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Which Microplastic Type Should be Considered in the Potomac River ERA?

PPAT Meeting

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Jennifer Flippin and Bob Murphy, Tetra Tech

complex world | CLEAR SOLUTIONS™

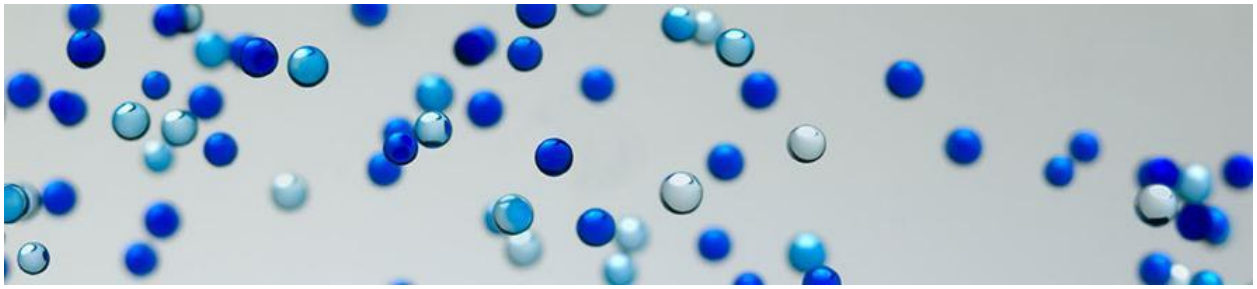
Introduction to Microplastics

- Pieces of plastic <5mm in length.
- Many types of polymers
- Some deliberately created as small pieces; others formed by degradation
- Classified by
  - Morphology
  - Size
  - Composition

Broad Categories of Microplastics

- **Primary Microplastics**
  - Deliberately manufactured as small pieces of plastic
  - Examples: Microbeads used for exfoliation in personal care products; abrasives for air blasting; pre-production plastic pellets

https://marinedebris.noaa.gov/



https://www.environment.gov.au/protection/waste-resource-recovery/plastics-and-packaging/plastic-microbeads

