**The Quantification of Microplastics in Salt Water from Five Los Angeles Beaches**

Grace S. Landers (Biology)

Mentor: Demian Willette, Ph.D. (Biology)

Discipline: Environmental Science

Loyola Marymount University

**Abstract**

Microplastics are defined as plastic particles from 1 to 5,000 μm. Through their hydrophobic properties and the concept of biomagnification, microplastics' small size make them a large threat to marine life and even humans. Their abilities to enter waterways through water runoff, wind and other ways, makes the problems of microplastics appear ever increasing. This paper proposes the quantification of microplastics at five Los Angeles beaches in order to gain knowledge about the concentration and set a foundation for assessing the greater risks that microplastics pose. Water samples will be collected at five beaches and then run through a filtration system comprised of different sized sieves. Microplastics will be examined through the sieves with the use of fluorescence. Microplastics are expected to be in all samples, but concentration is expected to vary based on factors of proximity to waste disposals, rain, ocean currents, and sampling depth.

**Introduction**

Given society’s increasing dependence on plastics for so many aspects of daily life, there has been an increased production, usage, and discarding of plastics. Plastic is often thought to be an issue on land, but often the negative effects on marine environments are overlooked (Hale et al., 2020). When larger pieces of plastic known as macroplastics break down through UV radiation from the sun, they form microplastics (Beri, 2015). Microplastics are defined as 1 to 5,000 μm particles of plastic (Hale et al., 2020). These harmful microplastics are transported from land environments into oceans through a variety of ways, via rivers, storm water runoff, and natural disasters (Hale et al., 2020). Once they have been released into oceans, the harmful chemicals they have accumulated are there forever in some form, as currently no apparent mass removal techniques for microplastics exists. Microplastics have the unique property of attracting and interacting with hydrophobic chemicals, which makes them a greater threat (Prajapati et al, 2022). Additionally, organisms can ingest microplastics, which will disrupt their physiological processes due to difficult digestion and the effect of chemicals attracted to microplastics (Law & Thompson, 2014). Microplastics also have the ability to move across trophic levels, which would consequently affect higher levels of the food pyramid and allow microplastics to interact with the commercial seafood species (Andrady, 2017). This leaves many questions about how they can affect humans but have yet to be answered. Before the larger impact of microplastics can be determined, there is a need for quantification of microplastics to assess their potential as a threat.

**Background/Related Work and Motivation**

The discovery and studying of microplastics is very recent, and thus, there is no standardized procedure for sampling, collecting, analyzing, and reporting microplastics. A number of sources offer an overview of the possible methods. One source breaks down the sampling and detection process into several general steps: collection of water samples, separation of microplastics from the samples, sample processing, identification and quantification, and mitigation of cross-contamination (Prata et al., 2019). However, each of these general steps can be conducted many different ways. For example, in collecting water samples, researchers can use different types of nets, each with advantages and disadvantages (Prata et al., 2019). Zobkov and Esiukova examine specific techniques for sampling, processing, and analyzing, noting which methods work better in certain environments and circumstances, as well as detailing how they work (Zobkov & Esiukova, 2018). Surface water samples and samples from the water column are collected with different nets, for example, for better and more accurate sampling (Zobkov & Esiukova, 2018). In Zobkov and Esiukova (2018) and Prata et al. (2019), the various ways of conducting research on microplastics described offers insight into selecting the methodology for sampling and analyzing microplastics. The sampling and quantification of microplastics in sediments was used to predict the amount of microplastics prey animals would consume (Alava, 2020). Thus, the quantification of microplastics appears to be vital to understanding the larger impact they have. According to the National Centers for Environmental Information (NOAA), there is a gap in sampling from Long Beach to San Clemente in Los Angeles, California (National Centers for Environmental Information, 2022). To fill in this gap, in addition to working towards a more standardized procedure, this research will quantify microplastics from five Los Angeles beaches.

**Methods**

The procedure is adapted from *How to sample Microplastics* (Beri, 2015). Water samples will be collected at five different westward facing beach locations in Los Angeles, California- Playa Del Rey Beach, Dockweiler Beach, Venice Beach, Manhattan Beach, and Santa Monica Beach. At each beach location, ten 1 liter ocean water samples will be collected. These samples will be collected at a depth of approximately 1 foot of water. Three samples will be collected at what will be known as mile zero. An additional four samples will be collected a quarter of a mile down the shoreline and will be known as mile 0.25. The final three samples will be collected an additional quarter of a mile down the shoreline and will be known as mile 0.5. All ten samples will be collected in 1 liter glass containers to avoid contamination by microplastics.

