Microplastics & Forever Chemicals in Our Lakes

Jonathan Petali, Ph.D., Toxicologist
NHDES Environmental Health Program

Jill Emerson, Water Quality Coordinator
Green Mountain Conservation Group

NH Lakes Congress
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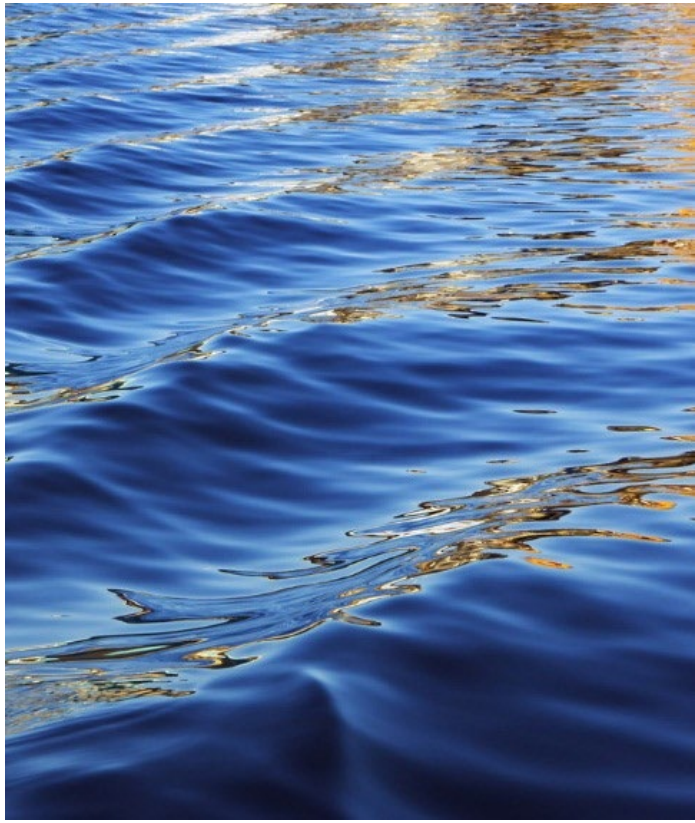


What are "emerging" contaminants and how do they impact NH Lakes?

"Emerging contaminants" are those that either have limited information about health and ecological risks, or their occurrence in the environment is poorly understood.

This lack of information limits the ability to regulate and direct resources to address these contaminants.

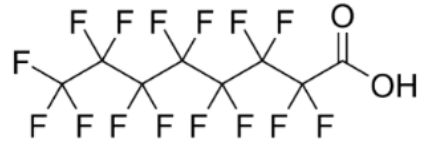
Examples of emerging contaminants include:

- **Per- and polyfluoroalkyl substances (PFAS)**
- **Microplastics**
- Personal care products and pharmaceuticals (e.g., drugs, antibiotics, and UV filters)
- Novel cyanobacteria and algae blooms
- Nanomaterials

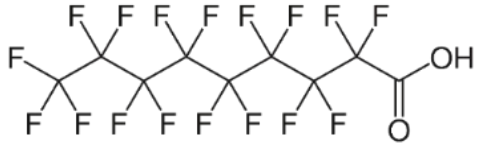
What the F (Fluorine) are PFAS?

- "**PFAS**" stands for **Perfluoroalkyl & Polyfluoroalkyl Substances**.
- > 4,000 compounds, formerly called *Perfluorochemicals* (PFCs).
- Different functional groups & carbon-chain lengths determine names.
- Short- (<5-6 carbons) versus Long-chain (>5-6 carbons)

Perfluorocarboxylic Acids (PFCAs)

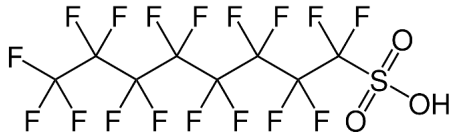


Perfluorooctanoic acid (PFOA)
8 carbon

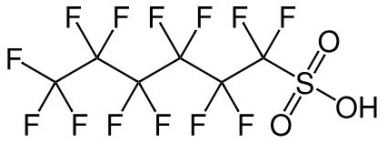


Perfluorononanoic acid (PFNA)
9 carbon

Perfluorosulfonic Acids (PFSAs)

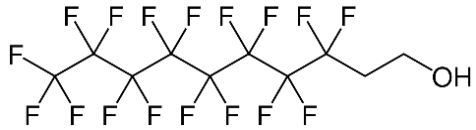


Perfluorooctane sulfonic acid (PFOS)
8 carbon

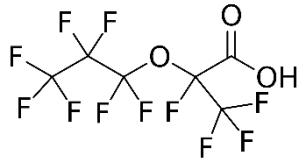


Perfluorohexane sulfonic acid (PFHxS)
6 carbon

"Other" PFAS



Fluorotelomer alcohol (8:2)



HFPO-DA
(2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid)

How are PFAS used?

Industrial Applications

- Aqueous Film-Forming Foam (AFFF)
- Chemical production
- Metal plating
- Textiles, upholstery, apparel, carpets
- Paper and packaging
- Rubber and plastics
- Medical devices
- Insect baits
- Semiconductor manufacturing
- Photoimaging

Commercial Products

- Non-stick cookware
- Fast food containers
- Candy wrappers & microwave popcorn bags
- Personal care and cosmetic products
- Paints and varnishes
- Stain-resistant carpet and chemicals
- Water-resistant apparel
- Cleaning products
- Electronics
- Ski wax

How are you exposed to PFAS?

- **Primary route of exposure is ingestion** (e.g. drinking water or food).
- Certain PFAS transfer from the placenta/breastmilk to infants.
- Inhaling/ingesting PFAS-containing dusts may contribute to exposure.
- Certain PFAS are **less efficiently absorbed across the skin**.
- **Certain PFAS are bioaccumulative**, meaning they "build-up" in the body.




Health Risks Associated with Per- and Polyfluoroalkyl Substances (PFAS)

- Increased cholesterol levels
- Changes in liver enzyme levels
- Small changes in infant birth weight
- Altered immune system function
- Increased risk of high blood pressure or pre-eclampsia in pregnant women
- Changes in thyroid and/or reproductive hormones
- Possibly increased risks for kidney or testicular cancer

These health outcomes are being studied nationwide by the Agency for Toxic Substances and Disease Registry (ATSDR), as well as by private and academic institutions.

This is a ***constantly evolving area of scientific research***. For more information from ATSDR, follow this link: https://www.atsdr.cdc.gov/pfas/index.html

What's the PFAS profile in certain NH Lakes?

- We know PFAS can "bioaccumulate" into fish and other aquatic organisms.
- This occurs through interaction with water, sediment and prey.
- Animals, including humans, that eat fish may have exposure to PFAS.

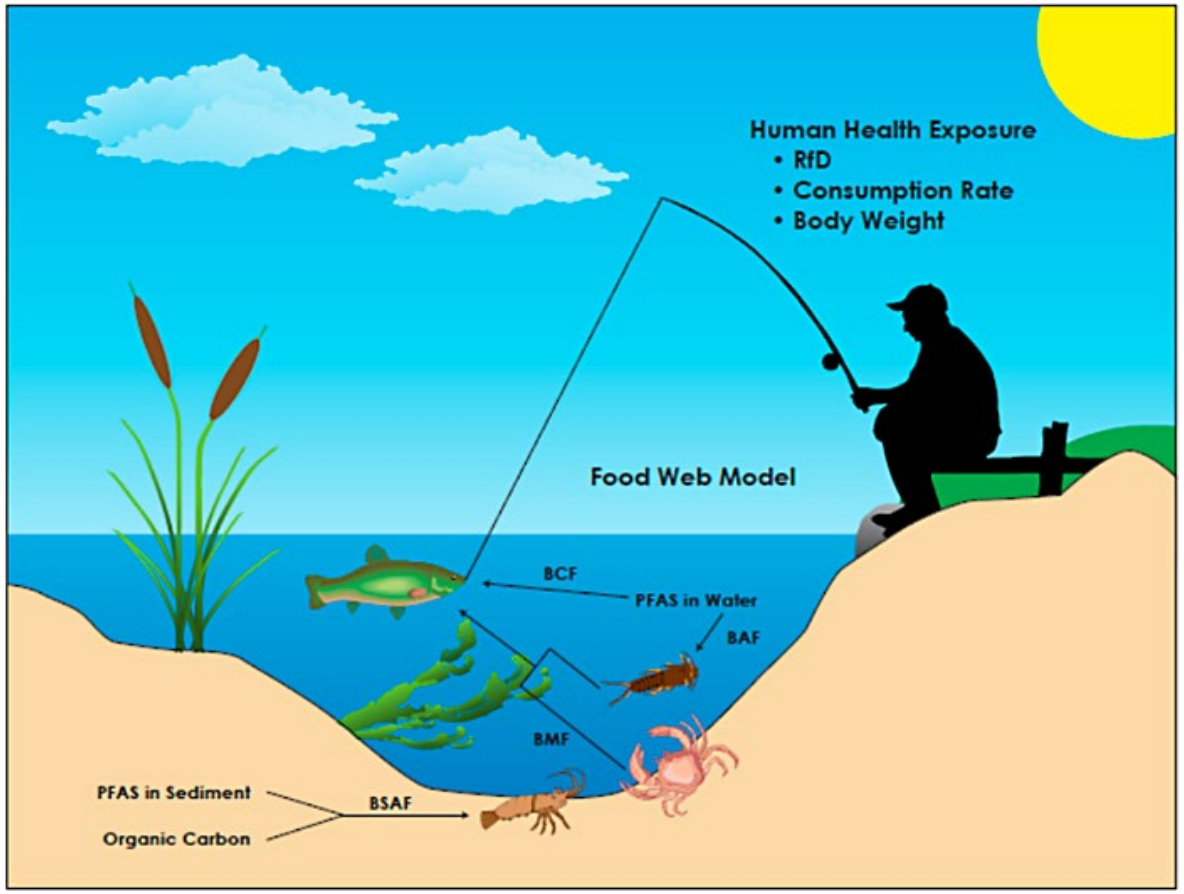


Diagram Source: Interstate Technology & Regulatory Council's PFAS Technical & Regulatory Guidance Document (Figure 17-1; https://pfas-1.itrcweb.org/)

