THE UNIVERSITY OF CHICAGO
MARINE BIOLOGICAL LABORATORY

Accumulation of microplastics in the salt marshes of Waquoit Bay

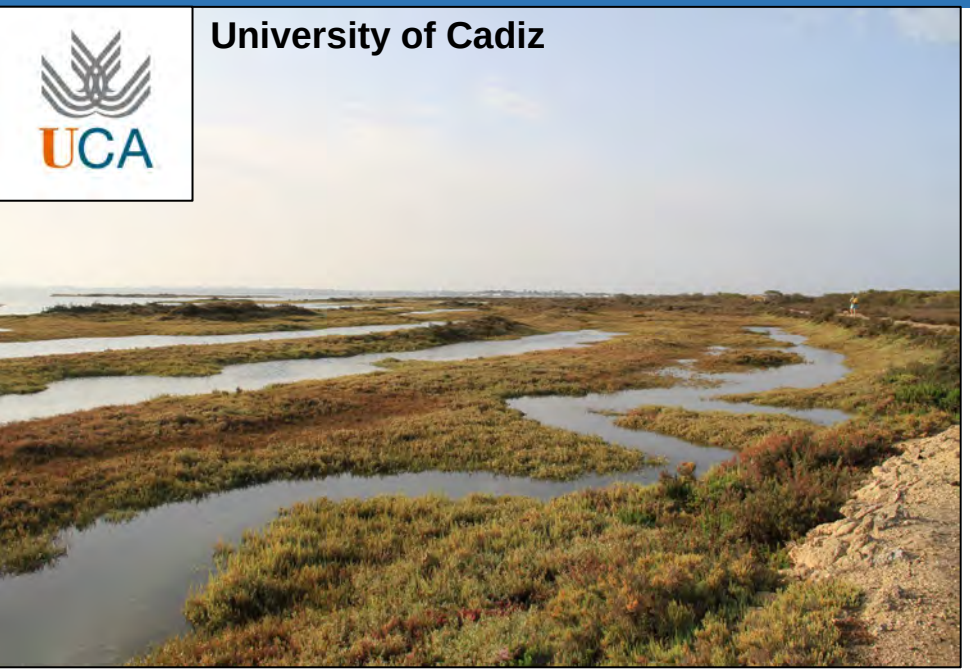
A story of urbanization and plastic waste in Cape Cod

Dr. Javier Lloret, Research Scientist

Marine Biological Laboratory

About me

University of Cadiz



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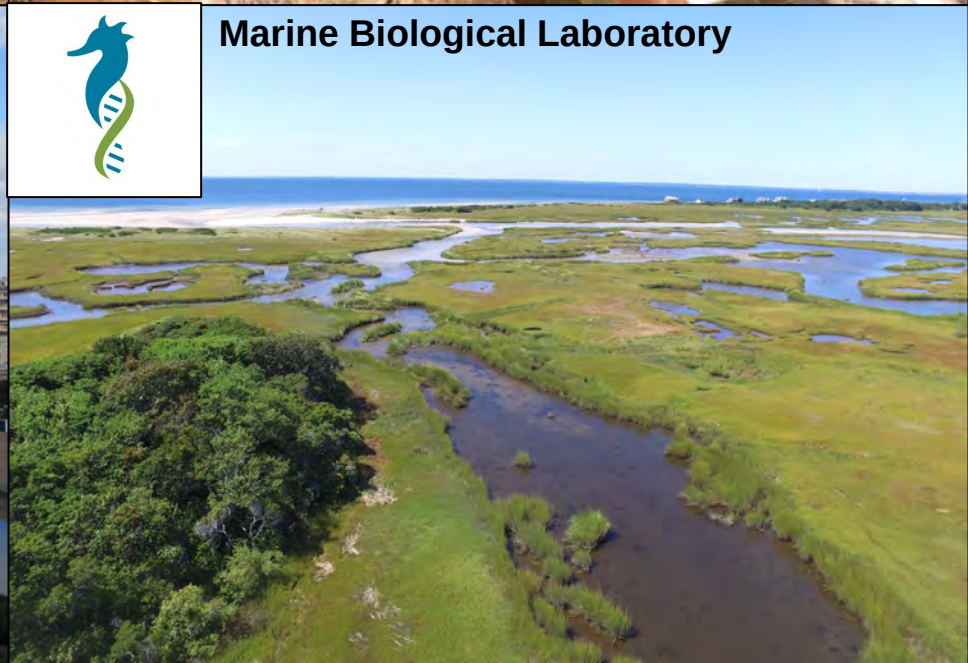
Marine Biological Laboratory



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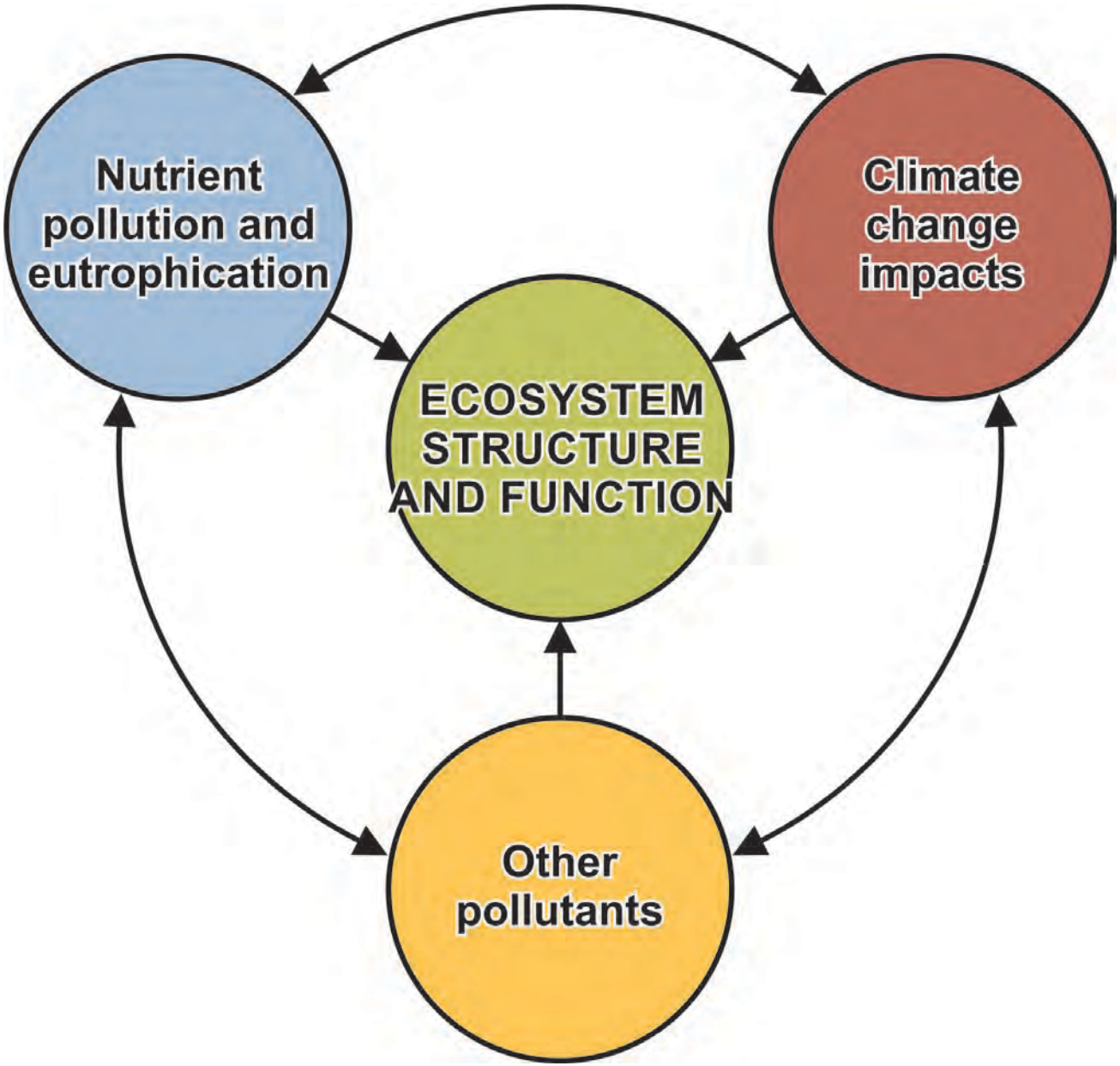
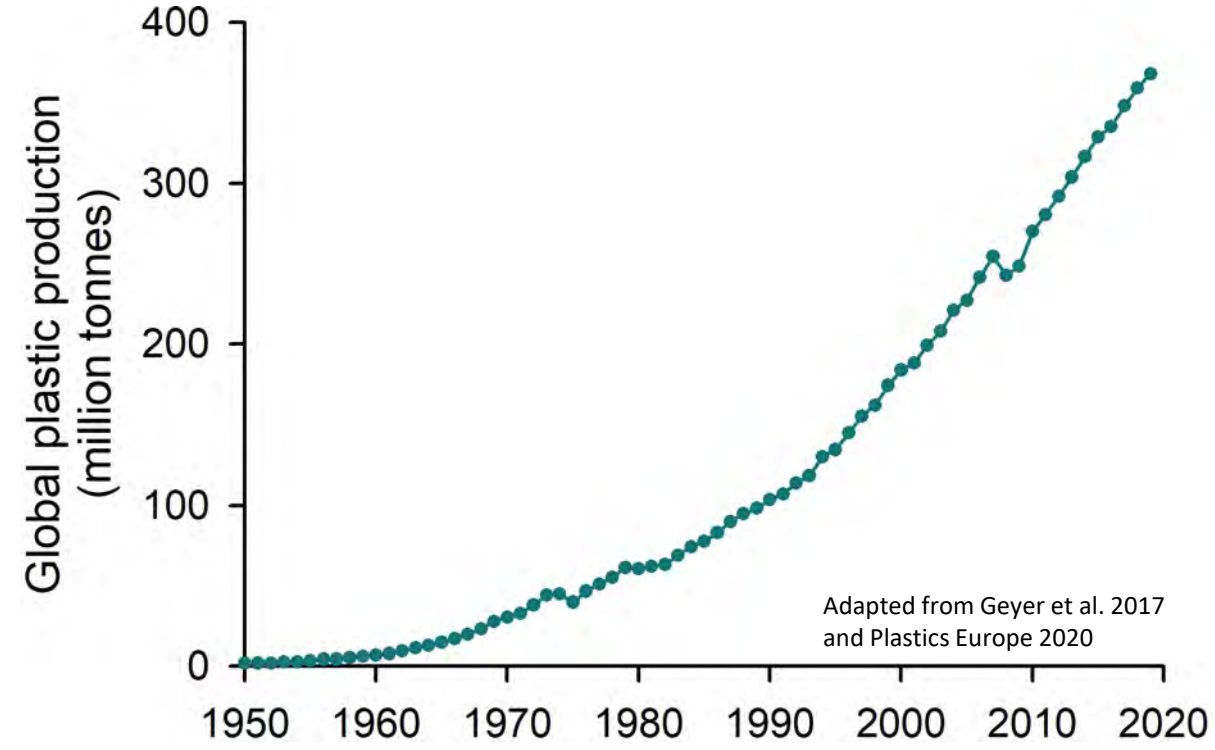

