



Metropolitan Water Reclamation District of Greater Chicago

**WELCOME
TO THE NOVEMBER EDITION
OF THE 2018
M&R SEMINAR SERIES**

BEFORE WE BEGIN

- **SAFETY PRECAUTIONS**
 - PLEASE FOLLOW EXIT SIGNS IN CASE OF EMERGENCY
 - AUTOMATED EXTERNAL DEFIBRILLATOR (AED) LOCATED OUTSIDE
- **PLEASE SILENCE CELL PHONES OR SMART PHONES**
- **A QUESTION AND ANSWER SESSION WILL FOLLOW PRESENTATION**
- **PLEASE FILL OUT THE EVALUATION FORM**
- **SEMINAR SLIDES WILL BE POSTED ON THE MWRD WEBSITE**
(www.MWRD.org: Home Page ⇒ Reports ⇒ M&R Data and Reports ⇒ M&R Seminar Series ⇒ 2018 Seminar Series)
- **VIDEO STREAM OF THE PRESENTATION WILL BE AVAILABLE ON MWRD WEBSITE** (www.MWRD.org: Home Page ⇒ MWRDGC RSS Feeds)

TIMOTHY J. HOELLEIN, Ph.D.

Current: Associate Professor, Dept. of Biology, Loyola University, Chicago. IL

Experience: Assistant Professor, Dept. of Biology, Loyola University, Chicago. IL;
Assistant Professor, Dept. of Natural Sciences, Baruch College,
City University of New York;
Research Technician, USGS. Biological Resources Division, Ft. Collins, CO.
Animal Care/Water Quality Monitor, Dolphins Plus, Key Largo, FL, USA and Road
Town, British Virgin Islands.

Education: B.S. in Biology, minor in Chemistry. Wesleyan College, West Virginia
Ph.D. Biology. University of Notre Dame. Indiana

Profession: Society for Freshwater Science
American Society of Limnology and Oceanography
Ecological Society of America

Award: Langerback Award. Excellence in Undergraduate Research Mentoring. Loyola
Univ. Chicago

Plastic litter in freshwaters: Abundance, movement, and biological interactions



Timothy Hoellein

*Associate Professor, Dept. Biology,
Loyola Univ. Chicago*

Metropolitan Water Reclamation District

Nov 30, 2018



Photo: Reptile Hunter



Photo: Reptile Hunter

The normative power of the actual



Photo: Sylvia Lee



River trash





Plastic debris on East Beach, Henderson Island

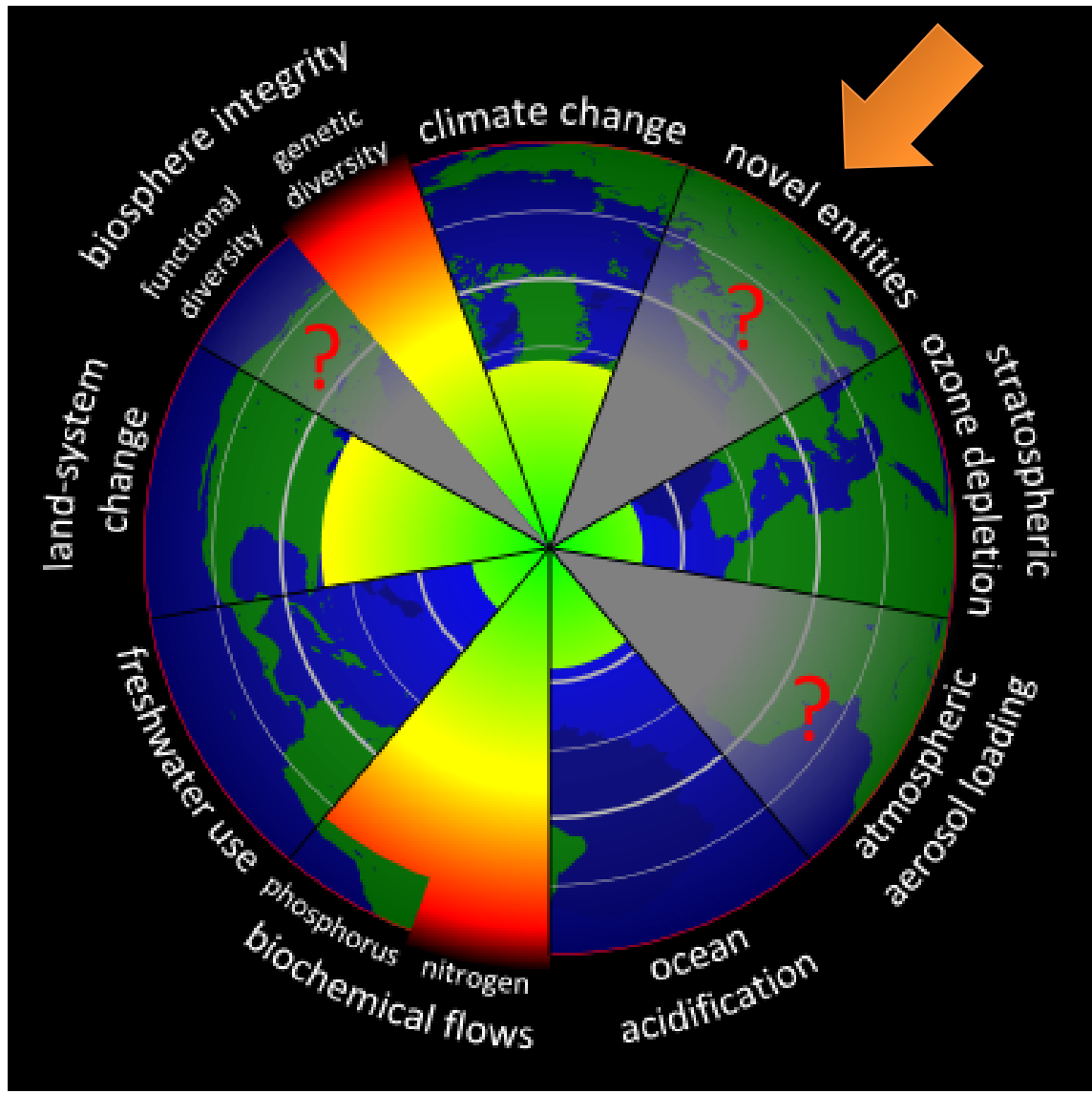
Jennifer Lavers

A Remote Paradise Island Is Now a Plastic Junkyard

Henderson Island is isolated and uninhabited—but its beaches are still covered in garbage.

The Atlantic. May 15, 2017

The Anthropocene Era – Human imprint on geologic record



What are the *sources, abundance, fate, and biological interactions* of litter in freshwaters?

1. State of 'garbage' science
2. Microplastic and wastewater effluent in rivers
3. Microplastic in L. Michigan tributaries: water and fish
4. 'Macro' litter in Chicago area rivers
5. Applications, solutions

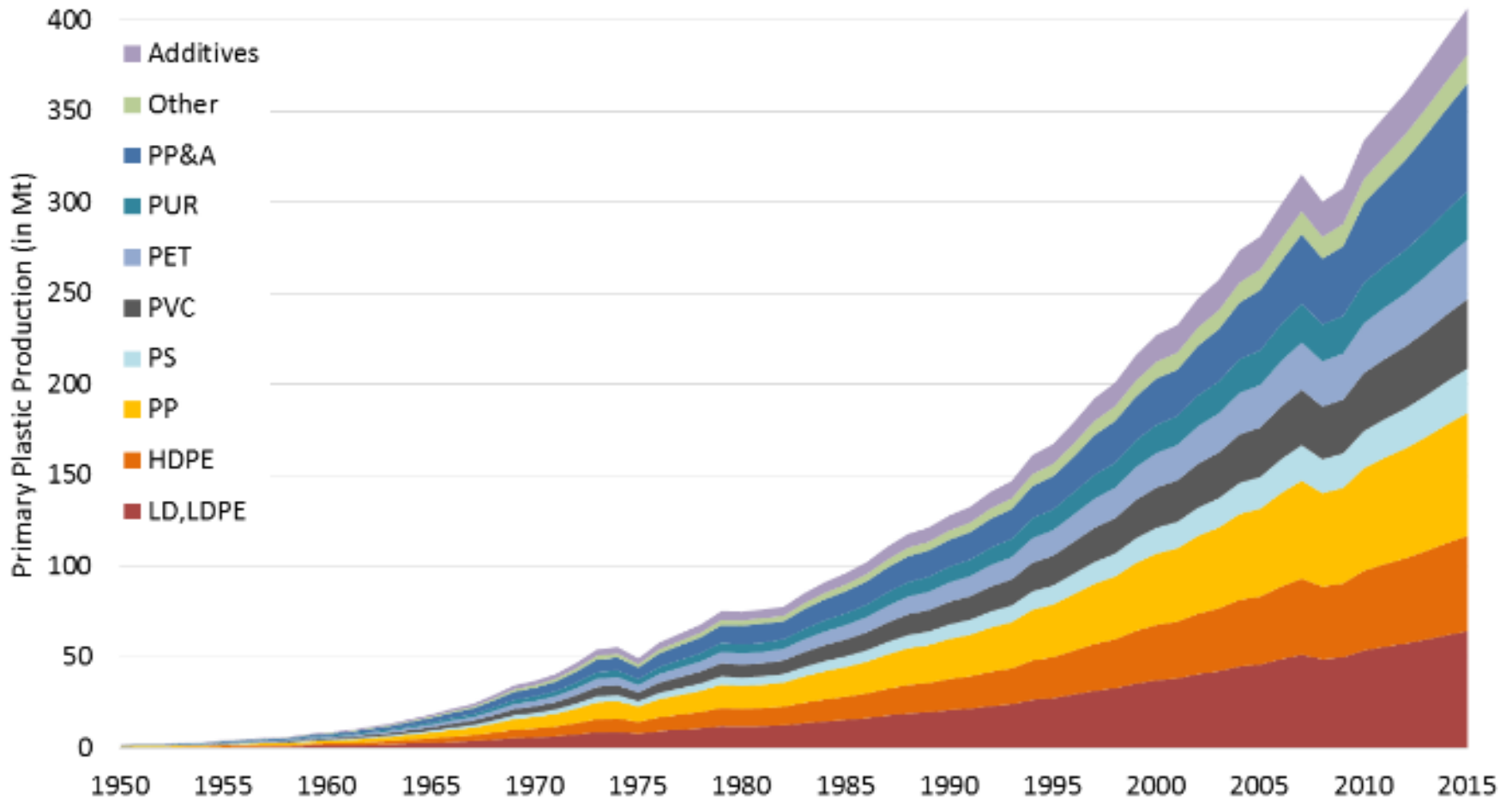


What are the *sources, abundance, fate, and biological interactions* of litter in freshwaters?

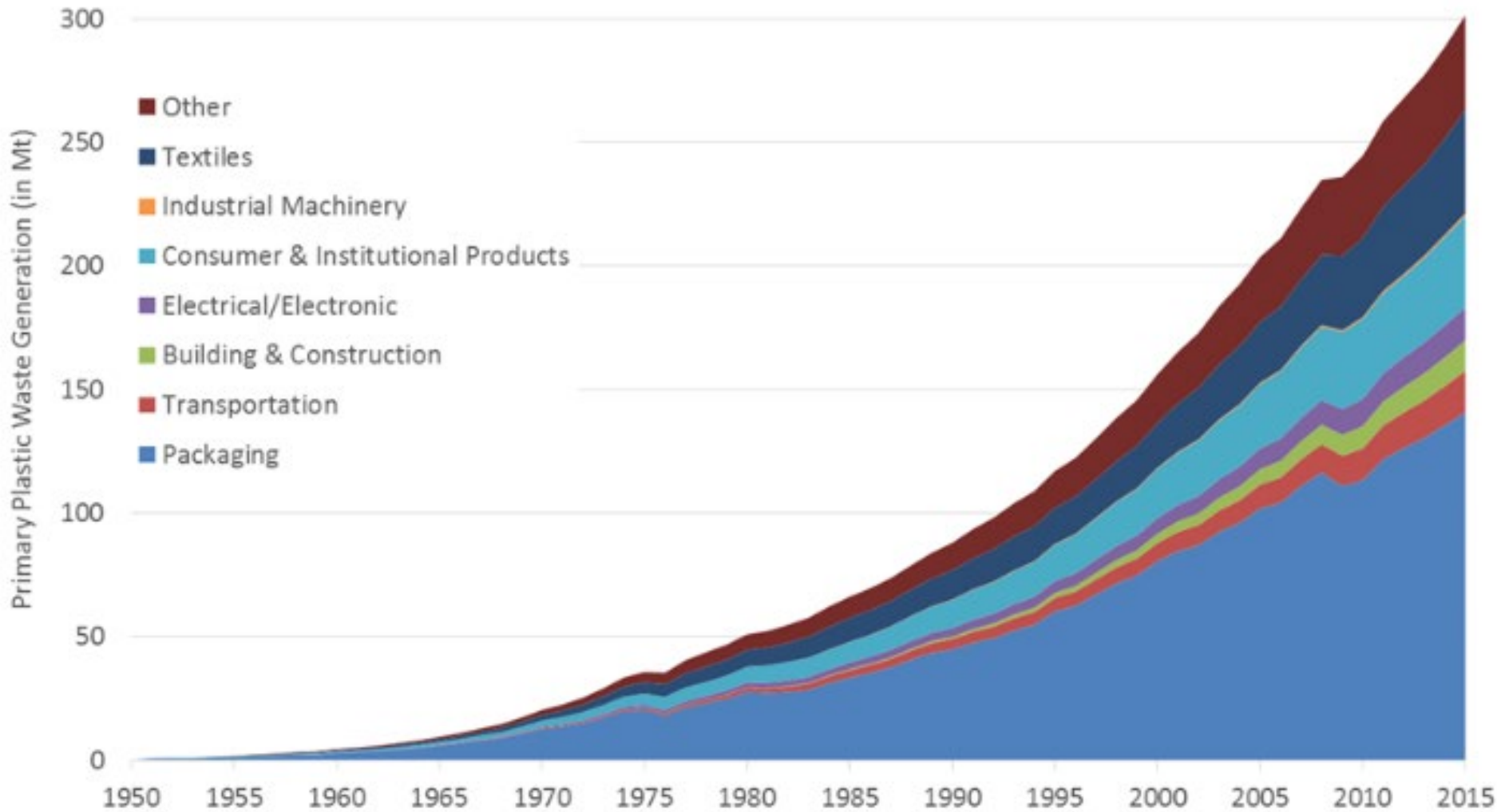
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Plastic production rates are accelerating



