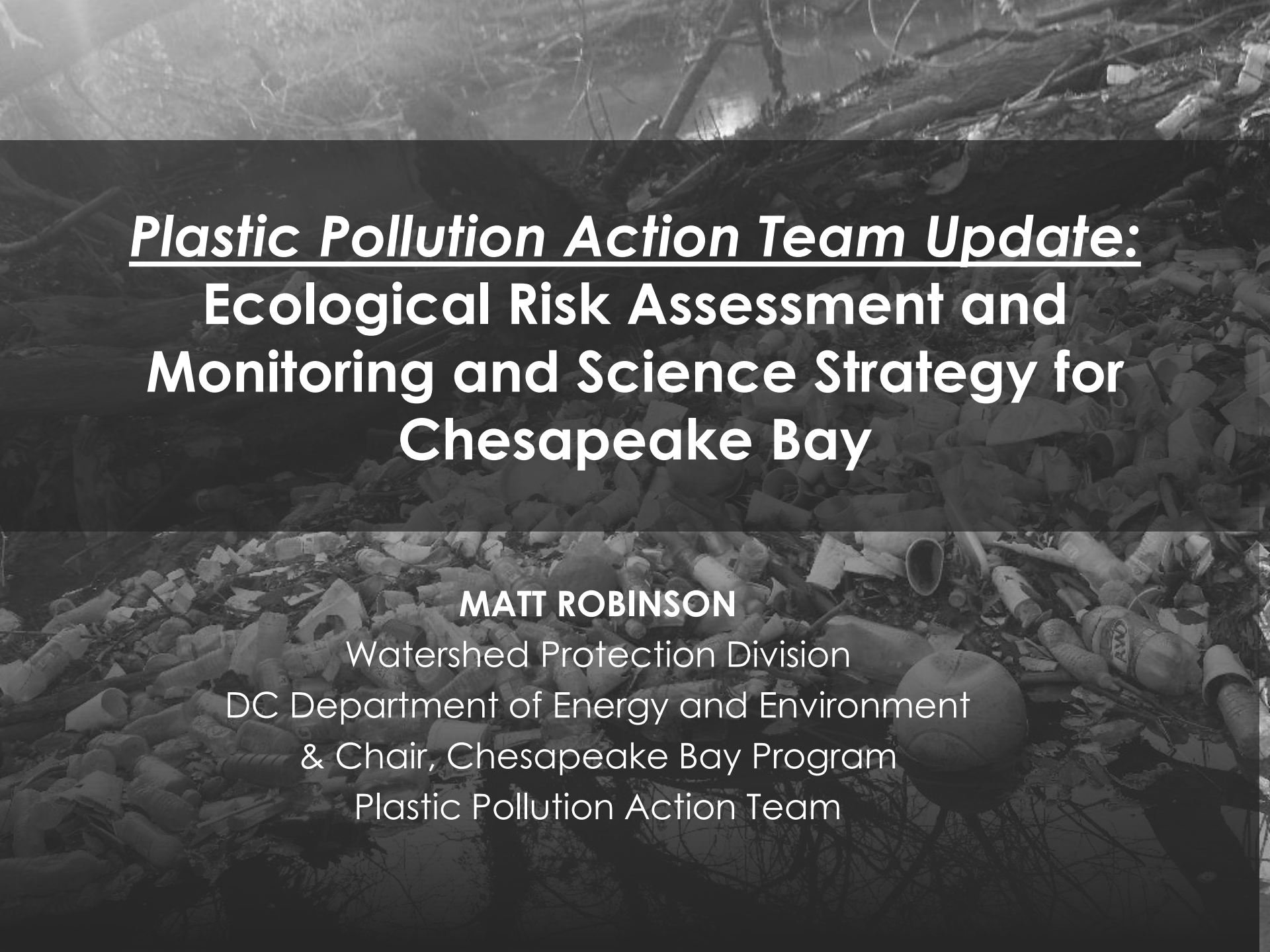
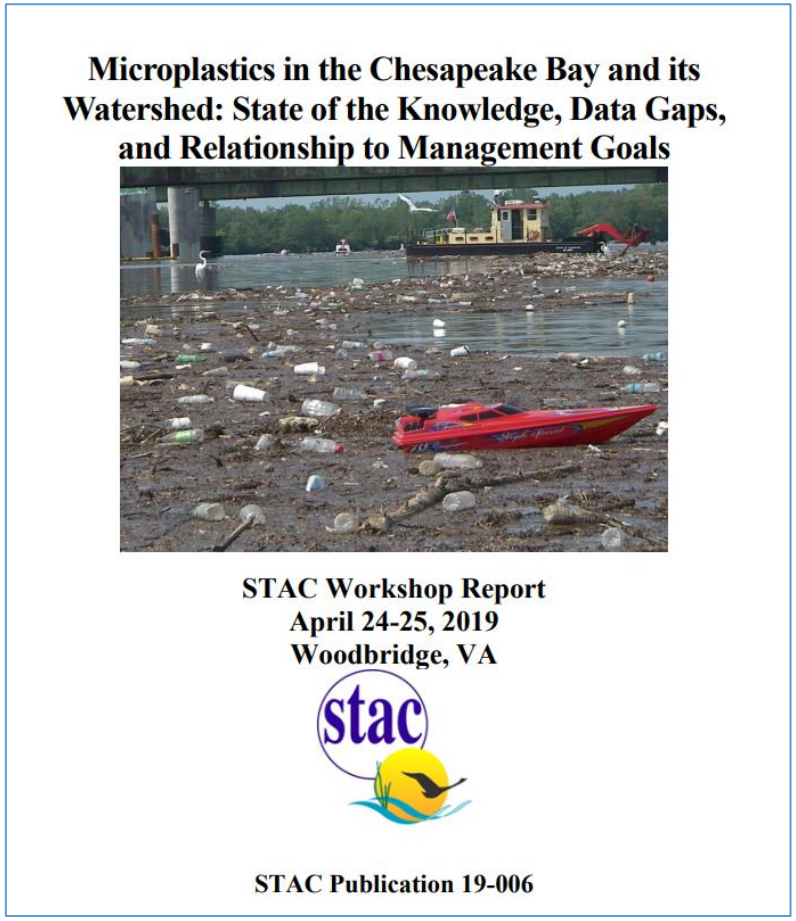