Nutrient pollution and eutrophication
Climate change impacts
ECOSYSTEM STRUCTURE AND FUNCTION
Other pollutants

What are microplastics?



- Since the 1950s, plastic production and use has grown exponentially
- Much of this production ends up in the environment as wastes
- The ocean is the final sink for plastics
- Plastics take hundreds of years to decompose

What are microplastics?

- Large items break up into increasingly smaller pieces
- Microplastics are pieces of less than 5mm in size
- They are everywhere!

Photo credit: Miriam Ritchie

New England salt marshes

Photo credit: Erin VanderJeugdt

New England salt marshes

Provide important ecosystem services:

- Wildlife habitat and fisheries support
- Protection against storms and coastal erosion
- “Blue carbon” sequestration
- Filtering of excess nutrient inputs from land
- Aesthetic value

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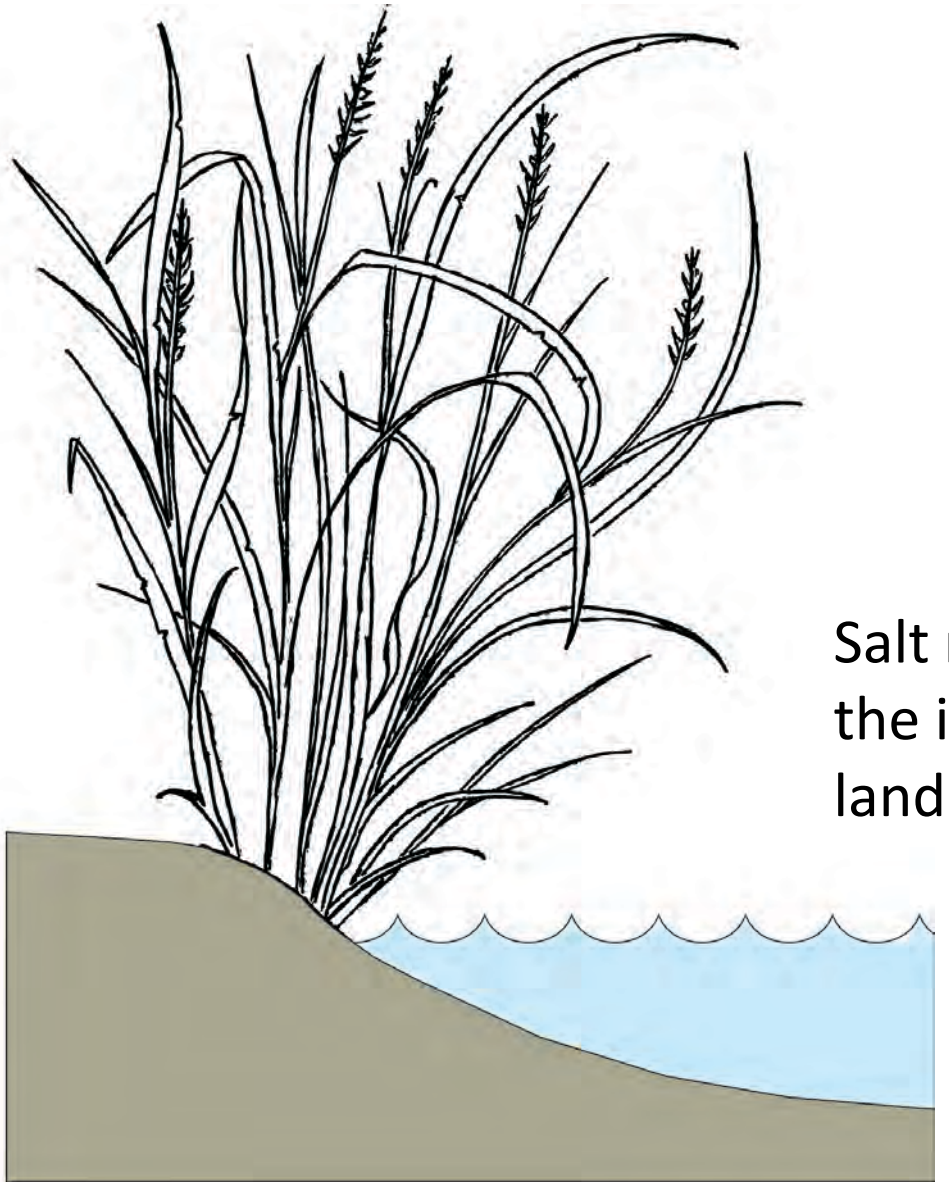
… but are potentially more sensitive to plastic pollution:

- Located between the land and the sea
- Surrounded by densely populated areas
- Many species of plant and animals depend on them
- Highly depositional environments

