The Effect of Urbanization in Micro- and Nano-plastic Levels in the Chattahoochee River

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Research Question

How do the micro- and nano-plastic levels in the Chattahoochee River fluctuate as more urbanization appears down the river?

Introduction

Microplastics (MPs) are particles of plastic with a diameter range of 5 mm to 1 um, and have been extensively researched within the current century. In the past decade however, a smaller particle with a diameter less than 1 um have been spotted within the oceans, the soil and the air we breathe [1]. The sheer size of these plastics, named nano-plastics (NPs), allow the particles to pass through barriers microplastics cannot, such as the circulatory system and the Blood-Brain Barrier and are seen to cause similar if not more irritation and gastrointestinal problems within marine life [2]. Most research details saltwater marine environments such as oceans and sediment for MPs, and NPs themselves are not well-researched enough for sufficient information on the properties and effects of the particles [3]. Additionally, although there is research on how urbanization and populations can effect the MP and NP levels within nearby rivers, such studies are sparse [4][5]. As such, this study sets out to test the correlation between the micro- and nano-plastic levels found within the Chattahoochee River and the nearby population density, along with testing whether light absorption using curcumin dye may be viable for measuring NP concentrations within river water as is the case for MPs [6].

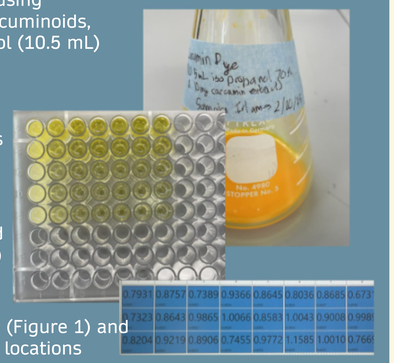
Methodology

Part 1: Collection

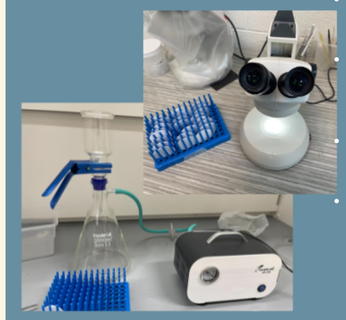
- Collected from boat launches from Helen to GA, 8 total sites (Left)
- Collected surface water in 50mL conical tubes (Right)
- Added 1 tsp of table salt for density separation
- Refrigerated until further use

Part 2: Light Absorption Material

- Nanoplastic (Quantitative) Analysis
- Created curcumin dye using curcumin dye (≥95 curcuminoids, 10 mg) and Isopropanol (10.5 mL) (Top)
- Created serial dilution with 0.8 um nanobeads with multiple dye amounts (Middle)
- Measured Light Absorption and created serial dilution (Bottom)
- Graphed serial dilution (Figure 1) and concentrations against locations (Figure 2-4)



Part 3: Filtering



- Microplastic (Qualitative) Analysis
- Filtered samples with 1 um filters with a vacuum filtration system (Bottom)
- Observed filters using light microscope up to 400X (Top)
- Compared filters from different locations and noted significant amounts of plastics/fibers (Figure 4-8)

Results and Discussion

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Figure 1: This shows the standard curve used when calculating the unknown sample concentrations. I tested 1 uL, 3ul, and 5uL dye amounts with the 5uL dye amount having the highest r^2 value. The trendline is a power trendline. This indicates that this method may be viable for general NP analysis in aquatic samples.

Figure 2: The graph to the right shows the resulting readings when the samples were collected from the middle of the sample tubes in comparison to their locations, with 1 being in the mountains and 8 in Atlanta. The blank had a higher concentration thana lot of the samples as indicated by the orange slope. This can be due to the source of the distilled water being from a plastic source under room temperature, which is also why I included the concentrations with the blank used for the standard subtracted from the readings, which shows a positive slope as indicated by the blue trendline.

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Figure 3: This graph compares the concentration readings in where the sample was taken within the conical tube, with the orange showing the middle and the blue showing the surface. The middle overall shows significantly higher concentrations than the surface, particularly in the 2nd, 4th, 5th and 8th location, with both showing a peak at the 6th location. The samples were not mixed or inverted since the addition of the table salt either.

Figure 4: The graph compares the concentrations with the populations of their respective cities as labeled 1-8, where the x axis is logarithmic for readability. The expected trend was an increase in concentration, yet this is not shown in either graph. This could be due to there being more microplastics sinking with the sediment, as seen in Figures 5-7 the city locations are abundant in microplastics.

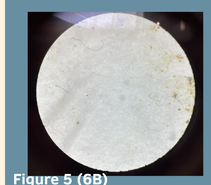

Figure 5 (6B)

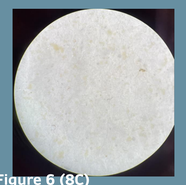

Figure 6 (8C)

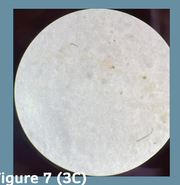

Figure 7 (3C)

Figures 5-7 show some of the filtering results from the samples. These filters have a pore size of 1 um. Some trends were that there were lots of small, irregular and transparent particles of plastic along with colored fibers. Additionally, there was more of the transparent particles found near the sediment that collected toward the bottom of the sample tubes, which suggests that a lot of the microplastics sunk to the bottom as either a result of time or the density separation applied with the table salt.

Conclusion and Reflection

Overall, it seems that the results are inconclusive on whether there is any correlation between the micro- and nano-plastic levels and the city population where the samples were collected, and factors such as flow, water temperature and time collected were unable to be taken into consideration. However, there is some promise with the use of light absorption to analyze the concentration of nano-plastics using curcumin dye as indicated in Figure 1, due to the high r^2 value indicated.

There was a lot learned in the process of collection and analysis of this project, including the difficulties of fieldwork such as finding accessible locations for sample collection along with getting to said locations; the many trials and errors included with procedure and result analysis; and how funding and time can impact the depth and quality of the research conducted.

Although the research and results are inconclusive, what has been accomplished may lay the grounds for viable analysis techniques on a new size of plastic and still raise awareness of the effects that plastic can have on the environment and those inhabiting them, including humans. With time, more research about nano-plastics will be collected to the point where there is a significant concern and a call to action to clean the environment for the better of the planet.

Acknowledgements

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Works Cited

Poster Works Cited.docx (Will be converted into a QR code later)