The Presence and Significance of Microplastics in Surface Water in the Lower Hudson River Estuary: 2016-2019

Helen Polanco[1], Siddhartha Hayes[1], Carrie Roble[1], Marika Krupitsky[1], Brett Branco, PhD[2,3];
Hudson River Park Trust, New York, NY[1]; Aquatic Research and Environmental Assessment Center,
Brooklyn College, Brooklyn, NY[2]; CUNY Graduate Center[3]

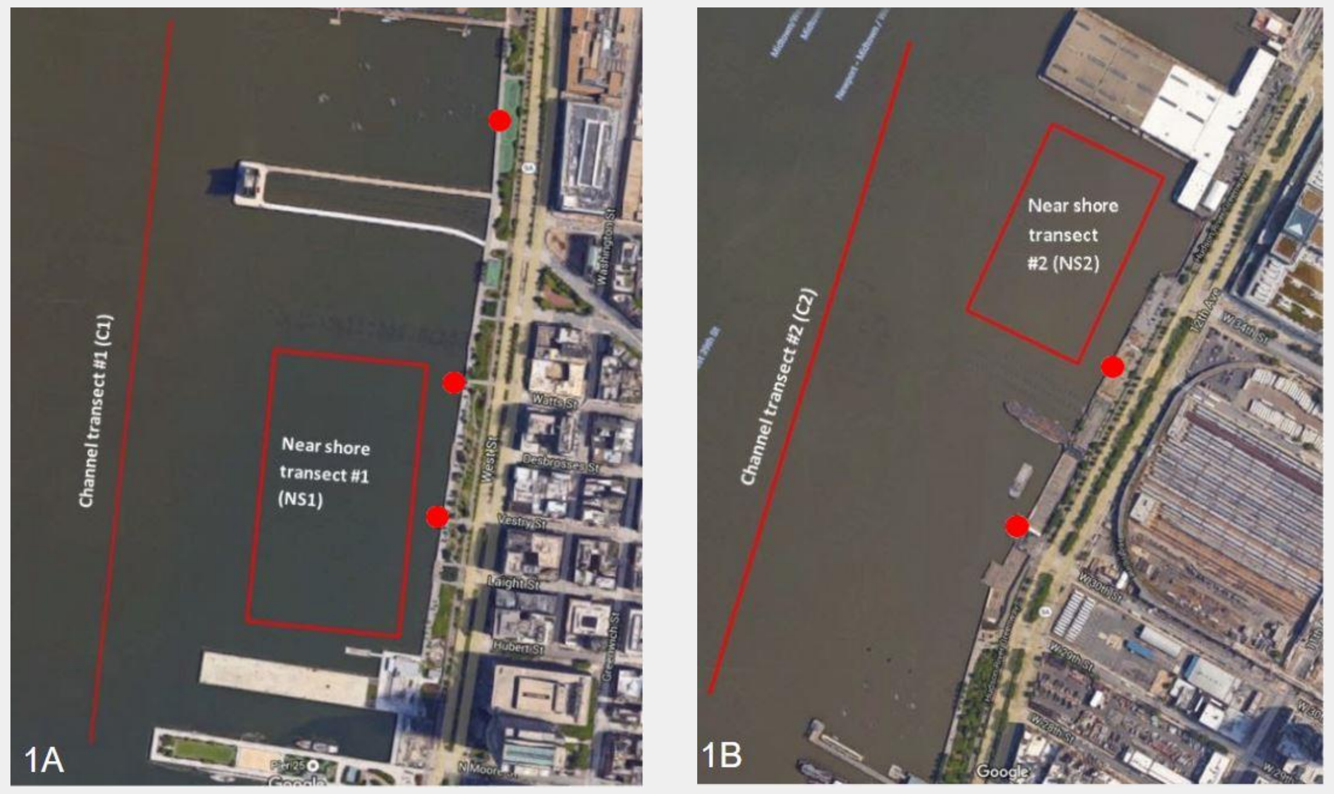


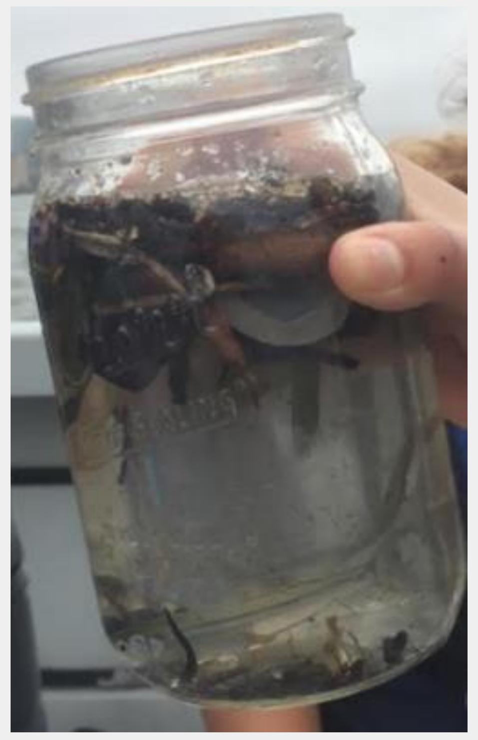
Fig. 1a & 1b | Satellite images of trawling sites conducted monthly (June - Oct.) at both channel and near shore locations within Hudson River Park's downtown (1a) and midtown waters (1b). Red dots indicate Combined Sewer Outfall (CSO) points.

INTRODUCTION

Since 2016, Hudson River Park's Estuary Lab has collaborated with Brooklyn College to survey the concentration and distribution of microplastics, plastics <5mm in size, in the Park's Estuarine Sanctuary. It was hypothesized that microplastic concentration is influenced by proximity to combined sewer outfall (CSO) **(Fig. 1a & 1b)**.This ongoing monitoring project has helped develop a baseline understanding of the presence of microplastics in the Hudson Estuary and aimed to understand how microplastic concentration is influenced by precipitation, and the semidiurnal tidal cycle.

METHODS

- During each trawl, a 1m wide, 0.3mm mesh neuston net collected samples within an attached 1L container.