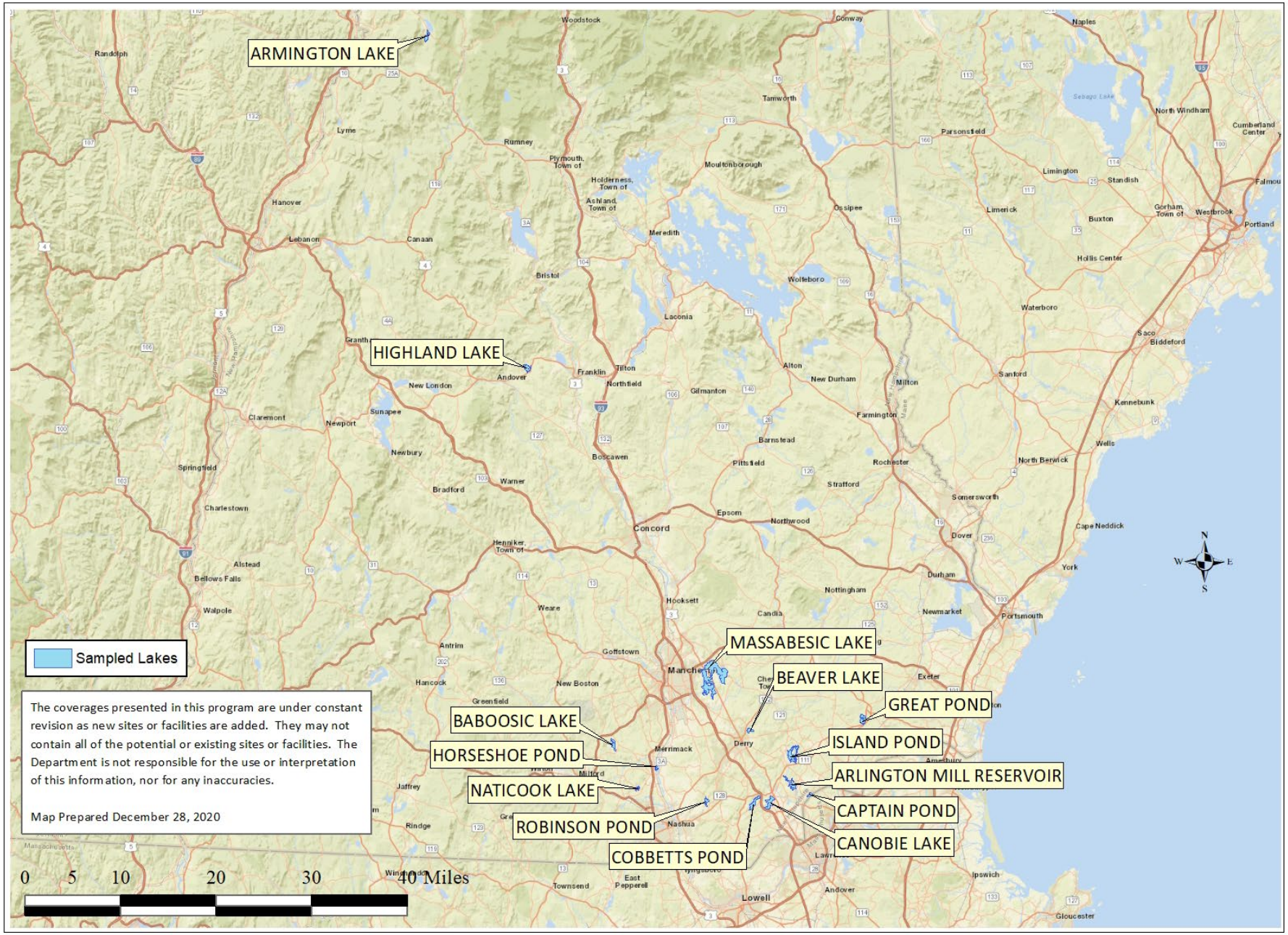
Study Lakes in Southern NH

1. Arlington Mill Reservoir, Salem
2. Baboosic Lake, Merrimack
3. Beaver Lake, Derry
4. Big Island Pond, Derry
5. Canobie Lake, Salem
6. Captain Pond, Salem
7. Cobbetts Pond, Windham
8. Great Pond, Kingston
9. Horseshoe Pond, Merrimack
10. Lake Massabesic, Auburn
11. Naticook Lake, Merrimack
12. Robinson Pond, Hudson

Reference Lakes

13. Highland Lake, Andover
14. Armington Lake, Piermont

Lakes in the Fall 2020 PFAS Sampling



What's the PFAS profile in certain NH Lakes?

Objective of this study was to learn about the occurrence of certain PFAS in southern NH waterbodies.

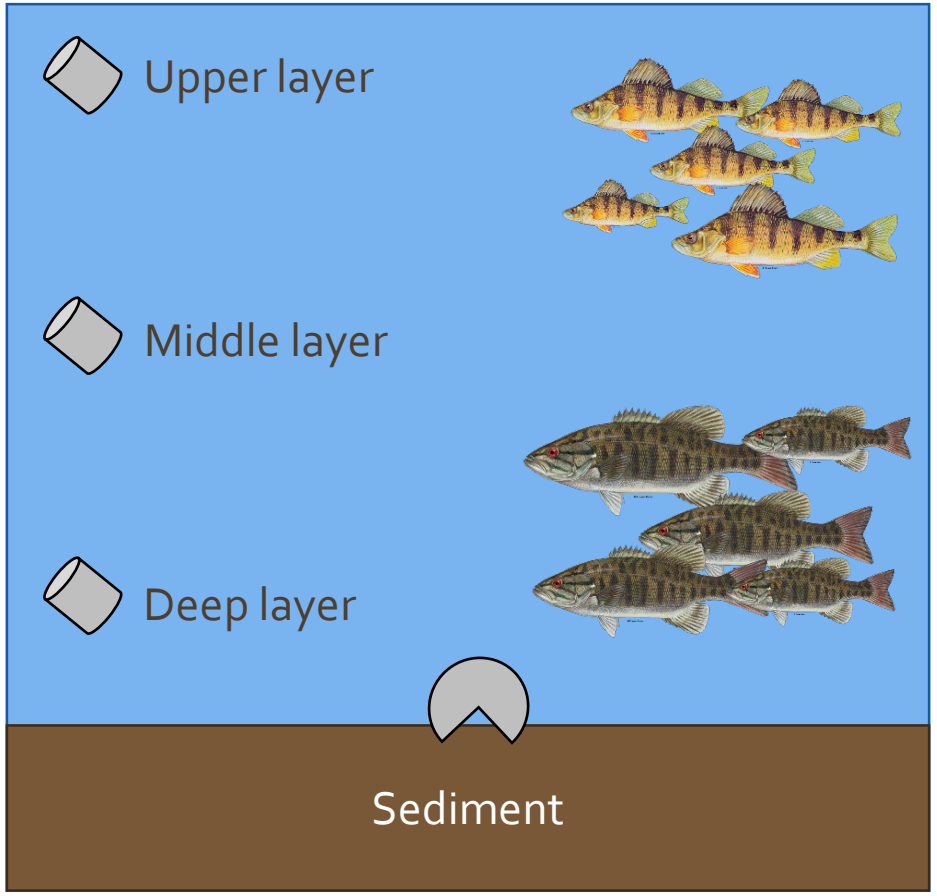
14 waterbodies in NH sampled in October 2020

Water samples at 3 depths and 1 **sediment samples** were also collected at each lake.

- Analyzed at Eurofins for 36 PFAS

2 fish species were composite sampled per waterbody

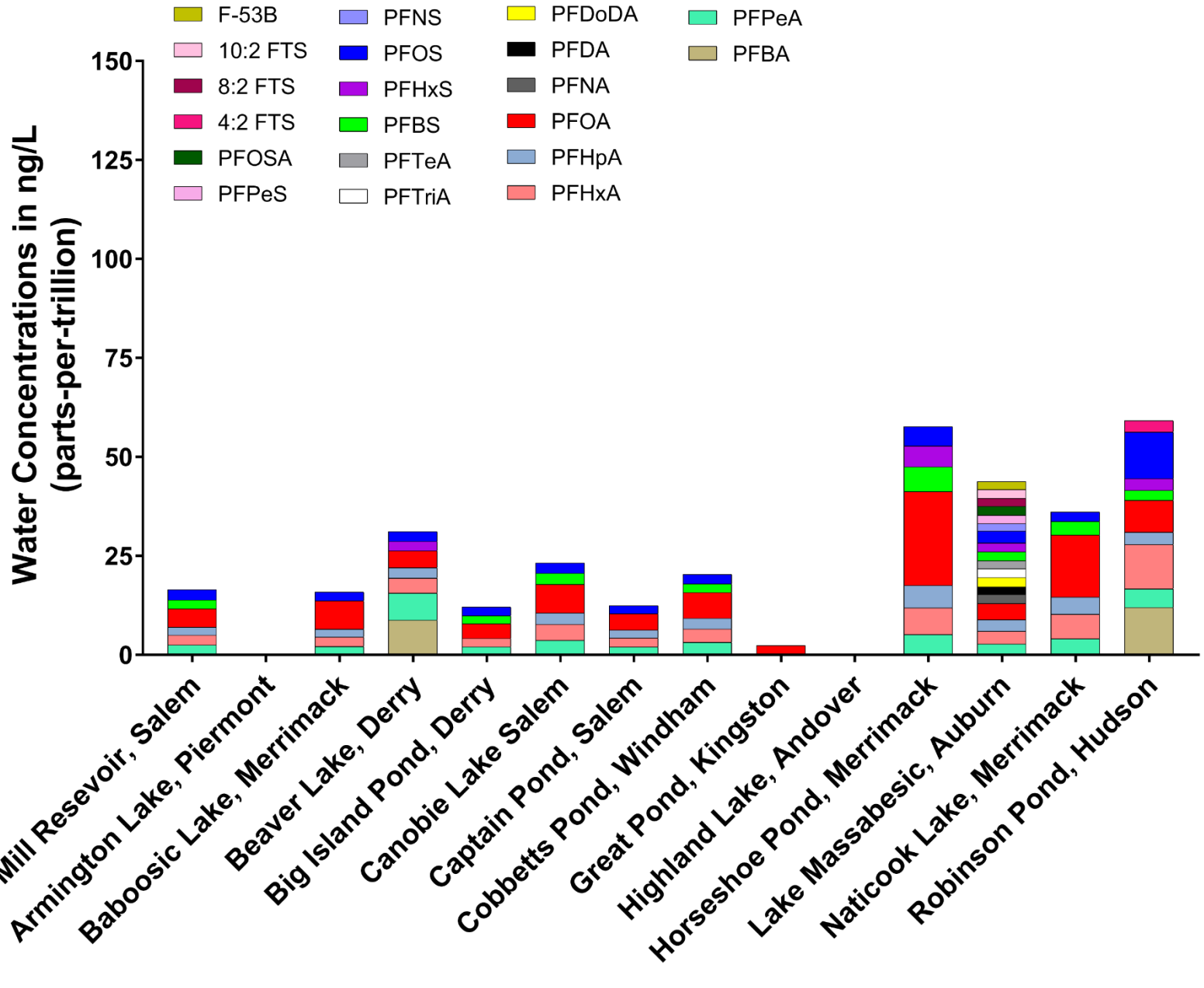
- 5 individual fish were combined to make 1 sample
- Analyzed at SGS-AXYS for 34 PFAS



Fish images: U.S. Fish & Wildlife. 2020. https://www.fws.gov/fisheries/freshwater-fish-of-america. Accessed 4/22/2020.

