Welcome to *The Current*, the North Central Region Water Network's Speed Networking Webinar Series

Emerging Containments – A Look at Microplastics: Wednesday January 12, 2022 at 2PM CT

1. Submit your questions for presenters via the Q&A panel. There will be a dedicated Q&A session following the last presentation. The Q&A panel can be found via the Q&A icon at the bottom of the webinar screen. Be sure to read existing questions and upvote!
2. If you are experiencing technical issues or have questions about the North Central Region Water Network or *The Current* Webinar Series, please use the chat feature. The chat feature is accessible via chat icon at the bottom of the webinar screen.
3. A phone-in option can be accessed by clicking the up arrow on the mute icon and clicking 'Switch to Phone Audio'.

This session will be recorded and available at northcentralwater.org and learn.extension.org.

Today's Presenters:

- **Sherri "Sam" Mason**, Sustainability Director, Penn State Erie, The Behrend College
- **Melissa Duhaime,** Assistant Professor, Department of Ecology and Evolutionary Biology, University of Michigan

Follow @northcentralh2o and #TheCurrent on Twitter for live tweets!

Sherri “Sam” Mason

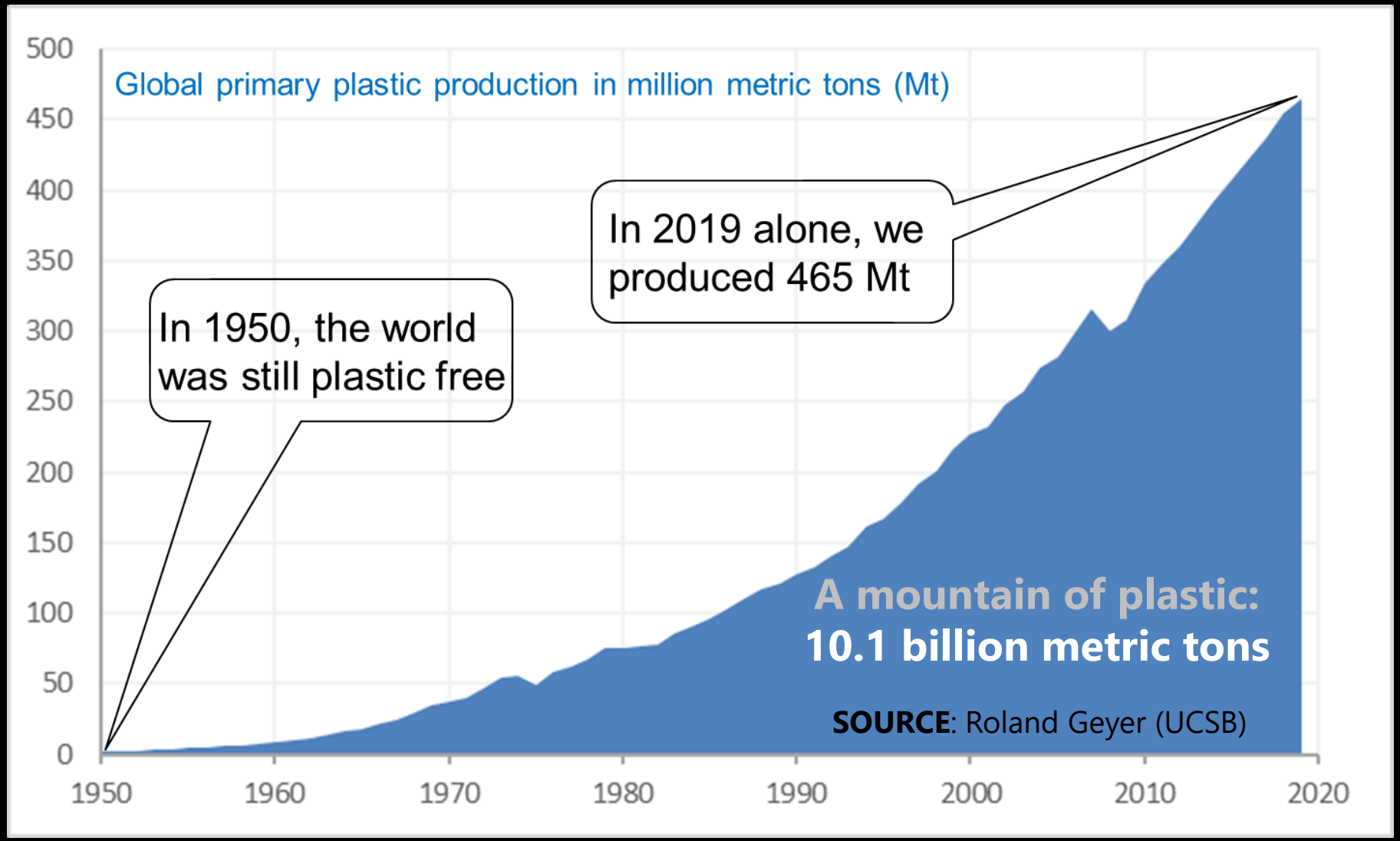
Dr. Sherri A. Mason (aka “Sam”) earned her bachelor’s degree from the University of Texas at Austin. She completed her doctorate in Chemistry at the University of Montana as a NASA Earth System Science scholar. Her research group is among the first to study the prevalence and impact of plastic pollution within freshwater ecosystems. Among her accolades Dr. Mason has been selected as an EPA Environmental Champion in 2016, awarded the Excellence in Environmental Research by the Earth Month Network in 2017, and earned the Heinz Award in Public Policy in 2018. While she continues her research endeavors, she has also recently moved into a new role as Sustainability Coordinator at Penn State Erie, The Behrend College.

Source: *Plastics: A Toxic Love Story* by Susan Freinkel

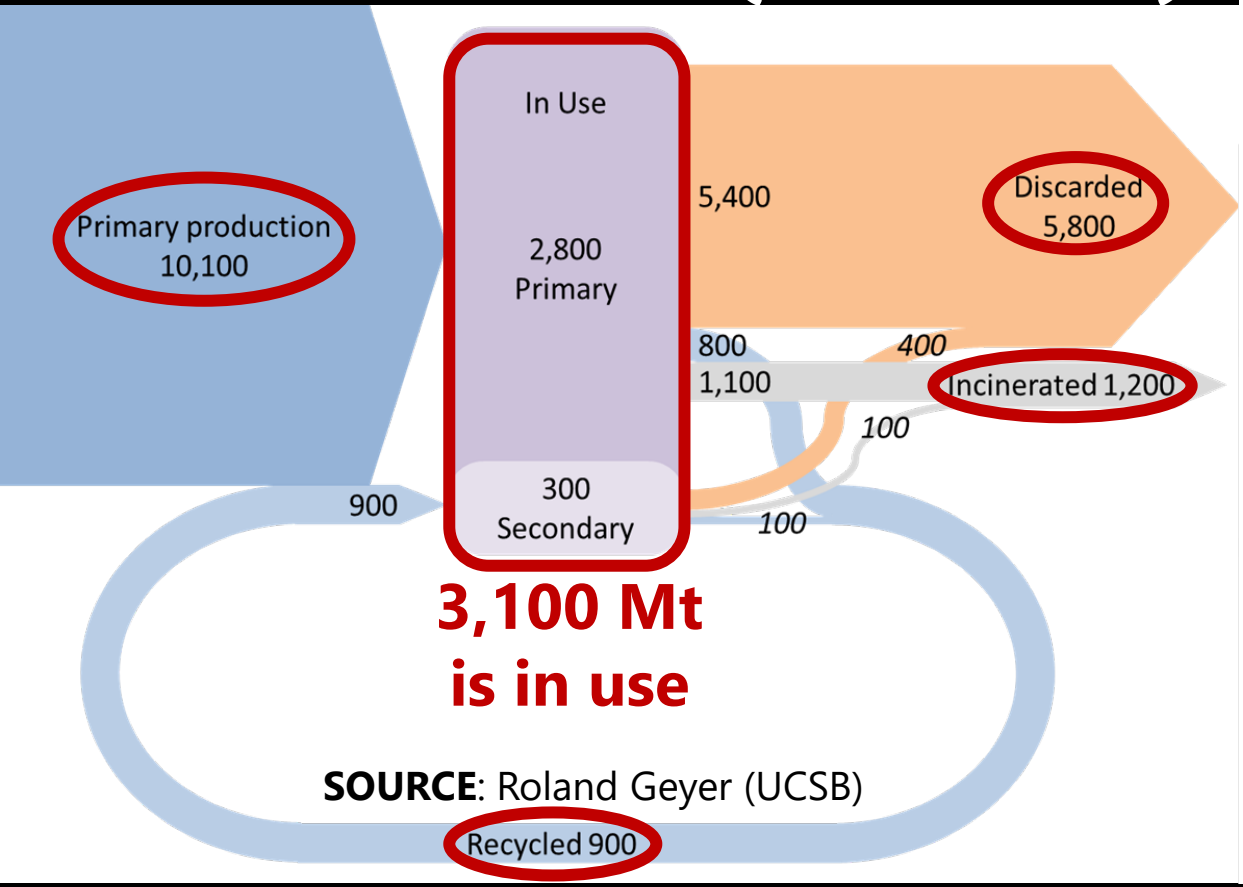
PRIMER

Dr. Sherri "Sam" Mason
Director of Sustainability
Penn State Erie, The Behrend College

Source: *Plastics: A Toxic Love Story* by Susan Freinkel


Global primary plastic production in million metric tons (Mt)
500
450
400
350
300
250
200
150
100
50
0
1950
1960
1970
1980
1990
2000
2010
2020
In 1950, the world was still plastic free
In 2019 alone, we produced 465 Mt
A mountain of plastic:
10.1 billion metric tons
SOURCE: Roland Geyer (UCSB)

Production, Use & Fate of All Plastic Ever Made (1950-2019)



