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’.

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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

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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.
PRIMER

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

Source: Plastics: A Toxic Love Story by Susan Freinkel
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A mountain of plastic:
10.1 billion metric tons

SOURCE: Roland Geyer (UCSB)

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)

- **3,100 Mt is in use**
- **7,000 Mt of plastic waste generated**
  - **74% discarded**
  - **10-15% Water**
  - **15% incinerated**
  - **11% recycled**

**SOURCE:** Roland Geyer (UCSB)

- **Primary production 10,100**
- **In Use**
  - **2,800 Primary**
  - **300 Secondary**
- **Discarded 5,800**
- **Recycled 900**
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.
Average Plastic Abundances

30,000 particles/km²

46,000 particles/km

17,000 particles/km²

230,000 particles/km²

160,000 particles/km

SOURCES: Earn et al., 2020; Cox et al., 2021
Average Plastic Quantities

- 2.5 Billion particles
- 2.8 Billion particles
- 4 Billion particles
- 4.5 Billion particles
- 1 Billion particles
MICROPLASTIC

Less than 5 mm

Primary Microplastics

Pre-Production Pellets

Microbeads

MicroFibers

Fragments

Secondary Microplastics

Photo-Degradation
Rivers
Collected using similar methods and mesh size, and analyzed by the same lab
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

325 particles/liter

5.5
Human Consumption of Microplastics

How We Eat, Drink and Breathe Microplastics

Average number of microplastic particles found per gram/liter/m² of selected consumables

<table>
<thead>
<tr>
<th>Material</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottled water</td>
<td>94.37</td>
</tr>
<tr>
<td>Beer**</td>
<td>32.27</td>
</tr>
<tr>
<td>Air**</td>
<td>9.80</td>
</tr>
<tr>
<td>Tap water</td>
<td>4.24</td>
</tr>
<tr>
<td>Seafood*****</td>
<td>1.48</td>
</tr>
<tr>
<td>Sugar*</td>
<td>0.44</td>
</tr>
<tr>
<td>Salt****</td>
<td>0.11</td>
</tr>
<tr>
<td>Honey**</td>
<td>0.10</td>
</tr>
</tbody>
</table>

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"
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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”

Three Takeaways

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Great Lakes plastics harbor distinct microbial communities (and species)
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Plastic Surface Environment: Microbes

Great Lakes plastics host pathogens ...
...especially at urban sites

WHO pathogen indicator genera differentially abundant on plastic
Great Lakes plastics host pathogens
...especially at urban sites

WHO pathogen indicator genera differentially abundant on plastic

- Acinetobacter
- Aeromonas
- Arobacter
- Clostridium
- Enterobacter
- Mycobacterium
- Pseudomonas
- Rickettsia
- Serratia
Takeaways

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Potential outcomes of microbial enzymatic activity
Studying microbial activity \textit{in situ}
Studying microbial activity in situ
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)*

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

Seasonal Temp and DO
ELA Lake 378

Biofouling: biofilm growth aggregation
Fragmentation: photochemical and biological (on-going work)

EPILOMNIION
Settling
Biofouling
Rising
Fragmentation

METALOMNIION
Settling
Biofouling
Rising
Fragmentation

HYPOLOMNIION
Settling
Resuspension
Biofouling
Fragmentation

SEDIMENT
Biofouling
Fragmentation

primary production
particle
CO₂
remineralization
DOC

with Dr. Matthew Hoffman, RIT
Three Takeaways

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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

Sam Mason – sam7201@psu.edu
Melissa Duhaime – duhaimem@umich.edu
Thank you for participating in today’s *The Current*! Visit [northcentralwater.org](http://northcentralwater.org), to access the recording and our webinar archive!

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