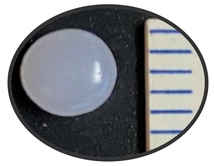
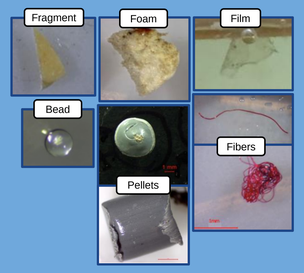
From Beach to Basin: Assessing the Spatio-temporal Distribution of Microplastics in Lake Champlain

Allison Morrow (SUNY Plattsburgh, Plattsburgh, NY)

Timothy Lloyd, Grace Calvelli, Taygin Jump, Aude Lochet, Timothy Mihuc, and Danielle Garneau



Background



Microplastics

- Plastic particles < 5mm in size
- Present in 90% of surface waters worldwide
- Primary (*e.g.*, beauty products, pre-production plastic pellets) and secondary microplastic sources (*e.g.*, degrading larger plastic, laundry effluent)
- Microrubber from worn tires and manufacturing is ubiquitous and a significant contribution of “microplastic’

The Great Lakes

- Lake Superior, Huron, and Erie are estimated to contain 43,000 particles per km² (0.27 particles per m³), though other studies report particulate to be tenfold

Health Concerns

- Microplastics harbor sorb and leach heavy metals, pharmaceuticals, and pathogenic bacteria whose biofilms can confer antibiotic resistance
- Human health impacts associate with consumption of ultra-processed foods and piscivorous diets

Goals & Hypotheses

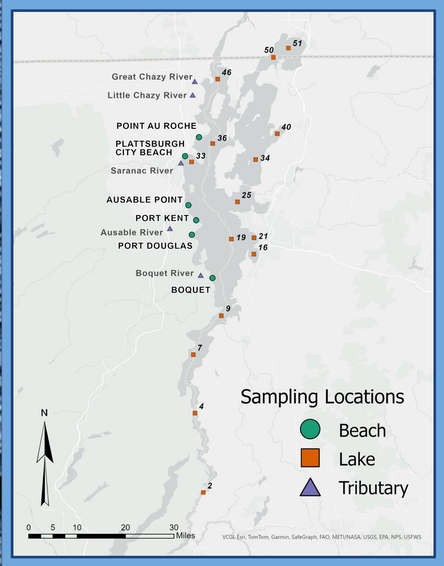
To characterize, quantify, and map the spatiotemporal distribution of potential pre-production microplastic pollution pathways in the Lake Champlain Basin

Lakewide: Microrubber will be more concentrated in areas in proximity to urban centers and industry and at lower depths

Tributaries: Tributaries will be a primary pathway of entry for microplastics into Lake Champlain

Beaches: Beaches near urban centers and/or those with higher visitation will have greater microplactic densities

Monitoring Sites



Long-term Monitoring of Lake Champlain

- Joint lake monitoring project involving NYSDEC, Lake Champlain Research Institute/SUNY Plattsburgh
- 15 lake monitoring stations using standardized sampling of factors including: water clarity and temperature, dissolved oxygen, pH, specific conductance, and chlorophyll A
- Vertical net (30cm d x 153um) sampling from lake bottom to the surface to survey phytoplankton and zooplankton communities, as well as microrubber
- N= 1189 samples processed, 25% of total bottles from 1992-2024

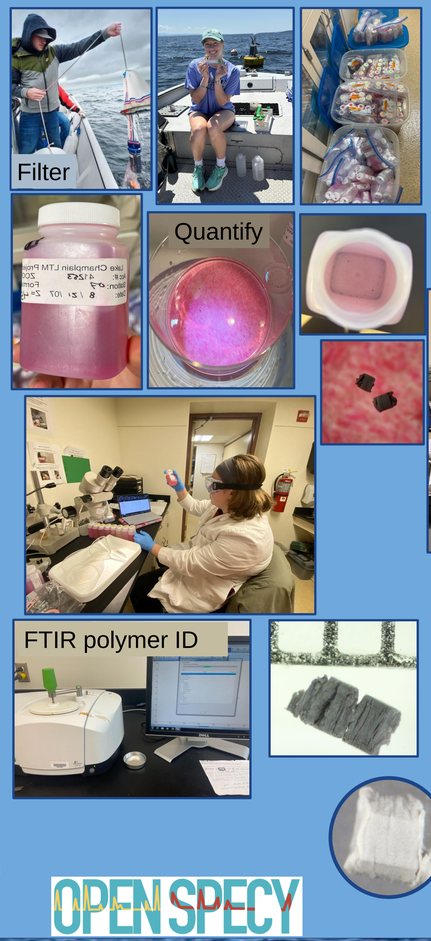
Tributaries (in collaboration with UVM)

