NNI Public Webinar:
Overview of U.S. Government Activities Addressing Micro- and Nanoplastics Issues
Session 1: Research Agencies

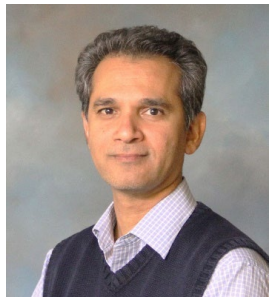
10:30 Introduction/background (Anil Patri, FDA, moderator)
10:35 NIST: Overview (Kate Beers)
10:45 NSF: Overview (Anne-Marie Schmoltner)
10:55 USDA: Overview (Hongda Chen)
11:05 DOE: Overview, including WaterPact (Ben Maurer)
11:15 NOAA Marine Debris Program (Amy Uhrin)
11:25 USGS: Overview (Shawn Fisher)
11:35 NIEHS: Overview (Nigel Walker)
11:45 Facilitated Q&A and discussion

Kate Beers
Manager, Circular Economy Program, NIST

Anne-Marie Schmoltner
Program Director, Environmental Chemistry, NSF

Hongda Chen
National Program Leader for Bioprocess Engineering and Nanotechnology, USDA/NIFA

Ben Maurer
Sustainable Oceans Lead, NREL



Anil Patri
Director, Nanotechnology Core Facility. FDA
(**Moderator**)

Amy Uhrin
Chief Scientist, Marine Debris Division, NOAA

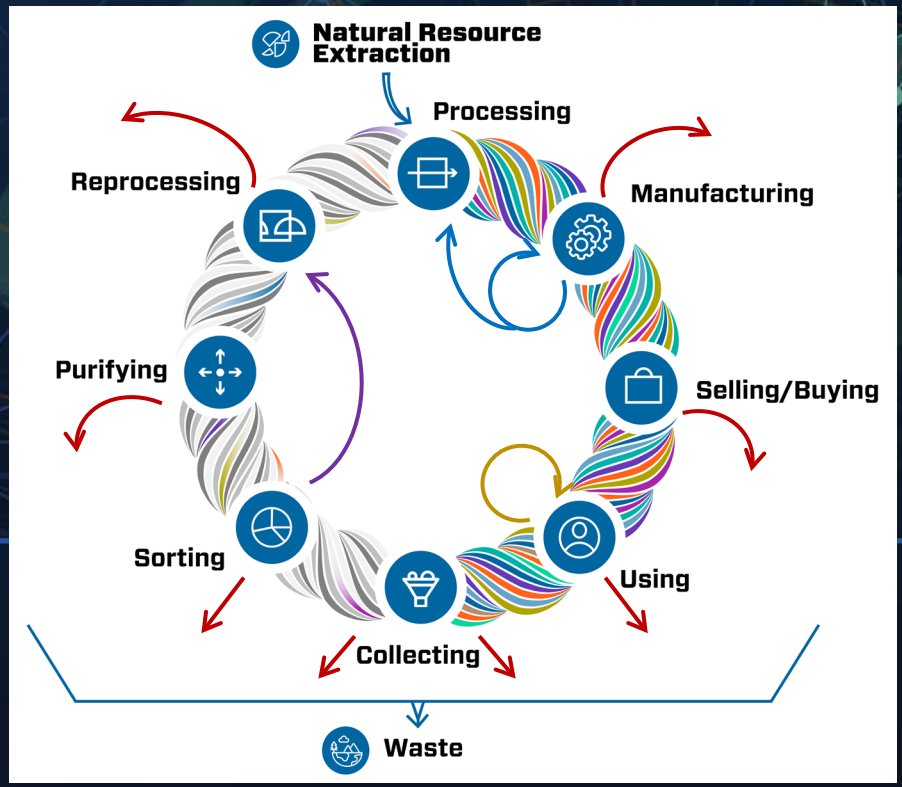
Shawn Fisher
Hydrologist, USGS New York Water Science Center

Nigel Walker
Acting Chief, Systems Toxicology Branch, NIH/NIEHS

https://www.nano.gov/PublicWebinars

NIST Overview: Nanoplastics-related research and products

Kathryn Beers
Leader, Circular Economy Program



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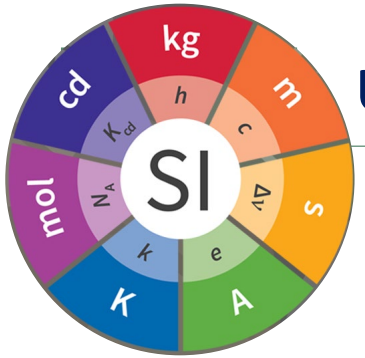
U.S. DEPARTMENT OF COMMERCE

NIST



US' National Metrology Inst.

- Industry's National Lab
- Measurement, Data, Standards
- Reference Materials, Calibrations

Plastic Pollution & The Circular Economy

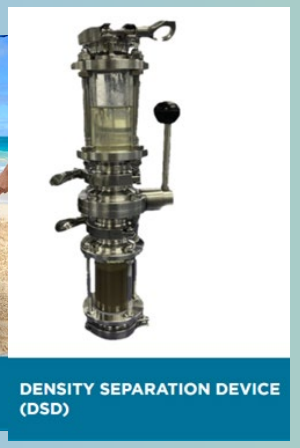
- Materials Science & Design
- Data & Decision Tools
- Environmental Impact Assessment

Keeping atoms and molecules inside the economy, producing value, and out of places we don't want them

Breadth of MNP Measurement and Standards Roles

Real Environmental Samples

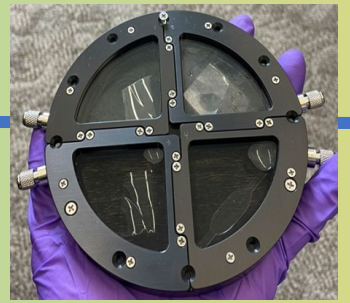
BUOYANCY SEPARATION DEVICE (BSD)

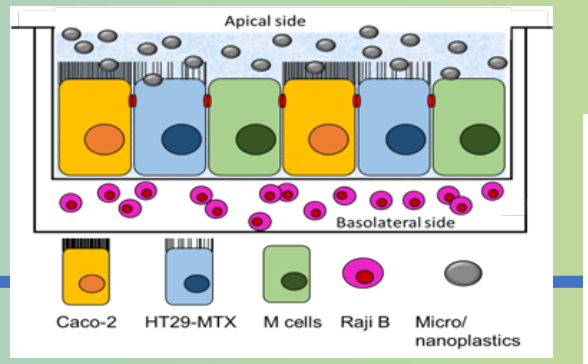


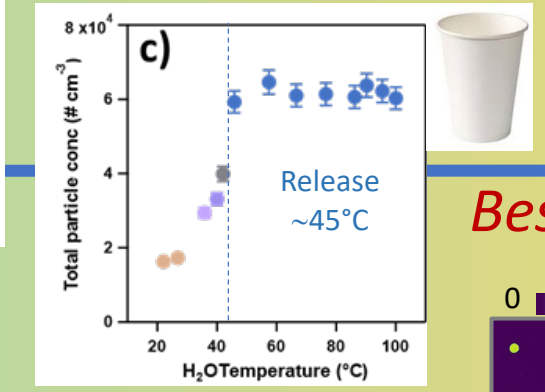
DENSITY SEPARATION DEVICE (DSD)

Laboratory Models

Advanced Instrumentation and Technology



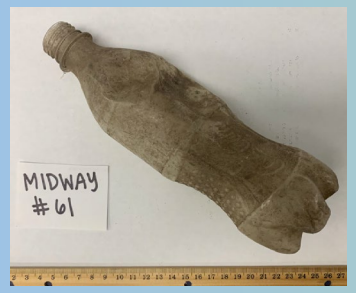




Frontiers of Physical Measurement

Documentary Standards

Best Practices



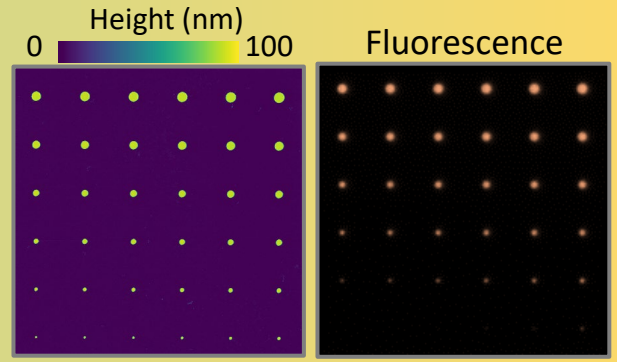
Joint Research Centre JRC

ISO

ASTM INTERNATIONAL

VAMAS

Reference Materials

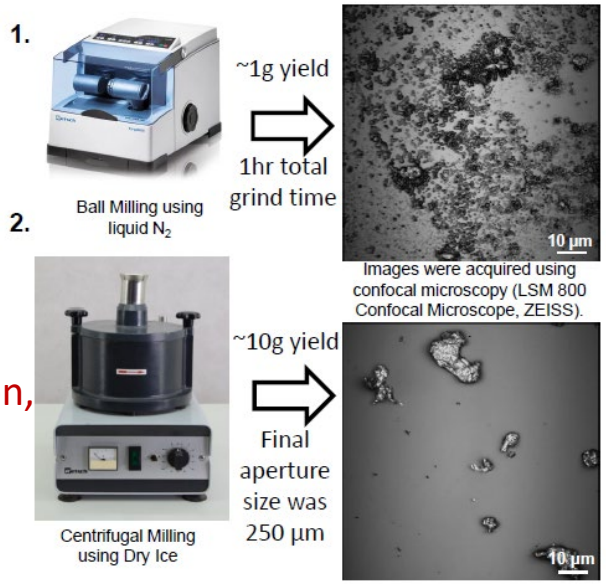


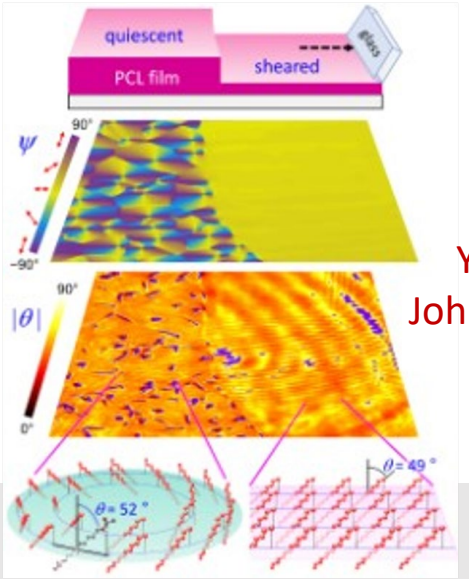
Methods and Tools are Key Products

Jenn Lynch
Katy Shaw,
et al.

RGTM production

Li-Piin Sung
Elijah Peterson,
et al.





Young Lee
John Pettibone,
et al.

Environmental Sampling

- Sediment, beach sand, fish guts, turtles
- Extraction/recovery method verification; cryomilling RGTMs
- Examining natural matrix SRMs
- Measurements from prototype asphalt runoff

Laboratory Models/Testing

- Accelerated aging/weathering: degradation in aquatic environments
- Milling protocols developed
- Cell-based model of intestinal tract to assess uptake of particles

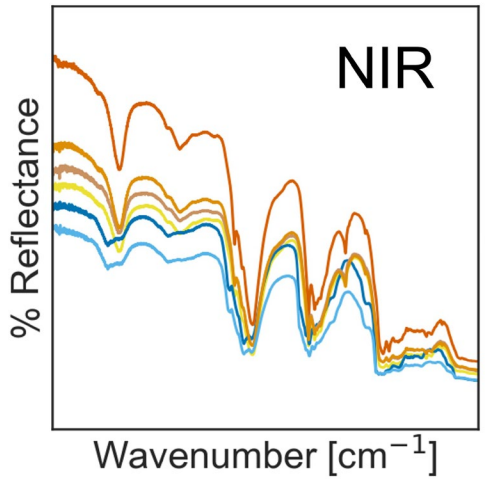
Advanced Measurement

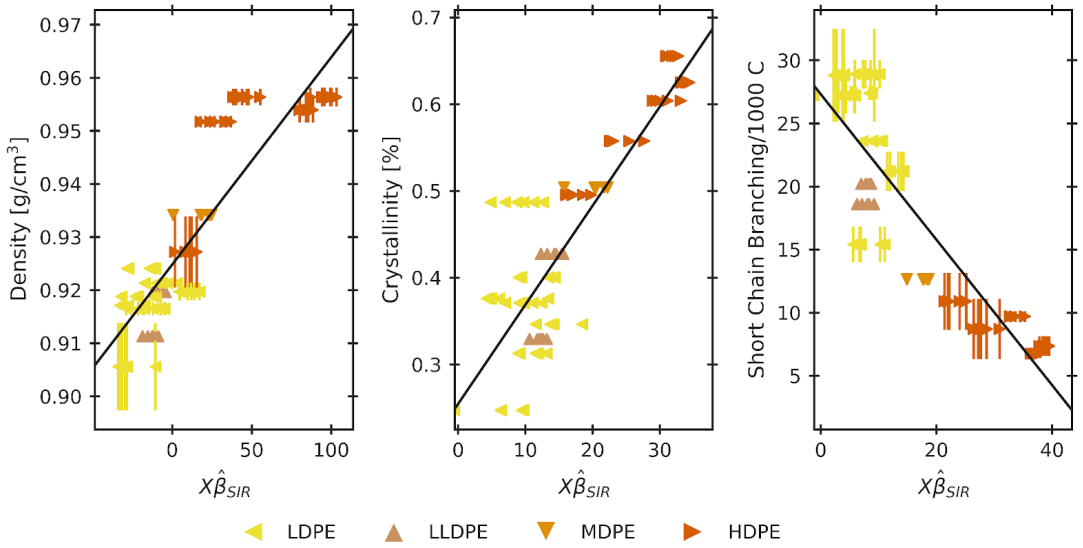
- New capabilities coming on-line (OPTIR, QCL-IR, w/ BCARS microscopies) to challenge detection limits for size, composition and structure
- New laboratory for nanoplastics in liquid media

Lessons in Data and Methods

Growing role of ML/AI and Data Science

Integration of advanced data analytics into multiple workflows



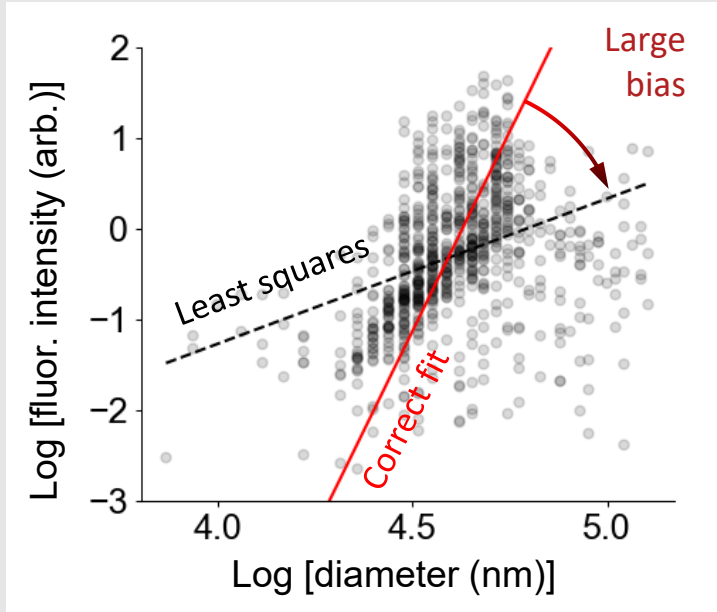


Brad Sutliff
Debbie Audus
Tyler Martin
Sara Orski

Nanoparticle measurement error

- *Disruptive to status quo*
- Improved reliability critically needed
- Small errors – large effects

ACS Nano, Letter to the Editor, in press



Andrew Madison
Adam Pintar
Sam Stavis

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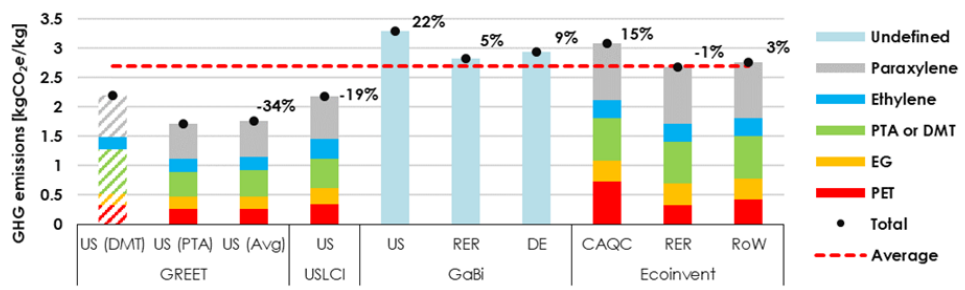
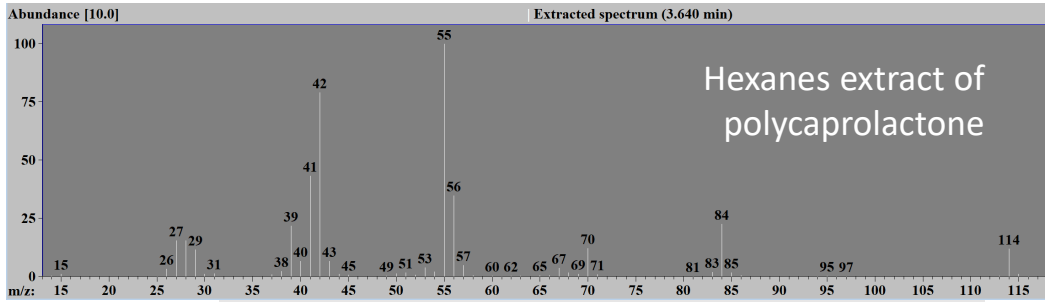
Related work - Partnerships



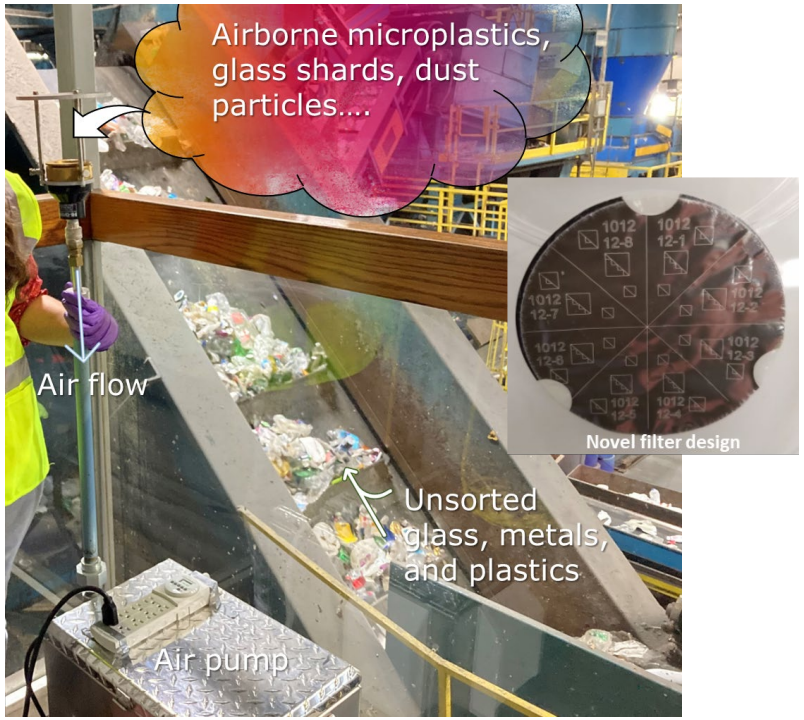
We work with many other agencies: NSF, NIH, NOAA, EPA, DOE, USDA, State, USTR, etc.



LCA Intercomparison Study

- Intercomparison of data inventories and models provides insight, and case for deeper analysis of LCA claims

Josh Kneifel (NIST), Taemin Kim (ANL), Troy Hawkins (ANL), et al.



Joe Conny, Diana Ortiz-Montalvo, Abigail Lindstrom, et al.

MS Database (NIST23)

- To be released at ASMS June 5
- > 8,000 new entries specific to plastic formulation (additives)
- New work on mixtures and polymer chain fragmentation

Yamil Simon, Bill Wallace, built on CompTox work with EPA, NIH and FDA

THANK YOU!

Rachel Cook
David Goodwin
Song-Syun Jhang
Sara Rostampour
Li-Piin Sung
Matt Triebe

David T. Newton
Adam L. Pintar
Gregory J. Stock

Debbie Audus

Ana Barrios
Peter Beaucage
Stephanie Cao
Joe Conny
John Elliott
Robert Fletcher
Tom Forbes
Amanda Forster
Justin Gorham
Robert Gutierrez
John Kucklick
Young Lee

Abigail Lindstrom
Jennifer Lynch
Tyler Martin
Diana Ortiz-Montalvo
Ana Morales
Sara Orski
Elijah Peterson
John Pettibone
Jimmy Radney
Kelsea Schumacher
Meredith Seeley
Katherine Shaw

Yamil Simon
Brad Sutliff
Bill Wallace
Eric Windsor
Chris Zangmeister

Craig R. Copeland
B. Robert Ilic
J. Alexander Liddle
Andrew C. Madison
Samuel M. Stavis
Daron A. Westly

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U.S. DEPARTMENT OF COMMERCE

beers@nist.gov

https://www.nist.gov/circular-economy

Support for Micro- and Nanoplastics Research at the National Science Foundation (NSF)

Anne-Marie Schmoltner, Program Director
Division of Chemistry
Directorate of Mathematical and Physical Sciences
aschmolt@nsf.gov
May 22, 2023

What is NSF and how do we support research?

