PlastiX-Snow: A Citizen Science Project to Identify Microplastics in Snow

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Abstract

Microplastics have become ubiquitous in all reaches of the world. Due to their small size, low density, and environmental persistence, they are transported throughout the Earth's system. Despite its importance, little is known about microplastic transport and deposition, especially by snow particles, and most people are not aware of the extent of the problem. The PlastiX-Snow Citizen Science Project aims to fill these research and informational gaps using crowd-sourcing to achieve scientific research outputs, educational programming, and active outreach and engagement. We will initially measure the spatial distribution of snow deposited microplastics throughout a region in New York State and expand nationally using community partners. As trained partners, the Snow Ambassadors will inform the local community about microplastics, recruit participants, and assist in leading trainings. As nodes of the project, they will expand the reach to a large demographic of people across the country, including both life-long learners and school groups. Citizen scientists will collect, examine, and report the snow-deposited microplastics in their own backyard. The PlastiX-Snow team also will collect snowmelt samples from participants to robustly analyze the microplastics at Lamont-Doherty Earth Observatory. According to a National Academy of Sciences, a primary concern regarding citizen science projects is the lack of engagement and feedback to the participants of the program's findings. We specifically address these challenges by actively and continually engaging our participants and partners through direct and virtual public programming, classroom visits, media, newsletters, and an interactive website. PlastiX-Snow goals are to 1. Collect data for a deeper understanding of microplastics disseminated by snow, 2. Teach the public about the dangers of microplastics and potential solutions, 3. Engage communities, students, educators, and the public to participate in groundbreaking, relevant scientific research. We aim to shed light on the severity of microplastic pollution, build a bridge between the public and the scientific community, connect citizen scientists to their natural environment through field work, and encourage them to serve as environmental stewards and leaders in their own communities.

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Abstract

Microplastics have become ubiquitous in all reaches of the world. Despite its importance, little is known about microplastic transport and deposition, especially by snow particles, and most people are not made aware of the extent of the problem. The PlastiX-Snow Citizen Science Project aims to fill these research and informational gaps by using crowd-sourcing to achieve scientific research outputs, educational programming, and active outreach and engagement. The project measures the spatial distribution of microplastics across the United States, prioritizing the engagement of a large demographic of people across the country. Both life-long learners and school groups are encouraged to participate. The goals of PlastiX-Snow are to 1. Collect data for a deeper understanding of microplastics disseminated by snow, 2. Teach the public about the dangers of microplastics and share potential solutions, 3. Engage communities, students, educators, and the public to participate in groundbreaking, relevant scientific research.

Background

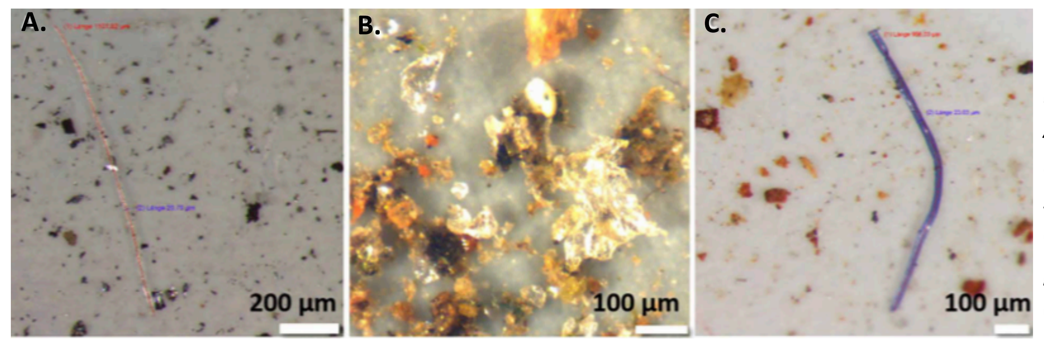

Figure 1: Photographs of MPs detected in snow
A. Polystyrene fiber from Svalbard 4 (length, 1101 µm)
B. Polypropylene particle from Heligoland (diameter, 256 µm)
C. Polyvinyl chloride fiber from Ice Floe 8 (length, 956 µm)
(Bergmann et al., 2019)

Microplastics (MPs) are a widely observed form of plastic pollution ranging in size from 1 micron to 5 mm (Da Costa et al., 2016; Hartmann et al., 2016). Due to their small size, low density, resistance to degradation, and environmental persistence (Song et al., 2017; Da Costa, 2018), MPs can be readily transported by ocean currents, wind, rain, and snow. However, there is very little specific information known about MP transport and deposition, especially through snow (Allen et al., 2019). The potential impacts of snow deposited MPs are grave. Snow could be a significant vector of conveyance for MPs to remote areas of the world. Additionally, MPs trapped in snow & ice can be carried into local waterways, groundwater and aquifers, the soil, the ocean and the air once the snow melts.

The PlastiX-Snow Citizen Science Project strategically uses crowdsourcing to create an expansive data set to strengthen scientific understanding of MP conveyance. The PlastiX-Snow participants will be contributing toward authentic scientific research while learning about the sources, dangers, and preventions of MP pollution through active and continual engagement.

