Microplastics in urban streams of the Northeast Region

A pilot study to assess conditions across USGS water-quality networks

National Water Quality Monitoring Council

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U.S. Geological Survey

New York Water Science Center—Coram

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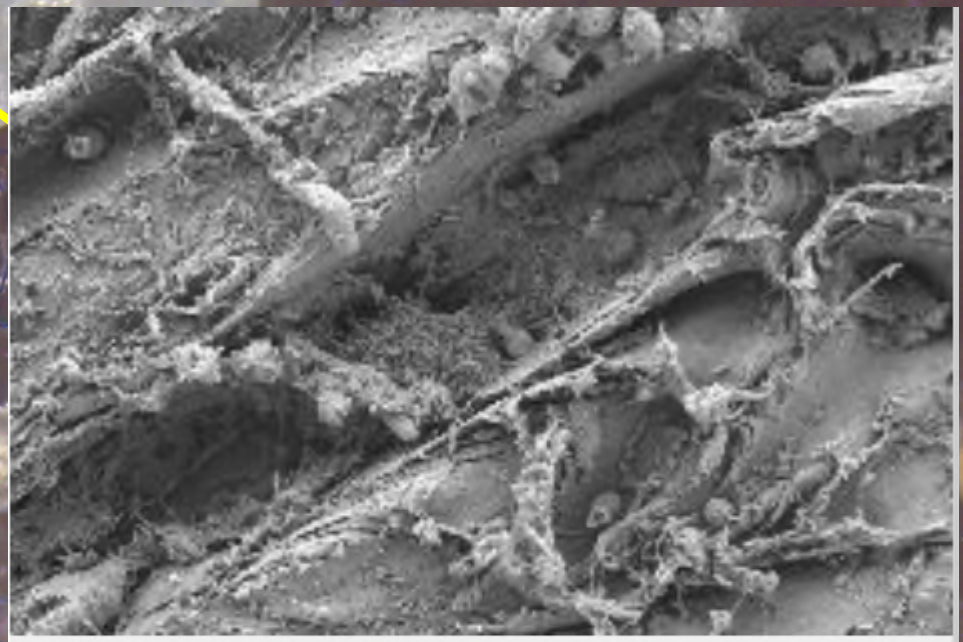
Microplastics

- Where do they come from?
  - Breakdown of plastic litter (foam, bottles, balloons)
  - Introduced through runoff from streets (cigarette butts)
  - Discharge from wastewater treatment plants and residential washing machines/dryers
  - Atmospheric deposition

- Why are they important?
  - They are small–defined as < 5 mm
  - Found in most natural surface waters
  - Can sorb and transport contaminants
  - Are being ingested by fish and shellfish
  - Routes of human exposure include shellfish consumption, inhalation (fibers), and various drinking water supplies



Electron microscopy reveals the inhabitants of a plastic bag fished from the Sargasso Sea.

T. Mincer/G. Proskurowski

Tangle of fibers

plant material

Photo: Sherri Mason, University of Fredonia

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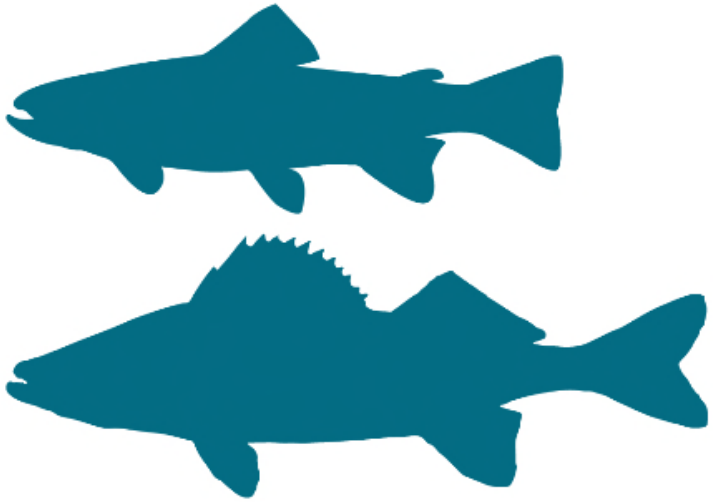
Studies have found particles in

12%

of **freshwater fish**[1]



50

particles per serving of commercially-cultured **oysters**

90

particles per serving of commercially-cultured **mussels**[2]