- NSF is an independent agency of the US Federal Government
- FY 2023 budget: $9.9B
- NSF funds basic research, mostly at academic institutions
- New Directorate: Technology, Innovation, and Partnerships (TIP)
- Disciplinary and interdisciplinary programs, Centers, STEM Education..
    - Nanoscale Science and Engineering (since ~2000)
        - Led by Mihail Roco
        - Included environmental, health and safety studies since 2000
        - Centers for Environmental Implications of Nanotechnology (CEIN)
    - Cross-government coordination: NNI, NSET, NNCO

NNI – National Nanotechnology Initiative
NSET – Nanoscale Science, Engineering and Technology SC
NNCO – National Nanotechnology Coordination Office

Nanoscience and Engineering and Nanoplastics

- Has been and continues to be funded through various programs at NSF
- Micro-and Nanoplastics are a topic of more recent interest

<u>Examples of recent larger-scale efforts:</u>

EFRI - Engineering the Elimination of End-of-Life Plastics (E3P)

FY20-FY21, 17 awards about $30M

GCR: Collaborative Research: Convergence on Micro- and Nanoplastics in Aquatic Environments, Award # 1935028

DCL NSF 20-050: Critical Aspects of Sustainability (CAS): Micro- and Nanoplastics (MNP)

EFRI: Emerging Frontiers in Research and Innovation
GCR: Growing Convergence Research

DCL NSF 20-050: Critical Aspects of Sustainability (CAS): Micro- and Nanoplastics (MNP)

Participating NSF Directorates and Offices:

Mathematical and Physical Sciences
Engineering
Geosciences
Biological Sciences
STEM Education
International Science and Engineering

Examples of recent awards

Formation, sources, measurement approaches/analytical techniques

CMMI - 2245155 Maryam Shakiba, Virginia Polytechnic Institute and State University

"CAREER: Pathways of Microplastics Creation: Multi-physics Study of Macroplastic Fragmentation, Foliation, and Fibration“

CBET - 1917614 and 1917676 Shannon Bartelt-Hunt, University of Nebraska-Lincoln, and Nicole Fahrenfeld, Rutgers University New Brunswick

"Terrestrial microplastic pollution: understudied sources, source tracking, and citizen science"

TI – 2136729 Jennifer Brandon, Applied Ocean Sciences, LLC

“SBIR Phase I: Developing the First Flow-Through Sensor for Real Time Microplastics Measurements”

DMR - 2034496 Qian Chen, University of Illinois at Urbana-Champaign

"Mapping the structure-property relationships of micro- and nanoplastics by in-situ nanoscopic imaging and simulation"

Examples of recent awards

Aging, adsorption of toxic substances, biofilms, aggregation, interactions with biological materials

CHE - 2035499 Julie Peller, Valparaiso University, and Stephen Mezyk, Cal State, Long Beach

"Laboratory Radiation Chemistry Methods to Induce Rapid Aging of Microplastics in Water to Assess Fundamental Chemical Reactivity Changes"

EAR - 2052956 Lauren Pincus, Postdoctoral Fellow

"Microplastics and Nanoplastics as Vectors for Inorganic Pollution: Examining the Effect of Environmental Systems Conditions on Degradation Pathway and Sorption Potential"

DBI - 2109523 Cody Garrison, Postdoctoral Fellow

"Microbes and Microplastics: Microbial Adaptations during the Anthropocene“

CBET - 2034855 Xin Yong, SUNY at Binghamton and Ke Du, University of California, Riverside

"Understanding "wild-type" nanoplastic uptake in single microalgae cells with fluorescence tracking and computational modeling"

Examples of recent awards

Transport, fate, and degradation

CBET - 2044836 Maryam Salehi, University of Missouri-Columbia

"CAREER: An Investigation of Microplastics Fate and Contaminant Transport in Storm Runoff, The Nexus of Environmental Engineering and Material"

AGS - 2028644 and 2028633 Qi Li, Cornell University and Gabriel Katul, Duke University

"Precursors of Long-Distance Aerial Transport of Microplastics from Urban Environments"

EAR - 2045871 Monica Arienzo, Desert Research Institute

"Microplastics in snow-dominated environments - sources, transport, and fate"

EAR - 2219334 Samuel Munoz, Northeastern University

"Evaluating Patterns and Controls on Microplastic Accumulation in Floodplains"

OCE- 2127503, 2127669, 2127305 Kara Law, Sea Education Association, Aron Stubbins, Northeastern University, and Valier Galy, Woods Hole Oceanographic Institution

"Assessing the contribution of plastics to marine particulate organic carbon"

Examples of recent awards

Impact on organisms and ecosystems, food webs, and communities

OPP - 2138316, 2138317, 2138318 Michael Steele, University of Washington, Alexandra Jahn, University of Colorado, Boulder, and David Bailey, UCAR

"Sea ice-ocean exchange of Arctic microplastics: linking small scales to the large-scale system"

DEB - 2136670 Corey Brelsfoard, Texas Tech University

"Predicting the impact of microplastics on the microbiota and viral transmission by mosquitoes"

DEB - 2035573 Tham Hoang, Loyola University of Chicago

"EAGER: Movement of microplastics within and between ecosystems: influences on zooplankton feeding behavior, primary productivity and nutrient availability in freshwater systems“

CBET - 2115447 Heejun Chang, Portland State University

"SRS-RN: Microplastics Across the Columbia River basin to the Ocean - Social-Ecological-Technological System"

Examples of recent awards

Solutions: reduce likelihood of formation; remove from wastewater

CHE - 1901635 Marc Hillmyer, University of Minnesota

"Center for Sustainable Polymers"

TI - 2043075 Ting Xu, University of California, Berkeley

"I-Corps: Biodegradable plastics that incorporate plastic degrading enzymes"

TI - 2126765 Kelsey Sakimoto, Biko Biolabs, LLC

"SBIR Phase I: Plastic Waste Oxidation to Soil Carbon Amendments"

CBET - 2200436 Hongbo Du, Prairie View A&M University

"Excellence in Research: Hybrid Ceramic Membrane Bioreactor and Reverse Osmosis Processes for the removal of Micro and Nano plastics from Municipal Wastewater"

CBET - 2029327 Carol Hall, North Carolina State University

"EFRI E3P: Massive Microplastics Remediation using Novel Microcleaners and Microbiome Processing Accelerated by Artificial Intelligence"

Examples of recent awards

K-12 and informal education, Broadening Participation

EES - 2112554 Arturo Pacheco-Vega, Cal State LA

"CREST Center for Advancement toward Sustainable Urban Systems"

EES - 2022887 Chunlei Fan, Morgan State University

"HBCU-RISE: Enhancing research and education infrastructure of the Bioenvironmental Science PhD program at Morgan State University"

EEC - 2150424 Marina Tsianou, Suny at Buffalo

"REU Site: Plastic Recycling and Advanced Chemical-physical Transformations for Improved Circular Economy“

Thank you for your interest!

Anne-Marie Schmoltner, Program Director
Division of Chemistry
Directorate of Mathematical and Physical Sciences
aschmolt@nsf.gov
May 22, 2023

USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

BIOENERGY, CLIMATE, AND ENVIRONMENT
FOOD PRODUCTION AND SUSTAINABILITY
YOUTH, FAMILY, AND COMMUNITY
FOOD SAFETY AND NUTRITION
INTERNATIONAL PROGRAMS

NIFA

Research, Education and Extension Activities on Micro- and Nanoplastics

Hongda Chen, National Program Leader

National Institute of Food and Agriculture (NIFA)

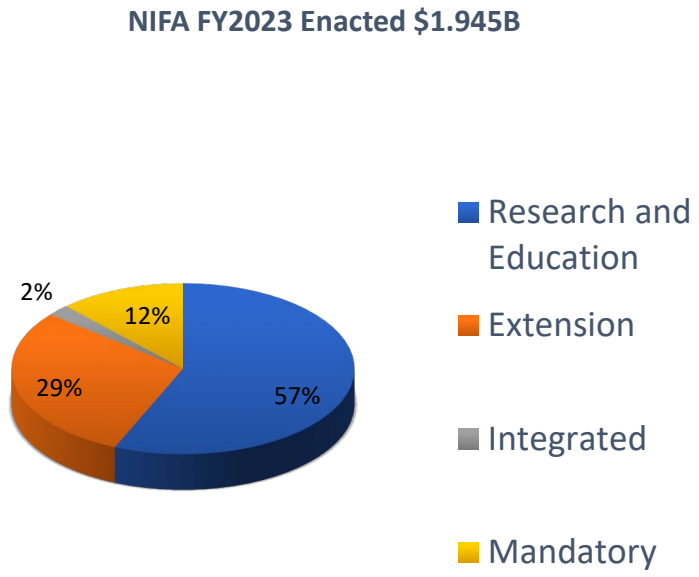
User Inspired Science Transforming Lives

MISSION*: Invest in and advance agricultural research, education, and extension to solve societal challenges*

VISION*: Catalyze transformative discoveries, education, and engagement to address agricultural challenges.*

Leadership: Dr. Manjit Misra, Director

Funding opportunities: Upcoming Request For Applications Calendar | National Institute of Food and Agriculture (usda.gov)

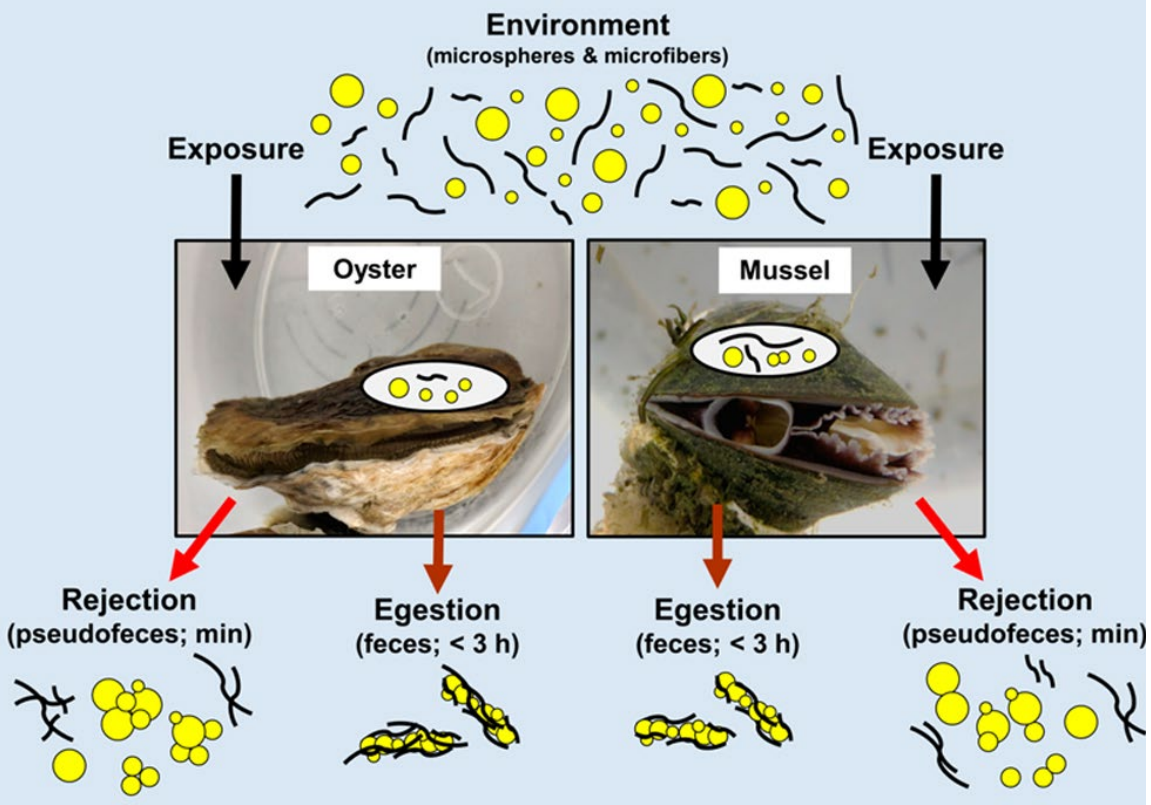


Potential Sources of Microplastics and Nanoplastics to Food Systems

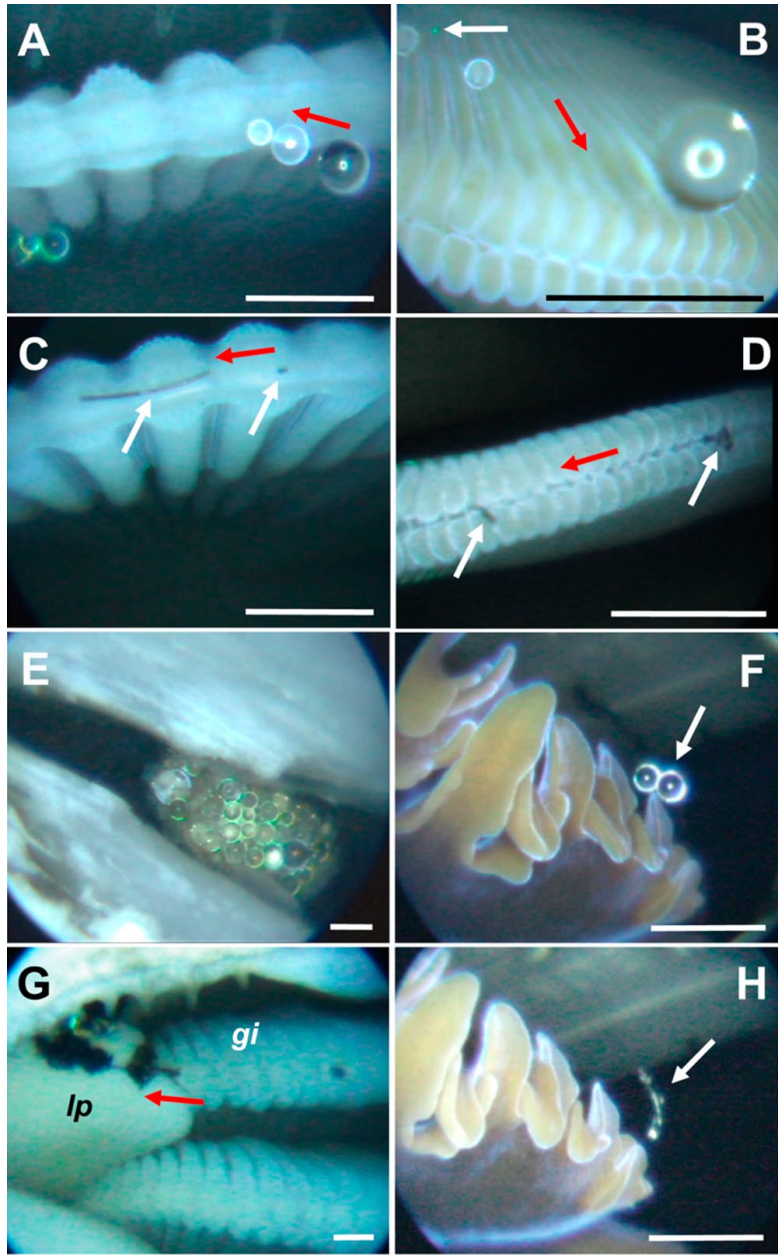
1. Environmental contaminations and degradation of plastic debris
2. Terrestrial agricultural and food production *(*mulch film, *coverings for high tunnels, silage film, drip tape, seed casings, plant trays and bags, and row covers)*
3. Delivery of functional materials in food and agricultural productions using polymeric carriers

Source: USDA Flickr

Ex: Ingestion and Egestion of Plastic Particles by Blue Mussel and Eastern Oyster

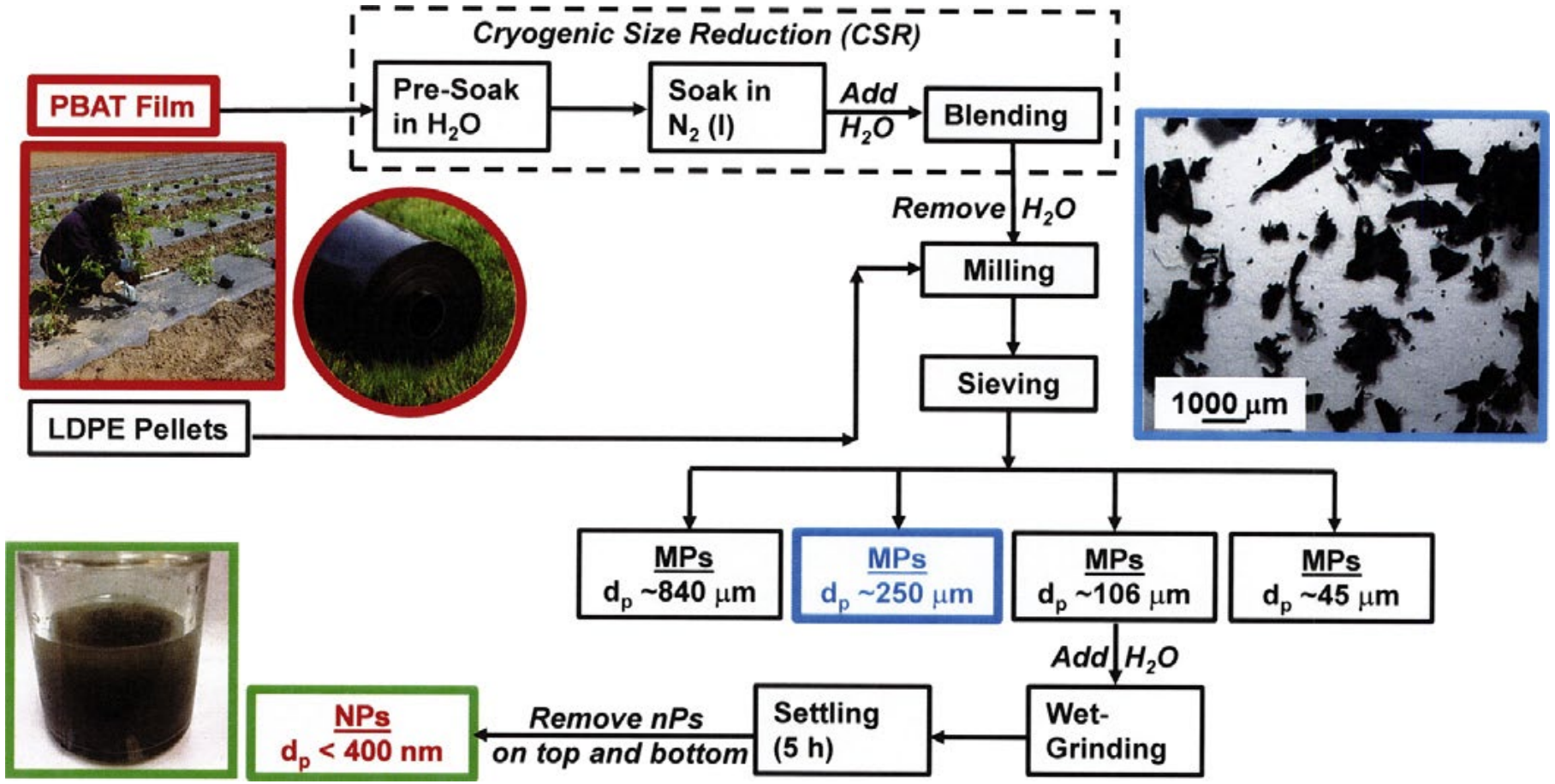


The number and types of MP found in bivalve gut will depend upon the physical characteristics of the particles



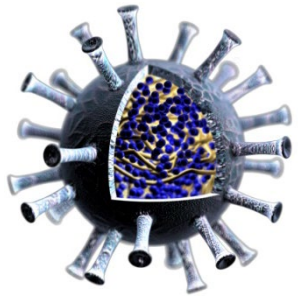
Ward, et al., Environ. Sci. Technol. 2019, 53, 8776−8784
Ward, et al., Anthropocene Coasts 2: 39–49 (2019) dx.doi.org/10.1139/anc-2018-0027

Ex: Mechanical formation of micro- and nano-plastic materials for environmental studies in agricultural ecosystems



From Hayes' group: Astner, et. Al., *Science of the Total Environment 685 (2019) 1097–1106*

