Copepods are an indicator species

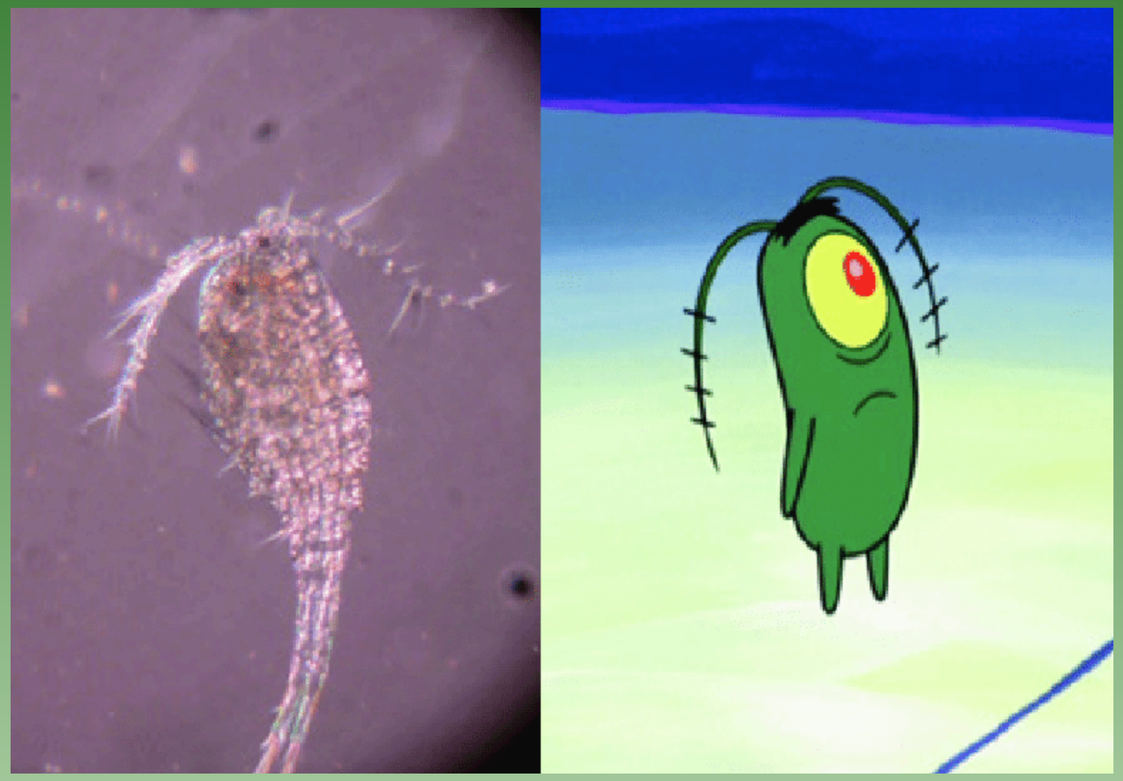

Photo By: Elisa Caref

Micro Organisms Vs. Micro Debris

An Examination of the Correlation Between Micro Organism and Micro Debris in the Hudson-Raritan Estuary

By: Marifer Sanchez-Gaspar

Advisor: Mauricio Gonzalez M. Sc.
Urban Assembly New York Harbor School
Marine Biology Research Program
2022

Background

Estuaries are the arms of the sea

Copepods + Amphipods are vital crustaceans in estuaries

Pollution, chemical imbalance, and global warming have caused damaging effects

Introduction

- **Micro Foam**: Lose pieces of polystyrene
- ***Amphipoda***: crustaceans that primarily inhabit saltwater (D.S. Glazier, 2014)
- **Copepods**: a class of small crustaceans that dominate the pelagic compartment of estuaries (K.Kwok, 2015)





Introduction: Continued

Micro Plastics: Small plastic pieces less than five millimeters long which can be harmful to our ocean and aquatic life (R.Sabarish, 2020)

