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

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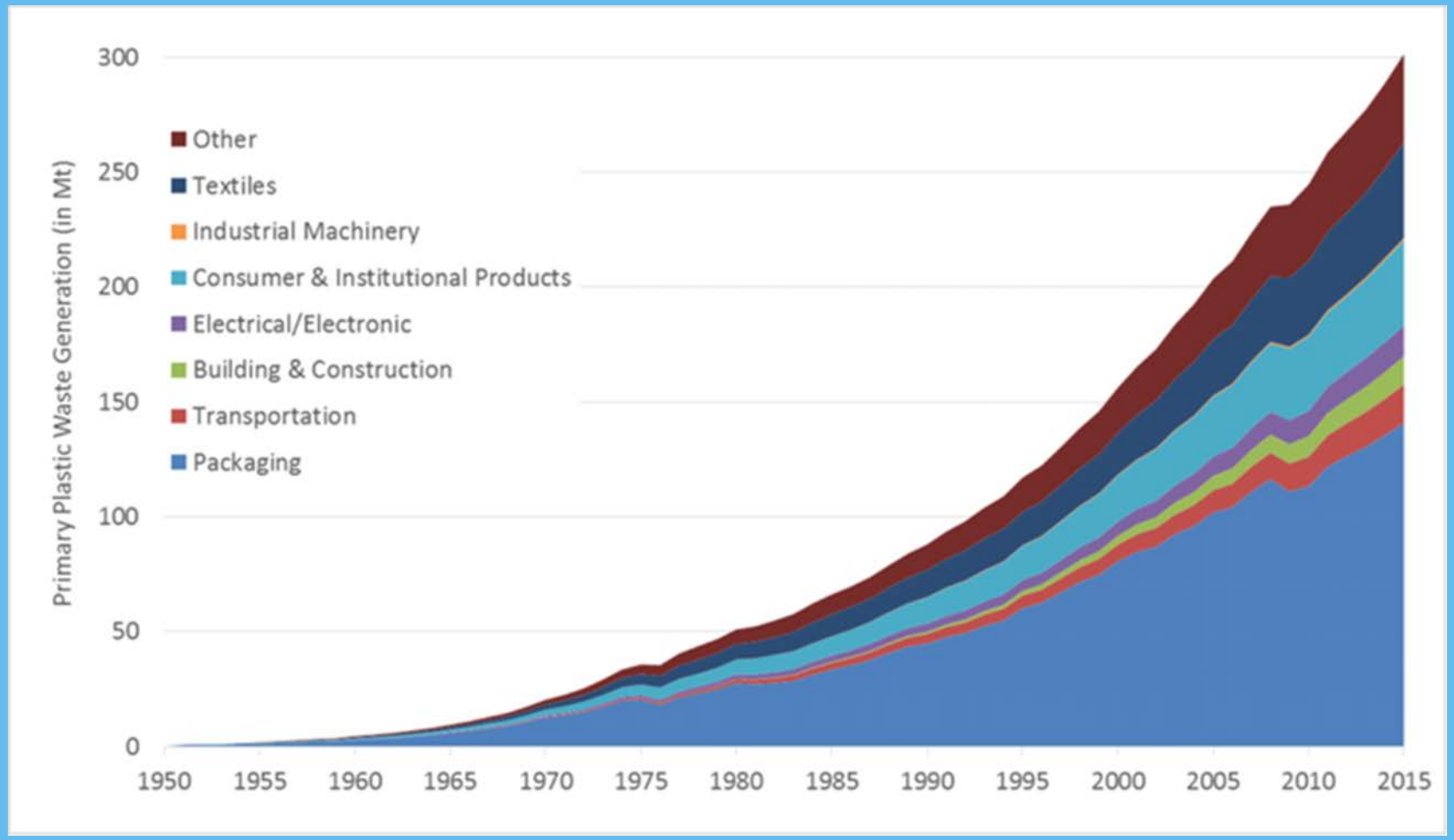
GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

A Global Problem



J. Geyer in Science Advances. 2017

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Every day in the US, we use 500 million straws.

What is the volume occupied by that many straws?

1 box of 40 straws from Harris Teeter: 3.6 cm X 8.0 cm X 20 cm = 576 cm^3

$$\frac{40 \text{ straws}}{576 \text{ } cm^3} = \frac{500 \text{ X } 10^6 \text{ straws/day}}{\text{volume } x}$$

Cross-multiply, solve for x, and convert cm^3 to m^3

$x = 7.2 \text{ X } 10^9 \text{ } cm^3$

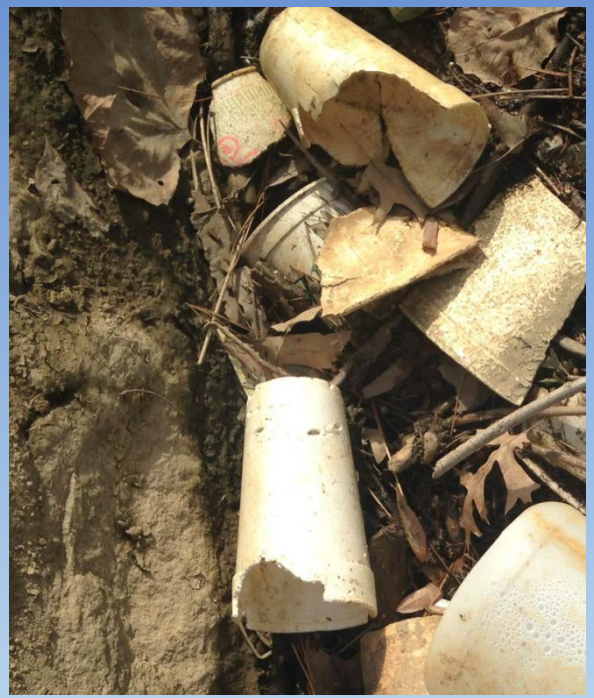
$(1 \text{ } m^3/10^6 \text{ } cm^3) = 7.2 \text{ X } 10^3 \text{ } m^3$