https://owi.usgs.gov/vizlab/microplastics/

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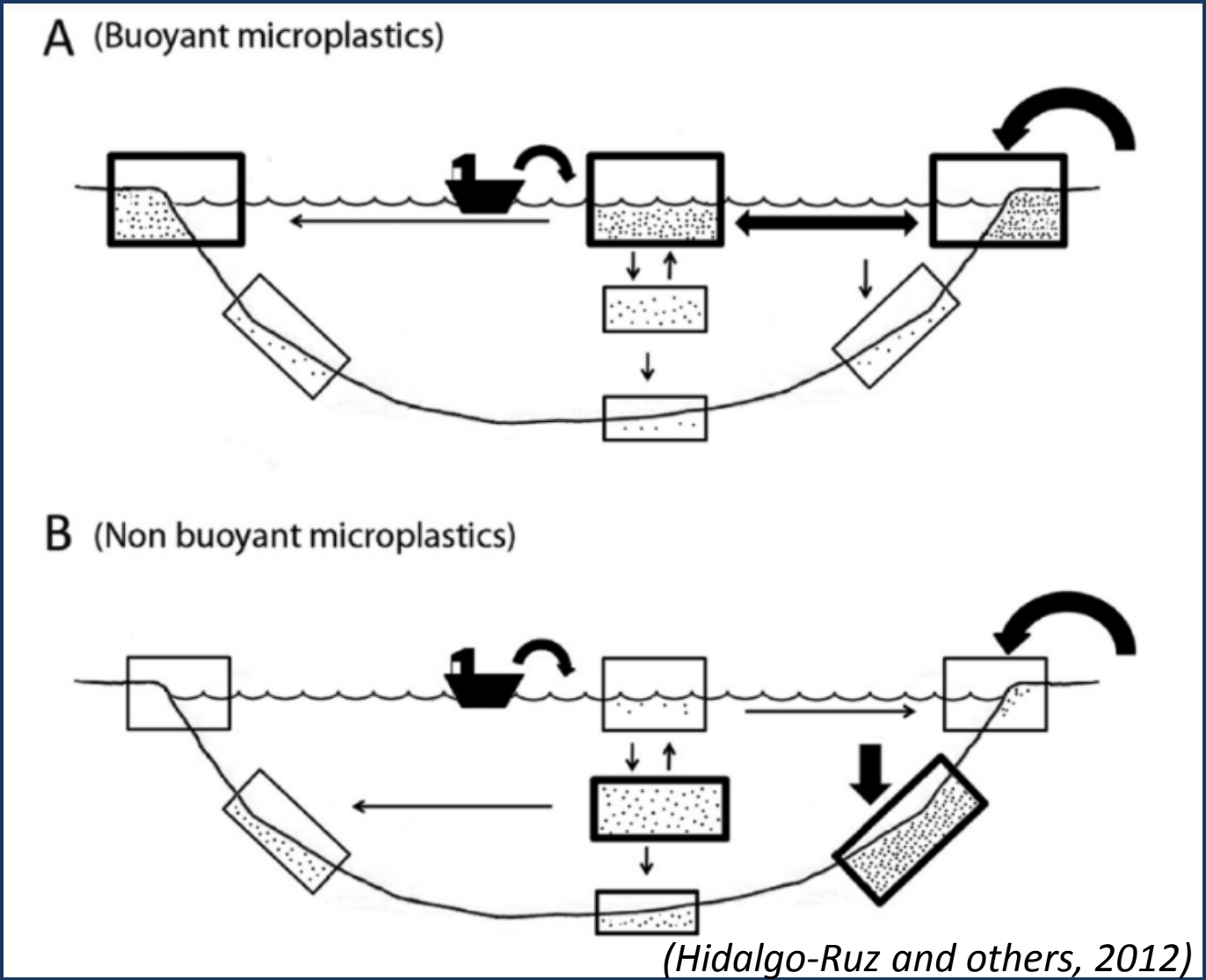
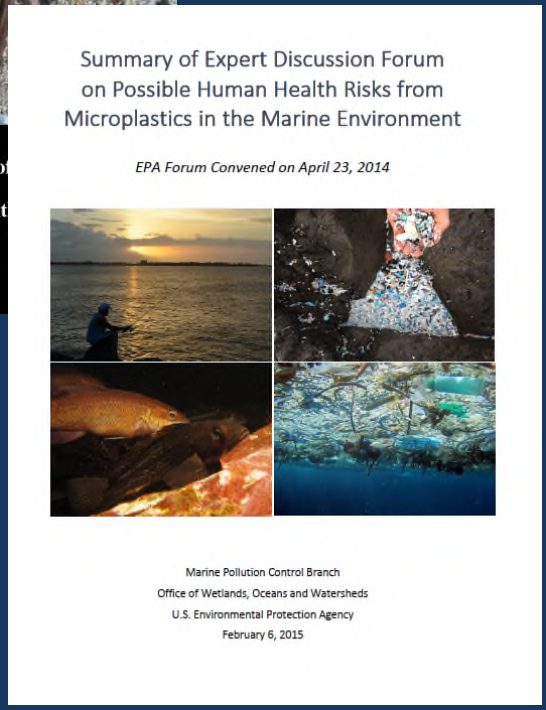
Microplastics characteristics



(Hidalgo-Ruz and others, 2012)

Who cares about microplastics?

- International – recent G20 report
- NOAA – Marine Debris Program
- EPA – Trash Free Waters
- USGS – Cooperative studies ongoing
- NPS – Studies on Park lands ongoing
- States, Tribes, local governments, and academics



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BACKGROUND

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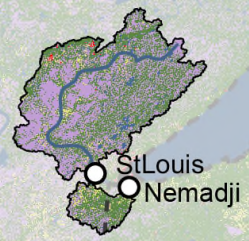
GLRI Study 2014

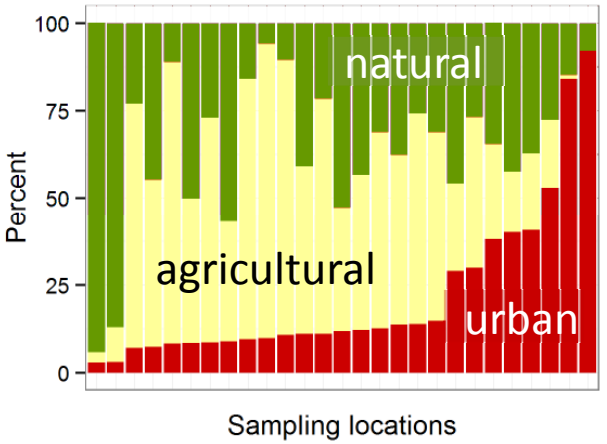
29 tributaries

~22% of total inflow to the Great Lakes

Range of land uses

4 samples/site (2 baseflow, 2 stormflow)





Fox
Manitowoc
Sheboygan
MilwaukeeMouth
Saginaw
GrandMI
Kalamazoo
PawPaw
StJoseph
Burns
IndianaHC
Clinton
Rouge
HuronMI
Raisin
Maumee
Portage
Sandusky
HuronOH
Ashtabula
GrandOH
BlackOH
Cuyahoga
Rocky
Genesee
Tonawanda
Buffalo