The questions

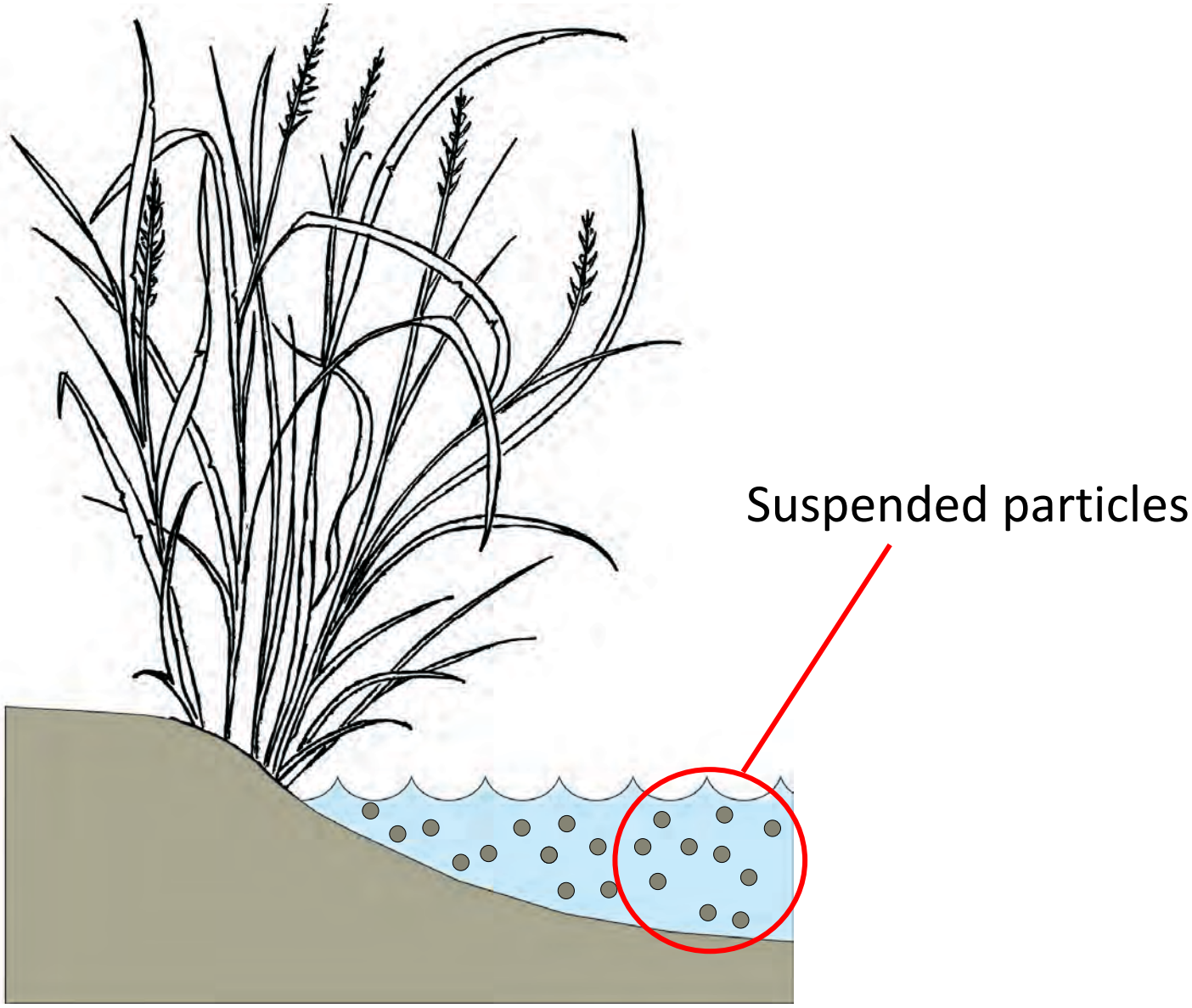
1. Do salt marshes accumulate microplastics?
2. How does the level of urbanization of watersheds affect the amount of microplastics found in salt marshes?
3. How has the historical urbanization of Cape Cod affected the accumulation of microplastics in salt marshes?

Do salt marshes accumulate microplastics?

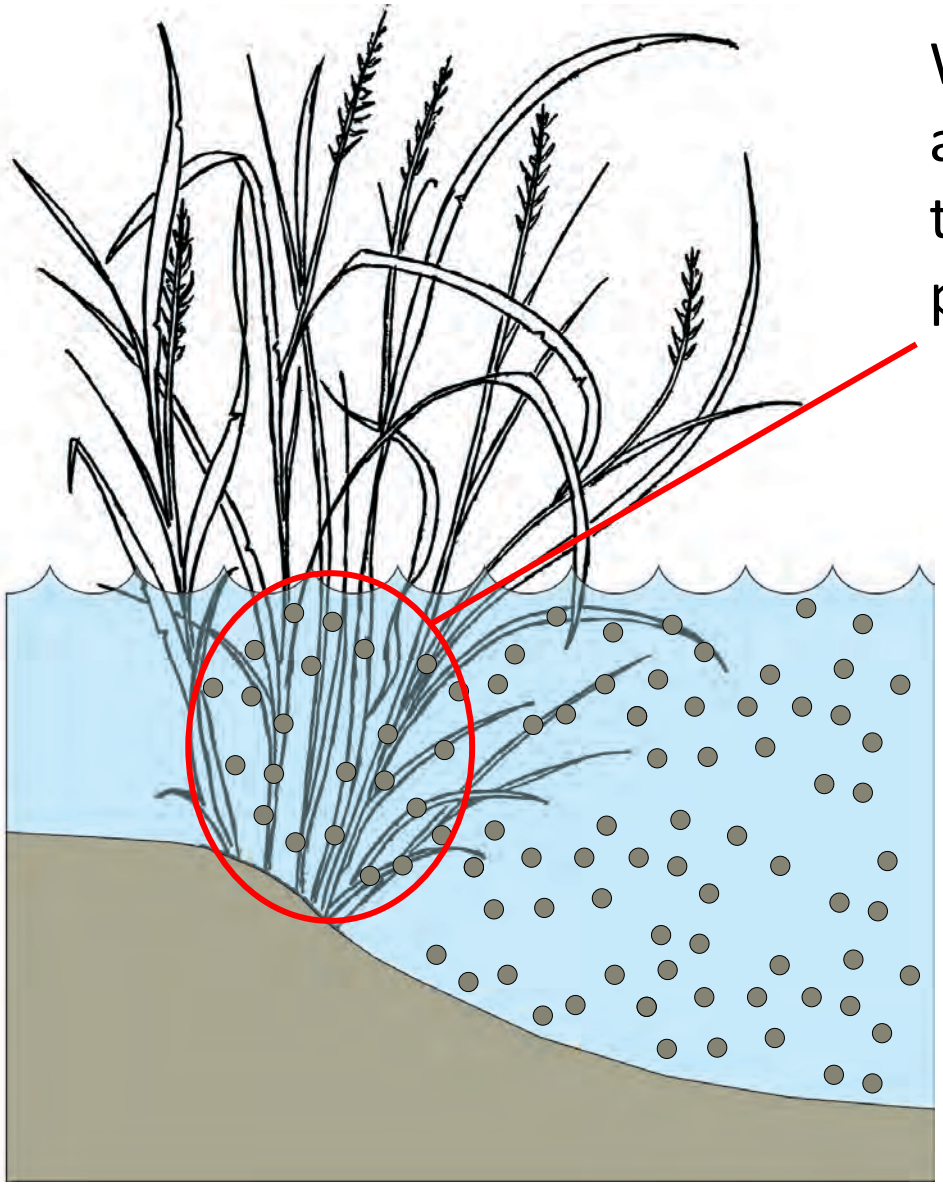


Salt marsh plants live at the interface between land and the sea

Do salt marshes accumulate microplastics?