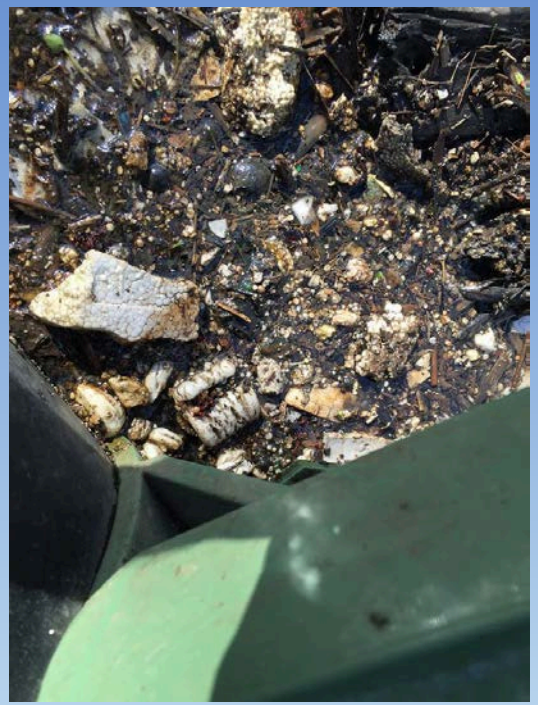
A bit more than 7,000 m^3 per day!

Compare that volume with the volume of this room.

What About the Small Stuff?

Foam and other plastics Starts Out as This…





…And Turns Into This


http://www.huffingtonpost.com/2011/10/26/plastic-ocean-pacific-conservation_n_1032897.html

Microplastics

Small plastic fragments, fibers, and granules

How small? Usage of the term in the literature varies from 0.1 µm to 10 mm--a size range of 5 orders of magnitude!

- **Primary Microplastics--**manufactured products used in:
  - Facial cleansers and cosmetics - microbeads
  - As vectors for drugs
  - As air-blasting media for removing rust – often contaminated with heavy metals (e.g., cadmium, chromium, lead)
  - Virgin plastic production **pellets** - Pellets are convenient to ship and are eventually melted down and molded into manufactured products
- **Secondary Microplastics--**pieces that have broken off larger plastic objects, through physical, biological, or chemical processes

Why Do We Care about Trash in the Chesapeake Bay?

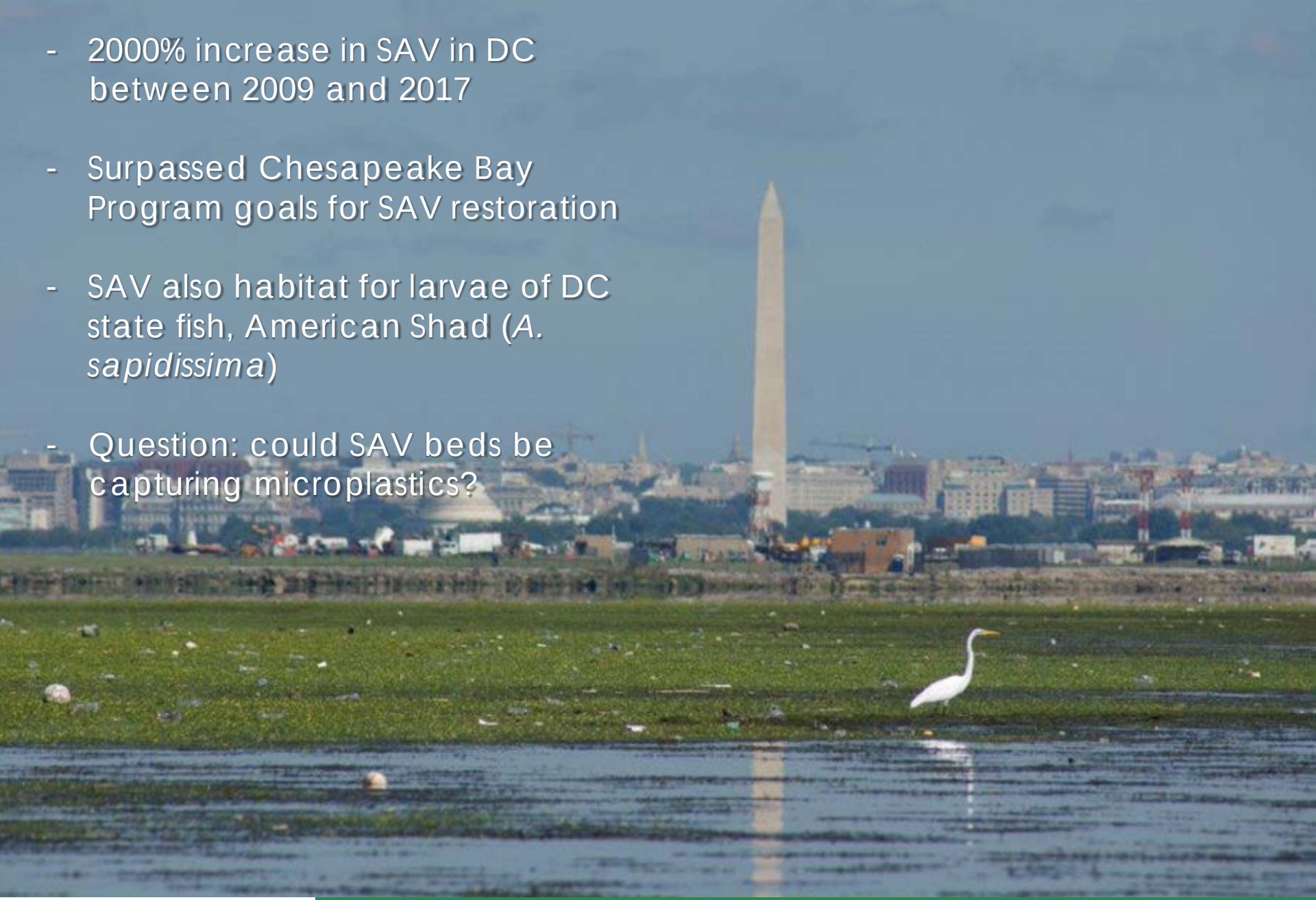
In March 2019, Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) estimated 95% of all seabird species will ingest some form of plastic by 2050

