our data could be attributed to a variety of factors; however, no definitive conclusion could be made without further research.

Our data also showed that the aquatic midges from the ponds we sampled were found to have ingested microplastics. Although this trend was only found in the Green-Wood ponds, it still supported our hypothesis. In addition, our data stayed consistent as Crescent Pond, which showed the highest abundance of microplastics, also produced the highest number of midges that ingested microplastics, whereas Dell Pond, the pond showing the lowest abundance of microplastics, produced the lowest number of midges that ingested microplastics.

The data we found for microplastics at different distances from the shoreline did not support our hypothesis that more would be found closer to the shoreline than further away from it. Overall, we found that the microplastics were dispersed pretty randomly throughout each pond. Thus, we concluded that the amount of microplastics found depends on the pond itself and that the results cannot be generalized in such a way.

Finally, the amount of microplastics found in our samples did not directly correlate with the amount of macroplastic litter found in each pond. Our data actually showed the opposite trend. The pond with the most macroplastic litter, Dell Pond, had the fewest number of microplastic particles present, and the pond with the least macroplastic litter, Crescent Pond, had the most microplastic particles present. However, this may be because Dell Pond is super shallow. Therefore, the litter is more exposed and easier to collect than the litter in Crescent, which could barely be seen or reached.

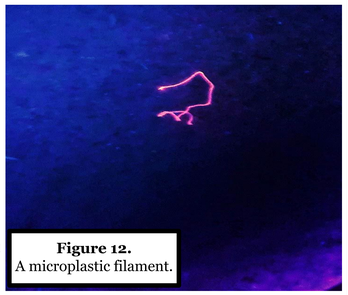

Figure 12. A microplastic filament.

FUTURE DIRECTIONS

Ultimately our research contributes to a much bigger picture. Now that we've done this and garnered tangible results, our method could be used on any source of water to identify and quantify microplastic abundance. This could lead to further research on the effects of microplastics on aquatic organisms, ecosystems, and human life.

To further our research, we would like to see these ponds fully surveyed. We believe more accurate testing would occur if more samples and replicates were taken at each pond, especially if it was possible to collect a sample of the entire surface layer of the water. In addition, microplastics have begun being found in soil, so we'd like to see a comparison study done between the abundance of microplastics in the pond sediments and the amount free floating in the ponds themselves.

Overall, this research served to increase the awareness of this global issue, and potentially even lead the way to finding a solution.

ACKNOWLEDGEMENTS

First and foremost, thank you to Brian O'Toole, Sarah Davis, Jason Aloisio, Dr. Alan Clark, and all of the other undergraduate, graduate, and research experts for supporting us in our research. Thank you to Fordham University, The Wildlife Conservation Society, and the Prospect Park Zoo for giving us all of the resources necessary to carry out our research. Thanks to the pond health team for helping us collect worms along the way. We would also like to thank the National Science Foundation for funding Project True and for giving all of us this opportunity.

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