The samples will then be filtered to visually examine microplastics present and quantify them. A filtering system will be set up consisting of filters that will get progressively smaller attached to a 19 inch lab stand. A 25 mL pipette will be used to place the water into the filtration system and a 1000 mL beaker will be used to collect the filtered water. The system will start with a 600 µm sieve, then a 500 µm sieve, then a 212 µm sieve, and finally followed by a 25 µm sieve. Each sieve will be followed by a glass funnel. Once a sample has been completely filtered, an acid-base treatment of approximately 5 mL of 1M NaCl will be applied to each individual filter to eliminate any fluorescence that may come from biological factors.

The treated sieves will individually be examined with a stereoscope and a Nightsea Fluorescence viewing system in the color royal blue. This should be done in a dark space with no light to ensure all microplastics are seen. The quantity, color, and type (fragment, string, etc.) of each microplastic will be recorded. To examine the quantity of microplastics in five different locations, an Analysis of Variance (ANOVA) will be used to determine how the presence of microplastics relate to factors that influence the populations of the beaches.

**Expected Results**

Due to the high presence of plastic use in everyday life, there is a growing quantity of microplastics. With the increasing production of microplastics, it is expected that all samples acquired will contain microplastics. The approximate location of waste disposals to the beaches can cause an increase in the microplastic concentration. Landfills have been found to be a starting point for microplastic pollution as opposed to the ending place (He et al., 2019). Microplastics thus have the ability to contaminate soil as well as surface run-off. Wind can pick up microplastics from landfills and soil, allowing it to be transferred to beaches and the ocean (He et al., 2019). Contaminated surface run-off can find its way directly to the beach and can contaminate the water (He et al., 2019). A waste disposal is located relatively close to Santa Monica Beach and Venice Beach, so a higher concentration of microplastics is expected in these samples. Rainfall can affect the concentration of microplastics, as on average rain introduces 4,800 microplastic particles into the environment per square kilometer per hour (Lehmann et al, 2021). Thus, samples collected after a rainfall and during the rainy season- winter and spring- are expected to have higher concentrations of microplastics. Additionally, ocean current patterns can impact the concentration of microplastics. Beaches in Spain that were enclosed bay-type beaches were observed to have higher concentrations of microplastics, while open-delta type beaches were seen to have lower concentrations in microplastics (Godoy et al., 2020). Since all of the locations chosen were open-delta type beaches, all samples are expected to have lower concentrations of microplastics compared to other beach locations that are enclosed bay-type beaches. The chosen sampling location of only approximately one foot of water could also lead to lower observed microplastic concentrations as greater concentrations of microplastics have been observed offshore (Godoy et al., 2020). As previously stated, the samples will be statistically analyzed through the use of an ANOVA test. The ANOVA is expected to show higher concentrations of microplastics at Santa Monica Beach and Venice Beach due to their proximity to a waste disposal, as well as samples collected after recent rains to have higher concentrations.

**Conclusion**

Microplastics pose a threat due to their small size and ability to attract hydrophobic chemicals (Prajapati et al, 2022). The biomagnification of these toxic chemicals poses a greater danger to organisms in higher trophic levels, leaving humans at the greatest risk (Alava, 2022). In organisms that have ingested microplastics, there has been disruptions with physiological processes, especially digestive processes (Law & Thompson, 2014). In order to be able to assess the threat of microplastics, it is important to fill in the gaps of knowing the concentration of microplastics in water sources. This research can aid filling the gap of unknown microplastic concentration from Long Beach to San Clemente. This experiment would reveal the concentration of microplastics, which can be used for future research and understanding of the impact that microplastics have. The procedure in this experiment could also hopefully contribute to standardizing the sampling and analyzing of microplastics. Overall, the unknowns and knowns of microplastic indicate that microplastics are a threat and have the potential to do more harm than what is already known. The use of plastics in everyday life should be reduced in an effort to prevent further introduction of microplastics into the environment and minimize the impact of microplastics on the health of animals and humans.

References

Alava, J. J. (2020). Modeling the bioaccumulation and biomagnification potential of

microplastics in a cetacean foodweb of the northeastern pacific: a prospective tool

to assess the risk exposure to plastic particles. *Frontiers in Marine Science*, *7*.

<https://doi.org/10.3389/fmars.2020.566101>

Andrady, A. L. (2017). The plastic in microplastics: a review. *Marine Pollution Bulletin*, *119*(1),

12–22. <https://doi.org/10.1016/j.marpolbul.2017.01.082>

Beri, Damien. (2015, May 14). *How to sample micro plastic* [Video]. Youtube.