World Economic Forum projects more plastic in the ocean than fish by 2050

Photo taken by Masaya Maeda, Anacostia Watershed Society

Evidence of Microplastics in DC

Photos by Masaya Maeda, Anacostia Watershed Society, 2017



- 2000% 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?

SAV as Sinks for Microplastics?

Contents lists available at ScienceDirect

Marine Pollution Bulletin

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

Thalassia testudinum as a potential vector for incorporating microplastics into benthic marine food webs

Hayley Goss[a], Jacob Jaskiel[a], Randi Rotjan[a,b,*]

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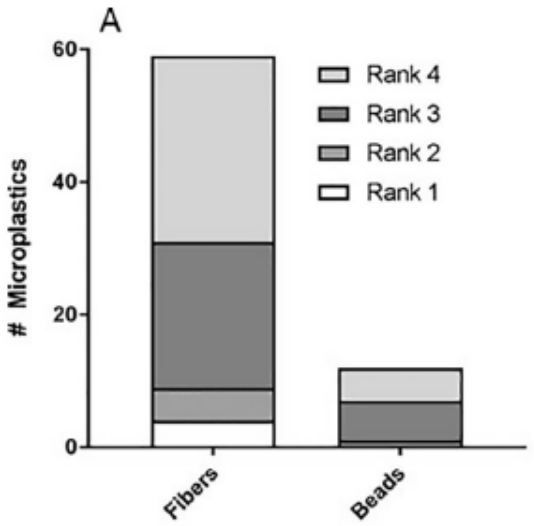


Study of Microplastics in SAV Beds in DC

- Sampling sites chosen in Potomac River based on Virginia Institute of Marine Science 2016 maps of SAV beds.
- Paired samples 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.