7,000 Mt of plastic waste generated

74% discarded

15% incinerated

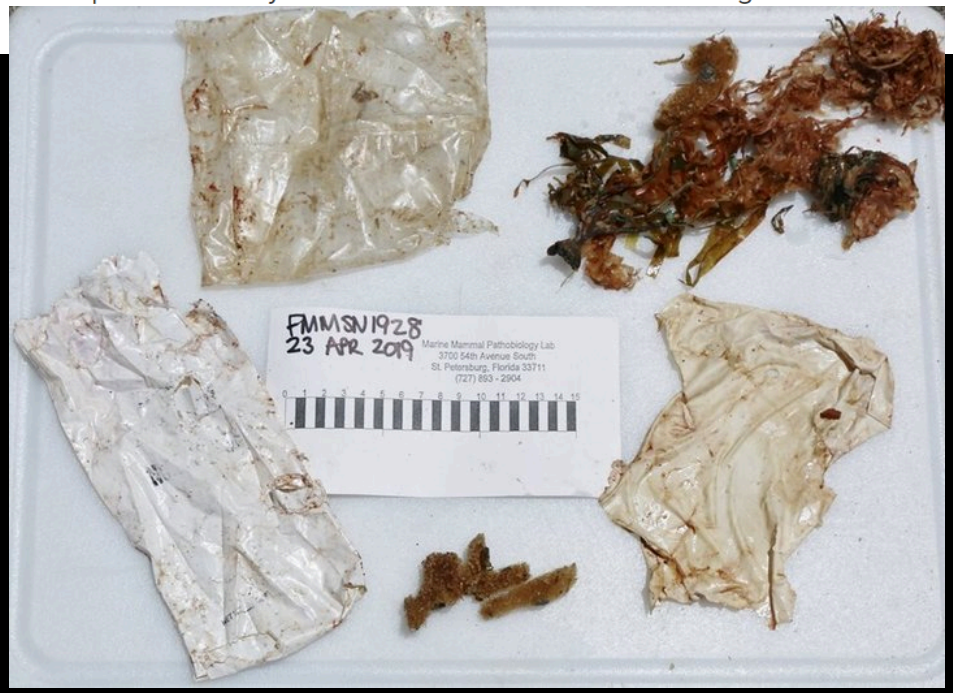
11% recycled

10-15% Water

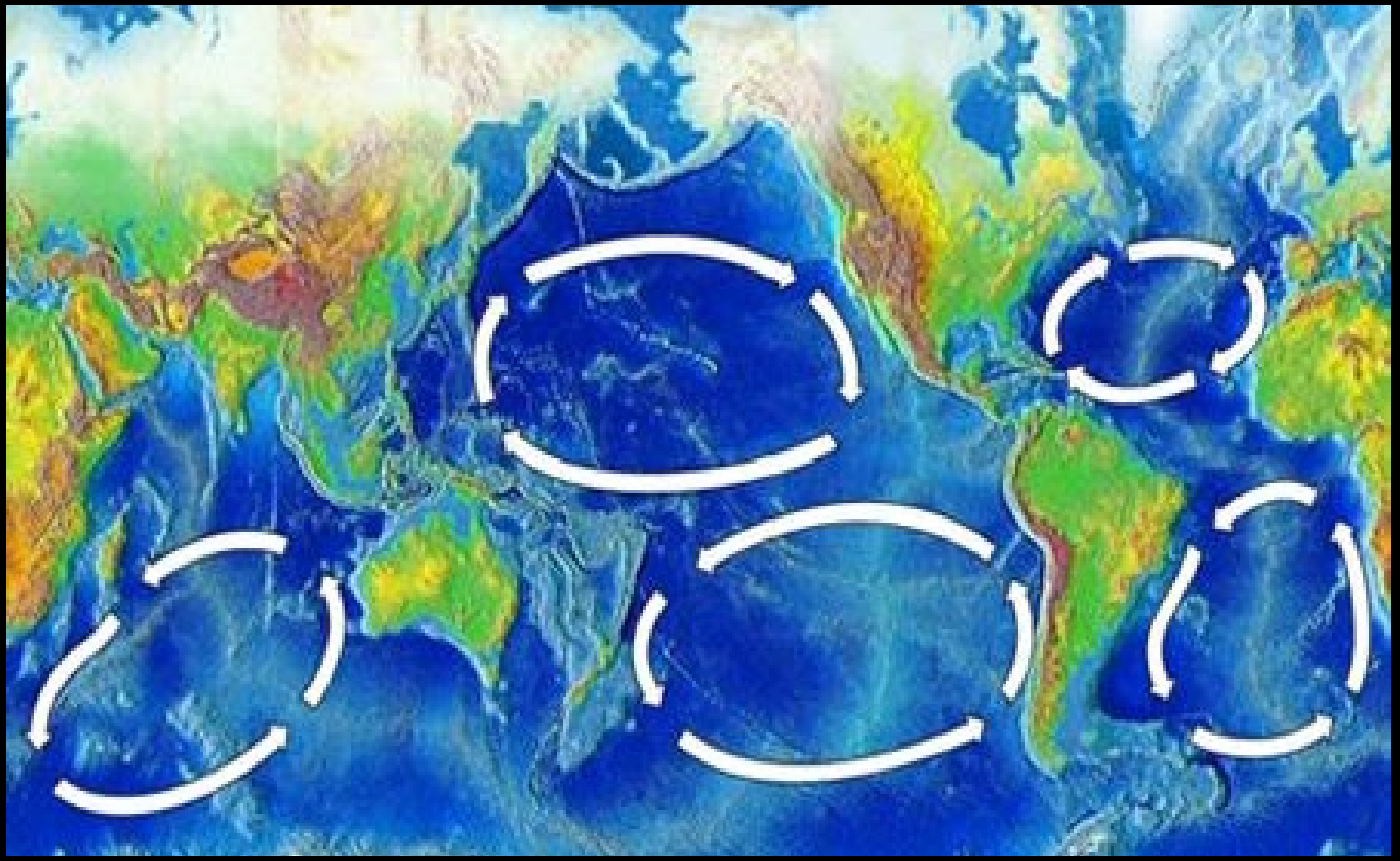
ENVIRONMENT 04/27/2019 03:53 pm ET

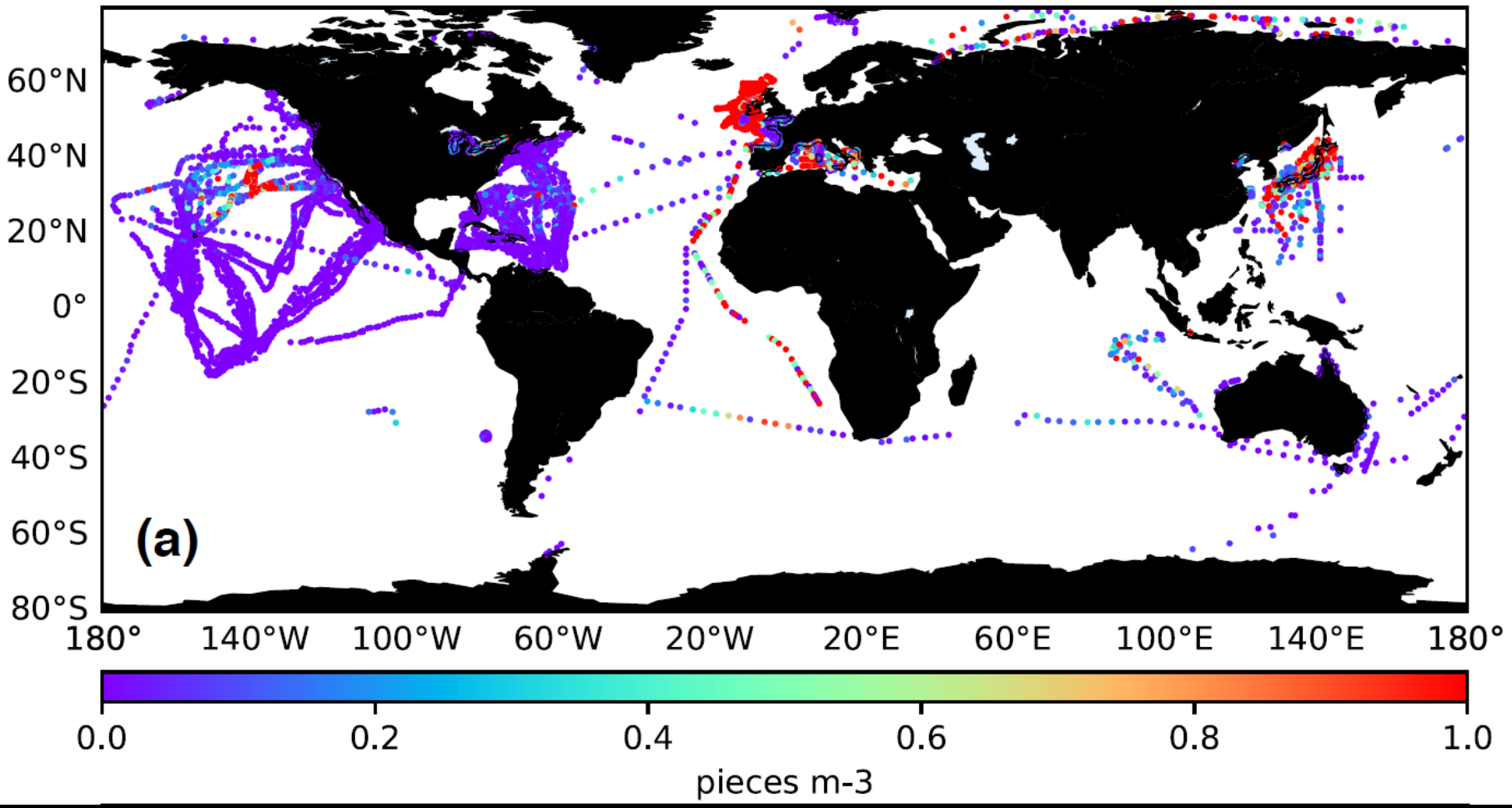
Stranded Dolphin Found With Plastic Bags, Piece Of Balloon In Stomach

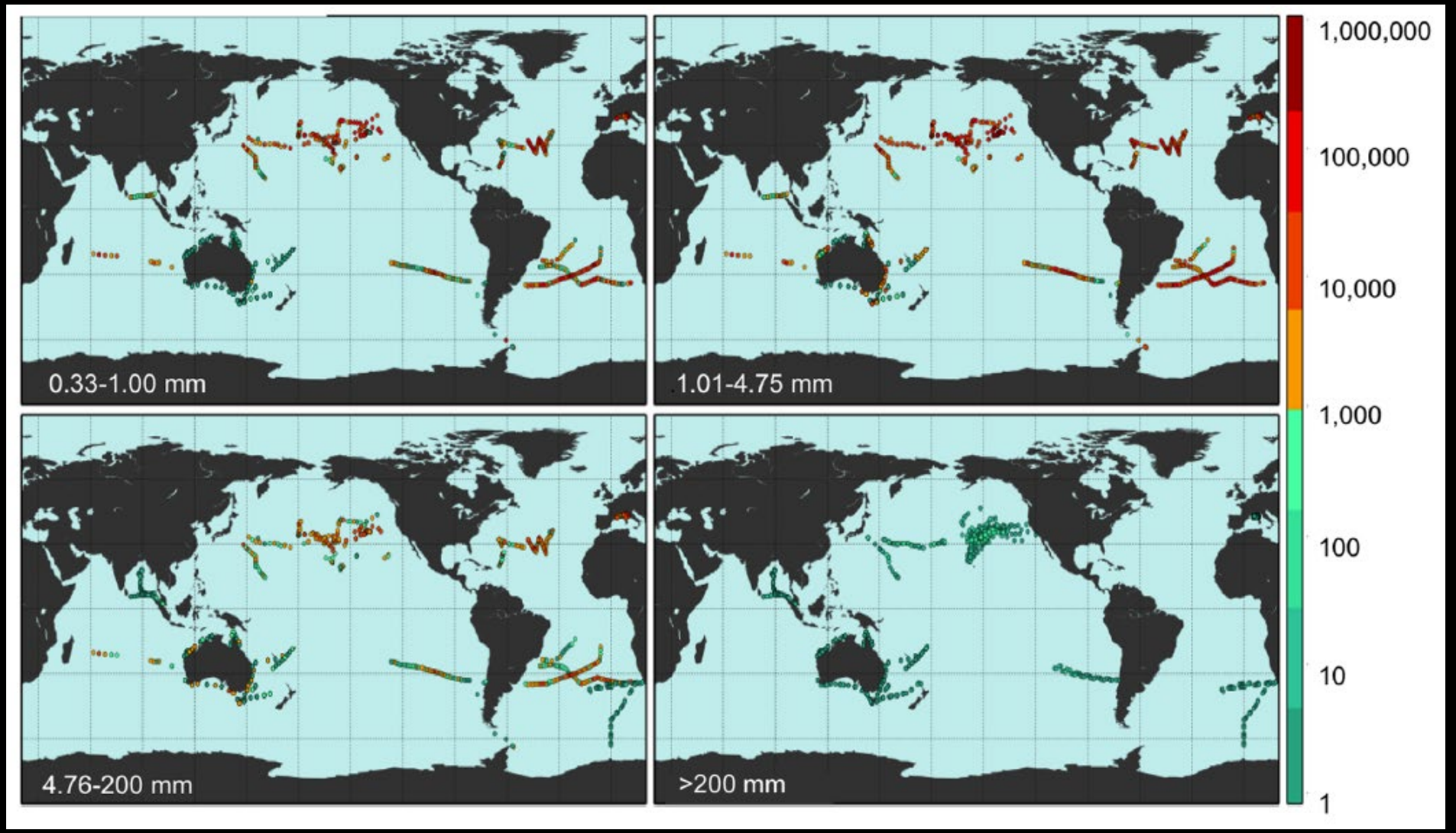
The female rough-toothed dolphin ultimately had to be euthanized after washing up on a Florida beach.