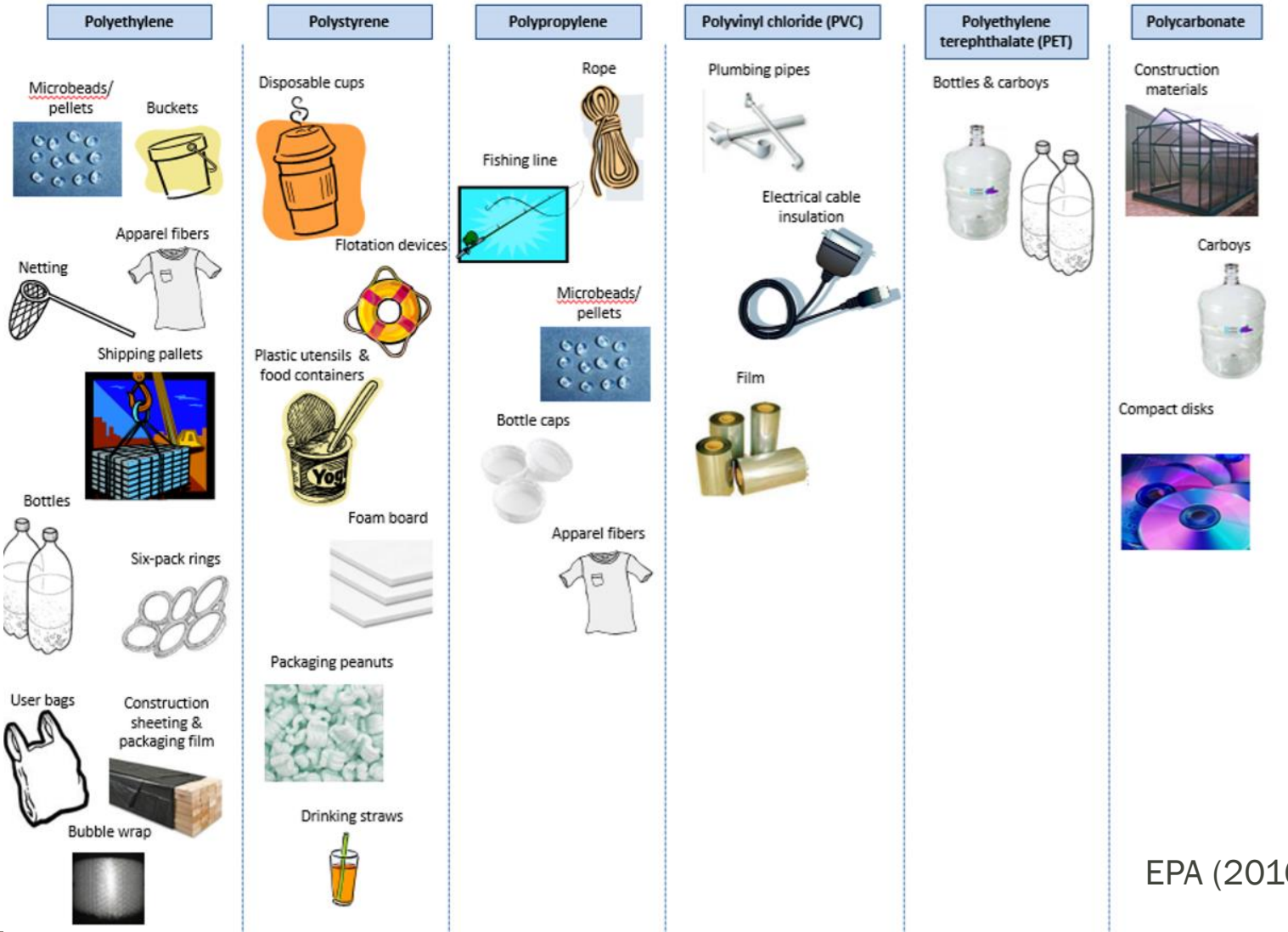
Broad Categories of Microplastics

- **Secondary Microplastics**
  - Larger plastic products broken into smaller pieces by environmental degradation
  - Examples: Pieces of plastic cups, bags, bottles.

Photo: http://blogs.ifas.ufl.edu/lakeco/2017/09/17/microplastics-whats-big-deal/

https://marinedebris.noaa.gov/

What Kinds of Polymers Commonly Make Up Microplastics?



EPA (2016)