Study of Microplastics in SAV Beds in DC

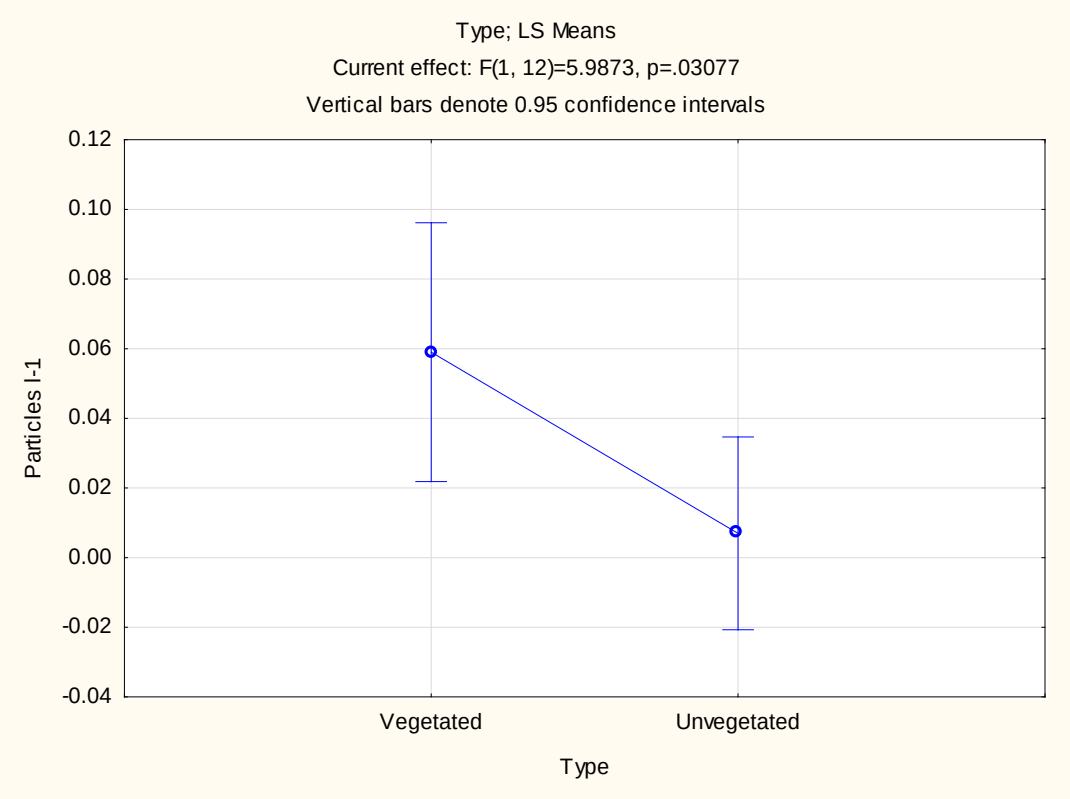
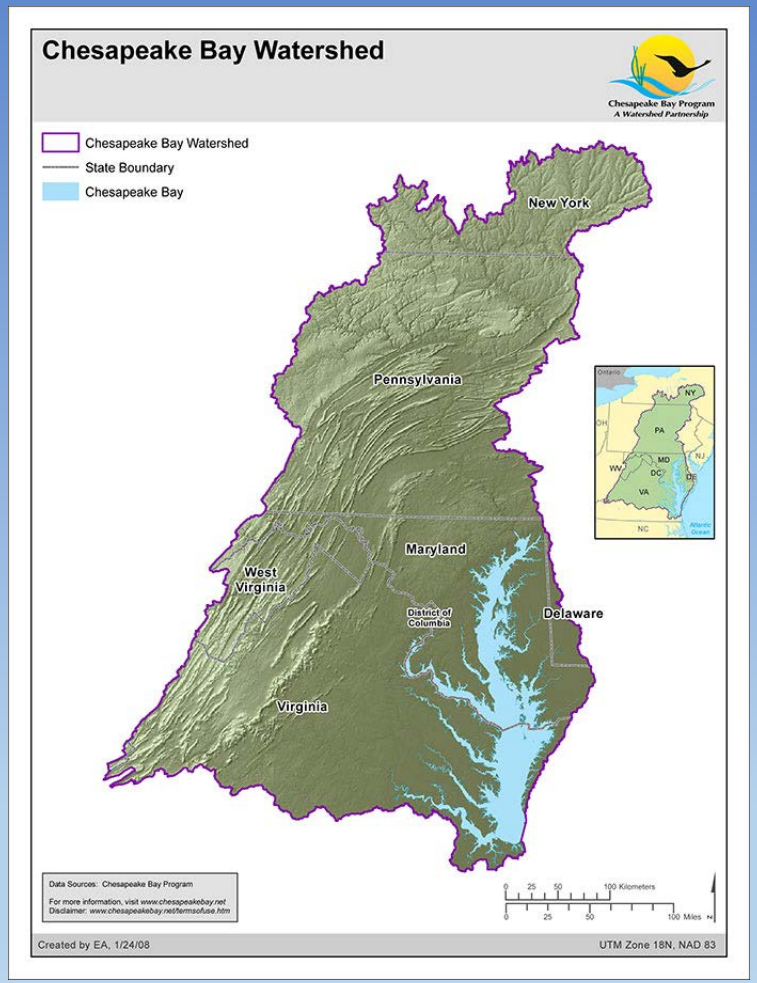


Figure 1 – Mean microplastic particle concentration (#of particles/volume of sample) in vegetated beds vs. unvegetated beds (n=14, 5 vegetated, 9 unvegetated)

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



Microplastics in Chesapeake Bay

Environmental Science & Technology

Article

2014 ES&T 48:14195-14202

Microplastics in Four Estuarine Rivers in the Chesapeake Bay, U.S.A.

Lance T. Yonkos,[*,†,‡] Elizabeth A. Friedel,[†] Ana C. Perez-Reyes,[†] Sutapa Ghosal,[§] and Courtney D. Arthur[†,⊥,∇]

Figure 1. Locations of estuarine sites within the Chesapeake Bay sampled for microplastics between July and December 2011.

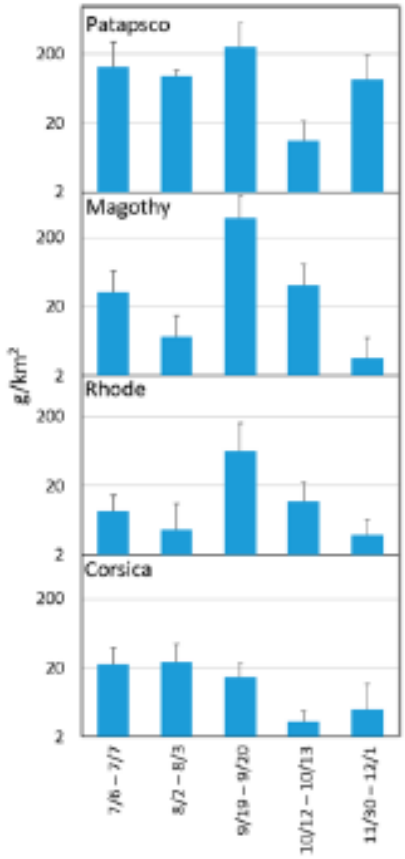


Figure 4. Concentrations of microplastics in surface water collections from four Chesapeake Bay tributaries on five occasions between July and December 2011; mean (log scale; $n = 3$) and standard deviation (error bars).