Plastic Pollution Action Team Update: Ecological Risk Assessment and Monitoring and Science Strategy for Chesapeake Bay

MATT ROBINSON
Watershed Protection Division
DC Department of Energy and Environment
& Chair, Chesapeake Bay Program
Plastic Pollution Action Team

Timeline of Progress

- Fall of 2019, STAC released a report from the 2019 workshop entitled, *Microplastics in the Chesapeake Bay and its Watershed: State of the Knowledge, Data Gaps, and Relationship to Management Goals*
- In November 2019, based on a recommendation from the report, the Management Board authorized the creation of a Plastic Pollution Action Team (PPAT).
- Spring of 2020, STAR assisted the PPAT with development of its charge.
- Spring of 2020, Management Board approved the PPAT charge.



PPAT Charge from the Management Board

- Based on recommendations from the 2019 STAC report, the Management Board created the PPAT "*to reduce the presence and impacts of plastic pollution on the Chesapeake Bay and its watershed. The PPAT will begin to address this issue by overseeing research that will help to determine the effects that specifically microplastics have on the Chesapeake Bay ecosystem.*"

- To accomplish this the Management Board assigned the PPAT the following tasks:
  1. Provide oversight of the development of preliminary ecological risk assessments (ERAs) of microplastics for one or more subwatersheds to the Chesapeake Bay (e.g. Potomac).

  2. Use the components and results of the preliminary ERAs to develop a strategy that identifies and if possible, prioritizes gaps in information concerning the effects of microplastic pollution on the Chesapeake Bay ecosystem, and highlights future research questions that need to be answered.

  3. Present results from ERAs to the MB in order to guide future action on addressing plastic pollution.

  4. Monitor policy advances at the state and federal level that could potentially impact, advance or complement this work to inform the science strategy and to identify potential policy or management options that could be utilized for source reduction strategies.

PPAT Charge from the Management Board

- The PPAT was authorized to exist for a two year period.
- During this first year, the PPAT has focused on guiding the development and execution of the preliminary ERAs.
- The second year was originally dedicated to reviewing the results of the preliminary ERAs, and using the results to develop a science strategy that identifies gaps in knowledge.
- The charge also allows for expansion of the two-year timeline if additional work for the PPAT is identified.

Accomplishments to Date

- PPAT was created in Spring of 2020, with 36 members from federal agencies, state agencies, and academia.

- Chaired by Matt Robinson, DC Department of Energy and Environment, and Vice-Chaired by Kelly Somers, EPA Region III

- EPA Region III Trash Free Waters Program secured funding in 2019 to contract Tetra Tech to work with the PPAT and STAC on implementing three of the STAC recommendations/PPAT Charge Tasks:
    1. Development of a Standardization of Terminology document for conducting microplastic research in the Chesapeake Bay and watershed.
    2. Development of a preliminary ERA for Striped Bass in the Potomac River
    3. Development of a microplastic monitoring and science strategy for the Chesapeake Bay

- PPAT met six times between June 2020 and April 2021, and all three tasks listed above were completed by Tetra Tech.