- Samples were filtered through a stacked series of sieves (0.3mm, 1mm, and 5.6 mm) and dried at 90°C overnight.
- Organic matter was degraded using wet peroxide oxidation; samples were divided using salt gradient density separation, and plastics were filtered out using a 0.3mm nitrex sieve.
- Plastics were counted and categorized, based on size and type, using 10x-40x magnification stereo microscopes.



RESULTS

- Significant difference was observed between near-shore (NS) and channel (C) locations over all four years (ANOVA $F(1,70) = 5.1$, $p<0.03$*)**(Fig. 2)**, with Tukey tests showing that 2018 near-shore concentrations were significantly higher than both channel concentrations in 2016, 2017, and 2019 ($p<0.002$*) and near-shore concentrations in 2016 and 2017 ($p<0.03$*).
- Mean concentration in 2018 was three times greater than both 2016 (243,772) and 2019 (244,142), and six times greater than 2017 (143,204) **(Fig. 3)**.
- Significant differences in microplastic concentrations were observed between 2018 and every other year (ANOVA $F(1,70) = 5.2$, $p<0.03$*; post hoc Tukey test $p<0.009$*)**(Fig. 3)**. No significant difference was found between 2016, 2017, and 2019.
- Fragments averaged 70% of all microplastic pieces observed across all years **(Fig. 4)**.
- No significant difference in samples collected during ebb and flood tides was found

