Results from the Chesapeake Bay Program Scientific & Technical Advisory Committee Workshop on Microplastics in the Chesapeake Bay and its Watershed

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stac

DEPARTMENT OF ENERGY & ENVIRONMENT

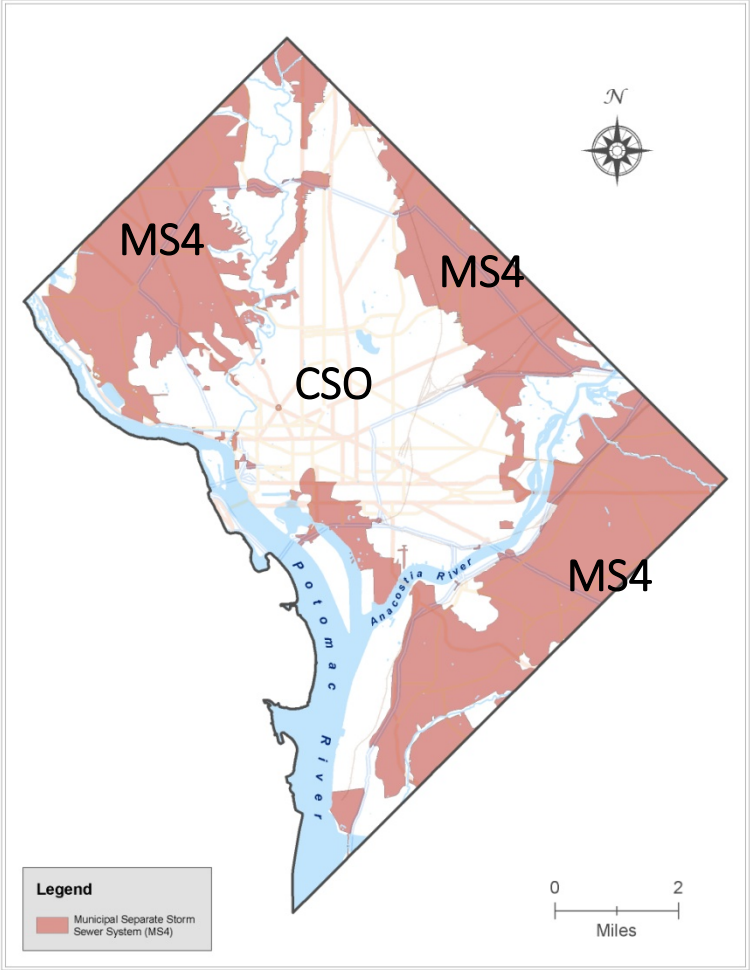
WE ARE WASHINGTON DC GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

SAV Workgroup
Chesapeake Bay Program

Why Do We Care about Trash in DC?

Photo taken by Masaya Maeda, Anacostia Watershed Society

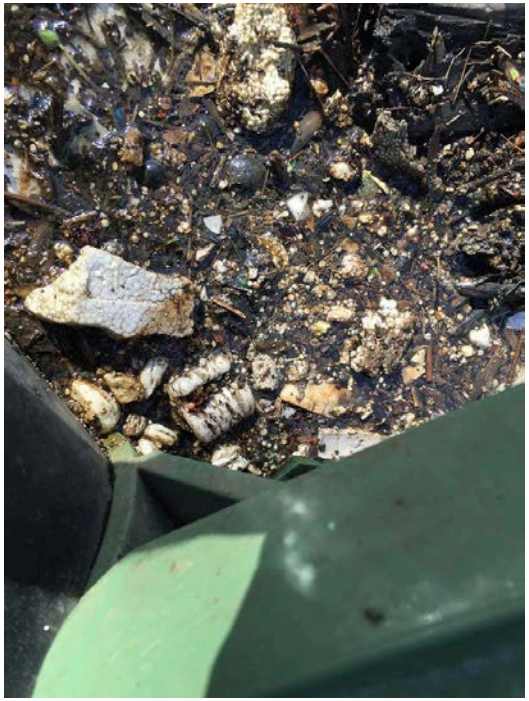
The Anacostia River Trash TMDL



- Anacostia river listed by DC as impaired for trash in 2006, followed by Maryland in 2008
- Almost 200,000 lbs/yr attributed to point sources→ Combined sewer system (CSS) and Municipal Separate Storm Sewer System (MS4)
- Over 20,000 lbs/yr attributed to non-point sources → illegal dumping
- But, only gets at trash greater than to an inch in diameter or length

What About the Small Stuff?