Ex: NANO- AND COLLOIDAL DELIVERY SYSTEMS FOR FOOD, AGRICULTURE, AND HEALTH APPLICATIONS



Project: Tissue biodistribution and safety of nanoparticles

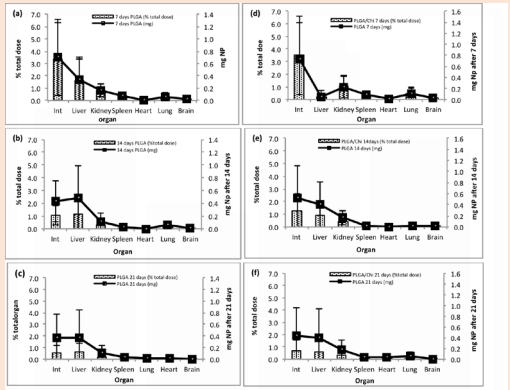
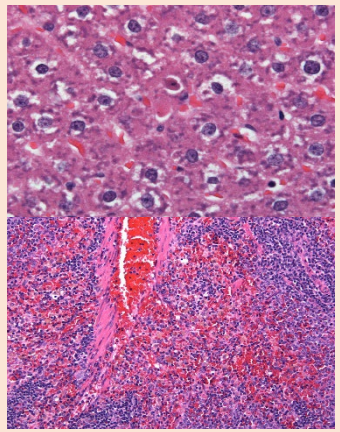
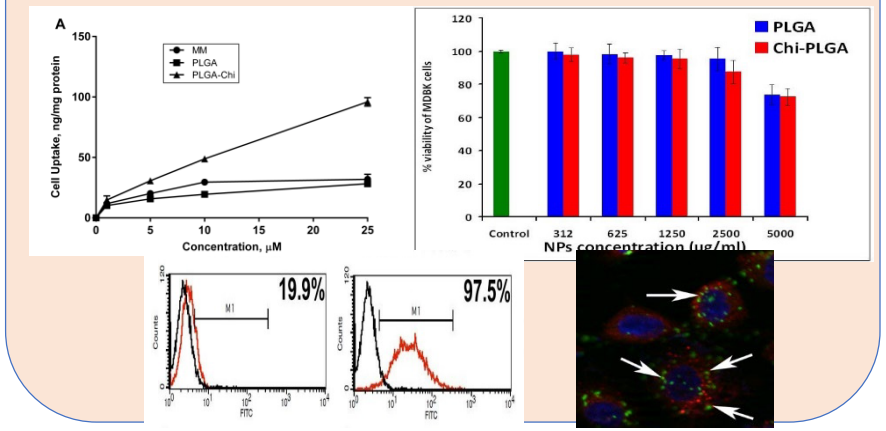
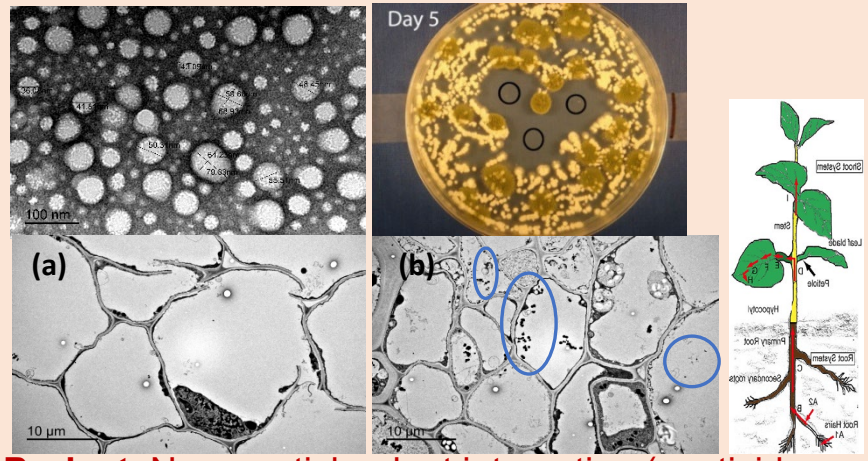


Figure 3. Percentage of total dose/organ and mass (mg) of PLGA nanoparticles (a, b, c) and PLGA/Chi nanoparticles (d, e, f) recovered after gavage for 7 days, 14 days and 21 days.

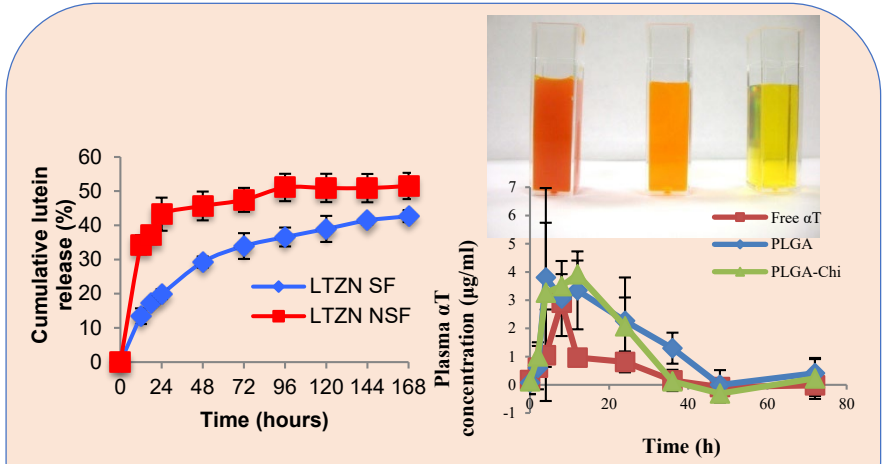


Project: Nanoparticle-cell interaction (biocompatibility, uptake, co-localization)





Project: Nanoparticle-plant interaction (pesticide application)



Project: Bioavailability and functionality of nanodelivered bioactive (food applications)

Courtesy of C.M Sabliov

Multistate Coordination Research

- ***NC-1194: NANOTECHNOLOGY AND BIOSENSORS***
  - Yu, C., Takhistov, P., Alocilja, E. *et al.* Bioanalytical approaches for the detection, characterization, and risk assessment of micro/nanoplastics in agriculture and food systems. *Anal Bioanal Chem* **414**, 4591–4612 (2022). https://doi.org/10.1007/s00216-022-04069-5
- *NE-1545: ONSITE WASTEWATER TREATMENT SYSTEMS: ASSESSING THE IMPACT OF CLIMATE VARIABILITY AND CLIMATE CHANGE (study microplastic beads that deliver naproxen in the environment)*
- *S-1054: BIOBASED FIBROUS MATERIALS AND CLEANER TECHNOLOGIES FOR A SUSTAINABLE AND ENVIRONMENTALLY RESPONSIBLE TEXTILE INDUSTRY (study bioplastics and biodegradable plastics, method development - SANS)*
- *W-3045: AGROCHEMICAL IMPACTS ON HUMAN AND ENVIRONMENTAL HEALTH: MECHANISMS AND MITIGATION (risk assessment of microplastics resulted from broken down agricultural plastics to human, food, and the environment)*
- *W-4188: SOIL, WATER, AND ENVIRONMENTAL PHYSICS TO SUSTAIN AGRICULTURE AND NATURAL RESOURCES (develop methods to extract, quantify, and characterize plastics in soils, with an emphasis on nano- and microplastics)*
- *W-4170: BENEFICIAL USE OF RESIDUALS TO IMPROVE SOIL HEALTH AND PROTECT PUBLIC, AND ECOSYSTEM HEALTH (characterizing environmental loading of microplastics from wastewater and biosolids, and evaluating their subsequent fate and transport in the context of integrated watershed to global scale environmental microplastic pollution cascades)*

Education Efforts

- *Undergraduate research - a survey of microplastics and nutrient monitoring in agricultural production near Kinnickinnic River, WI (2015-10133)*
- *Tribal college students learning through monitoring and quantification of microplastics in Waishkey bay water, sediment and locally caught native aquatic wildlife on multiple trophic levels (2017-03930)*
- *UPRM graduate students learned to use the zebra fish model for the testing of nanomaterials and microplastics for toxicity measurements in water (2016-06003)*
- *Establish a citizen science monitoring program for microplastics to gather baseline data on the presence of microplastics in the regional watershed (2018-04882).*

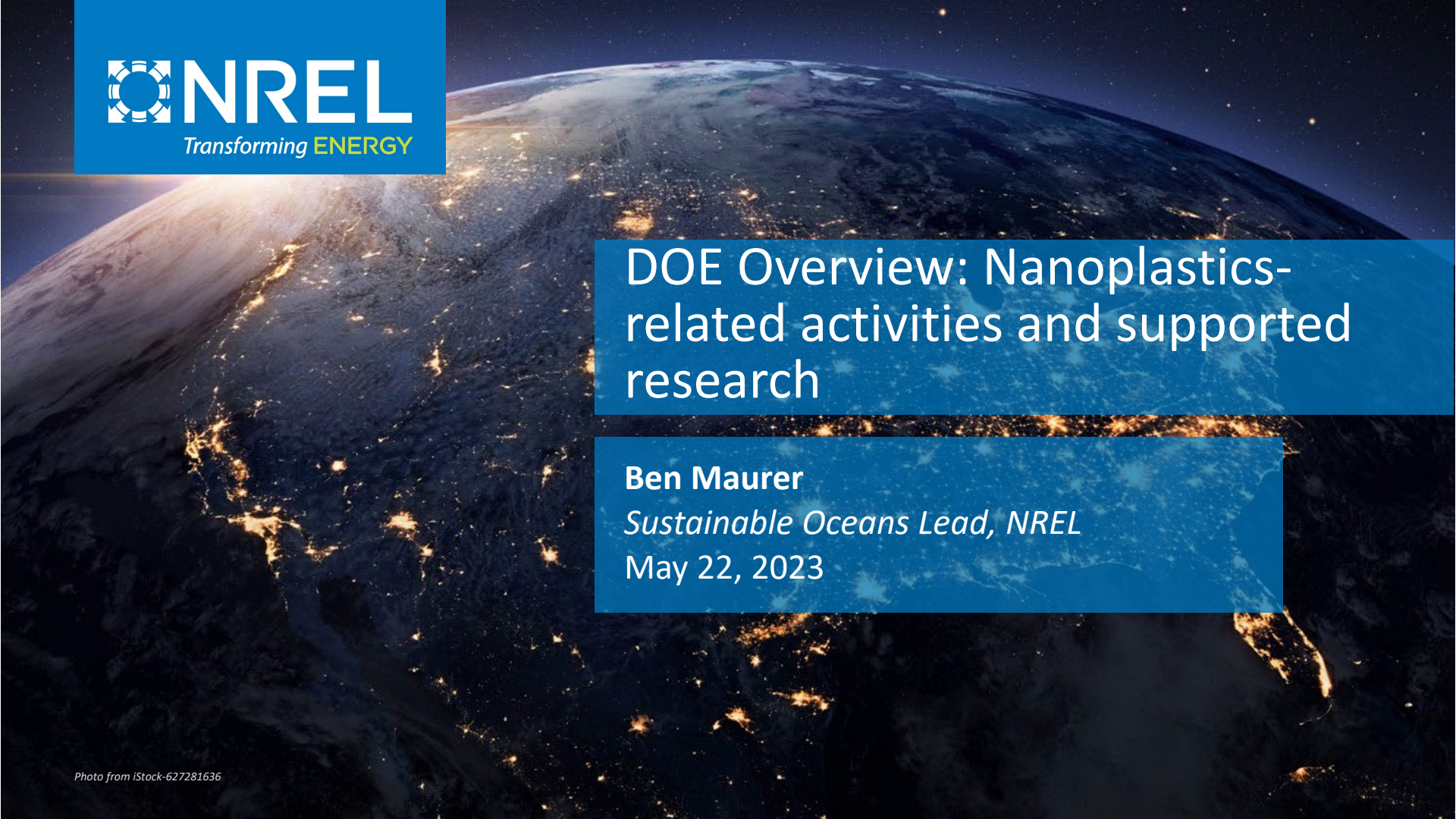
Food Safety Research Gaps

- Material characterization methods (qualitative and quantitative, standards, etc.)
- Risk characterization (hazard and exposure of food)
- Fate and transport of nanoplastics in the bodies of various aquatic species and crops, including the environmental microbiome
- Transformation of MPs and NPs in food production and under various food processing technologies
- …

Moving forward…

- Tools and approaches to characterize the hazards, exposure and risks of microplastics and nanoplastics to the safety of food and agricultural workers
- Characterization and monitoring of microplastics and nanoplastics in complex foods and agricultural production environments
- Engagement and communication of the issues and solutions to stakeholders and the public
- Partnerships to effectively advance sciences for understanding of the critical issues

Hongda.chen@usda.gov
202-445-5582



DOE Overview: Nanoplastics-related activities and supported research

Ben Maurer
Sustainable Oceans Lead, NREL
May 22, 2023

Photo from iStock-627281636

U.S. DOE Plastics Activities

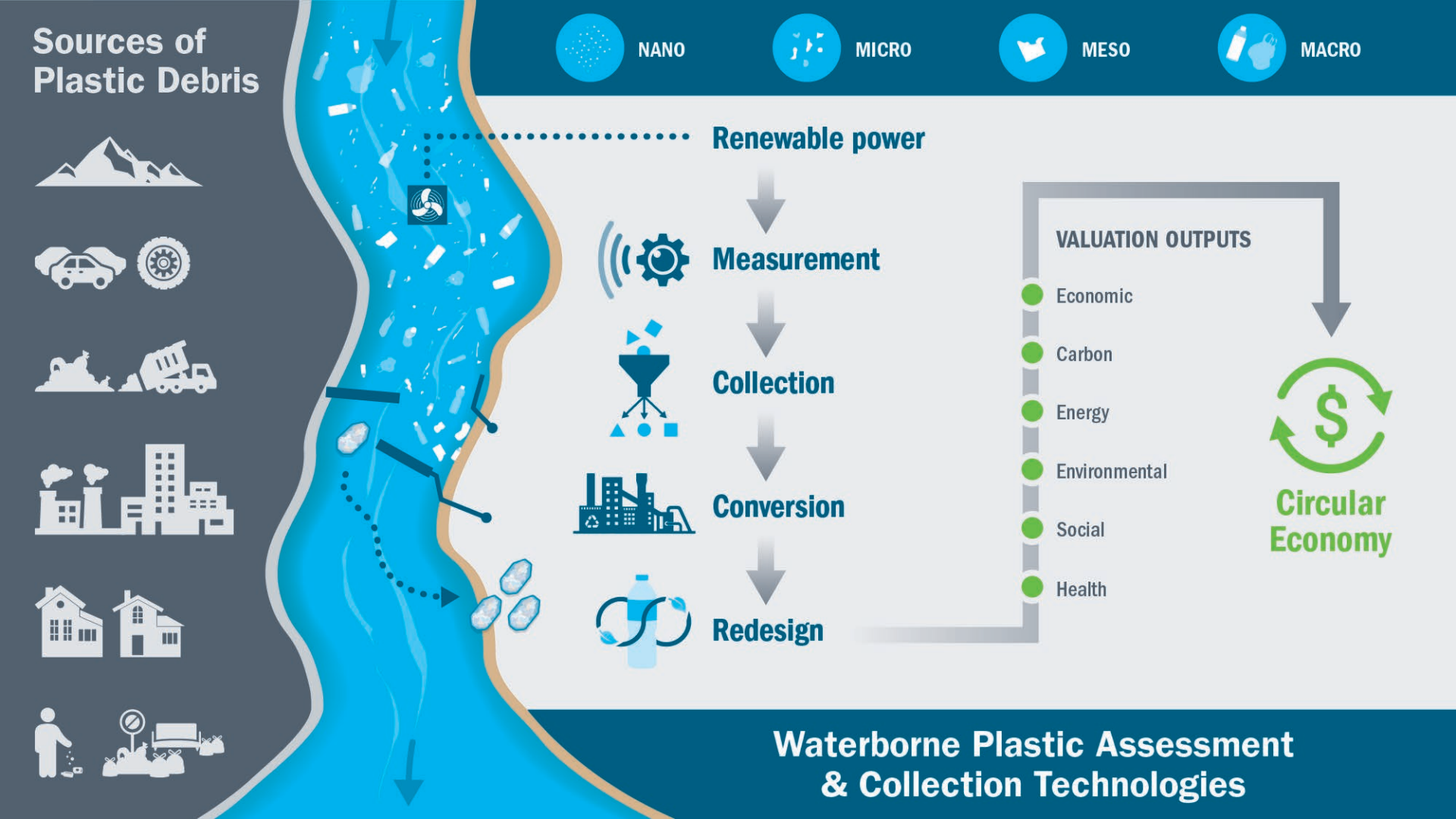
"transform our understanding of nature" & "American leadership in the transition to a global clean energy economy"

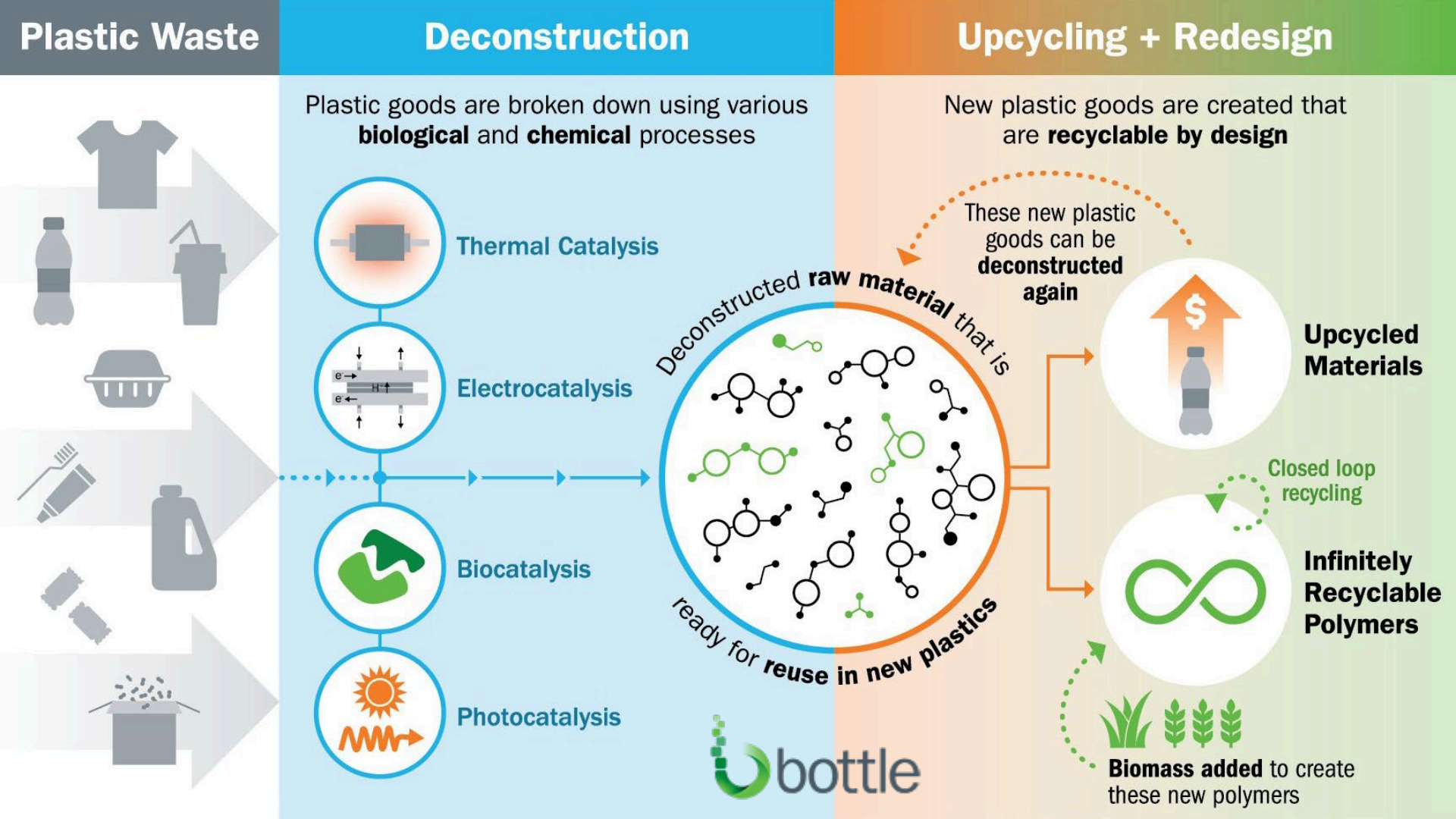
The mission of DOE's Office of Science is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States

The mission of EERE is to create and sustain American leadership in the transition to a global clean energy economy. Its vision is a strong and prosperous America powered by clean, affordable, and secure energy.

WaterPACT researcher, Dr. Ali Chamas processing fragmented plastics debris from the Delaware River.