<https://www.youtube.com/watch?v=FJ36Gt6Rn0k>

Godoy, V., Prata, J. C., Blázquez, G., Almendros, A. I., Duarte, A. C., Rocha-Santos, T., Calero,

M., & Martín-Lara, M. Á. (2020). Effects of distance to the sea and geomorphological

characteristics on the quantity and distribution of microplastics in beach sediments of

Granada (Spain). *Science of The Total Environment*, *746*, 142023.

<https://doi.org/10.1016/j.scitotenv.2020.142023>

Hale, R. C., Seeley, M. E., La Guardia, M. J., Mai, L., & Zeng, E. Y. (2020). A global

perspective on microplastics. *Journal of Geophysical Research: Oceans*, *125*, e2018JC014719. https://doi.org/10.1029/2018JC014719

He, Chen, L., Shao, L., Zhang, H., & Lü, F. (2019). Municipal solid waste (MSW) landfill: a

source of microplastics? -evidence of microplastics in landfill leachate. *Water Research (Oxford)*, *159*, 38–45. <https://doi.org/10.1016/j.watres.2019.04.060>

Law, K. L., & Thompson, R. C. (2014). Microplastics in the seas. *Science*, *345*(6193),

144–145. <https://doi.org/10.1126/science.1254065>

Lehmann, M., Oehlschlägel, L.M., Häusl, F.P. *et al.* Ejection of marine microplastics by

raindrops: a computational and experimental study. *Micropl.&Nanopl.* 1, 18 (2021). https://doi.org/10.1186/s43591-021-00018-8

National Centers for Environmental Information. (2022, December 11). *National Centers for*

*Environmental Information*. Marine Microplastics. Retrieved December 11, 2022, from https://experience.arcgis.com/experience/b296879cc1984fda833a8acc93e31476/page/Page/?views=Display-Filters%2CMap-Viewer

Prajapati, A., Narayan Vaidya, A., & Kumar, A. R. (2022). Microplastic properties and their

interaction with hydrophobic organic contaminants: A review. *Environmental Science*

*and Pollution Research*, *29*(33), 49490–49512. <https://doi.org/10.1007/s11356-022-20723-y>

Prata, J. C., Costa, J. P. da, Duarte, A. C., & Rocha-Santos, T. (2019). Methods for sampling

and detection of microplastics in water and sediment: a critical review. *TrAC Trends in*

*Analytical Chemistry*, *110*, 150–159. <https://doi.org/10.1016/j.trac.2018.10.029>

Zobkov, M. B., Esiukova, E. (2018). Microplastics in as marine environment: review of

methods for sampling, processing, and analyzing microplastics in water, bottom

sediments, and coastal deposits. *Oceanology, 58*(1), 137-143.

