

Homemade microplastic detector in rivers using fluorescent light and a smartphone

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Abstract

This research aimed to develop and evaluate a low-cost method for detecting microplastics in river water samples. Water samples were collected, filtered, and treated with Nile Red, a fluorescent dye that selectively adheres to plastic particles. The samples were then exposed to ultraviolet light within a homemade fluorescent detector, allowing for the visual identification of fluorescent particles using a smartphone. The results showed the presence of particles with characteristic fluorescence, consistent with microplastics, in the analyzed samples. It was concluded that the method used was effective for the visual detection of microplastics, and a future project proposes improving the observation system by adapting the smartphone lens and using appropriate protective covers to increase the clarity and precision of the observations.

Background & Motivation

After the impact of hurricanes Irma and Maria, the coasts and bodies of water in Puerto Rico were affected and heavily polluted. One of the most significant damages was the presence of microplastics. That is why we decided to develop a method to detect and compare the presence of microplastics in different areas of a river using a homemade fluorescence method with low-cost materials and a smartphone, to demonstrate the impact of human activity on water pollution..

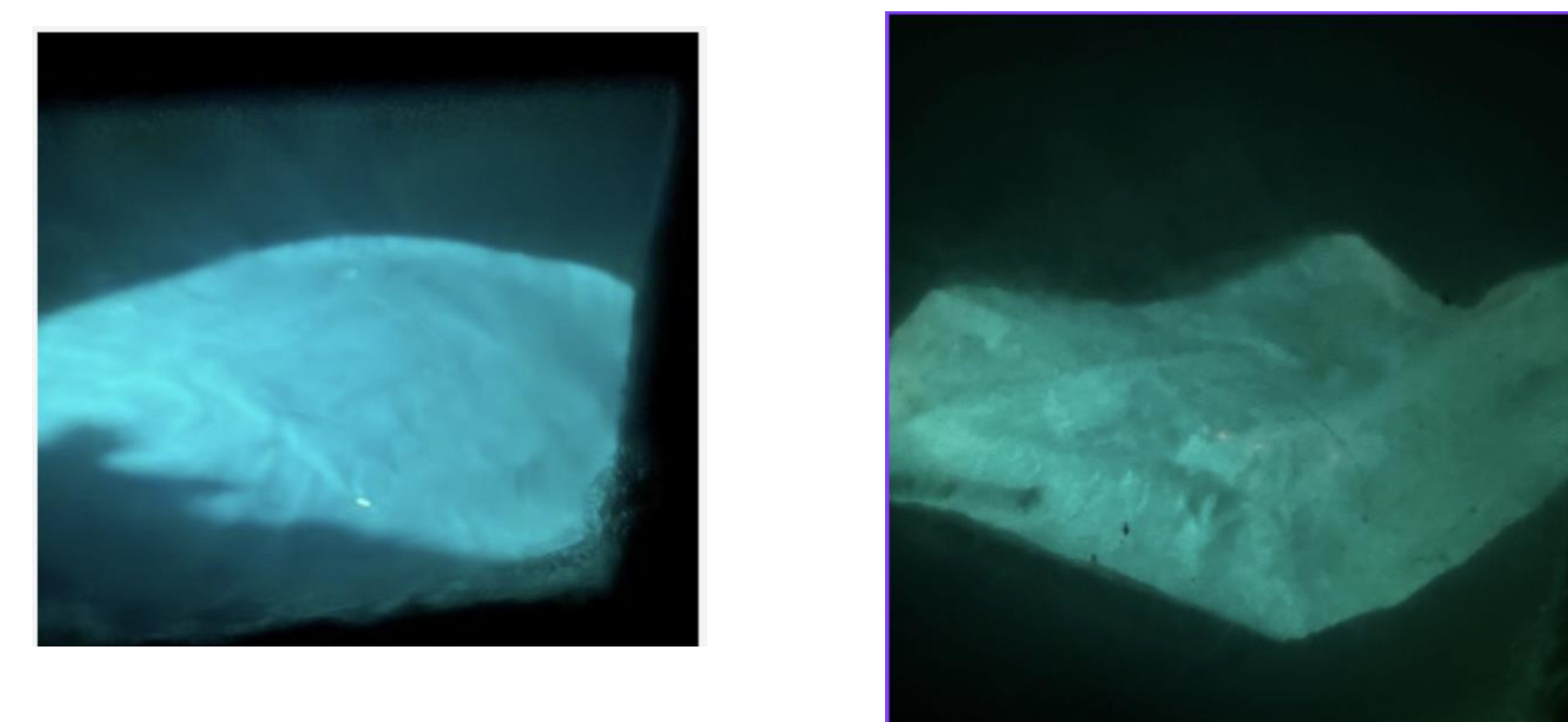
Methodology

Fluorescent device design:
 Build a cardboard box painted black on the inside to avoid reflections. Install a blue LED light (450 nm) on the side of the box. Place a transparent window at the front to observe the samples. Add a yellow filter in front of the phone's camera or in the viewing window.