Micro Fibers: Polyester and nylon (polyamide) fiber that is used to make fabric. The fiber is split many times smaller than a human hair (P.Mouthuy, 2011)

https://www.ehn.org/are-microplastics-toxic-2657135830.html

Literature Review

- Life within the estuary is sustained by micro organisms (K. Simon *et al.*, 1997)
- Micro organisms are essential to the production of global oxygen (Frangoulis *et al.*, 2005)
- New York Harbor has the great sediment toxicity (D.Wolfe *et al.*, 1996)
- No stable micro organism population = collapse of food web (R.Campbell, 2017)

http://www.wwdmag.com/contaminants/new-york-city-tap-water-isnt-kosher

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Scientific Problem

Does the concentration (per 100000L) of micro debris exceed the concentration of micro organisms (per 100000L) in the samples taken from the Hudson Raritan Estuary?

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Hypothesis

The concentration (per 100000L) of micro plastics will be higher than the concentration (per 100000L) of every micro organism category.

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Methods + Materials

Locality

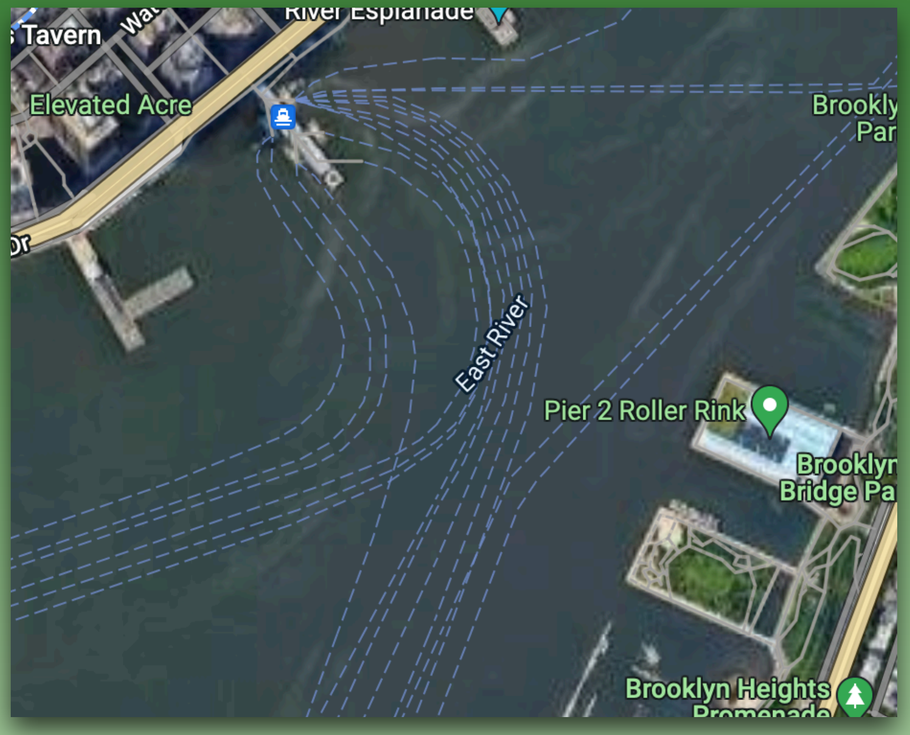


Figure 01. East river Samples were collected from the East River due to its relativity to the lab and therefore its significance to the team as a whole.