- STAC conducted a merit review of the standardization of terminology document and technical review of the ecological risk assessment.

PPAT Members

Matt Robinson, DC DOEE, Chair
Kelly Somers, EPA Region III, Vice Chair
Justin Shapiro, Staffer/CRC
Bob Murphy, Tetra Tech
Jennifer Flippin, Tetra Tech
Denice Wardrop, CRC/STAC
Kirk Havens, VIMS/STAC
Julie Lawson, DC/CAC
Jennifer Starr, LGAC
Meredith Seeley, VIMS
Rob Hale, VIMS
BK Song, VIMS
Dann Sklarew, GMU
Jonathan Cohen, Univ of Delaware
Rebecca Whiteash, PA DEP
Tish Robertson, VA DEP
Claire Svecik, DNREC
Brooke Landry, MD DNR
Donna Morrow, MD DNR
Mark Trice, MD DNR
Anna Kaskow, MDE
Alex Lopez, Penn State
Phong Trieu, Metro Wash Council of Govts

Claire Buchanan, ICPRB
Christina Davis, ICPRB
Kristen Saunders, UMCES
Michael Gonsior, UMCES
Ryan Woodland, UMCES
Marty Gary, Potomac River Fisheries Commission
Shawn Fisher, USGS
Christy Kehoe, NOAA
Amy Uhrin, NOAA
Carlie Herring, NOAA
Doug Austin, EPA
Bill Jenkins, EPA
Emily Trentacoste, EPA

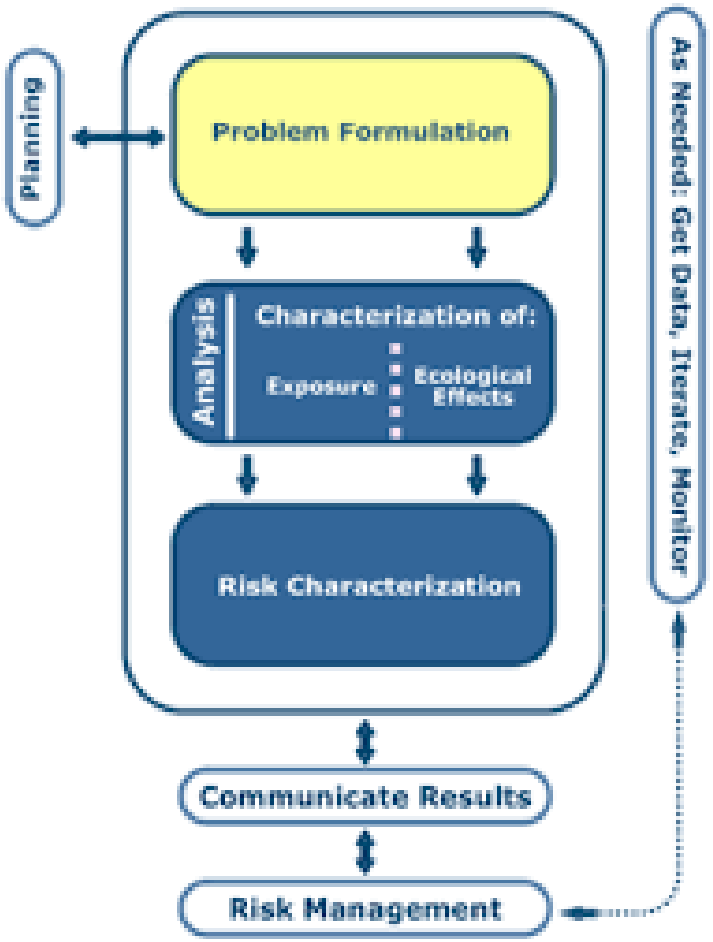
What is an Ecological Risk Assessment?

- A process for evaluating how likely it is that the environment might be impacted as a result of exposure to one or more environmental stressors, such as chemicals, land-use change, disease, and invasive species.

- Three Major Components to an ERA:
  1. Problem Formulation – What is at risk?

  2. Analysis - Exposure Assessment (i.e. what could be exposed?) and Effects Assessment (i.e. research on exposure levels and possible effects)

  3. Risk Characterization – Risk estimation (i.e exposure level assessment) and Risk description (i.e. what are the potential harmful effects)



Problem Formulation: Endpoint - Striped Bass (ages 0-2 YO)

Why Striped Bass?

- Apex predator - Food chain analysis for this species encompasses a multitude of trophic levels and other species.
- Wealth of knowledge on 0-2 age classes based on state juvenile index surveys and diet studies (Boynton et al, 1981; Idhe et al, 2014)
- Iconic Chesapeake Bay species (i.e. Popular sport fish species for several of the Bay states and the District).