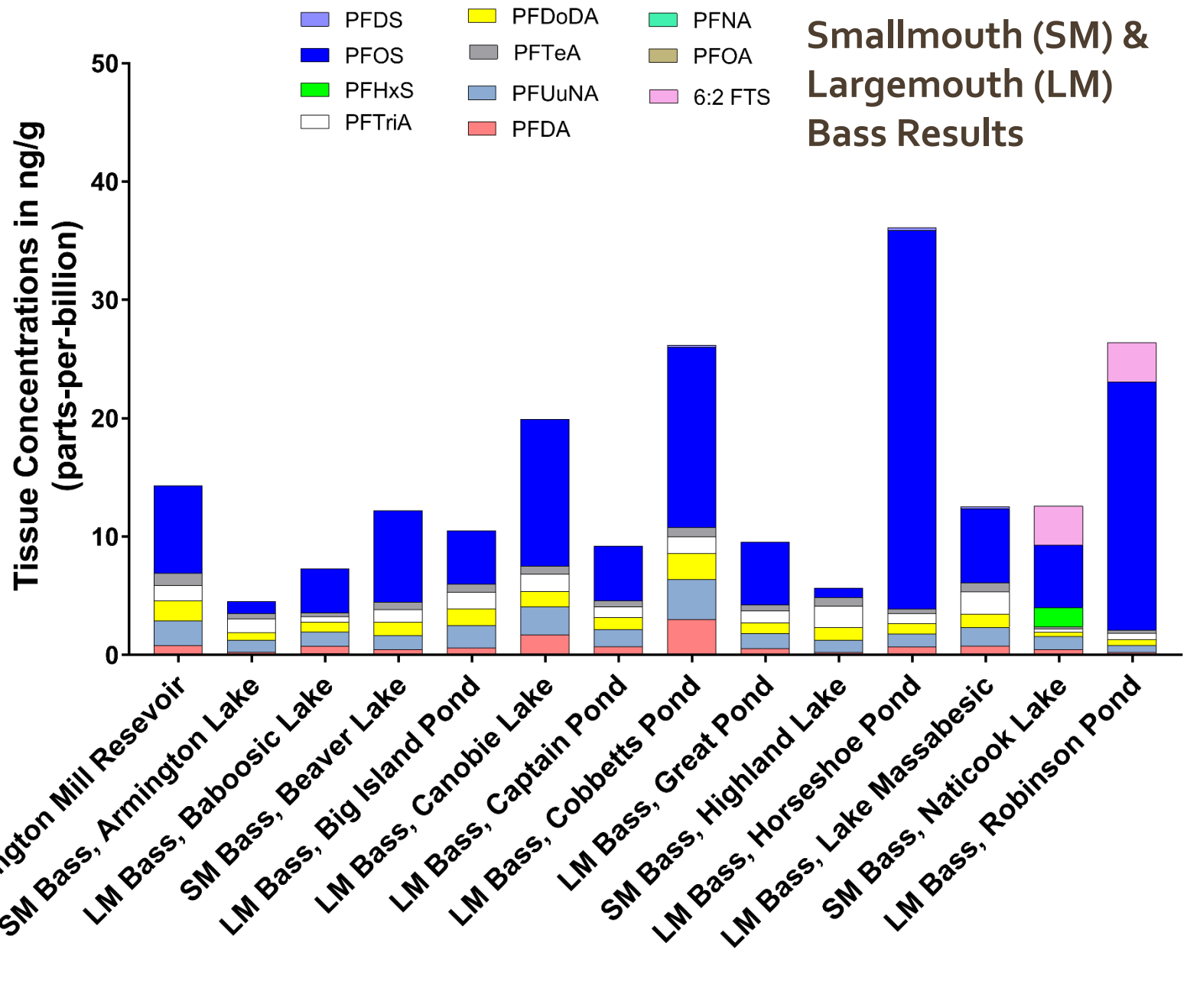
Water & Sediment Results

- PFAS are present in NH lakes.
- The occur as mixtures, likely due to multiple sources.
- Less frequently detected in sediments using currently analytical chemistry.
- Some analytical challenges complicate testing.



Fish Tissue Results

- PFAS are present in fish sampled from ***all*** lakes.
- Again, PFAS occur as mixtures but different than water.
- PFOS is the most common and abundant PFAS in fish.
- Result for ***other species*** are available in the Full Report: https://www4.des.state.nh.us/nh-pfas-investigation/wp-content/uploads/2020-lake-fish-water-sediment-PFAS-report.pdf

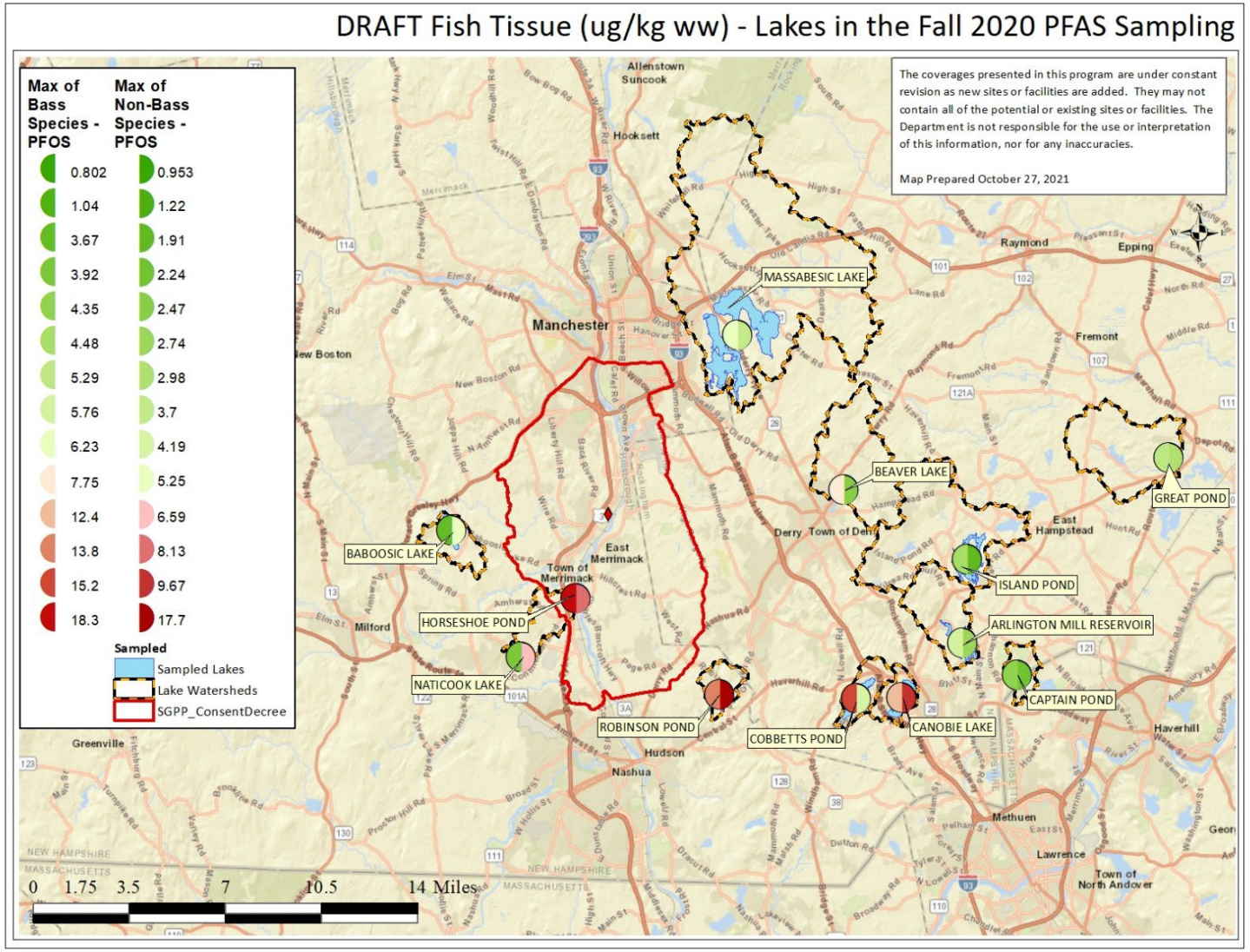


Recommended Additional Advisories Above and Beyond the State-wide Mercury Advisory

Lake	Species	Population Segment CBA = Childbearing Age	Recommended Maximum Consumption Rate (meals/month)
NH *Statewide* Mercury Advisory	Most Species	Typical Adult	4 meals/month
		Women CBA & Children	1 meal/month
Derry, Beaver Lake	Bass Species	Typical Adult*	3 meals/month
		Women CBA & Children	1 meal/month (same as Hg)
Salem, Canobie Lake	All Species	Typical Adult*	3 meals/month
		Women CBA & Children	1 meal/month (same as Hg)
Windham, Cobbetts Pond	Bass Species	Typical Adult*	2 meals/month
		Women CBA & Children	1 meal/month (same as Hg)
Merrimack, Horseshoe Pond	All Species	Typical Adult*	1 meal/month
		Women CBA Children**	1 meal/month (same as Hg) DO NOT EAT
Hudson, Robinson Pond	All Species	Typical Adult*	2 meals/month
		Women CBA Children**	1 meal/month (same as Hg) DO NOT EAT

Words of Caution

- Small sample sizes and composite sampling of fish tissue.
- Sampling is biased to South Central NH, not representative of the state.
- Risk of total PFAS is unknown.
- Other contaminants are present.
- Relative risks versus benefits of fish consumption.



Looking to the Future

- Risk assessment of PFAS will ***change with new research***.
- New ***EPA toxicity values, health advisories or policies*** may result in new criteria for certain media.
- ***More basic and applied research is needed*** to assess risks from dermal contact and inhalation.
- ***Local partnerships are helping*** to address knowledge gaps.
- ***Risk communication is critical***, especially with our affected communities, legislators and the regulated community.

Questions?