THE
LAST
STRAW
Evening Standard Campaign

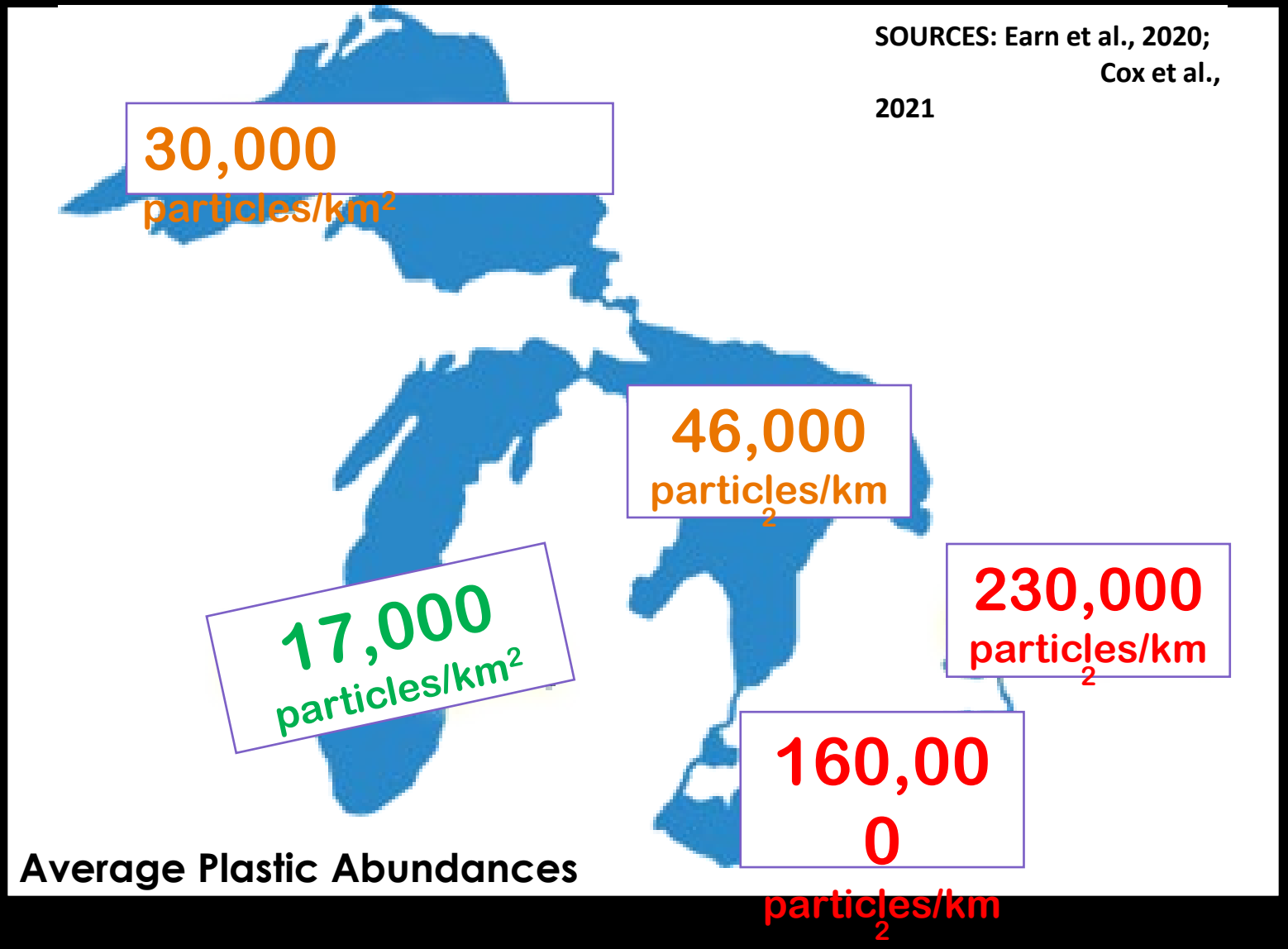


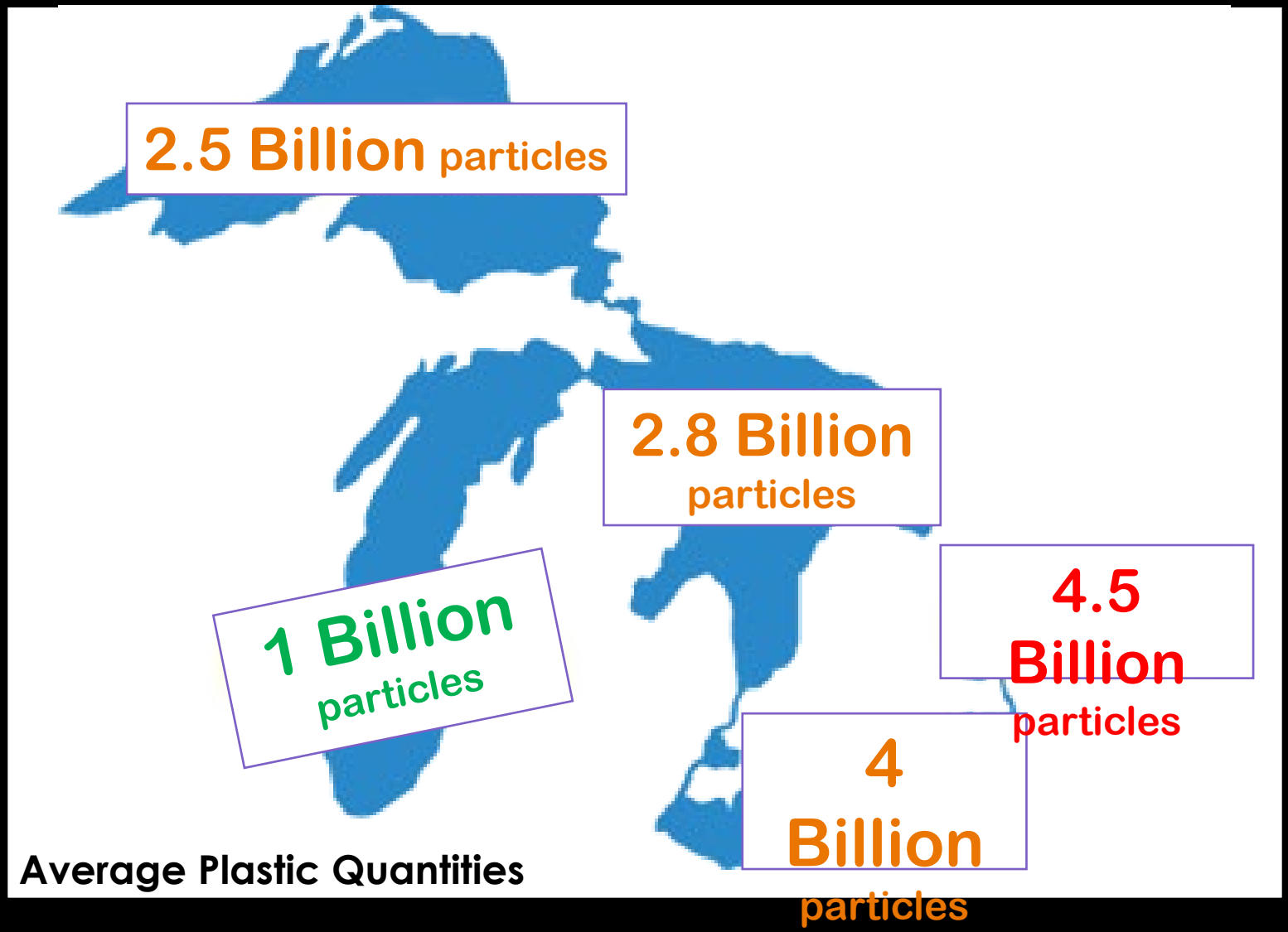

60°N
40°N
20°N
0°
20°S
40°S
60°S
80°S
180°
140°W
100°W
60°W
20°W
20°E
60°E
100°E
140°E
180°
(a)
0.0
0.2
0.4
0.6
0.8
1.0
pieces m-3


0.33-1.00 mm
1.01-4.75 mm
4.76-200 mm
>200 mm
1,000,000
100,000
10,000
1,000
100
10
1


NATIONAL
GEOGRAPHIC


Superior
Huron
Michigan
Ontario
Erie


SOURCES: Earn et al., 2020; Cox et al., 2021
30,000 particles/km2
46,000 particles/km2
17,000 particles/km2
230,000 particles/km2
160,000 particles/km2
Average Plastic Abundances


2.5 Billion particles
2.8 Billion particles
1 Billion particles
4.5 Billion particles
4 Billion particles
Average Plastic Quantities