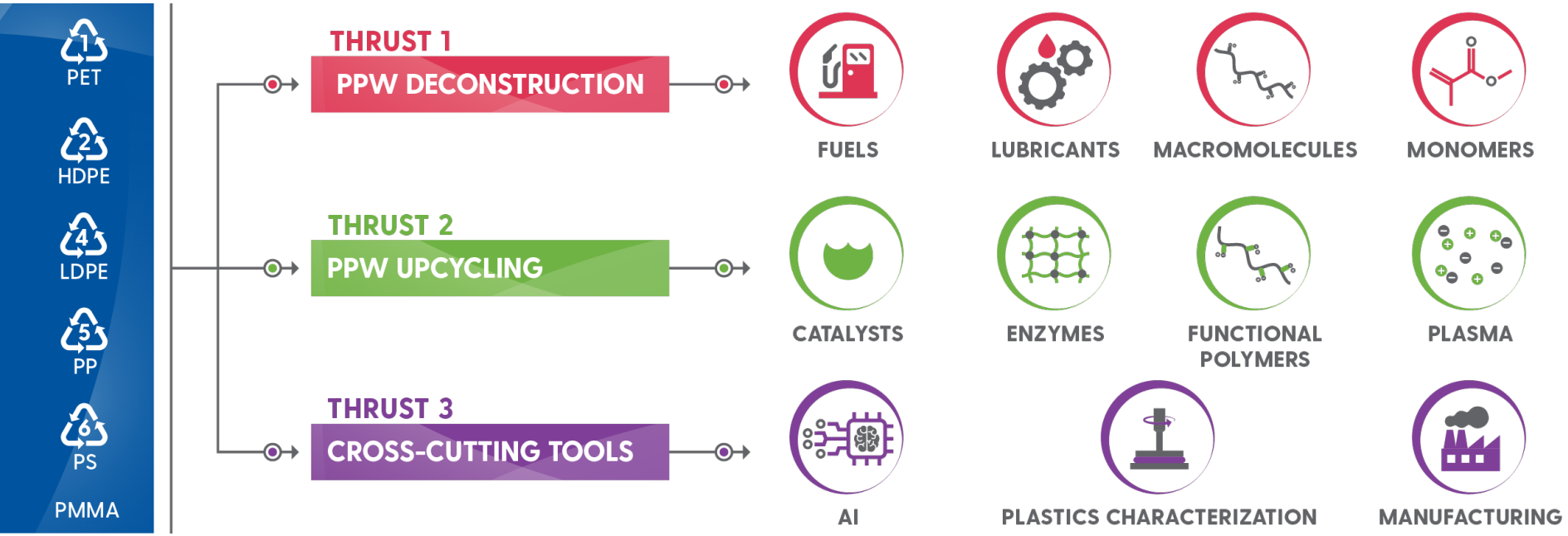
Photo by Werner Slocum, NREL 75130


Sources of Plastic Debris
NANO
MICRO
MESO
MACRO
Renewable power
Measurement
Collection
Conversion
Redesign
VALUATION OUTPUTS
Economic
Carbon
Energy
Environmental
Social
Health
Circular Economy
Waterborne Plastic Assessment & Collection Technologies


Plastic Waste
Deconstruction
Upcycling + Redesign
Plastic goods are broken down using various biological and chemical processes
New plastic goods are created that are recyclable by design
Thermal Catalysis
Electrocatalysis
Biocatalysis
Photocatalysis
Deconstructed raw material that is ready for reuse in new plastics
These new plastic goods can be deconstructed again
Upcycled Materials
Closed loop recycling
Infinitely Recyclable Polymers
Biomass added to create these new polymers
bottle

CENTER *for*

PLASTICS INNOVATION



UNIVERSITY OF DELAWARE · Penn University of Pennsylvania · THE UNIVERSITY OF CHICAGO · UMASS AMHERST · OAK RIDGE National Laboratory

For additional information

Waterborne Plastics Assessment & Collection Technologies (WaterPACT)
National Renewable Energy Laboratory. 2023. "Waterborne Plastics Assessment and Collection Technologies." Accessed May 19, 2023. https://www.nrel.gov/water/waterpact.html
Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory. 2023 "Waterborne Plastics Environmental Weathering Leachates." Accessed May 19, 2023. https://www.emsl.pnnl.gov/project/51941

Bio-Optimized Technologies to keep Thermoplastics out of Landfills and the Environment (BOTTLE)
Bottle. 2019. "About BOTTLE." Accessed May 19, 2023. https://www.bottle.org/about.html

Center for Plastics Innovation
University of Delaware. 2022. "Center for Plastics Innovation." Accessed May 19, 2023. https://cpi.udel.edu/

U.S. DOE Strategy for Plastics Innovation
U.S. DOE. 2023. "Strategy for Plastics Innovation." Accessed May 19, 2023.
https://www.energy.gov/entity%3Anode/4394292/strategy-plastics-innovation

U.S. SBIR Projects
Small Business Administration. 2023. "Awards Information." Accessed May 19, 2023.
https://www.sbir.gov/sbirsearch/award/all/%22plastic%20debris%22?f%5B0%5D=im_field_agencies%3A105731

NOAA Marine Debris Program Activities & Supported Research

Amy V. Uhrin

Chief Scientist, NOAA Marine Debris Program

Public Webinar - Overview of U.S. Government Activities Addressing Micro- and Nanoplastics

May 22, 2023

Marine Debris Program
Applicable Congressional Acts

2006
Marine Debris Research, Prevention, and Reduction Act

2012
Marine Debris Act (amended)

2018
Save Our Seas Act (amended & reauthorized)

2020
Save Our Seas Act 2.0 (amended)

2021
Bipartisan Infrastructure Law

Marine Debris Program
Key Authorities

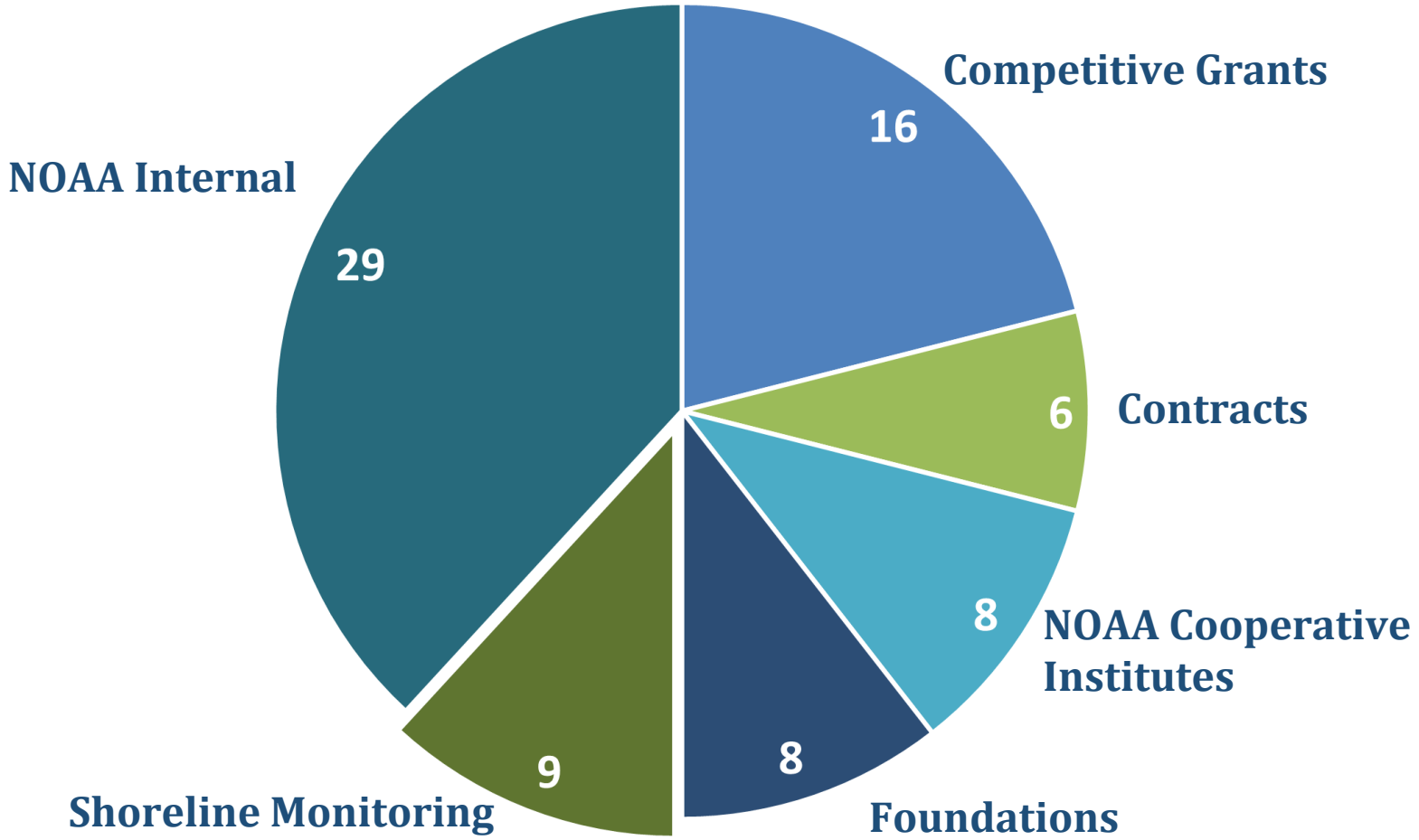
- Identify, determine sources, assess, prevent, reduce, remove marine debris
- Provide national and regional **coordination**
- Chair the **Interagency Marine Debris Coordination Committee**
- Conduct **outreach & education** esp. with other Federal agencies
- Promote **international action**
- Respond to **severe marine debris events** (declaration authority)
- Reduce adverse impacts of **derelict fishing gear** (DFG)
- Provide **grants** for marine debris projects (research, prevention, removal)
- Maintain Marine Debris **Clearinghouse** of all funded projects
- Establish a Marine Debris **Foundation**
- **Conduct studies** on DFG, microF, US contributions to ocean plastic waste

Marine Debris Program
Mission & Pillars

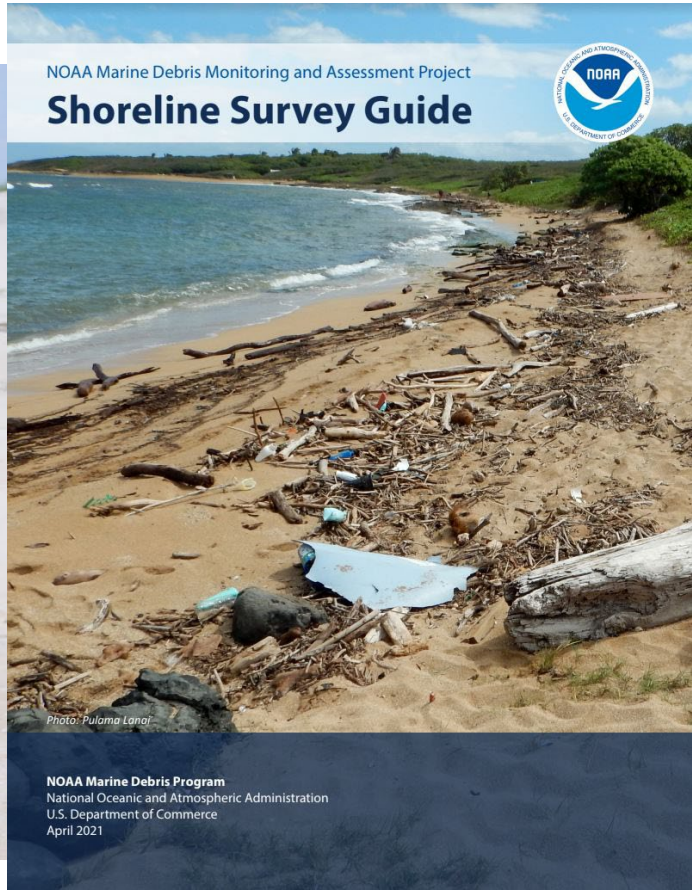
Mission: to investigate and prevent the adverse impacts of marine debris

- Prevention
- Removal
- Research
- Monitoring & Detection
- Response
- Coordination

Research Portfolio
By Funding Mechanism
FY05 - FY22



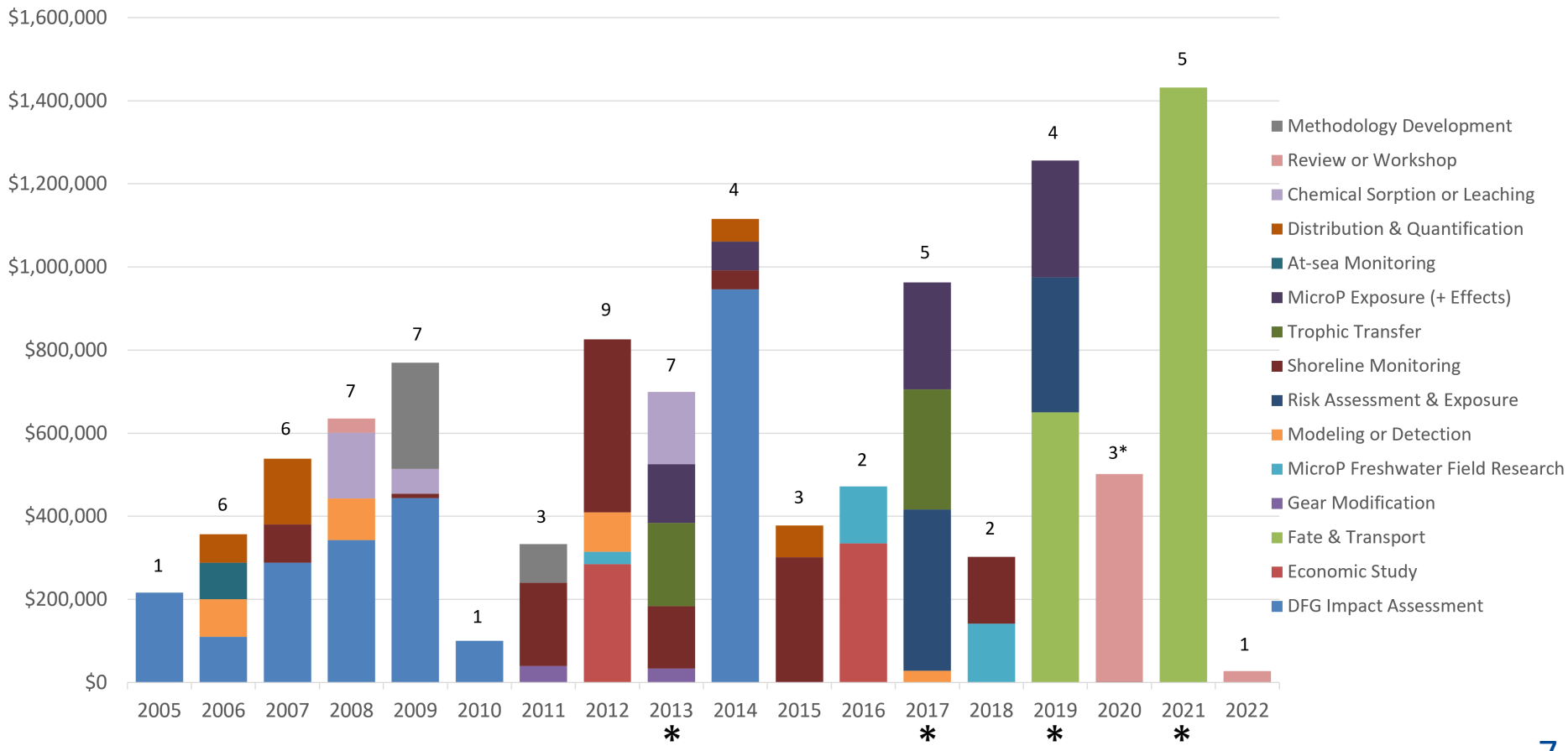
Marine Debris Monitoring & Assessment Project



https://marinedebris.noaa.gov/our-work/monitoring

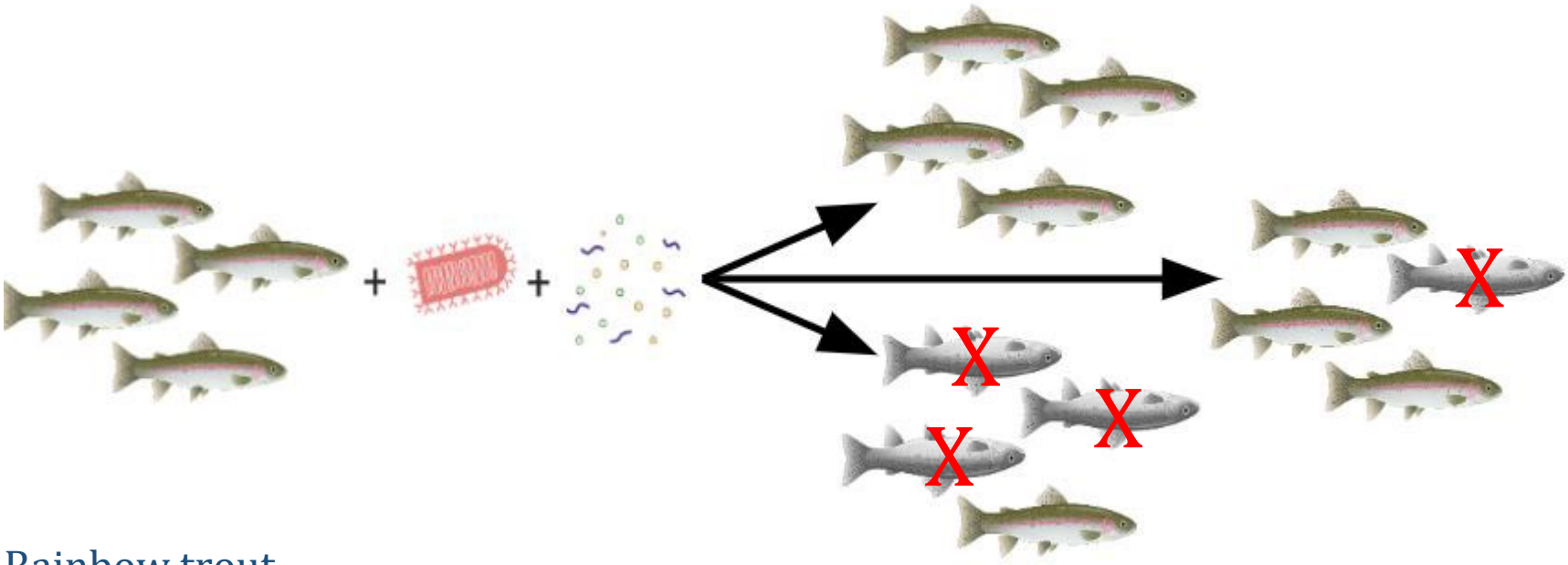
Research Portfolio
By Funding Level, Fiscal Year and Theme

76 projects totaling $11 million USD



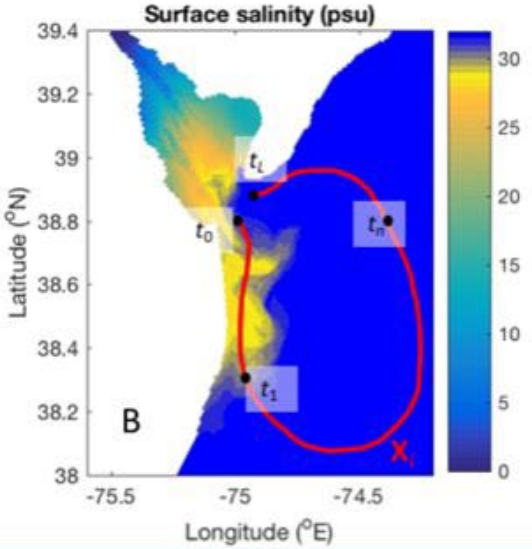
FY19 Example Projects
Virginia Institute of Marine Science
Microplastics & Disease Susceptibility

Rainbow trout + virus + microP = mortality?