Measurement Parameters

Gear and Mesh Size: Net - 333 Micron Mesh
Duration:10 minute tow
Speed: 2 knots per minute
Depth: Sub-surface (meters)
Tools: Bogorov Chamber (6 mL)

Photo By: Harbor SEALs

Preparing for Sampling: Materials

Tools	Qty.	Purpose
Safety Team	Group of 2-3 people	Insures everyone has PPE & spots people sampling
Labeling Team	Group of 2-3 people	Lables each sample according to label key
Manta Tow	1	To practice using it and assembling
Neuston Net	1	To practice using it and assembling
Assembly Team	Group of 3-5 people	On day of sampling they will assemble the tool
Spray Team	Group of 2 people	Will learn how to funnel debris on manta tow into sample bottle
Sprayers	2	People will practice using it and assembling

Preparing for Sampling

1. Before forming teams, have a conversation about what project will entail

2. Create a spray team, safety team, assembly team, and labeling team. **Make sure everyone in a team knows what their job is**

3. Allocate practice time for spray team & assembly team

4. Thoroughly explain the labeling key to labeling team

Manta Tow Collection: Materials

Tools	Qty.	Purpose
Manta Tow	1	Structure to hold Neuston net
Neuston Net	1	Primary tool used to collect debris
Sprayers	2	Will spray down contents of the manta tow into sample bottle
PFDs	1 for each person on board	Prevents people from drowning
Sample Bottles	3-4	Contents of the Manta Tow collection will go here
A Water Vessel	1 to fit everyone on the team	Creates traction for collection on water
Gloves	Pair for everyone working	To avoid touching contaminents

Manta Tow Collection: Notes

- Advisor will call communicate with Captain when to start, pause, and end the tow
- Safety team should insure everyone has proper PPE on (PFD, gloves, and work clothes)
- Every team member should be on time and understand what is expected of them

Photo By: Harbor SEALs

Manta Tow Collection: Deploying Manta Tow

1. Safety team will spot people deploying

2. Slowly lay the wooden piece and mesh into the water

3. Let go of Manta Tow and start the vessel

Photo By: Harbor SEALs

Manta Tow Collection

1. Alert the captain to pause the tow

2. Bring manta tow and net into the boat, hovering above a sample bottle

3. Sprayers should begin spraying the mesh to funnel the debris on it into the sample bottle

4. Seal sample bottle and hand to labeling team

Data Processing: Materials

Tools	Qty.	Purpose
Microscope	1 for each group	Allows further observation of organisms
Petridish	1 for each group	Holds containments of a sample for observation
Bogorov Chamber	1 for each group	Holds containments of a sample for observation
A Sample Bottle	1 for each group	This is what will be observed
Access to Internet	Every member of the group	To help identify organisms
Micro Organisms Classification Book	1 for each group	To help identify organisms
Data Analysis Groups	1 group; 2 people per team	In charge of processing the data
Data sheet	1 for each member	Where all observations will go

Data Processing

1. Each group picks observation tool and is responsible for PPE

2. Pour 6 mL of sample into observation tool and place under microscope.

3. Cross reference observed organisms under microscope with micro organism identification books or info from internet.

4. Tally each organism observed in data sheet

Project Scope

Limitations

- Two different groups collected samples (11 & 12 grade)
- Only one chance for sampling
- Ambiguity in classification
- No comparison standard