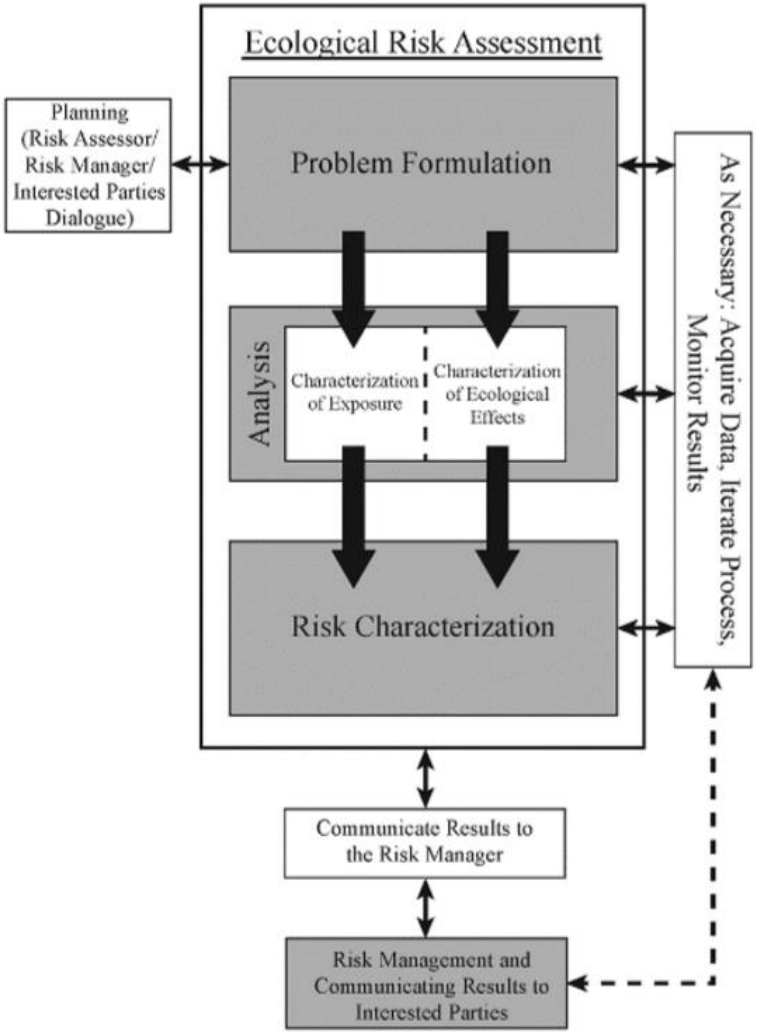
Microplastic Morphologies

- Fragment
- Film
- Fiber
- Foam
- Sphere
- Fiber bundle

Microplastic Project Tasks

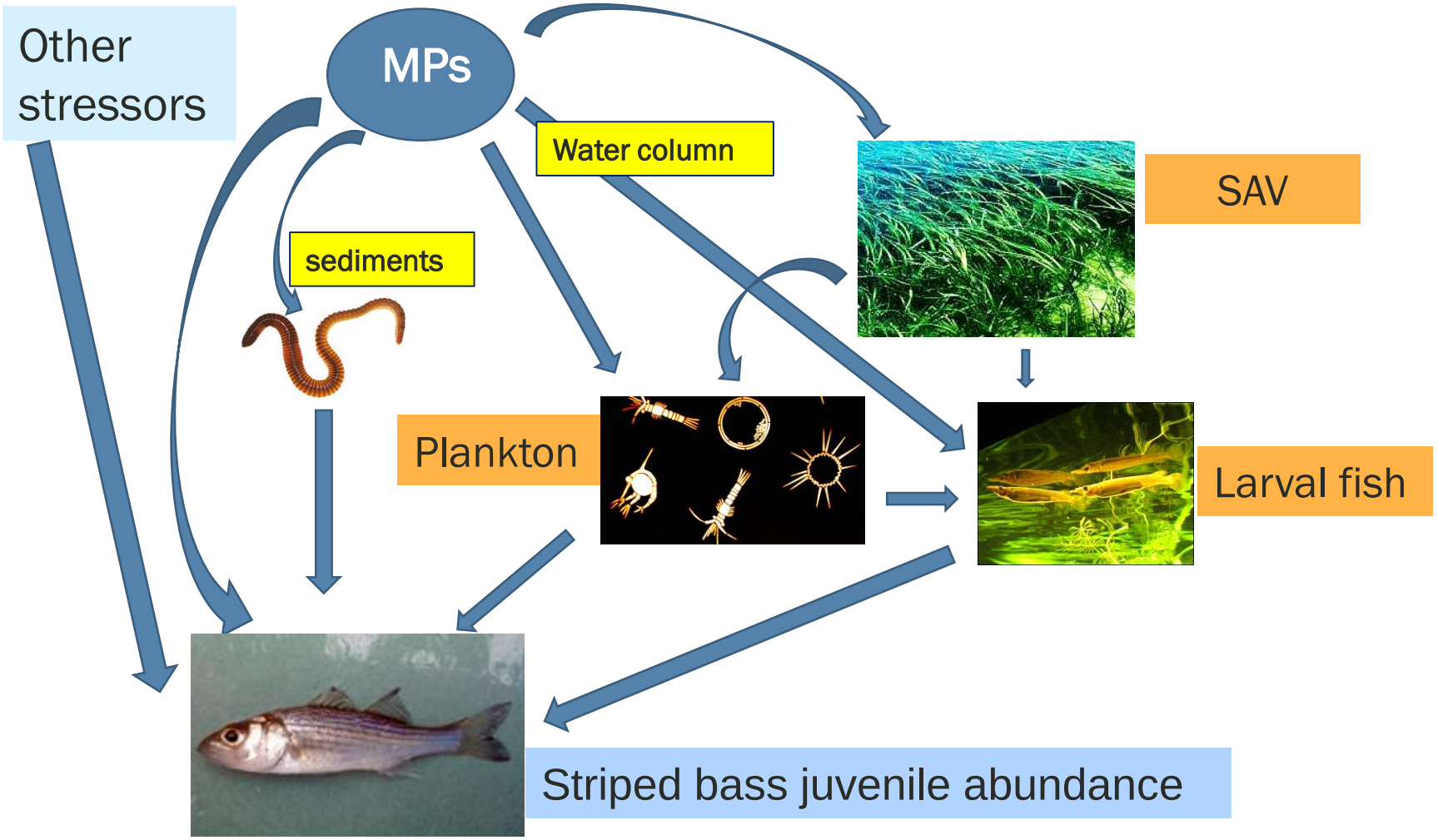
1) Develop a Uniform Size Classification and Concentration Unit Terminology to Describe Microplastics

