

# Microplastic Research and Pollution Preventative Measures at the US Environmental Protection Agency



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# Office of Water: Trash Free Waters

## 2017 Microplastic Expert Workshop-Interagency governmental and academic experts

Risk assessment-based approach, addressed four major topics:

- 1) Microplastics methods: standardization and validation
- 2) Microplastics sources, transport and fate
- 3) Ecological risks
- 4) Human health risks

### Microplastics Expert Workshop Report

*Trash Free Waters Dialogue Meeting  
Convened June 28-29, 2017*



*EPA Office of Wetlands, Oceans and Watersheds  
Primary Author: Margaret Murphy, AAAS S&TP Fellow  
Report Date: December 4, 2017*

# Model III: Microplastics Toxicokinetics/Toxicodynamics

Little information; low confidence

Some information; moderate confidence

Most information; good confidence

Biomagnification

Sensory Cues

Egestion

Excretion

Nutritional Effects/  
Energetics

Particle Toxicity?

Tissue/  
Cellular Damage

Immune Response

Organism

Bioavailability

Ingestion  
(Incidental/  
Intentional)

Inhalation/  
Gill Uptake

Dermal  
Exposure

Particle Retention Time?

Particle Toxicity/Tissue Damage?

Particle Retention/Absorption/Assimilation

Translocation  
of Particle

Bioaccumulation  
of Chemicals  
(Additives)