<https://doi.org/10.1134/S0001437017060169>

Budget

Anticipated total: $11,598.00

|  |  |  |  |
| --- | --- | --- | --- |
| Item | Quantity | Cost | Link |
| Transportation |  | $200 |  |
| Glass Containers | 12 | $311.87 | <https://www.hbarsci.com/products/ch0156fw?currency=USD&variant=1287917268&utm_medium=cpc&utm_source=google&utm_campaign=Google%20Shopping&cmp_id=17329522514&adg_id=&kwd=&device=c&gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe7F9W90G0k7mfRlgubV8FX9SLZ3etPk4XKjzT7XIE4YyKro5gUhYN0aAnMqEALw_wcB> |
| Brass Sieve 600 µm | 3 | $168.13 | <https://www.zoro.com/endecotts-test-sieve-600-microns-3-in-dia-30meshsz-003baw600/i/G8672903/> |
| Brass Sieve 500 µm | 3 | $393.98 | <https://www.zoro.com/endecotts-test-sieve-500-microns-3-in-dia-35meshsz-003baw500/i/G8672894/> |
| Brass Sieve 25 µm | 3 | $90.07 | <https://www.sepsol.com/product/endecotts-brass-test-sieves/> |
| Brass Sieve 212 µm | 3 | $1,606.70 | <https://www.amazon.com/Endecotts-Test-Sieve-Microns-500MeshSz/dp/B07H5T85J2> |
| Glass Funnel | 8 | $313.84 | <https://www.usalab.com/usa-lab-150mm-glass-funnel/?action=select&sku=&gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe5vfjB5OjXtIZ5GuIFsryxHVXqr8KHD6rBDywk3r4C8anj1qFkTZLMaAsqZEALw_wcB> |
| Lab Stand | 2 | $39.91 | <https://www.usalab.com/lab-stand-small-4-x-7-with-19-steel-rod/?action=select&sku=&gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe5-o2g5oM16Kz8EX5flEY2ZwGhtGDplCbrJ5Ij2oOSJk4XjT50COEAaArwSEALw_wcB> |
| 3 inch Ring Clamp | 8 | $75.49 | <https://www.labdepotinc.com/p-9433-support-rings-cast-iron?gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe4-9_BTptM1fVvCyo597s_kExQgjgX4TStDJZDVczCcwfX_4IDqrG8aAuP7EALw_wcB> |
| Stand Clamp | 7 | $724.12 | <https://www.coleparmer.com/i/cole-parmer-essentials-heavy-duty-three-prong-extension-clamp-dual-large/0802116> |
| Clamp Holders | 8 | $228.50 | <https://shopbvv.com/products/clamp-holder-premium-offset-boss-head?variant=39452392390752&utm_medium=cpc&utm_source=google&utm_campaign=Google%20Shopping&gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe7-X5rHO64Z2hFhggeyzskIaLayszmS3_0cO6Cf_ccBMqWlePyBt3YaAhcWEALw_wcB> |
| Pipette | 1 | $66.03 | <https://www.fishersci.com/shop/products/bel-art-scienceware-economy-pipette-pump-iii-pipetters/03410533?ef_id=Cj0KCQjwwfiaBhC7ARIsAGvcPe5V6oLUYWBBD9V3VHdKLfYFLWJizYcPkM62wSo62khIfYkm5gwA4NcaAuLVEALw_wcB:G:s&ppc_id=PLA_goog_2086145674_79470364258_03410533__381625326898_16444278225623417361&ev_chn=shop&s_kwcid=AL!4428!3!381625326898!!!g!829891647581!03410533&gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe5V6oLUYWBBD9V3VHdKLfYFLWJizYcPkM62wSo62khIfYkm5gwA4NcaAuLVEALw_wcB> |
| 25mL Pipettes (200) | 1 | $66.85 | <https://www.drummondsci.com/product/pipet-aid/serological-pipet/?gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe5Uq_CwsmcqAjtYVkYR_AGi_j8_q6FEQNmClts5OxSguK2D_-EridIaAvHXEALw_wcB> |
| 1000 mL Beaker | 3 | $43.56 | <https://www.hbarsci.com/products/ch0124i?currency=USD&variant=33440917137&utm_medium=cpc&utm_source=google&utm_campaign=Google%20Shopping&cmp_id=17329522514&adg_id=&kwd=&device=c&gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe5ycYZ7jA1LCVlSlj5hkGWj6moHSKFJBDLuajFE1QttSPNJnRk5eRAaAgV2EALw_wcB> |
| 500 mL of 1M NaCl | 3 | $89.49 | [https://www.coleparmer.com/i/labchem-sodium-hydroxide-1-0-n-1-0-m-500-ml/8004383?PubID=UX&persist=true&ip=no&gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe4mYKyVZX6Rs1CexZrxa2EZxlhSKfh1pN2SIsMnfALJgCs0DwDDeAAaAhddEALw\_wcB\](https://www.coleparmer.com/i/labchem-sodium-hydroxide-1-0-n-1-0-m-500-ml/8004383?PubID=UX&persist=true&ip=no&gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe4mYKyVZX6Rs1CexZrxa2EZxlhSKfh1pN2SIsMnfALJgCs0DwDDeAAaAhddEALw_wcB%5C) |
| 10 mL Graduated Cylinder | 2 | $36.36 | <https://www.labdepotinc.com/p-62103-graduated-cylinders-glass-class-a?gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe6rAUYB-46MV8mHTUmKqgDot48ZKG85erhmfnqtV-hOJpo_U9HD0tMaApfQEALw_wcB> |
| Nightsea Adapter Viewing System | 1 | $1,644.50 | <https://www.stellarscientific.com/nightsea-fluorescence-viewing-system-with-royal-blue-with-dimmer-base/?gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe5POyQSuJEp26DNSxOKWYbffFWdUzo3JrKg84k0VSQQFvN8shkzqRcaAkr7EALw_wcB> |
| Stereoscope | 1 | $878.17 | <https://amscope.com/products/sm-1tsw2-l6w-m?gclid=Cj0KCQjwwfiaBhC7ARIsAGvcPe5XFi-yKxlPhy4RuX0NfbbEuvvyYjqPMImauAbJx7MaTFZ-t3RWz5gaAjEoEALw_wcB&gclsrc=aw.ds> |
| Labor | 280 hours | $4,620 |  |
| **Total** |  | **$11,598** |  |

Timeline

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Week | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Water Sample from Beach 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Filtration of Samples from Beach 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Water Sample from Beach 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Filtration of Samples from Beach 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Water Sample from Beach 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Filtration of Samples from Beach 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Water Sample from Beach 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Filtration of Samples from Beach 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Water Sample from Beach 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Filtration of Samples from Beach 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Organization of Data |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Statistical Testing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Formal Report |  |  |  |  |  |  |  |  |  |  |  |  |  |  |