Jonathan Petali, Ph.D., Toxicologist
Environmental Health Program
New Hampshire Department of Environmental Services

Phone: (603) 271-1359
Email: jonathan.m.petali@des.nh.gov

https://www4.des.state.nh.us/nh-pfas-investigation/ (***changing soon!)***

Microplastics and Our Lakes

Jill Emerson, Water Quality Coordinator

Support from: NH State Conservation Commission

The Moose Plate Grant Award

GREEN MOUNTAIN CONSERVATION GROUP

Conservation & Heritage License Plate Program

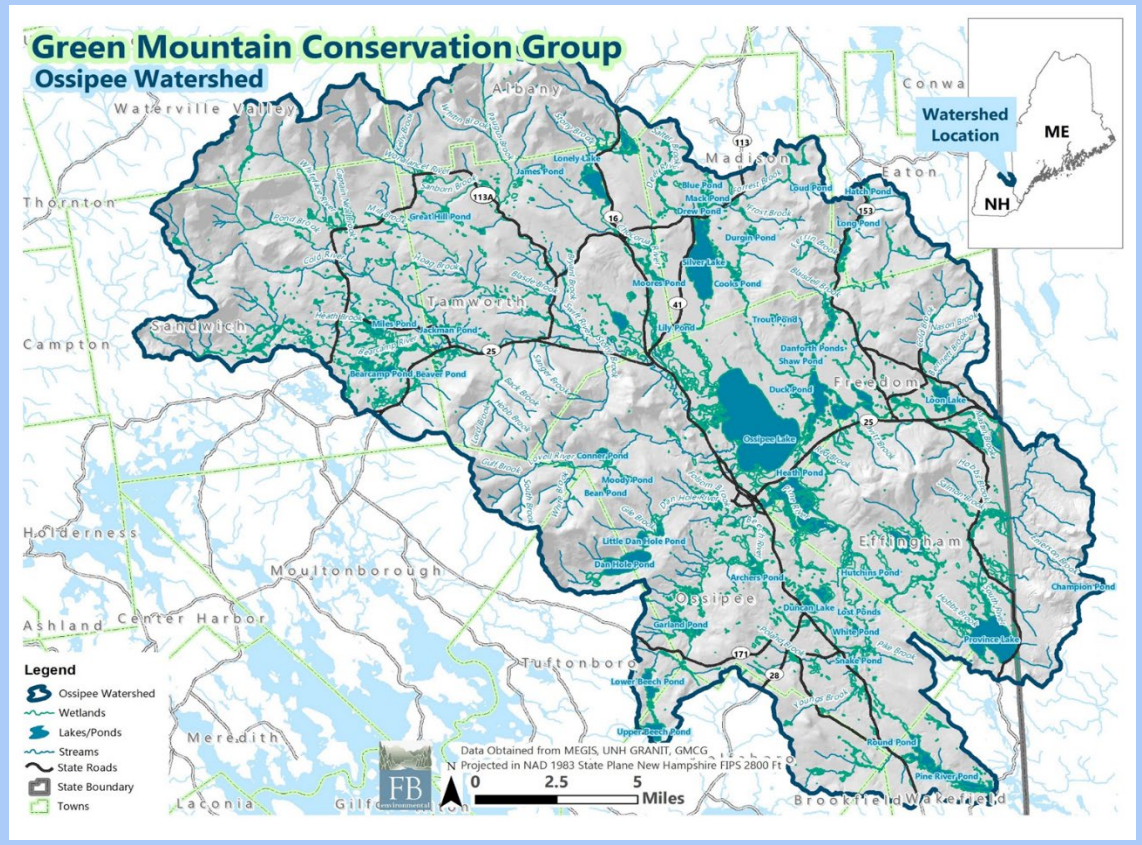
Huge thank you to:
NH State Conservation Commission
The Moose Plate Grant Award

The New Hampshire State Conservation Committee (SCC) is the state government agency responsible for managing the Conservation Grant Program. Competitive grants are awarded annually to physical and tangible environmental projects that foster stewardship and the sustainability of New Hampshire's natural environment.

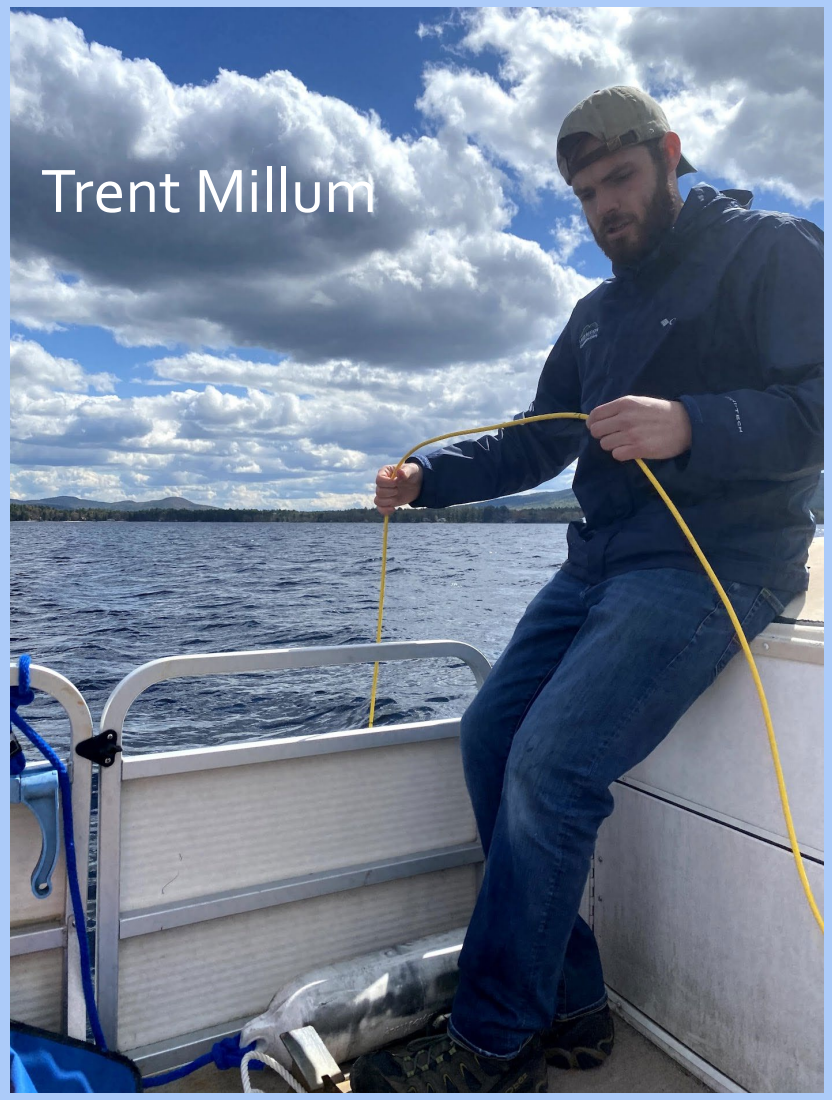
Green Mountain Conservation Group

is a watershed organization committed to the conservation of shared natural resources in the Ossipee Watershed through research, education, advocacy and land conservation. The primary towns include Eaton, Effingham, Freedom, Ossipee, Madison, Sandwich and Tamworth. GMCG also partners with the Saco River Corridor Commission in Maine.