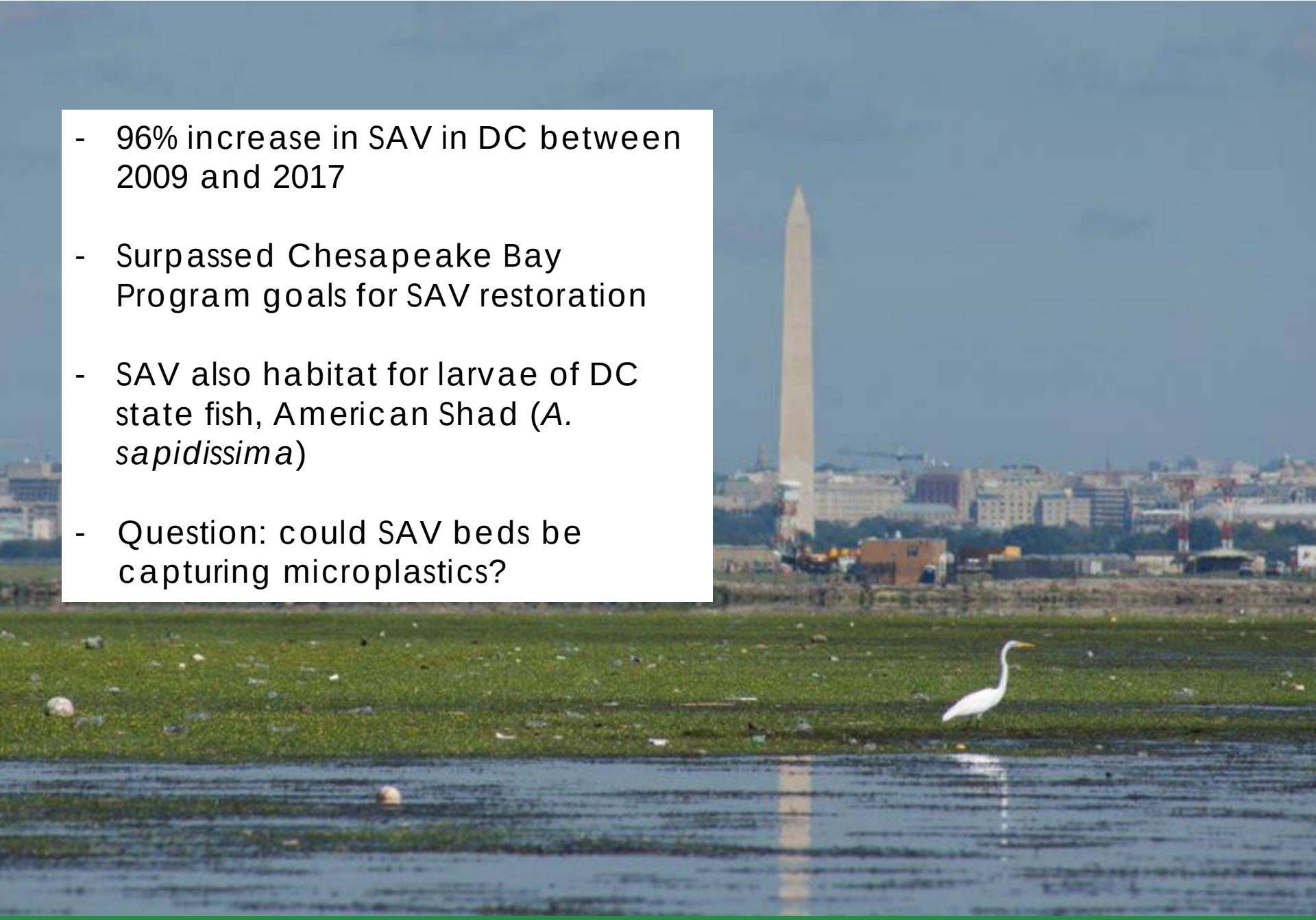
Foam Starts Out as This…



…And Turns Into This

Evidence of Microplastics in DC

Photos by Masaya Maeda, Anacostia Watershed Society, 2017



- 96% increase in SAV in DC between 2009 and 2017

- Surpassed Chesapeake Bay Program goals for SAV restoration

- SAV also habitat for larvae of DC state fish, American Shad (*A. sapidissima*)

- Question: could SAV beds be capturing microplastics?