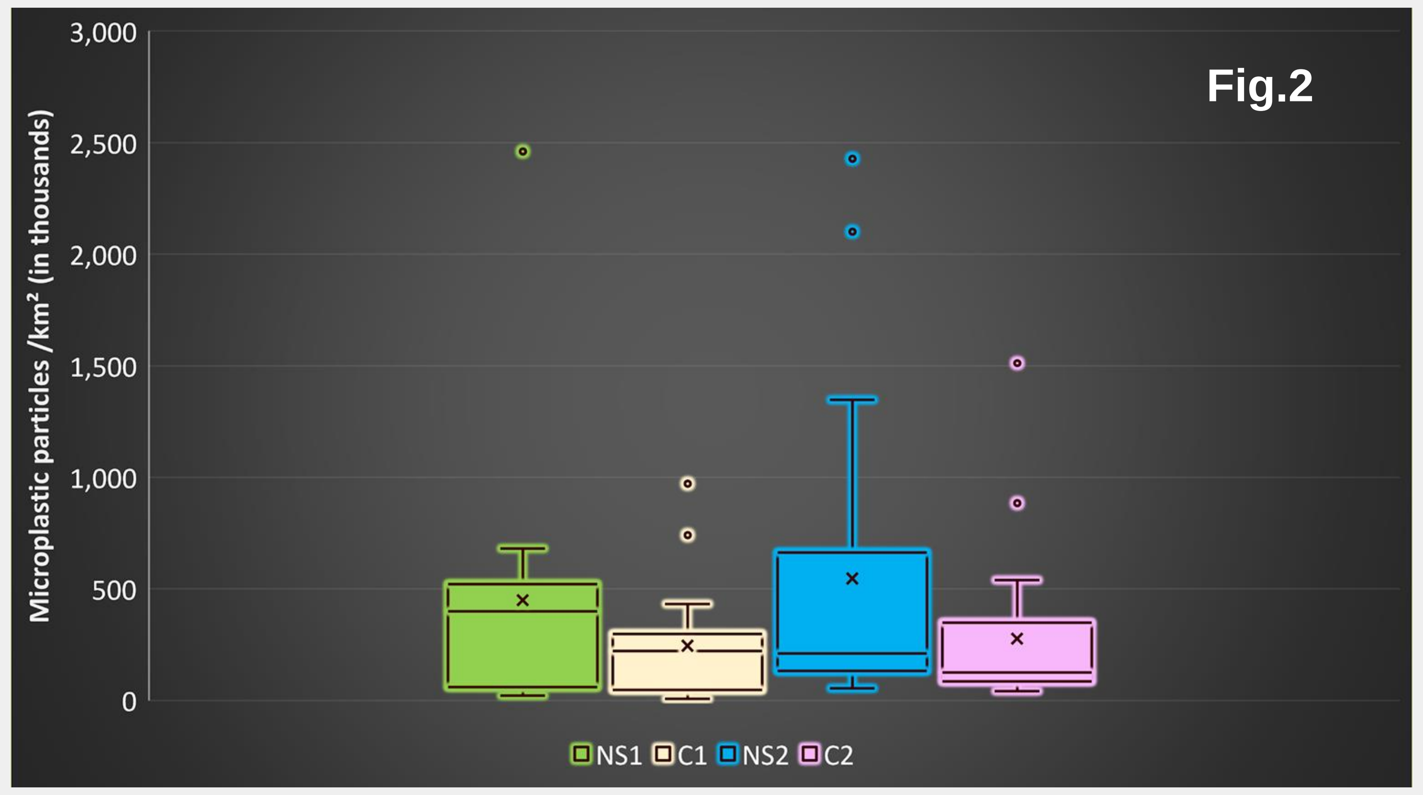


Fig. 2 | Distribution of microplastic concentrations in samples collected at channel and nearshore sites 2016 - 2019