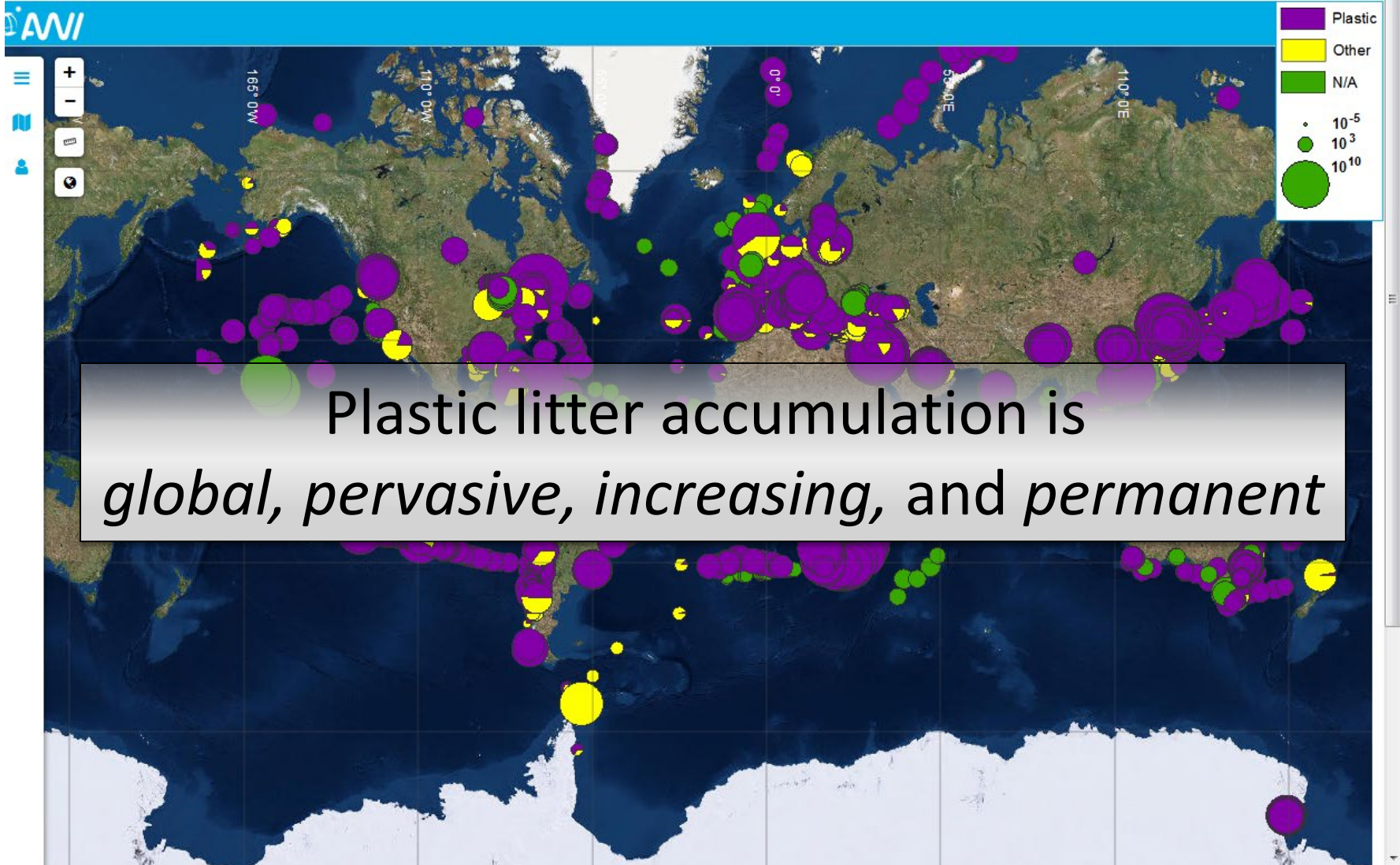
Plastic waste generation is accelerating



Primary production
8300



~92% of the plastic that was ever produced still exists...
somewhere, in some form

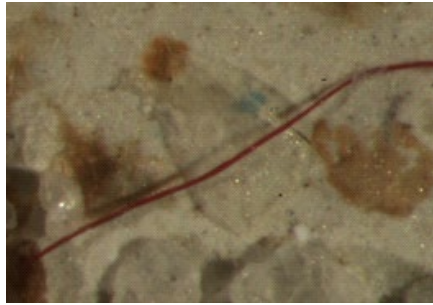
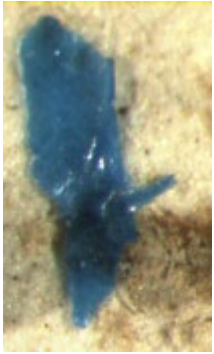


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Microplastic particles (< 5 mm)



Microplastic from N. Shore
Channel, Chicago
(*Hoellein, McCormick*)



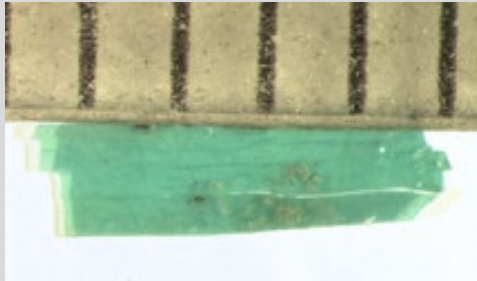
Microplastic from open ocean
(*5 Gyres Institute*)

Microplastic Sources

Fragmentation



archipelago.gr



Production pellets

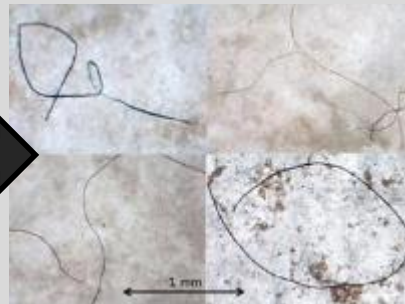


www.frbiz.com



www.alibaba.com

Synthetic fibers



<http://workjournal.archipelago.gr/tag/microplastics/>

Personal care products



Biological effects of microplastic

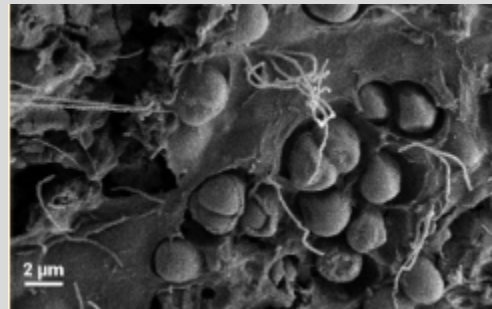
- Ingestion
- Transfer: prey -> predator
- Toxic
 - Chemicals stick to it, and leech from it
- Selects for distinct microbial communities



Cole et al. 2013, abstract image



www.ecology.com



Zettler et al. 2013, abstract image

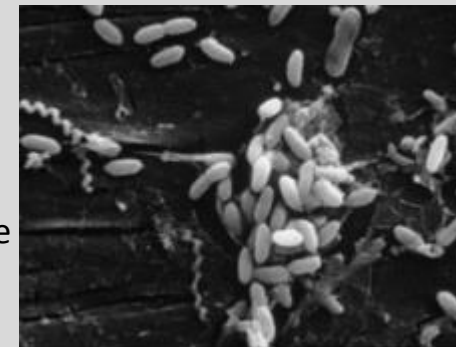
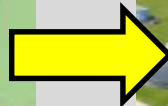


Image by J. Schluep

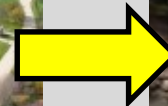
Is wastewater effluent a source of microplastic to rivers?



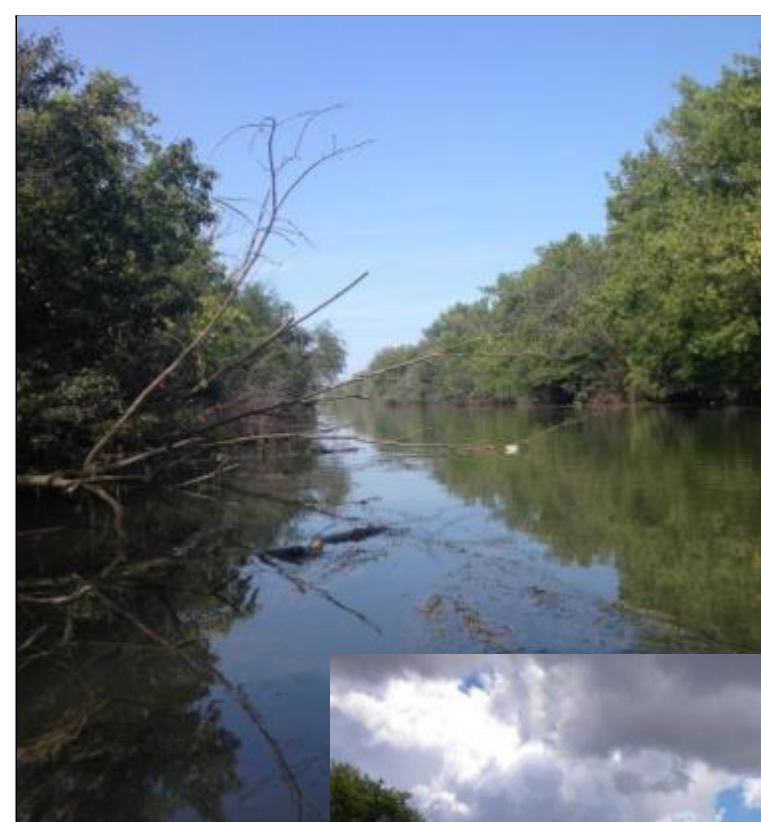
puff.lbl.gov



www.sustainable-chicago.com



Plant	Water Body, <i>City</i>	2013 Mean Effluent (MGD)	Contrib. of effluent to downstream flow (%)	Tertiary sand bed (Y/N)
Kirie WRP	Higgen's Cr, <i>Des Plaines</i>	38.72	110.82	N
Wheaton WWTP	Springbrook Cr, <i>Wheaton</i>	7.39	86.18	Y
Bloomington SE	Little Kickapoo Cr, <i>Bloom.</i>	4.24	78.93	Y
O'Brien WRP	N Shore Channel, <i>Chicago</i>	225.00	70.00*	N
Bloomington W Oakton	Goose Cr, <i>Bloomington</i>	15.93	46.51	Y
Springbrook WRP	DuPage Ri, <i>Naperville</i>	19.68	20.82	Y
Bartlett WWTP	W Br DuPage Ri, <i>Bartlett</i>	2.16	15.99	N
Elmhurst WRP	Salt Cr, <i>Elmhurst</i>	7.03	13.17	N
Woodridge Greene Valley	E Br DuPage Ri, <i>Woodridge</i>	10.00	13.24	Y



Body

Plaines

Wheaton

r, Bloomington



ary
bed
N)