Problem Formulation: Where? Potomac River

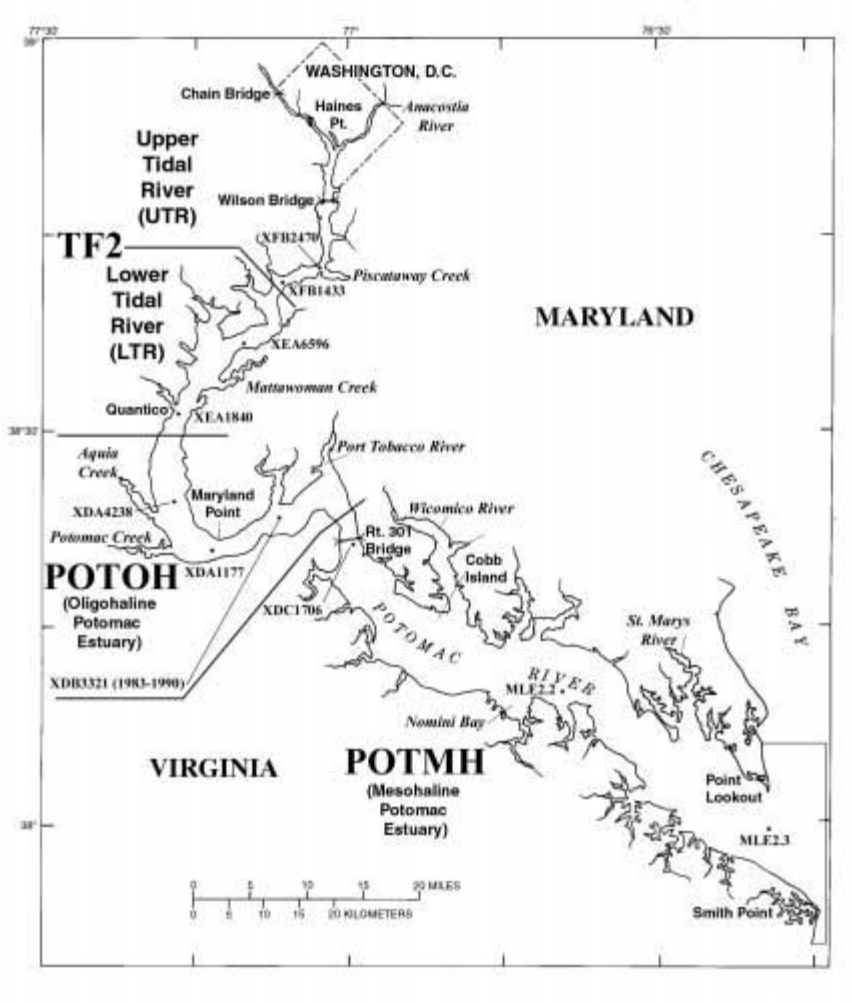
Why the Potomac River?

- Appropriate scale waterbody given the current funding.
- Contains species and habitats prevalent throughout the entire bay.
- The second most important nursery for Striped Bass along the east coast.

ERA Model Input and Criteria for Inclusion Potomac River Striped Bass 0-2YO[1]