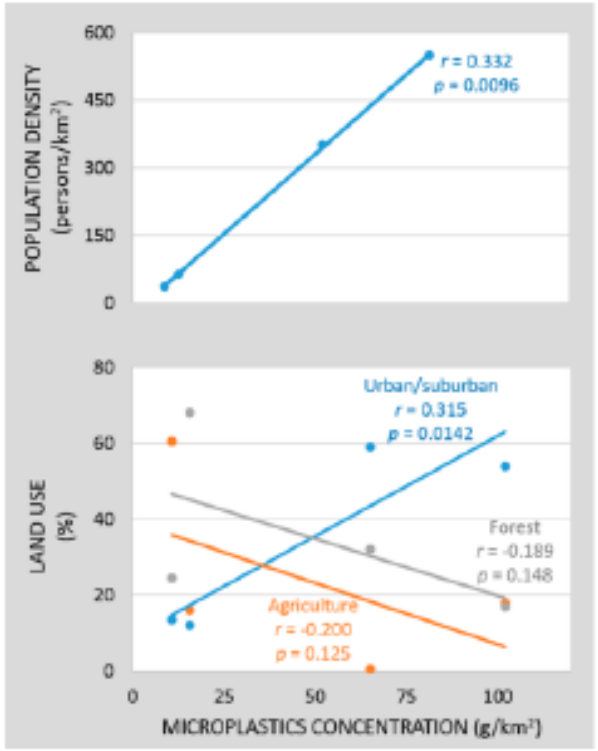
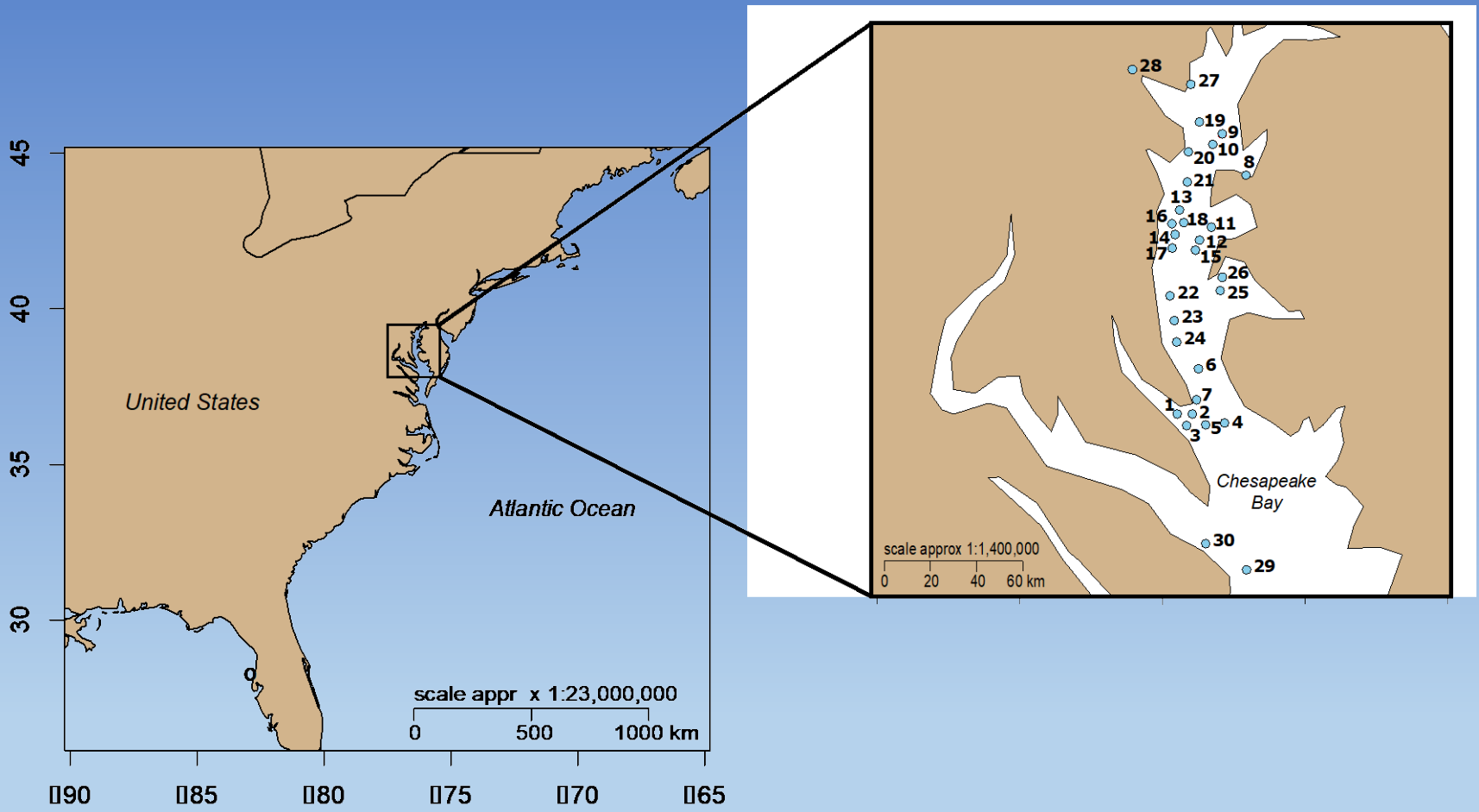


Figure 6. Associations between watershed characteristics and microplastics concentrations in Chesapeake Bay surface waters: population density (top); land use patterns (bottom); positive correlation coefficients (r) indicate variables that tend to increase together while negative correlation coefficients indicate that one variable tends to decrease while the other increases; only variable pairs with p-values below 0.050 (e.g., population density, urban/suburban land use) are statistically significant.