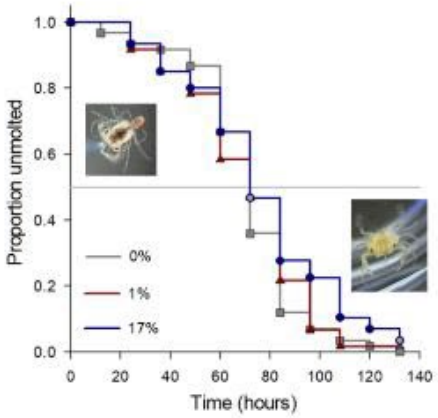
Rainbow trout

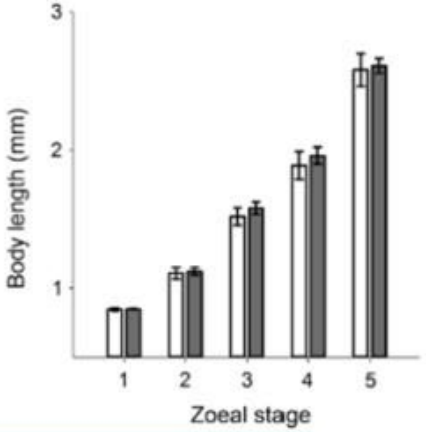
FY19 Example Projects
University of Delaware
Risk of Microplastics Exposure to Blue Crab Larvae



Modelling and Observations (microplastics & larvae)

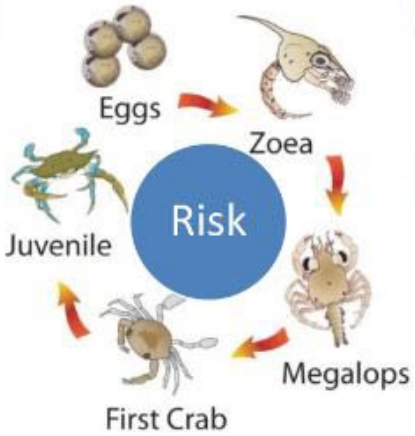
- Determines time-integrated exposure





Laboratory Experiments (survival & growth)

- Determines adverse response function



Blue crab life cycle

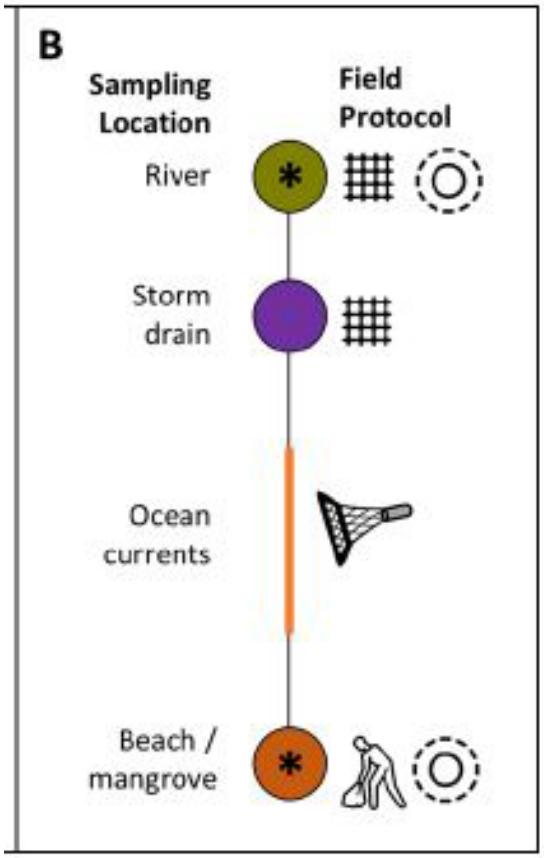
FY21 Example Projects
San Diego State University
Sources of Marine Debris in San Diego River

Encampment debris

Debris fragmentation cage

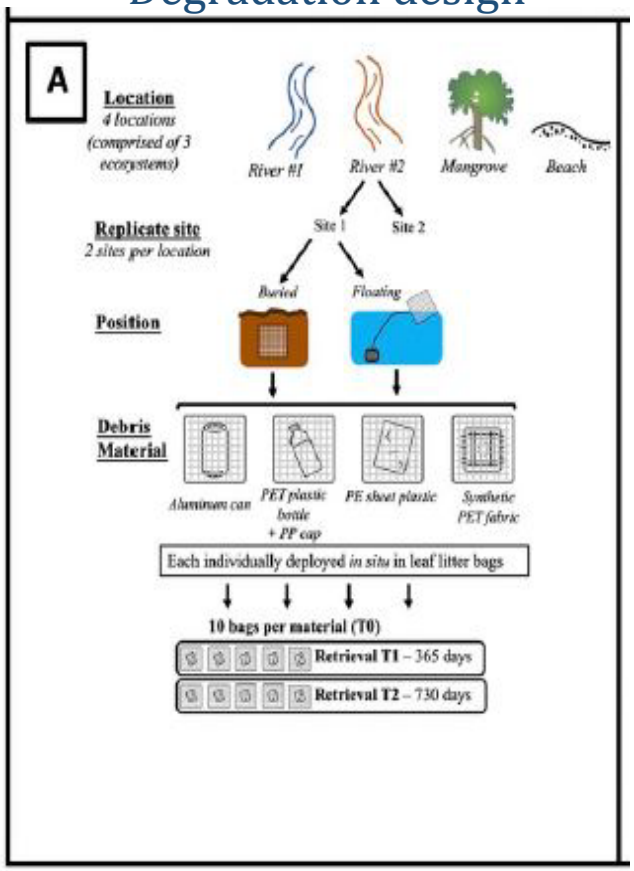
FY21 Example Projects
Villanova University
Pathways & Degradation within the Guánica Watershed

Field samples



Guánica Bay, Puerto Rico

Degradation design



Thank you!

https://marinedebris.noaa.gov/our-work/research

USGS
science for a changing world

Overview of U.S. Government activities addressing micro- and nano-plastics issues

U.S. Geological Survey

Shawn C. Fisher

NNI Public Webinar | May 22, 2023

U.S. Department of the Interior
U.S. Geological Survey

U.S. Geological Survey

Department of the Interior

- Monitors, analyzes, and predicts current and evolving Earth-system interactions and delivers actionable information at scales and timeframes relevant to decision makers.

- Non-regulatory, unbiased

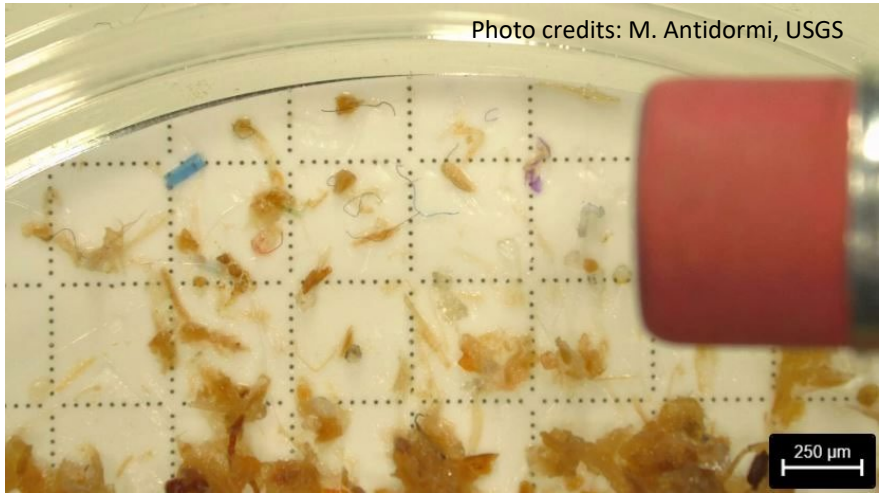
- *Science for a Changing World*
  - 5 Mission Areas
  - 60 Science Centers
  - 100s of Laboratories and Research Facilities

USGS

https://www.usgs.gov/

Supporting water-resource and ecological evaluations of microplastics in the environment

- Hydrogeology
  - Water chemistry and quality
  - Physical conditions
  - Atmospheric deposition
- Ecology
  - Aquatic species
  - Habitat



- Linking microplastic distribution to sources and environmental conditions
  - Particle type, size, and polymer type in water and soil/sediment
  - Correlations with streamflow and precipitation/stormwater runoff
  - Land-use, imperviousness, and climate
  - Fish tissue and biological assessments

USGS

Microplastics strategy and quality assurance

- Standardized sampling procedures
  - Develop methods for various media: water, air, soil/sediment, biological
  - Integrate sampling for microplastics with streamgaging and traditional water-quality sampling
  - Work with Federal and academic partners

- Ensure high level of quality and reproducibility
  - Minimize plastic equipment and limit cross-contamination
  - Collect sufficient quality-control samples (blanks, replicates)
  - Share procedures among Science Centers and Mission Areas

Photo credits: USGS

Water sampling methods

Photo credits: USGS

USGS

Collaboration on microplastics research and methods development

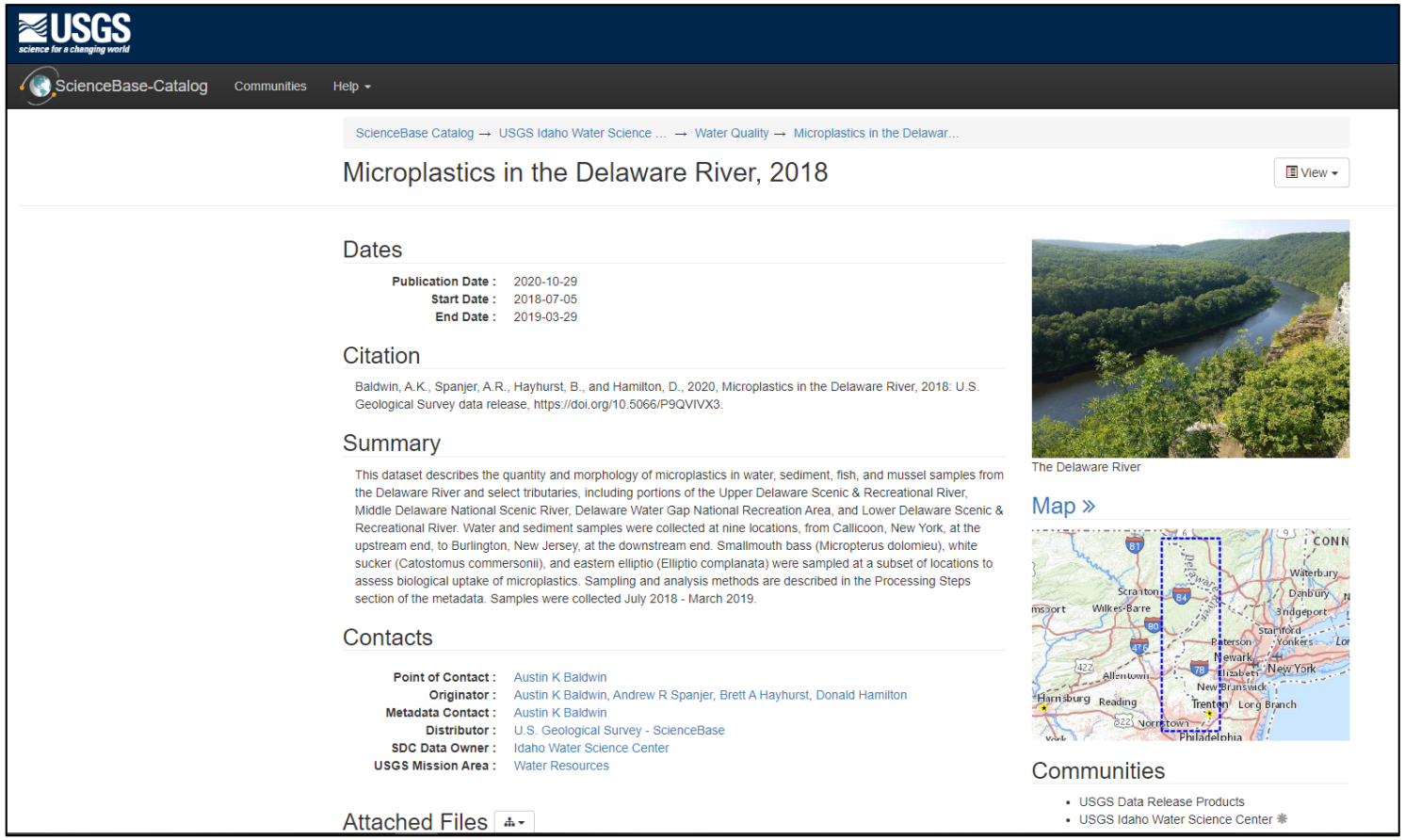
- Federal partners
  - Sample collection (EPA, NPS)
  - Advanced analytical capabilities (EPA, NOAA)
  - Standardization (NIST)

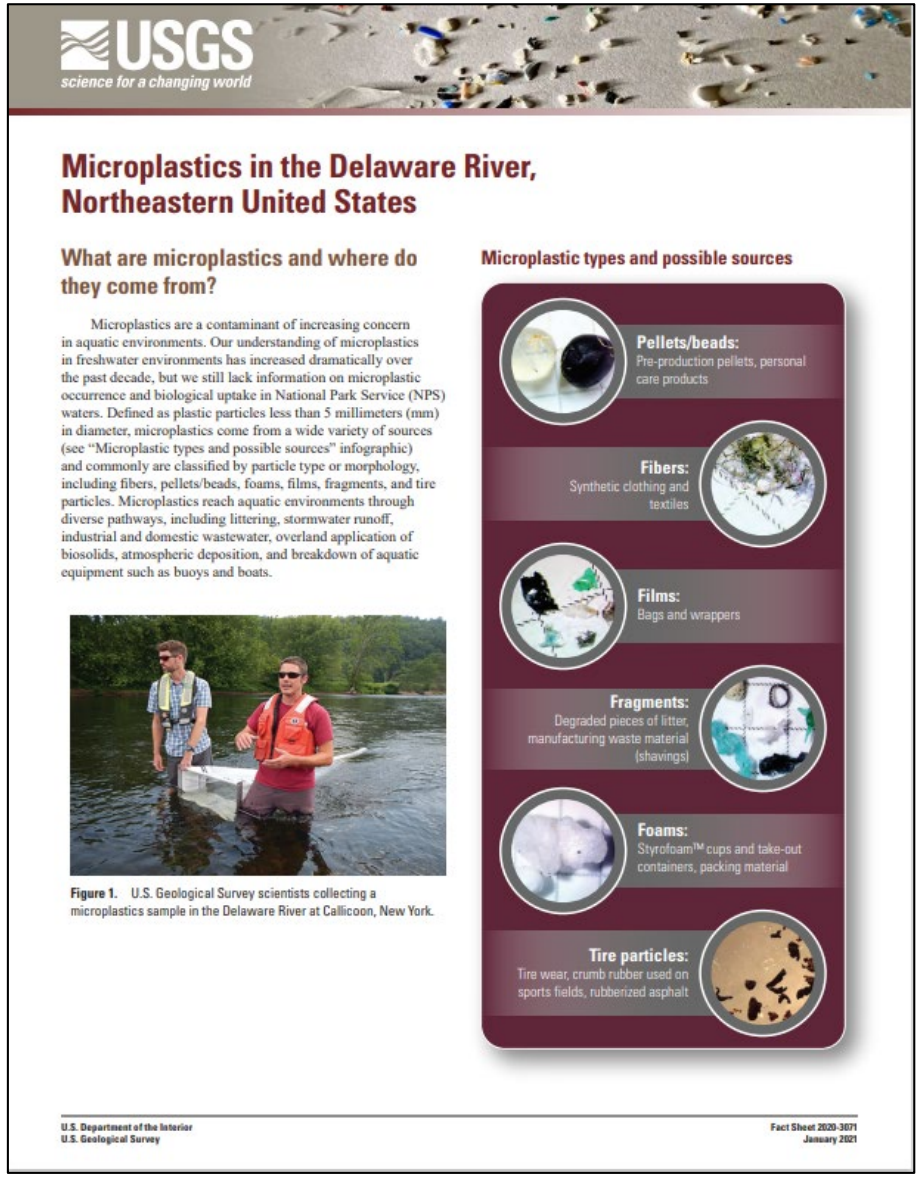
- Academic partners
  - Novel analytical approaches (University of Oklahoma)
  - Advanced onsite analysis (University of Alabama)
  - Sample analysis (University of Illinois)

- State and local stakeholders

USGS

USGS data and reports





USGS

Baldwin, A.K., Spanjer, A.R., Hayhurst, B., and Hamilton, D., 2021, Microplastics in the Delaware River, northeastern United States: U.S. Geological Survey Fact Sheet 2020-3071, 4 p., https://doi.org/10.3133/fs20203071

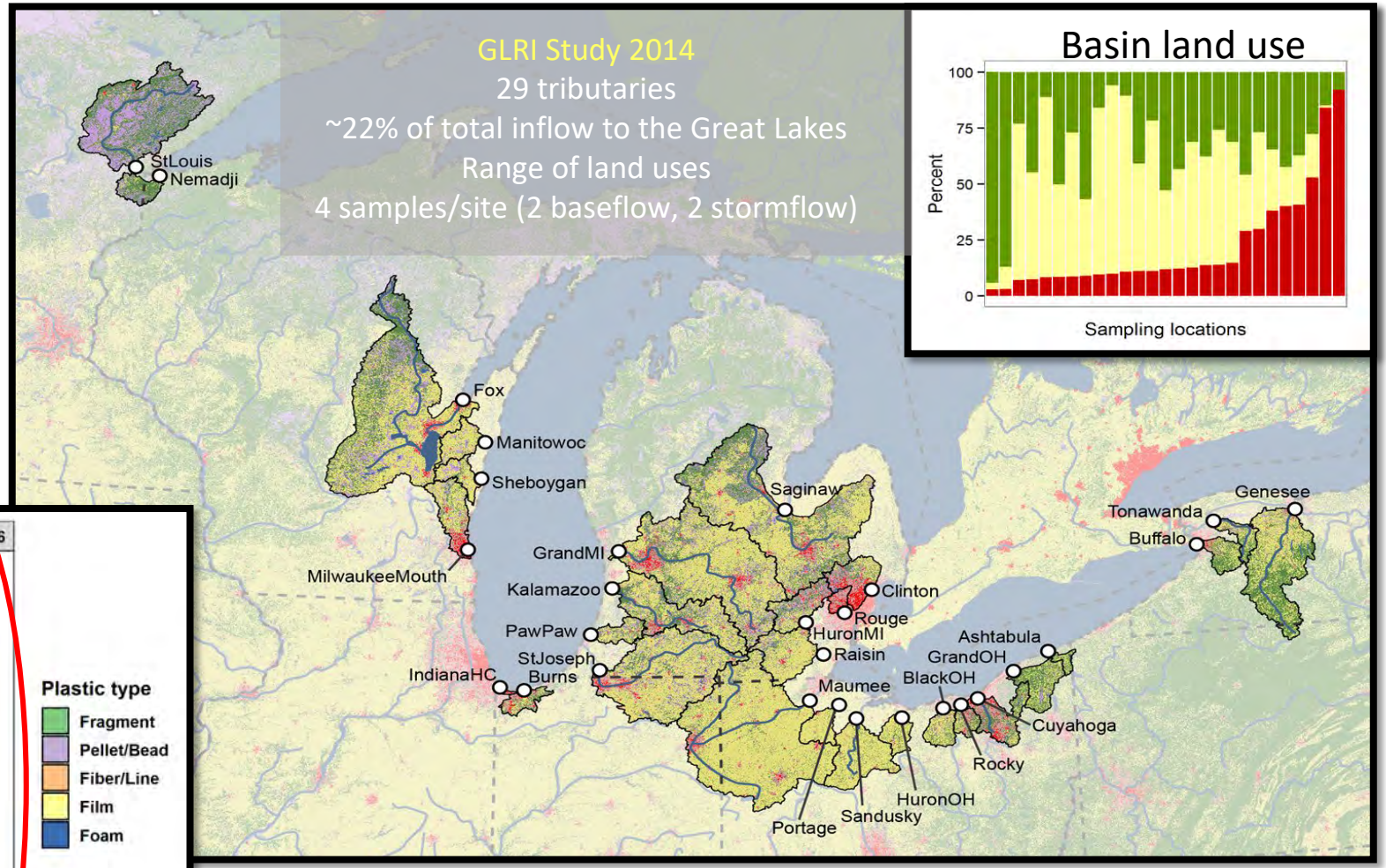
USGS – Research Highlights

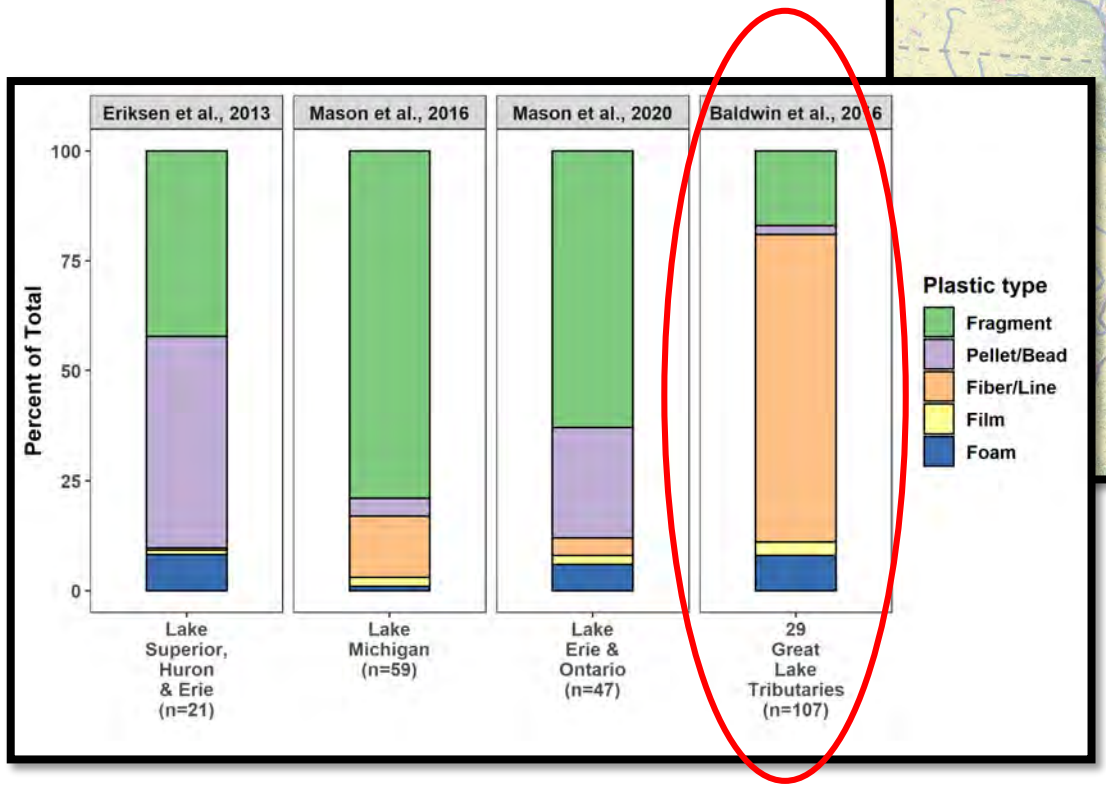
Studies and monitoring

USGS science for a changing world

USGS General Information Product 196 (https://pubs.usgs.gov/gip/196/gip196.pdf)