Literature Review

1. Potomac River data
2. Chesapeake Bay/other tributary studies
3. Other Atlantic Coast
4. Global



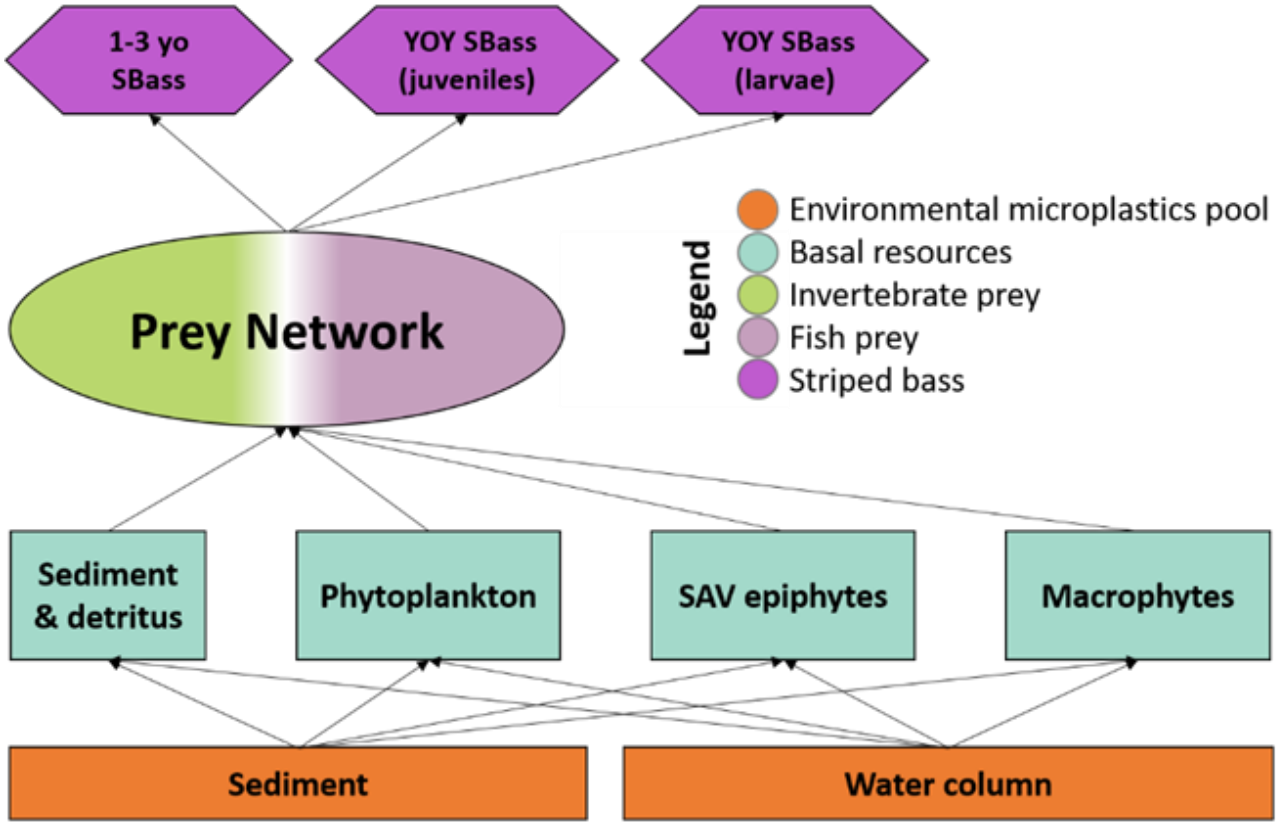
Model Development

Step 1: Defining Biological endpoints of potential interest

Step 2: Determine Qualitative food web interactions that could lead to microplastic intake by Striped Bass;

Step 3: Develop Semi-quantitative food web interaction scenarios for Striped Bass living in different salinity regimes.