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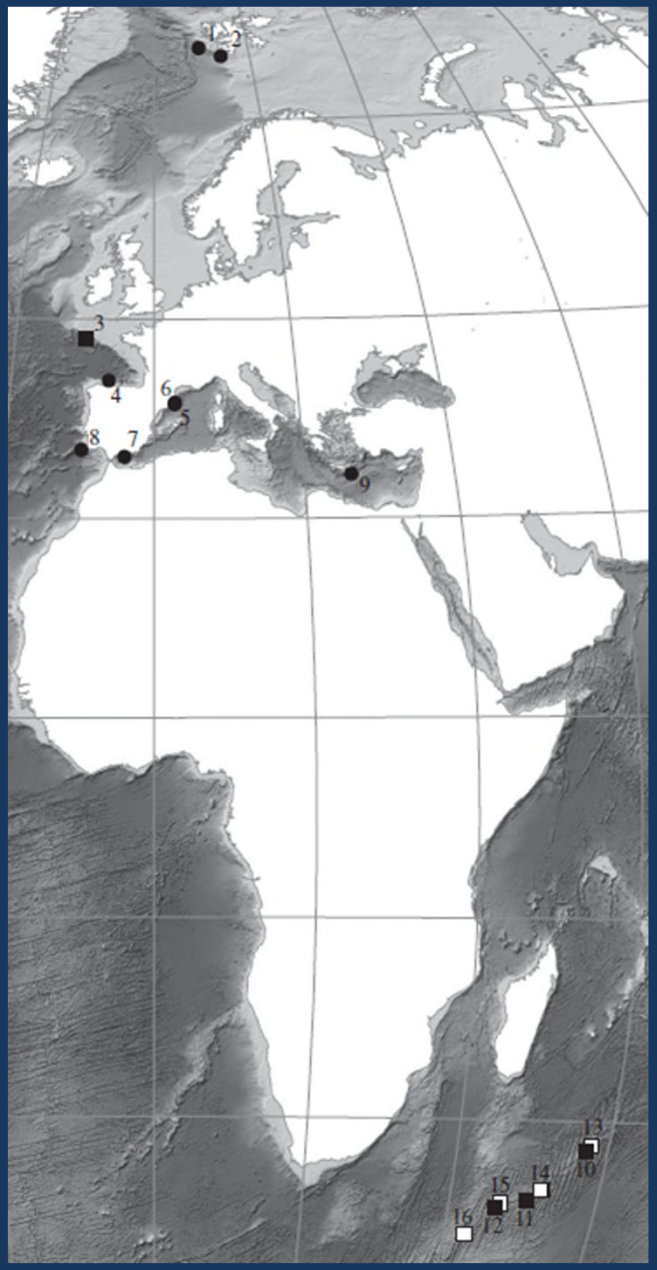
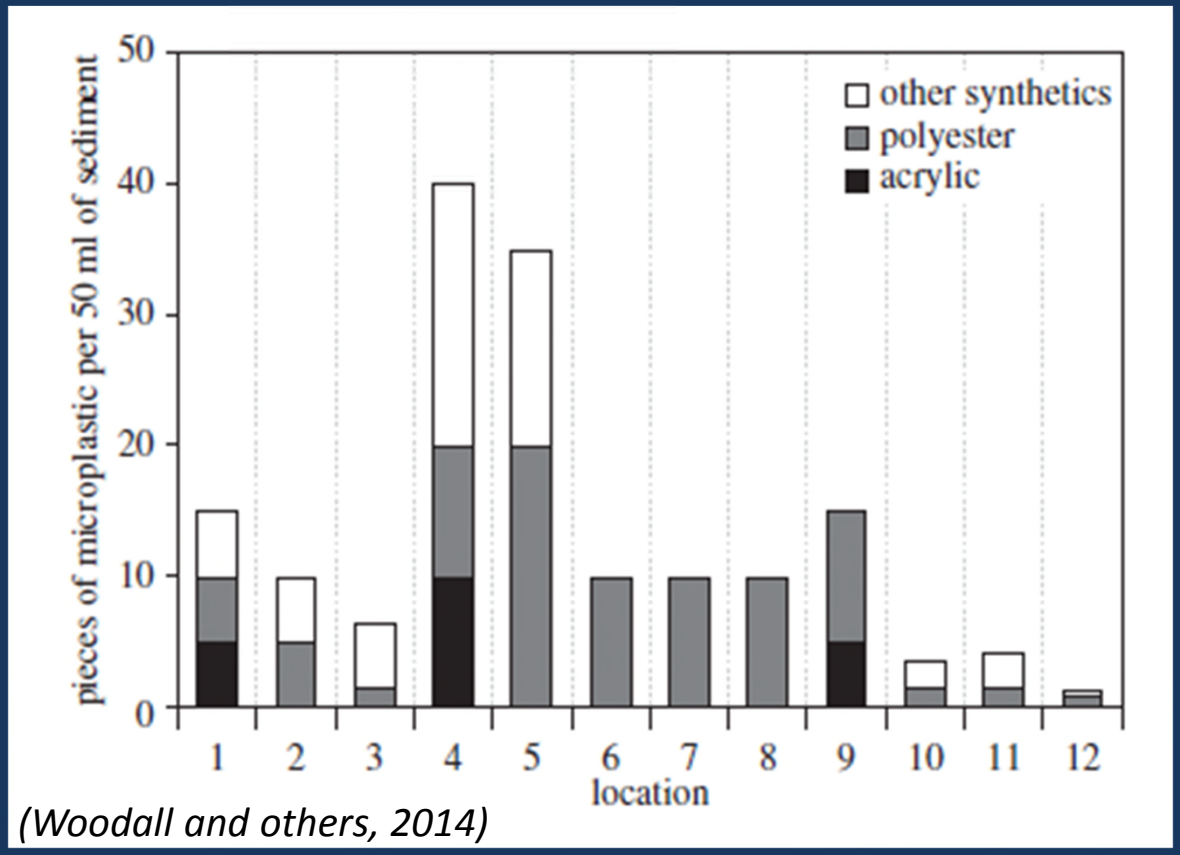
FREDONIA STATE UNIVERSITY OF NEW YORK



Fibers in deep-sea sediment



(Woodall and others, 2014)

- Concentrations in sediment 4 orders of magnitude greater than at ocean surface
- Average of 13 fibers/50 mL sediment

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Chesapeake Bay

Marine Debris Program OFFICE OF RESPONSE AND RESTORATION

ABOUT US | DISCOVER THE ISSUE | CURRENT EFFORTS | IN YOUR REGION | RESOURCES | MULTIM

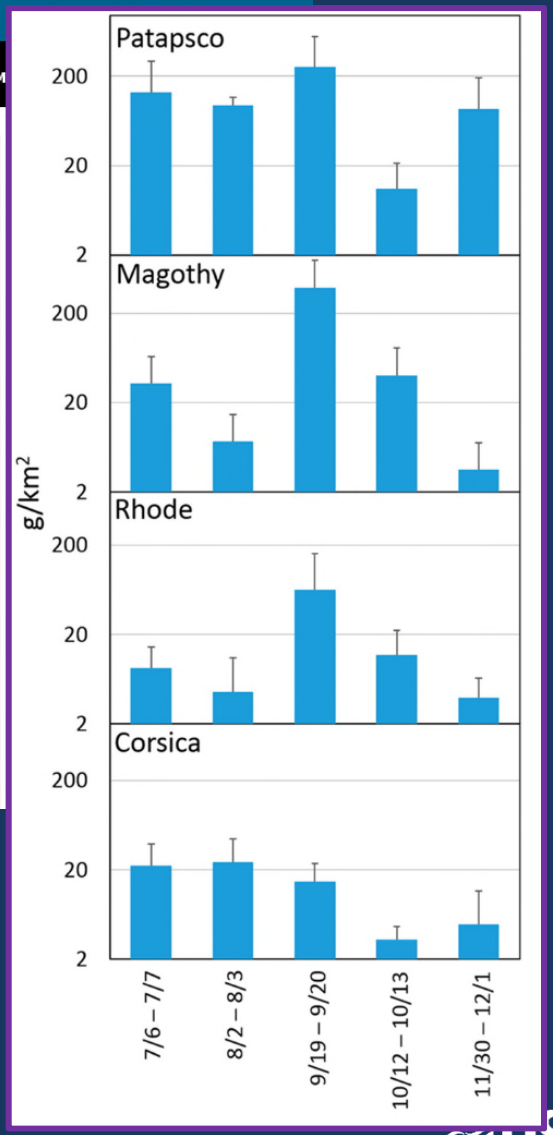
Home › Current Efforts › Research › Analysis of Microplastics in Chesapeake Bay and Coastal Mid-Atlantic Water Samples

Analysis of Microplastics in Chesapeake Bay and Coastal Mid-Atlantic Water Samples

Microplastics sample from the Rhode River. (Photo Credit: Will Parson, courtesy of the Chesapeake Bay Program)

The University of Maryland's Wye Research and Education Center Aquatic Toxicology Group, by request of the NOAA Marine Debris Program, analyzed archived surface-water samples from four Chesapeake Bay tributaries for microplastic debris. The project found that microplastic concentrations increased near urban areas and peaked after major rains, providing important baseline data for the area and supporting the prioritization of upstream prevention efforts in urban locations.

