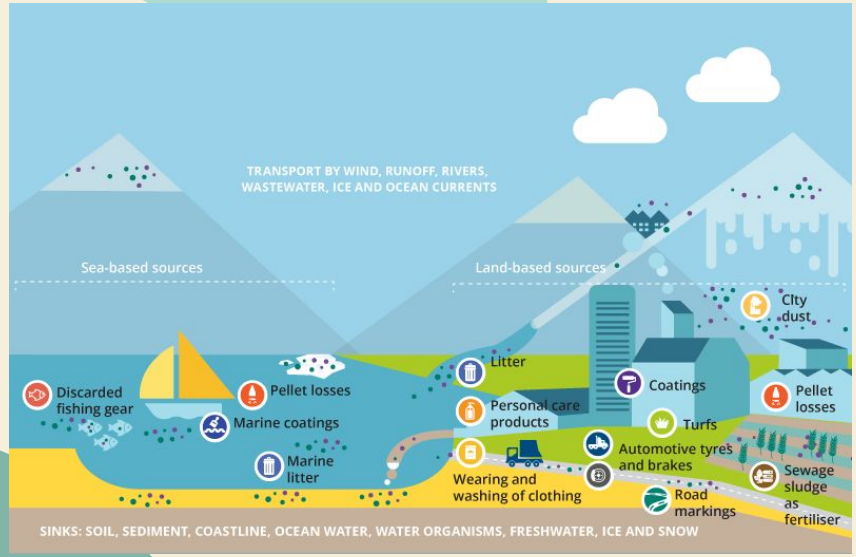
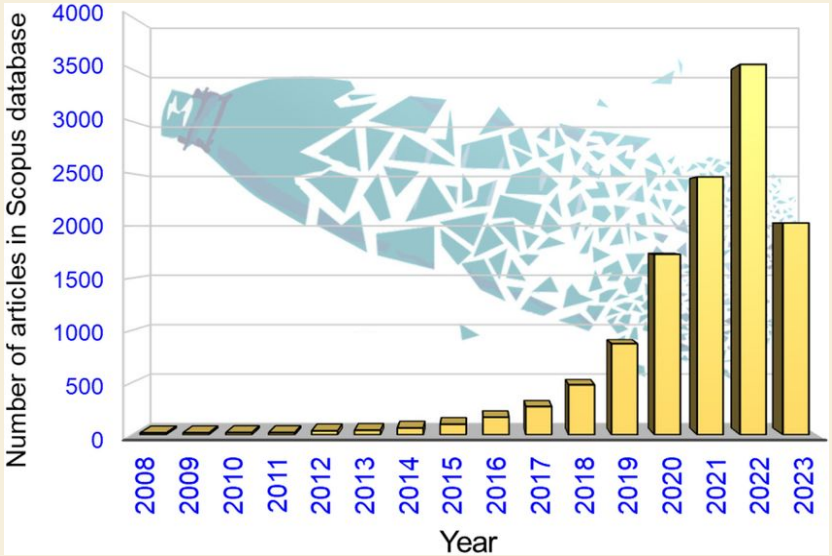
Assessing the Presence of Microplastics in Jug Bay

Ruth Olawumi – University of Wisconsin-Madison
Dr. Patricia Delgado – Jug Bay Wetlands Sanctuary
In collaboration with **The AnthroHydro Lab** at The Catholic University of America

The Problem of Microplastics



(European Environmental Agency 2023)



(Muthulakshmi et al 2023)

Objective

(Jug Bay Trails)

- Analyze water samples various sites in Jug Bay before (baseflow) and after rain events
- Determine concentration of microplastics in each sample
- Gain a better understanding of microplastic concentrations in the area