Study of Microplastics in SAV Beds in DC

- Sampling sites chosen in Potomac River based on Virginia Institute of Marine Science 2016 maps of SAV beds.
- Paired samples of SAV tissue taken during Fall 2017 in SAV beds and adjacent open water column (i.e. 2 in the bed, 2 outside the bed).
- Samples captured using 500 um nitrex bag affixed to D-frame. SAV was severed at the sediment surface and the bag was cinched tight.
- Depth taken to determine volume of water.
- Microplastics were extracted in the lab using visual sorting.

Tetra Tech staff conducting sampling

Study of Microplastics in SAV Beds in DC

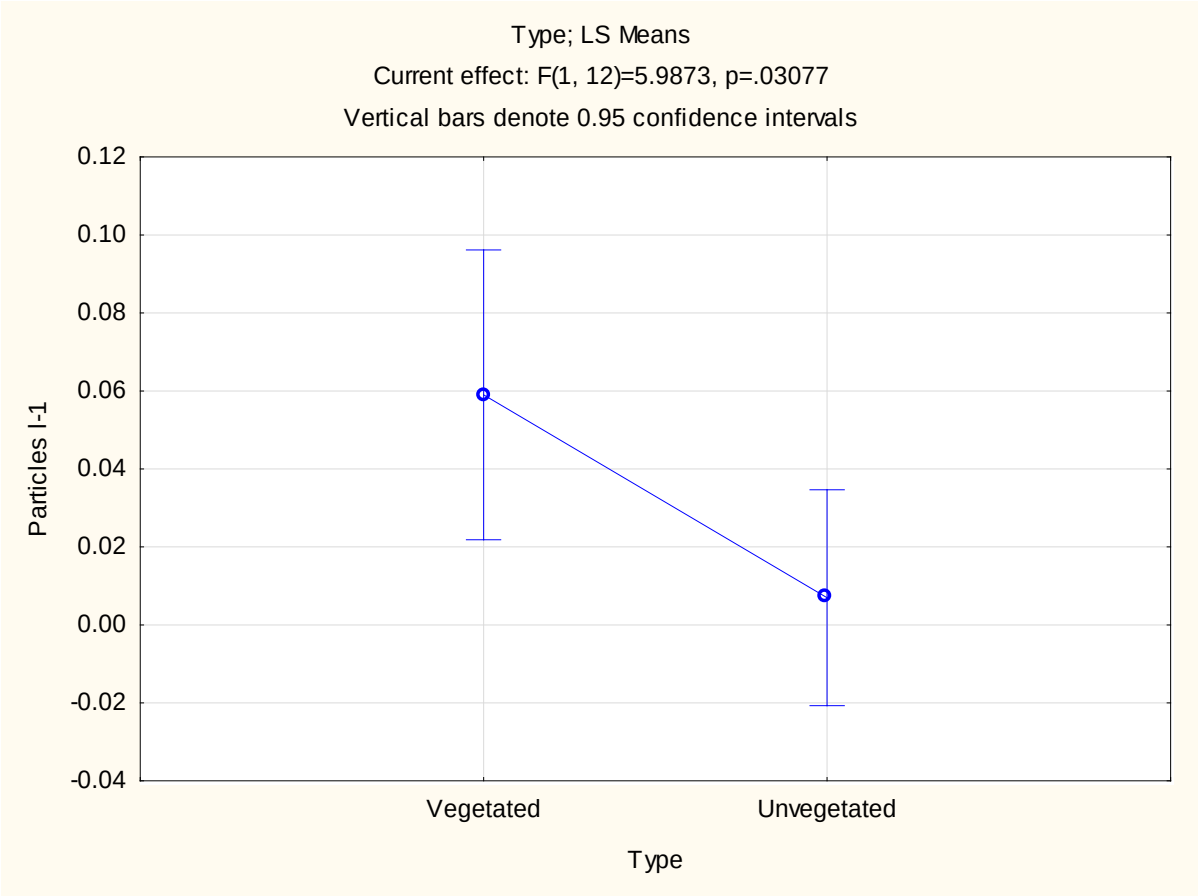
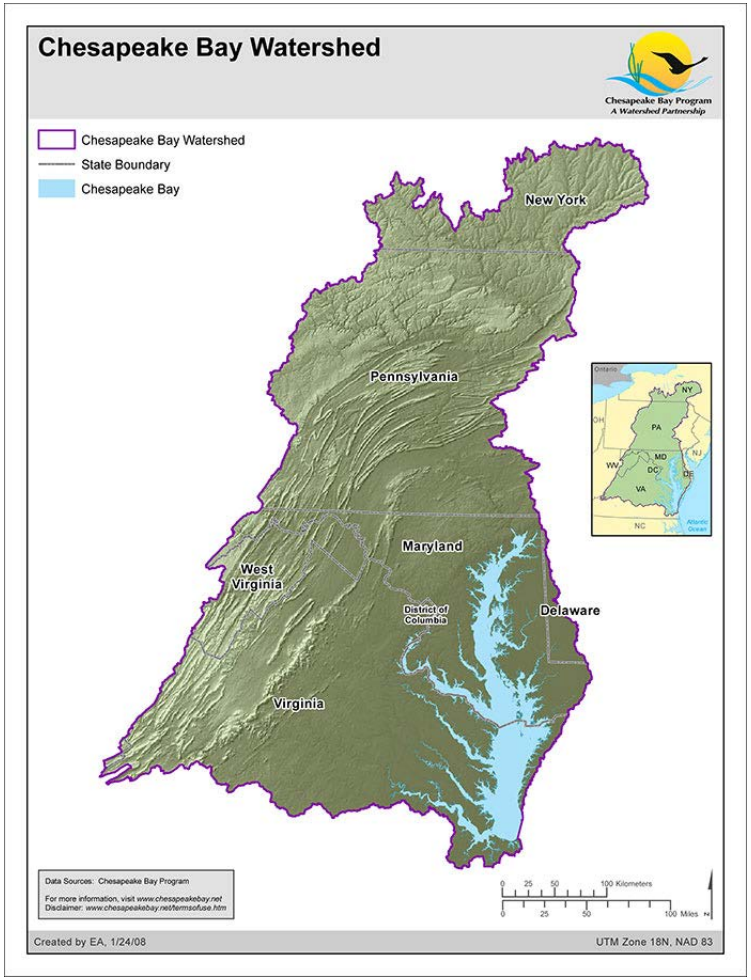