Project Goals

Scientific Goals:

1. Collect data about MPs transported by snow (abundance, physical type, chemical composition)
2. Compare the spatial distribution of snow deposited MPs throughout the United States: MP abundance/types in rural vs. urban areas
3. Ultimately, strengthen the scientific understanding of MP conveyance.

Education Goals:

1. Educate participants about the source and dangers of MP pollution
2. Develop professional skills and enhance scientific literacy among the participants
3. Build a community of passionate students, formal and informal educators, and life long learners that participate in PlastiX-Snow
4. Foster a connection between the public and the natural world to create a greater environmental conscious society
5. Encourage the PlastiX-Snow participants to be environmental stewards by making sustainable, daily choices and to be the leaders in their communities

Methods

Methodology of implementing a nation-wide citizen science project:

- **Partner with Snow Ambassadors** (i.e. environmental centers, K-12 schools, universities, etc.) across the country to assist in disseminating information about MPs, recruiting citizen scientists, and hosting training workshops.
- **Recruit Snow Stewards:** citizen scientists, school groups, formal/informal educators, and the public.
- **In-Person/virtual training sessions and classroom visits** to discuss the chemical and physical properties of plastics, the various types, sources and transport of MPs, and the environmental impacts and health implications of MP pollution.
- **Active and continual engagement** throughout the year with updates and program's findings.

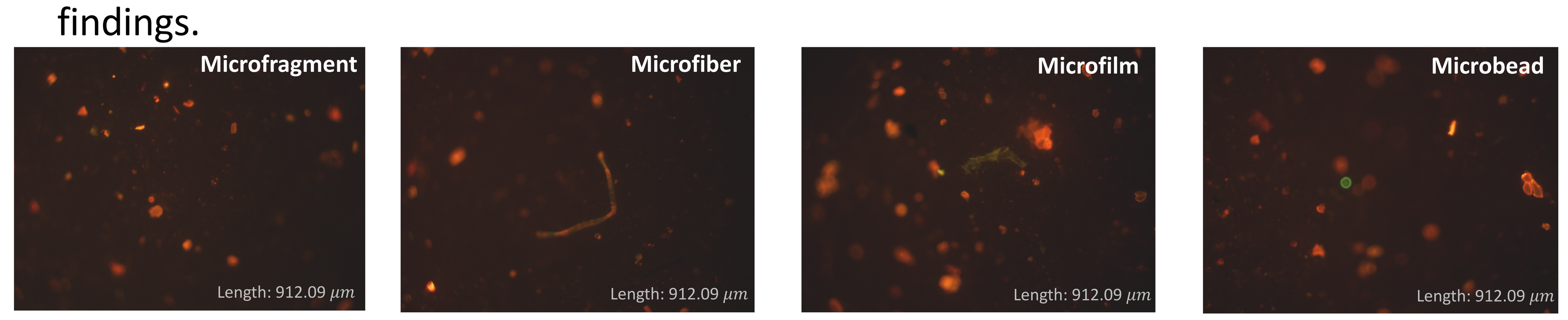

***Figure 2:** Aspen, Colorado snowmelt samples found 4 types of MPs*

Citizen Science methodology of MP detection in snow:

- **Snow collectors** designed to collect snowfall and prevent wind drive MP contamination
- **Filter syringe** to isolate MP from snowmelt
- **NightSea fluorescing light with filter** to illuminate the MP
- **USB microscope** to observe, quantify, and photograph the MPs via computer/phone and send to the PlastiX-Snow team
- **Glass vial** to send pure snowmelt samples to Lamont for further analysis using Nile Red Staining technique and FT-IR spectroscopy

Discussion

Project Benefits for Scientists

- **Crowdsourcing** allows for a large spatial, long term data set
- **Deeper scientific understanding** of microplastic conveyance
- Encourage participants to become **environmental stewards and community leaders**

Project Benefits for Snow Stewards

- **Knowledge capital-** Learn about microplastics from experts
- **Connectivity-** Join a nationwide group of citizen scientists and the scientific community
- **Training and Technology**- Learn methods and techniques to identify MPs
- **Contribute to a data set** that has immediate relevance and meaning to their lives