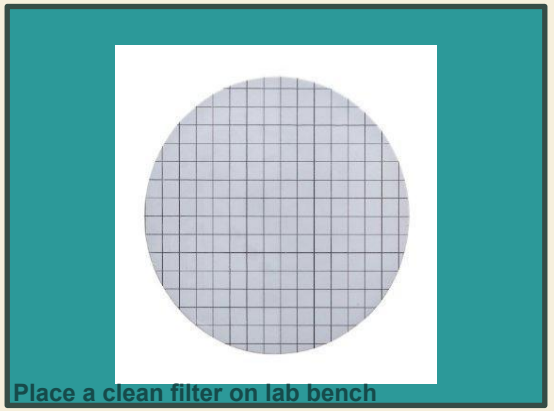
Methods

Step 1:

Vacuum filtration of 500mL of sample through Whatman gridded filters

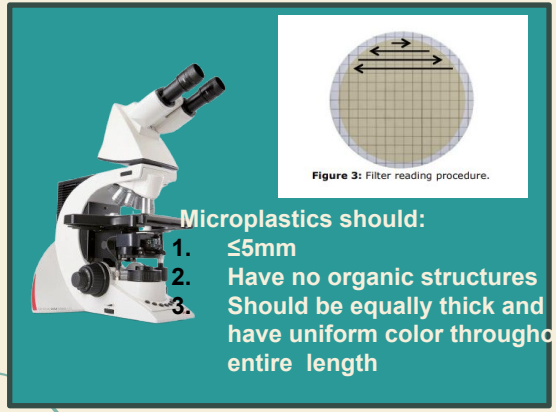
Step 2:

Set out a "blank" filter to capture particles in the air during analysis



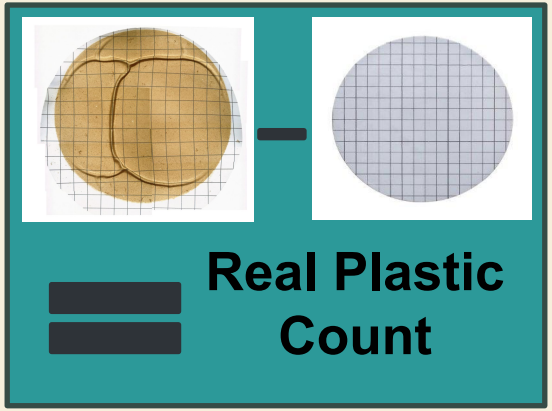
Step 3:

Visually identify and count microplastics with optical microscope

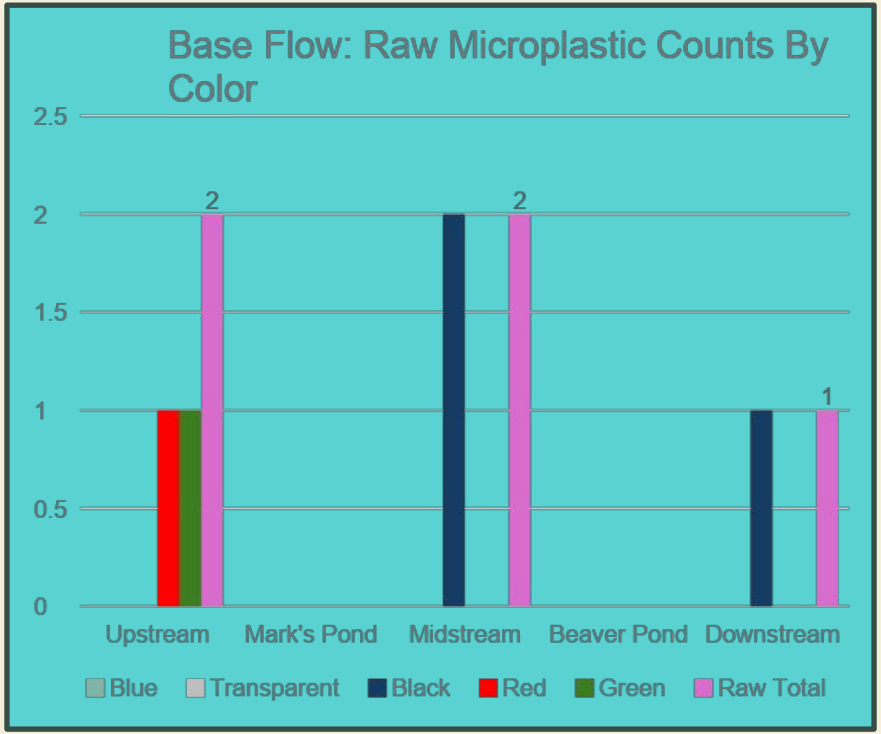


Step 4:

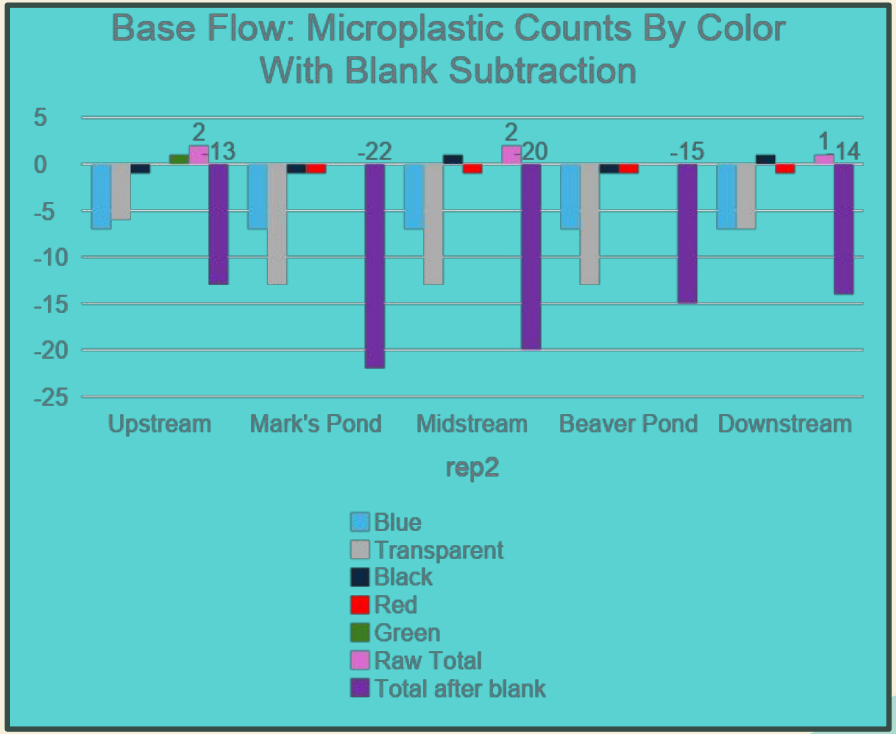
Subtract particles on the blank from each filter by color