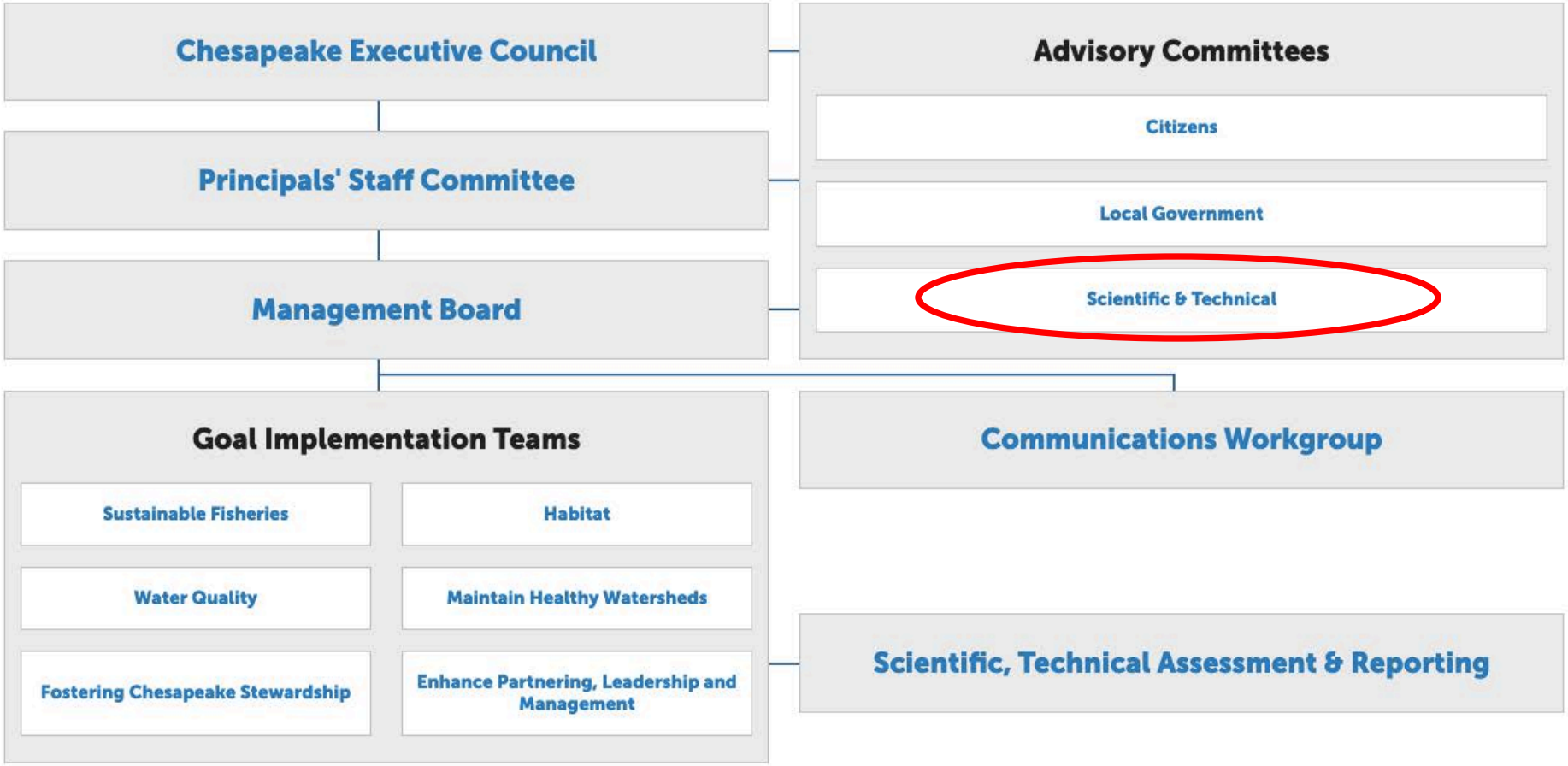
Figure 1 – Mean microplastic particle concentration (#of particles/volume of sample) in vegetated beds vs. unvegetated beds (n=14, 5 vegetated, 9 unvegetated)