Biological Endpoints



Potential Assessment Endpoints

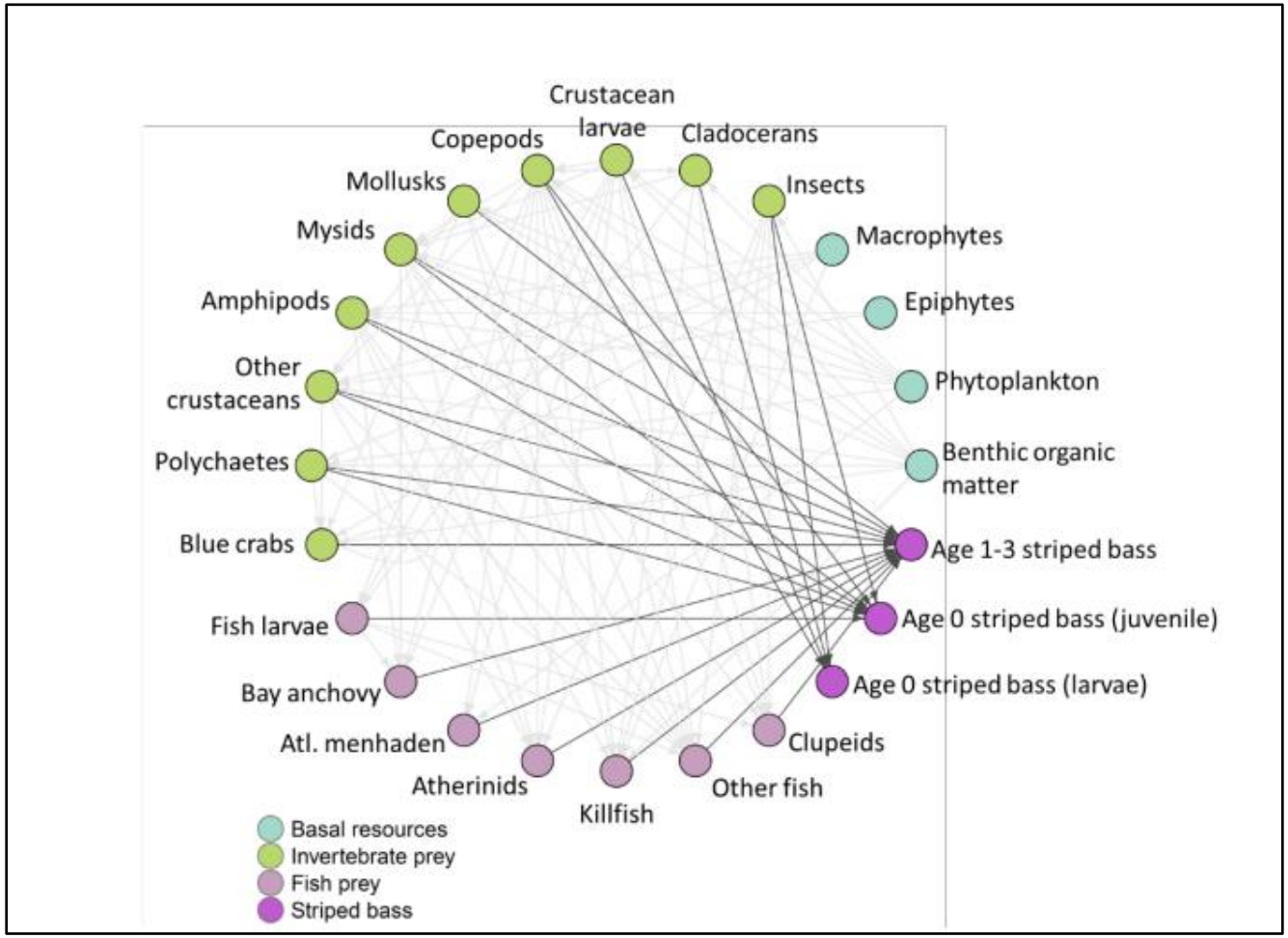
Individual Assessment Endpoints

- Growth rates
- Fecundity
- Predator susceptibility
- Direct mortality
- Physiological condition
- Behavior change

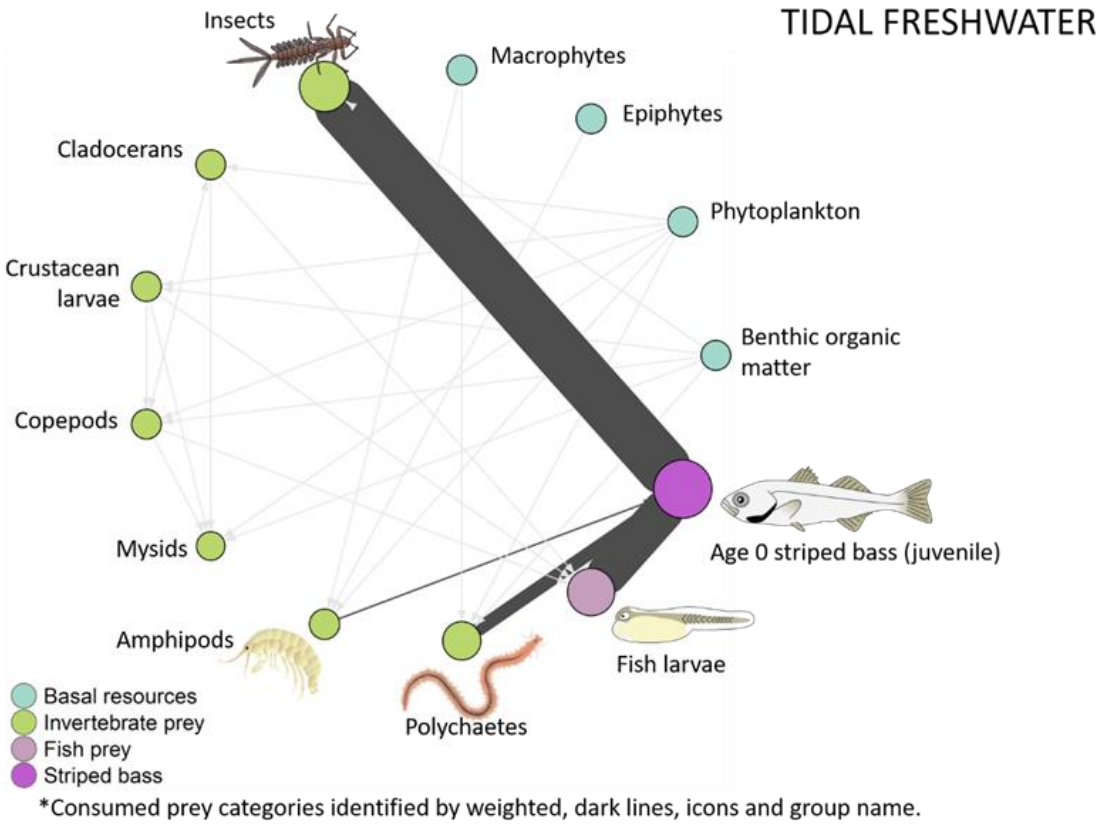
Population Assessment Endpoints

- Catch-per-unit-effort
- Size-at-age
- Age-structure
- Mortality
- Spawning stock biomass

Qualitative food web interactions



Example Semi-quantitative food web interaction



Models completed for tidal freshwater, oligohaline, mesohaline, and bay mainstem.