Project Dates: April 2012 - June 2013



- Microplastic studies in Chesapeake Bay and its tributaries appear limited
- A Technical Review was generated for Chesapeake Bay (Wardrop and others, 2016: STAC Pub. 16-002, 27 pp.)

(Yonkos and others, 2014, ES&T v. 48 [24], p. 14195-14202)

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REGIONAL ASSESSMENT

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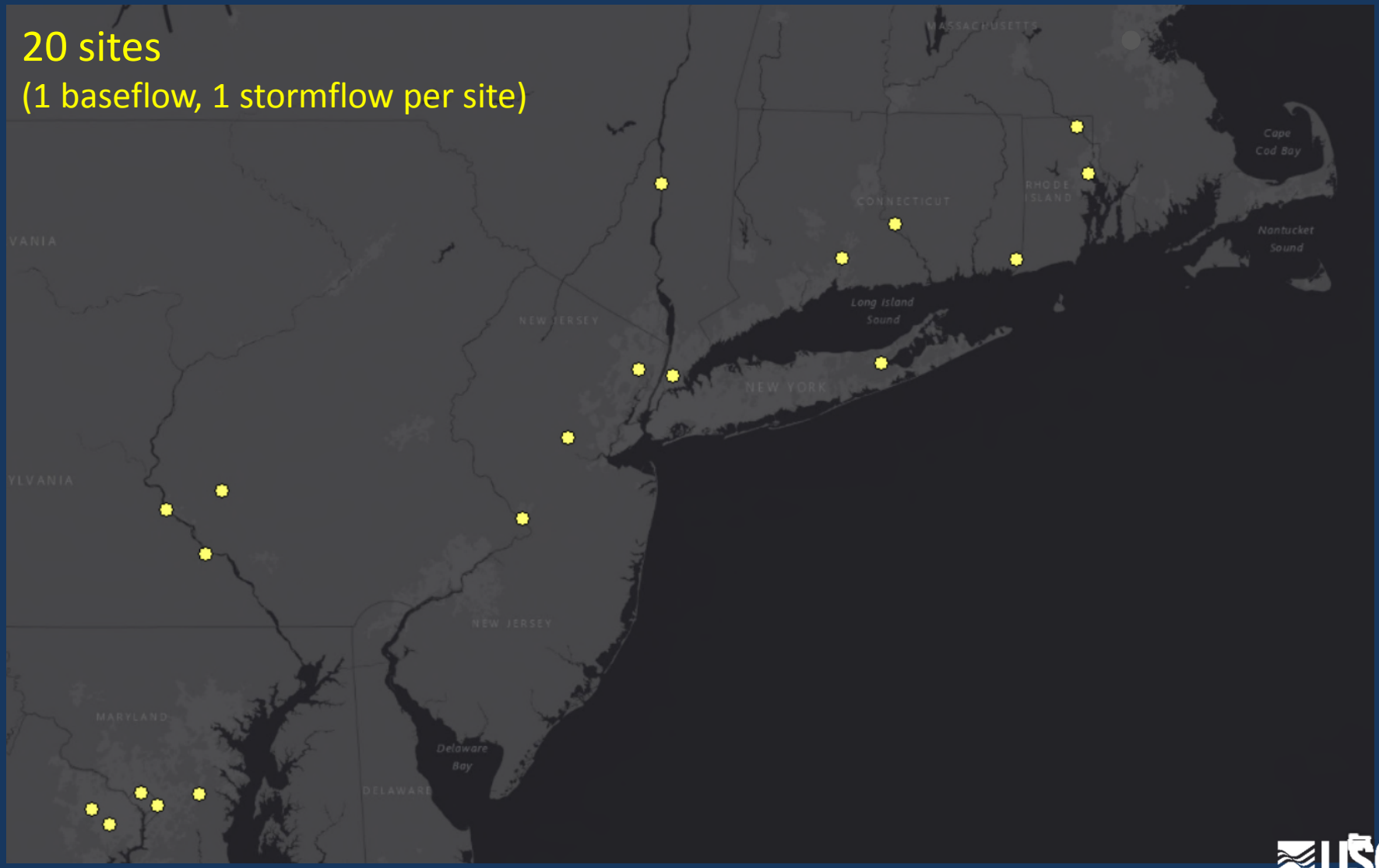
Study objectives

- Assess a variety of urban streams for microplastics under storm and non-storm conditions
- Leverage existing projects collecting water-quality data
- Develop broader USGS capabilities within the Northeast Region for microplastics assessment
- Engage local cooperators and stakeholders by sharing results and providing context

Microplastics in the urban environment—Northeast Region

2017-19



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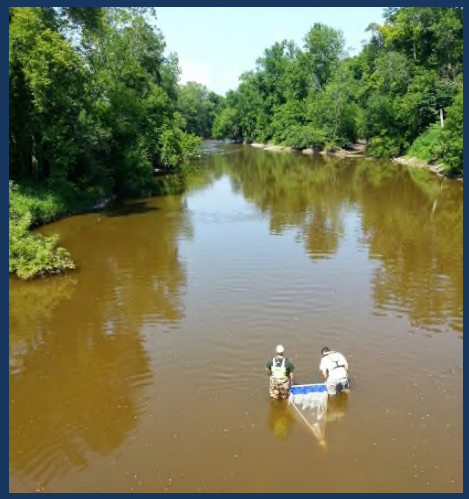
Sample collection



Images provided by Austin Baldwin, USGS IDWSC

Sample processing

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Images provided by Austin Baldwin, USGS IDWSC

Samples for analysis

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Images provided by Austin Baldwin, USGS IDWSC

Analytical Methods

(photos of Sherri Mason's lab at SUNY Fredonia; similar to the USGS WA microplastics lab)

Sieved into three size classes:

- 0.355-0.999 mm
- 1.00-4.749 mm
- >4.75 mm

Digestion of organic matter using wet peroxide oxidation

Floatation in salt water to separate plastic particles

Photos courtesy of Tim Hoellein

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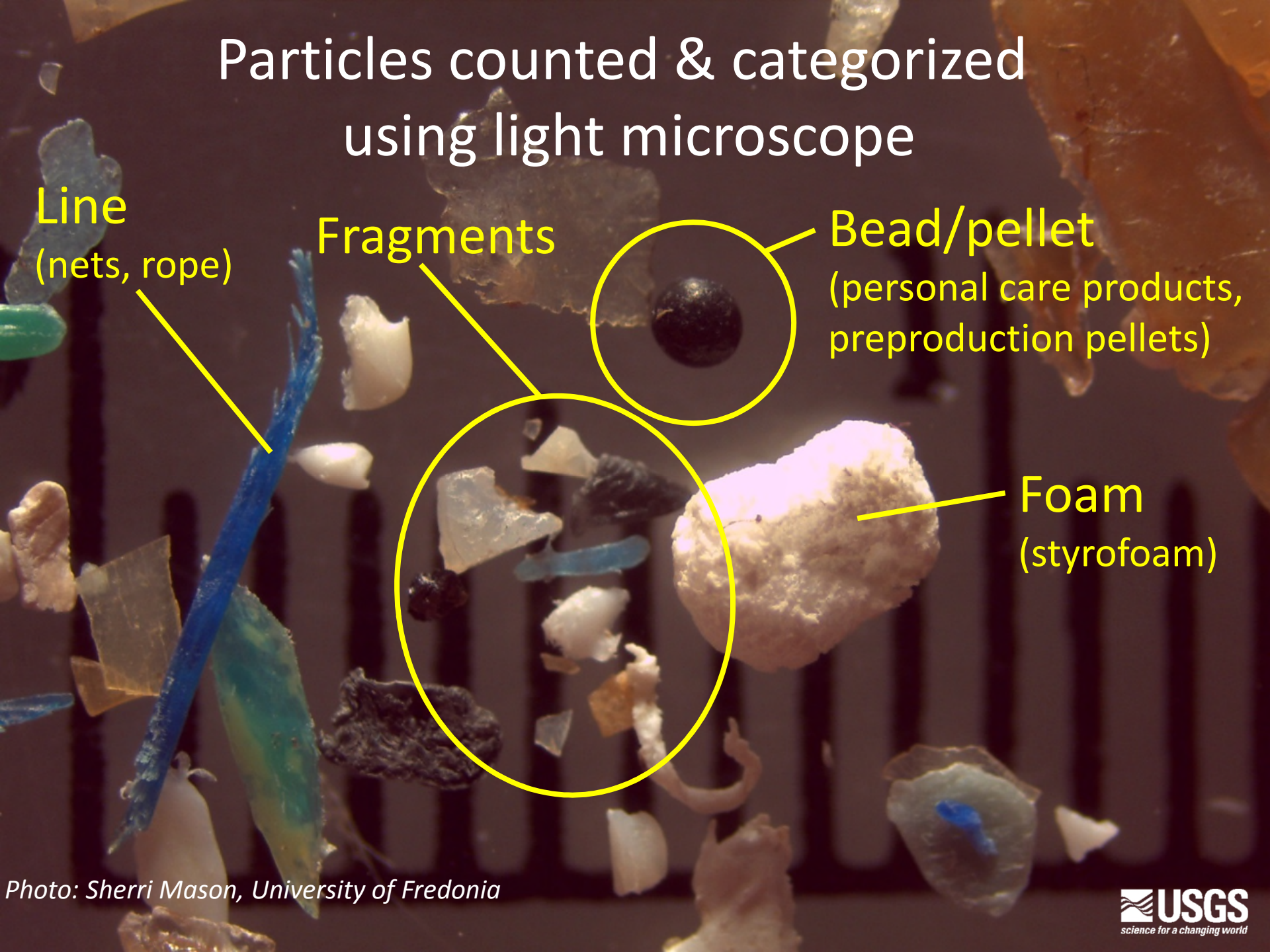
Particles counted & categorized using light microscope
Line
(nets, rope)
Fragments
Bead/pellet
(personal care products, preproduction pellets)
Foam
(styrofoam)
Photo: Sherri Mason, University of Fredonia
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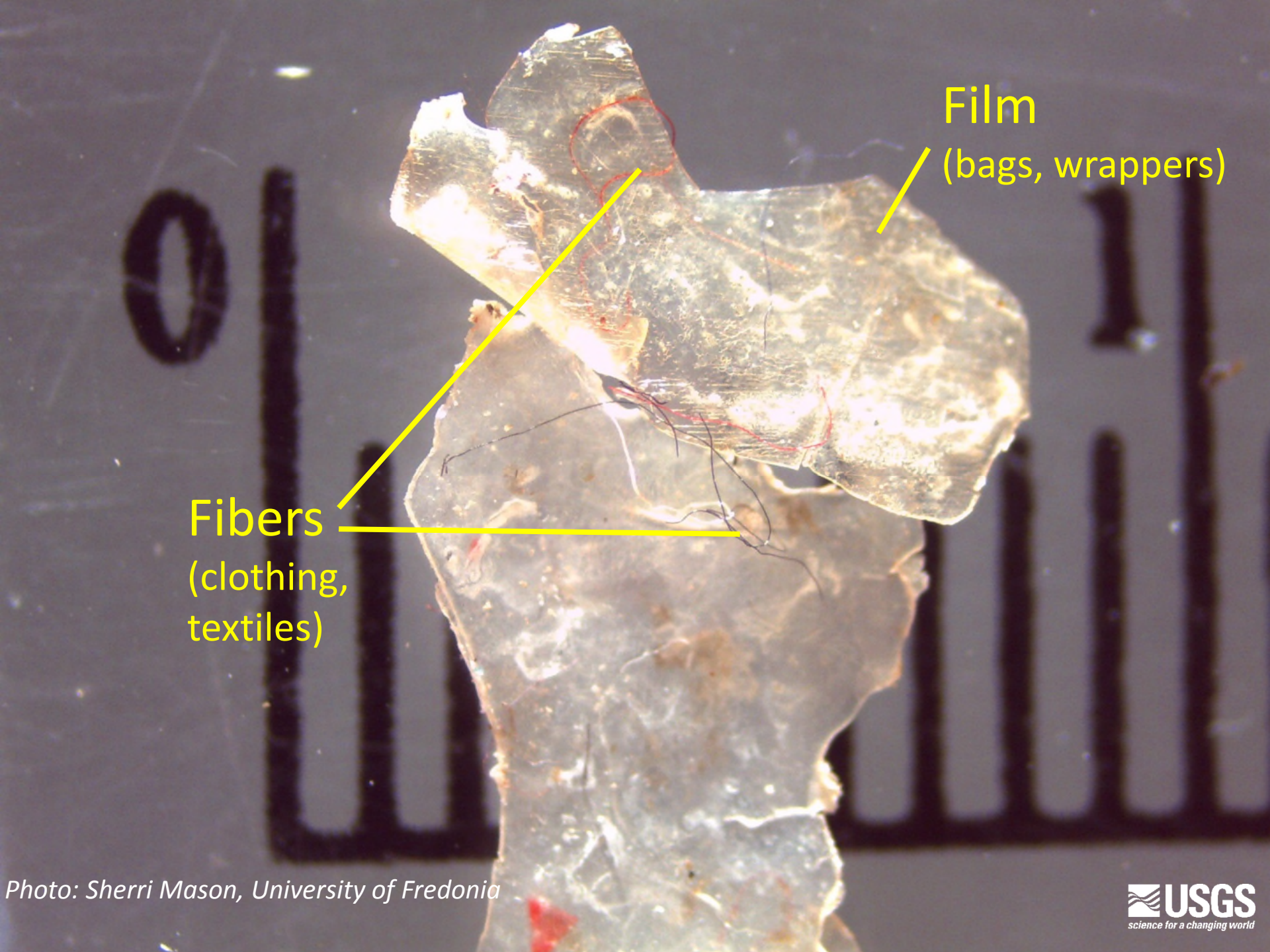