Initial Results

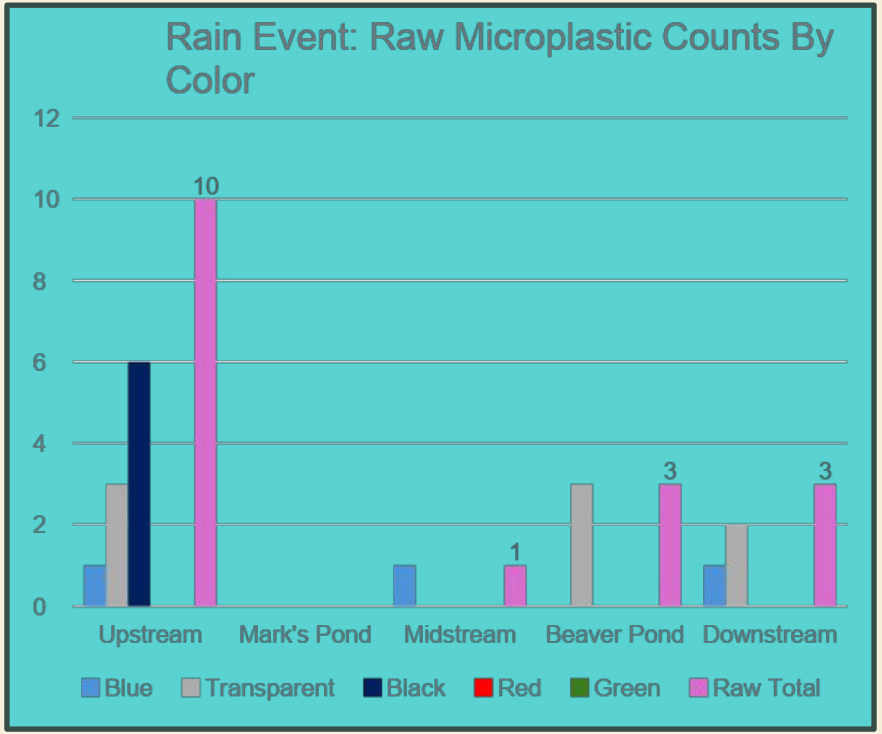


Average # of microplastics per filter: 1

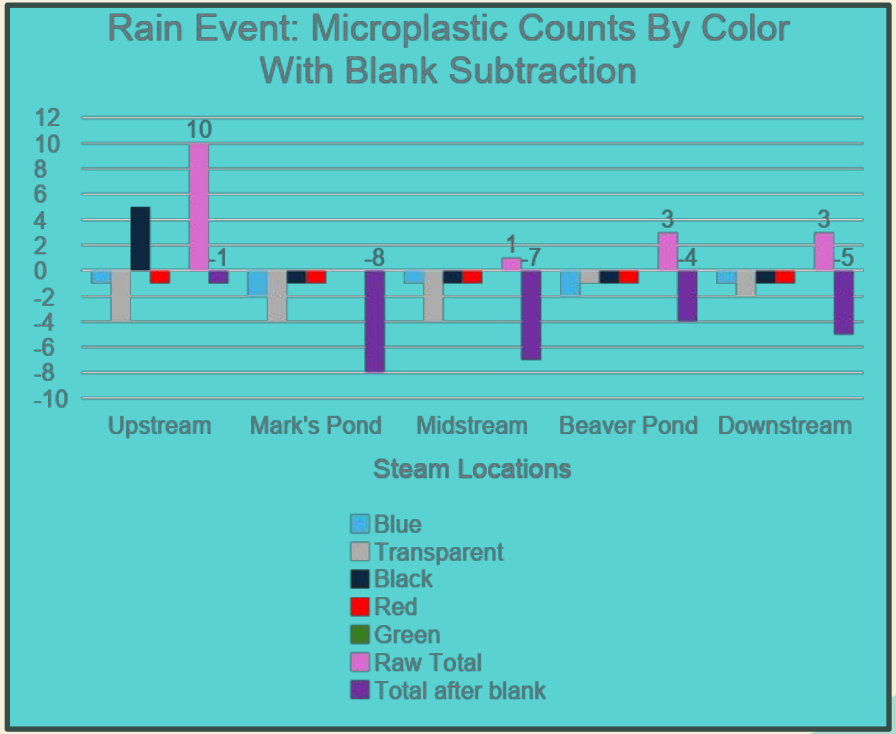


Average # of microplastics per filter: -16.8

Initial Results



Average # of microplastics per filter: 3.4



Average # of microplastics per filter: -5

Limitations With Initial Method

Documentation

Limits the possibility of comparing results or replicating the study

No Chemical Identification

Prevents interpretation of the microplastics sources

Observer Bias

Individual biases and expectations can lead to inconsistent data

Excessive Organic Matter

Layer of soil over filter potentially hid microplastics and affected the counts

Initial Methods

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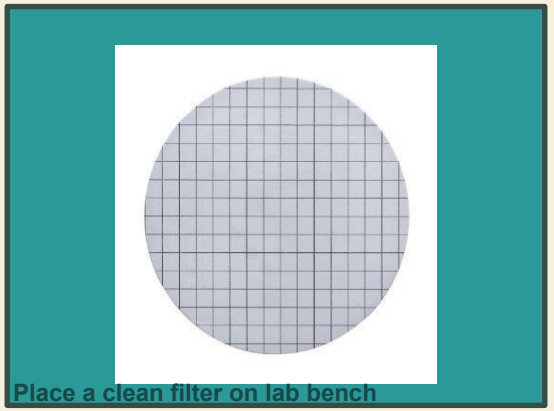