GREEN MOUNTAIN CONSERVATION GROUP

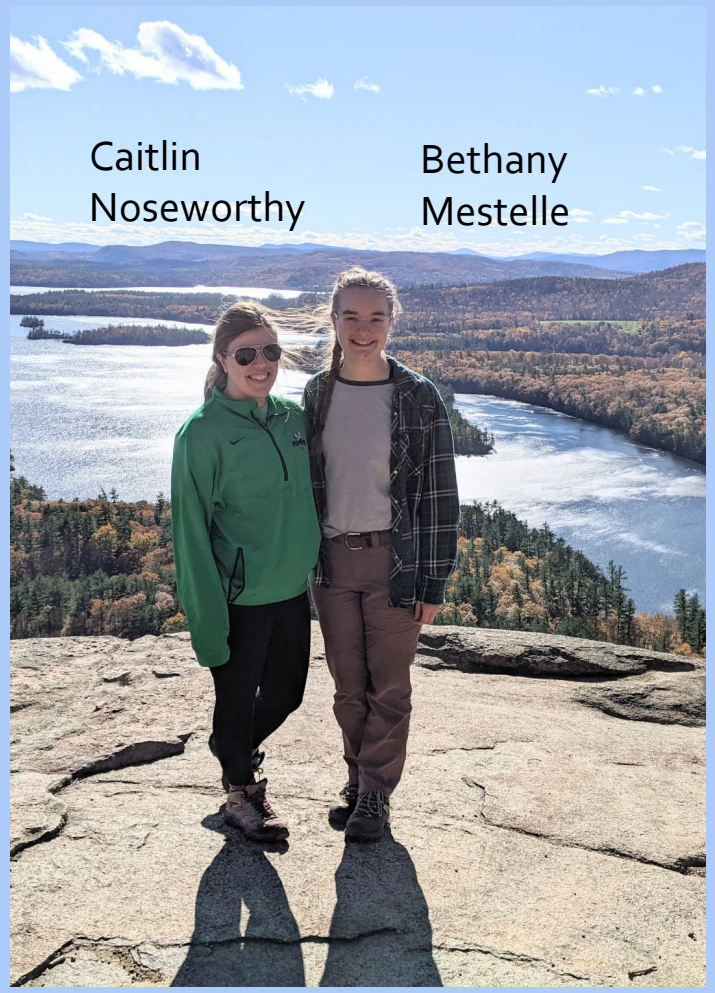


Special thanks to the AmeriCorps program



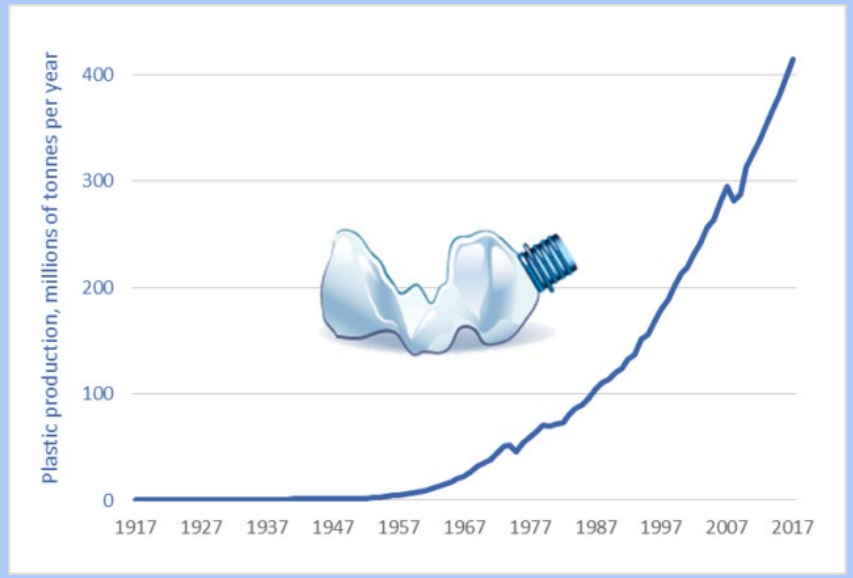
AmeriCorps

LAKES REGION CONSERVATION CORPS

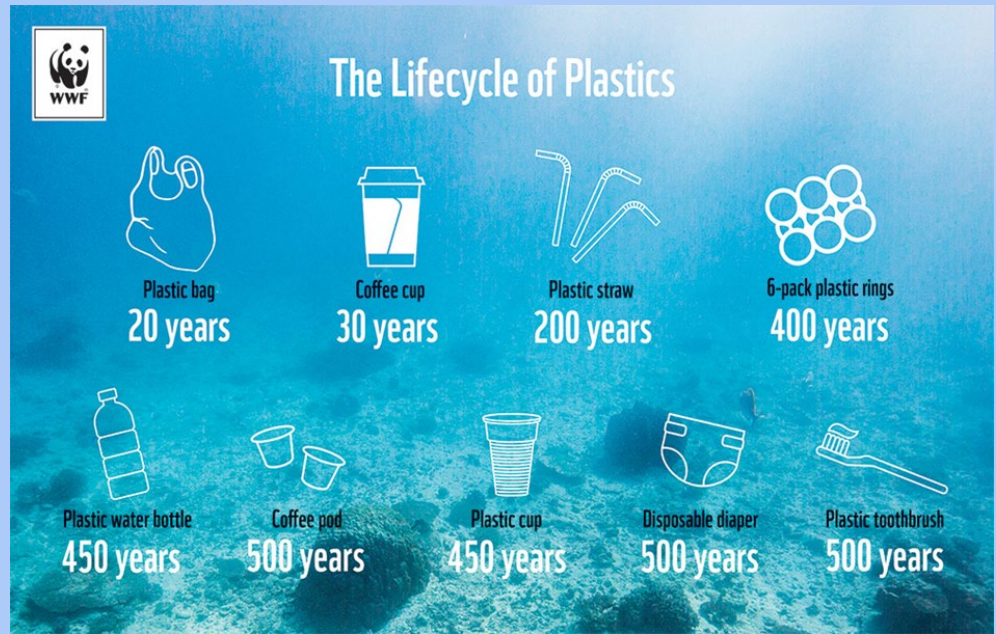


Plastic pollution – how did we get here?

- "Plastic" means pliable and easy to shape
- 1869 – first synthetic polymer developed to replace ivory
- 1907 Bakelite became the first synthetic plastic
- WWII rationing launched plastic production
- US generates more plastic waste than any other country in the world
- By 2050, it is estimated that there will be more plastic in the ocean by weight than fish



Source: https://www.darrinqualman.com/global-plastics-production/



The Recycling Myth

Plastic Resin Identification Codes

1 PETE	2 HDPE	3 PVC	4 LDPE	5 PP	6 PS	7 OTHER
Polyethylene Terephthalate	High-Density Polyethylene	Polyvinyl Chloride	Low-Density Polyethylene	Polypropylene	Polystyrene	Other
Common products: soda & water bottles; cups, jars, trays, clamshells	Common products: milk jugs, detergent & shampoo bottles, flower pots, grocery bags	Common products: cleaning supply jugs, pool liners, twine, sheeting, automotive product bottles, sheeting	Common products: bread bags, paper towels & tissue overwrap, squeeze bottles, trash bags, six-pack rings	Common products: yogurt tubs, cups, juice bottles, straws, hangers, sand & shipping	Common products: to-go containers & flatware, hot cups, razors, CD cases, shipping cushion, cartons, trays	Common types & products: polycarbonate, nylon, ABS, acrylic, PLA; bottles, safety glasses, CDs, headlight lenses Recycled products: electronic housings, auto parts,

https://www.bluelinelabels.com/glossary-of-resins-containers-decorating/

Plastics are everywhere!


Mariana Trench


Mount Everest


Antarctica

Arctic Circle

Basically if you…..

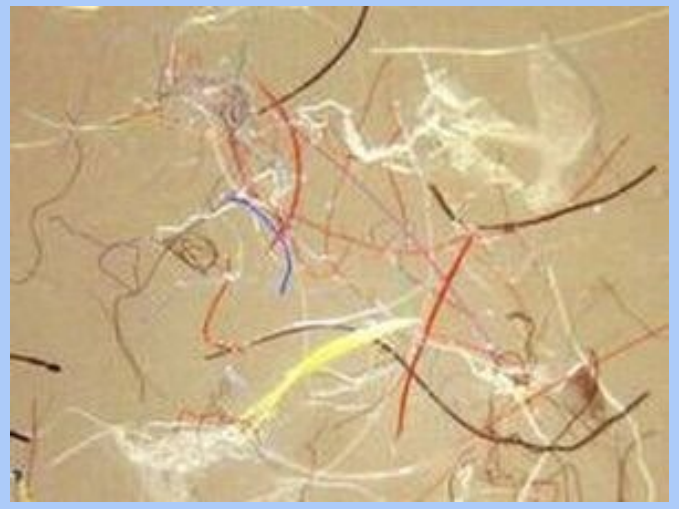
…..you have plastics in you.

What are microplastics?

- Coined in 2004 by a UK marine biologist
- Frequently defined as being 5mm (1/5”) or less in length
  - Nanoplastics are less than 1uM
- Two classifications of microplastics
  1) Primary microplastics - purposely produced to be small
  2) Secondary microplastics - broken down from larger plastic sources