WRP
Bloomington W
Oakton

Springbrook WF

Bartlett WWTP

Elmhurst WRP

Woodridge Gree
Valley



12-11-2018 10:18 AM, 11/20/18

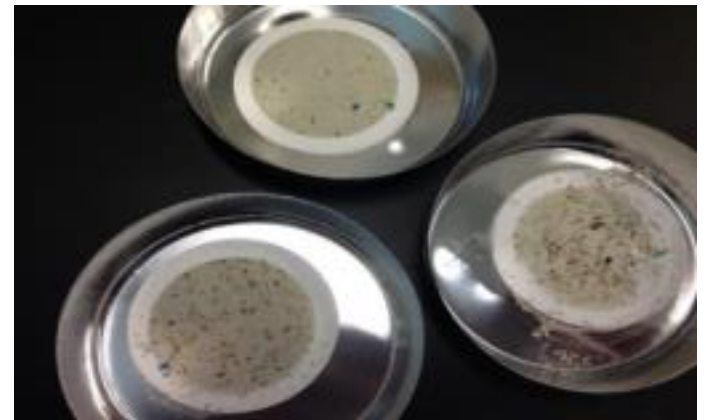
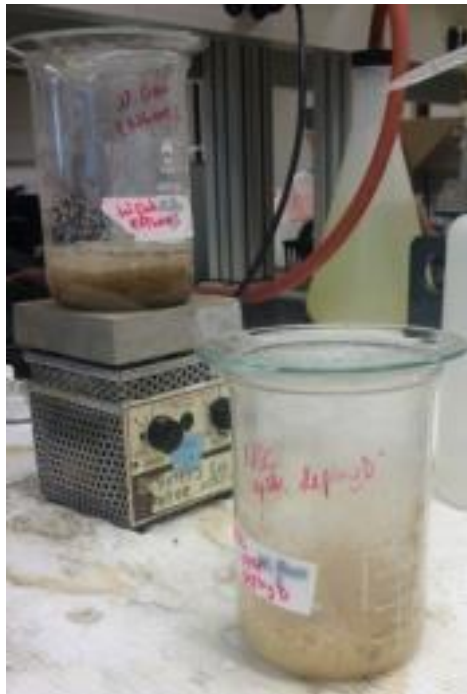




Josh Hittie



Max London



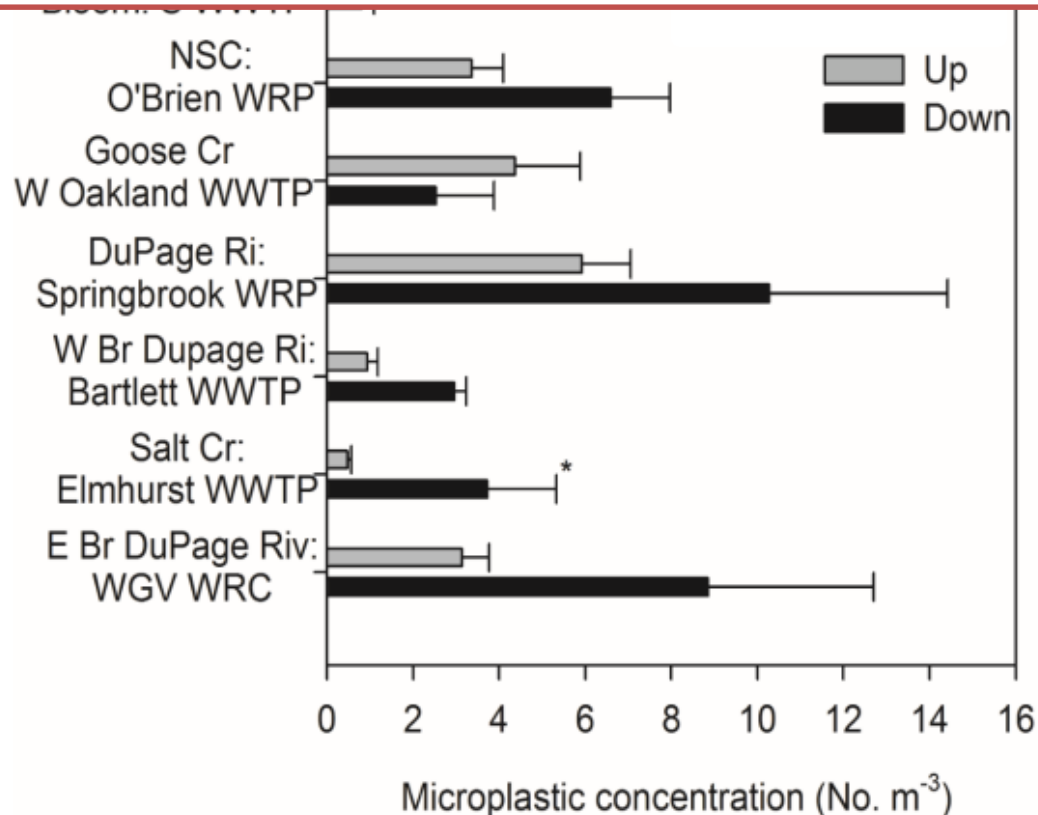


Pellets

fragments

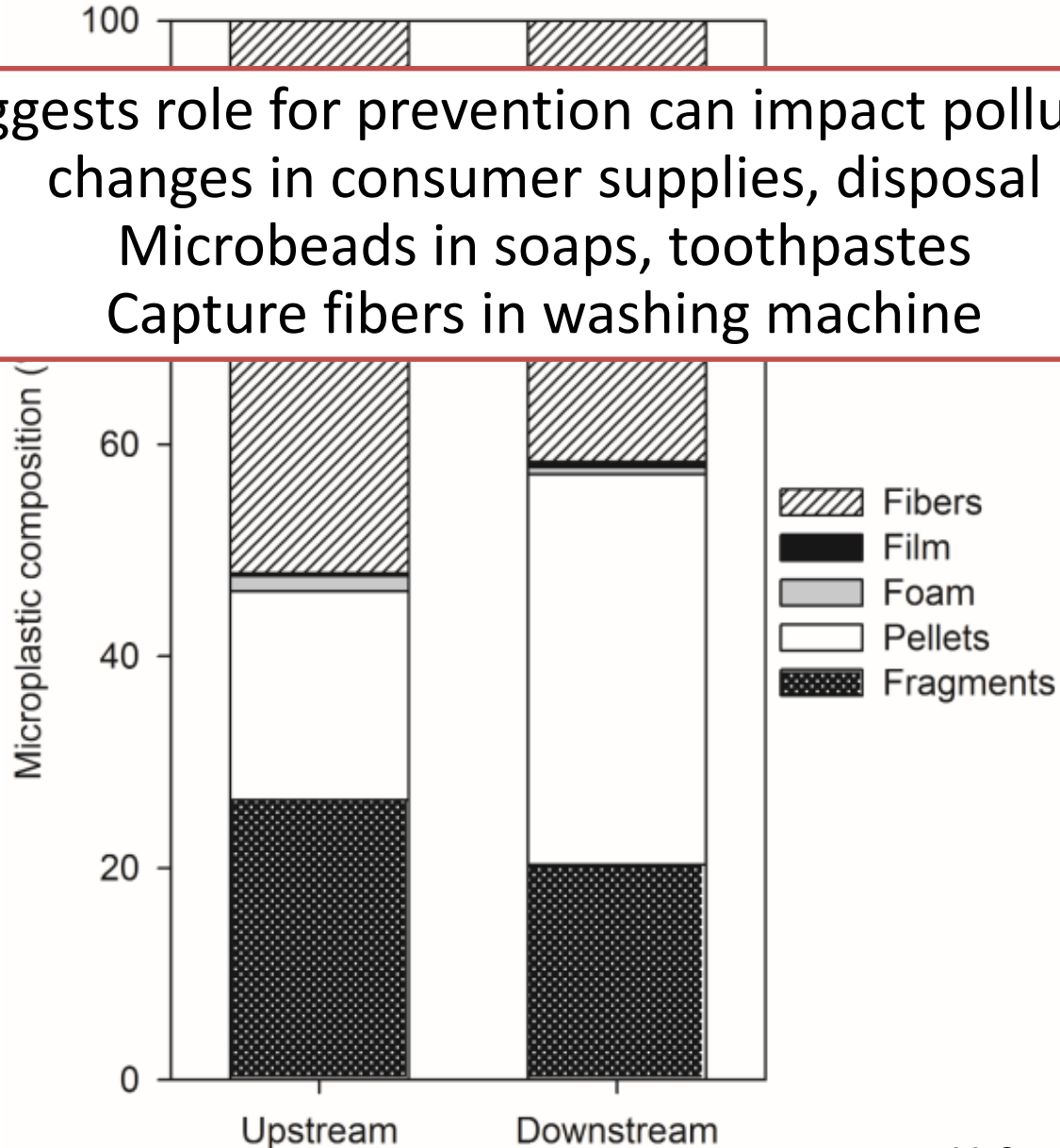
Wastewater can be one source of microplastic to streams.
Not in all cases. Variation among streams high.

Other research: High retention of microplastic in WWTP
Role of finishing treatment (e.g., sand filtration).
Other sources (combined sewers, street runoff, atmospheric
deposition, fragmentation)



Higher relative abundance of pellets downstream

Suggests role for prevention can impact pollution
changes in consumer supplies, disposal
Microbeads in soaps, toothpastes
Capture fibers in washing machine



What are the *sources, abundance, fate, and biological interactions* of litter in freshwaters?

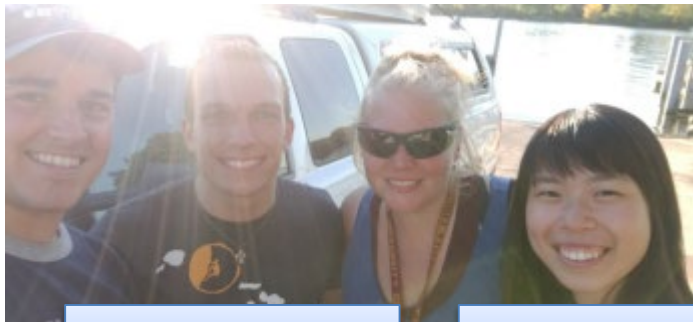
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Rachel McNeish Anna Vincent Paul Risteca
Brenainn Turner Lisa Kim