MICROPLASTIC

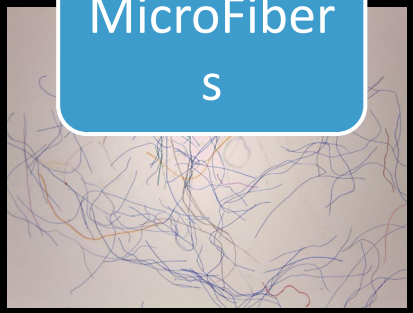
Less than 5 mm

Primary Microplastics

Pre-Production Pellets

Microbeads

MicroFibers

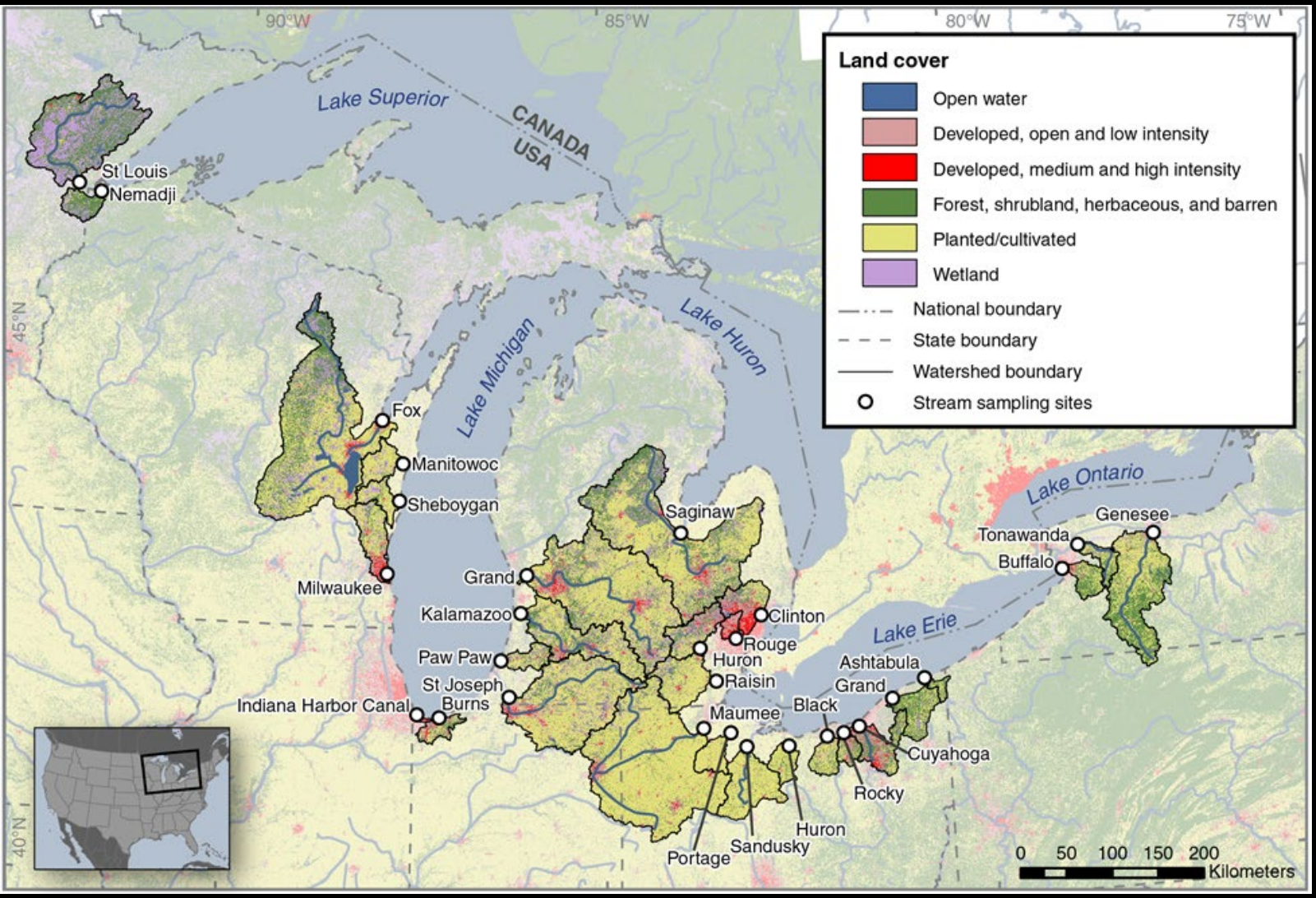


Fragments

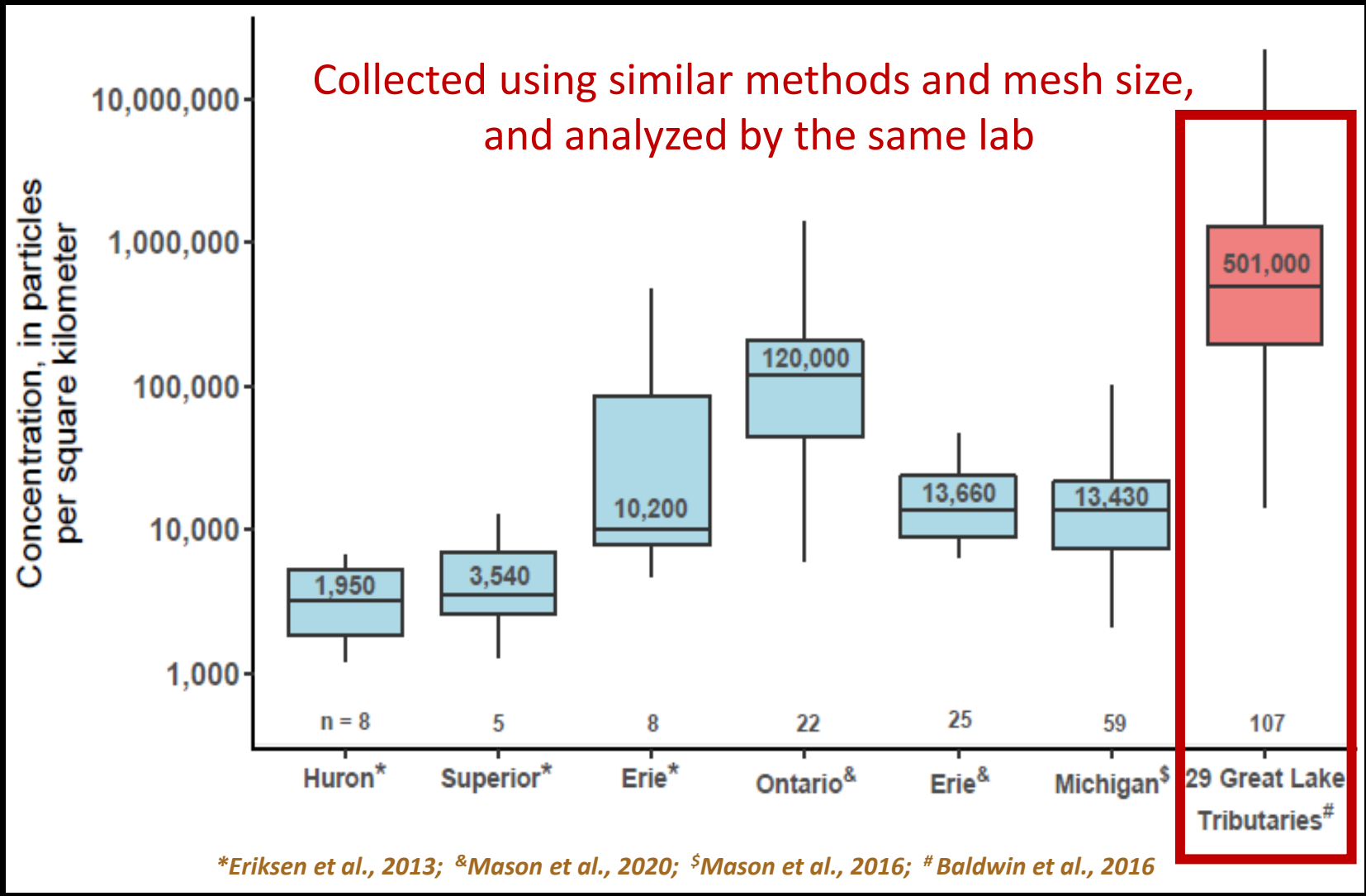
Secondary Microplastics

Photo-Degradation


Rivers



SOURCE: Baldwin et al. (2016)

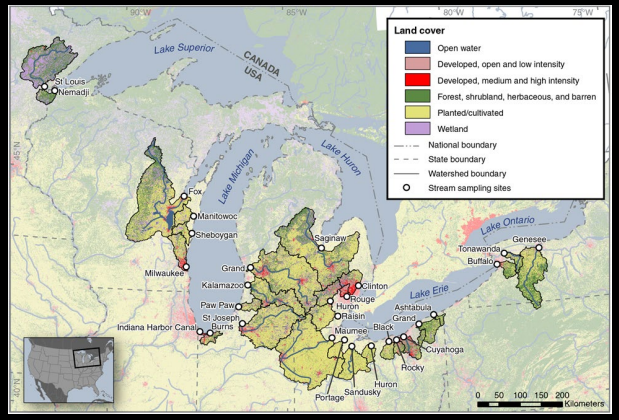

Collected using similar methods and mesh size, and analyzed by the same lab
Concentration, in particles per square kilometer
10,000,000
1,000,000
100,000
10,000
1,000
1,950
3,540
10,200
120,000
13,660
13,430
501,000
n = 8
5
8
22
25
59
107
Huron*
Superior*
Erie*
Ontario&
Erie&
Michigan$
29 Great Lake Tributaries#
*Eriksen et al., 2013; &Mason et al., 2020; $Mason et al., 2016; # Baldwin et al., 2016


Wastewater
Treatment
Plants

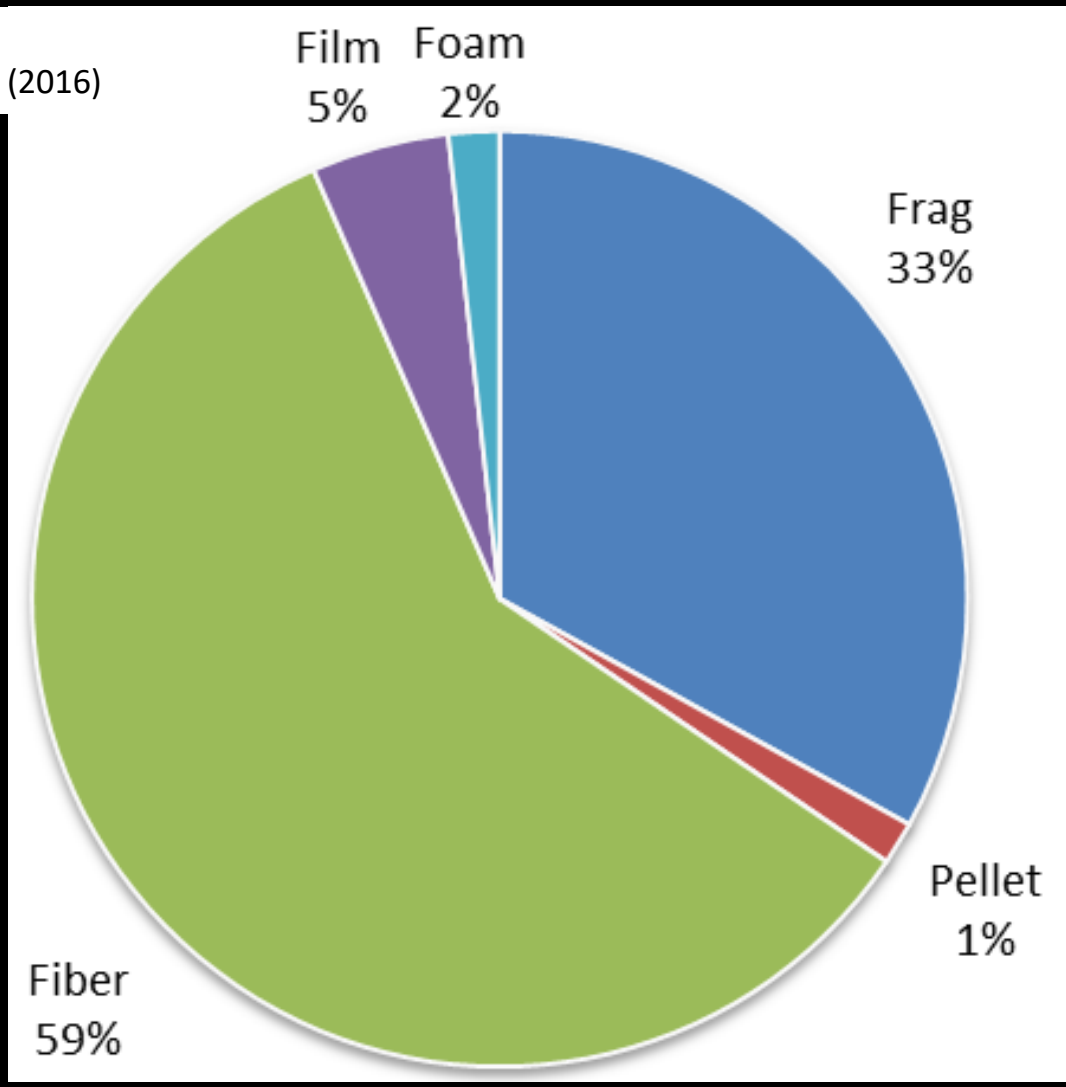
WWTP

⬇

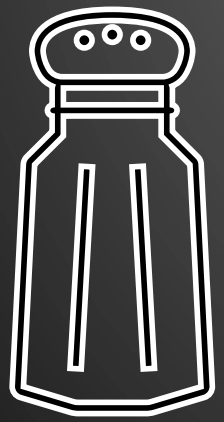
> 4 million particles/day

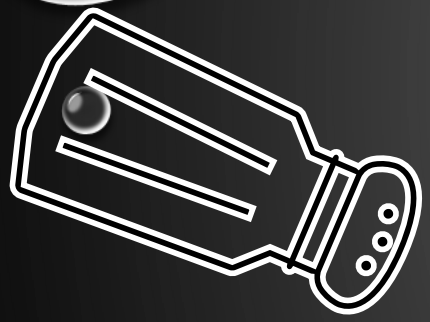


SOURCE:
Mason et al. (2016)