Microplastic Project Tasks



2) Develop a Preliminary Ecological Risk Assessment Model

- Select a representative microplastic
- Sources of Microplastics
- Impacts to Ecosystem Health
- Assessment Endpoint


Other stressors
MPs
Water column
SAV
sediments
Plankton
Larval fish
Striped bass juvenile abundance

Challenges for Applying ERA Framework to Microplastics

Traditional ecorisk framework needs to be adjusted to be applicable to MPs

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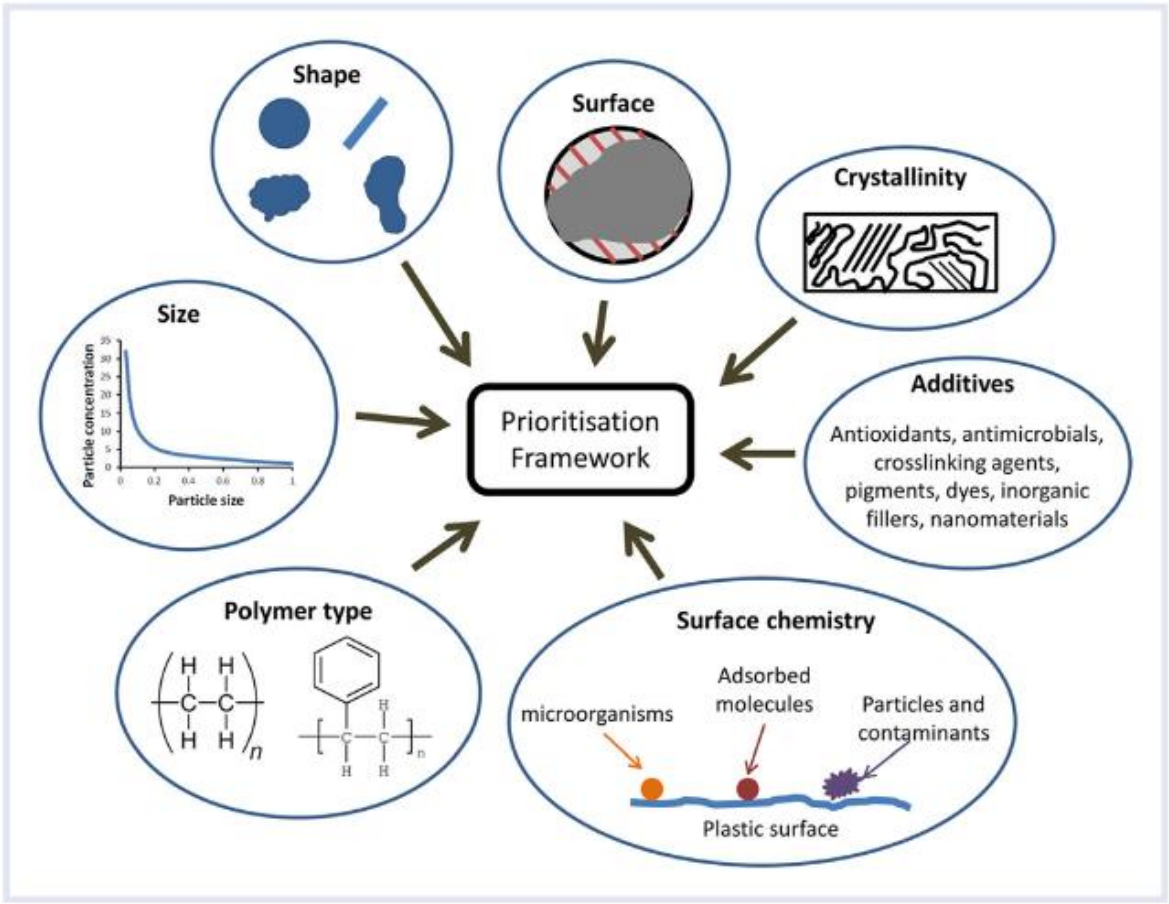
Traditional Paradigm