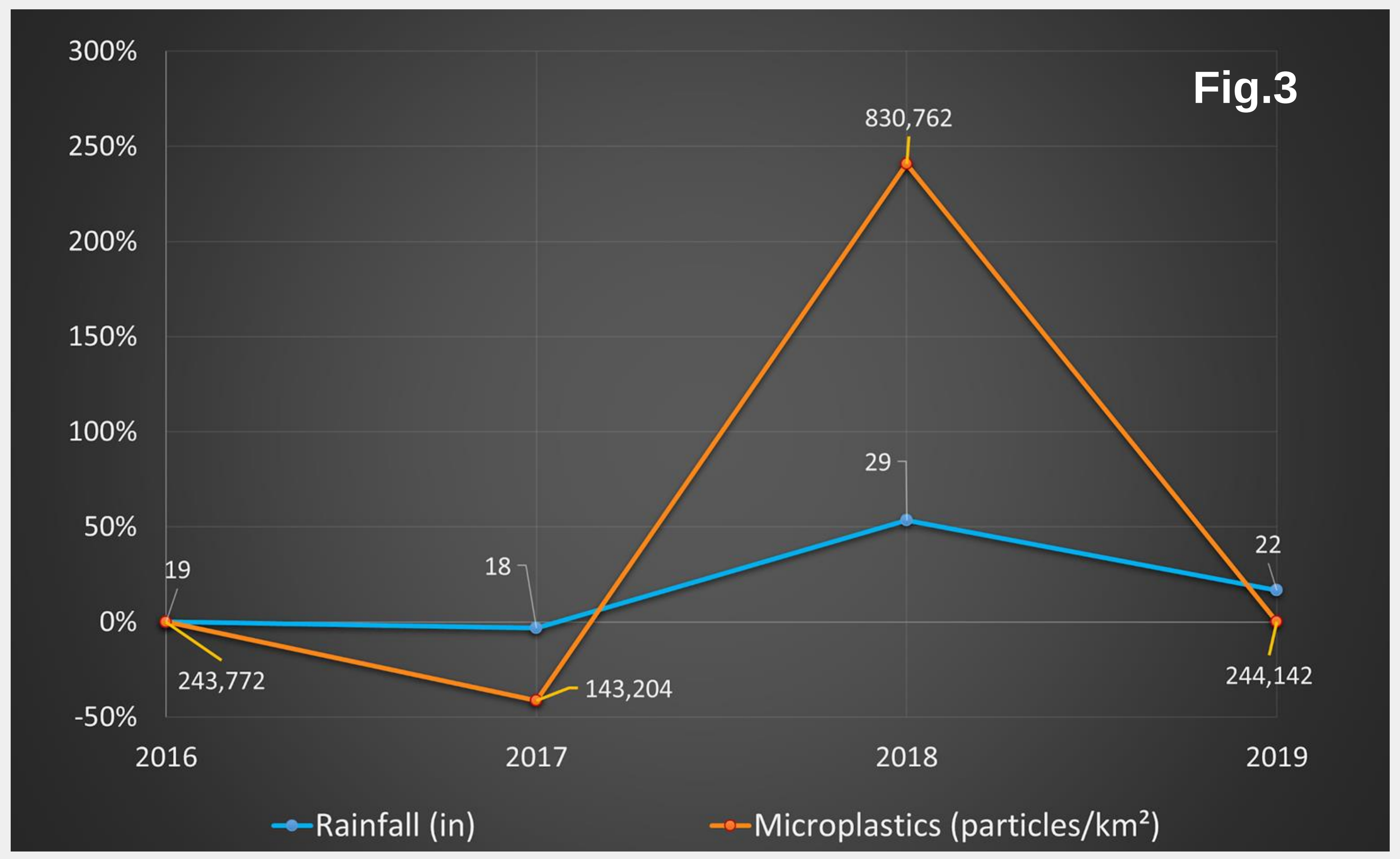


Fig. 3 | Percent change of mean seasonal microplastic concentration versus mean seasonal rainfall in inches, 2016-2019. Sampling season is defined as June-October.