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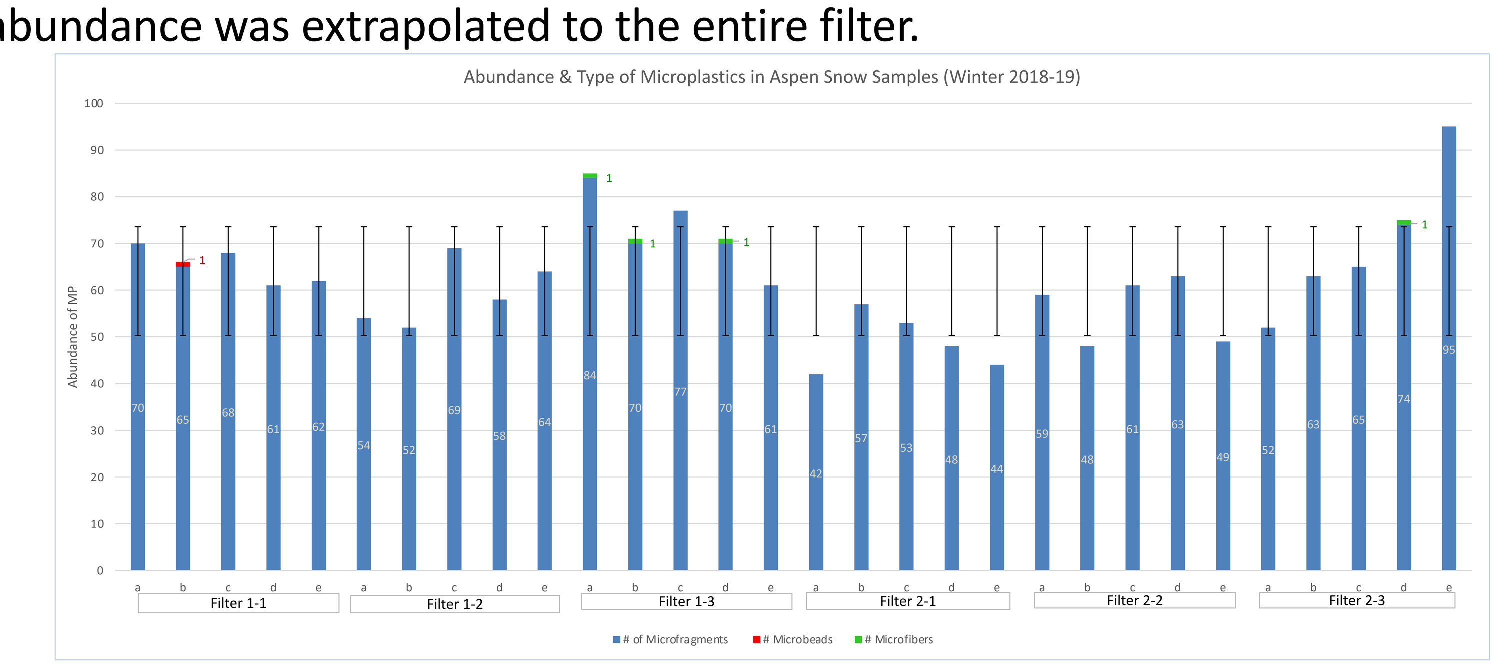
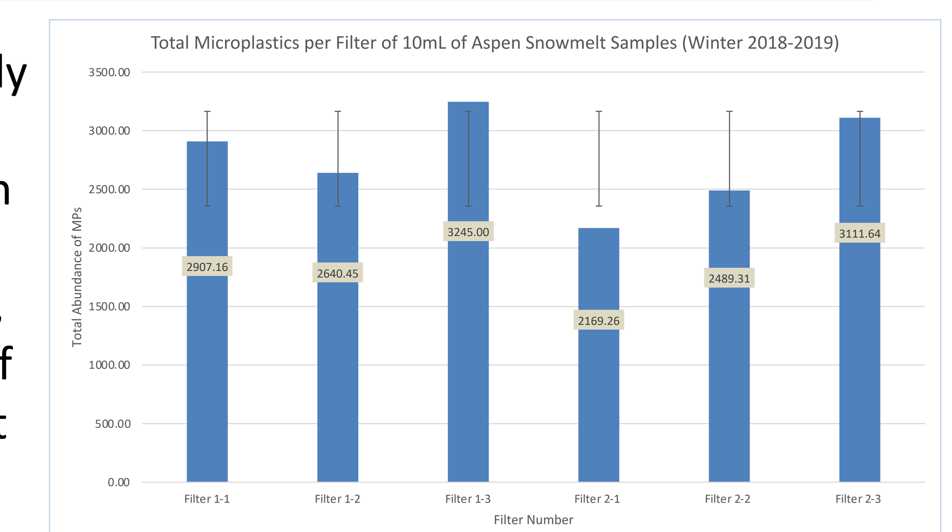
Preliminary Results

Snow Stewards sent two snowmelt samples (~1.8 L each) from Aspen, Colorado from the 2018-2019 winter season. Each snowmelt sample was broken into 3 subsets of 10mL per filter (6 total samples). After the Nile Red staining technique, we found each filter was highly concentrated with MP particles. Therefore, 5 randomized quadrats per filter were assessed and MP abundance was extrapolated to the entire filter.



The MP abundance was relatively comparable across the samples, ranging from ~2169-3245 MPs in 10 mL of snowmelt. While microfragments were dominant, we identified 4 different types of MPs throughout the 2 snowmelt samples (fig. 2).



The snow sample was shoveled from the ground so we cannot determine the direct source of the MPs. While the sample is not freshly fallen snow, this provides us with a preliminary look at the relative abundance of MPs in snow.

Next Steps

- Secure funding for the full implementation of the project
- Focus on initially engaging and collecting data in our local New York State community
- Recruit and train 'Snow Ambassadors' and 'Snow Stewards' to join the PlastiX-Snow team

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