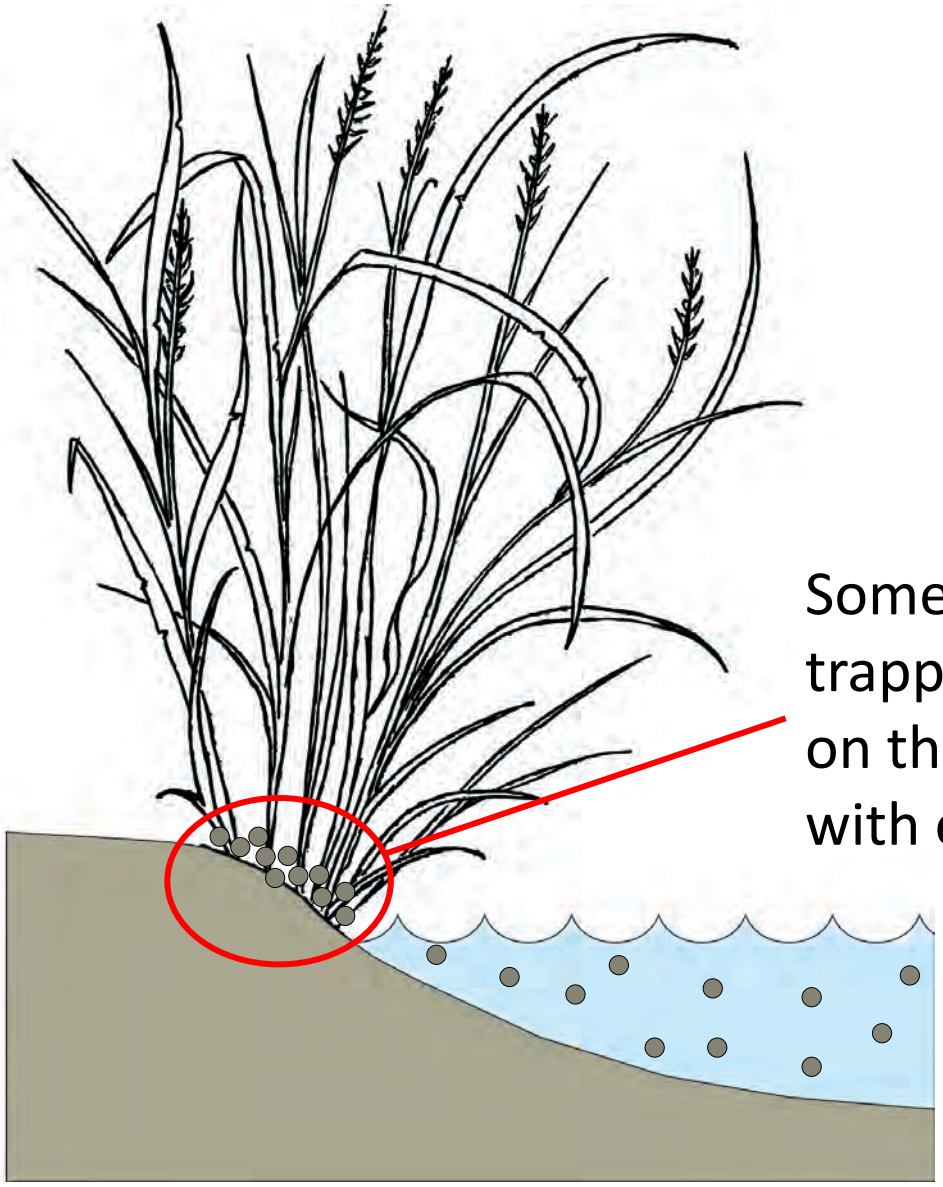


Do salt marshes accumulate microplastics?



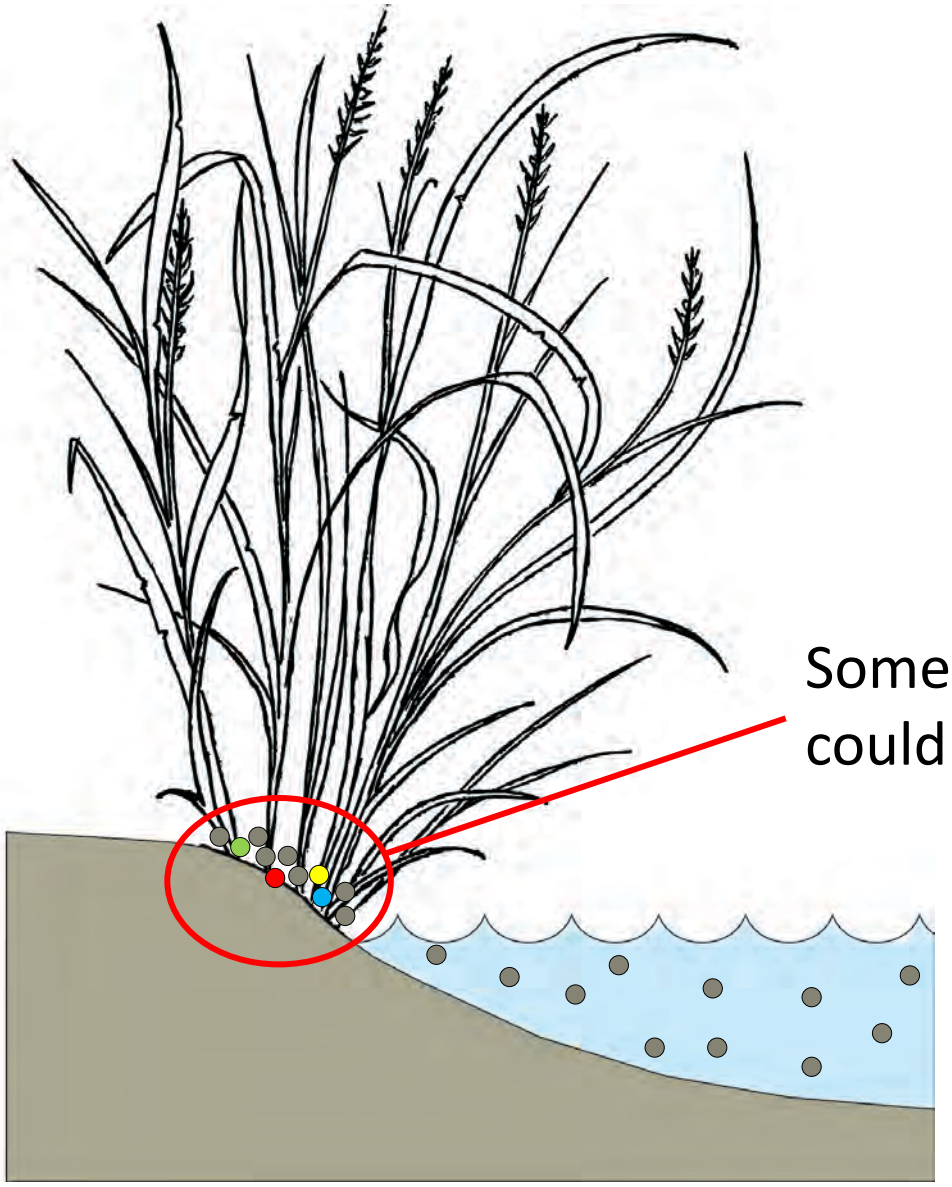
When marsh plants are inundated by the tides they act as particle “traps”

Do salt marshes accumulate microplastics?



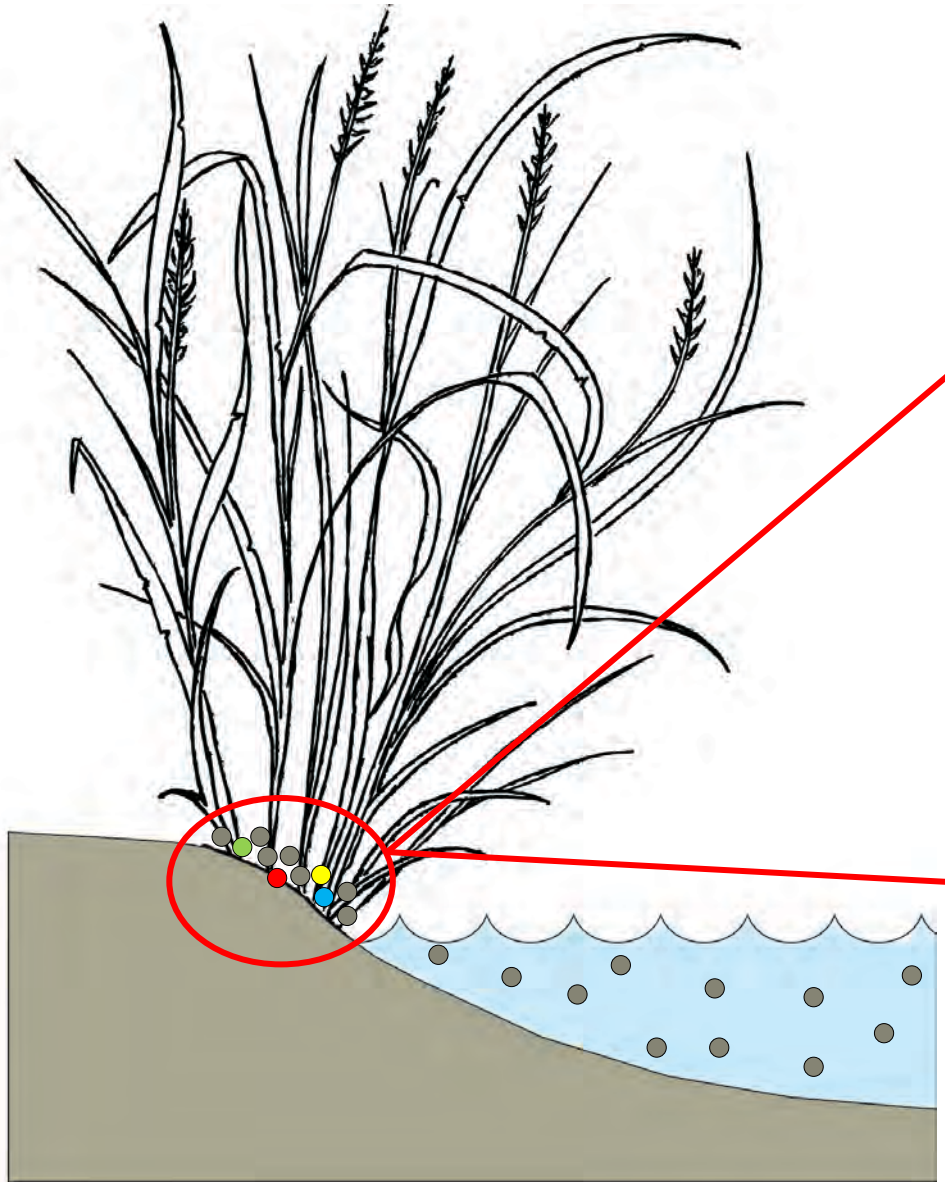
Some particles get trapped and accumulate on the marsh platform with each tide

