

A SIMULATION OF NANOPLASTICS FATE AND TRANSPORT FROM HEADWATERS TO THE OCEAN

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Nanoplastic fate and transport are dependent on plastic type

BACKGROUND

- Plastic contamination is ubiquitous.
- Very little is known about the environmental fate of microplastics (0.1-5mm), and less is known for nanoplastics (<100nm).
- Many metal nanoparticles tend to agglomerate (stick together) under high salt concentration, increasing the chances of particles falling out of suspension.
- Currently, it is unknown if nanoplastics would behave in a similar fashion.

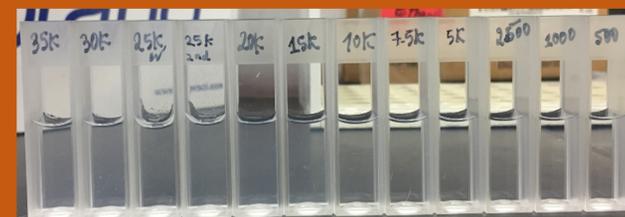
METHODS

- 100nm Latex, 47nm Polystyrene, 50nm PMMA-Plain, and 50nm PMMA-COOH were purchased from Thermo Fisher Scientific.
- 35ppt Artificial Pacific Oceanwater was diluted to 30ppt, 25ppt, 20ppt, 15ppt, 10ppt, 7.5ppt, 5ppt, 2.5ppt, 1ppt, and 0.5ppt (from ocean salinity to freshwater).
- DLS measurements were performed using a Zetasizer ZS (Malvern Instrument, UK) at an angle of 173° Backscatter, and temperature of 20°C.
- Statistical analyses (Two-way ANOVA and Multiple Comparison Procedures) and graphical representations were conducted using the SigmaPlot software.

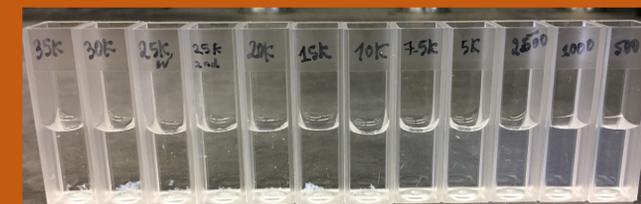
RESULTS

- PMMA-COOH did not show any significant increase in size distribution throughout the salinity range.
- The size distribution (Z-average) of nanoplastics increased as the media salinity increased, except for PMMA-COOH.
- Salinity of the media significantly affects the size distribution of nanoplastics (ANOVA, $p=0.005$).
- The nanoplastic type also has a significant effect on the size distribution of all nanoplastics (ANOVA, $p<0.001$).
- Similar behavior with changes in salinity were observed for: PMMA-Plain vs PMMA-COOH, Polystyrene vs Latex, and Latex vs PMMA-Plain.

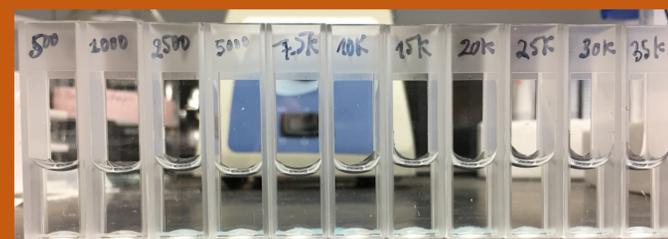
- Latex nanoplastics are expected to fall-out in the estuaries
- Polystyrene and PMMA-Plain will be settled-out at the head of the estuaries
- PMMA-COOH nanoplastics are predicted to pollute ocean



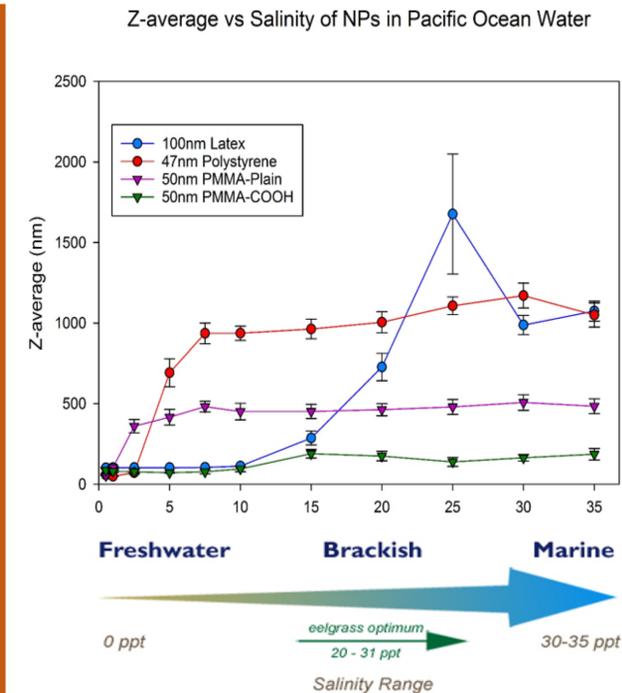
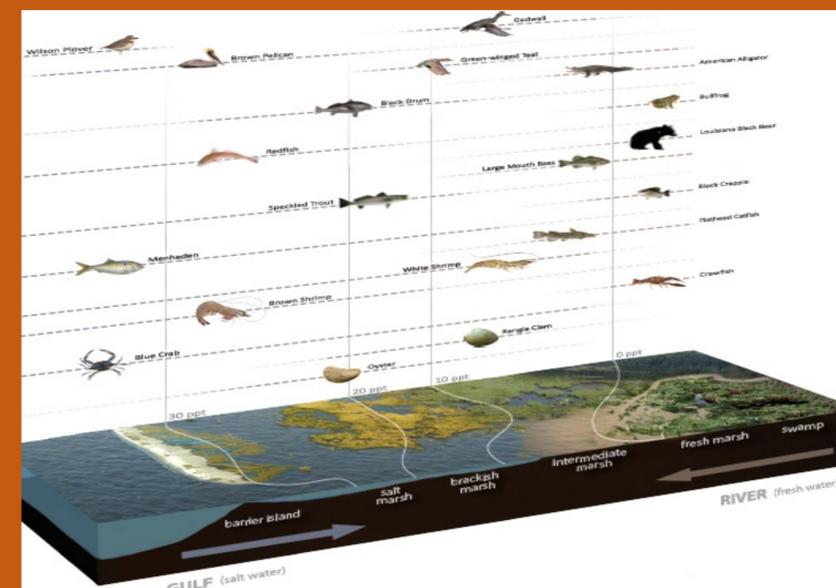
100nm Latex nanoplastics at time t=0



100nm Latex nanoplastics 3 days later



Agglomerated 50nm Polystyrene nanoplastics



DISCUSSION

- The agglomeration condition of nanoplastics is similar to metal nanoparticles.
- Carboxylic functional groups (-COOH) have the ability to stabilize nanoparticles.
- Latex nanoplastics started agglomerating significantly at 20ppt with each successive measurement being larger than the last.
- Polystyrene and PMMA-Plain started agglomerating at 2.5ppt and 1ppt, respectively.

CONCLUSIONS

- Predicting the location of suspended nanoplastics can help us strategically select organisms having increased exposure and potentially consuming nanoplastics.
- This information is useful for future studies on environmental and health risk assessment of nanoplastics.

ACKNOWLEDGEMENT

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