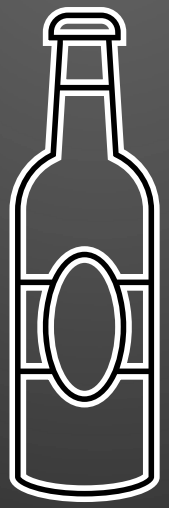


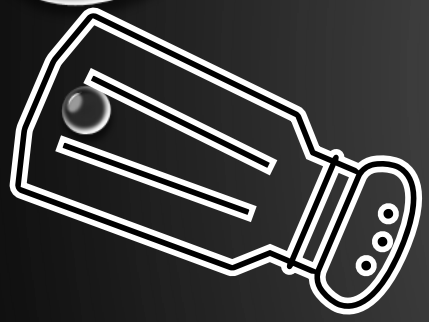
MICROPLASTICS IN HUMAN CONSUMABLES





212 particles/kg



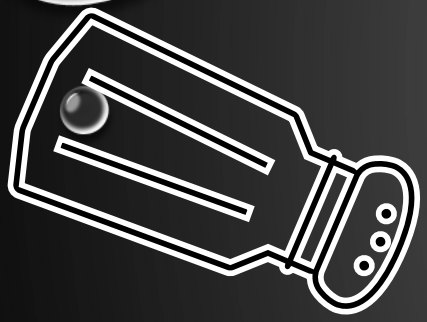


212 particles/kg

5.5

4 particles/liter

particles/liter



212 particles/kg

4 particles/liter

5.5 particles/liter

325 particles/liter

Environmental Science & Technology

Article

Cite This: *Environ. Sci. Technol.* 2019, 53, 7068–7074

pubs.acs.org/est

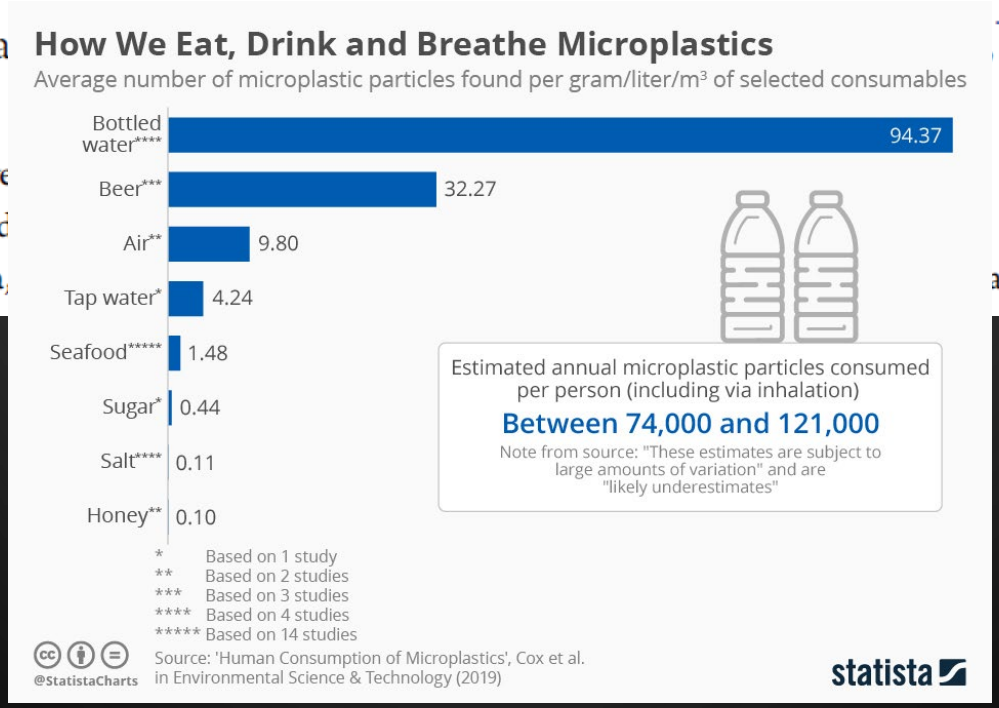
Human Consumption of Microplastics

Kieran D. Cox,*[,†,‡] Ga[†] Francis Juanes,[†] and Sarah E. Dudas[†,‡,§]

[†]Department of Biology, Unive

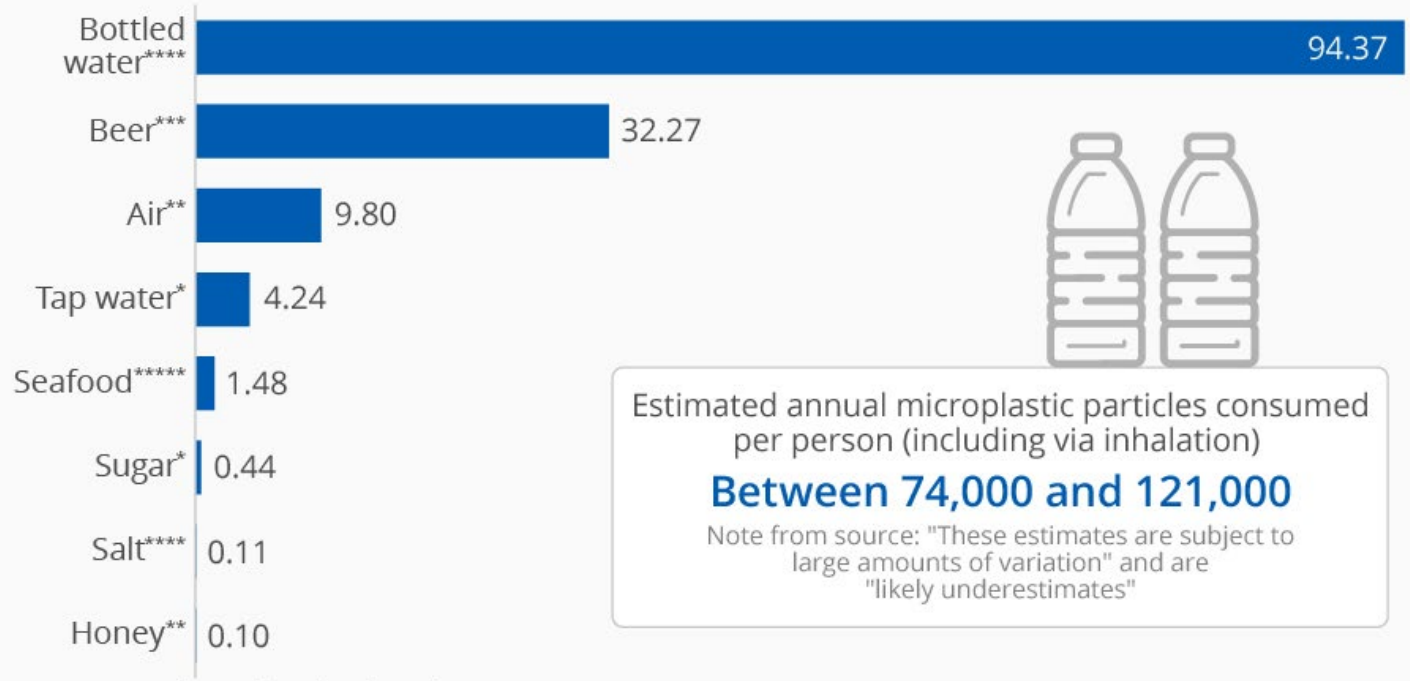
[‡]Hakai Institute, Calvert Island

[§]Fisheries and Oceans Canada, anada



How We Eat, Drink and Breathe Microplastics

Average number of microplastic particles found per gram/liter/m^3 of selected consumables



Estimated annual microplastic particles consumed per person (including via inhalation)

Between 74,000 and 121,000

Note from source: "These estimates are subject to large amounts of variation" and are "likely underestimates"

* Based on 1 study
** Based on 2 studies
*** Based on 3 studies
**** Based on 4 studies
***** Based on 14 studies

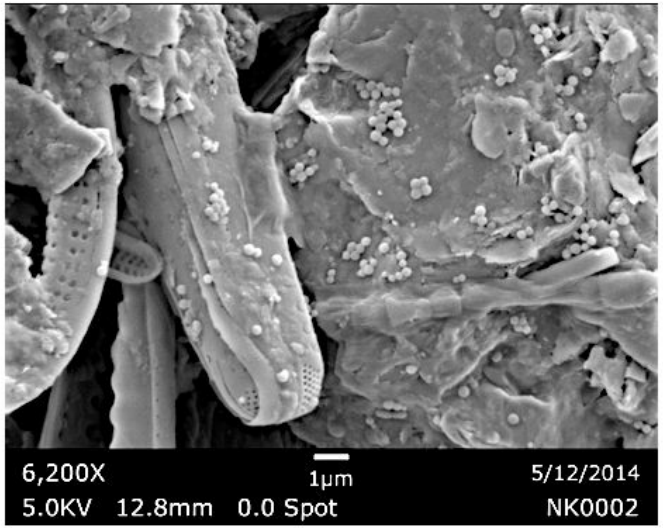
Source: 'Human Consumption of Microplastics', Cox et al. in Environmental Science & Technology (2019)

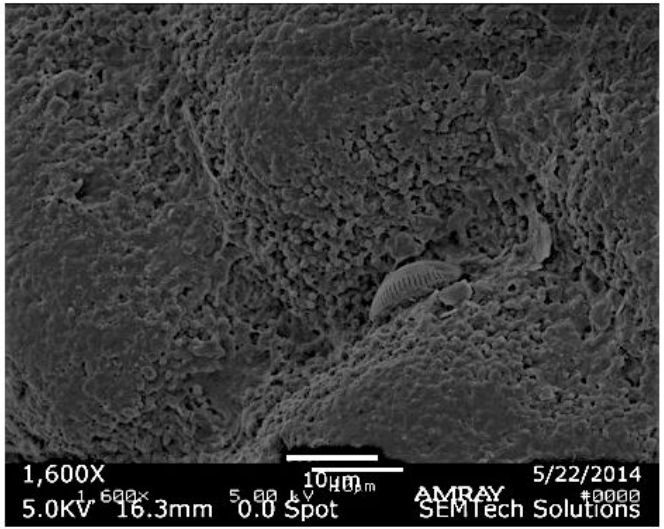
statista

Melissa Duhaime

Melissa Duhaime studied microbiology as an undergraduate at Cornell University, then went on to get graduate degrees in microbial genomics from the Max Planck Institute for Marine Microbiology in Bremen, Germany. She studied marine viral ecology as a post-doc at the University of Arizona before starting her own research group in the Dept of Ecology and Evolutionary Biology at the University of Michigan, where she is currently an assistant professor. Her research group studies microbes in both ocean and freshwater systems, from the viruses of the Southern Ocean to Lake Erie's harmful algal blooms. As a microbiologist, Dr. Duhaime studies the interactions between microbes and microplastics, be they the role the microbes play in biodegrading the plastics or the organic chemicals that leach from the plastics or the impacts that the plastics have on the health and function of the microbes that serve as the base of aquatic food webs.

Microbe-Microplastics Interactions in Freshwater Systems





Melissa Duhaime
Assistant Professor, Ecology and Evolutionary Biology, Univ Michigan

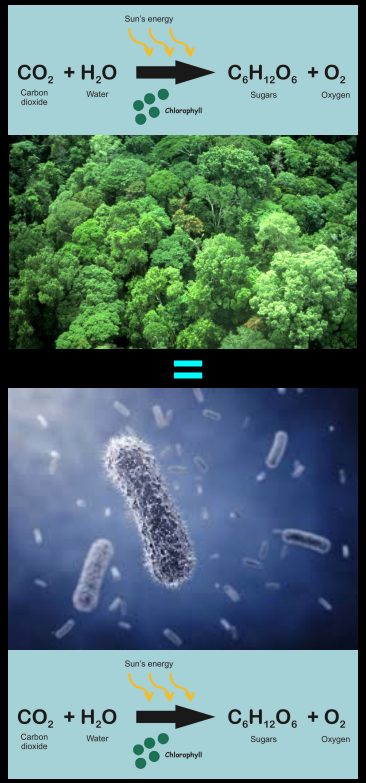
Three Takeaways

- **Microbes matter**, they are the base of aquatic food webs and drive ecosystem processes
- **The "Plastic microbiome" is distinct**: novel, distinct assemblages of microbes live on plastic
- There are **a multitude of potential microbe-microplastics interactions** that we study in our research group
  - Effects of plastic (and leachates) on microbial community composition and function
  - Effects of microbial biofilms on plastic fate (degradation, but also biofilm growth and impacts on hydrodynamics)

Three Takeaways

- Microbes matter, they are the base of aquatic food webs and drive ecosystem processes

Microbes rule the world.