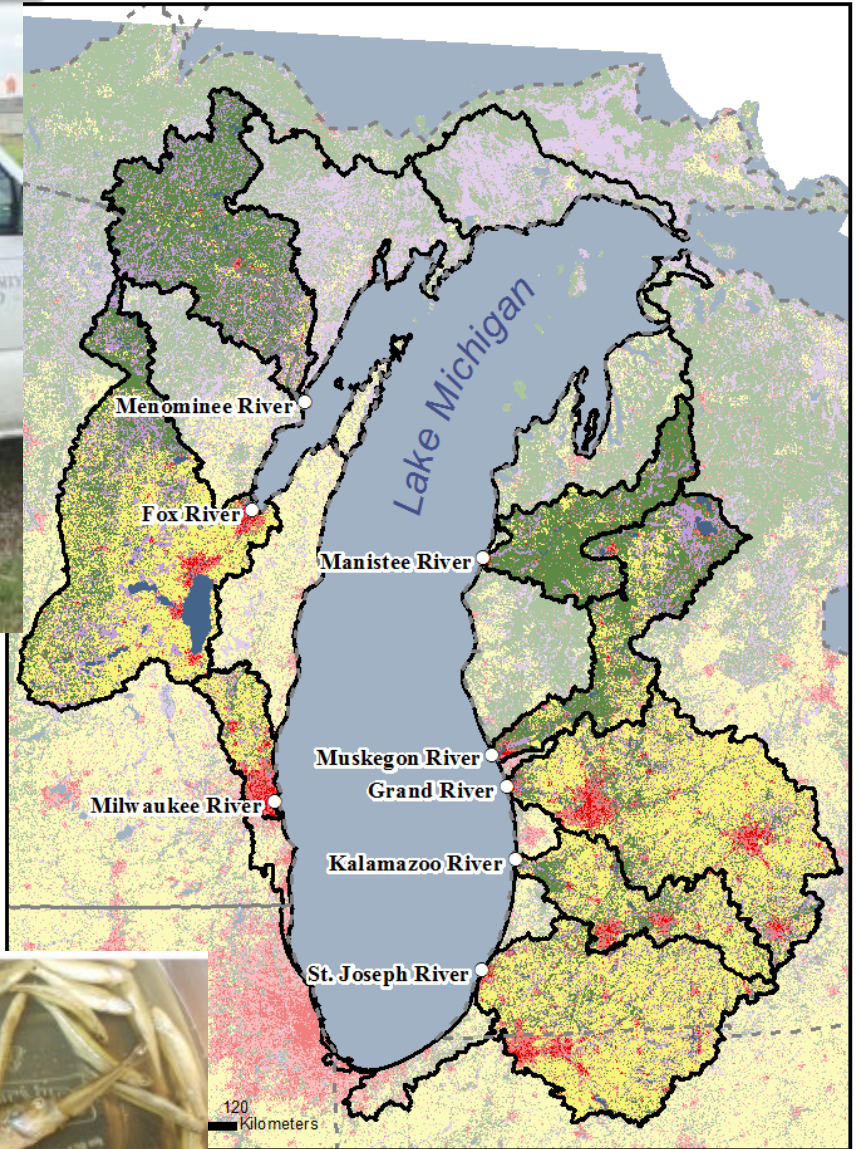


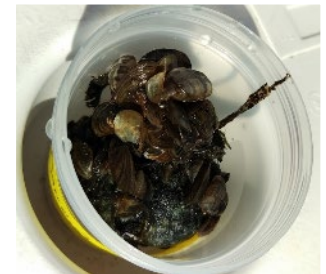
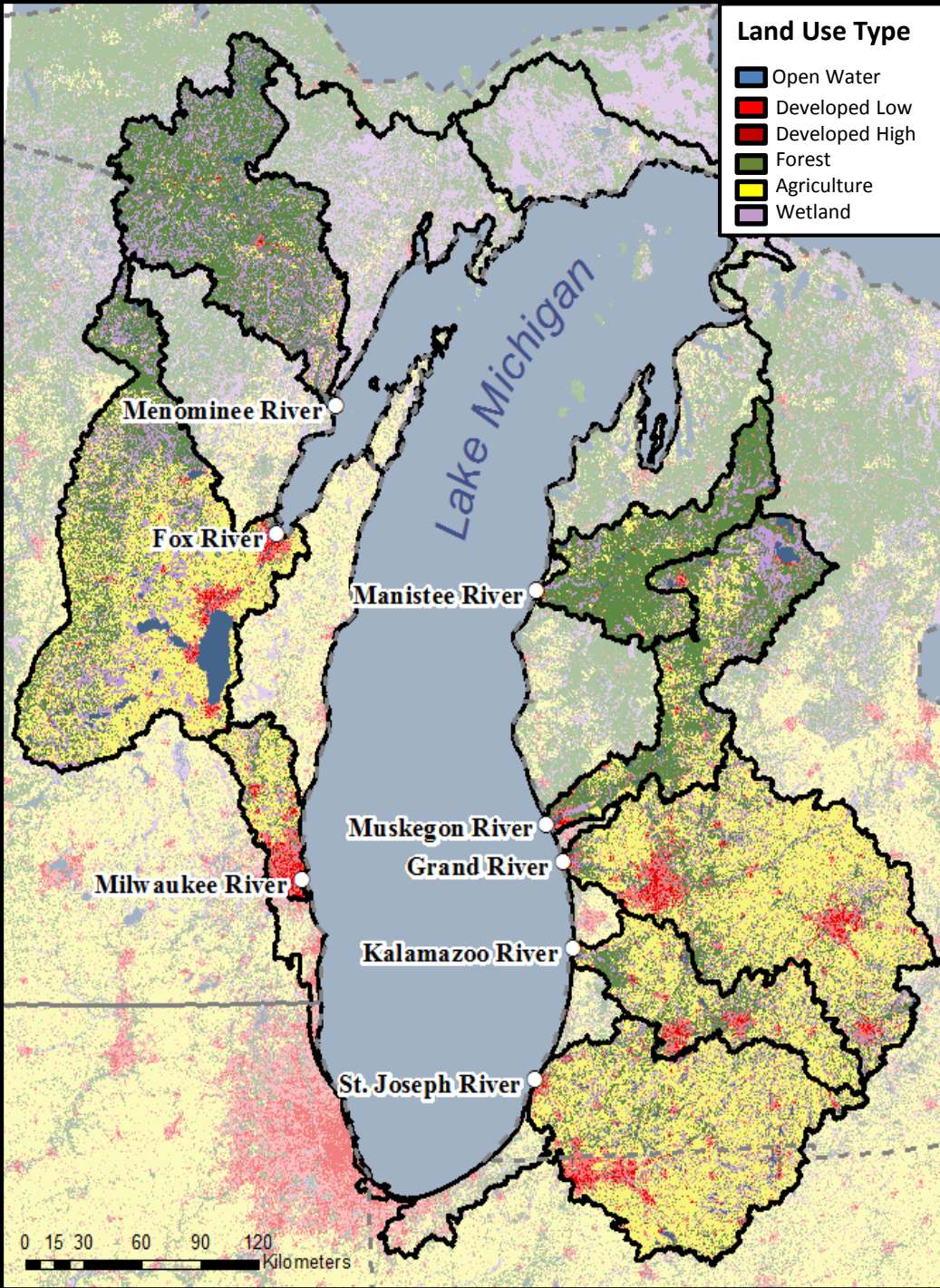
Melissa Achettu

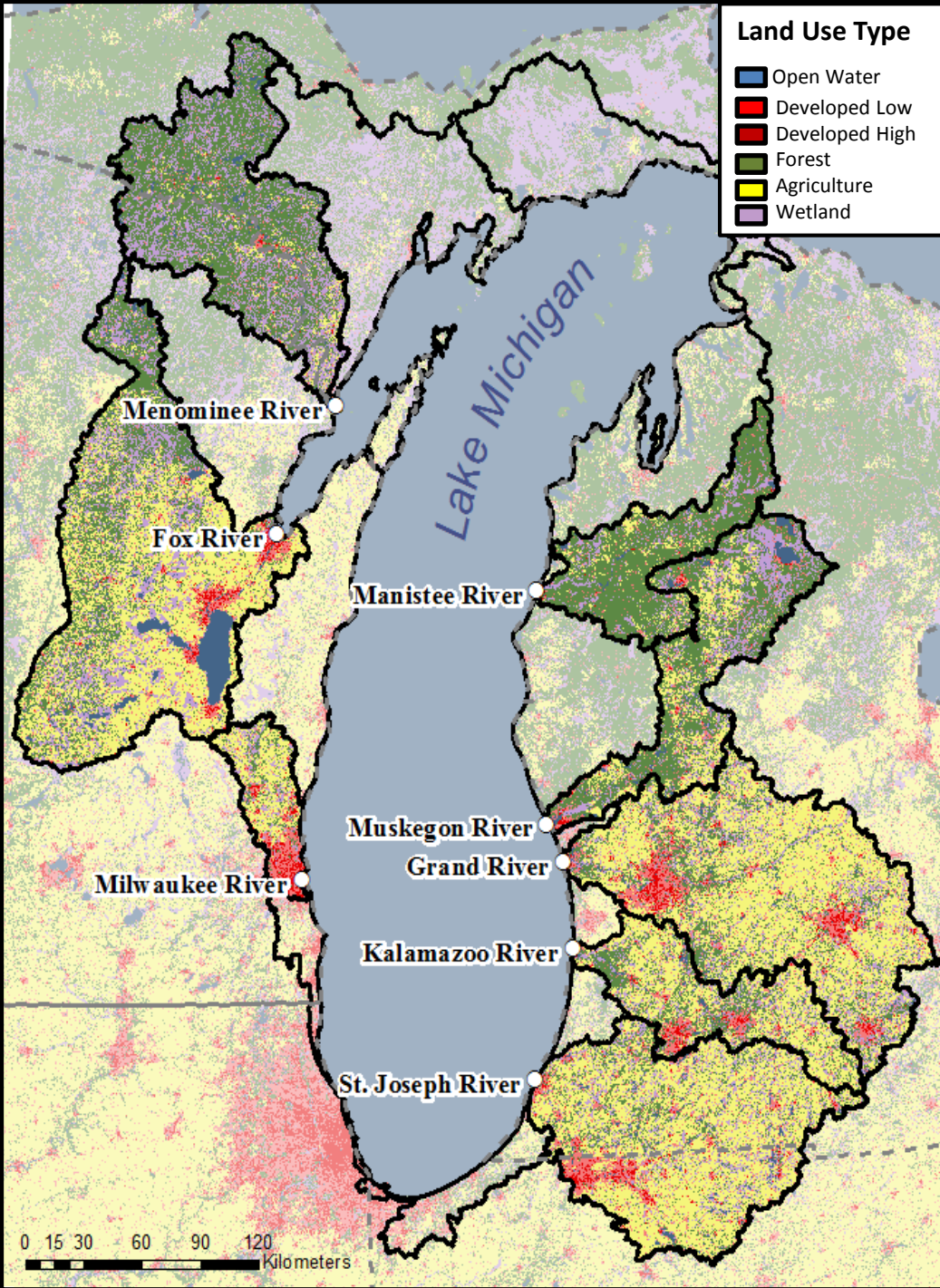


Randy Cybulski

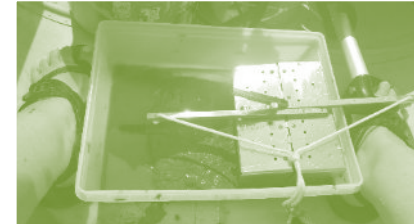
Loren Hou







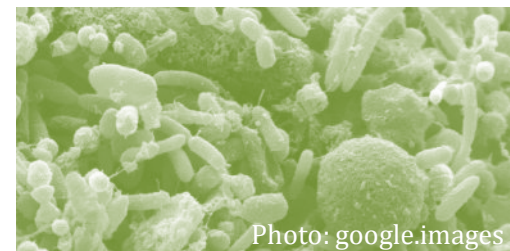
Sediment



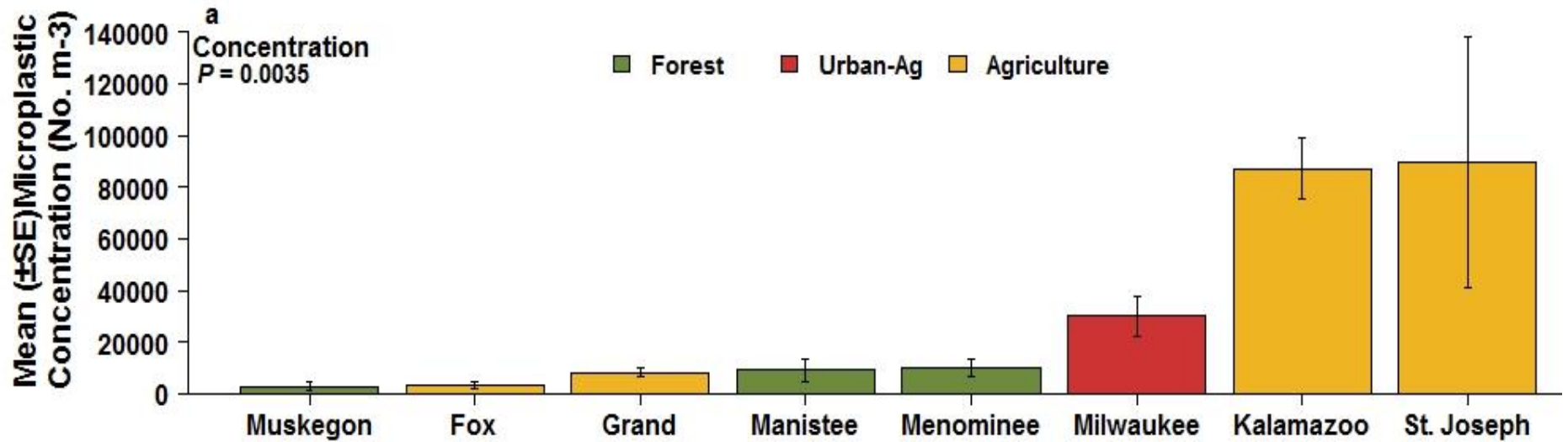
Macroinvertebrates



Microbes



Microplastic Abundance in L. Michigan's Rivers



Polyethylene (PE) – packaging material – bottles, shopping bags, toys

Polyacrylonitrile – textiles, filtration membranes, fish rods, badminton rackets

Polyacetal – eyeglass frames, fasteners, knife handles, automotive industry, and electronics

Polyvinyl Acetate – emulsifier for porous materials; cloth, wood glue, primer for drywall