Chemical Toxicity

Chemical  
Metabolism

Detoxification/  
Excretion of  
Chemical

Biomarkers  
Behavioral Effects

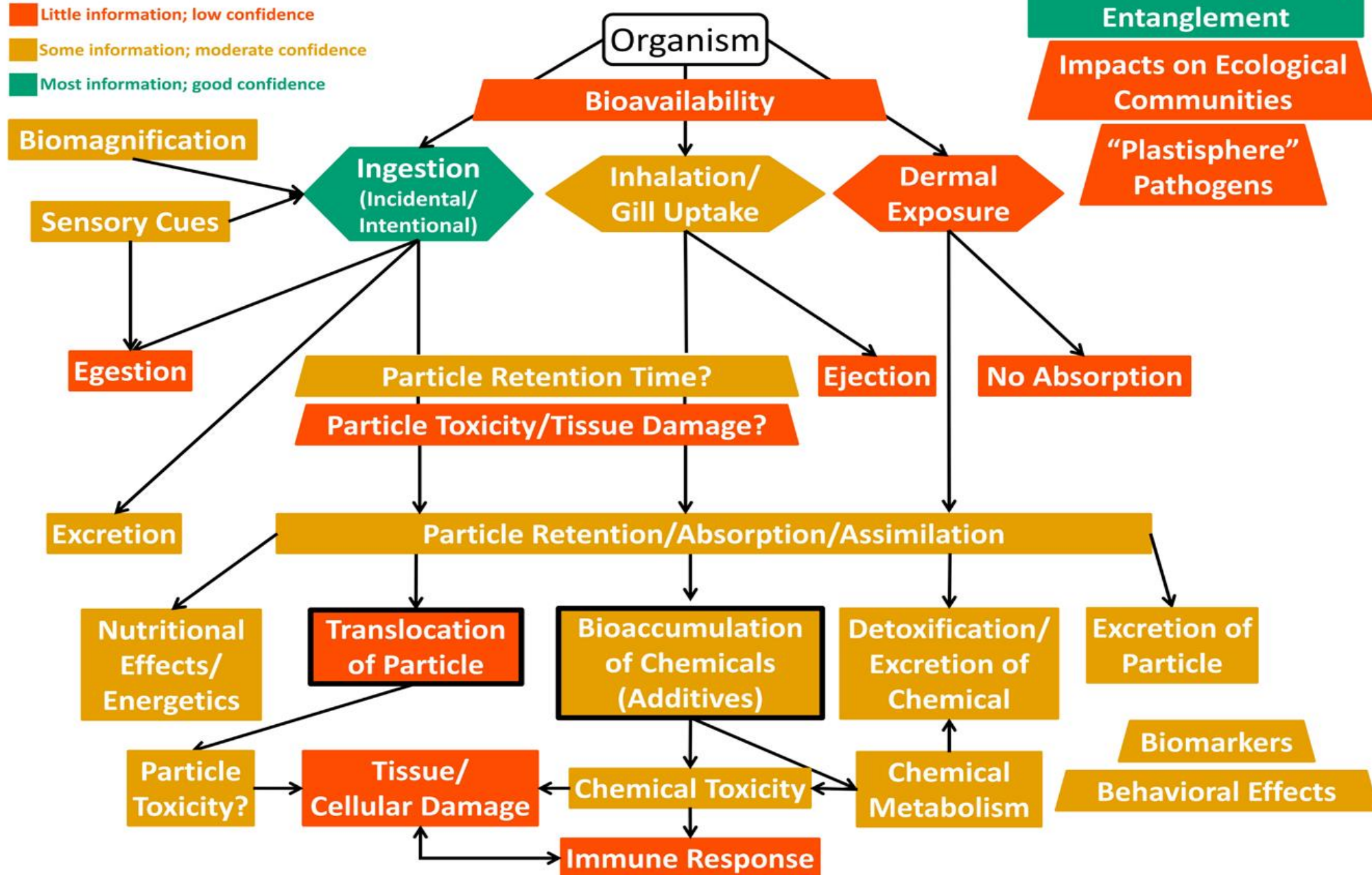
Ejection

No Absorption

Macroplastic Ingestion/  
Entanglement

Impacts on Ecological  
Communities

"Plastisphere"  
Pathogens