Photo: Sherri Mason, University of Fredonia

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REGIONAL ASSESSMENT —PROVISIONAL RESULTS

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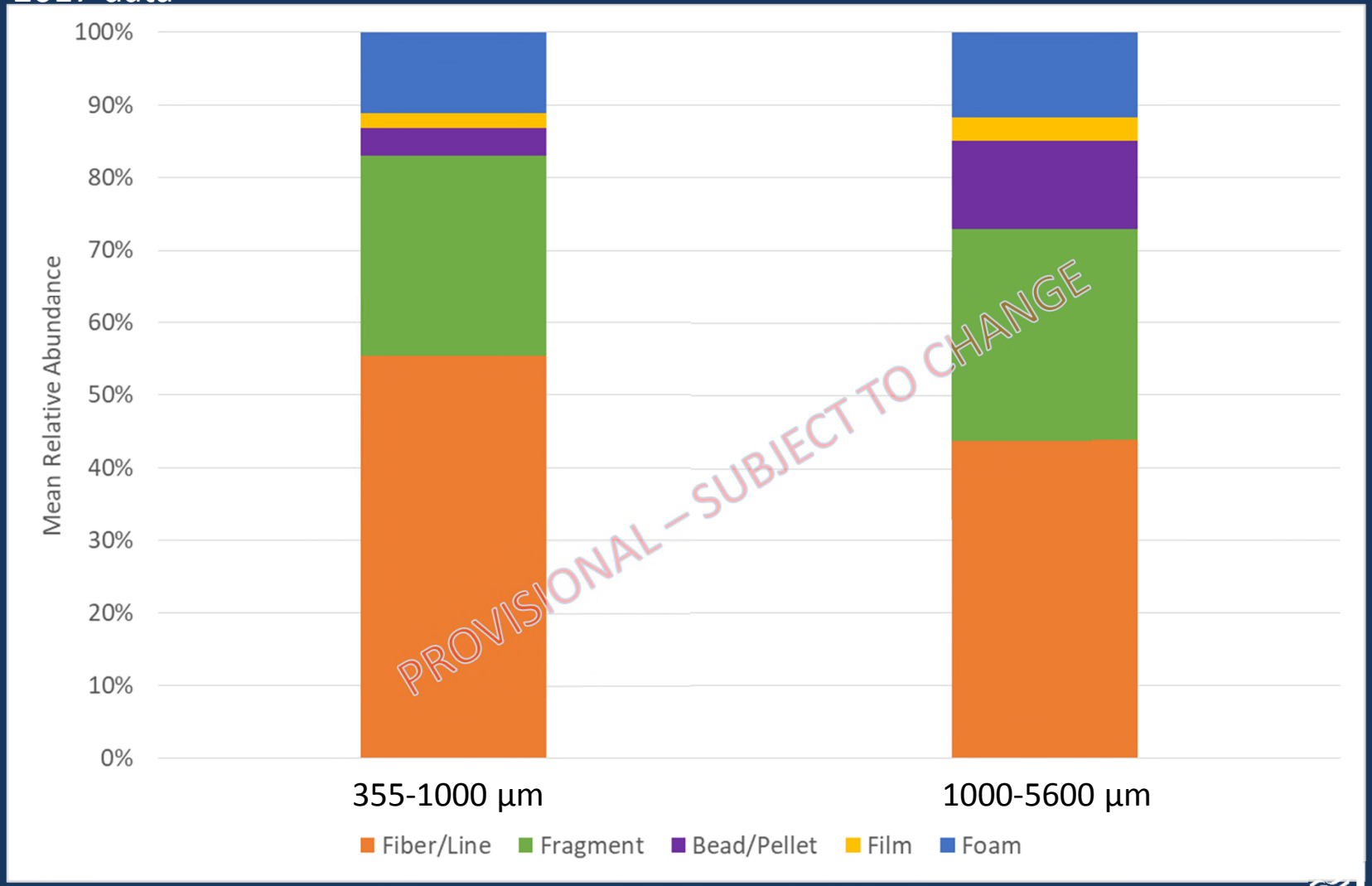
Relative Abundance