Polyethylene Terephthalate (PETE) – textiles; also called polyester

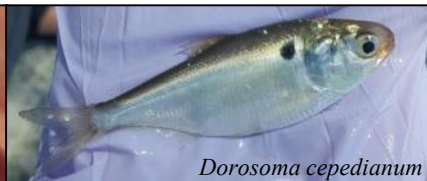


Taxa	Common Name	Functional Feeding Group	Trophic Fraction	Abundance	Size Range (cm)
<i>Dorosoma cepedianum</i>	Gizzard Shad	Detritivore	2.40	6	3.6 – 11.4
<i>Catostomus commersonii</i>	White Sucker	Detritivore	2.46	16	4.5 – 12
<i>Pimephales promelas</i>	Fathead Minnow	Omnivore	2.80	10	5.6 – 6.5
<i>Carpoides cyprinus</i>	Quillback	Omnivore	2.59	1	9.0
<i>Notropis stramineus</i>	Sand Shiner	Omnivore	2.37	17	3.9 – 6.9
<i>Notropis hudsonius</i>	Spottail Shiner	Omnivore	2.74	20	4.4 – 6.7
<i>Hybognathus hankinsoni</i>	Brassy Minnow	Zoobenthivore	3.09	1	5.6
<i>Labidesthes sicculus</i>	Brook Silverside	Zoobenthivore	3.35	15	4.6 – 6
<i>Micropterus salmoides</i>	Largemouth Bass	Zoobenthivore	3.84	3	6.3 – 6.8
<i>Micropterus dolomieu</i>	Smallmouth Bass	Zoobenthivore	4.09	4	6.3 – 7.7
<i>Micropterus sp.</i>	Bass sp.	Zoobenthivore	4.09	1	5.6
<i>Percina caprodes</i>	Logperch	Zoobenthivore	3.43	5	5.8 – 7.1
<i>Morone chrysops</i>	White Bass	Zoobenthivore	4.40	3	4.5 – 12.8
<i>Fundulus diaphanus</i>	Banded Killifish	Zoobenthivore	3.18	4	4.5 – 7.6
<i>Notropis atherinoides</i>	Emerald Shiner	Zoobenthivore	2.80	2	6.5 – 9.6
<i>Neogobius melanostomus</i>	Round Goby	Zoobenthivore	3.30	14	4.1 – 9.4
<i>Cyprinella spiloptera</i>	Spotfin Shiner	Zoobenthivore	3.44	4	5.0 – 8.1
<i>Lepomis gibbosus</i>	Pumpkinseed	Zoobenthivore	3.27	1	8.2

- 161 fish spanning 18 taxa across tributaries (so far)
- ~ 93% fish contained microplastic in the digestive tracts



Micropterus sp.



Dorosoma cepedianum



Fundulus diaphanus

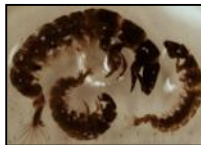
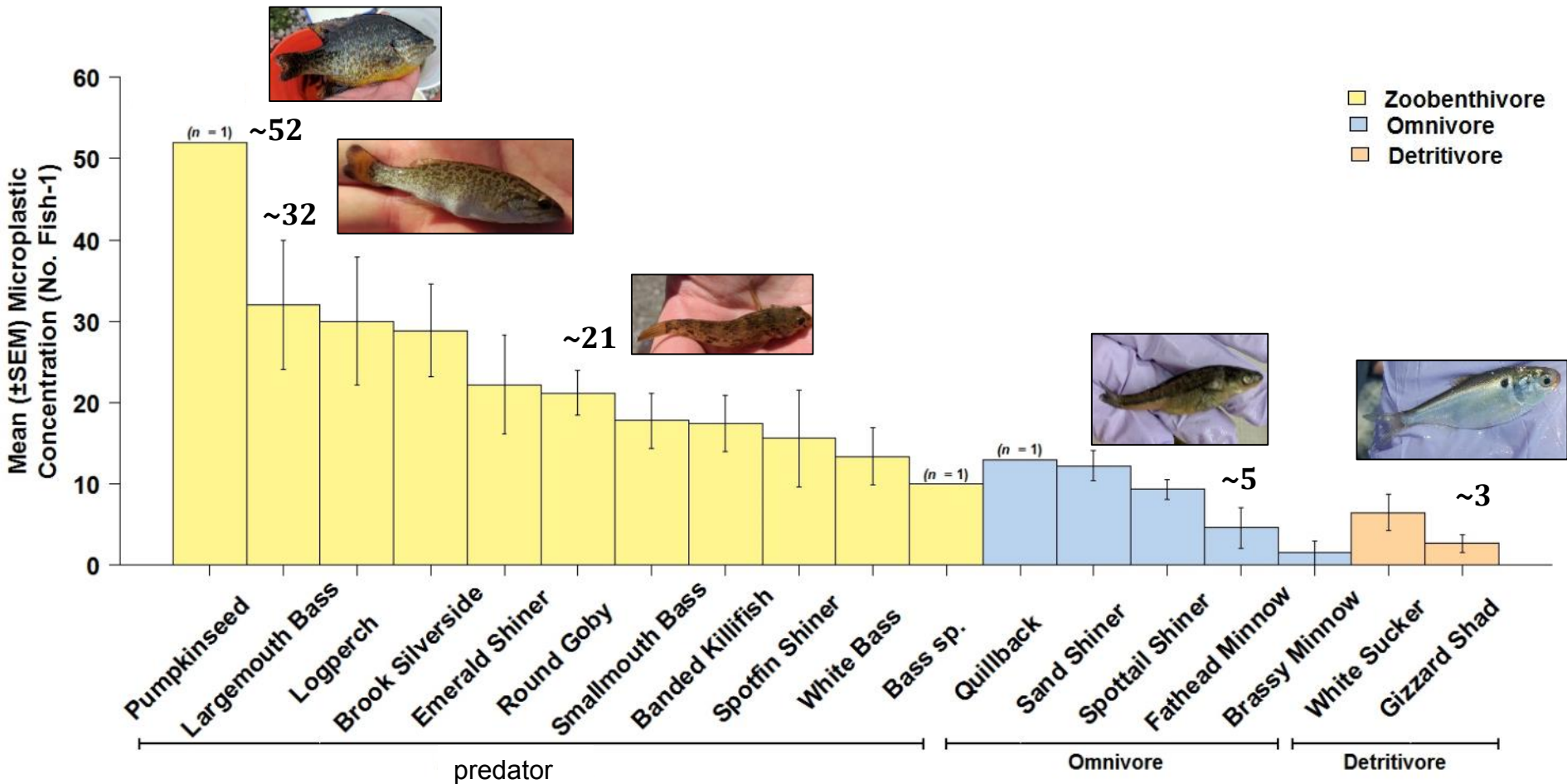


Neogobius melanostomus



Notropis sp.

Microplastic is in almost all fish – highest in predators



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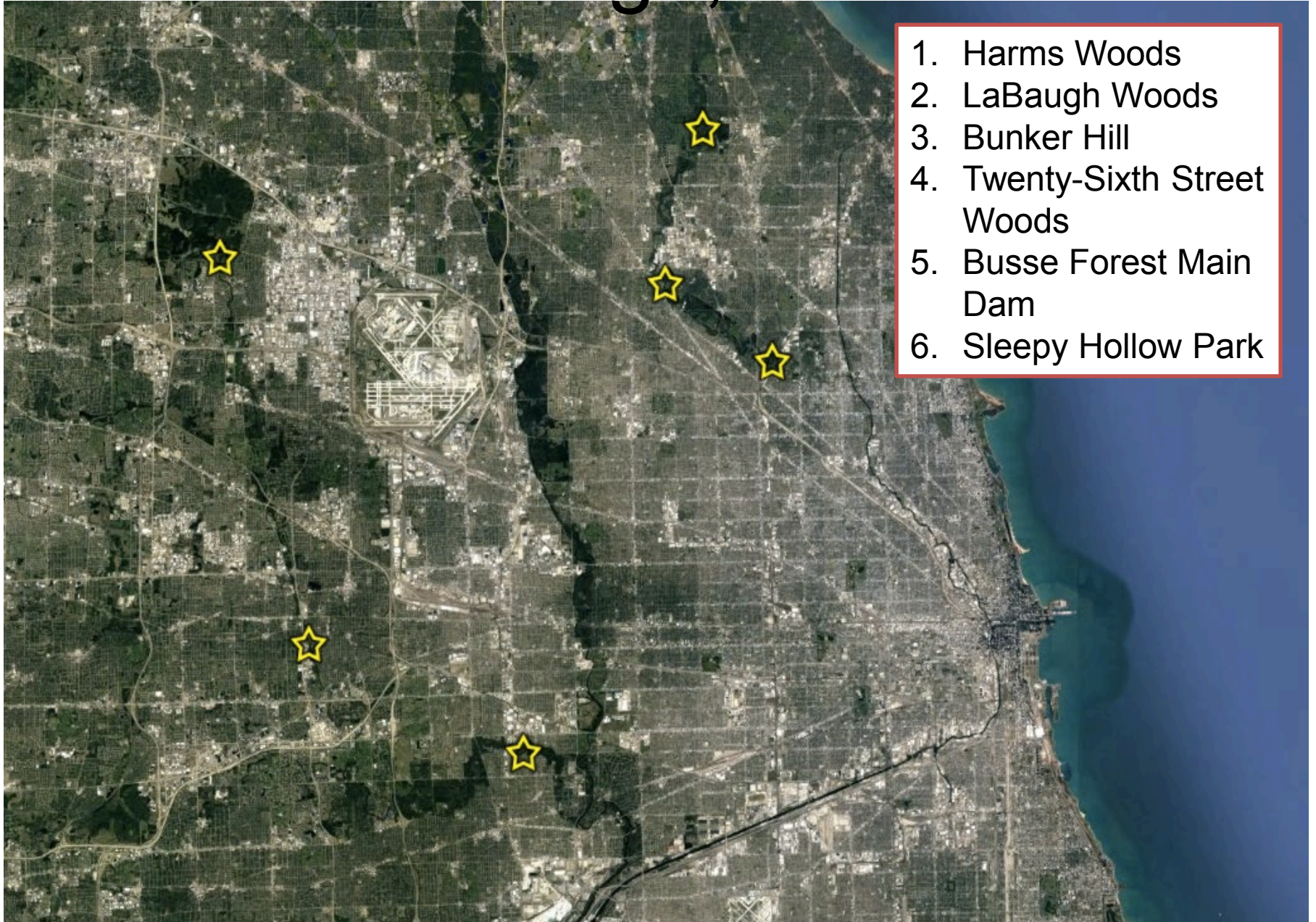






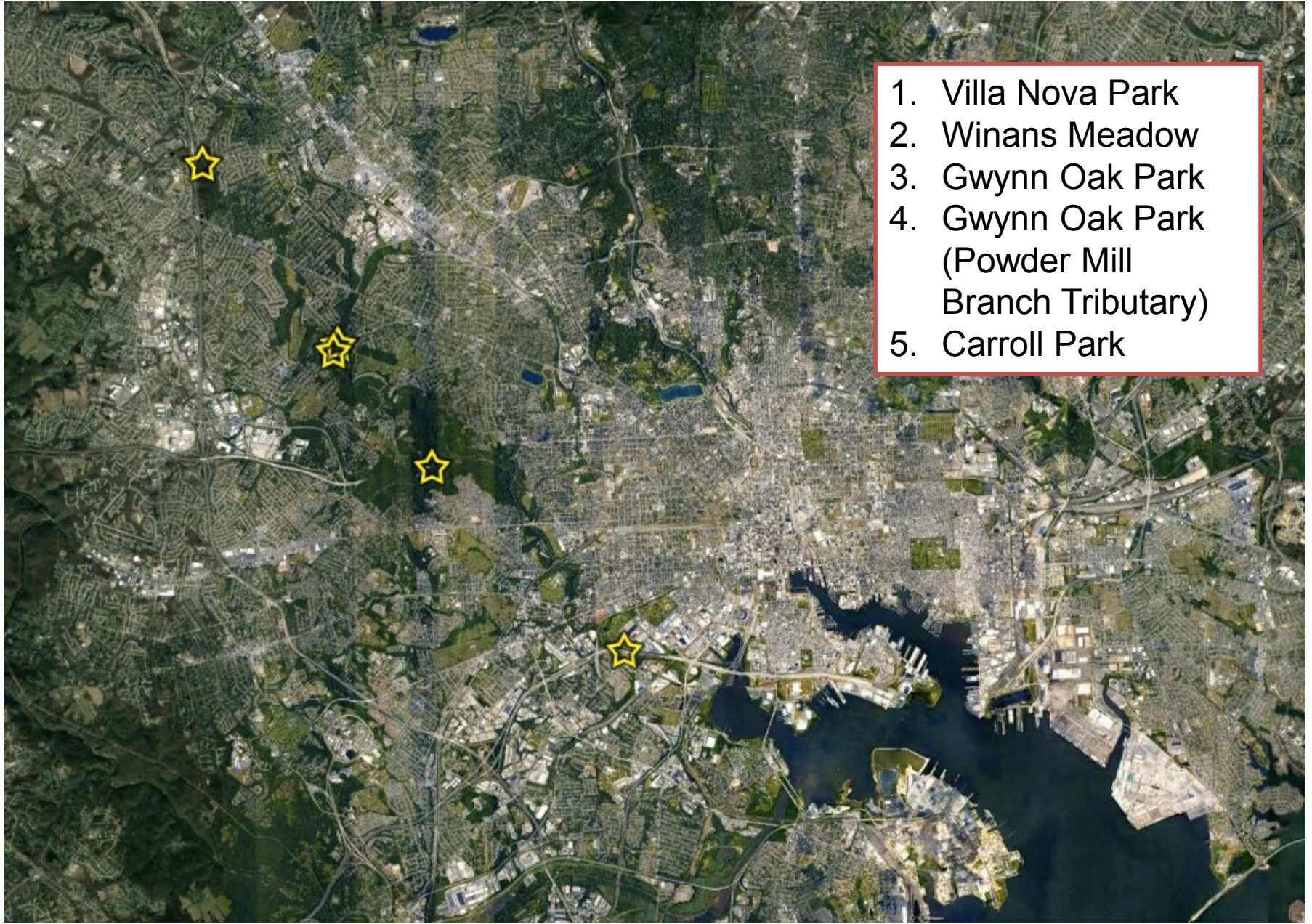
[Link to video clip](#)