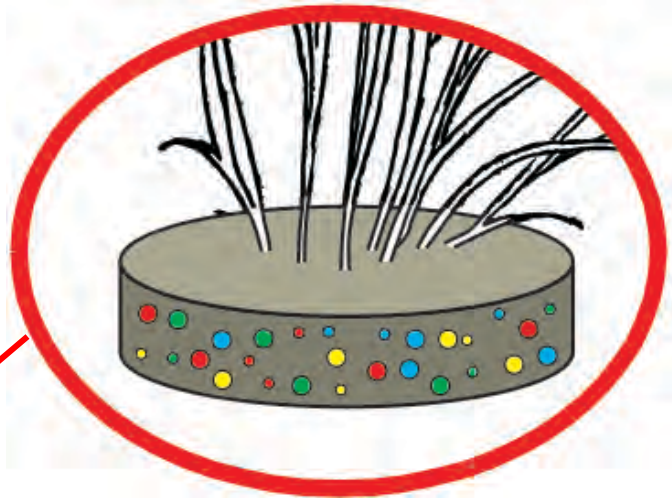
Do salt marshes accumulate microplastics?



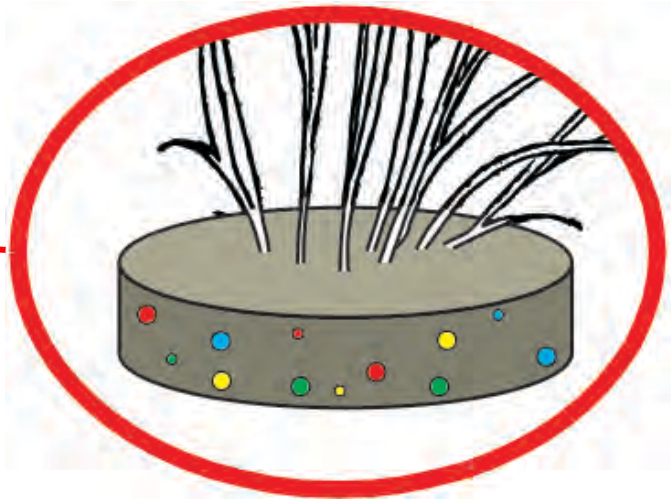
Some of those particles could be microplastics!

Does urbanization affect microplastic accumulations?



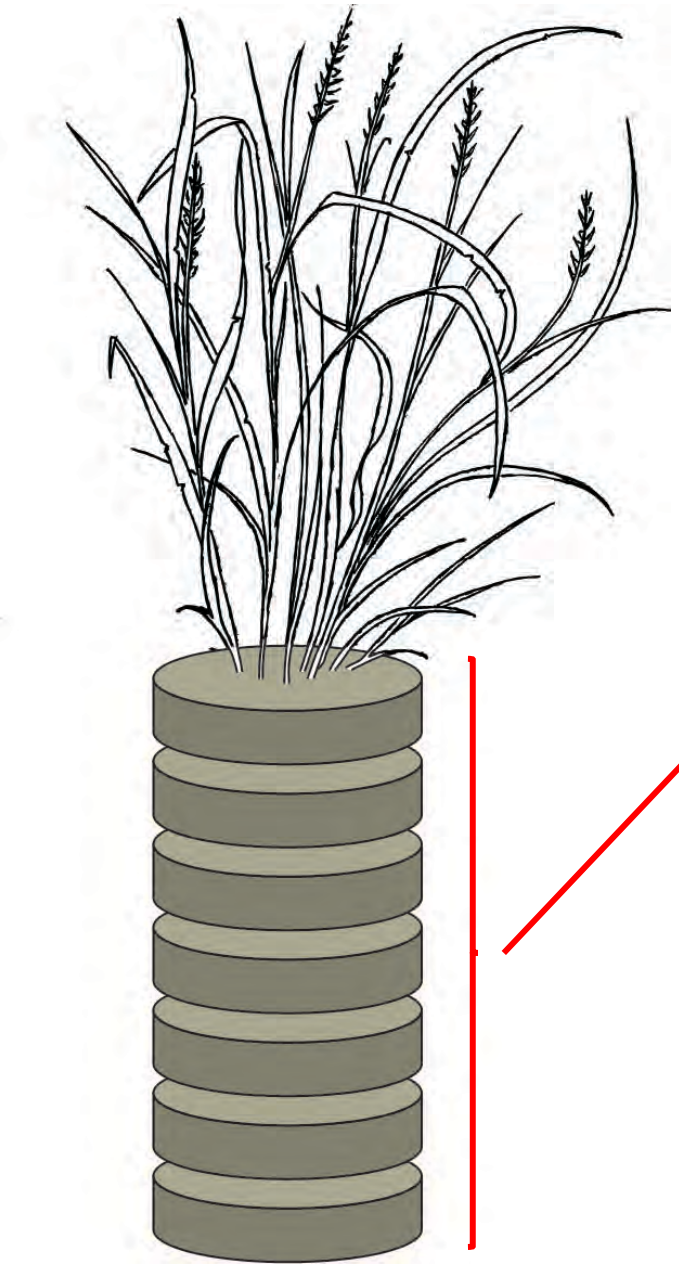


Urbanized area



Non-urbanized area

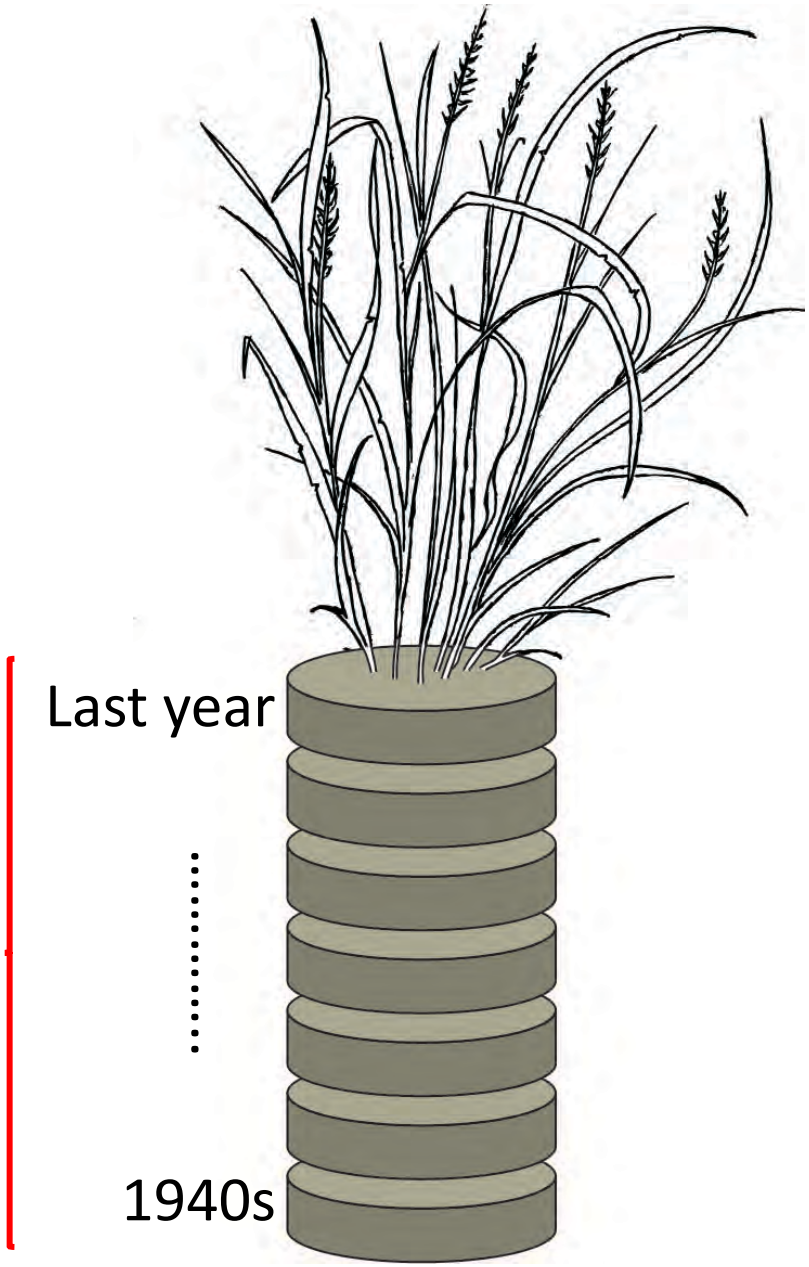
What's the history of microplastics in these marshes?