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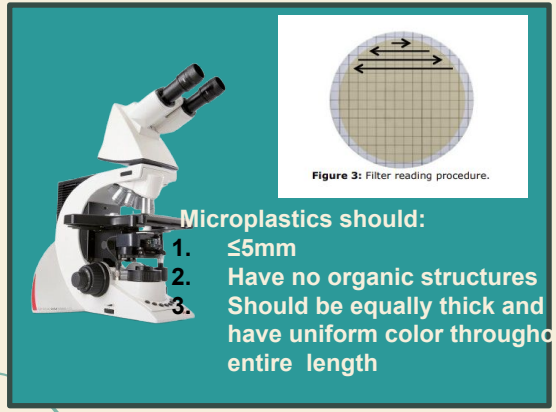

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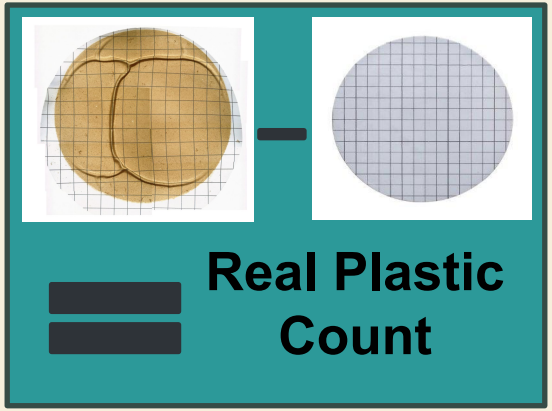
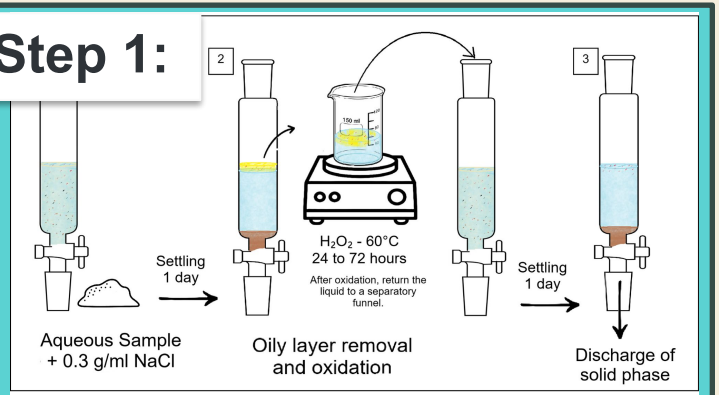


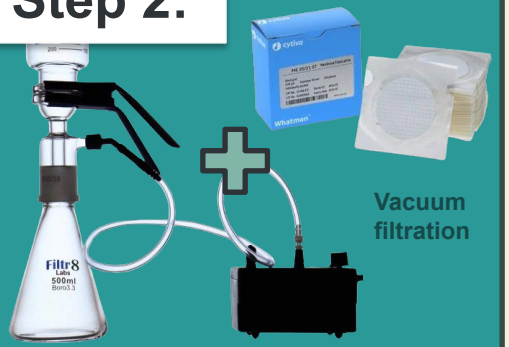
Revised Methods

Step 1:

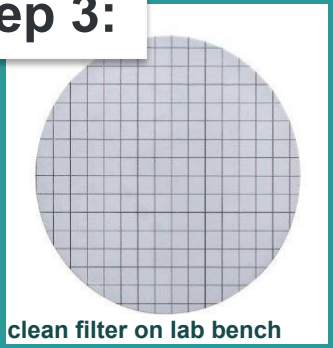


*Started with 200mL from Old Beaver Pond

Step 2:



Step 3:



Place a clean filter on lab bench

*Counted ~300 particles between 50-4000um

Step 4:

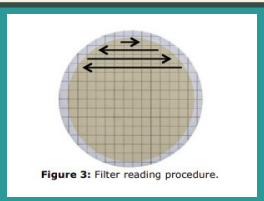


Figure 3: Filter reading procedure.