Water sample collection
 Choose three different points on the same river (rural area, urban area and downstream area). Collect 1,500 mL of water in glass containers clean.

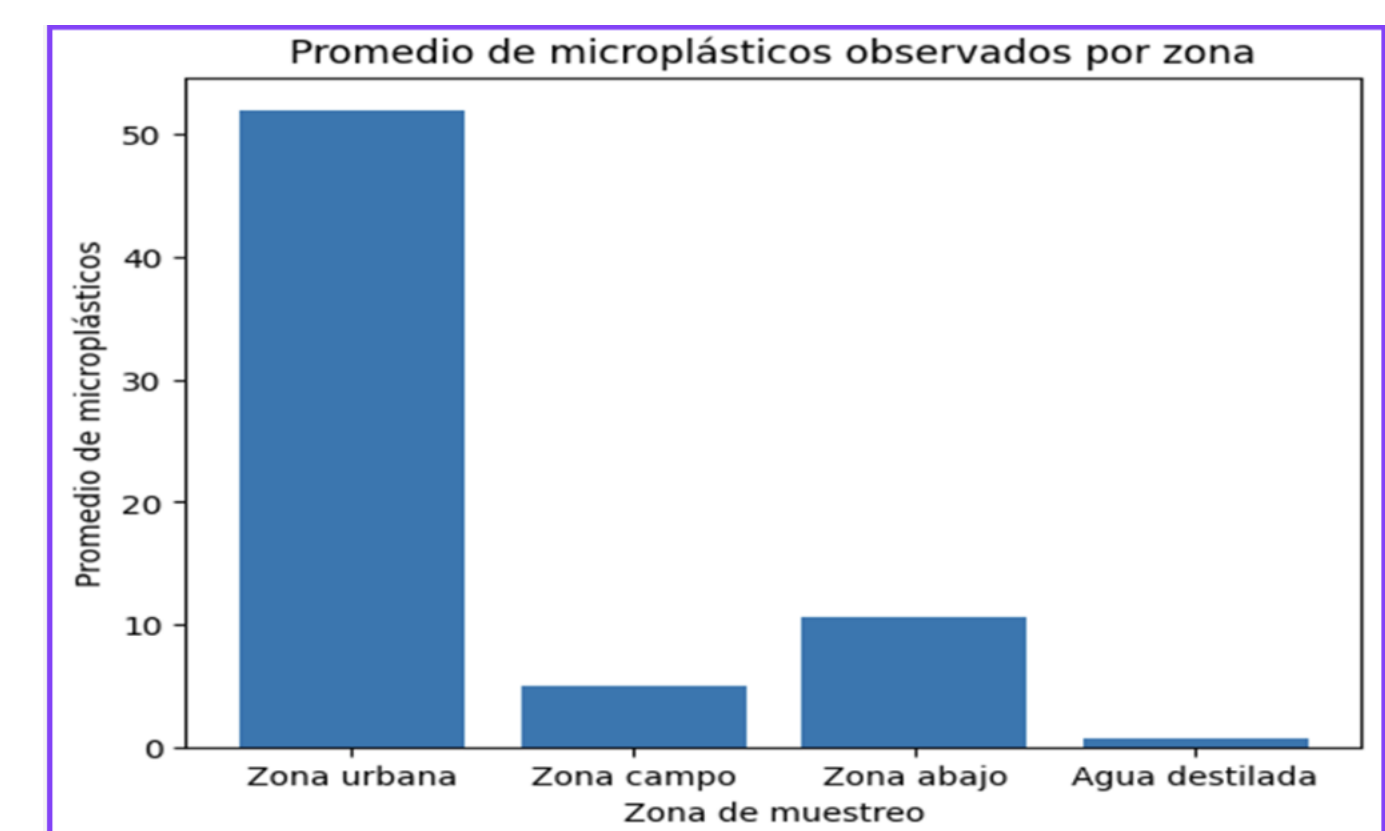
Microplastic filtration:
 Pass each sample through a filter or sieve (5 mm, 1 mm and 300 µm) with coffee filters to separate particles of different sizes. Allow the samples to dry at room temperature.

Observation with the detector:
 Use Nile Red solution to spray the sample. Place the stained sample inside the fluorescent box. Turn on the blue LED light and observe the sample through the yellow filter. Take photos with your cell phone to record particles that shine in orange or reddish tones (indicative of microplastics).