Microbeads

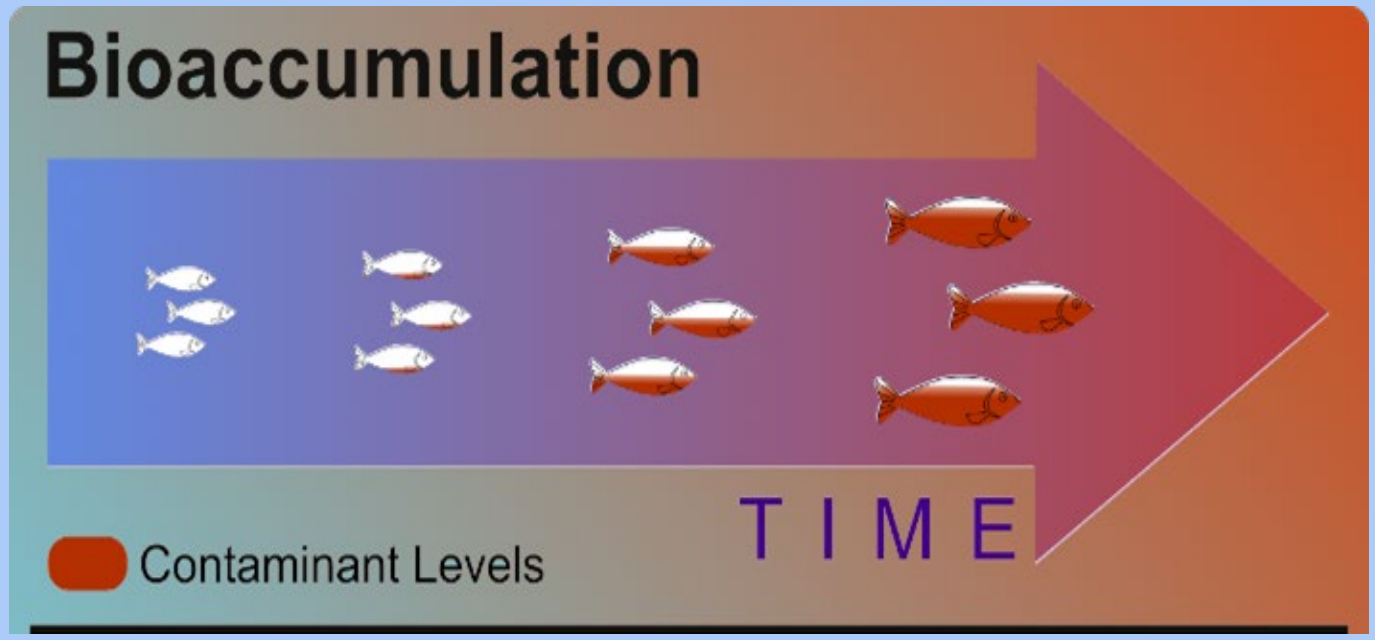
Microfibers



Microfragments

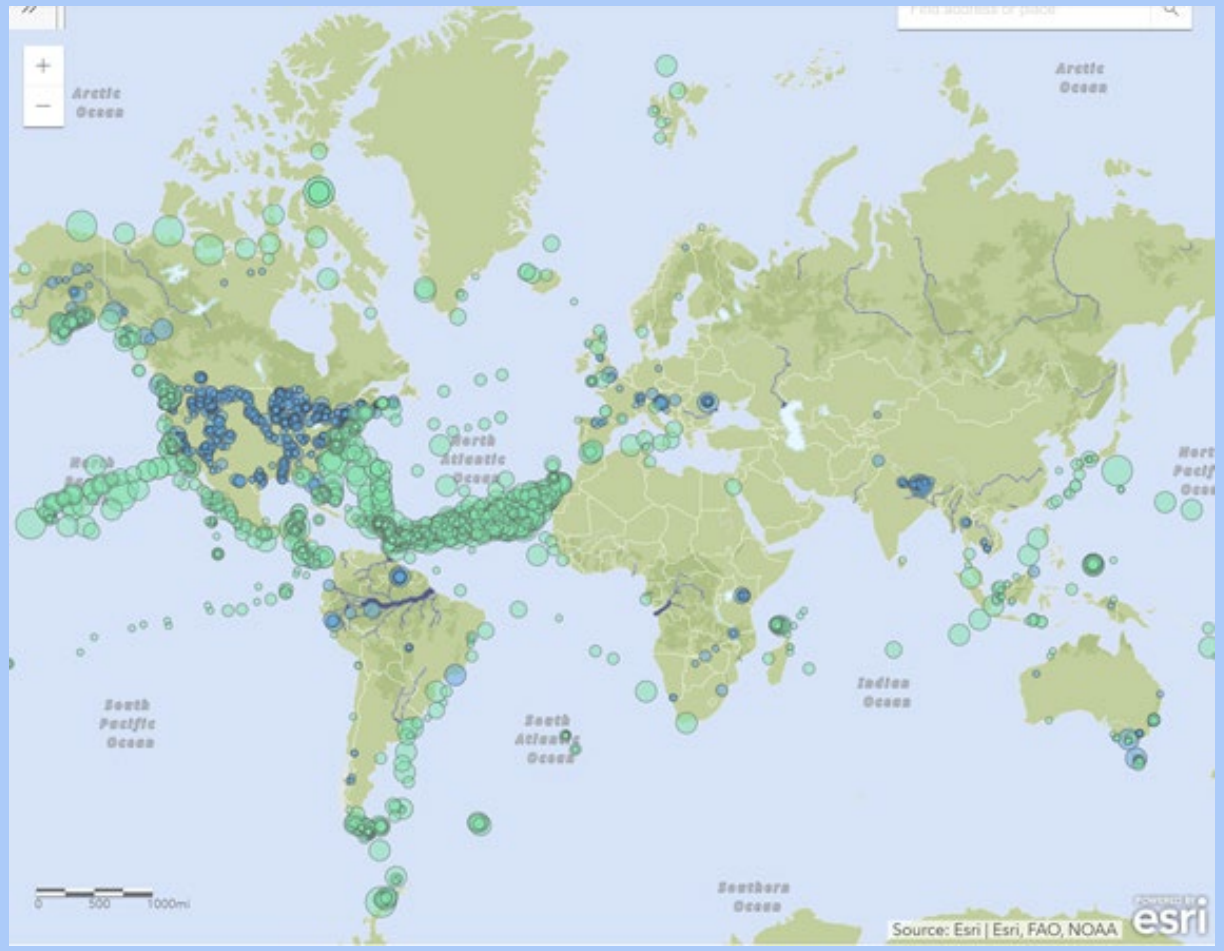
Ingesting Plastics

https://wwf.panda.org/wwf_news/?348337/Revealed-plastic-ingestion-by-people-could-be-equating-to-a-credit-card-a-week



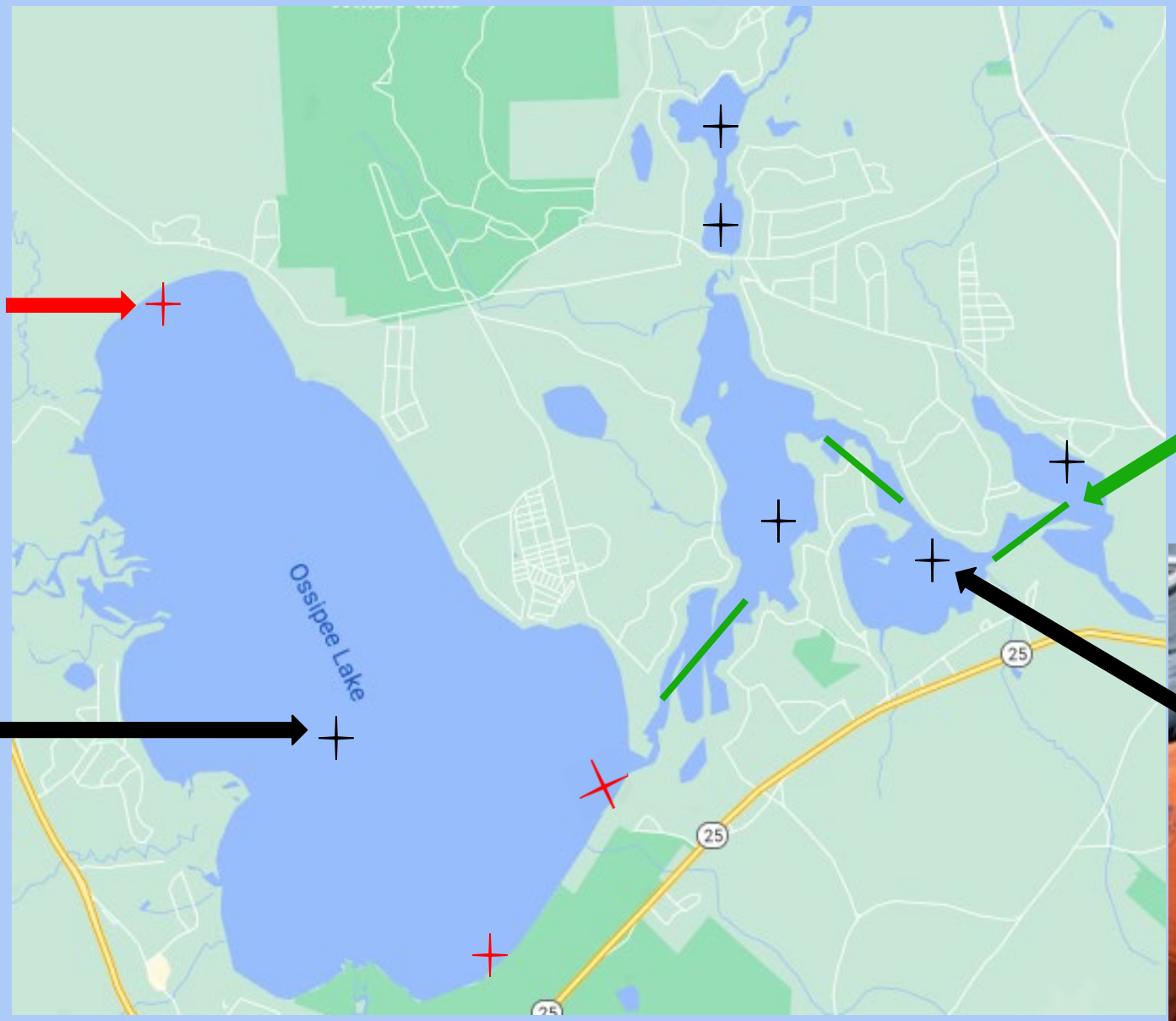
https://static1.squarespace.com/static/53e8ee02e4b09aec917742e6/t/54ae94f2e4b0342c02bd216b/1413554775702/3-bioaccumulation-vs-biomagnification+small.png

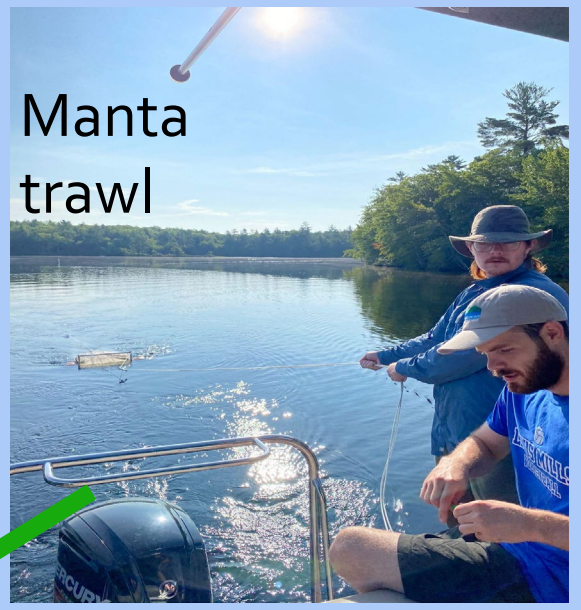
Knowledge gaps in freshwater

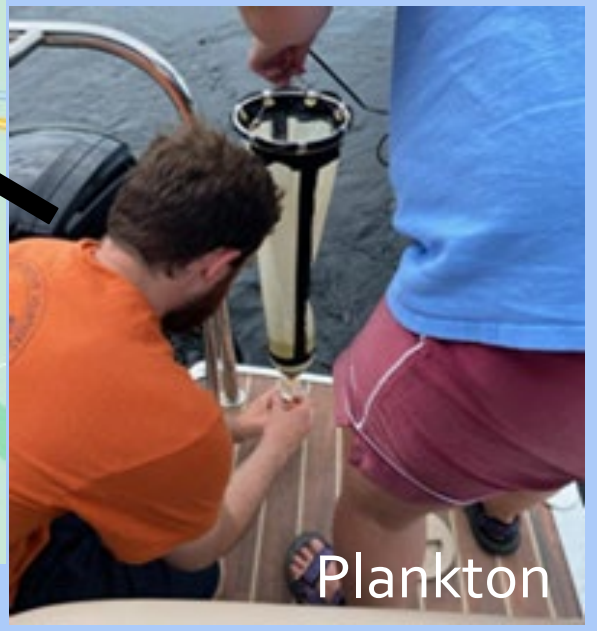


- Much of what is known about microplastics comes from marine environments and controlled laboratory experiments
- Adventure Scientists compiles microplastics data submitted in a singular location
  - Not an exhaustive list
- Microplastic effects in surface and drinking water are not widely known

GMCG's Research…Ossipee Lake System

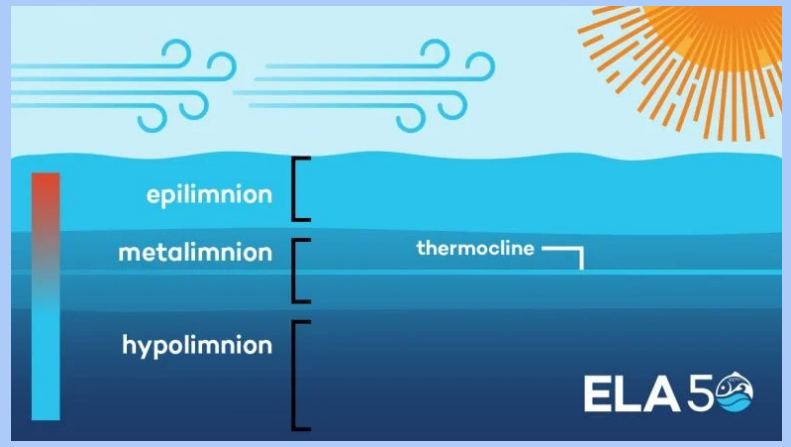






Graphic by EB

Water collection



Deep spot sampling

- May-September
- Deep spot identified by GPS and depth finder
- Layer determination by DO and temperature
- Integrated tube sample taken to thermocline