Microplastic pathways

- Literature review conducted on studies looking at presence of microplastics in Striped Bass prey taxa.
- Studies conducted outside of the Chesapeake Bay and its watershed were included in the literature review.
- 14 different taxa were identified as potential vectors for microplastics to Striped Bass.
- These taxa were given high priority for future research on Striped Bass.
- Additional information gaps were also identified and included in the science strategy.

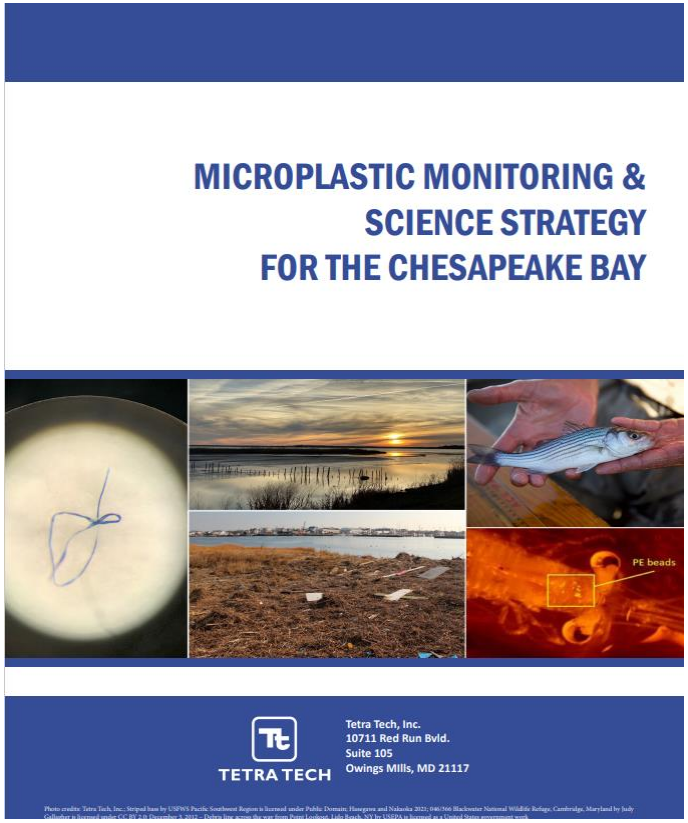
Major Taxa	Confirmed MP presence or consumption? (Y/N)	Location	Citation	Notes
Amphipods	Y	Laboratory	(Jeong et al. 2017, Mateos Cárdenas et al. 2019)	Jeong et al proposed an adverse outcome pathway for microplastic exposure that covers molecular and individual levels.
Mysids	Y	Laboratory	(Setälä et al. 2014, Lehtiniemi et al. 2018, Wang et al. 2020)	Hasegawa et al (2021) demonstrated trophic transfer of microplastics between mysids and fish predator
Polychaetes	Y	Newfoundland; laboratory; Norway	(Mathalon and Hill 2014, Setälä et al. 2014, Knutsen et al. 2020)	
Blue crab	Y	Murderkill and St. Jones Rivers, DE; Texas;	(Santana et al. 2017, Cohen 2020, Waddell et al. 2020)	Santana et al found little trophic cascade; Cohen's work in similar systems to tidal Potomac;
Crustacea (other)	Y	Florida; North Sea	(Devriese et al. 2015, Waite et al. 2018)	Waite et al found MPs in *Panopeus*, a known prey item for striped bass;

Example table showing literature date on microplastic presence in Striped Bass prey taxa

Development of the Science Strategy

- Original Purpose of Science Strategy
  "…will help guide future research on the impacts of microplastic pollution in the Potomac River, Chesapeake Bay, and contributing watersheds. Using the information gaps identified in the development of the preliminary ERA conceptual model, shall draft a document that outlines the necessary research that is needed to address these gaps"

- The PPAT organized the science strategy around four management questions.