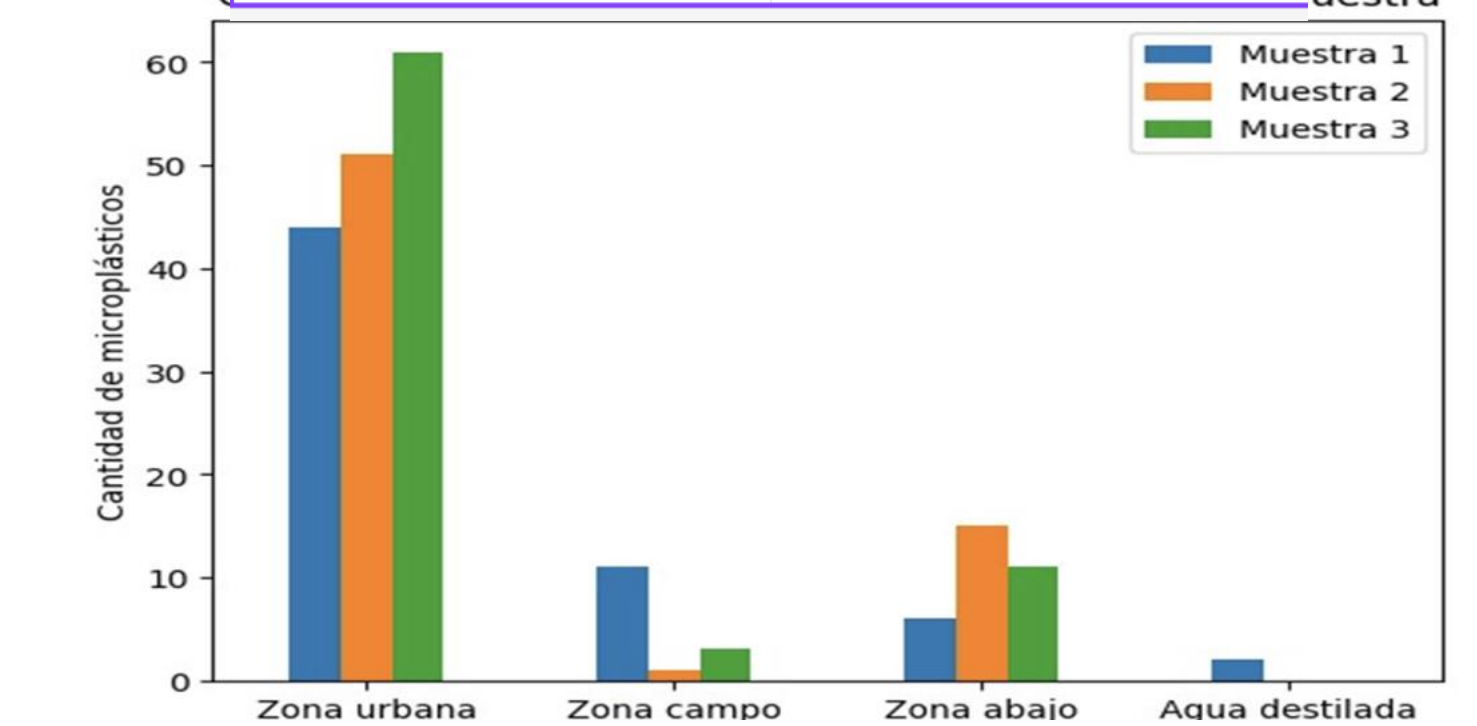


Results & Discussion

The results show that the water in the urban area has more microplastics than the other areas, indicating greater pollution caused by human activities. The downstream area showed a moderate amount, possibly because the microplastics move with the river current. The rural area had fewer microplastics, suggesting less pollution. The distilled water showed almost no particles, confirming that the microplastics found came from the environment and not from the experiment.



Zona de muestreo	Promedio de microplásticos
Zona urbana	52
Zona campo	5
Zona abajo	10.7
Agua destilada	0.7



Zona de muestreo	Muestra 1	Muestra 2	Muestra 3
Zona urbana	44	51	61
Zona campo	11	1	3
Zona abajo	6	15	11
Agua destilada (control)	2	0	0

Conclusion

The hypothesis was accepted because, by using a blue LED light, a yellow filter, and fluorescent staining with Nile Red, it was possible to visually detect the presence of microplastics in the analyzed water samples. The observed fluorescent particles confirmed the effectiveness of the method used. Furthermore, the analysis of the samples showed a greater quantity of microplastics in urban areas compared to rural areas, supporting the link between human activity and microplastic pollution.

Next Steps

- Incorporate a camera with magnification or macro lens to improve counting.
- Create simple software that automatically recognizes fluorescent particles.
- Extend the study to other bodies of water (lakes, beaches, reservoirs).
- Design community educational campaigns on reducing plastics.

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