Drive the chemical reactions essential for life and planet cycles (oxygen, carbon)

Animals (humans!) and plants are "mostly microbes"

Falkowski et al, 2008 / Theis & Bordenstein, 2015

Three Takeaways

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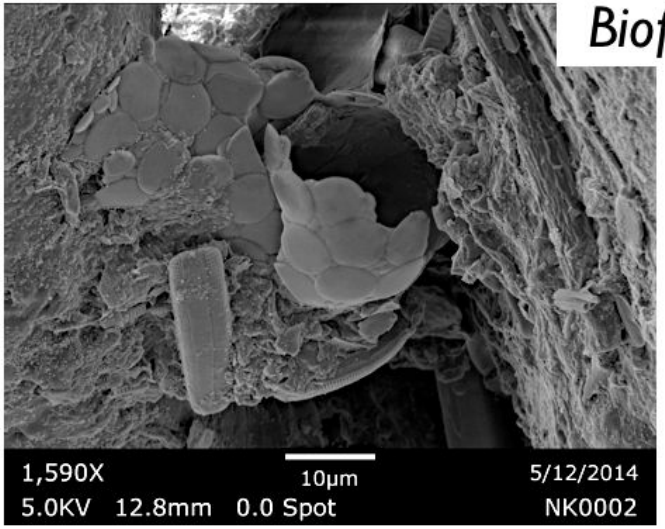
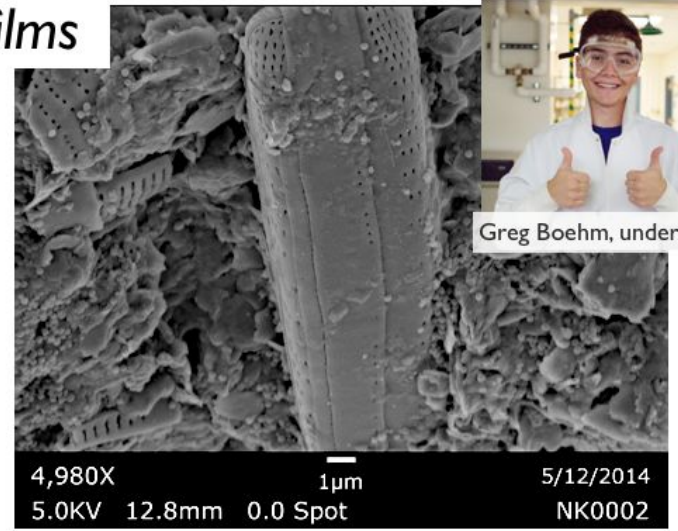
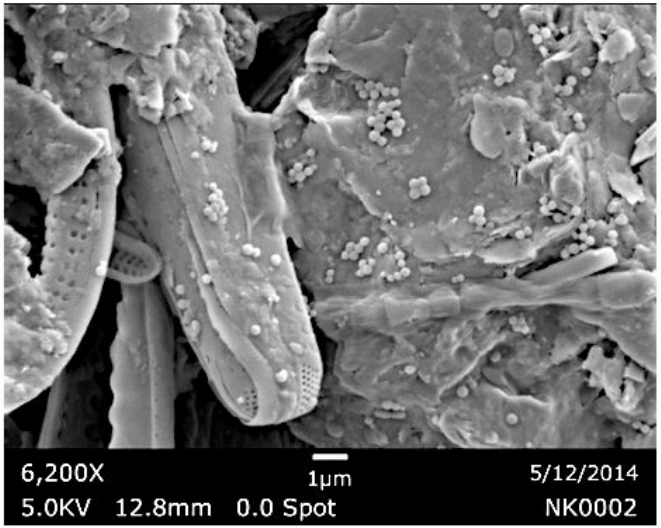
- The “Plastic microbiome” is distinct: novel, distinct assemblages of microbes live on plastic

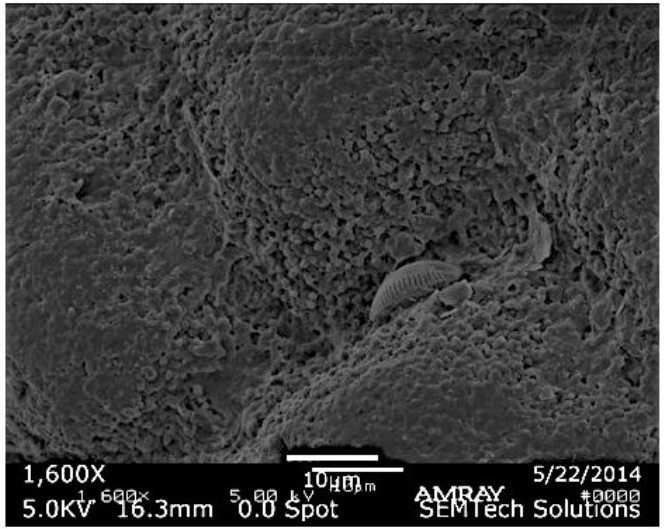
Biofilms





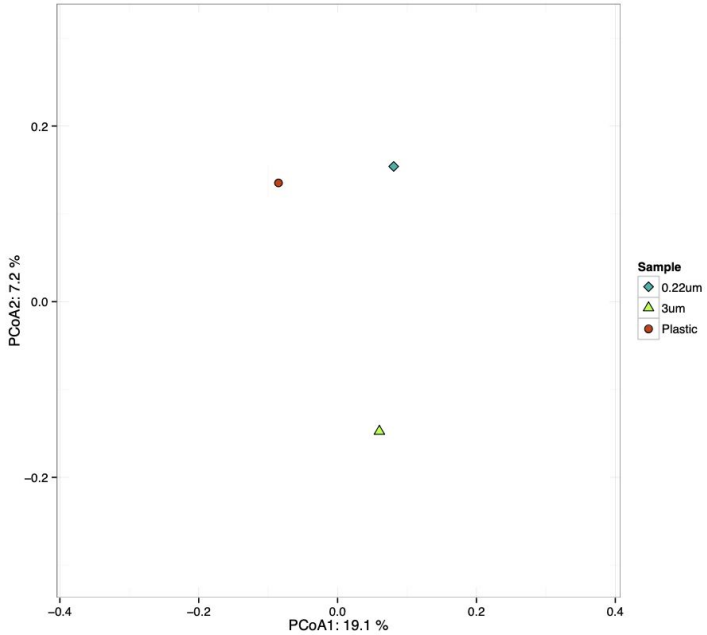
Greg Boehm, undergrad

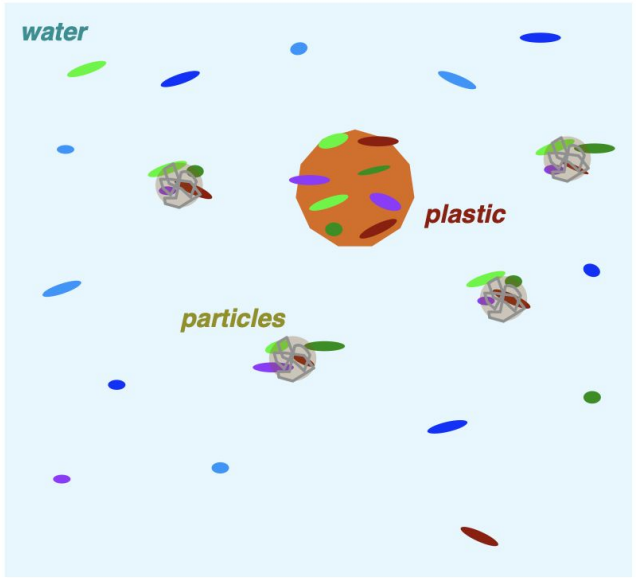




Great Lakes plastics harbor distinct microbial communities (and species)

Differences in "species lists" between samples





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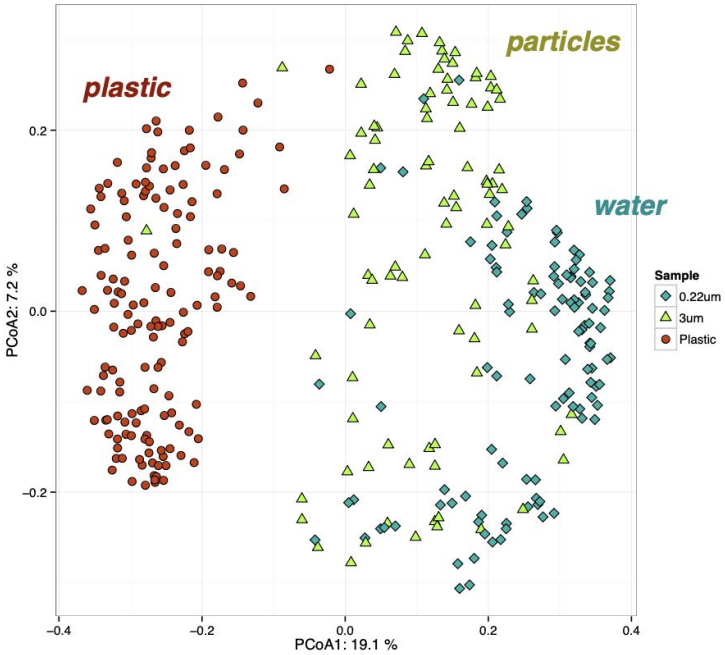
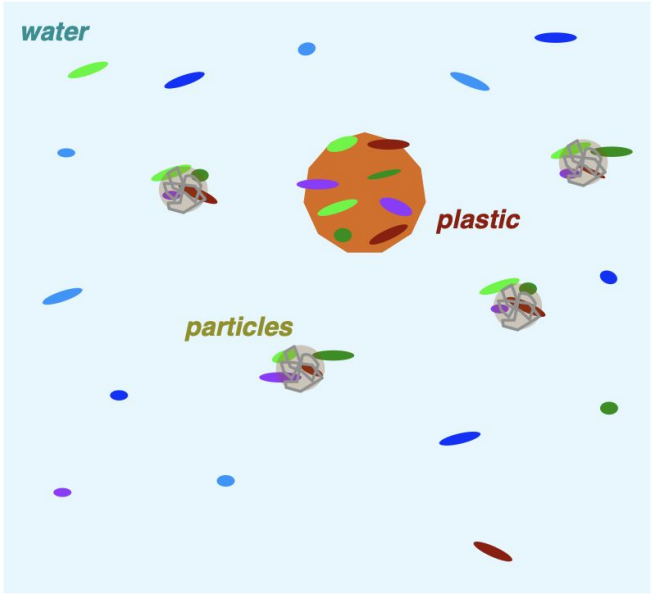
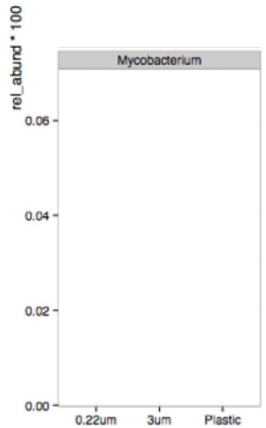




Great Lakes plastics host pathogens

…especially at urban sites

WHO pathogen indicator genera differentially abundant on plastic



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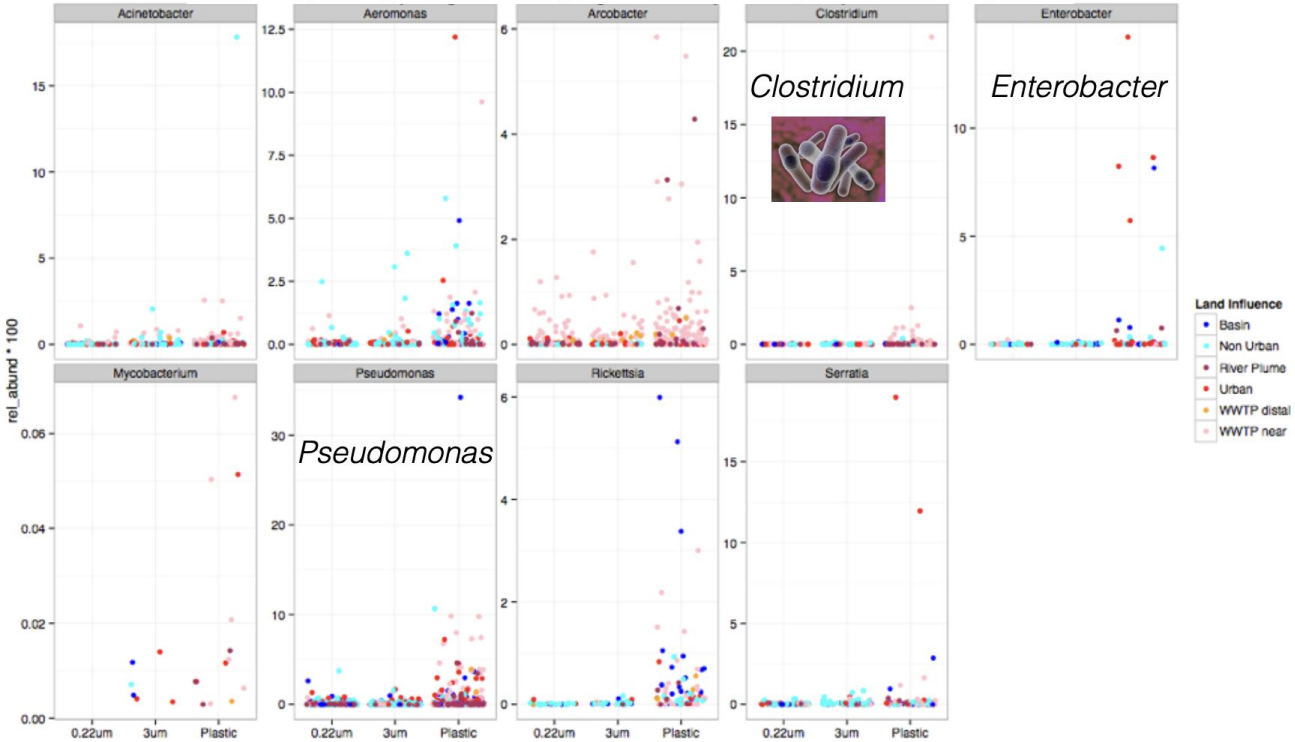