Manta Trawl sampling

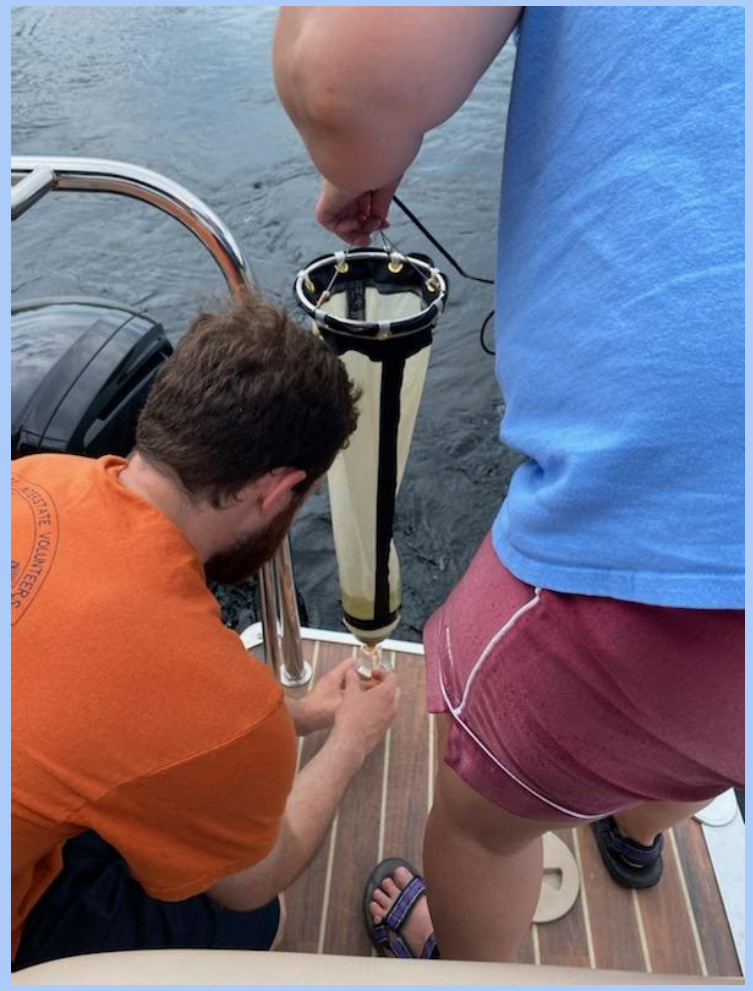
- In channels in between Lake Ossipee bays, the manta trawl was deployed

What is a manta trawl?

A manta trawl is a net system used for sampling surface waters. It is towed behind the wake of a boat travelling at low speeds and filters water based on the net pore size (ours is 100uM).

Plankton collection

- At the deep spot
- Net lowered down to the thermocline
- 1-2 collections per deep spot
- Samples were filtered to collect the plankton
- Plankton were dried o/n
- Mechanical grinding
- Alkaline digestion & neutralization
- Treated as a water sample

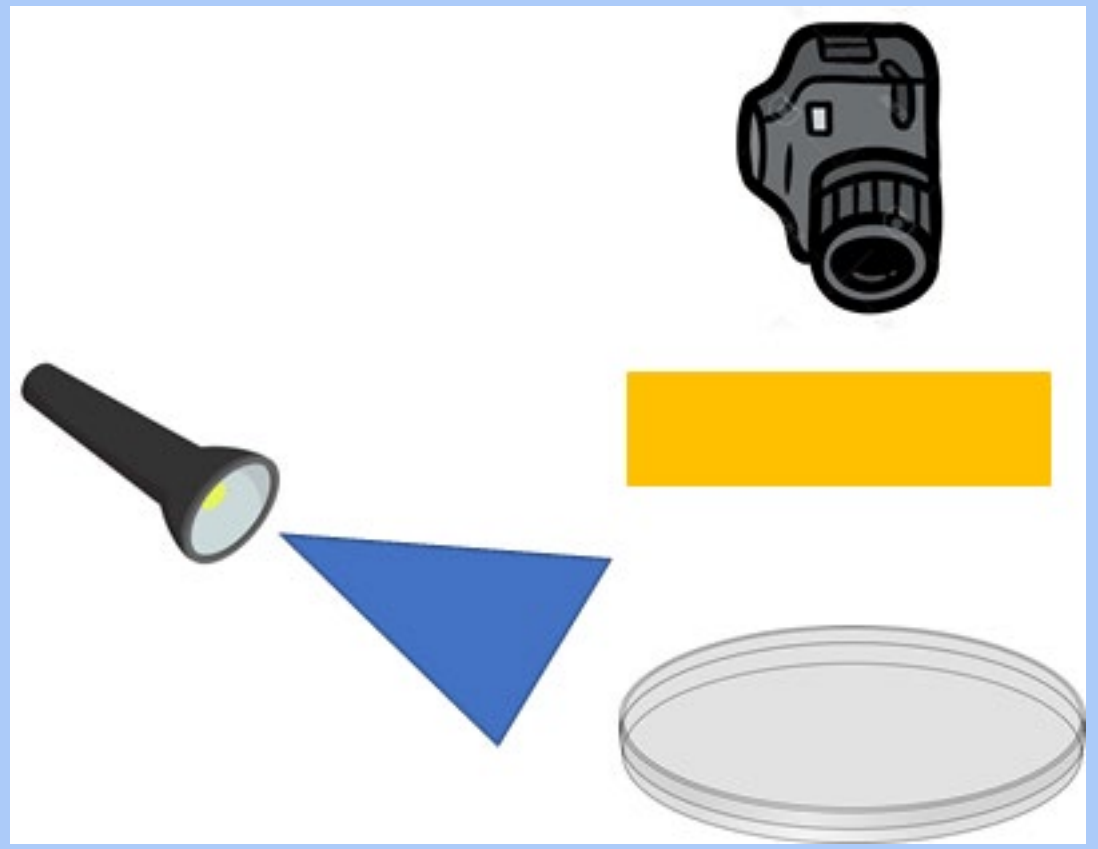


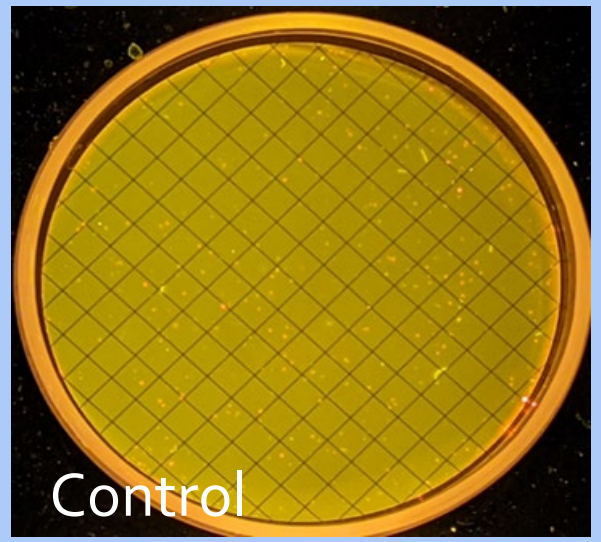
Cladocera
UNH CFB

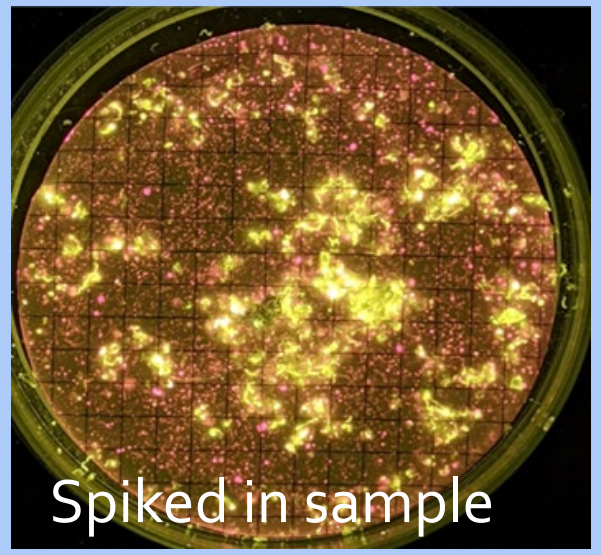
Rotifer
UNH CFB

How does Nile Red (NR) work in identifying microplastics?

- Nile Red (NR) is a commercial dye originally used to stain lipids
- Has been shown to adhere to many different types of plastics, most likely through hydrophobic interactions
  - -Essentially, water is polar, plastic is not – dye wants to play with other non polar things
- Excitation via blue light
- Observe through orange filter