Microplastics in Great Lake tributaries

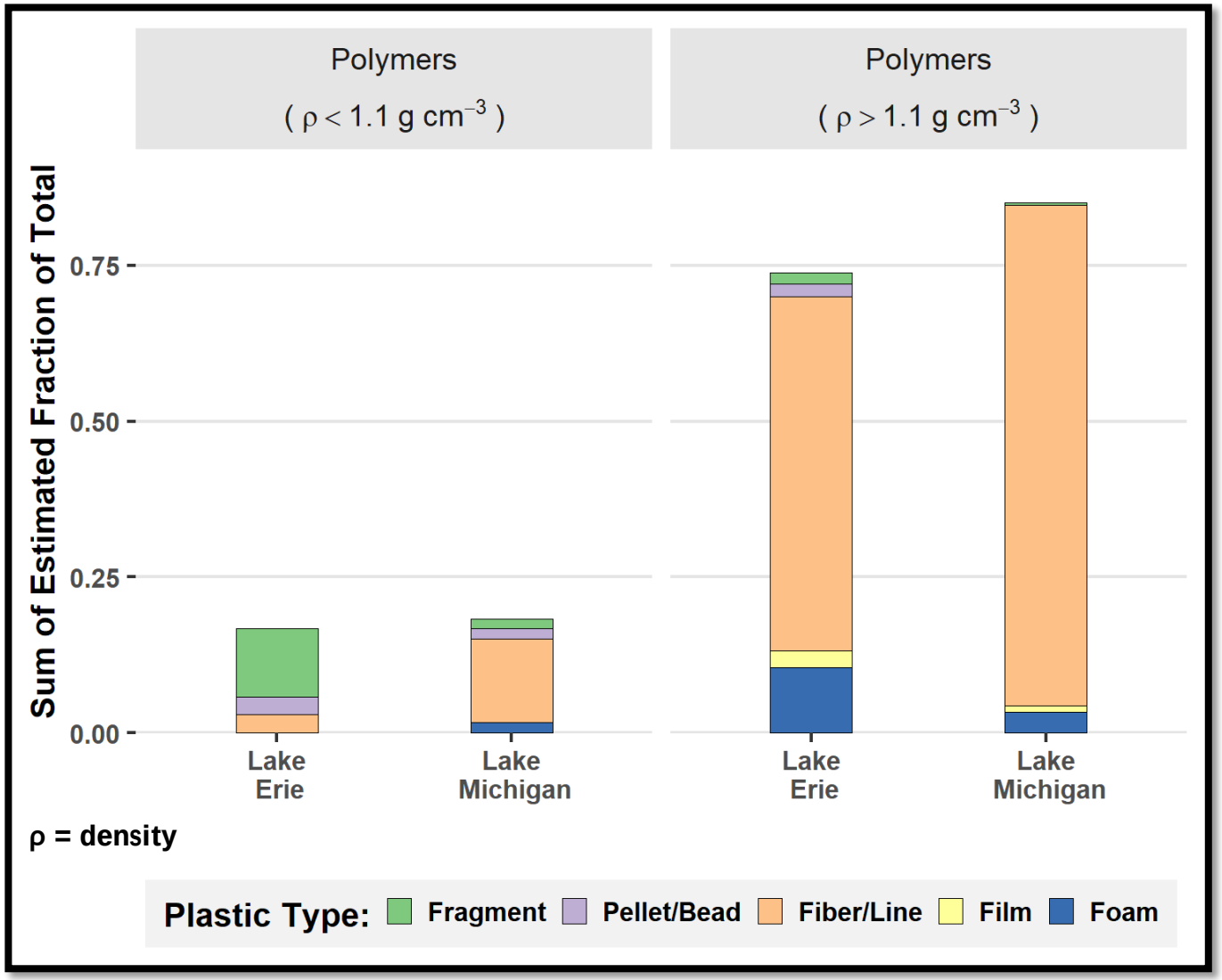




USGS

Baldwin, A. K., Corsi, S. R., Mason, S. A., 2016, Plastic Debris in 29 Great Lakes Tributaries: Relations to Watershed Attributes and Hydrology. Environ. Sci. Technol., vol. 50, no. 19, p. 10377–10385. https://doi.org/10.1021/acs.est.6b02917

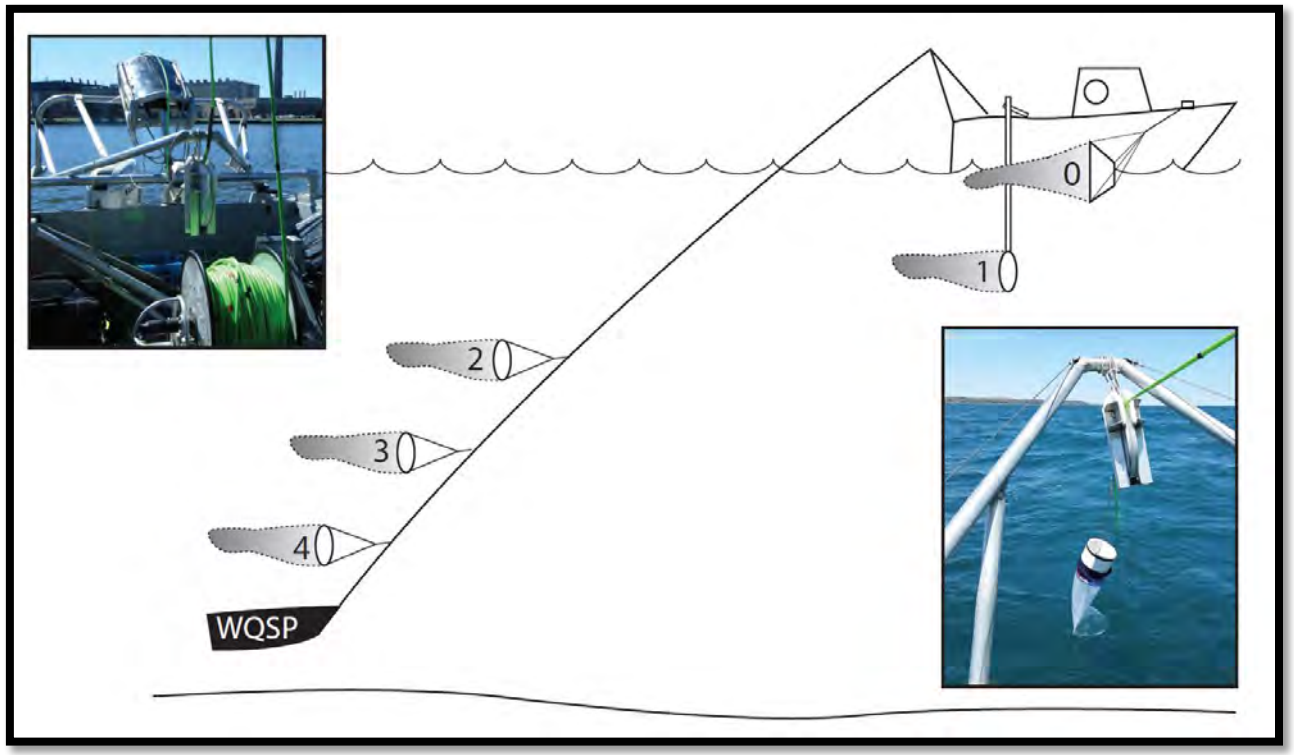
Microplastics in Lake Michigan and Lake Erie sediment



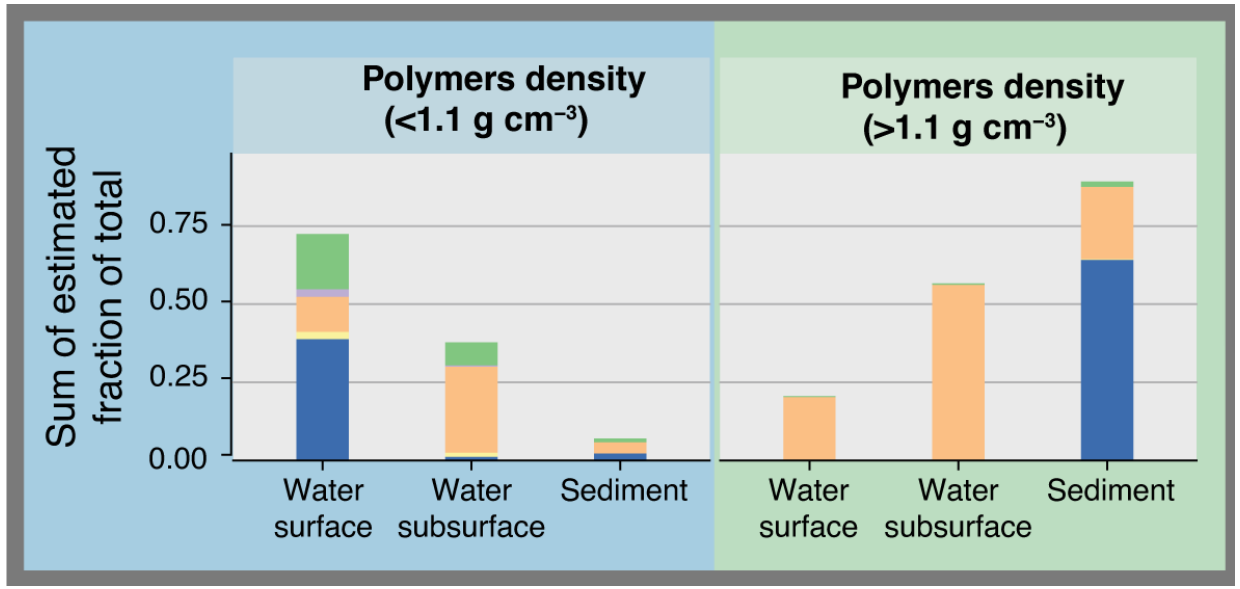
USGS

Lenaker, P. L., Corsi, S. R., Mason, S. A., 2021, Spatial Distribution of Microplastics in Surficial Benthic Sediment of Lake Michigan and Lake Erie: Environ. Sci. Technol., vol. 55, no. 1, p. 373–384. https://doi.org/10.1021/acs.est.0c06087

Vertical distribution of microplastics in the Milwaukee River Basin



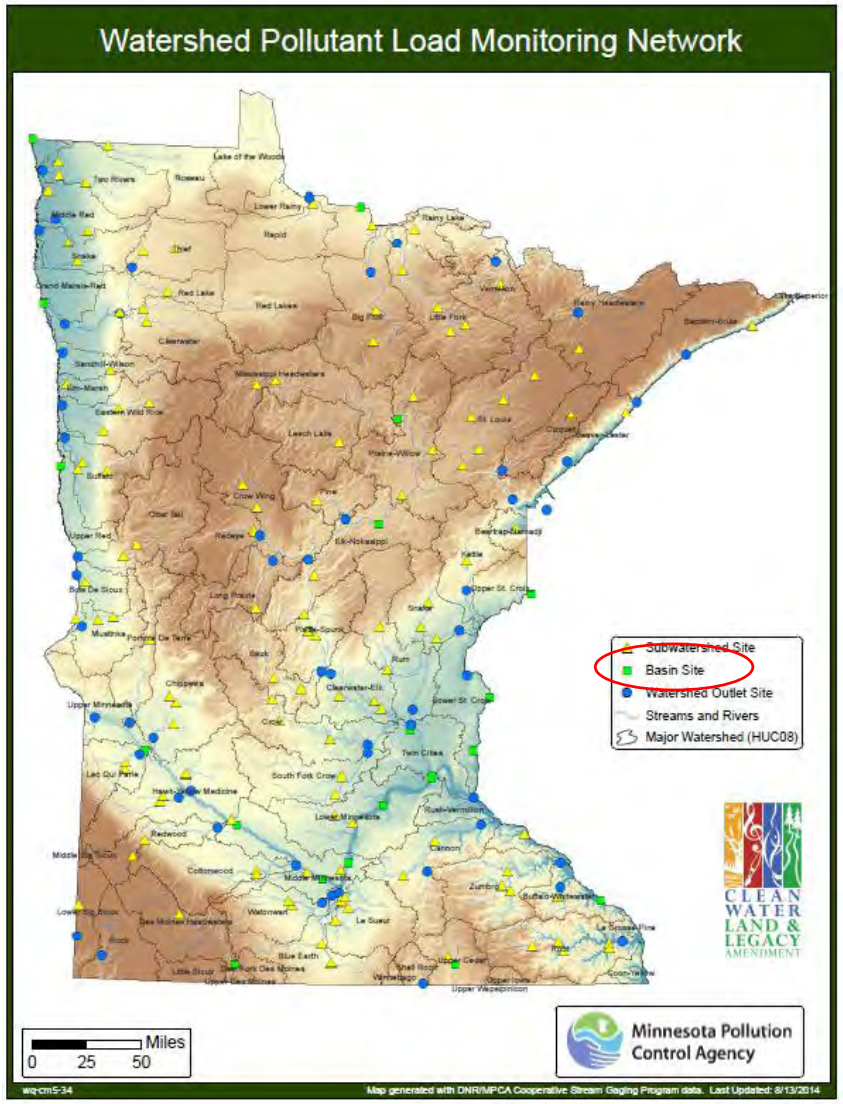
WQSP, water-quality sensor package

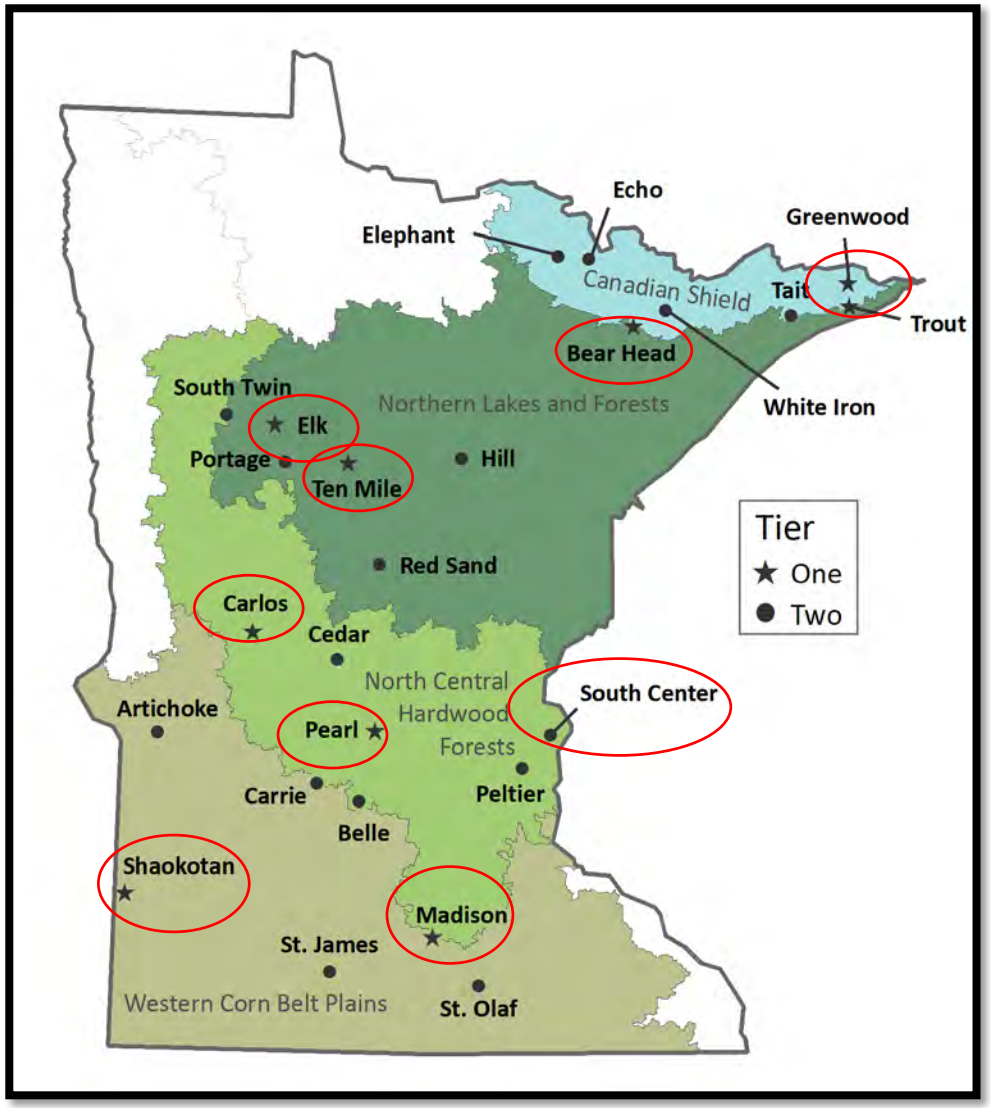


USGS

Lenaker, P. L., Baldwin, A. K., Corsi, S. R., Mason, S. A., Reneau, P. C., and Scott, J. W., 2019, Vertical Distribution of Microplastics in the Water Column and Surficial Sediment from the Milwaukee River Basin to Lake Michigan: Environ. Sci. Technol., vol. 53, no. 21, p. 12227–12237.

Spatial assessment of microplastics in Minnesota Rivers and Lakes

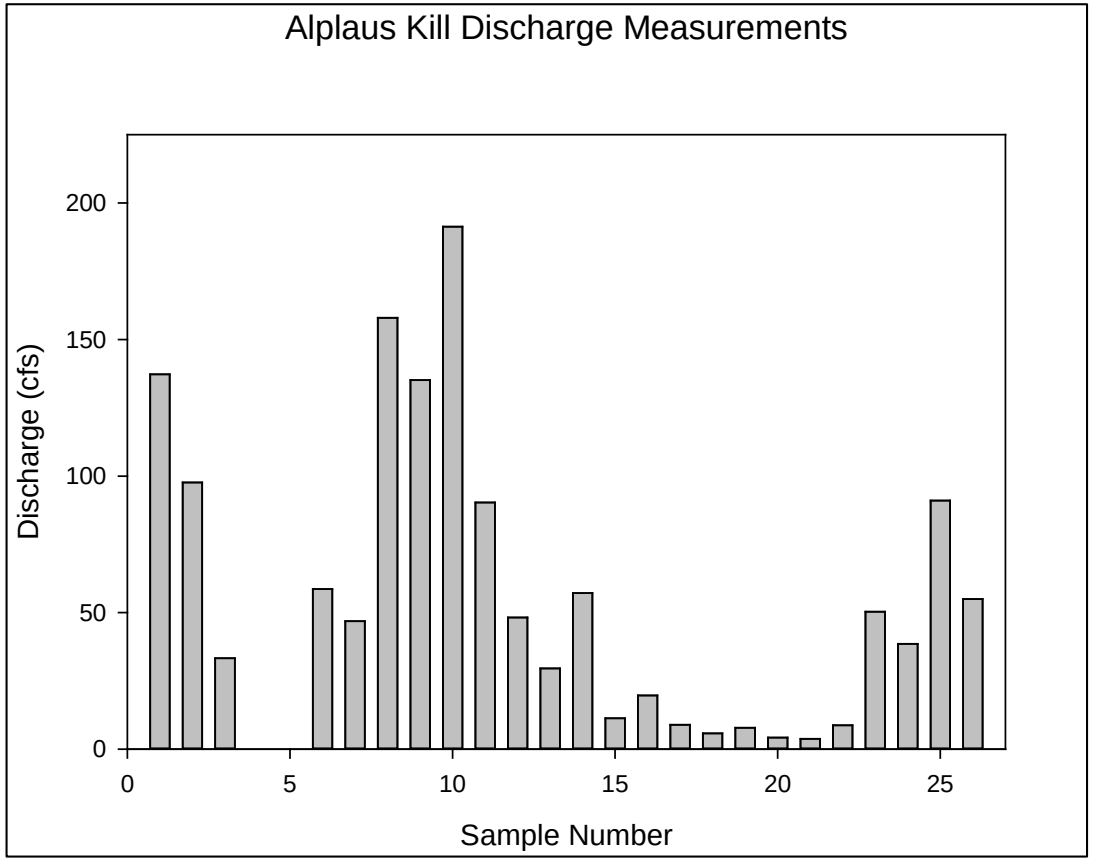




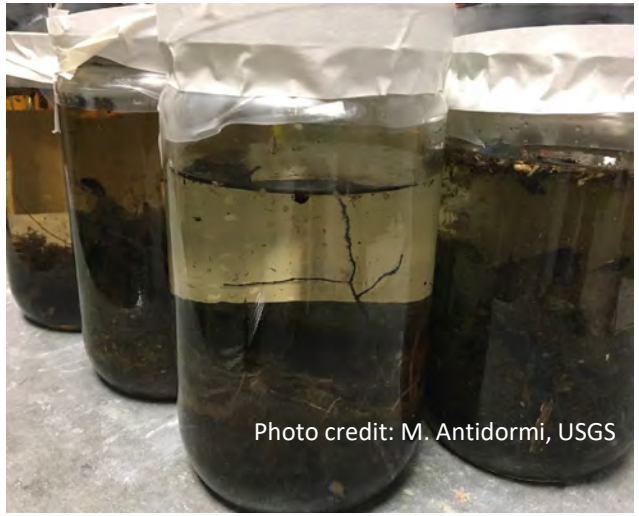
USGS

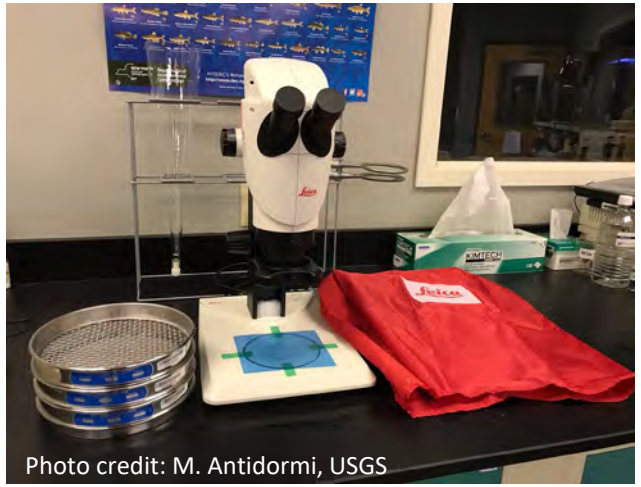
Study ongoing | Upper Midwest Water Science Center | contact: Peter Lenaker (plenaker@usgs.gov)