Takeaways

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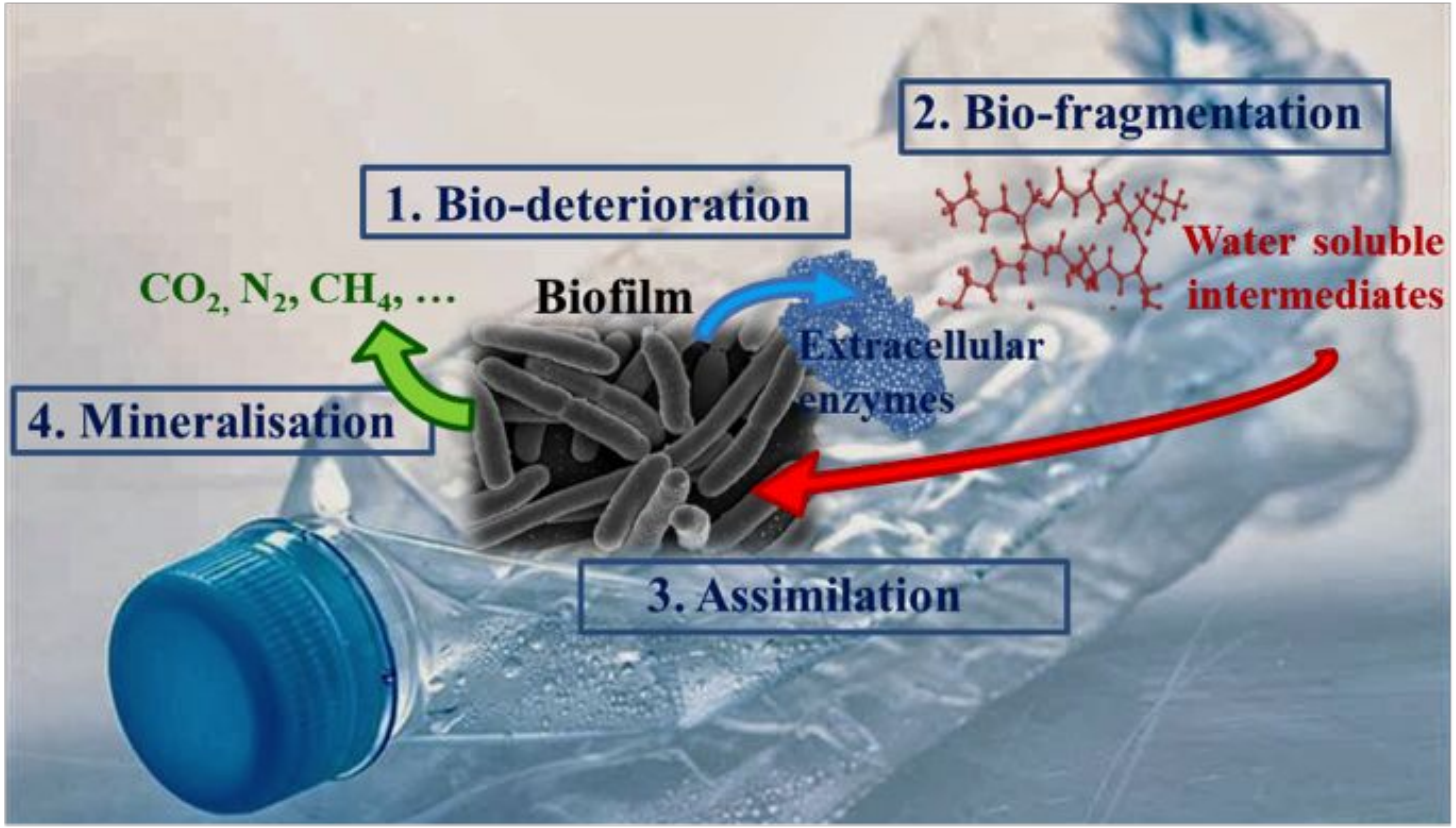
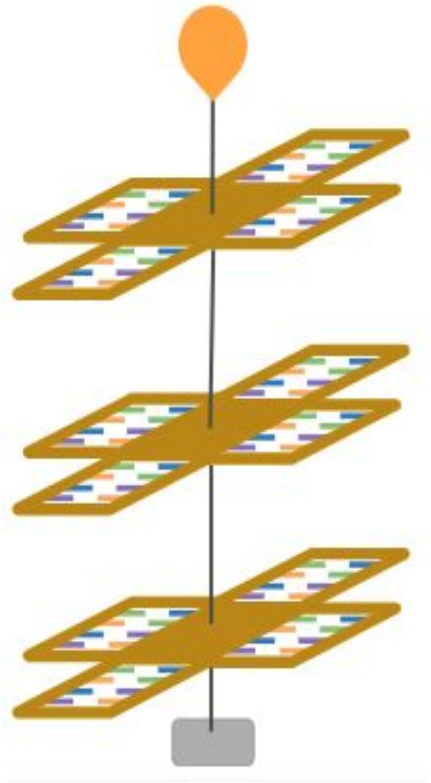
- There are a multitude of potential microbe-microplastics interactions that we study in our research group
    - Effects of plastic (and leachates) on microbial community composition and function
    - Effects of microbial biofilms on plastic fate (degradation, but also biofilm growth and impacts on hydrodynamics)

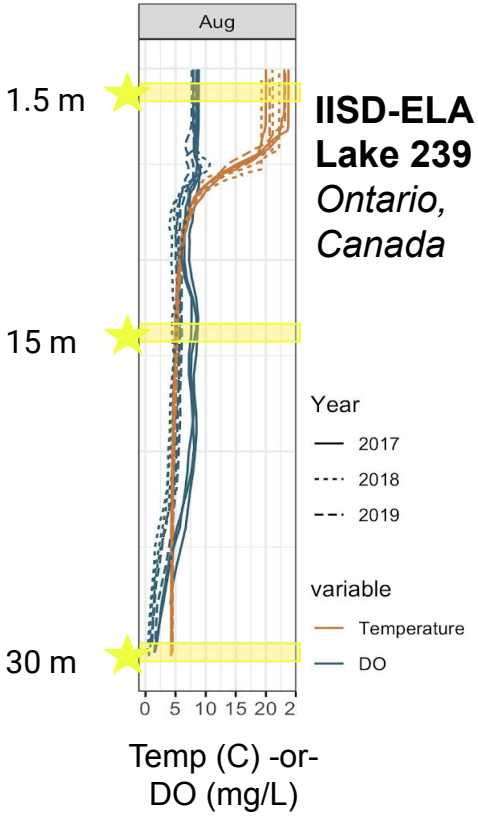
Potential outcomes of microbial enzymatic activity



Studying microbial activity *in situ*

Studying microbial activity *in situ*





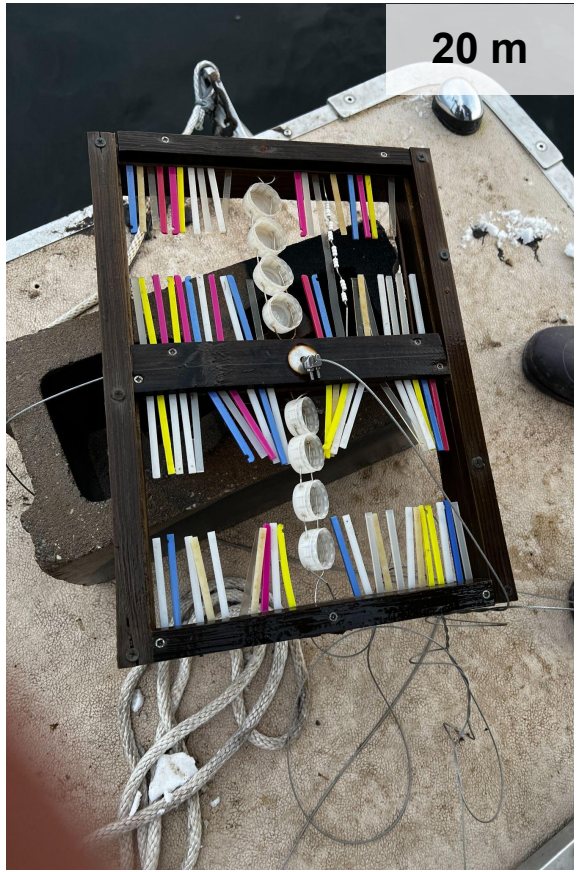
IISD-ELA
Lake 239
Ontario, Canada

pELAstics Team - Chelsea Rochman, Univ. Toronto https://rochmanlab.wordpress.com/the-pelastic-project/

Retrieval of deployments at the UM Biostation

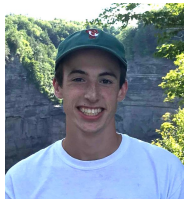
Rachel Cable
UM grad student

Retrieval of deployments at the UM Biostation



Studying plastic biofilm communities and function:
Out of the lake and into the lab(s)

Agniva Bhaumik



Max Murray

Isabelle Montilla

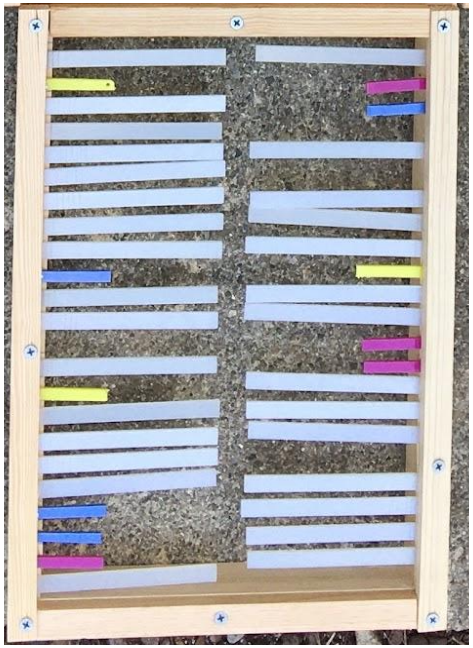
Elizabeth Michaelson

Biofilm imaging & quantification:

- SEM, crystal violet staining

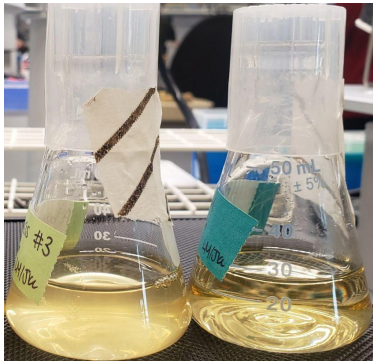
Microbial taxonomy & function:

- 16S & ITS sequencing
- Total DNA & RNA sequencing
- Total proteins & metabolites
- Isolation of live cultures

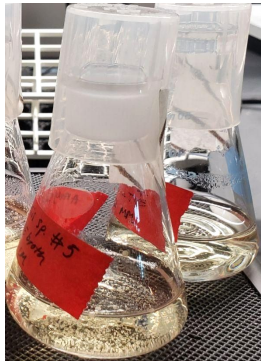


Studying microbial activity of plastic biograders in the lab

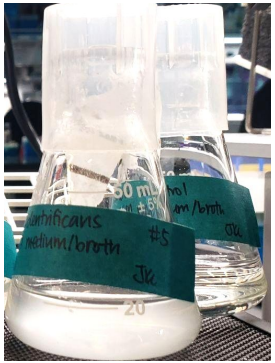
BACTERIA



Alcanivorax borkumensis

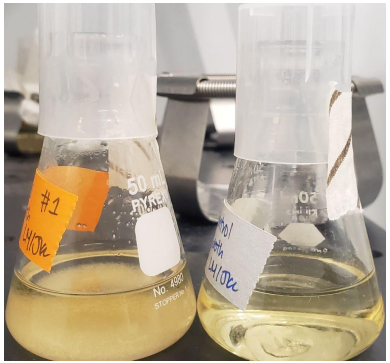


Amycolatopsis sp.