- Physical, chemical or biological stressor is readily quantified unambiguously
- Sources of the stressor are typically known or assumed based on BPJ
- Laboratory experiments often used to provide effects information

Microplastics

- MPs may encompass many forms, types, sizes; challenging to quantify
- Sources may be diffuse and may influence types of MPs; MPs produced intentionally (e.g., microbeads) and MPs from degradation of macroplastics
- Effects information may be specific to a site, types of MPs, etc

Physico-chemical properties of MPs can influence which type of MPs are available for uptake



Lambert et al 2017 IEAM 13: 470-475

What are some of the critical questions/unknowns?

- What is the true exposure of aquatic organisms to MPs?
- Are the size fractions of MPs usually being sampled appropriate from an ecological exposure and effects view? What is the occurrence and potential effects of MPs smaller than 300 microns?
- Are adverse effects on aquatic biota possible at concentrations found in worst-case scenarios?
- Can metals and trace organic compounds adsorbed to MPs be a risk concern, given their concentrations in nature and chemical uptake rates?

From G.A. Burton WERF White Paper 2017

Challenges ahead

- No standard methods exist for sampling and quantifying MPs, making it difficult to compare studies or reliably predict exposure, effects, hazards, or risks.
- Improved MP exposure models for effluent discharges and other sources into receiving waters are needed to predict whether MPs may be a stressor of concern.
- Measurement methods for MPs vary significantly and there is no universal protocol for sample preparation, which can make results difficult to compare.
- Much of the effects information for MPs stems from direct exposure studies; indirect effects due to trophic transfer have been less explored.
- Need more information relating organismal effects of MPs to population level consequences

What Do We Know About Microplastics in the Potomac and Chesapeake Bay?

Contents lists available at ScienceDirect

Marine Pollution Bulletin

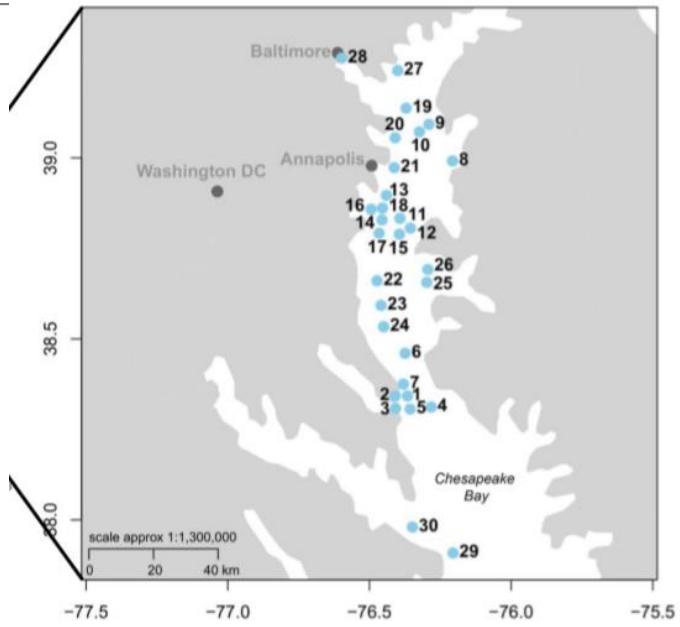
journal homepage: www.elsevier.com/locate/marpolbul

Microplastics and other anthropogenic particles in the surface waters of the Chesapeake Bay