Biweekly microplastic sampling in Alplaus Kill, New York



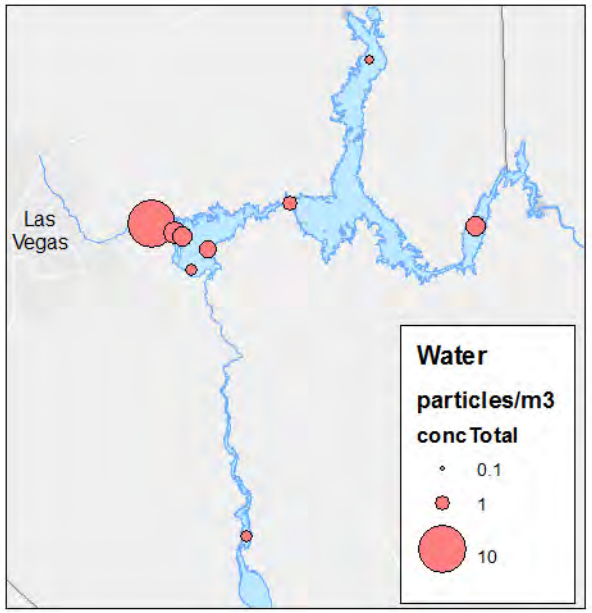
cfs, cubic feet per second

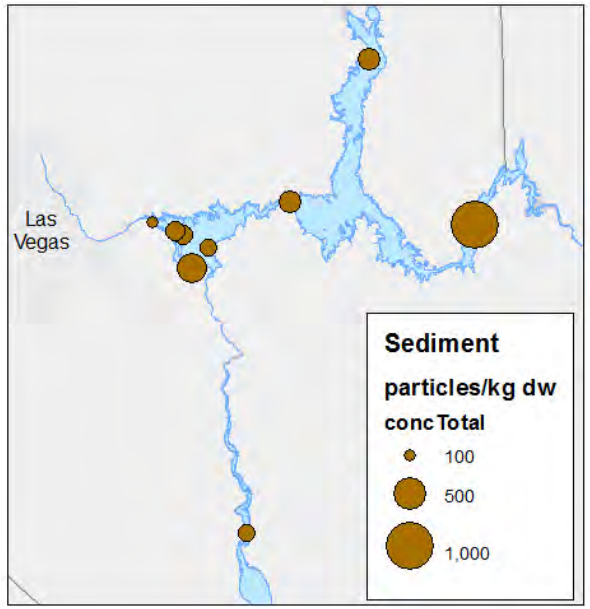




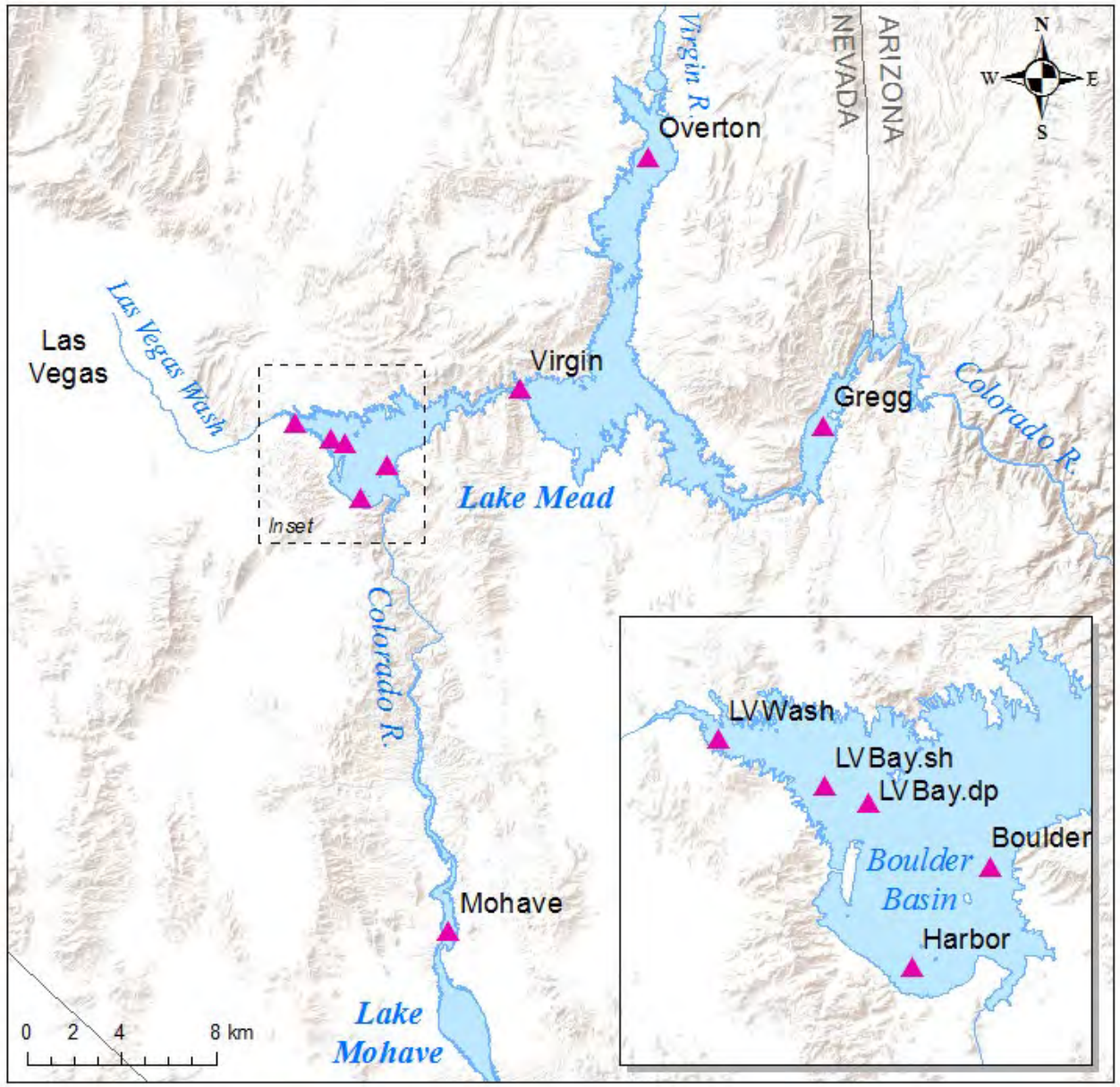
Study completed | NY Water Science Center | contact: Michael Antidormi (mantidormi@usgs.gov)

Microplastics in Lake Mead, Nevada





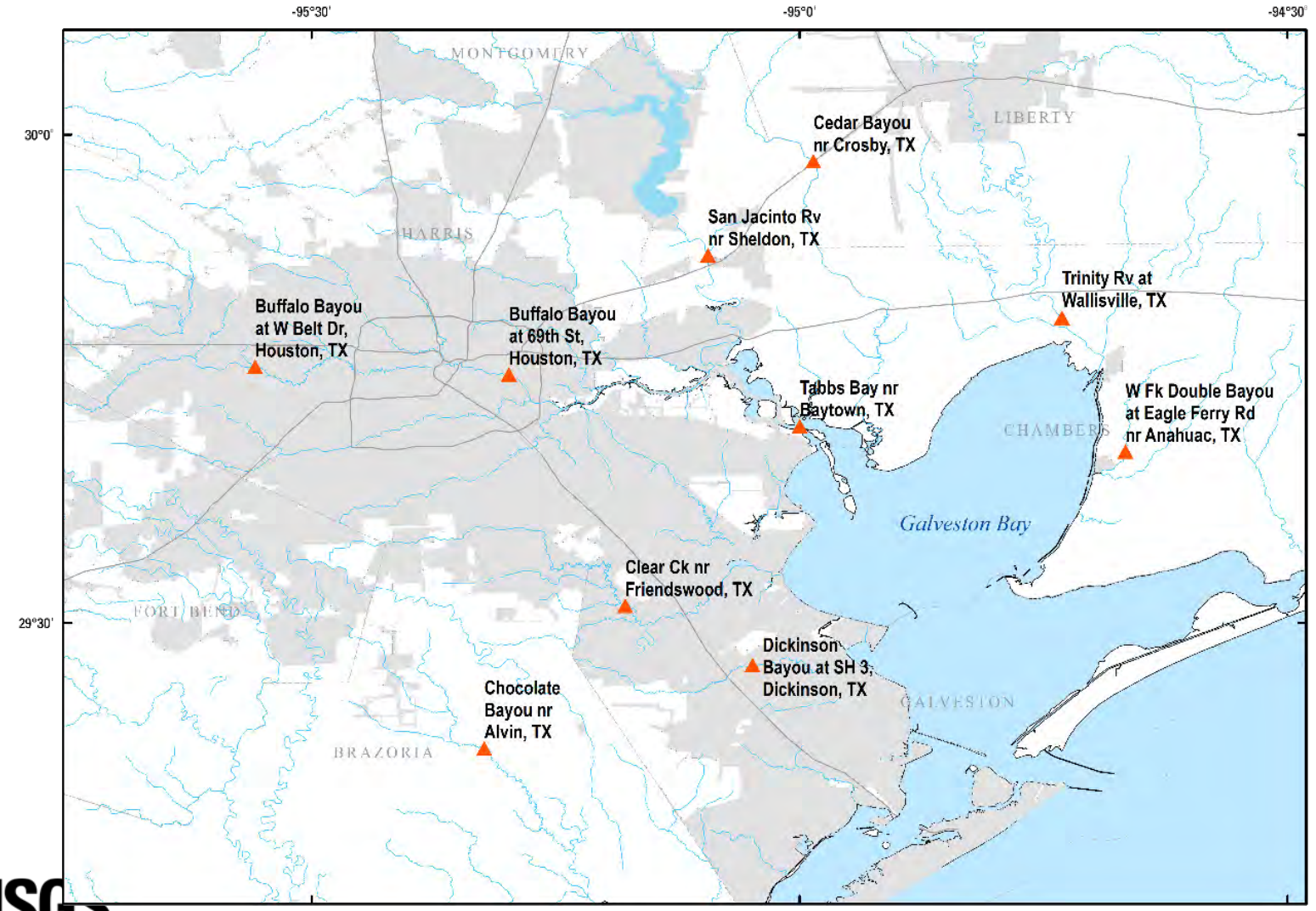
m3, cubic meter
conc, concentration
dw, dry weight



USGS

Baldwin, A.K., Spanjer, A.R., Rosen, M.R., and Thom, T., 2020, Microplastics in Lake Mead National Recreation Area, USA: Occurrence and biological uptake: PloS One, vol. 15, no. 5. https://doi.org/10.1371/journal.pone.0228896

Microplastics in Galveston Bay, Texas



Drainage areas
33 to 3,970 mi^2

Land cover characteristics
- 6-72% urban
- 1-37% forested
- 18-76% agricultural

Study under
- Baseflow
- Stormflow

USGS

Milwaukee Metropolitan Sewerage District

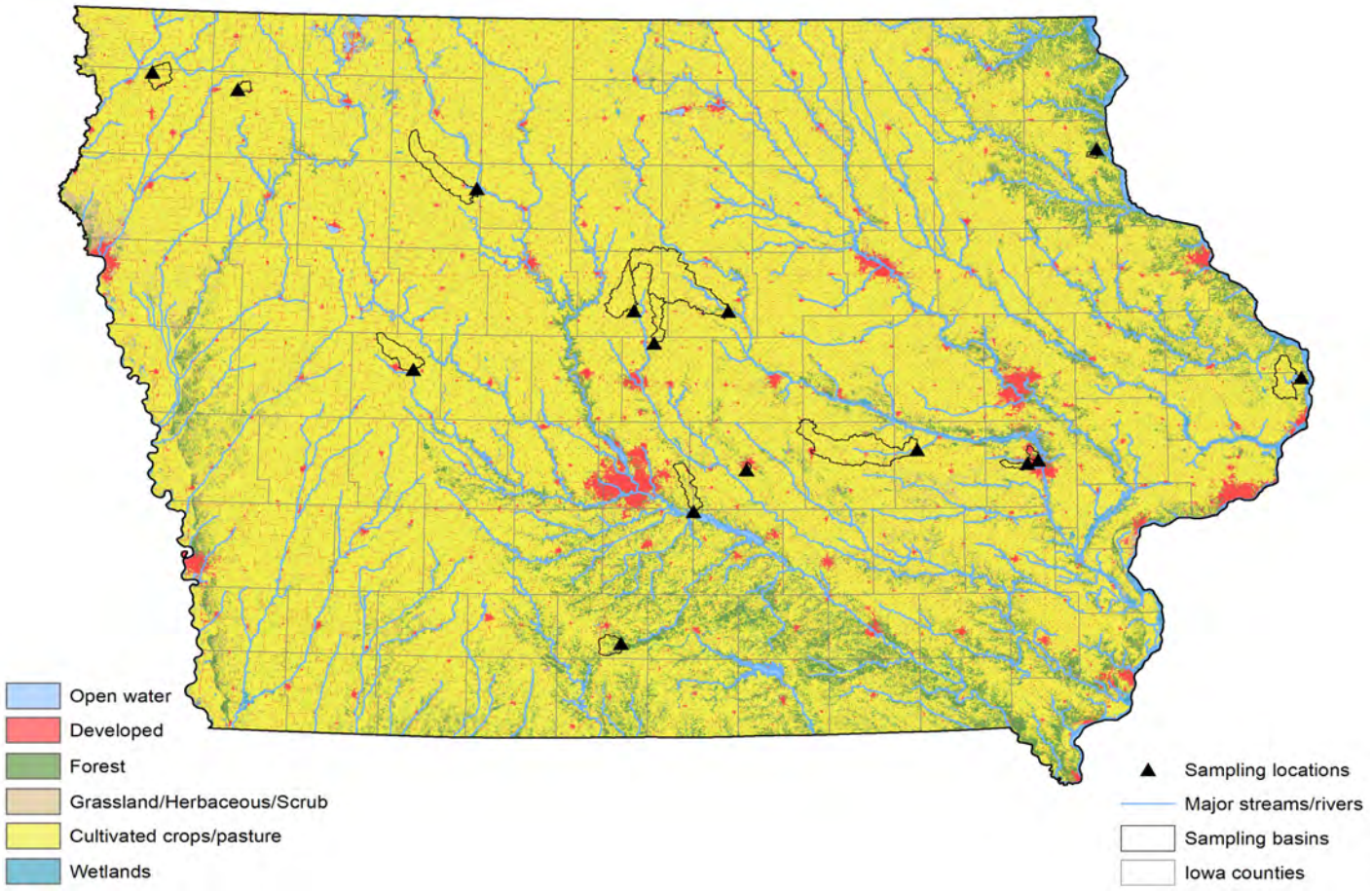
Microplastics sources and green infrastructure

Photo credit: Pete Lenaker

USGS

Study ongoing | Upper Midwest Water Science Center | contact: Peter Lenaker (plenaker@usgs.gov)

Correlating microplastics and water-quality constituents with land use in Iowa rivers



Water

- Microplastics, PFAS, pesticides, nutrients, suspended sediment, bioassays, neonicotinoids, pharmaceuticals, microbial

Bed sediment

- Microplastics, PFAS, neonicotinoids, pharmaceuticals, microbial

Fish tissue

- Microplastics, PFAS, neonicotinoids, pharmaceuticals

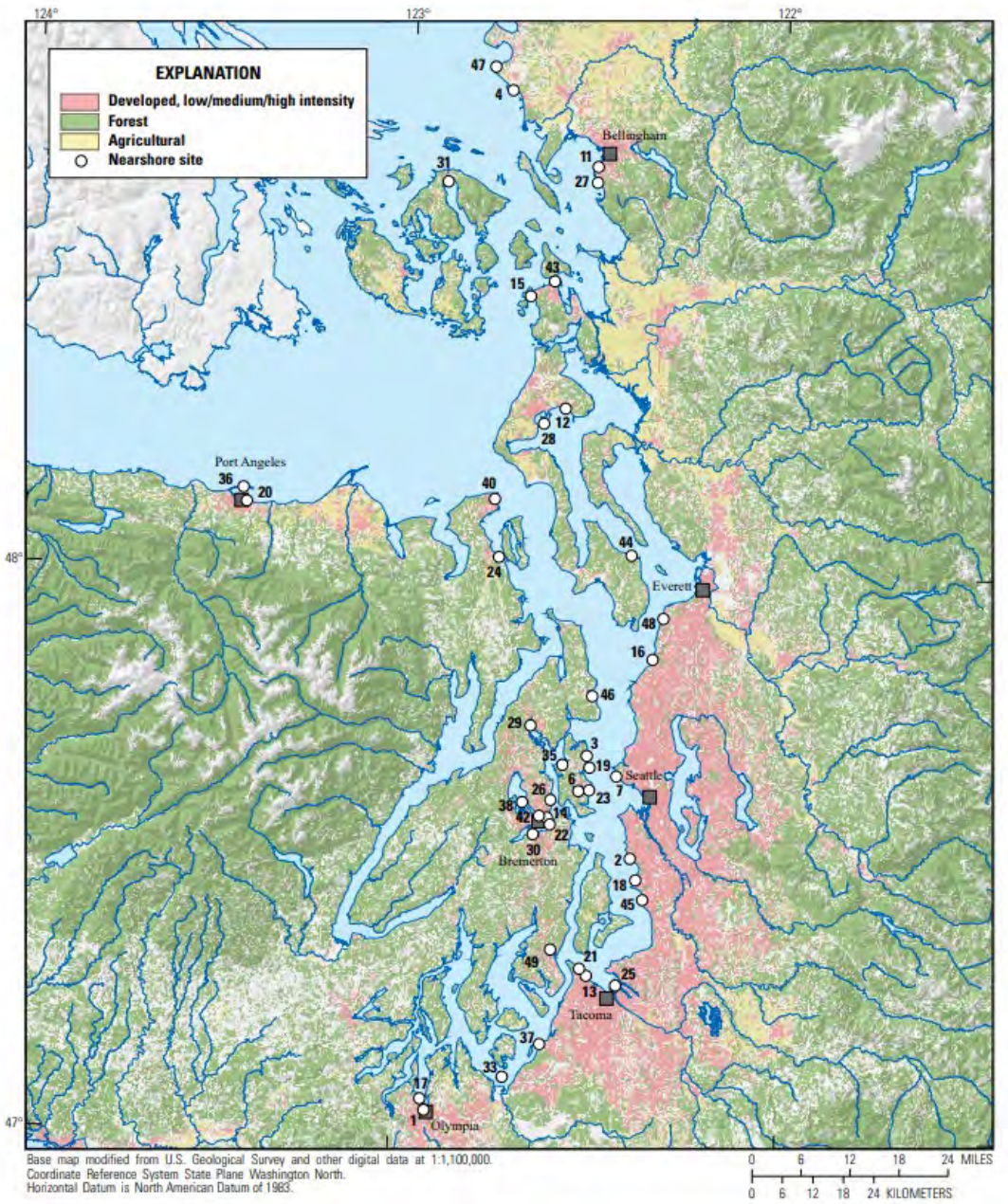
PFAS, per- and polyfluoroalkyl substances

USGS

Study ongoing | Central Midwest Water Science Center | contact: Shannon Meppelink (smeppelink@usgs.gov)