by size

2017 data



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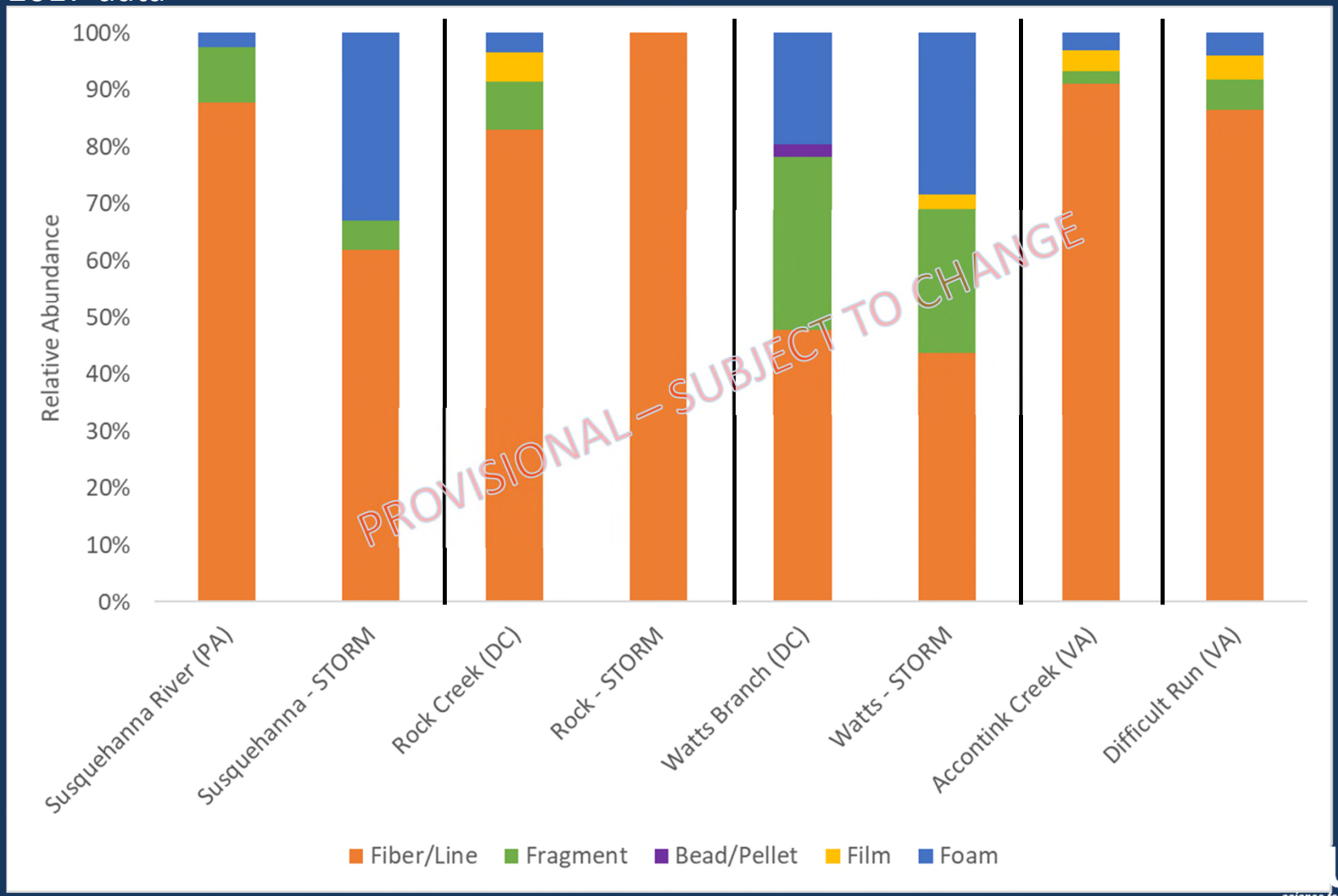
Relative Abundance

by site; condition (355-5600 µm)

2017 data



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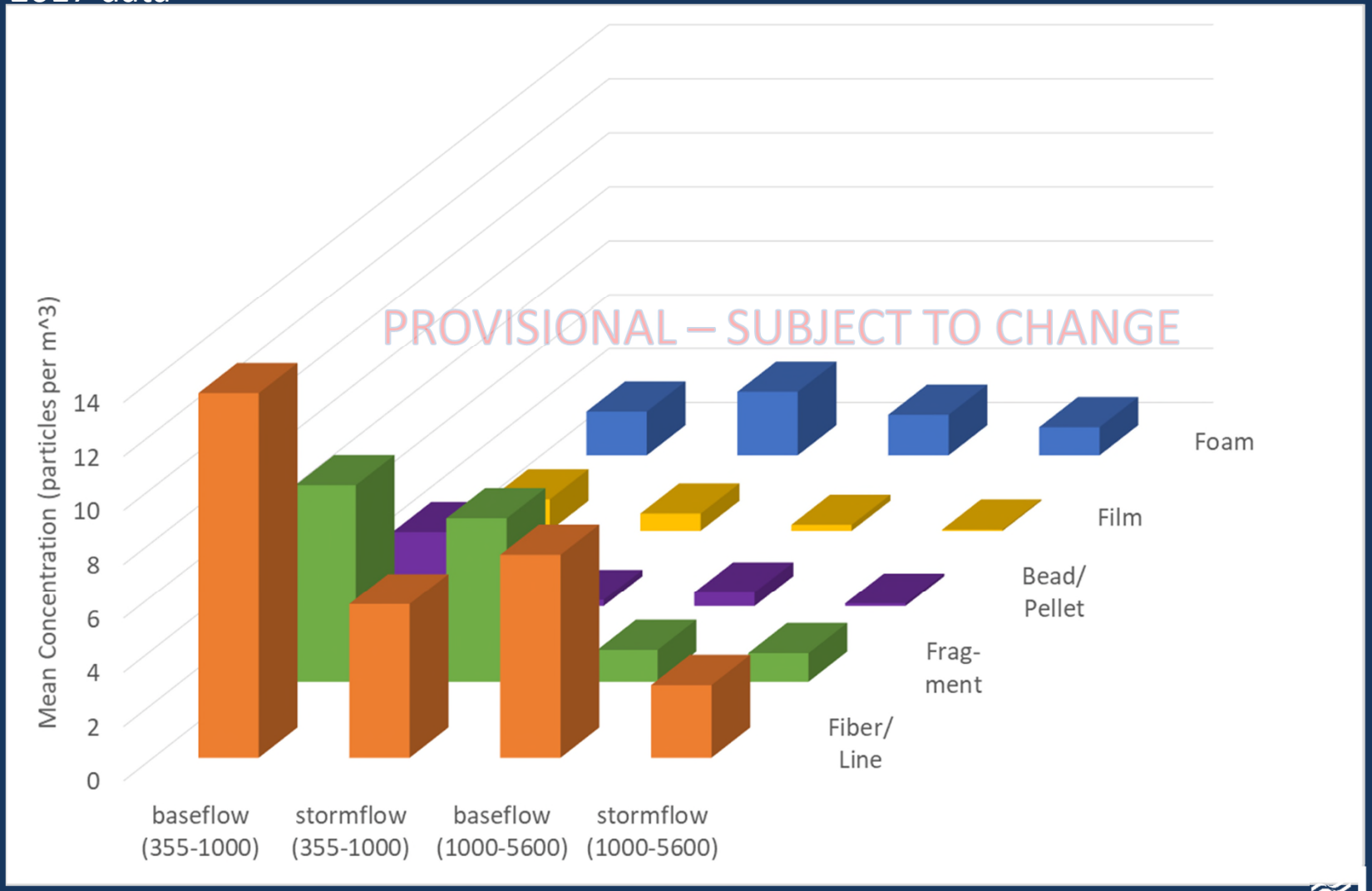
Average Concentration

by condition; size (µm)