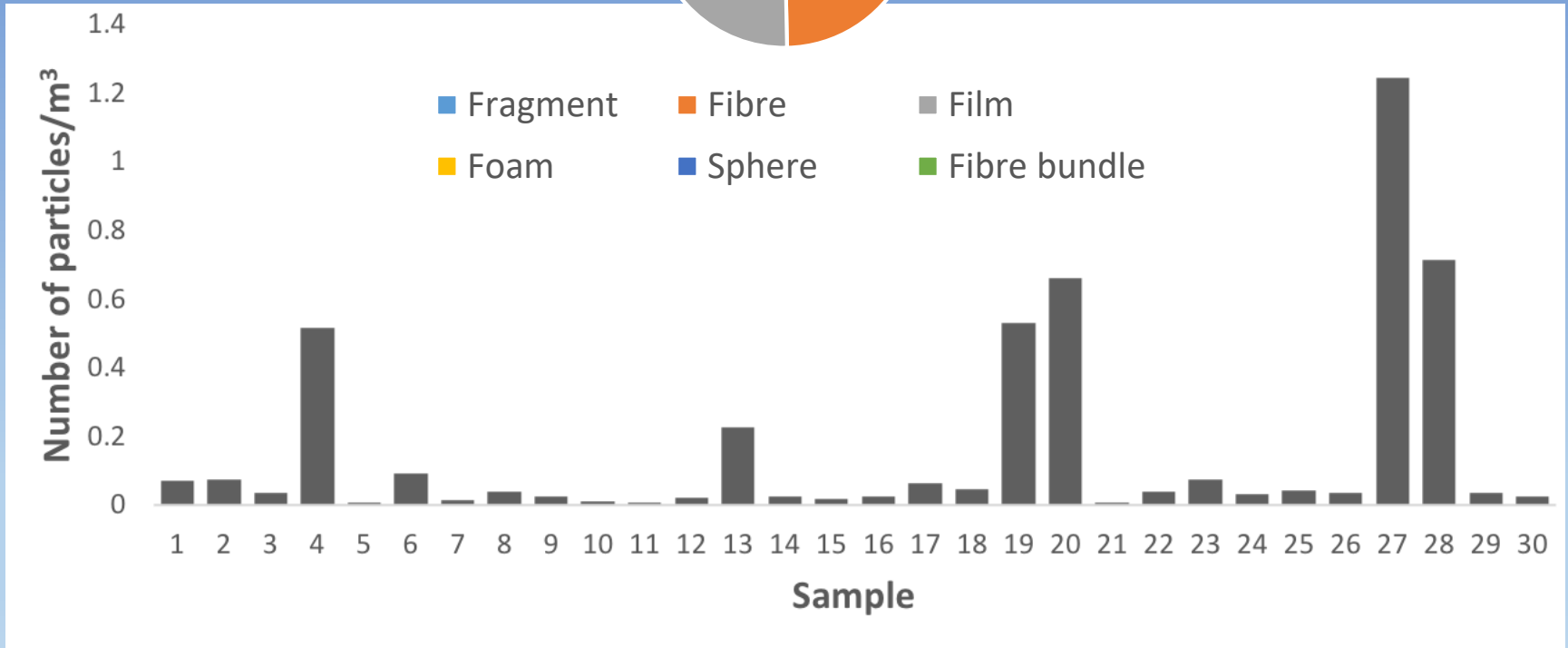
Screen size of 300 µm

Trash Free Maryland: Trash Trawl
Surface Water Manta Trawl Across the Bay (Courtesy DNR, TFM, Univ Toronto)