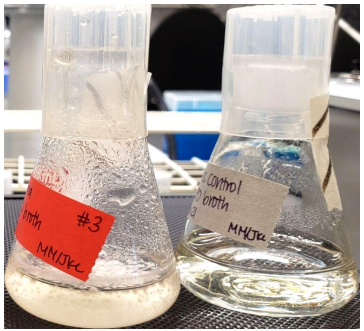
Virgibacillus halodenitrificans

Rhodococcus ruber

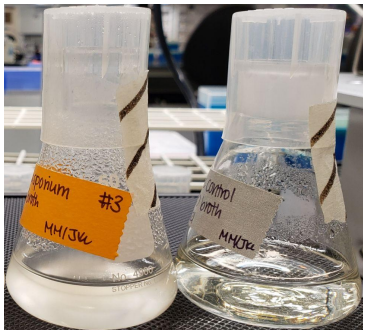


Streptomyces viridosporus

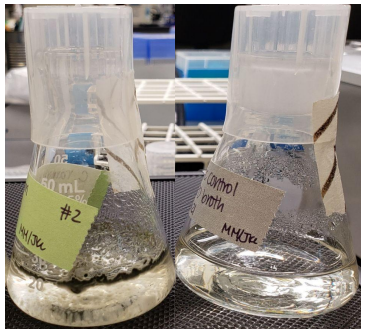
FUNGI



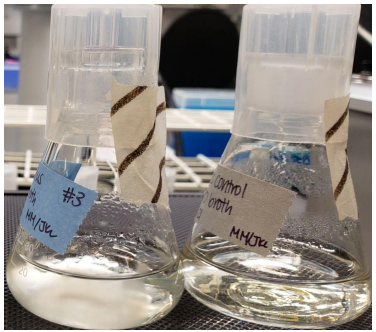
Mortierella alpina



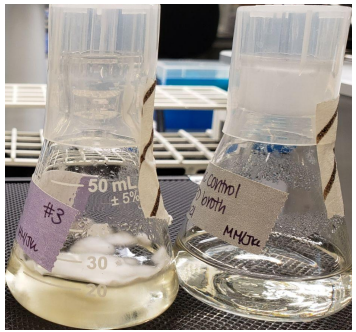
Phanerochaete chrysosporium



Cladosporium ramotenellum

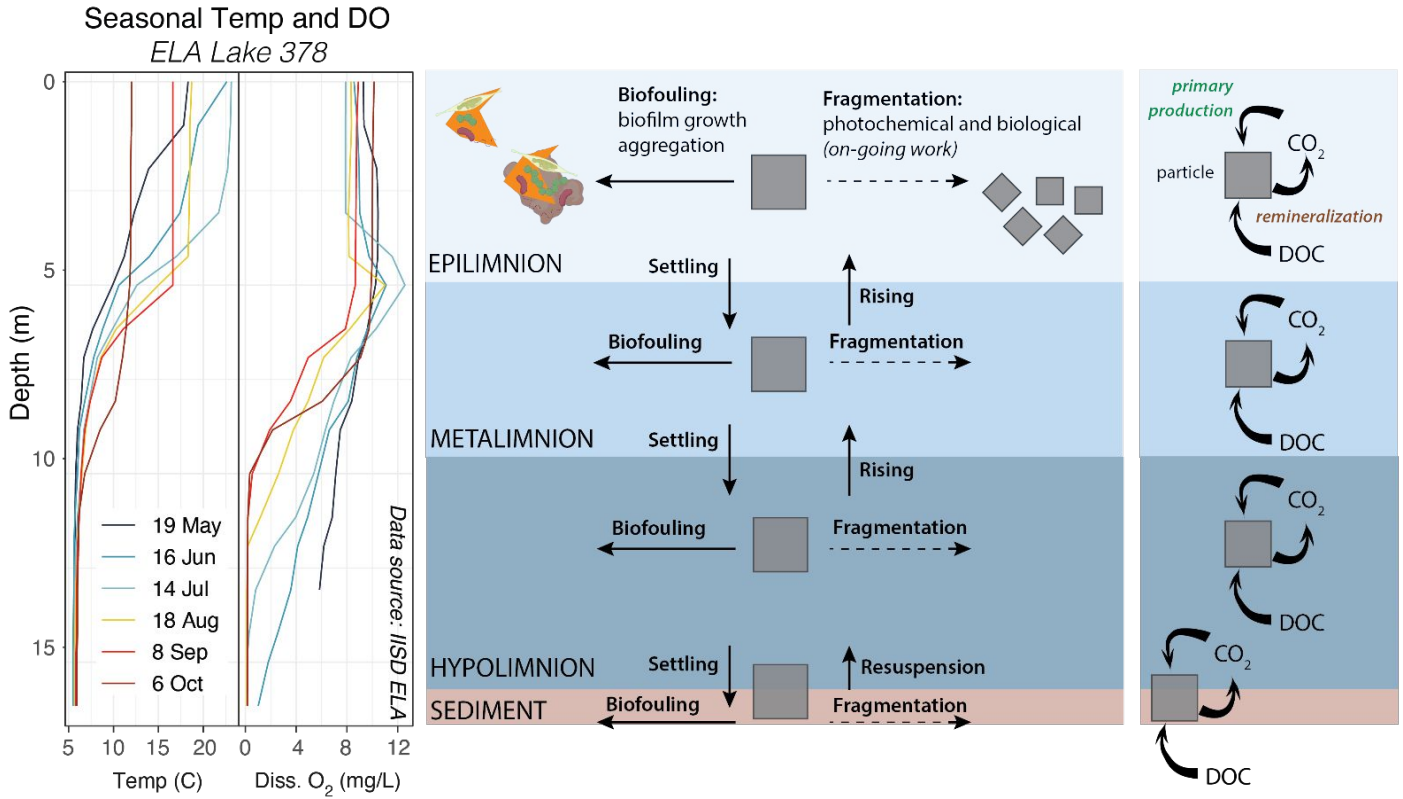


Talaromyces pinophilus

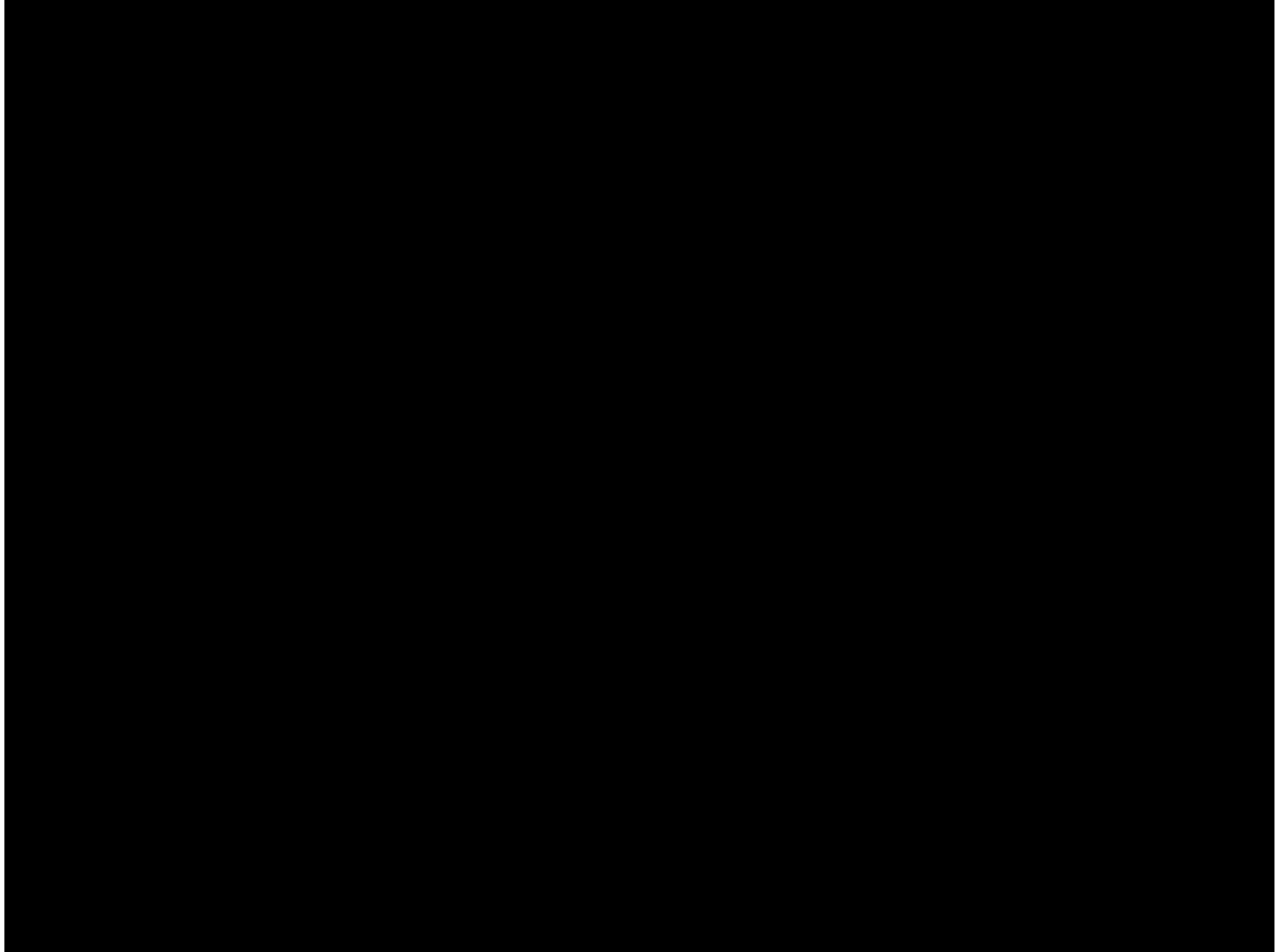


Aspergillus brasiliensis

Zooming back out: Potential for ecosystem-level impacts



with Dr. Matthew Hoffman, RIT



Three Takeaways

- **Microbes matter**, they are the base of aquatic food webs and drive ecosystem processes
- **The "Plastic microbiome" is distinct**: novel, distinct assemblages of microbes live on plastic
- There are **a multitude of potential microbe-microplastics interactions** that we study in our research group
  - Effects of plastic (and leachates) on microbial community composition and function
  - Effects of microbial biofilms on plastic fate (degradation, but also biofilm growth and impacts on hydrodynamics)

Thanks!

Question and Answer Session

We will draw initial questions and comments from those submitted via the chat box during the presentations.

Today's Speakers

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Melissa Duhaime – duhaimem@umich.edu

Thank you for participating in today's *The Current*!

Visit northcentralwater.org, to access the recording and our webinar archive!

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