J. Bikker[a], J. Lawson[b], S. Wilson[c,d], C.M. Rochman[a,*]

[a] Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, ON, Canada
[b] Trash Free Maryland, Baltimore, MD, USA
[c] Story of Stuff Project, Berkeley, CA, USA
[d] Peak Plastic Foundation, Berkeley, CA, USA

Marine Pollution Bulletin 156 (2020) 11125



Fragment, Film, and Fiber are most abundant

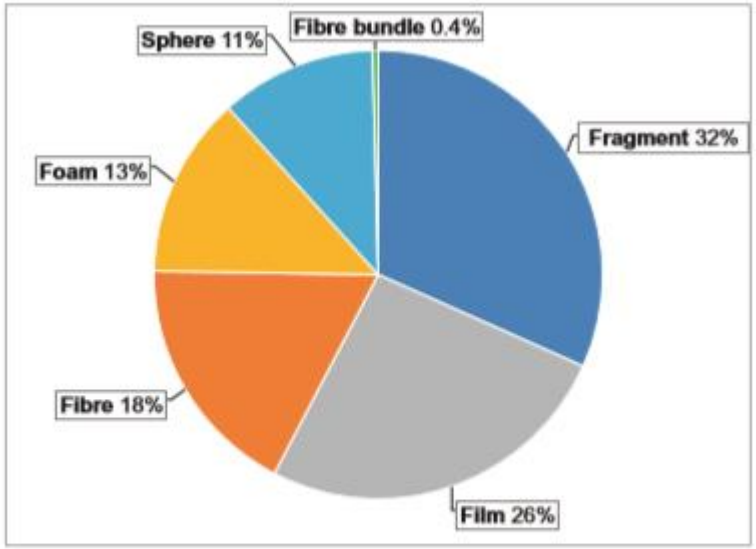


Fig. 3. Morphology of particles from thirty surface water samples (after blank correction) in the Chesapeake Bay.

What Do We Know About Microplastics in the Potomac and Chesapeake Bay?

Microplastic abundance in submerged aquatic vegetation beds in the Anacostia River, Washington, DC

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Metropolitan Washington Council of Governments
777 North Capitol Street NE
Suite 300
Washington, DC 20002

PRESENTED BY

Tetra Tech, Inc.
10711 Red Run Blvd.
Suite 105
Owings Mills, MD 21117

Figure 5: Sample of microplastics on filter under dissecting microscope

Fiber and Fragments are most abundant

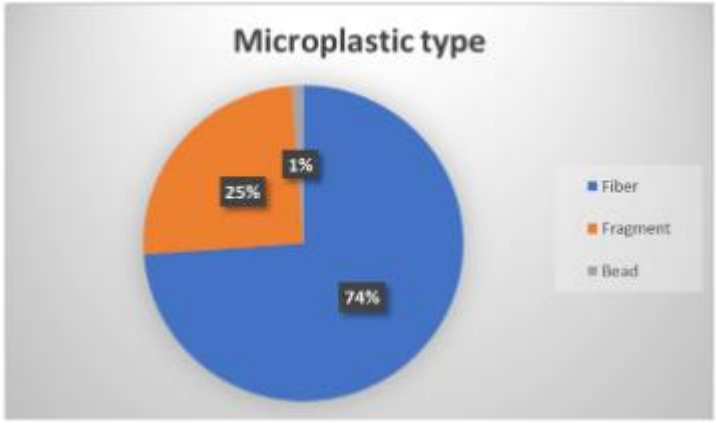
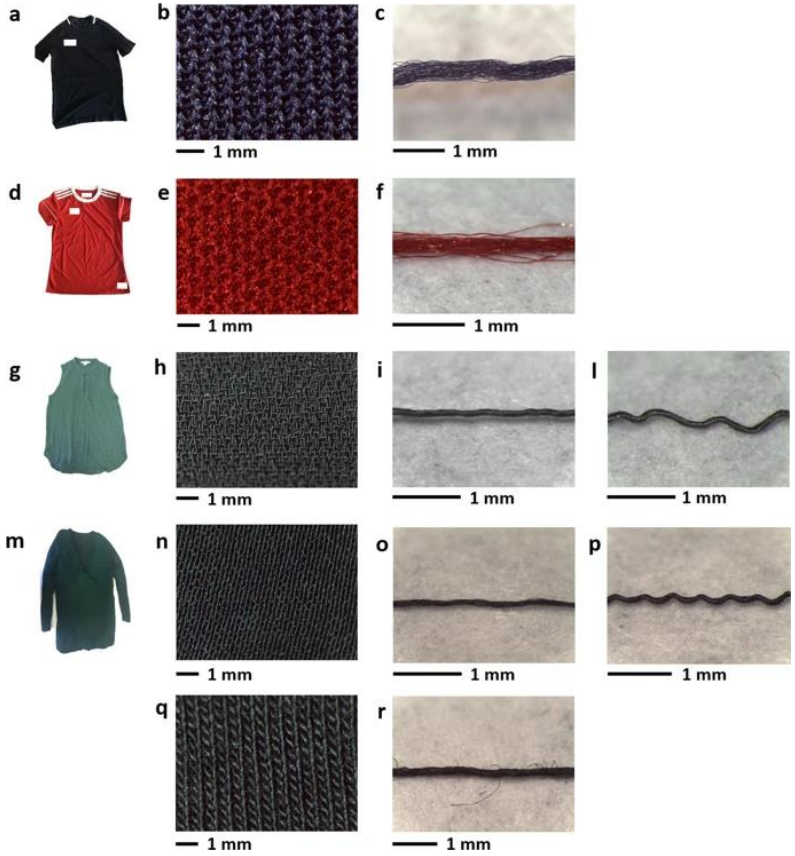