Chicago, IL



1. Harms Woods
2. LaBaugh Woods
3. Bunker Hill
4. Twenty-Sixth Street Woods
5. Busse Forest Main Dam
6. Sleepy Hollow Park

Baltimore, MD



1. Villa Nova Park
2. Winans Meadow
3. Gwynn Oak Park
4. Gwynn Oak Park
(Powder Mill
Branch Tributary)
5. Carroll Park



Before Collection



After Collection

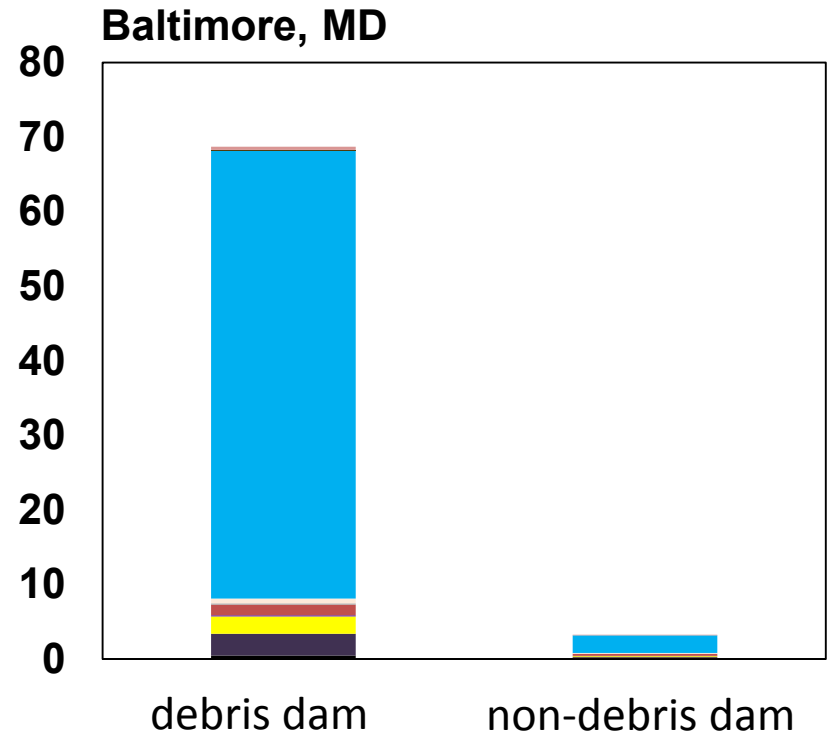
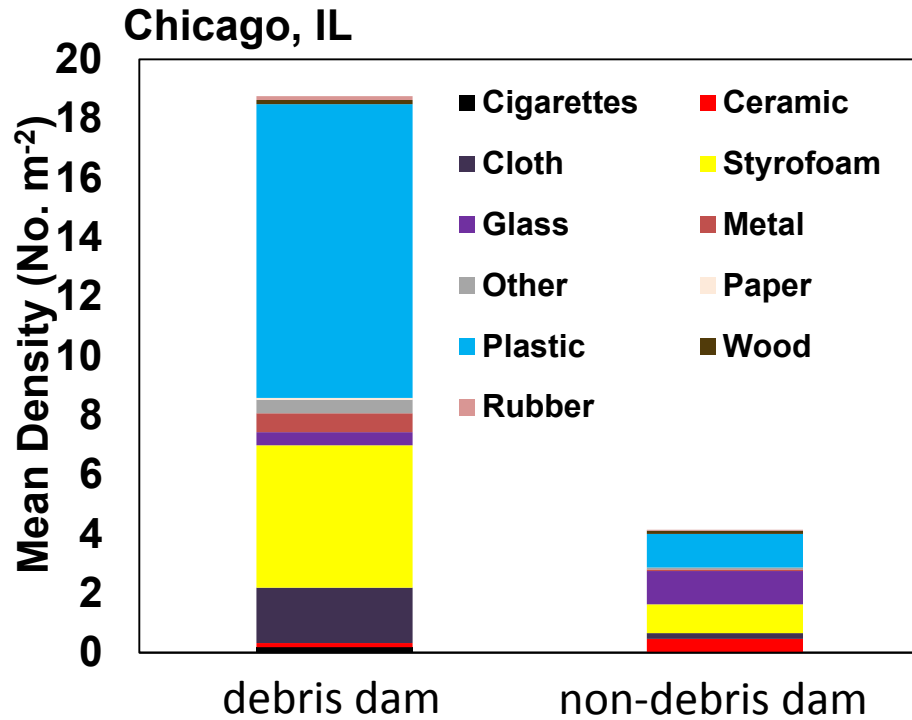


Lisa Kim

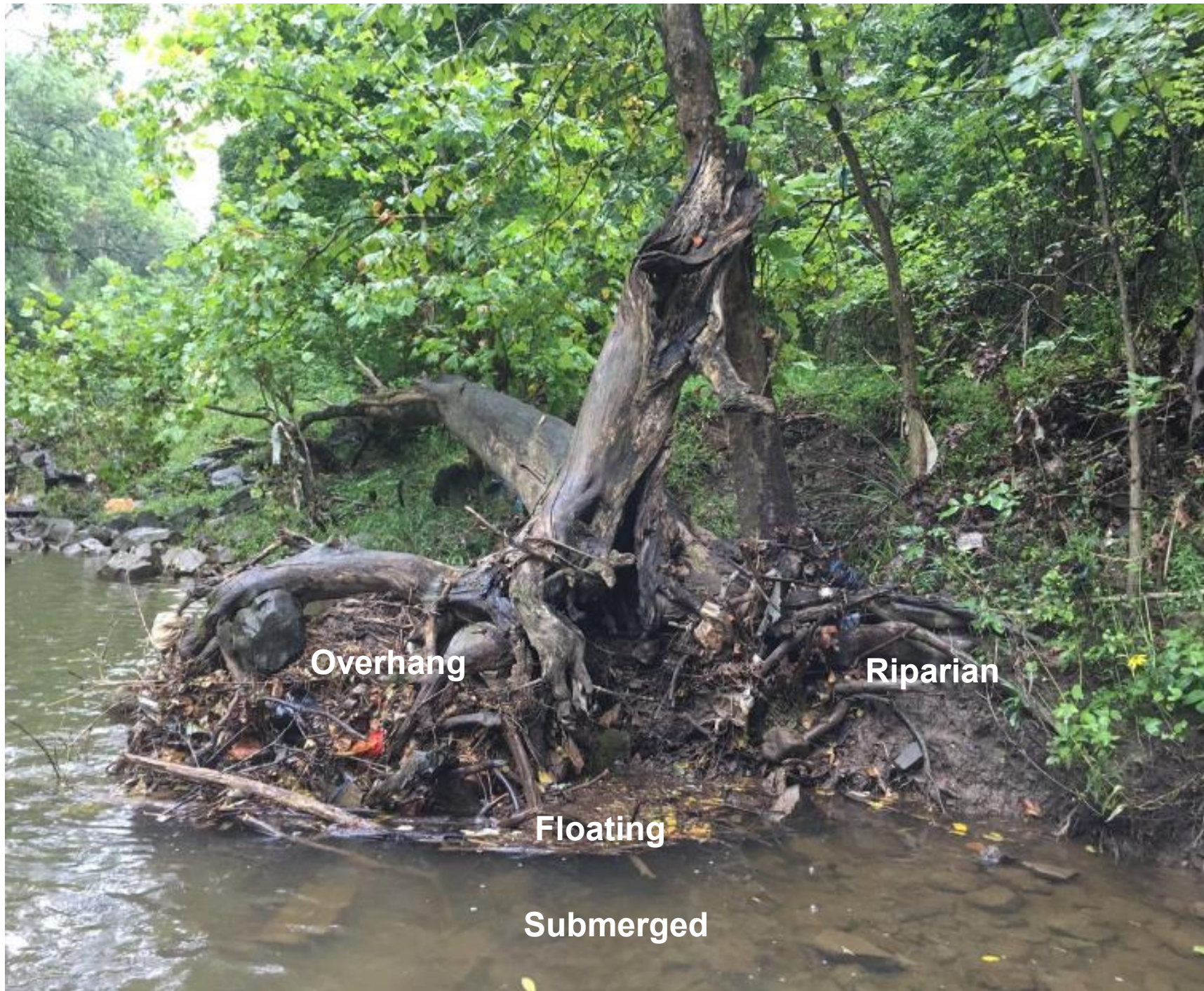
Anna Vincent







Much more litter in debris dams.
Mostly plastic

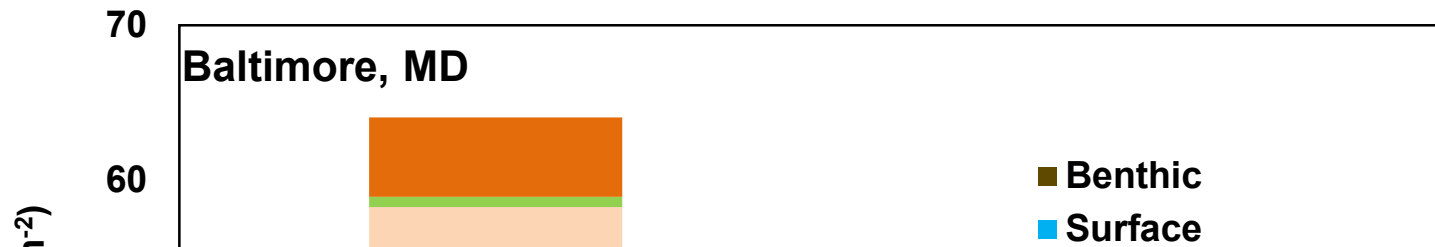


Overhang

Riparian

Floating

Submerged



Overhanging structures trap litter.

Pliability and lightweight plastic -> higher retention in debris dams.

Moves and 'sticks' during floods.