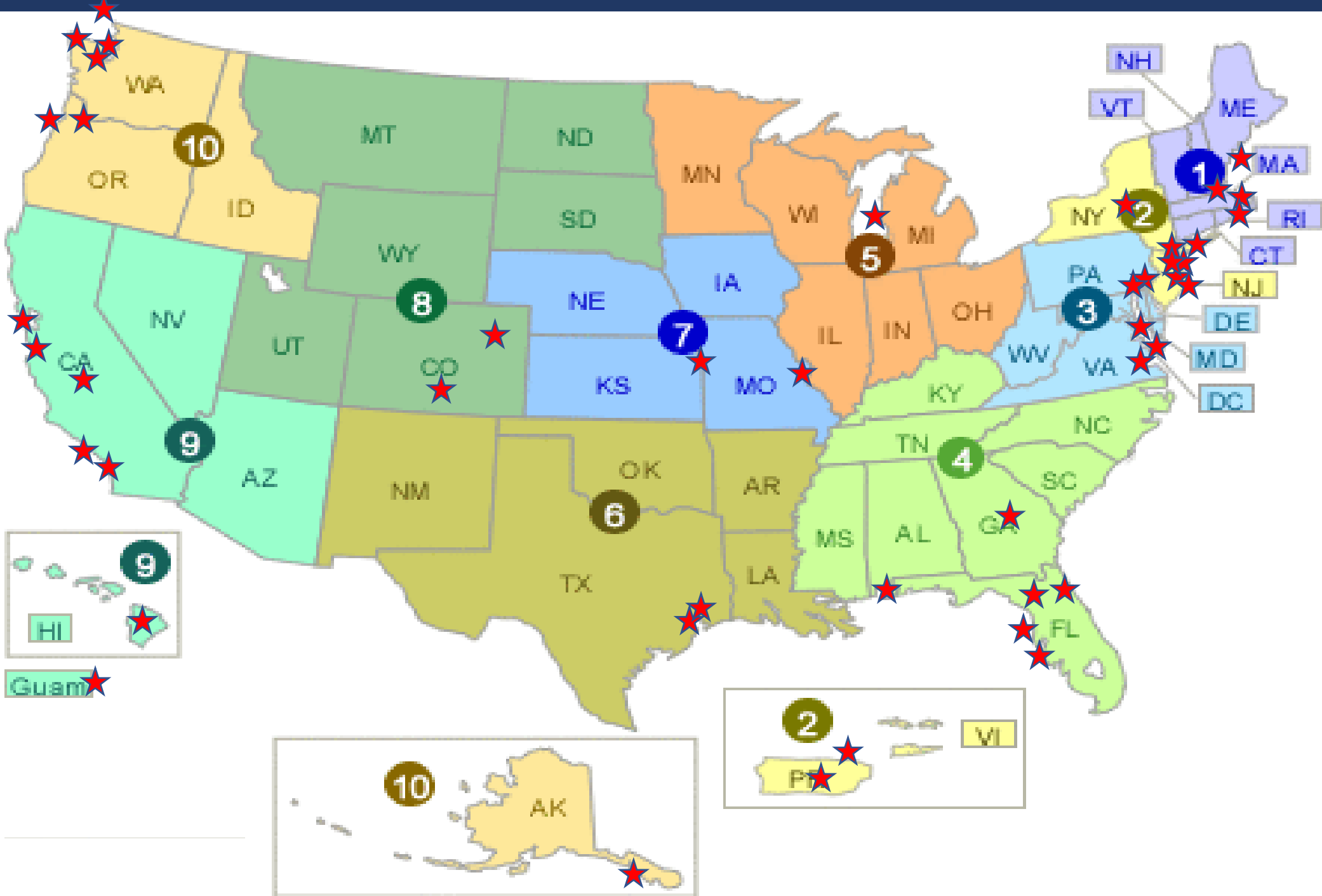


# Great Lakes multi-trophic level study: Microplastic particles and prey identified in the stomach of Great Lakes sport fish



Undigested prey items saved from stomachs of sport fish for analysis of microplastic particles. Partnering with the California Department of Public Health