Microplastics in the Chesapeake Bay and Watershed

- How can we bring more attention to this issue regionally?
- SAV Workgroup at the Chesapeake Bay Program applied for a Scientific & Technical Advisory Committee (STAC) grant to hold a workshop in 2019 about microplastics in the bay and watershed
- DC a full partner in the CBP partnership since the signing of the 1987 Chesapeake Bay Agreement



The Chesapeake Bay Program



Background on STAC

- Founded in 1984
- Provides scientific and technical guidance to the Chesapeake Bay Program on measures to restore and protect the Chesapeake Bay.
- One way it does this is through sponsoring workshops focused on a specific question of concern to bay restoration and protection.

2019 STAC Workshop on Microplastics in the Chesapeake Bay and its watershed

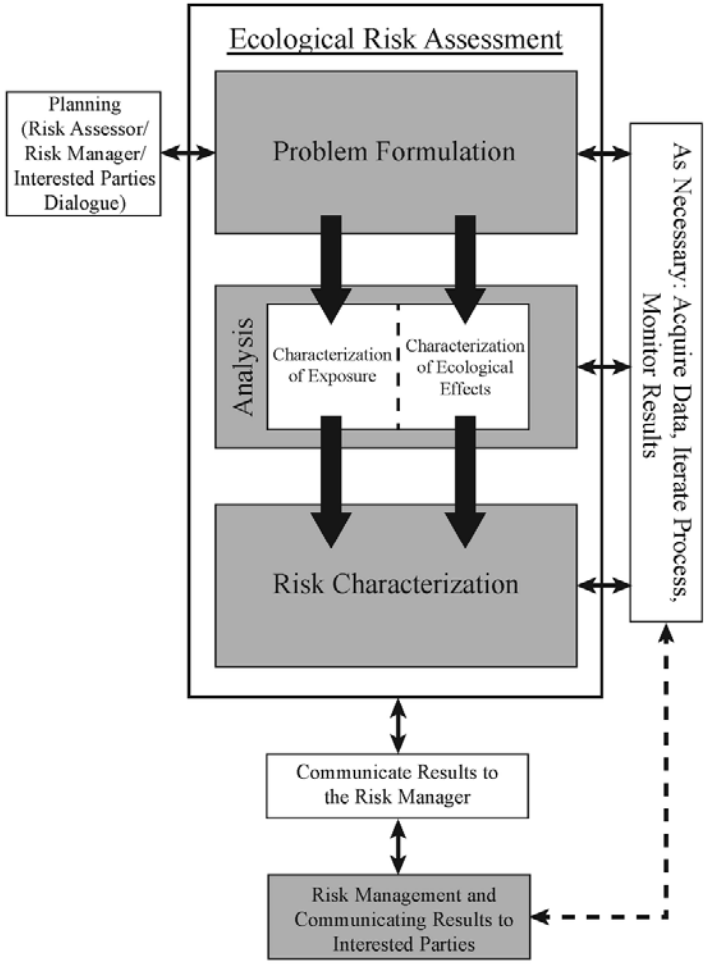
- April 24th & 25th, 2019 at George Mason University Potomac Science Center, Woodbridge, VA

- Attended by over 50 scientists, resource managers, and policy professionals from federal and state agencies, academia, and NGOs

Workshop Format

- Steering committee decided early on that the workshop should be formatted around conducting an ecological risk assessment (ERA)

- The Ecological Risk Framework consists of the following components:
  1. Problem Formulation: Determine assessment endpoints and measurement endpoints
  2. Risk Analysis: Identify testable linkages between sources, stressors and assessment endpoints
  3. Risk Characterization: What are the risk and effects? Ex. LC50 – Lethal concentration to kill 50% of a population



Ecological Risk Framework (EPA, 1992)

Workshop Questions

1. What are the sources of microplastics to the bay and its tributaries?

2. How common are microplastics in the Chesapeake Bay and its tributaries?

3. What additional information do we need to gauge distribution?

4. Possible effects of microplastics on habitat and living resources?

5. Are there any policy and management tools being used to address plastic pollution in the bay (e.g., Anacostia River Trash TMDL)? How effective have they been?

6. Can we recommend pursuing future studies or new management and policy? Can we recommend more funding be made available for research at this time?

Example Presentations

- Introduction to Ecological Risk Frameworks – Jerry Diamond, Tetra Tech

- Sources
  1. Wastewater – Chris Burbage, Hampton Roads Sanitation District
  2. Stormwater – Phong Trieu, Metropolitan Washington Council of Governments

- Presence in the Bay and Watershed
  1. Tidal waters– Lance Yonkos, University of Maryland
  2. Non-tidal waters – Shawn Fisher, USGS

- Effects on Living Resources
  1. Black seabass – Susanne Brander, Oregon State University
  2. Oysters– Christine Knauss, University of Maryland

- Policy & Management Tools
  1. VA Marine Debris Plan – Katie Register, Clean VA Waterways
  2. Anacostia River Trash TMDL – Matt Robinson, DC DOEE

Conclusions

- Studies have shown microplastics are ubiquitous throughout the bay and its tributaries. They have been found in both tidal (Yonkos, 2014; Rochman, 2019) and non-tidal waters (Fisher, 2019).

- There is general agreement that plastics represent a widespread, but largely unquantified, threat to the Chesapeake Bay ecosystem.

- Need standardization of terminology (e.g. microplastic size class)

- There are a number of piecemeal efforts to monitor plastics in the Bay, but no systematic effort and no organized effort directed at micro- and nano-plastics.

- **The MOST URGENT need is to identify assessment endpoints that represent areas of environmental and human health concern and to characterize the severity of those risks.**

Could Microplastics Affect Success of Restoration?