Count Sample + Blank:

1. Record particles > 50um
2. Determine location (Row and Column)
3. Write a description of each(Color/Shape)

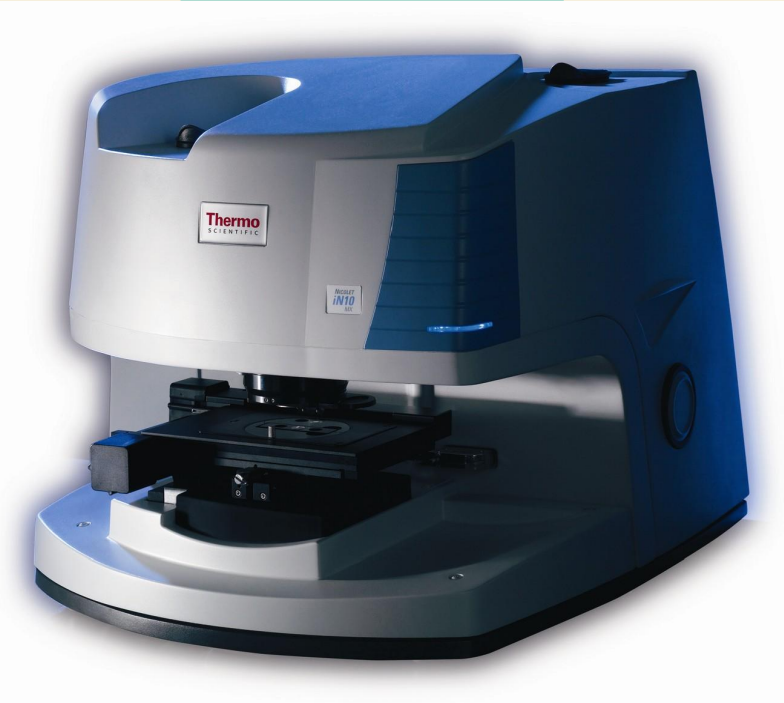
*Counted ~900 particles between 50-10,000um

Step 5:

FTIR:

1. Collect coordinates of particles
2. Select 10 particles
3. Collect spectra from each particle

µFourier Transform Infrared Spectroscopy for Microplastic Analysis



(ThermoScientific Nicolet iN10 mx µFTIR)

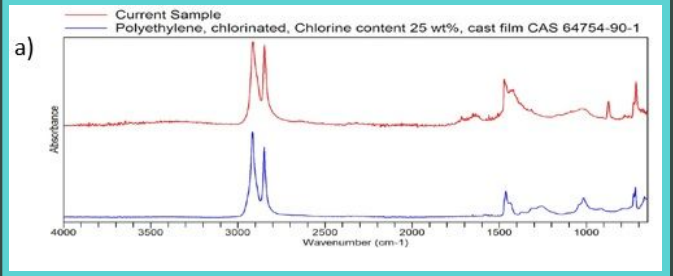
Advantages

- Chemical identification of particles
- Non-destructive
- Reduces bias

Limitations

- Constraints on sample uniformity (filters must be flat)
- Samples must be pre-processed
- Size limitations