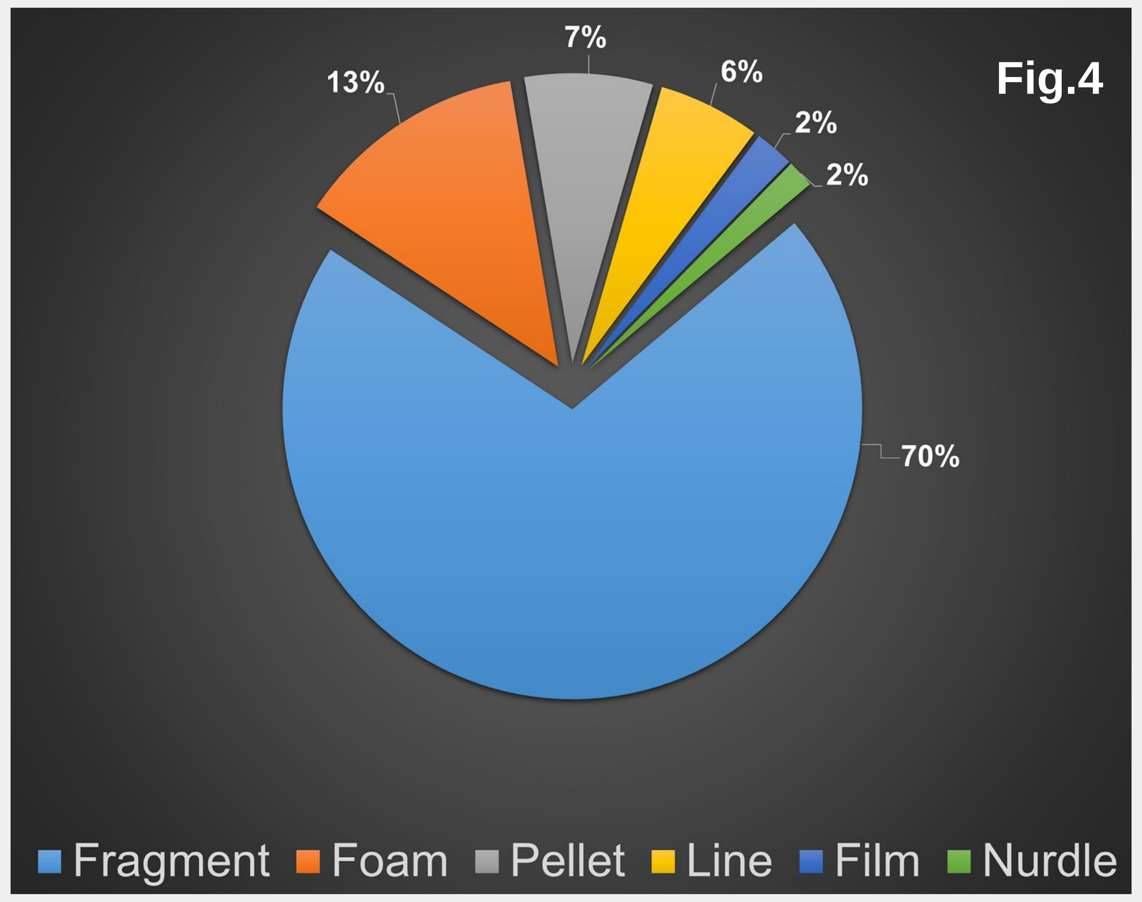


Fig. 4 | Combined proportion of plastic types found from 2016 to 2019. Where total pieces of plastics = 46,158.

DISCUSSION

- The results of this study suggest that the presence of microplastics in the river is related to the water's proximity to shore and CSO locations.
- The prevalence of fragments in our microplastic samples indicates that larger plastics are not being disposed of properly and are ending up in local waterways after CSO events, triggered by rain fall, and continue to degrade into smaller pieces due to UV and salt exposure **(Fig. 4).**
- Although no significant correlation between microplastic concentration and rain was found using spearman's r, a possible explanation for this increase in plastics could be related to the slight increase in rainfall in 2018.
- Chemical analysis using pyrolysis, gas chromatography- mass spectrometry (GC–MS) was conducted on archived samples from August and October of 2018 in a collaboration with NOAA, where pieces exhibited several of the common chemical compositions of various plastics.
- The continued collection of samples and factoring in of tidal forces and hydrodynamics could elucidate the relationship between microplastics, rain and CSOs. Additionally, future microplastic pollution surveys, conducted by Estuary Lab staff, following the 2019 styrofoam ban in New York City and other discharge reduction measures can assess the effectiveness of these policies in reducing microplastic pollution in the Hudson Estuary.

REFERENCES

- City of New York. (2018). Mayor de Blasio Announces Ban On Single-use Styrofoam Products In New York City Will Be In Effect Beginning 2019. https://www1.nyc.gov/office-of-the-mayor/news/295-18/mayor-de-blasio-ban-single-use-styrofoam-products-new-york-city-will-be-effect
- Masura, J., Baker, J. E., Foster, G. D., Arthur, C., & Herring, C. (2015). Laboratory methods for the analysis of microplastics in the marine environment: recommendations for quantifying synthetic particles in waters and sediments.

ACKNOWLEDGEMENTS

The authors acknowledge Hudson River Park and Brooklyn College for funding this research. Special thanks to Captain Jim Gill, Emma Samstein, Theresa Trelles, and Elena Davis, Natalie Monterrosa, Dr. Ashok Deshpande, Christiana Hooker for their field and lab support.