# OW Trash Free Water Plastic Related Projects

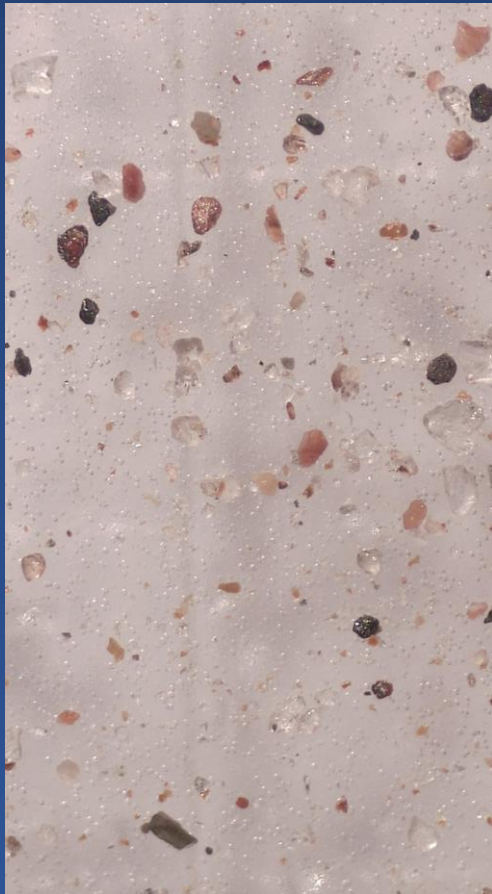


Reg.	St	Watershed/City	Title/Keywords	Partners
1	ME	Gulf of Maine	Gulf of Maine Marine Debris Working Group	NOAA
	NH	Piscataqua/ Durham	Trash Free Piscataqua working groups on single-use plastics litter, pet waste, and derelict fishing gear.	NEP
	MA	Mystic River/Boston	Mystic River Watershed Association testing of Escaped Trash Assessment Protocol; info on BMPs for trash management and assistance on outreach (especially geared towards municipal officials)	UW
	RI	Narragansett/ Providence	1) RARE microplastics sediment research; inter-regional with 2, 3, 9, and 10. 2) Narragansett Bay Estuary Program and Save The Bay anti-litter and source reduction collaboration	ORD, NEP
2	NY	Bronx & Harlem River Watershed/NYC	1) Project WASTE (Waterway and Street Trash Elimination) program expansion with the Bronx River Alliance and a NFWF grant. 2) Cafeteria Culture's Community Art+Media for Trash Free Waters. 3) Trash Free NYC/The Bag Challenge and reusable bag program with Mayor's Office	UW, NEP, NFWF
	NY	Long Island Sound	Product Stewardship Institute Restaurant Guide for Greenport	NEP
	NY	Peconic Estuary	Education and outreach, with monofilament recycling infrastructure installation	NEP
	NJ	Asbury Park	ReThink Disposable's restaurant and music festival engagement in Asbury Park	NJDEP
	NJ	Barnegat Bay/Toms River-Atlantic City	1) Trash Free Waters and Tourism; how NEPs can leverage more community partners and resources. 2) Hydration stations. 3) illegal dumping education campaign. 4) Stockton-NOAA derelict gear removal	NEP; NERR, NOAA
	NJ	Passaic River/NY-NJ Harbor	Stopping Trash Where It Starts in the NY-NJ Harbor Estuary Program study area with Hudson River Foundation; engaging citizens and reducing sources.	UW, NEP
	NY-NJ	State-wide	Public park water bottle refilling stations; 37 locations (21 NY, 16 NJ)	NYSDEC , NJDEP
	PR	San Juan Bay	1) Trash Free Waters and Tourism; how NEPs can leverage more community partners/resources. 2) Debris removal/characterization at 2 flood-pump stations	UW, NEP
	PR	Island-wide	Aguas Sin Basura working group, meetings and 5 target single-use plastics	UW, NEP

# Regional Applied Research Effort (RARE) in conjunction with ORD

- Quantification/comparison of sediment methods (Kay Ho, Robert Burgess; Michaela Cashman ORD, ACESD)
- Development of methods for corals (Cheryl Hankins; ORD, Gulf Breeze, FL)
- Standardization of water methods via ASTM (Anna-Marie Cook; Region 9)

# Quantification/ Comparison of Sediment Extraction Methods



## Background

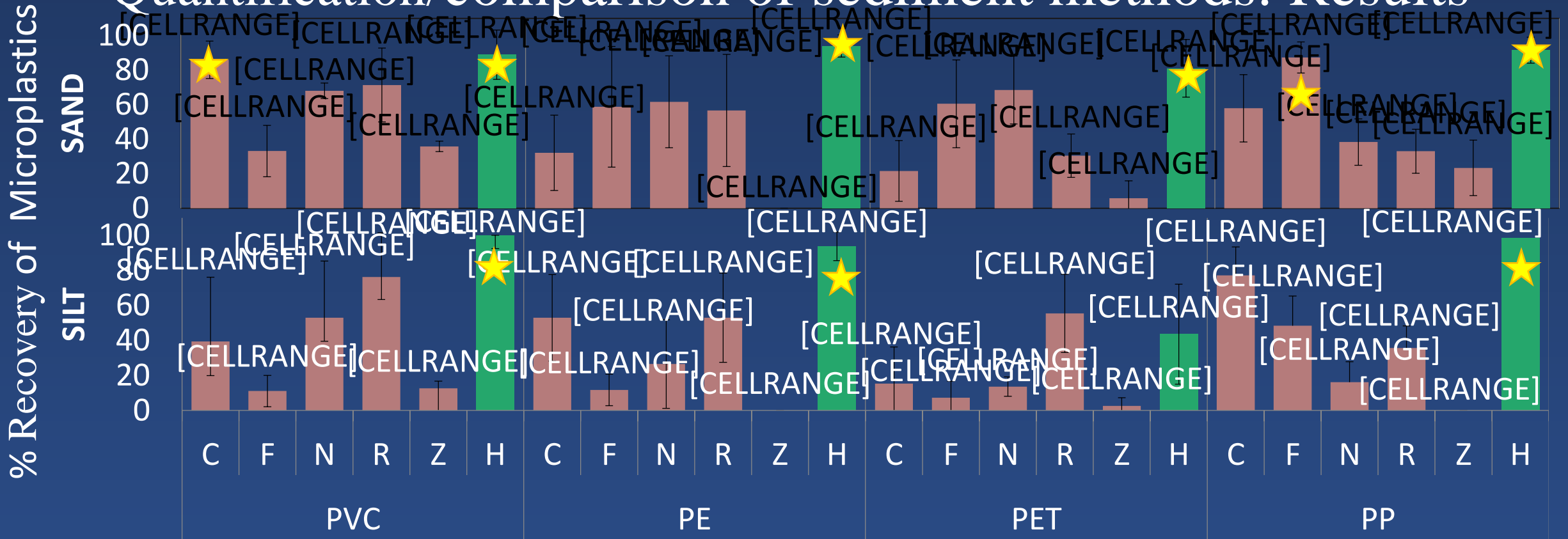
- Many existing methods, all different.
- Comparison of results among the methods not meaningful.