Figure 6: Relative abundance of microplastic types

Recommendations

- Fibers



https://www.nature.com/articles/s41598-019-43023-x

- Polymer strands displaced by washing synthetic garments
- Prevalent in the Bay and a freshwater tributary (Anacostia)
- Field studies show that the majority of incidental ingestions are fibers (Desforges et al. 2015, Peters et al. 2017, Sun et al. 2019)

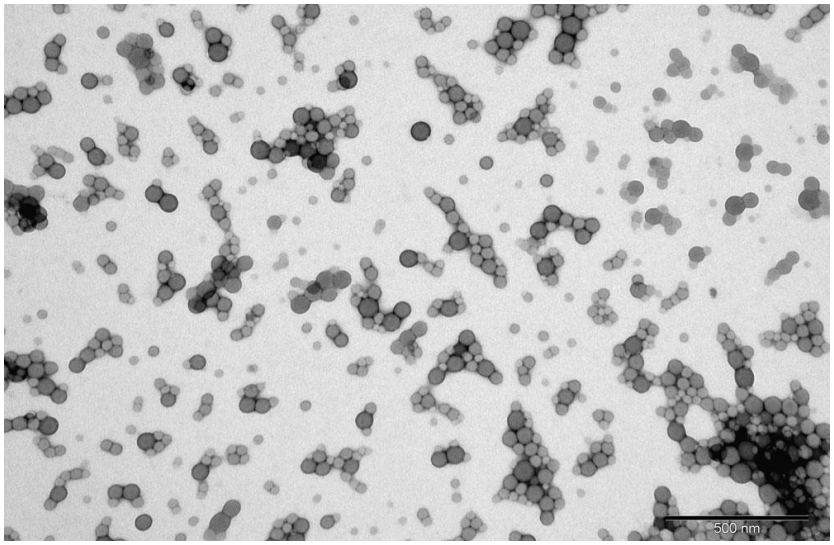
Recommendations

- Fragments

- Degradation of larger pieces of plastic
- Trash like bags and bottles are contributors
- Prevalent in the Bay and a freshwater tributary (Anacostia)

Recommendations

- Polymers ≤ 150 microns



- Degradation of larger plastics and some small produced plastics
- Includes many polymer types
- Also includes nanoplastics
- Upper size limit for biologically reactive particles

Discussion

- Fibers and Fragments are common in the Bay
- Fibers are commonly ingested
- Polymers $\leq$ 150 microns are easily ingested

- What makes most sense for selecting a microplastic for the ERA?