Salt marshes grow vertically by accumulating layers of sediments and plant material forming peat

What's the history of microplastics in these marshes?

In the lab we can estimate the date of deposition of these layers



What's the history of microplastics in these marshes?

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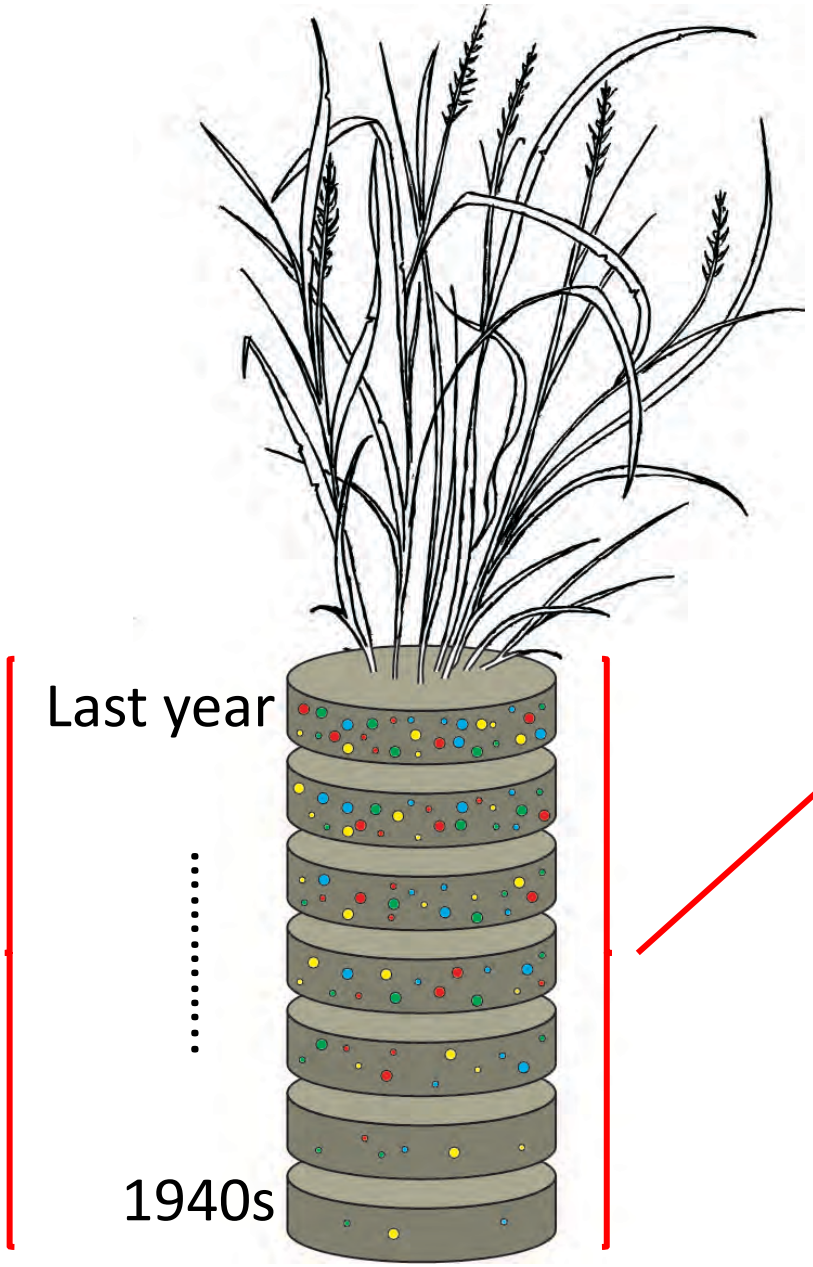
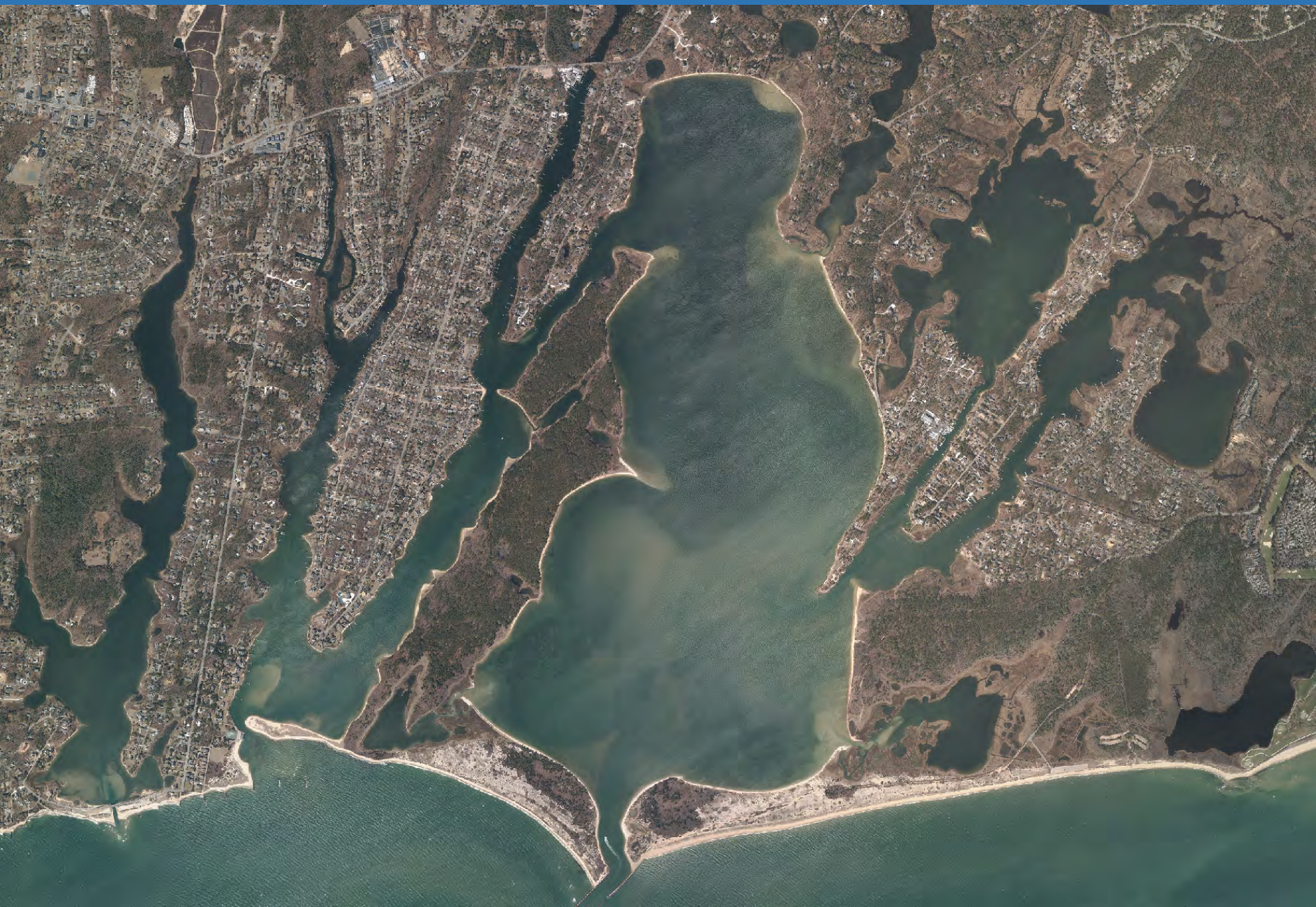
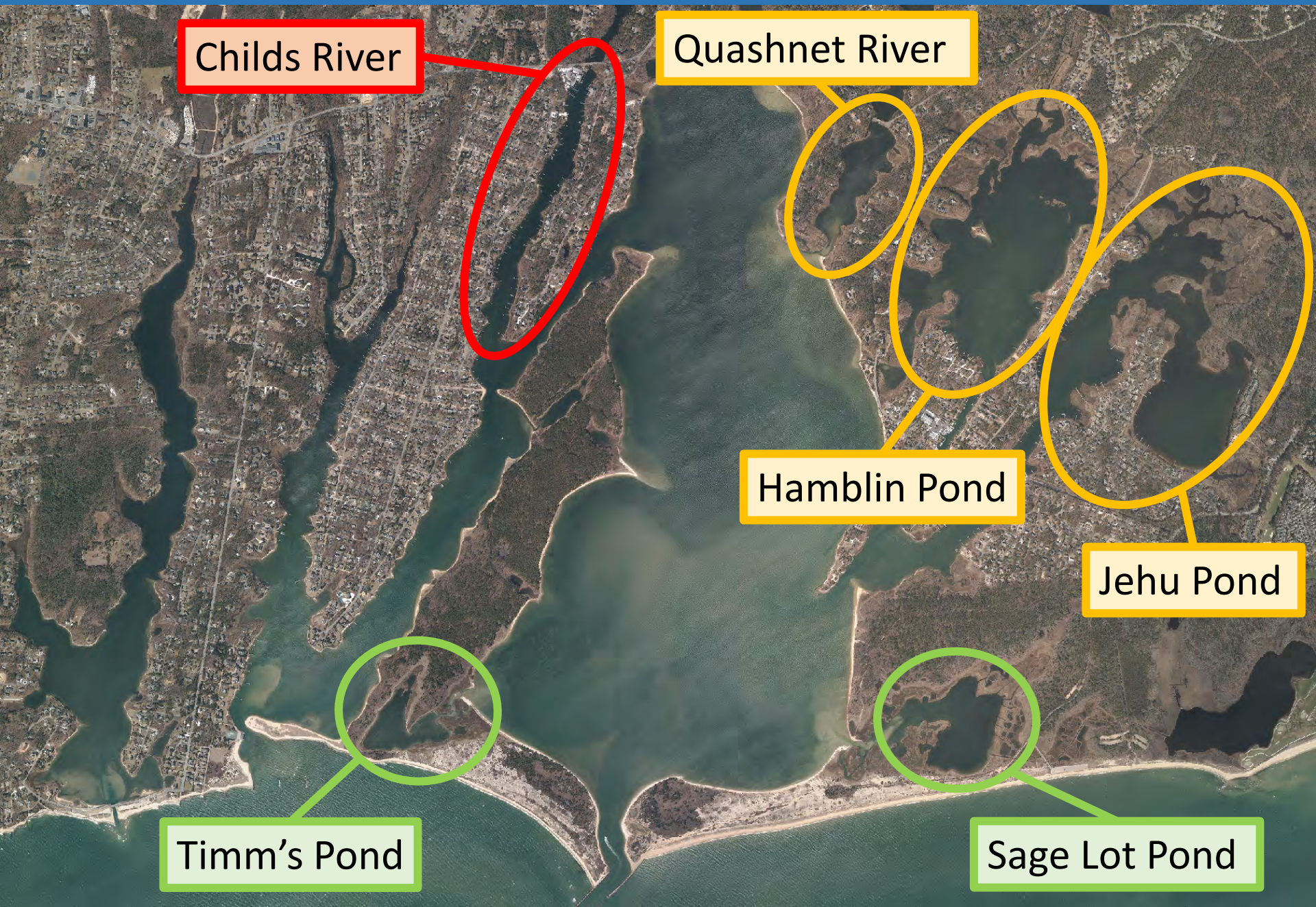