## Objective

- Assess 5 current methods for the extraction and isolation of microplastics from samples using 2 sediments, 5 plastic types.
- Based on initial findings, develop hybrid method to extract MPs from sediments.



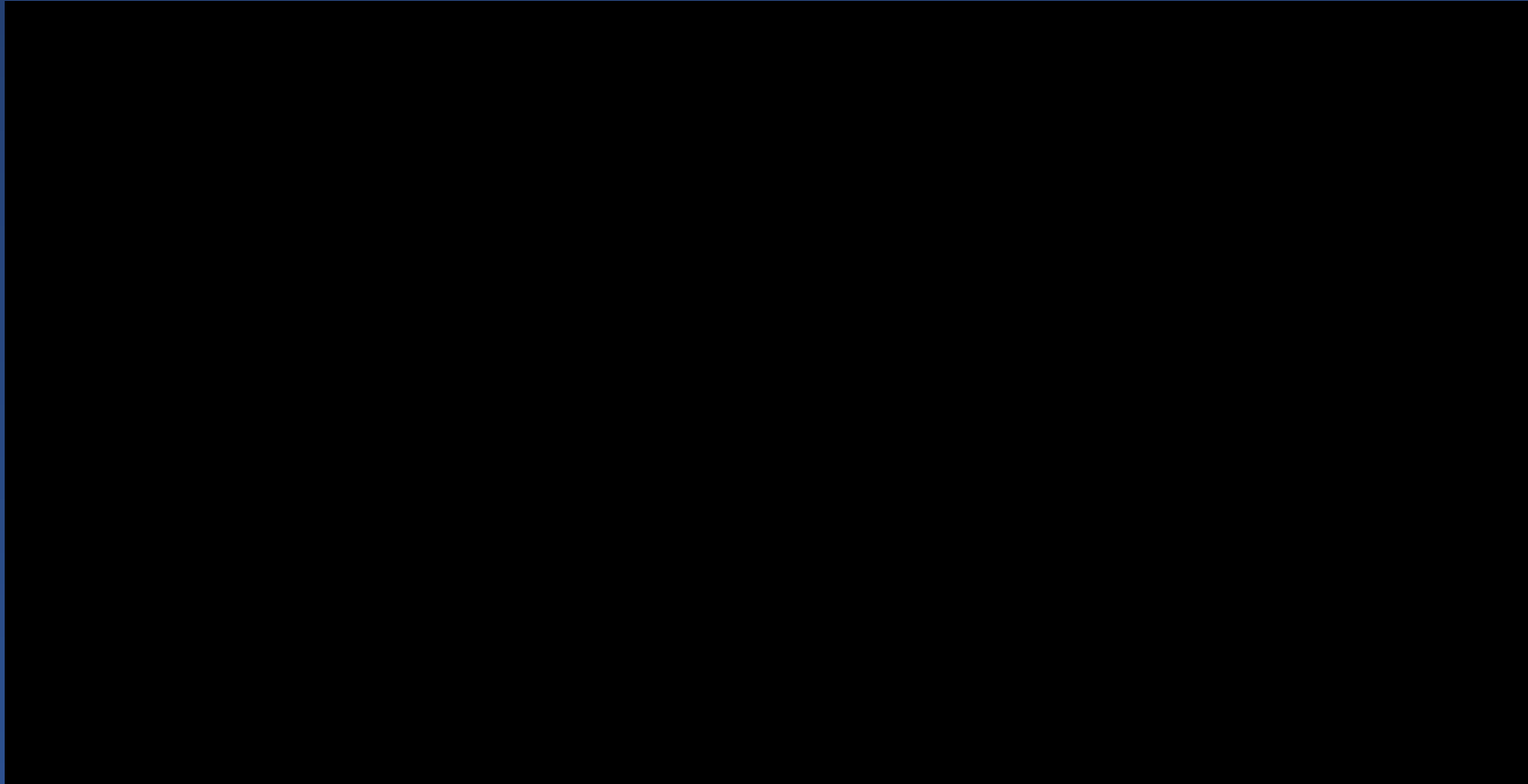
# Quantification/comparison of sediment methods: Results