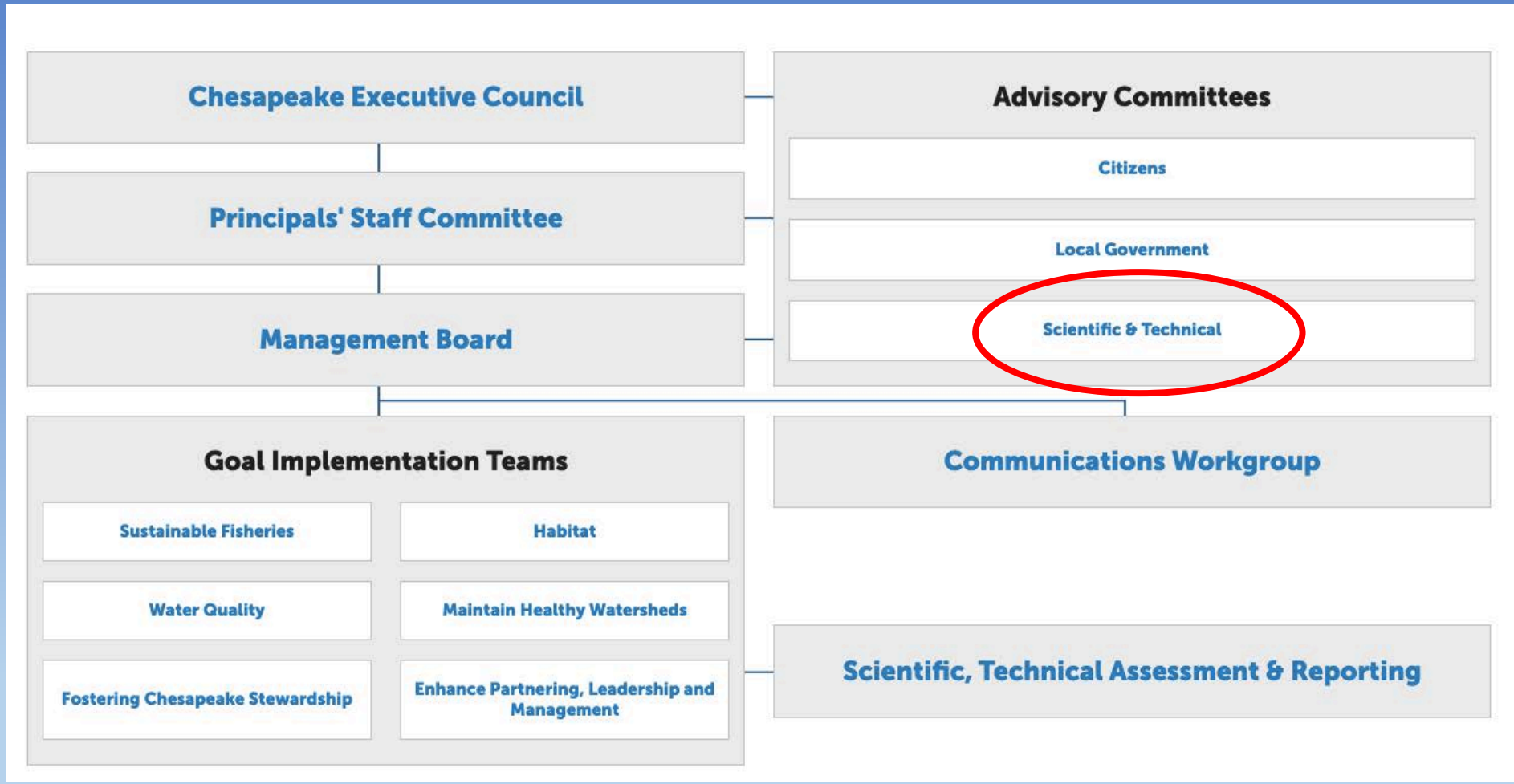
Trash Free Maryland: Trash Trawl
Surface Water Manta Trawl Across the Bay



Trash Trawl Results
(courtesy DNR, TFM, Univ. Toronto)



The Chesapeake Bay Program



Scientific & Technical Advisory Committee

Workshops

Mission Statement: Workshops are a primary mechanism by which the Scientific and Technical Advisory Committee (STAC) of the Chesapeake Bay Program (CBP) brings the broad expertise of the scientific and technical community to bear on critical and timely issues relevant to the successful restoration of the Chesapeake Bay.

- SAV Workgroup Sponsored
  - ❖Brooke Landry (MD DNR, SAV WG Chair)
  - ❖Matt Robinson, DC DOEE
- Emerging Issues of Concern

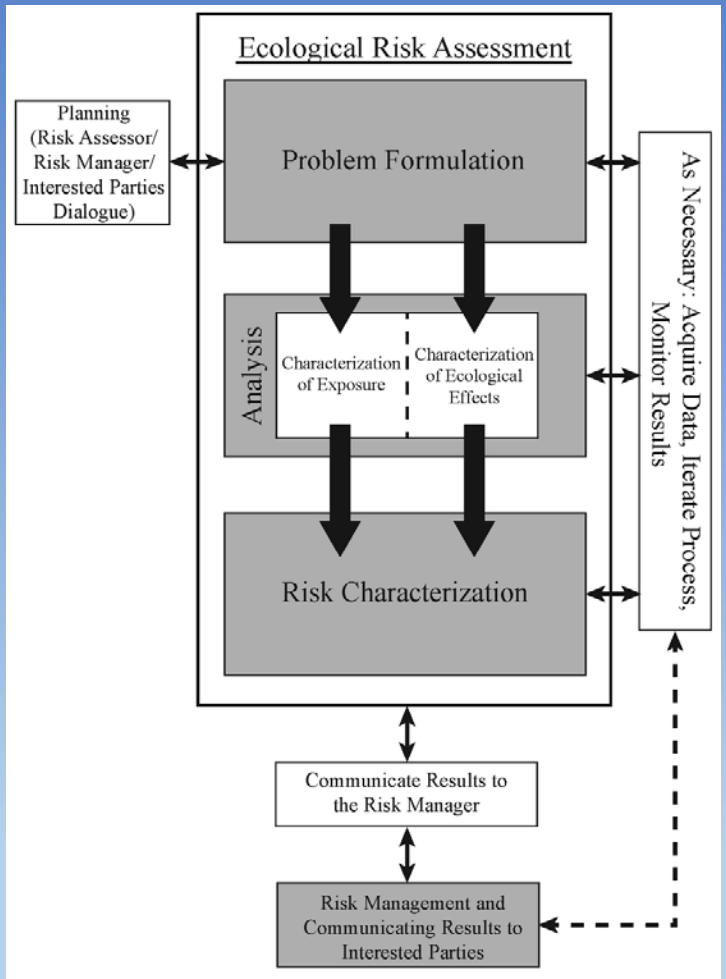
Workshop Goals

- Assess the state of the knowledge on microplastic pollution in the Chesapeake Bay and its tributaries
- Assess possible effects of microplastics on various habitats and associated living resources
- Identify existing policy and management tools being used to address plastic pollution in the watershed and beyond, and their effectiveness
- Identify research gaps moving forward, and develop recommendations for future studies or new tools