Lisa Kim



Plastic and leaf litter breakdown – biofilm and invertebrate communities

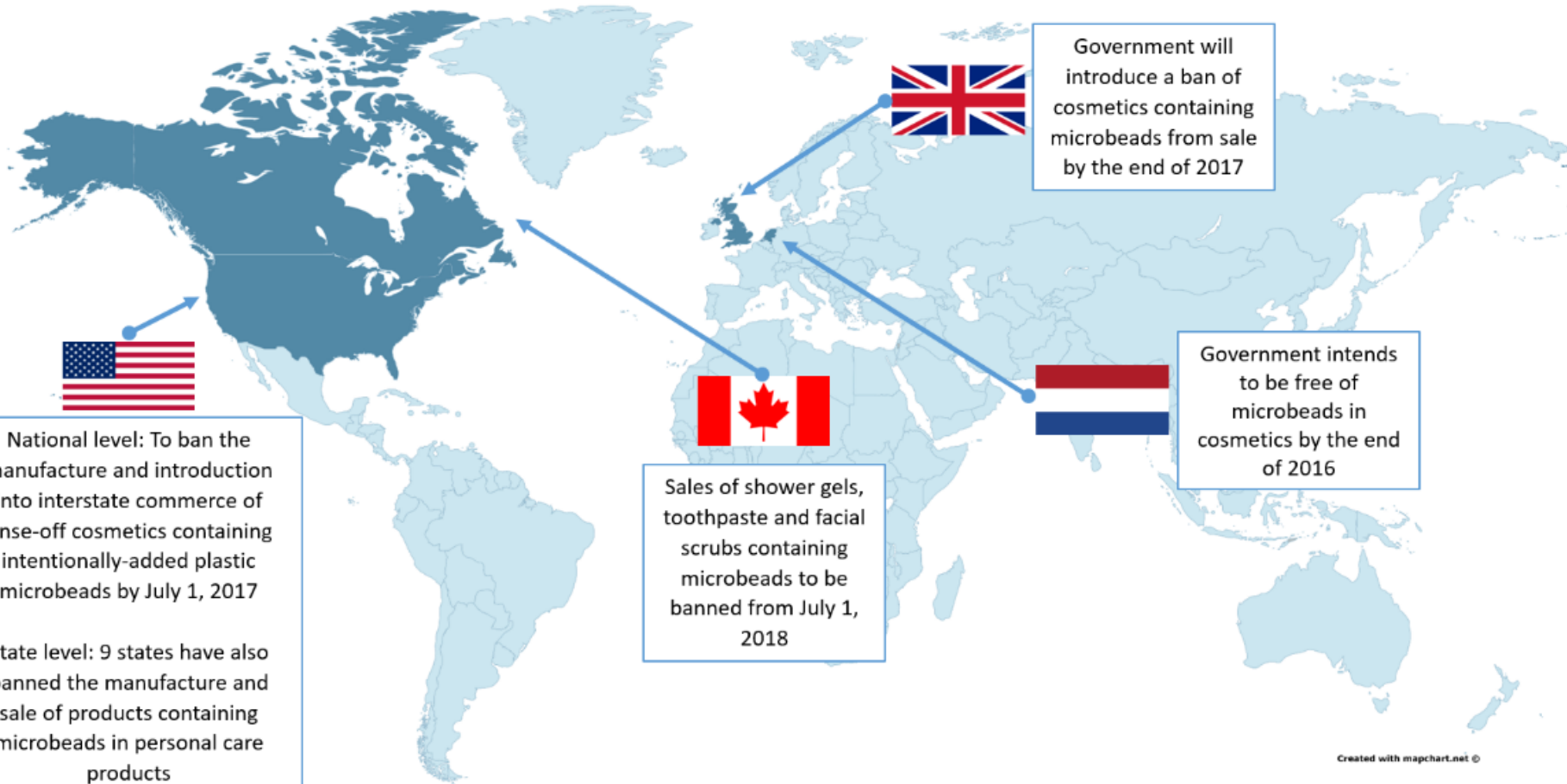
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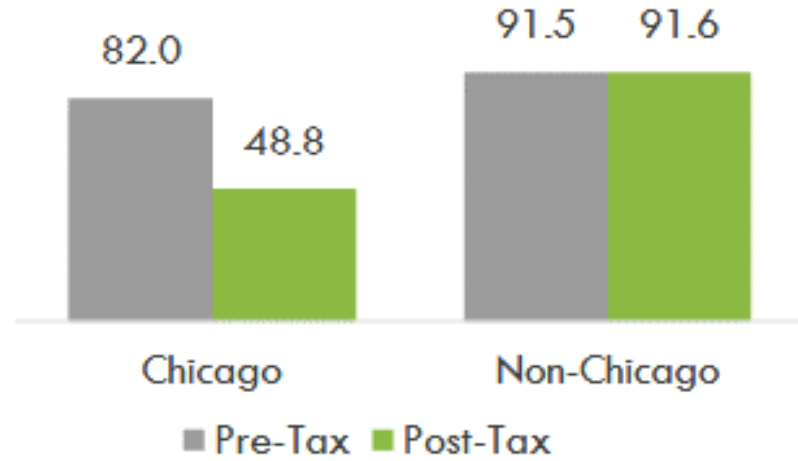
1. Microbeads



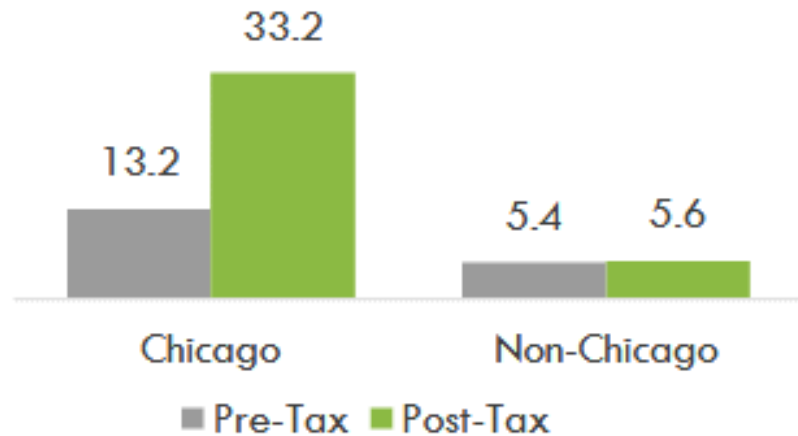
2. Plastic shopping bags



% Customers Using Disposable Bags



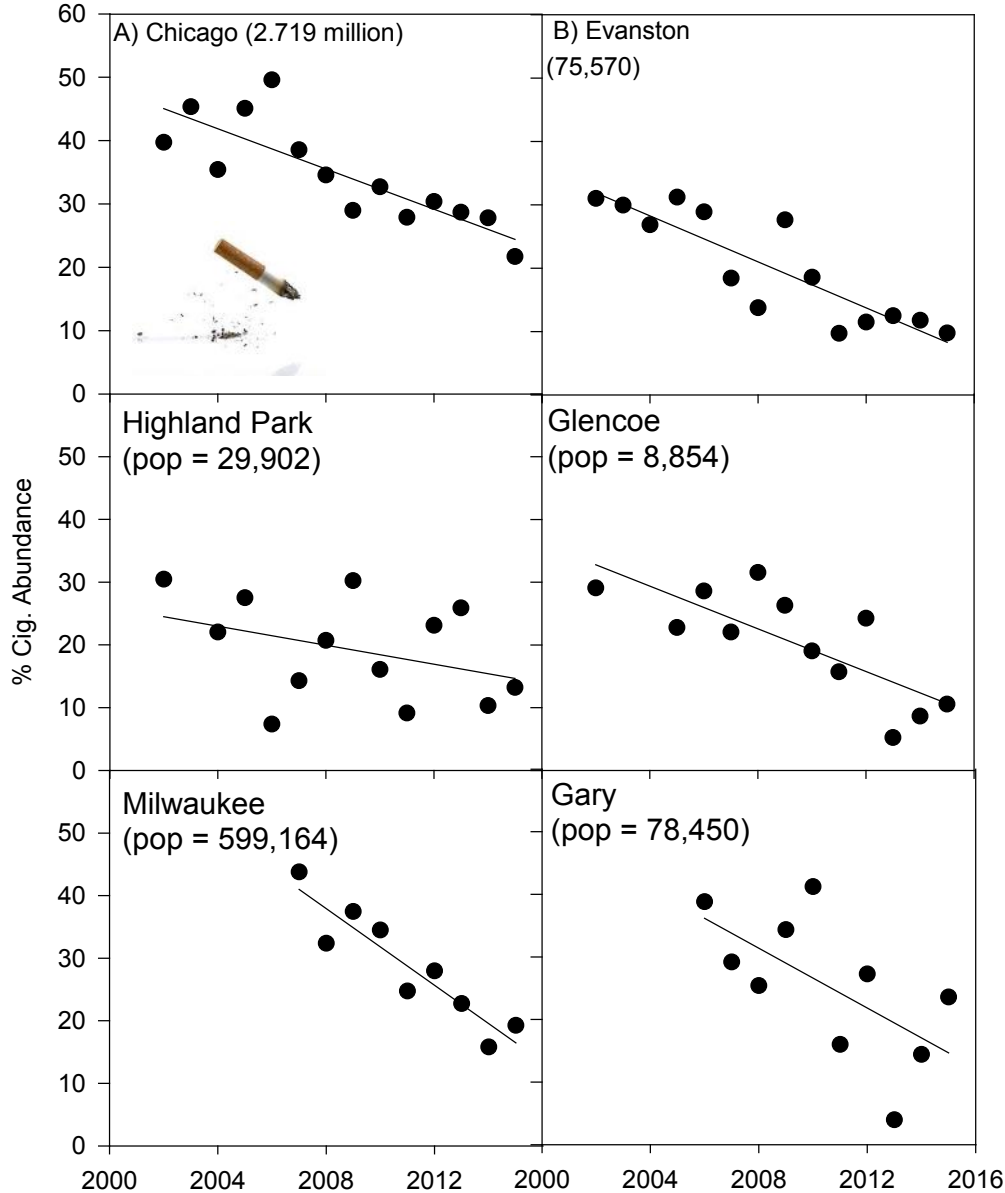
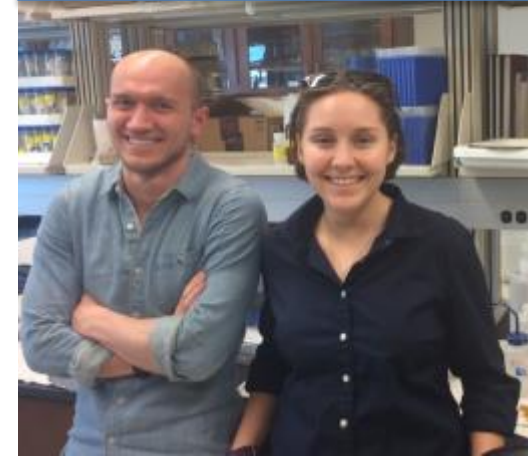
% Customers Using Reusable Bags



3. Cigarettes

Tony Overhiser

Anna Vincent



ALLIANCE *for the*
GREAT LAKES

4. Washing machine water



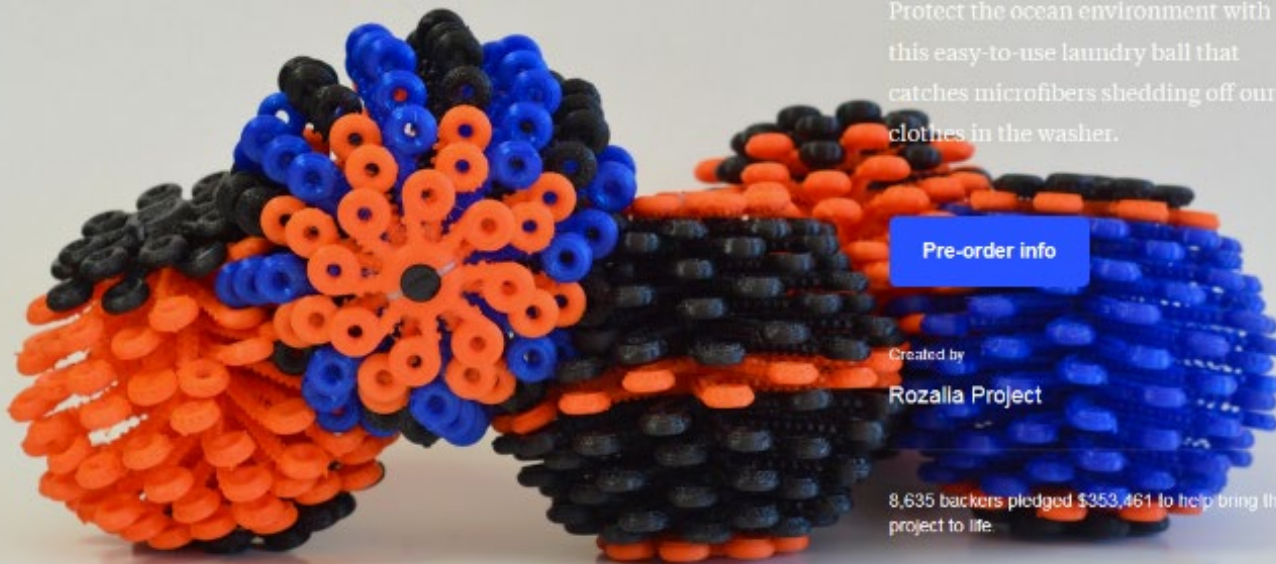
Cora Ball - Microfiber Catching Laundry Ball

Protect the ocean environment with this easy-to-use laundry ball that catches microfibers shedding off our clothes in the washer.

[Pre-order info](#)

Created by
Rozalla Project

8,635 backers pledged \$353,461 to help bring this project to life.



5. Plastic straws

TOP 3 REASONS TO #SheddTheStraw 

The straw in your drink seems small, but all the straws we use add up to a big problem for our oceans, lakes and rivers. These single-use plastics never disappear...and they harm the animals that call our waters home.

f **t** **i** Share your pledge to #SheddTheStraw!
Learn more at sheddaquarium.org/earthday

Shedd AQUARIUM

1 ROUGHLY **19 BILLION POUNDS OF PLASTIC** WIND UP IN THE OCEANS ANNUALLY.

2 BECAUSE STRAWS DON'T BIODEGRADE AND ARE NEARLY IMPOSSIBLE TO RECYCLE, IT'S LIKELY THAT **EVERY STRAW EVER USED** STILL EXISTS ON OUR PLANET.