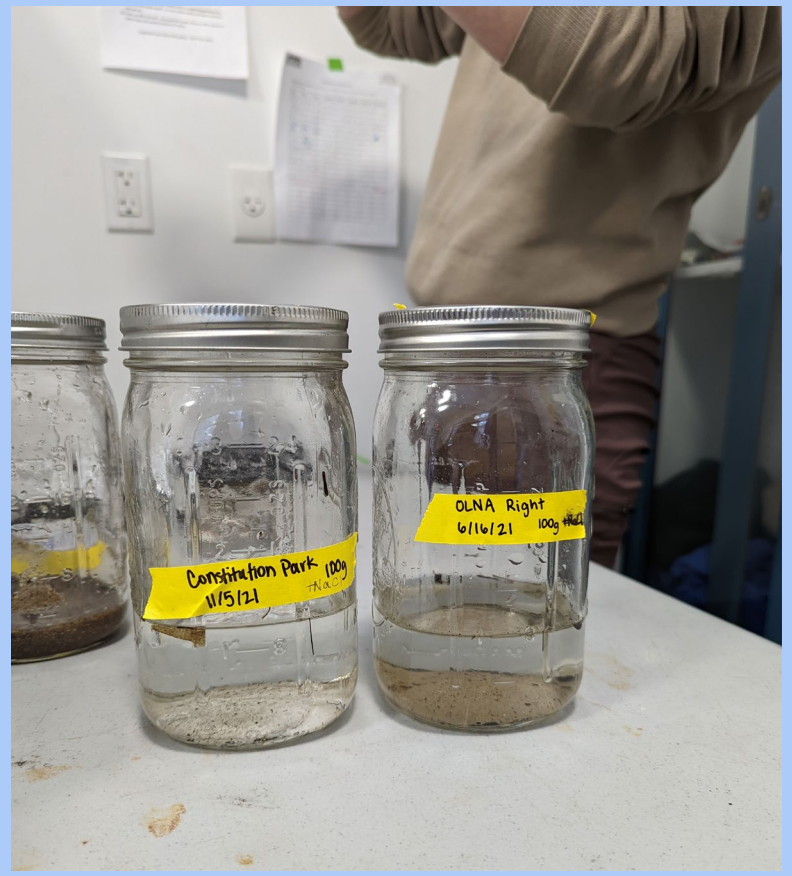




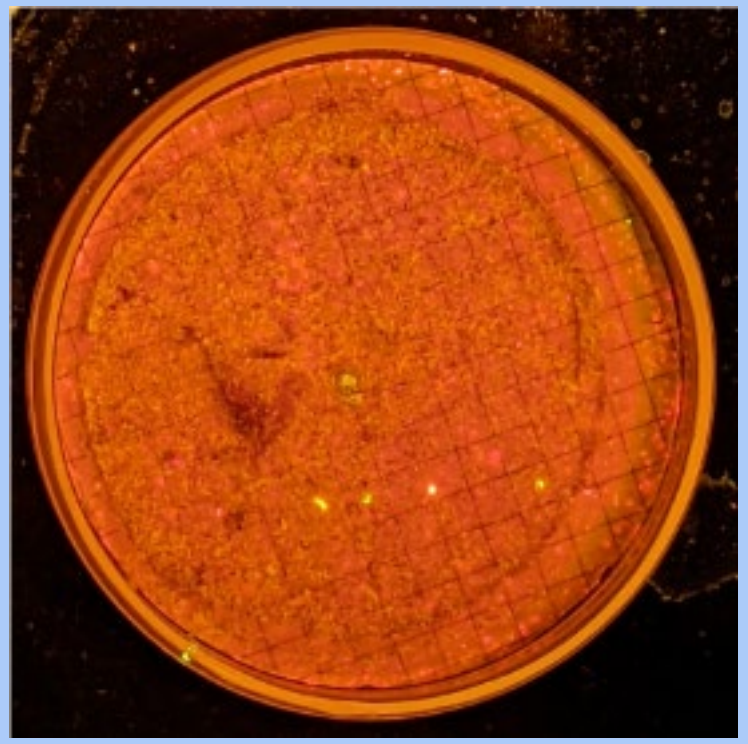


Science research in a plastic world

- At each step of this research, we were trying to come up with workarounds
- Sample collection was done in Mason jars
- Glass, ceramic, and metal alternatives were identified for many different steps
- Calculated risks when a good alternative didn't present itself

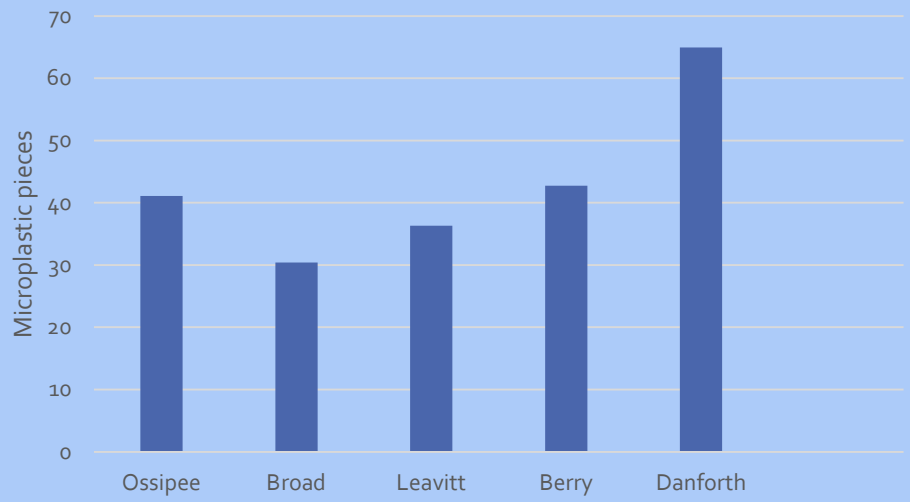


Initial findings from Ossipee Lake System - Water



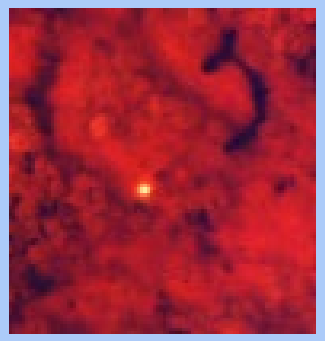
Deep water sample (average):

- Ossipee – 41.12 pieces
- Broad – 30.39 pieces
- Leavitt – 36.33 pieces
- Berry – 42.73 pieces
- Danforth – 64.93 pieces

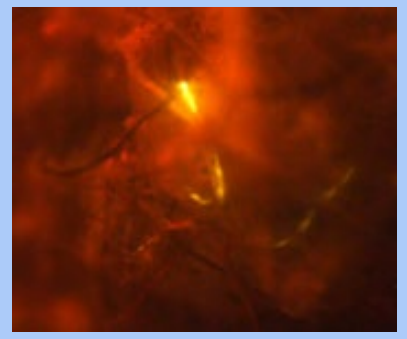


Manta trawl (average):

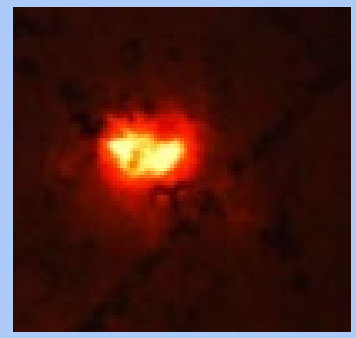
- 80.7 pieces



Microbeads



Microfibers



Microfragments

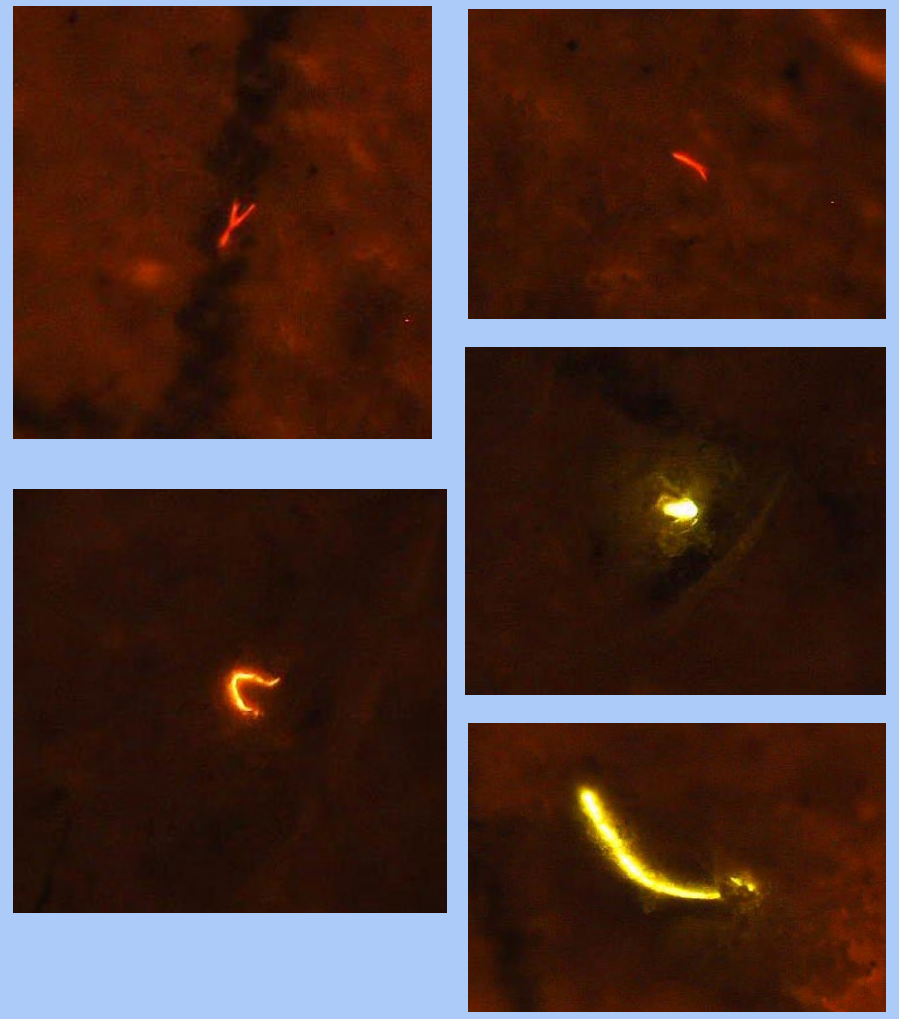
Initial findings from Ossipee Lake System - Plankton

In total, 57 pieces of microplastics were found in plankton, with an average of 19 being found per sampling event.

Areas of improvement:

1) Gathering more plankton per trawl trip
2) Better filtration step
3) Maybe a rinsing step
4) Work on digestion step (ended up with a lot of debris to sort through).

Future work: mollusk population



Education & Outreach about Microplastics

- Local elementary school field days
- Summer Camp programs at local camps, summer schools, library programs
- Coffee Hour Talks
- Online presentations of research to the public
- Farmer's Markets
- Earth Day Less Plastic Challenge & Online Programs
- Integrating microplastic research into schools
- Less Plastic Guide – educational programming

LESS PLASTIC CHALLENGE

Will you take on the challenge of up-cycling single-use plastics?

What: Transform single-use plastics into something new!

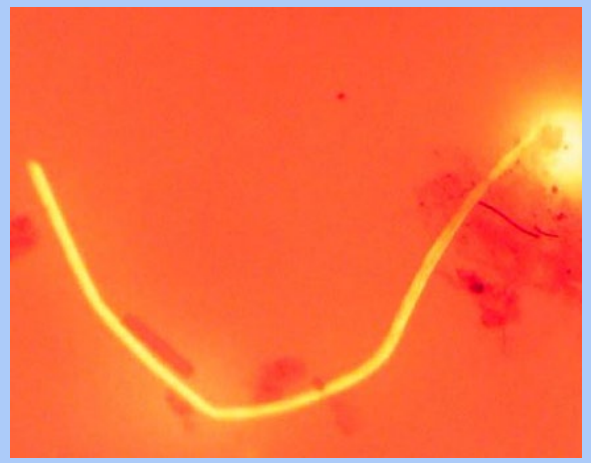
Where: Submit your name, town, and a photo of your project with a written or video explanation to education2@gmcg.org

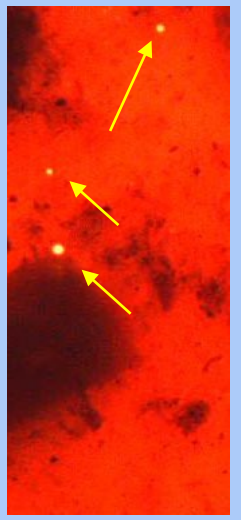
When: Submissions will be accepted through April 15th. Winners will be announced on Earth Day (April 22nd)

For more submission information visit gmcg.org

GREEN MOUNTAIN CONSERVATION GROUP

GMCG's Research…rivers & streams with schools





Want to know more about our research projects or other programs?

- info@gmcg.org
- 603-539-1859
- gmcg.org

Jill Emerson, MB (ASCP)CM
Water Quality Coordinator
Green Mountain Conservation Group
water@gmcg.org