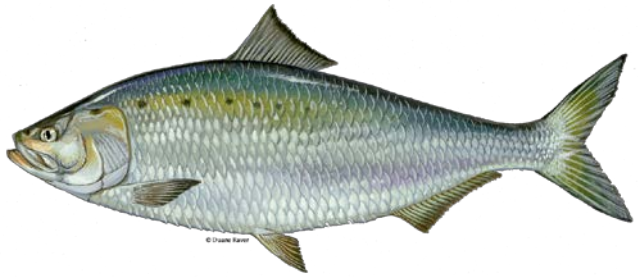
- Water Quality and Human Health:
  - Seeley et al. (2019) found impacts of PVC particles on benthic bacteria which could affect N cycle.
  - Laverty and Dobbs (2018) found microplastics serve as habitat for bacteria and pathogens, specifically *Vibrio* spp. Potential human health effects?
  - Research has shown nanoplastics cross cellular membranes. Potential effects on cellular processes?

- Fishery Species: We know things are eating microplastics in the bay and watershed
  - Smallmouth bass: Parks et al. (2019) showed 95% of bass sampled (n=67) in central Susquehanna river had microplastics in gut.
  - Oysters: Knauss (2019) show some impact on oyster larvae respiration. Could this impact larval survival?
  - Black Sea bass: Brander (2019) showed effects on respiration of Black Sea bass.

- Habitat
  - Murphy et al. (2019) found microplastics accumulate in SAV bed canopies in Potomac River

How do we communicate the impact to the CBP?

Example Endpoint?



Healthy Fish (e.g. Am Shad→ DC State Fish!)

Potential effects?

- Digestive system
- Growth
- Respiration

Risk? Plastics are everywhere. Uptake through ingestion or potential physical harm to gills.

Exposure? Plastic in the water, sediment, and food

How do plastics get there? Stormwater, Wastewater, Air, Non-point sources

What do we know about these sources?

How do we communicate the impact to the CBP?

What info. do we have on the following?

The two we know most about in this region?

	Regulated Stormwater	Waste Water
Plastic Characteristics	Size →meh? Type→meh?	✓ Size Type→meh?
Plastic Sources	✓ Macroplastics Microplastics→meh? Nanoplastics???	✓ Microplastics Nanoplastics???
Source Behaviors	✓ Improper Disposal (e.g. littering)	✓ Washing clothes ✓ Personal Care Products ✓ Dishwashing
Source Management Controls	✓ BMPs addressing macroplastics	???

Recommendations - **URGENT**

- Include Ecological Risk Assessment for plastics in the update to the Chesapeake Bay Program Science Strategy.
  - Focus on things we care about (e.g. fish, shellfish)
  - Should look at effects of microplastics and nanoplastics

- Conduct a STAC technical review of plastic particle size classifications. (i.e. macro, micro, nano, pico?)

- Formation of Chesapeake Bay Program Action Team focused on plastics

Next Steps

- Draft report due to STAC by July 25th
- 30-day review at the Chesapeake Bay Program before public dissemination
- Presentation to the Chesapeake Bay Program Management Board later this Fall
- Upcoming Fall 2019 study in DC: Microplastic abundance in SAV benthic sediments vs. adjacent bare bottom (Funding from EPA Trash Free Waters and Chesapeake Bay Programs)

Special Thanks

Bob Murphy (Tetra Tech), workshop co-Chair, and Brooke Landry (MD DNR), CBP SAV Workgroup Chair and workshop sponsor.

Rachel Dixon, CBP STAC Coordinator

Our Host: Dann Sklarew, George Mason University Department of Environmental Science & Policy

Workshop Steering Committee:

- Mark Luckenbach, Virginia Institute of Marine Science
- Denice Wardrop, Penn State
- Lance Yonkos, University of Maryland
- Jason Rolfe, NOAA Marine Debris Program
- Kelly Somers, EPA Region III
- Greg Allen, EPA Chesapeake Bay Program Office
- Kim Grubert, MD DNR
- Phong Trieu, Metropolitan Washington Council of Governments

Katherine Antos, Branch Chief of DOEE WPD Partnering & Environmental Conservation Branch and DC Chesapeake Bay Program Coordinator

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