Management Questions

1. *How can government and resource managers develop sound policies to reduce [micro]plastic pollution and assessing the economic impacts?*

2. *What health risks are posed by microplastics?*

3. *What are the sources, pathways, composition, and fate of microplastic loadings into the Chesapeake Bay?*

4. *What management actions or policies may be effective in reducing microplastic pollution?*

Recommendations: Sampling and Analytical Methods

- Followed the recommendations outlined in *Uniform Size Classification and Concentration Unit Terminology for Broad Application in the Chesapeake Bay Watershed*

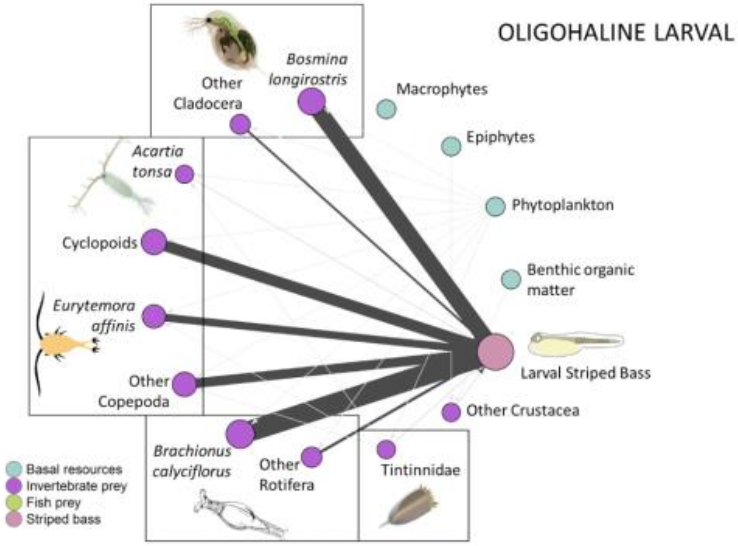
- Standardization of terminology and measurement units for research and monitoring

Recommendations: Addressing Data Gaps

- Lack of experimental data showing effects of microplastic on organisms
  - Relevant conditions (e.g., exposure, biology, ecology)
  - Individual- and population-level effects

- Need for better understanding of trophic transfer
  - Trophic pathways
  - Spatial and temporal dependence?

Basic data such as microplastics load in consumers/prey are not available



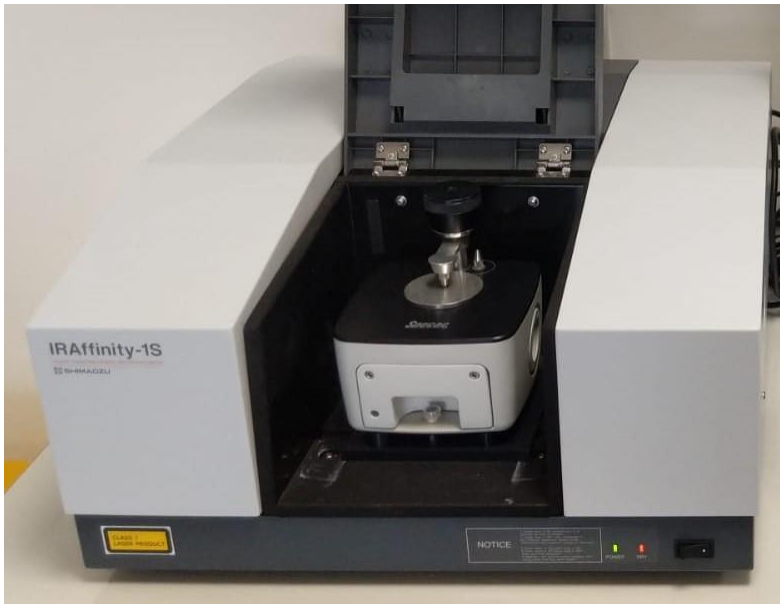
Recommendations: Monitoring Strategy

- Utilize existing CBP framework
  - Benthos
  - Fish
  - Water column
  - Plankton (to be added)
  - Non-tidal

- Methodology
  - Use recommendations outlined in Size classification document

Partnerships and Resources

- Federal and state governments for financial resources and partnership
- Foundation support
- Academic and intellectual resources
- Technical resources (e.g. laboratory equipment)



Takeaways

- Studies have shown microplastics are ubiquitous throughout the bay and its tributaries. They have been found in both tidal (Yonkos et al, 2014; Bikker et al, 2020) and non-tidal waters (Fisher, 2019).

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

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

- The ERA reveals there could be significant impacts on a valuable Chesapeake resource, Striped Bass (i.e. 14 prey taxa are potential MP vectors). Further refinement of the ERA is needed to provide more accurate estimate of the effects to the resource.

- Implementation of the science strategy will put us on a path for understanding the impacts of plastic pollution on Striped Bass and other ecosystem endpoints important to the CBP.

Additional Comments?

MATT ROBINSON
Watershed Protection Division
DC Department of Energy and Environment
& Chair, Chesapeake Bay Program
Plastic Pollution Action Team
matthew.robinson@dc.gov
(202)420-1472