CALIFORNIA LUTHERAN UNIVERSITY - DEPARTMENT OF BIOLOGY

The Comparison of Microfibers in Sand Sediment in Southern California Beaches, Harbors, and Bays

Amir Mejia, Andrea Huvard PhD

California Lutheran UNIVERSITY

ABSTRACT

Microplastics have been an emerging environmental threat to terrestrial and aquatic habitats worldwide. The non-biodegradable waste we are drawing our attention to in this study is microfibers. Microfibers measure less than 5mm in length and make up 80% of all microplastic pollution, contributing to 35% of primary plastic pollution in ocean water. Locations of sediment range from San Diego, CA. moving up the coast to Morro Bay, CA. 100mL of sand was analyzed from each site. Samples were mixed with 200mL of instant saltwater in a 500mL beaker to suspended the microfibers. Each sample was filtered through a Buchner Funnel having a 5µm cellulose nitrate membrane filter. Filters were placed under dissection microscopes for quantification. Microfibers were detected in all study site samples, averaging between 42-59 microfibers per 100ml of sand sediment, while the harbor and bay areas had a higher concentration of microfibers than open water beaches.

INTRODUCTION

Microfibers are a subcategory of Microplastics that measure less than 5mm in length and make up 80% of all microplastic pollution. These Microfibers are deposited into the environment from primary and secondary microplastics.

- The primary source of microfiber pollution is clothing, (Ocean Conservacy, Messinger 2016, Gago et al., 2018).
- Cosmetics
- Toiletries
- Furniture and Carpets
- Fragmented plastics.

Plastic debris is highly susceptible to biofouling accumulation, sediment retention, and the establishment of bacterial colonies, which increases the plastic's density. Approximately 54% of the manufactured plastics have a higher density than seawater (Watts 2015).
Microplastics have been detected in beaches and subtidal sediments worldwide (Claessens 2013). However, few research articles focus on Microfibers and almost no research articles for our local areas, such as Morro Bay and Channel Islands Harbor.

Aim

Objective

Our objective is to determine and quantify microfibers in sand sediment in various locations along Southern California.

Hypotheses

- The beaches will have the least number of microfibers.
- The bays will have more microfibers than beaches but fewer than harbors.
- The harbors will have more microfibers than beaches and bays.

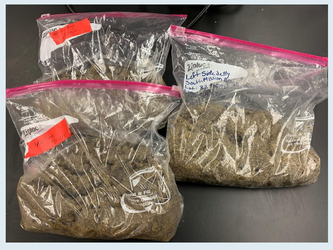
METHOD

Harbors: Enclosed area on the coast that is protected from rough water.
Bays: A part of the coast where the land curves in so that the seawater is surrounded by land.
Beaches: A sandy coastline by the ocean where rough water usually crashes.

Photo 1

- Beach samples were collected in Buenaventura, San Diego (*Photo 1*), and Ventura State Beach.
- Harbor samples were collected in Ventura and Newport Harbor.
- The Bay samples were collected in San Diego and Morro Bay.

Photo 2 *Photo 3*



A corer (*photo 2*) was used to dig 20 inches into the ground, and the samples were labeled and stored in a bag (*Photo 3*) and transferred into a container.

Photo 4 *Photo 5*

100ml of sand were mixed with 200mL of instant saltwater in a 500mL beaker (*Photo 4*).This mixture was then poured in a Buchner funnel filtration over a 5 µm cellulose nitrate membrane filter (*Photo 5*). Each filter paper was quantified under a microscope. This process is repeated 6 more times.

RESULTS

Photo 6 *Photo 7*

Photo 6 and *7* are Microfibers on the 5 µm cellulose nitrate membrane filter paper. Length of Microfibers varied and colors such as black, white, blue, pink, green were observed. Photos were captured with an iPhone X.

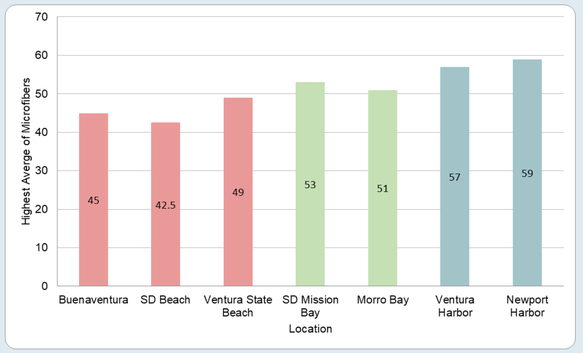


Figure 1. Shows the highest average of Microfibers for each location.

Data Table 1. This tables shows pairwise comparisons between each environment. Each tested environment were statistically significant when compared to each other.

Pairwise Comparisons	P-value
Beaches: Bays	0.0001
Beaches: Harbors	0.0001
Bays: Harbors	0.006

Data Table 2. This table describe a One-Way Analysis of Variance between the means of the Beaches, Harbors, and Bays.

Source	Sum of Squaares	Degrees of Freedom	Mean Square
Between Treatments	11105.14	2	5552.57
Within Treatments	22726.99	170	133.69
Total	33832.14	172	
F-Value	41.53		

Total mean for Beaches: 10.68; Bays: 22.47; Harbors: 29.33. ***The P-value when comparing all three environments is <0.0001***.

DISCUSSION

Conclusion:

•Initial hypotheses were proven to be correct as harbors had the highest concentration of Microfibers followed by bays, then beaches. A plausible explanation is that these harbors have still water which is best for storing ships, while beaches are open to the ocean, which faces rough waters. Harbors are known to have higher rates of accumulation than rocky shorelines due to their low energy environments, where particle deposition is more easily transported (Barrows 2018).

Limitations:

•Currently, we do not have access to equipment that would help us analyze these microfibers' components.
•COVID-19 constrained the possibility of traveling to new locations and collected more samples to add to the data already obtained before COVID Restrictions.

Future Implications:

•There is sufficient evidence supporting Harbors having the highest concentration of microfibers, which can cause potential negative consequences on species that live in these habitats. Microplastics have been shown to be ingested by over 140 different species of Marine animals, (Watts 2015).
•This research can be further expanded on mapping out more local areas to build a stronger foundation of available data.

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