Photo By: Harbor SEALs

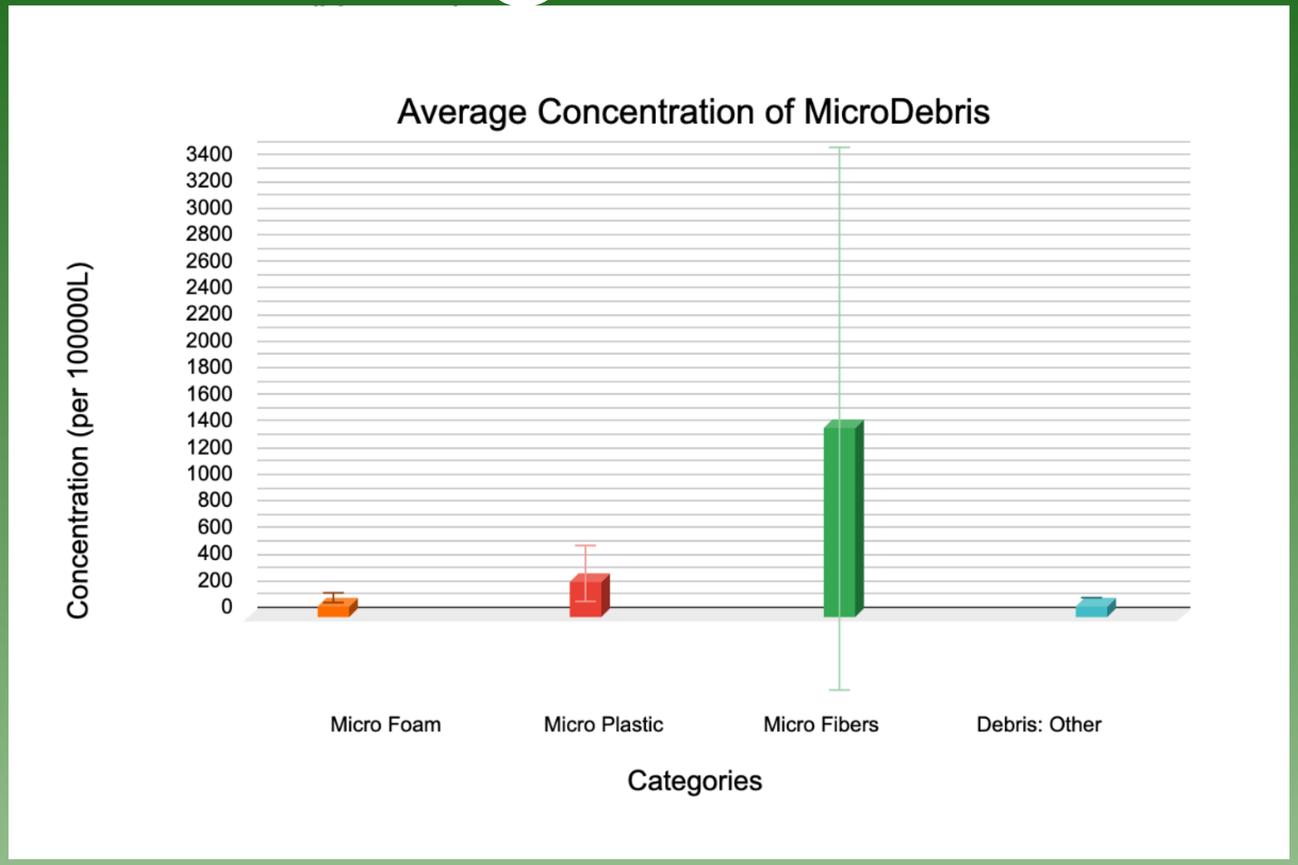
Safety

Communication
PPE
Spotting
Teamwork

Photo By: Harbor SEALs

Results

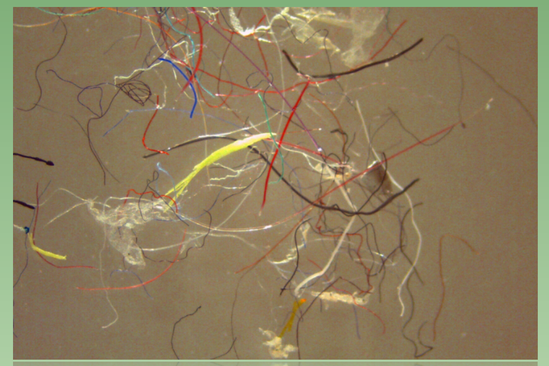
Figure 02.



<u>Figure 02</u>. Average Concentration of Microorganisms: The data shows a significant difference between the 3 Microorganisms. The average concentration of Copepods is greater than both *Amphipoda* and *Tunicata*: Larvacea, Salps.

Analysis Figure 02.