3 AMERICANS USE AN ESTIMATED **500 MILLION STRAWS A DAY**—ROUGHLY THE SAME WEIGHT AS **1,000 CARS**.



McDonald's to test plastic-straw alternatives in U.S. later this year

Zlati Meyer, USA TODAY

4-5 minutes

CLOSE



A bill proposed in California would make it illegal for restaurant servers to give guests plastic straws unless requested — with the threat of a \$1,000 fine or jail time attached. Buzz60



6. Institutional policies

ASSOCIATION
OF ZOOS &
AQUARIUMS

[JOBS](#) [FIND A ZOO OR AQUARIUM](#) [CALENDAR](#) [DONATE](#)

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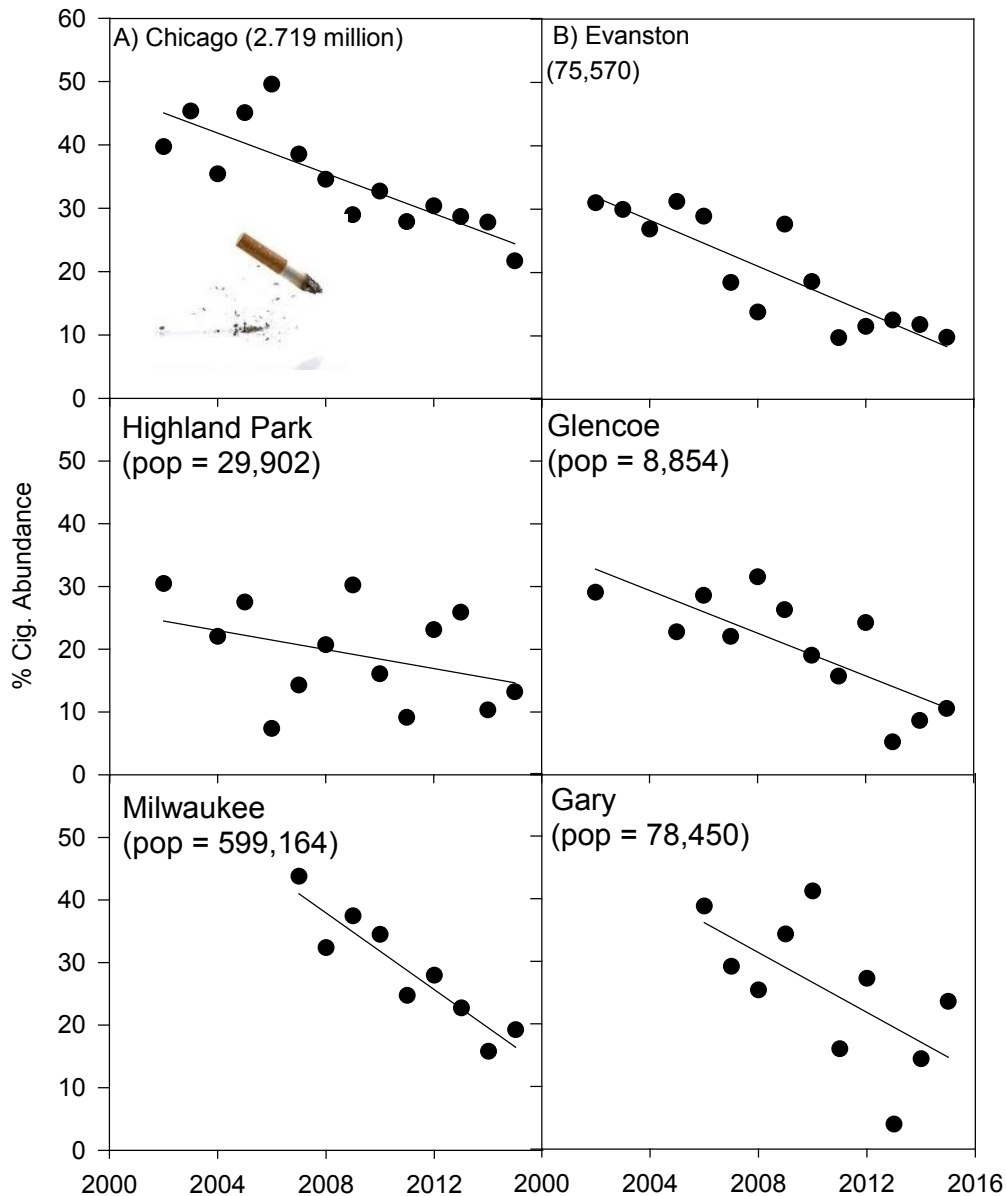
[AZA SERVICES](#)



Parting With Plastics

MARCH 2017

7. Community Engagement

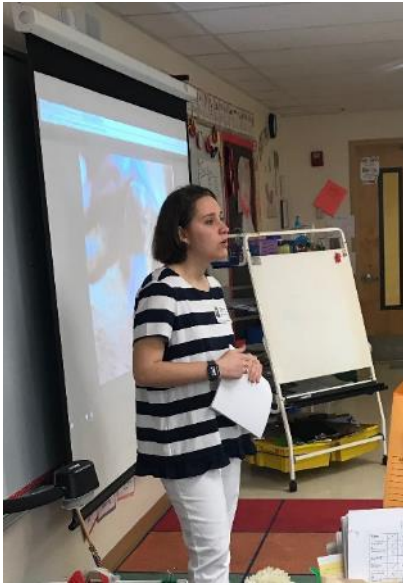


[Home](#) > [Get Involved](#) > [Adopt-a-Beach](#)

Adopt-a-Beach™

Working together to protect the Great Lakes through clean-ups and community projects.

8. Education

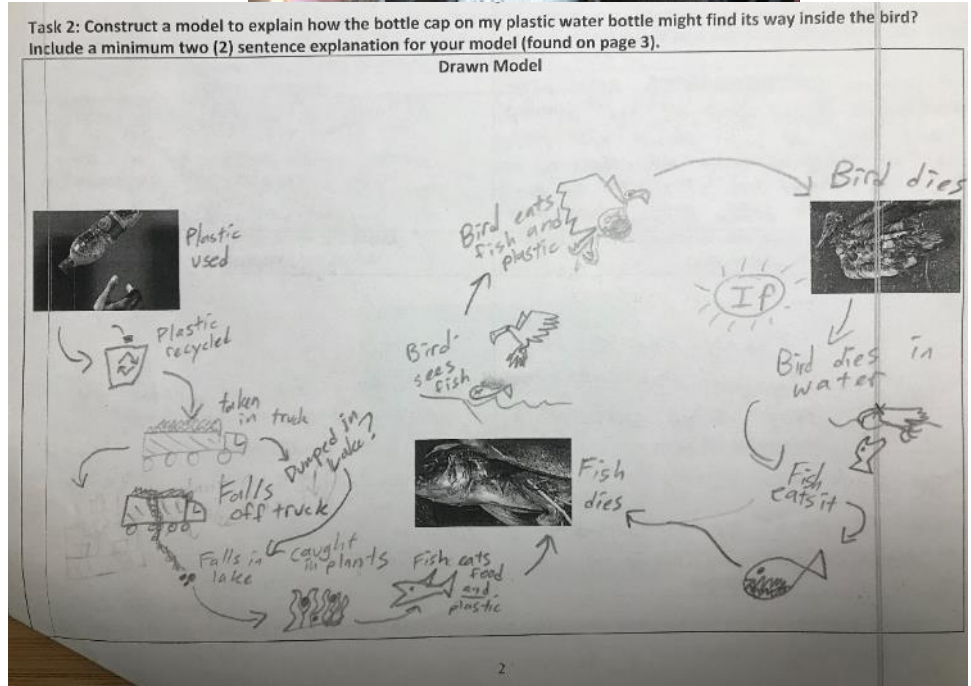


Anna Vincent

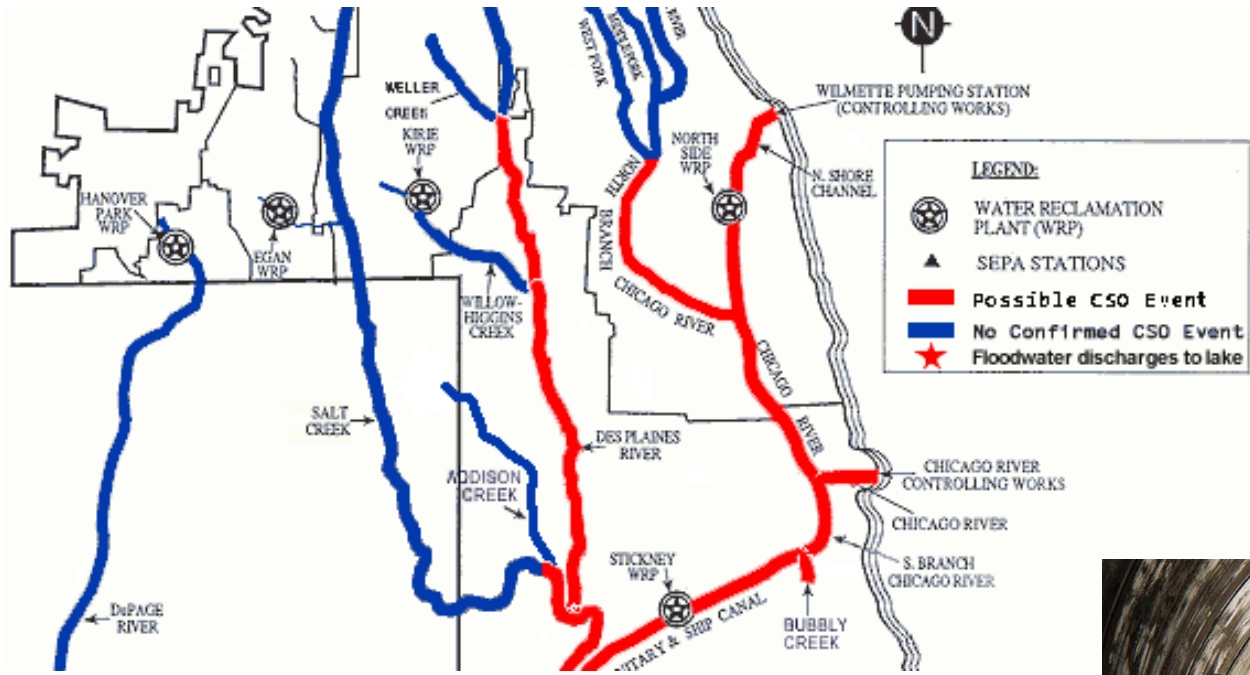


Micah Zaker

How do you know where the garbage is?



9. Infrastructure



Thank you MWRD,
regional citizens,
governments



TRASH HEAP

a large, matronly, sentient compost heap
"I'm orange peel, I'm coffee grounds,
I'm wisdom!"

motifake.com



Many sources, many solutions

We all contribute to pollution.
All are welcome and valued in
contributing to solutions

Education, engagement, and
change is possible with
optimism and inclusivity

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Loyola Undergraduate Students:

- Paul Risteca
- Anna Vincent
- Randy Cybulski
- Loren Hou
- Aye-Aye Myint
- Genesis Bustamante
- Veronica Lourich
- Tony Overhiser
- Melissa Achettu
- Catherine Rovegno
- Deeb Omari
- Nils Hoffman
- Homira Wardak
- Sameer Khan
- Daniella Drapatsky
- Hailey Chan
- Janet Ross
- Mia Wrey
- Stuti Desai
- Alejandra Bravo
- Ricardo Tijerina
- Naiha Sharma
- Rachel Meyer
- Asad Hasan
- Mohammad Baleegh
- Ian Comerford
- Reyan Atassi
- Raul Lazcano
- Hamza Asim
- Omer Quddus
- Taha Saddiqui
- Homira Wardak
- Amy Fetters
- Micah Zaker

Thank you

Senn High School:

- Brandon Cifuentes
- Aamna Siddiqui
- Fatima Ghulam

Loyola Graduate Students:

- Lisa Kim
- Brenainn Turner
- Amanda McCormick
- Anna Vincent
- Loren Hou
- Elizabeth Berg

Post-doctoral Scholars

- Rachel McNeish
- Sam Dunn

Collaborators:

- John Kelly
- Sherri Mason
- John Scott
- Lara Smetana
- Paul Chiarelli
- Jennifer Tank
- Olga Lyandres
- Elie Rivkin
- Abby Barrows
- Caleb McMahan

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