Step 6: Compare known plastic spectra to spectra from samples



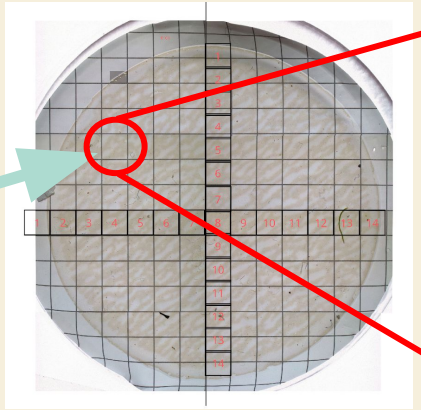
How I Used The µFTIR

Particle #	Location (Row and Column.order found in square)	Revised Locations (Universal columns)	Color	Size(µm)	ID # (filter #, row,column)	Type	Notes
276	7,6.7		Gray/Transparent	9808.201	F01R7C6.7	Fiber	Long tangled fibers. Ends in R10C7
476	8,13.2		Green	4208.947	F01R8C13.2	Fiber	Starts in R713. Ends in R913
98	5,2.2	5,3.2	Yellow/Transparent	3029.218	F01R5C2.2	Fiber	
839	13,4.6	13,7.6	Gray	2888.949	F01R13C4.6	Fiber	stretches into R13C5
633	10,9.6	10,10.6	Gray	2770.953	F01R10C9.6	Fiber	Long and tabgled. Extends into R11C9
724	11,10.4	11,11.4	Gray	2624.54	F01R11C10.4	Fiber	
730	11,11.3	11,12.3	Blue+Gray	2535.103	F01R11C11.3	Fiber	Blue with gray ends
566	9,14.1		Gray	2389.824	F01R9C14.1	Fiber	
368	8,3.1		Gray/Transparent	2366.765	F01R8C3.1	Fiber	
89	4,11.11	4,12.11	Transparent	2057.345	F01R4C11.11	Fiber	tangled fiber
144	5,12.2	5,13.2	Gray/Transparent	2013.601	F01R5C12.2	Fiber	
600	10,4.7	10,5.7	Gray/Transparent	1971.488	F01R10C4.7	Fiber	
164	6,2.2		Gray/Transparent	1969.606	F01R6C2.2	Fiber	
666	11,3.1	11,4.1	Brown/Green	1818.72	F01R11C3.1	Fiber	
218	6,11.4		Gray/Transparent	1756.164	F01R6C11.4	Fiber	frayed
824	13,2.9	13,5.9	Gray	1690.006	F01R13C2.9	Fiber	
624	10,8.5	10,9.5	Gray/Transparent	1646.497	F01R10C8.5	Fiber	
258	7,5.1		Gray/Transparent	1539.806	F01R7C5.1	Fiber	
614	10,7.3	10,8.3	Gray	1518.384	F01R10C7.3	Fiber	
333	7,12.3		Gray	1517.193	F01R7C12.3	Fiber	
540	9,9.5		Blue/Gray	1509.534	F01R9C9.5	Fiber	
787	12,7.5	12,9.5	Gray/Transparent	1508.675	F01R12C7.5	Fiber	
733	11,11.6	11,12.6	Gray/Transparent	1453.925	F01R11C11.6	Fiber	
737	11,12.3	11,13.3	Gray/Transparent	1424.585	F01R11C12.3	Fiber	tangled
660	11,2.5	11,3.5	Gray/Transparent	1417.153	F01R11C2.5	Fiber	
756	12,4.1	12,6.1	Black	1350.575	F01R12C4.1	Fragment	
262	7,5.5		Blue	1341.617	F01R7C5.5	Fiber	
522	9,7.1		Gray	1317.286	F01R9C7.1	Fiber	
254	7,4.7		Transparent	1305.183	F01R7C4.7	Fiber	

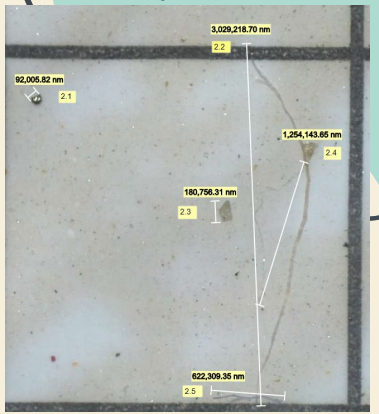
How I Used The µFTIR

Select a particle

Particle #	Revised Locations (Universal columns)	Color	Size(µm)	ID # (filter #, row,column)	Type	Notes
276		Gray/Transparent	9808.201	F01R7C6.7	Fiber	Long tangled fibers. Ends in R10C7
476		Green	4208.947	F01R8C13.2	Fiber	Starts in R713. Ends in R913
98	5,3.2	Yellow/Transparent	3029.218	F01R5C2.2	Fiber	
839	13,7.6	Gray	2888.949	F01R13C4.6	Fiber	stretches into R13C5