- No existing method consistently extracted >70% of each MP
- Sediment, MPs, and extraction methods all affect percent recovery
- Hybrid method generally extracted >70% from both sediments and most MPs
- Next step use hybrid method to extract MP from regional sediments.

# Coral Reef Methods (Cheryl Hankins ORD, Gulf Breeze)

- Develop methods for the quantification of microplastics in coral reefs
- Determine retention time and coral size preference for microplastics



Ultra-sonic disruption for tissue processing is successful but needs confirmation via FTIR identification

# Office of Research and Development (ORD)

## National Research Program (FY2020)- Safe and Sustainable Waters Program

Method Development for isolation/identification of MPs in water and sediment

- State of California - Drinking water methods for MPs by Fall 2020
  - Southern California Coastal Water Research Project (SCCWRP)
  - Methods for sediment in the outyears
- Evaluate hybrid sediment method in a limited field survey in 2020-National Coastal Condition Assessment
- Build capacity in EPA labs and standardize methods for micro/nano plastic identification and quantification using  $\mu$ FTIR, raman, hyperspectral imaging, flow cytometry, density gradient centrifugation, ultrafiltration, magnetic and metallic labeling and separation, nanoparticle tracking analysis (NTA), flow field flow fractionation (AF4), ICPMS and scanning electron microscopy (SEM).

# Colonization of Plastics by Pathogenic Bacteria (Marirosa Molina, RTP.)

## ORD Pathfinder Innovation Project

- Identify conditions that favor the establishment of pathogenic bacteria in the plastisphere.
- Metagenomic analysis, functional gene probing, flow cytometry and microscopy.
- Use machine-learning techniques to combine numerical and categorical data to generate predictive models for pathogen presence in biofilms.



Urban watershed



# Other Research at EPA

# Impacts of Microplastics on SAV Beds in the Anacostia River

EPA Region 3, DC Department of Energy and Environment, Metropolitan Washington Council of Governments (MWCOCG), and Tetra Tech (TT)

Previous work indicated higher concentrations of MP found in SAV Beds in the Potomac versus the open water column. Do MP concentrate in SAV bed sediments versus unvegetated areas.

This research could reveal whether SAV beds act as a sink for microplastics and potentially expose other aquatic organisms to microplastic contamination.



# Microplastics in Tribal Subsistence Foods in Southeast Alaska

EPA Environmental Justice Group

The Sitka Tribe, University of Alaska, Mount Edgecumbe High School, the Southeast Alaska Watershed Coalition, and Sitka Conservation Society.

MP were found in almost all bivalves usually less than 10/organism.



- Food chain effects of microplastics on Tern Island (Hawaiian archipelago) (Anna- Marie Cook- Superfund)
- Bivalve uptake and cellular effects of nanoplastics (ORD-ACESD, Univ of CT)