2017 data



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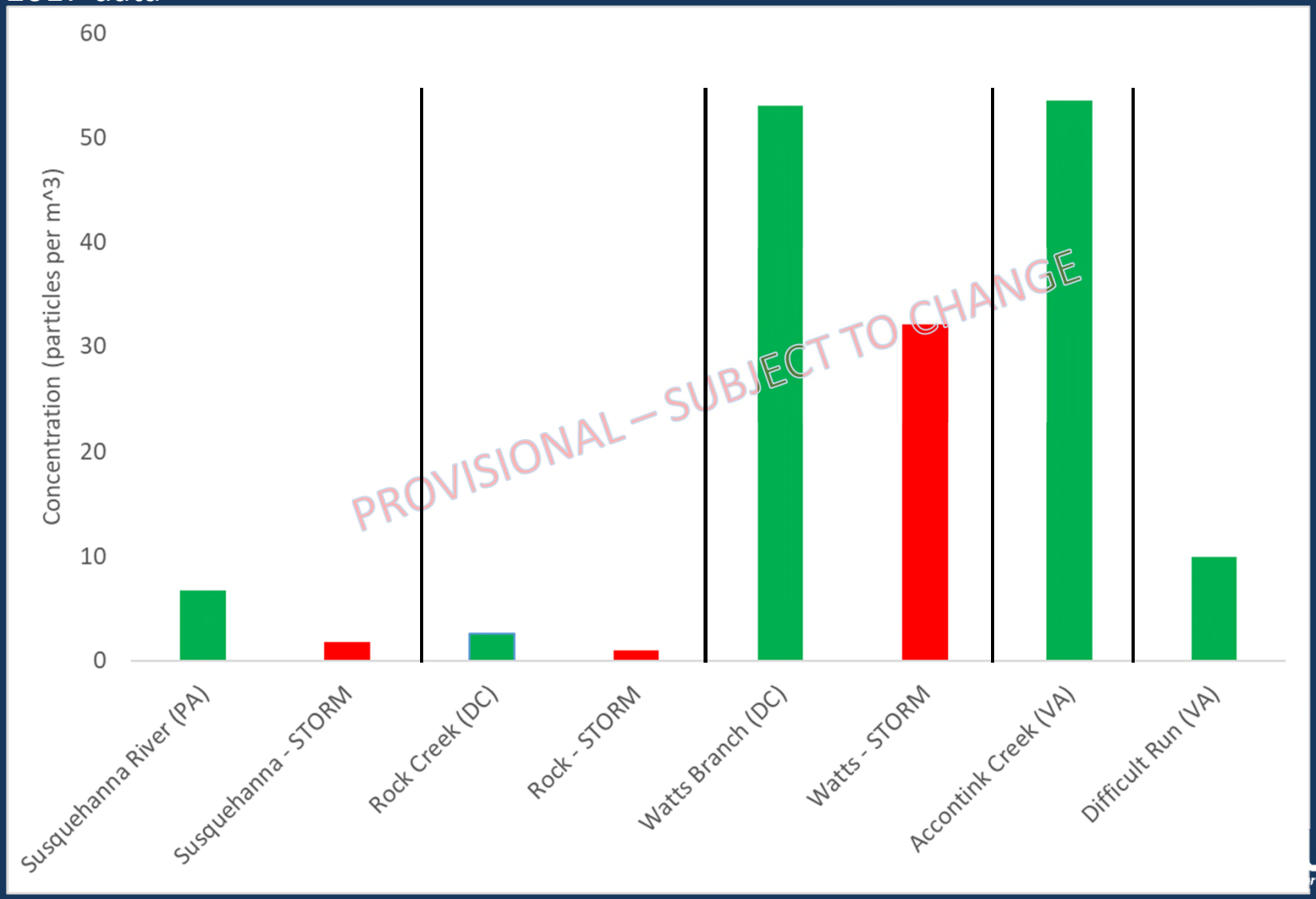
Concentration

by site; condition

2017 data



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Data Summary

- Microplastics present in every sample collected by USGS to date and could impact human and ecological health

- Relations with flow condition, land use, and wastewater effluent require additional analyses and likely additional monitoring

- Fibers dominate over other particle types in most tributaries
  - May be settling out
  - Sources beyond WWTP effluent
    - Atmospheric deposition
    - Overland sludge application

- More data are needed to better understand relative changes in microplastics concentrations during a storm

Monitoring to inform resource management

- Identify major contributors
  - STP outfalls
  - Direct discharge
  - Road runoff
  - Atmospheric deposition
- Understand impacts of BMPs designed to reduce the number of microplastics reaching environment
- Determine impact to local ecology (and economy) and food chain effects
- Classify type/size/shape/composition to better understand sources, fate, and transport

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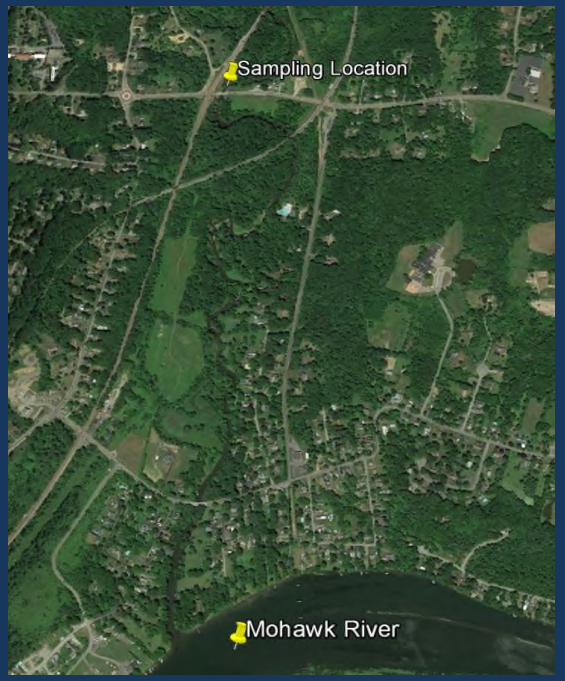
Example of program development

Mohawk River basin: Alplaus Kill, NY



Objectives

- Collaborate with a Union College study of microplastics in Mohawk River tributaries
- Collect high-frequency (every 2 weeks) data for a tributary to the Mohawk River throughout 2019
- Continue to expand sampling to monitor microplastics in New York's freshwater ecosystems

In cooperation with:

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

UNION COLLEGE FOUNDED 1795

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QUESTIONS?

Shawn Fisher – NY WSC – *Northeast Regional study* – scfisher@usgs.gov

Urban Landscapes Capability Team

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