By extracting and analyzing particles in these layers we can reconstruct the history of microplastics in these sediments

The study area



The study area: The effects of urbanization



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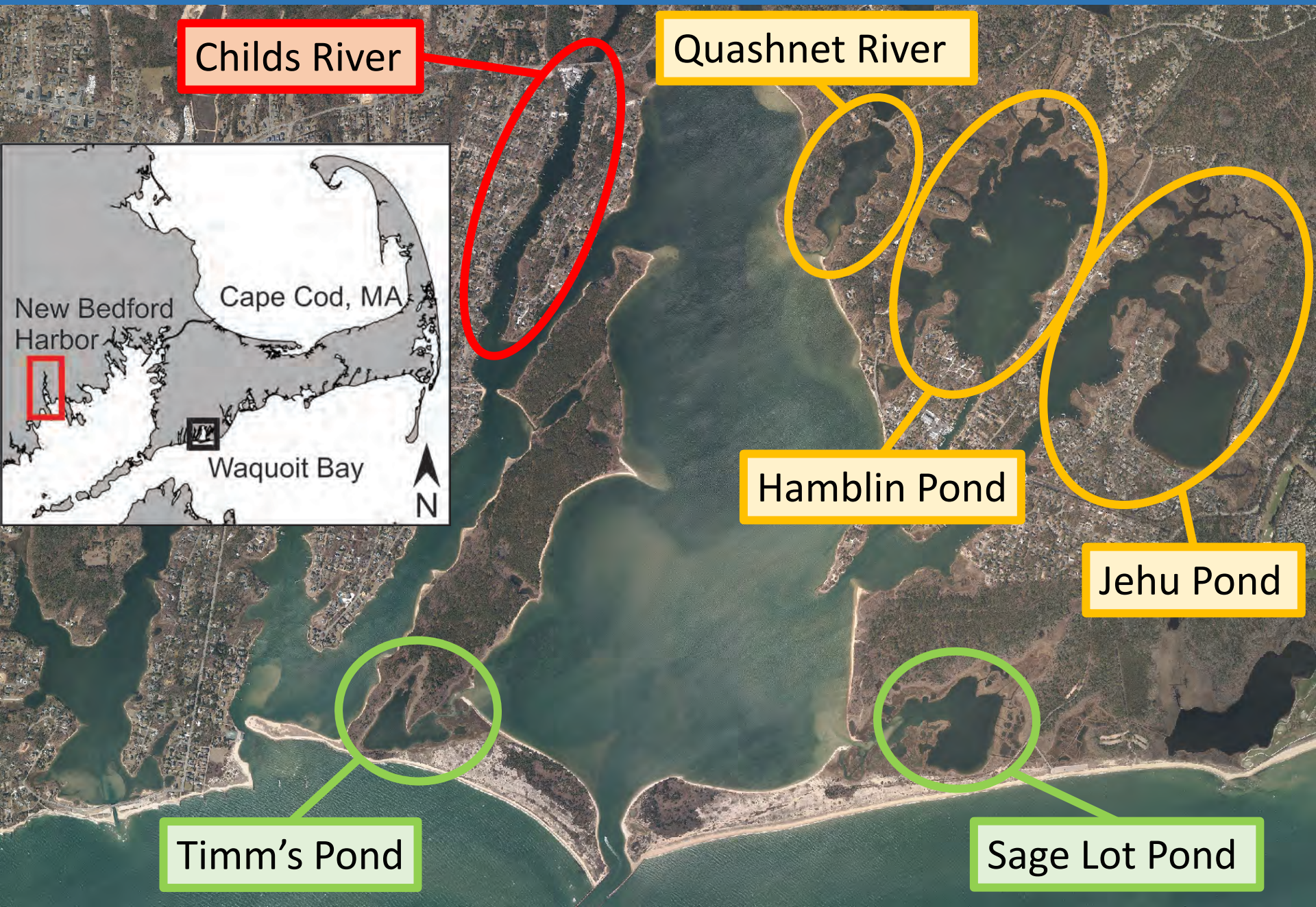