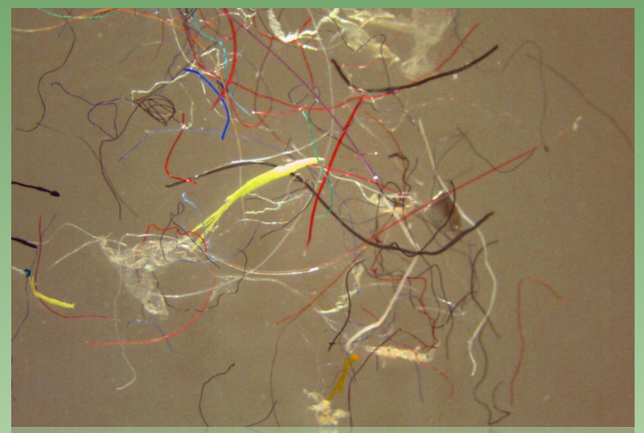
- 13 million tonnes of synthetic fabric waste entering the ocean and adjoining rivers each year, most comes from laundry waste (S.Mishra, *et al.,* 2019) (H.Savelli, *et al.,* 2019)
- As supported by the data micro fibers are becoming more prevalent in the environment showing adverse ecological impacts (S.Mishra, *et al.,* 2019)



https://www.intelligentliving.co/microfibers-what-you-can-do/

Analysis Figure 02.

- The average of each micro debris is close to each other with the highest average being micro fibers
- 34.4% of the Hudson Rivers watershed drainage area contributes an average of 300 million anthropogenic origin micro fibers into the Atlantic Ocean per day (R.Miller, *et al.,* 2017)



https://www.intelligentliving.co/microfibers-what-you-can-do/

Figure 03.

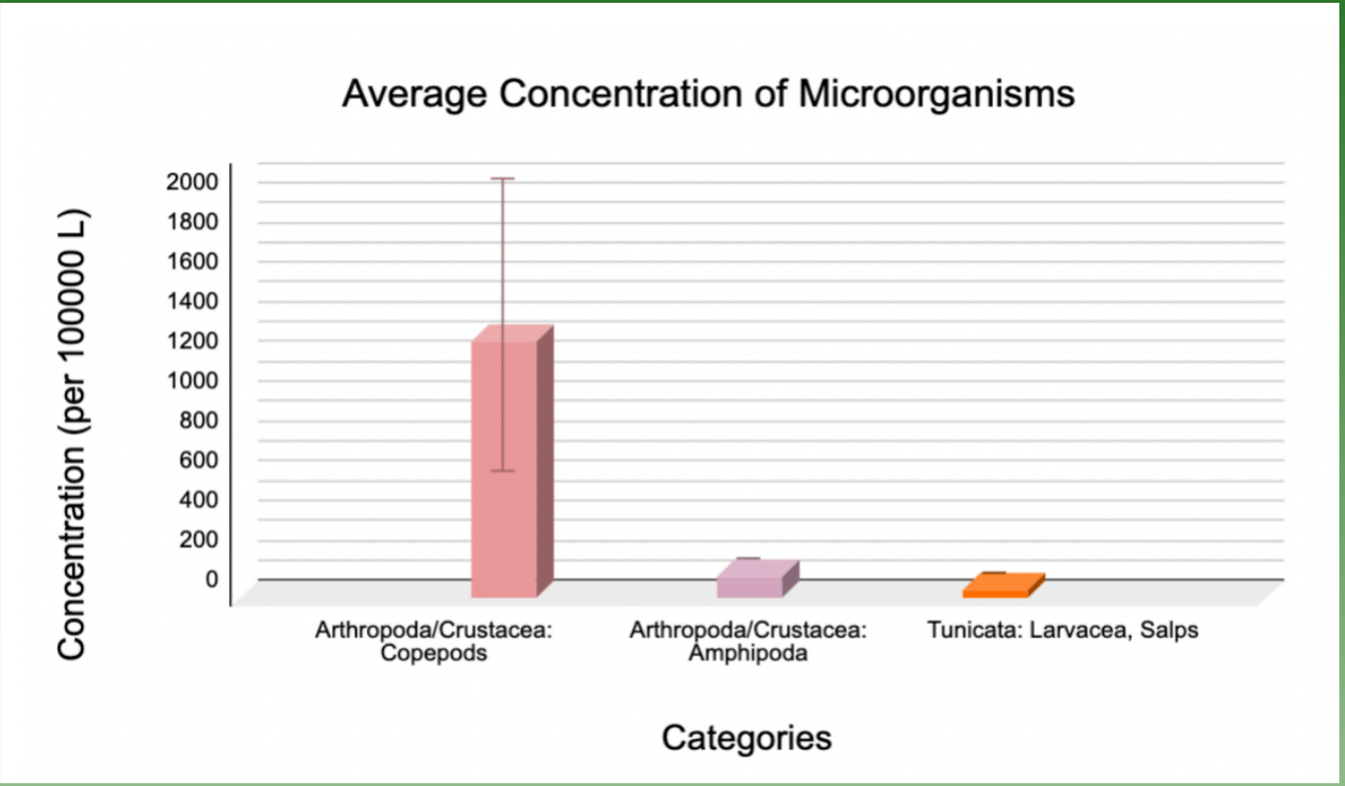
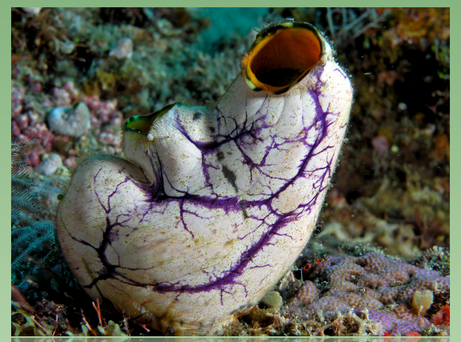