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)

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

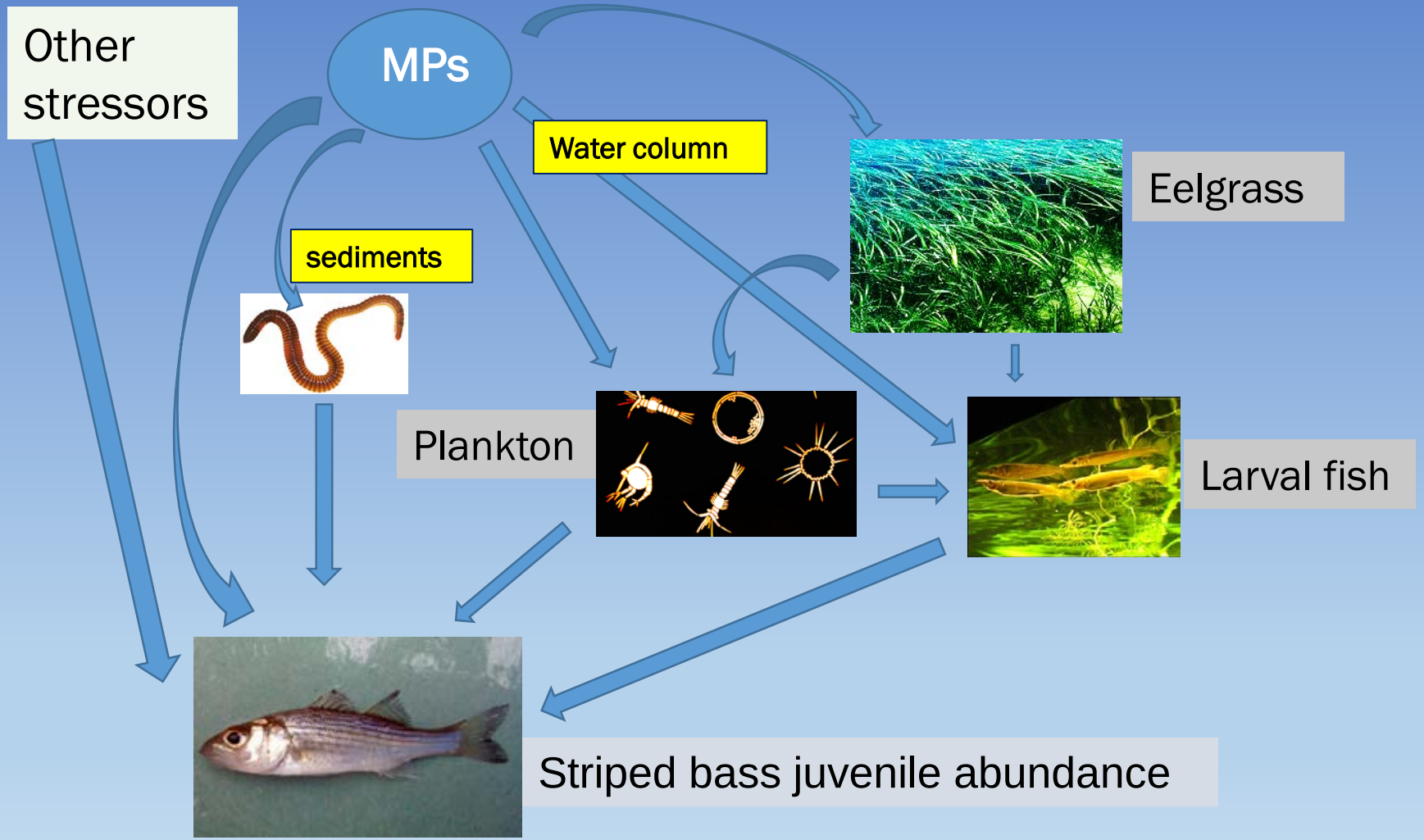
- Effects on Living Resources
  1. Black seabass – Susanne Brander, Oregon State University
  2. Oysters– Christine Knauss, University of Maryland

- 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 fairly 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
- 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.**

Stressor and Assessment Endpoint Focused Conceptual Model



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

- CBP should explore using the existing monitoring network to sample for microplastics
  - Questions concerning microplastic monitoring should be d ed before a monitoring strategy is developed;
  - Data collection methods for monitoring microplast n the sapeake Bay and watershed should be defined; and
  - Other sources of microplastic sampling d a he C peake Bay and watershed should be explored.
- Conduct a STAC technical revi of tic cle siz ass ns and concentration units. (i.e. macro, micro, nano, p)
- Include Ecologic Ris es ent l as pdate to the Chesapeake Bay Program Sci c te
  - Focus ng c b e.g hellfish)
  - Should lo t e c cro tics and nanoplastics
- Formation of Che ay rogram Action Team focused on plastics

URGENT

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

Matt Robinson, DC DOEE, Workshop co-chair

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

Questions