- 5x tributaries sampled 6 x during summer-fall 2024.
- Neuston net (153 um) deployed off a bridge 2 x 10min each sampling bout
- N= 60 samples

Beaches (in collaboration with UVM)

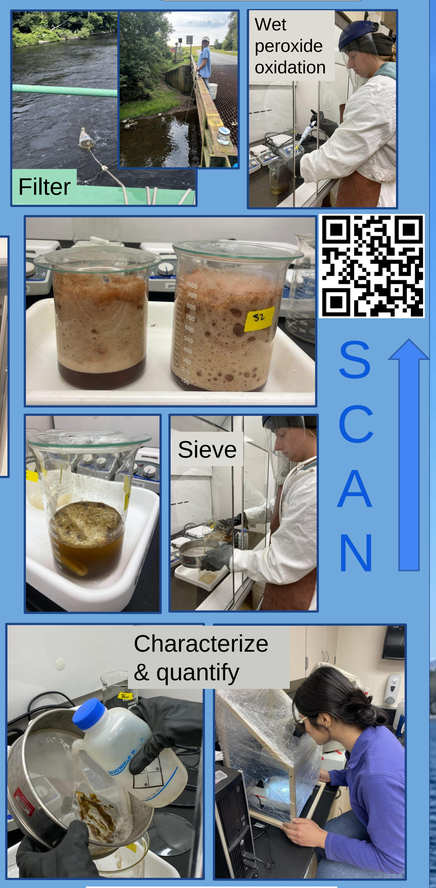
- 6x beaches sampled 6 x throughout summer-fall 2024.
- Sites selected along a gradient of urban (Plattsburgh City) to rural (Boquet among others) beaches.
- N=180 samples

Long-term Monitoring



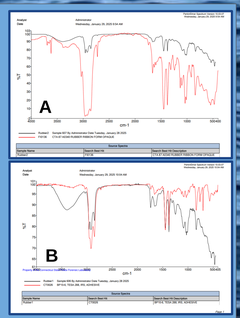
Beaches

Tributaries

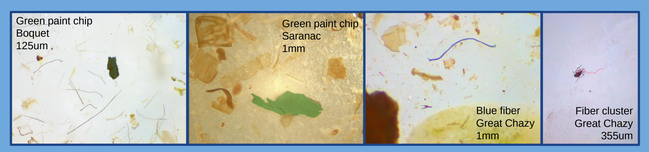


Preliminary Results

- LTM findings support a lakewide distribution of microrubber
- Microrubber present at all 15 sampling stations from 2012-25
- Polymer type varies between polyisoprene rubber ribbon (A), “BP10-6, TESA 288, IRS, ADHESIVE” (B) among others



- Tributaries are not a major pathway of pre-production pellets
- Most tributary particulate are fibers and paint chips



- Local beaches do accumulate pre-production pellets
- Highest loads at Plattsburgh City Beach and Ausable Point
- Pellet distributions are higher near the dunes than wrack line
- Pellets are primarily polyethylene and polypropylene

Future Directions/Broader Impacts

- Adjust methods to capture perpendicular pellet distribution on beaches
- Density separation of particulate <1.18mm will be performed on 50g of homogenized sand samples per beach survey bout
- Our findings will help inform regional industries, landowners, recreationalists, and offer guidance for future infrastructure projects (*e.g.*, road repair, bridge sandblasting) on ways to reduce pre-production plastic entering into Lake Champlain

Acknowledgements

Many thanks to the Lake Champlain Basin Program for funding this research. Special thanks to our UVM collaborators Nurjahan Begum, Andrea Stumpf, Arden Degrenier, and Dr. Anne Jefferson.