Locate particle



Position µFTIR over particle

Document particle's coordinates

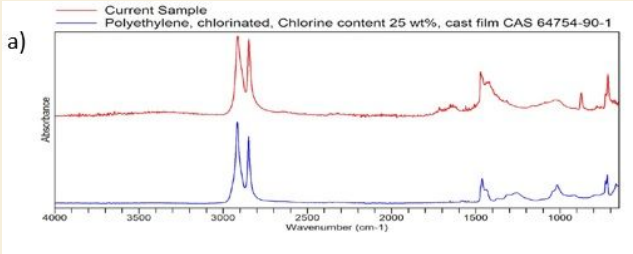
Particle #	Color	Size(µm)	ID # (filter #, row,column)	Type	Notes	Coordinates
276	Gray/Transparent	9808.201	F01R7C6.7	Fiber	Long tangled fibers. Ends in R10C7	(870, -7930)
476	Green	4208.947	F01R8C13.2	Fiber	Starts in R713. Ends in R913	(1750, 12350)
98	Yellow/Transparent	3029.218	F01R5C2.2	Fiber		(-550, -17400)
839	Gray	2888.949	F01R13C4.6	Fiber	stretches into R13C5	(17615, -3650)

Future Work

How I *Would Have* Used The µFTIR given more time

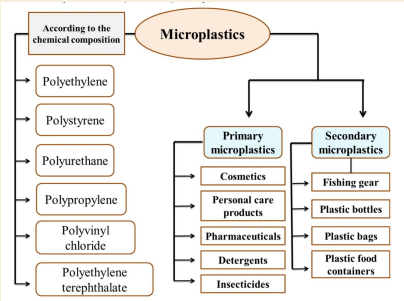
- Collected spectra for all 900 particles on sample filter and the 300 from the blank

- Compared results to known plastic spectra to chemically identify everything



(Samsu et al. 2024)

- Determined sources of microplastic pollution in Jug Bay

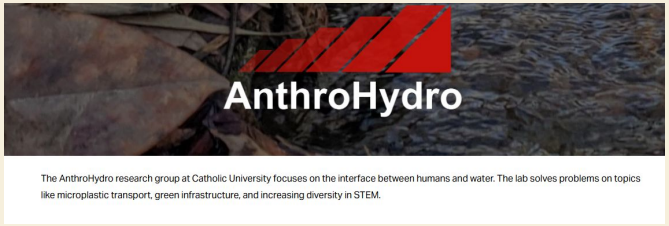


(Osman et al. 2023)

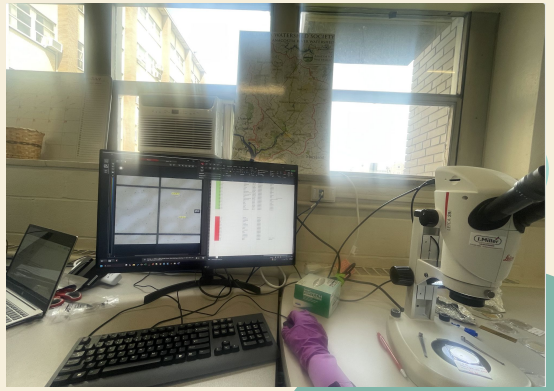
Key Takeaways

- **Proper documentation** is key to making sure a study is reproducible
- Use of an FTIR can provide **more accurate results** compared to purely visual identification for microplastics
- Sample **pre-processing is necessary** to get rid of organic material
- **Systems thinking**/problem solving abilities were developed

THANK YOU!



Jug Bay Wetlands Sanctuary



Does anyone have any questions?