Figure 02. Average Concentration of Microorganisms: The data shows a significant difference between Copepods and *Arthropoda*/Crustacea; *Tunicata*: Larvacea, Salps as a group. There is no overlap of the 4 error bars.

Analysis Figure 03.

Amphipoda are most commonly found in tropical warm places (L.Hughes *et al.*, 2016)

Sea squirts have been recognized as an invasive species due to their rapid spread and ability to easily be transported (L.Curran *et al.*, 2015)



https://hudsonriverpark.org/the-park/parks-river-project/science/wetlab/invertebrates/sea-squirts/

https://hudsonriverpark.org/the-park/parks-river-project/science/wetlab/invertebrates/sea-squirts/

Analysis Figure 03.

Copepods most commonly inhabit the Hudson-Raritan Estuary (M.Zettler *et al.*, 2013)

Sea squirt invasiveness can be worsened by climate change, radiation, and human interference (L.Curran *et al.*, 2015)

https://hudsonriverpark.org/the-park/parks-river-project/science/wetlab/invertebrates/sea-squirts/

https://hudsonriverpark.org/the-park/parks-river-project/science/wetlab/invertebrates/sea-squirts/

Discussion

The highest average for micro organisms was 1300 Copepods per 100000 L (Figure 03.)

The highest average for micro debris was 14000 micro fibers per 100000 L (Figure 02.)

There is a slight infestation of sea squirts (Figure 02.)

Discussion: Continued

There is a slight infestation of sea squirts (Figure 02.)

The average concentration of Copepods is greater than both *Amphipoda* and *Tunicata*: Larvacea, Salps

The number of Amphipoda/Crustacea is close to the number of Tunicata: Larvacea, Salps (Figure 02.)

Counter Arguments

While abundance of Copepods is observed it doesn't directly indicate good health of estuary

Too much ambiguity surrounding micro debris naming (N.Hartmann *et al.*, 2019)

Plastic pollution only became an issue in the 1960's. Why care now? (J.Vince *et al.*, 2018)

https://www.theguardian.com/

Conclusion

The hypothesis was not correct
Copepods are the majority inhabitants in the pelagic level
Micro Fibers = most abundant micro debris

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