Microplastics and chemical analysis of sediment in Puget Sound, Washington

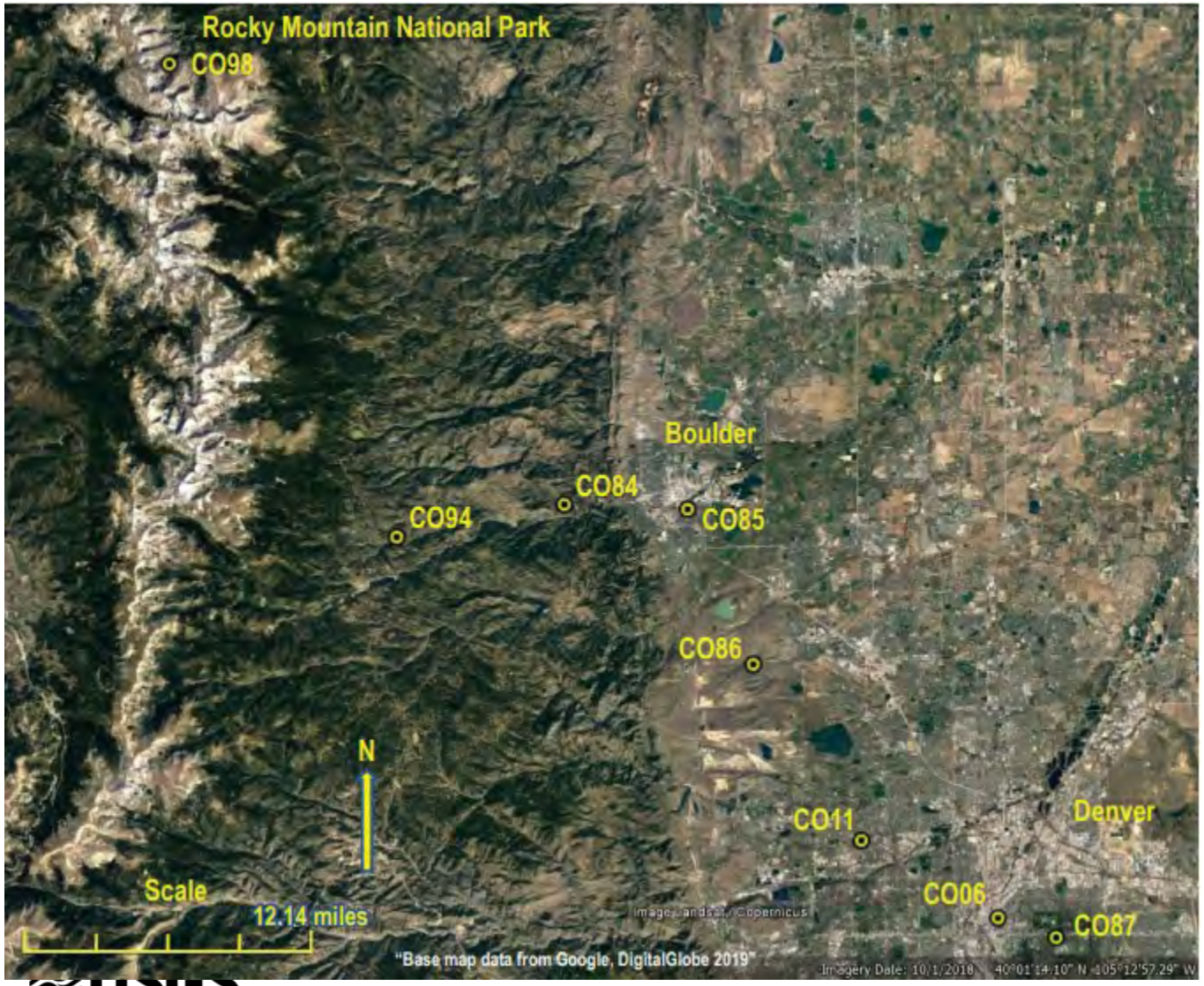
Photo credits: Abby Barnes, Washington State Department of Natural Resources

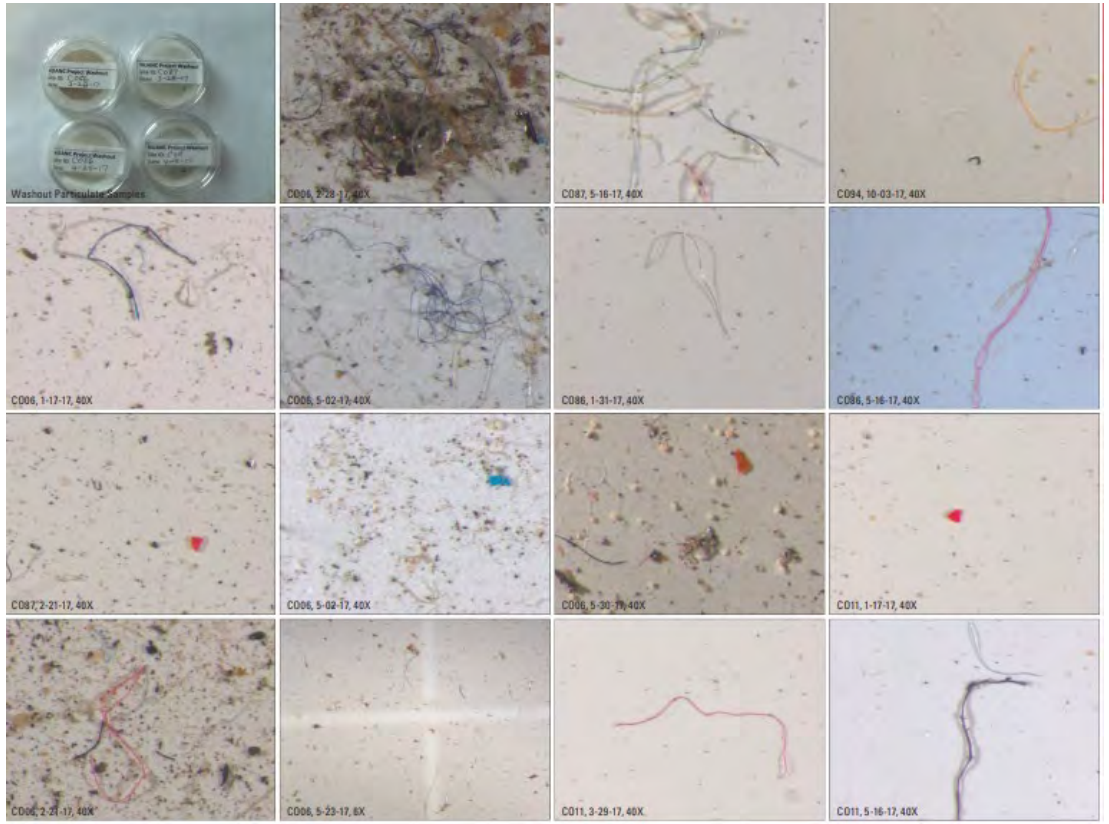


USGS

Black, R.W., Barnes, A., Elliot, C., and Lanksbury, J., 2018, Nearshore sediment monitoring for the Stormwater Action Monitoring (SAM) Program, Puget Sound, western Washington: U.S. Geological Survey Scientific Investigations Report 2018-5076, 53 p., https://doi.org/10.3133/sir20185076

Microplastics in atmospheric deposition, Colorado

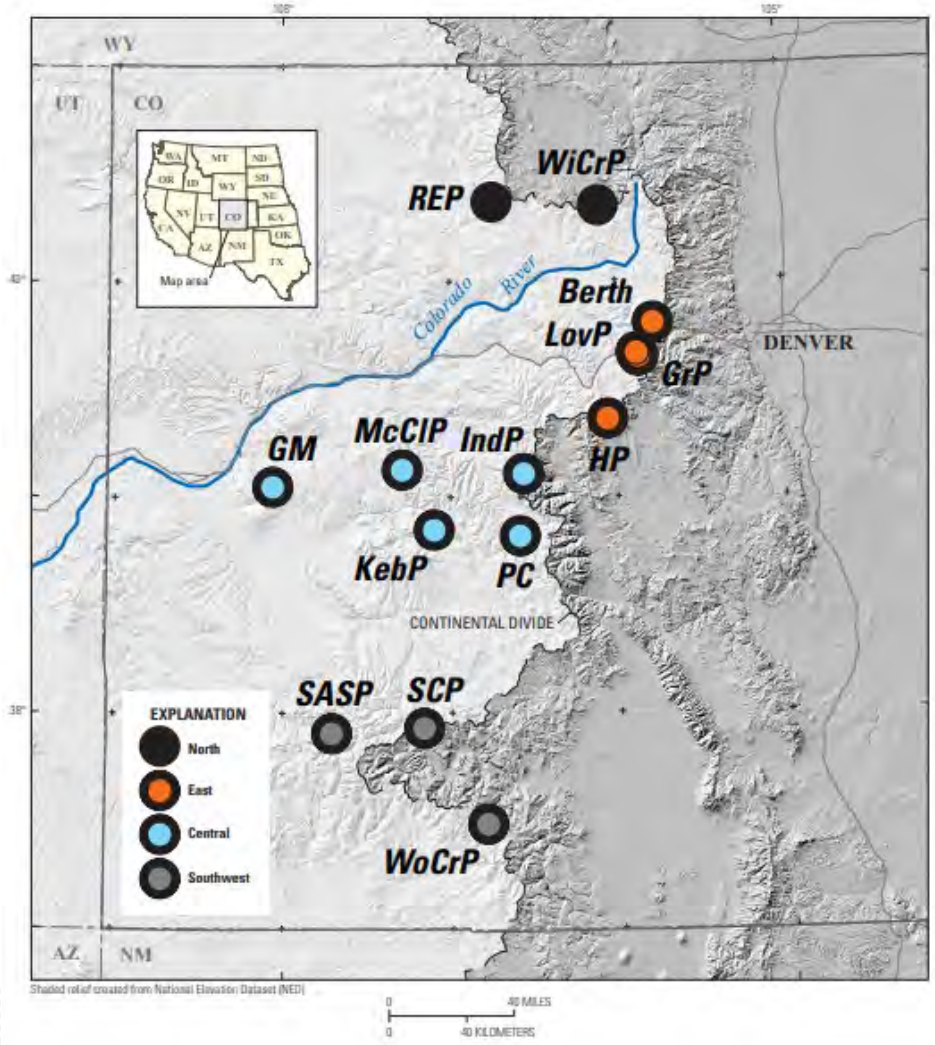


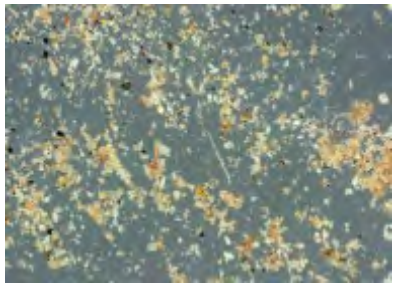


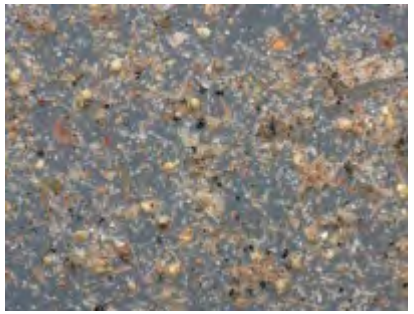
CO## denotes National Atmospheric Deposition Program (NADP) site in Colorado

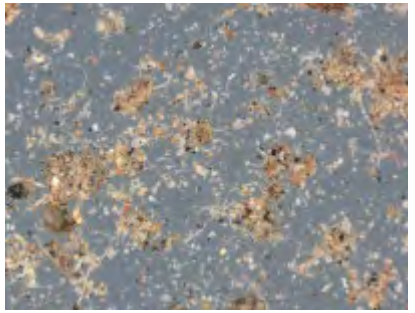
Wetherbee, G., Baldwin, A., Ranville, J., 2019, It is raining plastic.: U.S. Geological Survey Open-File Report 2019–1048, 1 sheet, https://doi.org/10.3133/ofr20191048.

Microplastics in dust-on-snow, Colorado









Reynolds, R.L., Goldstein, H.L., Kokaly, R.F., and Derry, J., 2022, Microplastic particles in dust-on-snow, Upper Colorado River Basin, Colorado Rocky Mountains, 2013–16: U.S. Geological Survey Open-File Report 2022–1061, 7 p., https://doi.org/10.3133/ofr20221061

Thank you

Shawn Fisher | USGS New York Water Science Center | scfisher@usgs.gov

USGS

Overview of U.S. Government Activities Addressing Micro- and Nano-plastics Issues:

National Institute of Environmental Health Sciences (NIEHS)

Nigel Walker PhD DABT

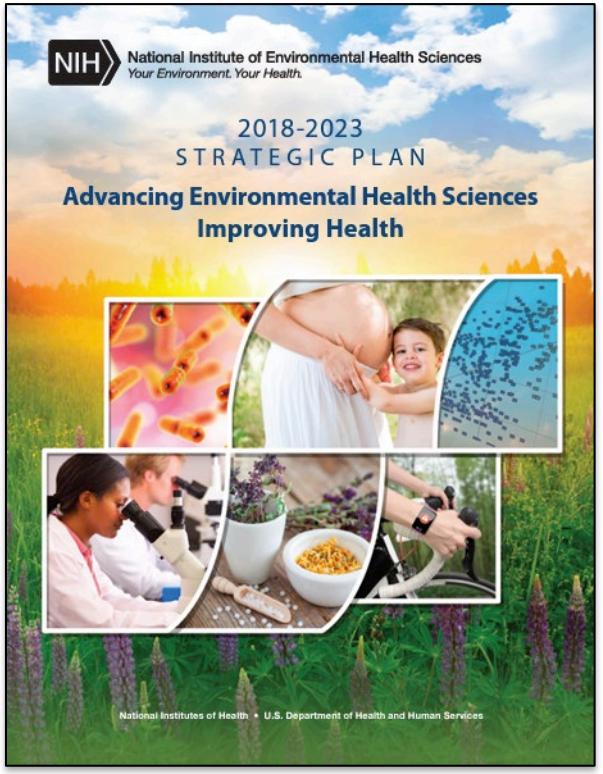
May 22nd 2023

National Institute of Environmental Health Sciences (NIEHS)

- One off the 21 Institutes that comprise the National Institutes of Health (NIH)
  - Located in North Carolina
- NIEHS Mission
  - *Discover how the environment affects people in order to promote healthier lives.*
- Leadership
  - Rick Woychik, PhD; Director
  - Trevor K Archer, PhD; Deputy Director

Overview of NIEHS research

- Funded by NIEHS
  - Division of Extramural Research and Training (DERT)
    - Funding of extramural grant programs that support research and research training in environmental health
    - Superfund Research Program
    - Worker Education and Training
- Conducted by NIEHS
  - Division of Intramural Research (DIR)
    - Investigator-initiated in-house research
  - Clinical Research Unit
  - Division of Translation Toxicology (DTT)
    - Programmatic Team-science primarily utilizing external R&D contract research organizations (CROs) and in-house capabilities
    - Headquarters of the National Toxicology Program (NTP)



Current Microplastics (MPs)/Nanoplastics (NPs) grant funding

- NIEHS Notice of Special Interest (NOSI); NOT-ES-23-002
  - Understanding Exposure and Health Effects of Microplastics (MPs) and/or Nanoplastics (NPs)
- Research Objectives
  - Support research to gain comprehensive understanding of the physiochemical characterization, exposure, and related human health effects of MPs and/or NPs.
- Exploratory (R21) and Research Projects (R01)
  - Accepted through November 16, 2027
- Inquiries:
  - Lingamanaidu (Ravi) V. Ravichandran, Ph.D.
    - Program Officer, DERT, NIEHS
  - lingamanaidu.ravichandran@nih.gov
  - https://grants.nih.gov/grants/guide/notice-files/NOT-ES-23-002.html

SCAN ME

(NOSI):Specific Topics of Research Interest: Exposure Assessment

- Development of screening methods to rapidly detect and quantify MPs or NPs in air, food, drinking water, and other media
- Development and application of analytical methods or technologies to directly characterize or assess the MPs or NPs
- Standardization of approaches for methods of sample collection, processing from complex mixtures for real-world sample analysis
- Development and application of reference standards, quality controls
- Development and validation of sensor/monitoring technologies or tools that can be applied to detect personal exposure levels of MPs or NPs

- *It is important the proposed studies include MPs/NPs with defined physical and chemical properties and/or special emphasis placed on the characterization of the MPs or NPs species for the size, shape, type, and concentration.*

(NOSI):Specific Topics of Research Interest; Health Effects

- Application of *In vitro* & Air Liquid Interface (ALI) models and micro-physiological systems for characterizing the biological or toxicological effects of well characterized MPs or NPs.
- Evaluation of acute and/or sub-chronic toxicity or risk assessment in diverse species/strains using well characterized MPs or NPs with studies focused on the relevant biological or toxic effects.
- Utilization of alternative model systems (e.g. Zebra fish, *C. elegans*) for developmental, acute, subchronic and/or chronic toxicity studies of well characterized and diverse MPs or NPs or mixtures of different types, size, shapes, and aged MP particles.
- Characterization of biodistribution, bioaccumulation, absorption, biotransformation, biological interaction, and excretion of well characterized and environmentally relevant MPs or NPs.

- *It is important the proposed studies include MPs/NPs with defined physical and chemical properties and/or special emphasis placed on the characterization of the MPs or NPs species for the size, shape, type, and concentration.*

Past Extramural programs on nanomaterial safety

- History of funding research programs on nanomaterials since 2009
  - NIEHS Centers for Nanotechnology Health Implications Research (NCNHIR) Consortium
  - NIEHS Nano Grand Opportunity Grant Program (Nano GO)
- Nanomaterials Health Implications Research (NHIR) Consortium
  - Links the physical and chemical properties of high priority engineered nanomaterials (ENM) and newly developed ENMs to biological responses using a variety of testing approaches
- Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants program
  - Helps small businesses develop innovative and commercially viable products or technologies across a broad spectrum of topic areas, including ENMs.

- https://www.niehs.nih.gov/research/supported/exposure/nanohealth/index.cfm

Division of Translational Toxicology (DTT)

- Utilize existing knowledge with nanomaterial characterization to develop novel methods that are applicable to mixtures of nanoplastics
  - Interagency agreement between NIEHS/DTT and FDA/National Center for Toxicological Research (NCTR)
    - Anil Patri PhD; Director, Nanocore, NCTR
    - Develop validated methods for detection, identification and quantitation of various mixtures of nanoplastics in the food chain
- National Toxicology Program
  - NTP toxicological studies and health assessments
    - Polymer Precursors and synergists (e.g. BPA, Styrene, vinyl halides)
    - Plasticizers (e.g. Phthalates, NBBS)
    - Additives (e.g. Brominated flame retardants, Antimony trioxide, PFAS)
    - Crumb rubber
  - NIEHS-CEBS database
    - https://cebs.niehs.nih.gov/cebs/

NNI Public Webinar:
Overview of U.S. Government Activities Addressing Micro- and Nanoplastics Issues
Session 2: Regulatory/Collaborations, June 6, 2023, 1-2:30 pm ET

1:00 Reconvening/introductory remarks (Anil Patri, FDA, moderator)
1:05 State Dept.: International Collaborations & Negotiations (Rob Wing)
1:15 EPA: Overview (Kay Ho)
1:25 FDA: Scientific Review (Stacey Wiggins)
1:35 ATSDR and NCEH: Overview (Custodio Muianga, Gaston Casillas, Max Zarate-Bermudez)
1:50 CPSC: Interagency Collaborations (Joanna Matheson)
2:00 Facilitated Q&A and discussion

Anil Patri
Director, Nanotechnology Core Facility. FDA
(Moderator)

Rob Wing
Deputy Director, Office of Environmental Quality, State/OES

Kay Ho
Environmental Research Scientist, Environmental Effects Research Lab, EPA

Stacey Wiggins
Science Advisor, Center for Food Safety & Applied Nutrition, FDA

Custodio Muianga
Environmental Health Scientist CDC/ATSDR

Gaston Casillas
Research Fellow, CDC/ATSDR

Max Zarate-Bermudez
Epidemiologist, CDC/NCEH

Joanna Matheson
Toxicologist, Program Manager, Nanotechnology, CPSC

https://www.nano.gov/PublicWebinars

Refreshing the NNI's Environmental, Health, and Safety Research Strategy

May 31 – June 1, 2023

Hybrid, in person at L'Enfant Plaza SW

Jaleesia Amos

Doctoral Candidate, The Wiesner Group, Duke University

Scott Brown

Associate Director and GSK Fellow, GlaxoSmithKline

Rick Canady

Director and Founder, NeutralScience

Christie M. Sayes

Associate Professor, Environmental Science and Toxicology, Baylor University

Monita Sharma

Nanotechnology Specialist, PETA Science Consortium International e.V.

Jo Anne Shatkin

Director and Founder, Vireo Advisors, LLC

Phil Demokritou

Henry Rutgers Chair and Professor in Nanoscience and Environmental Bioengineering, Rutgers School of Public Health, Rutgers Biomedical Health Sciences

Jacqueline Isaacs

Professor and Vice Provost for Faculty Affairs, Mechanical & Industrial Engineering, Northeastern University

Sagar Kamarthi

Professor, Mechanical and Industrial Engineering, Northeastern University

Joana Sipe

Postdoctoral Associate, The Wiesner Group, Duke University

Mark Wiesner

James B. Duke Distinguished Professor of Civil and Environmental Engineering, Duke University

Julie Zimmerman

Professor, Chemical & Environmental Engineering, Environment and Epidemiology, Yale University

Greg Lowry

Walter J. Blenko, Sr. Professor, Civil and Environmental Engineering, Carnegie Mellon University

Andre Nel

Distinguished Professor of Medicine and Research Director of the California Nano Systems Institute at UCLA; Director of the

Srinivasan Radhakrishnan

Assistant Teaching Professor, Northeastern University

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