The study area: Different urbanization histories

Sampling salt marshes with students

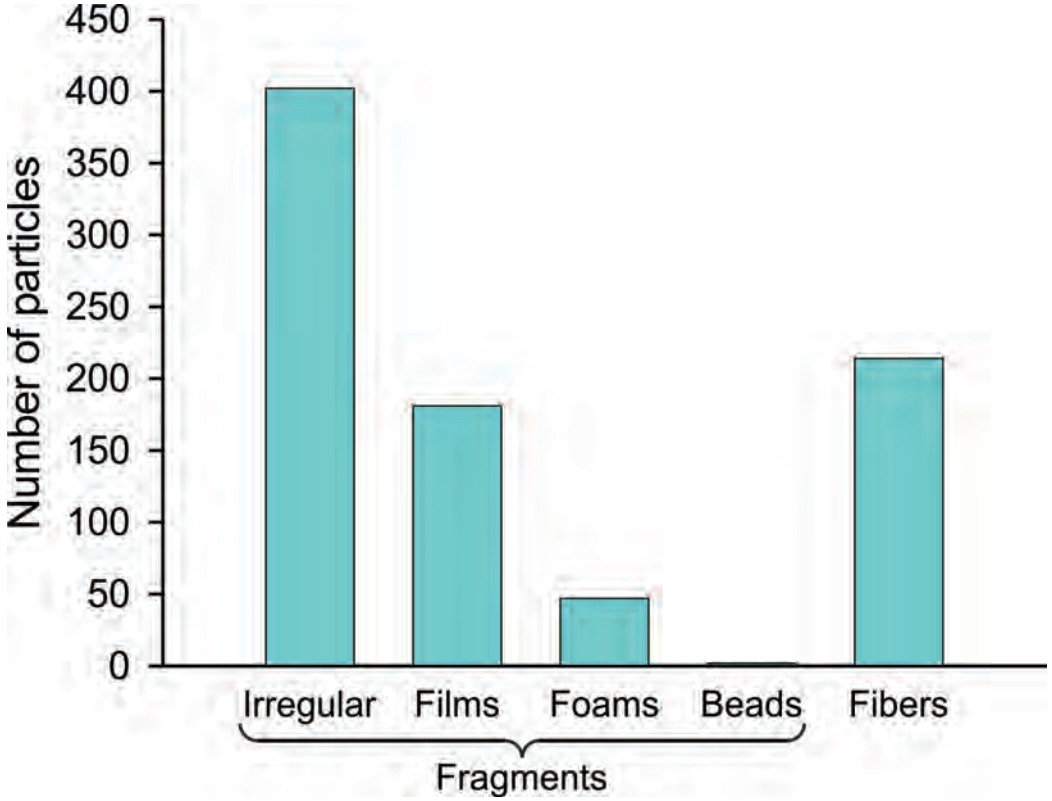

Nicole Vandal


Miriam Ritchie

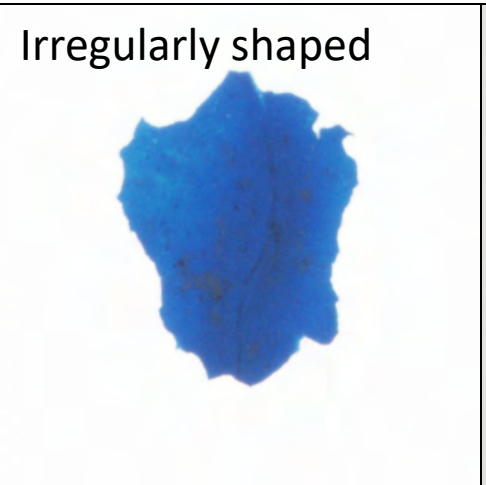

Ruby Rorty with Kelsey Chenoweth

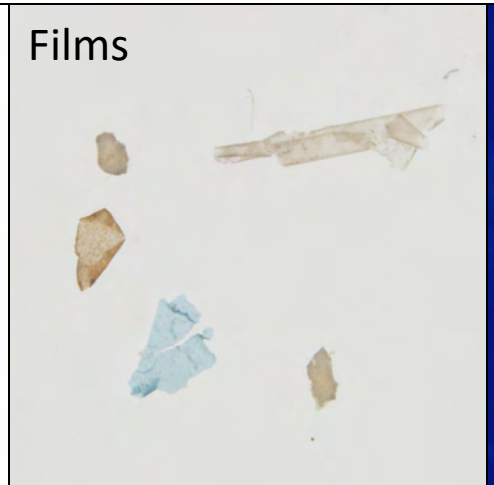

Claire McGuire

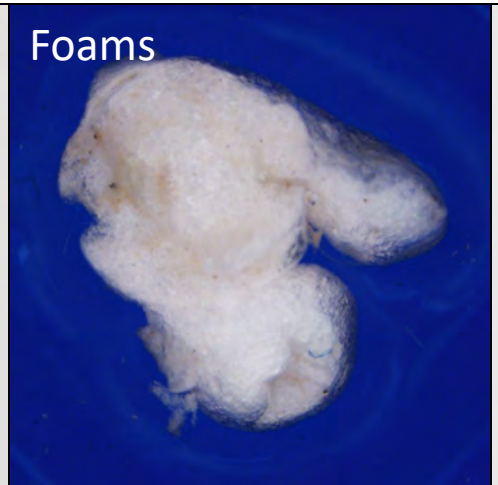
Do salt marshes accumulate microplastics?

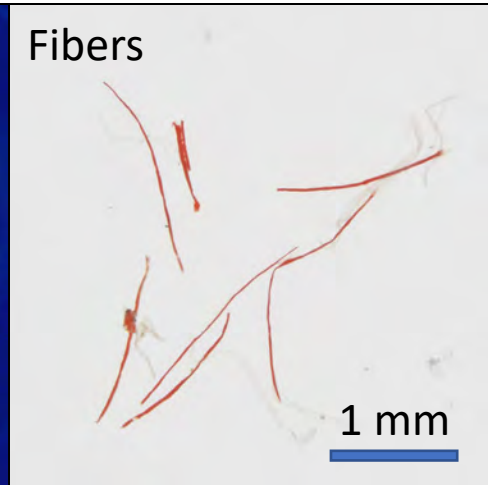


- 846 microplastic particles
- Present in all sampled marshes
- Different shapes, sizes and colors

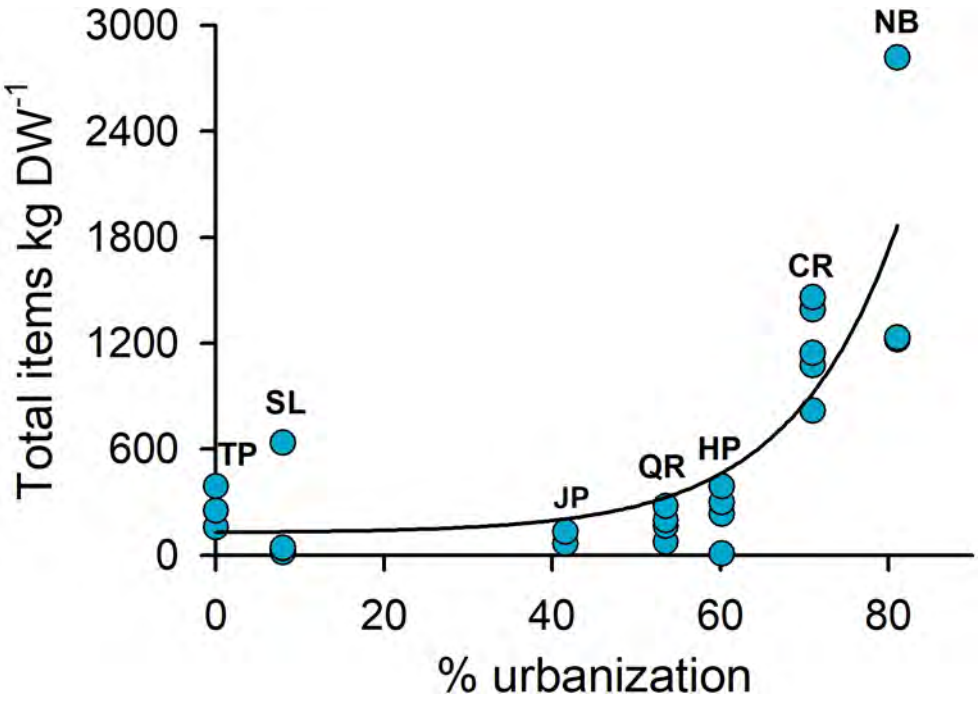






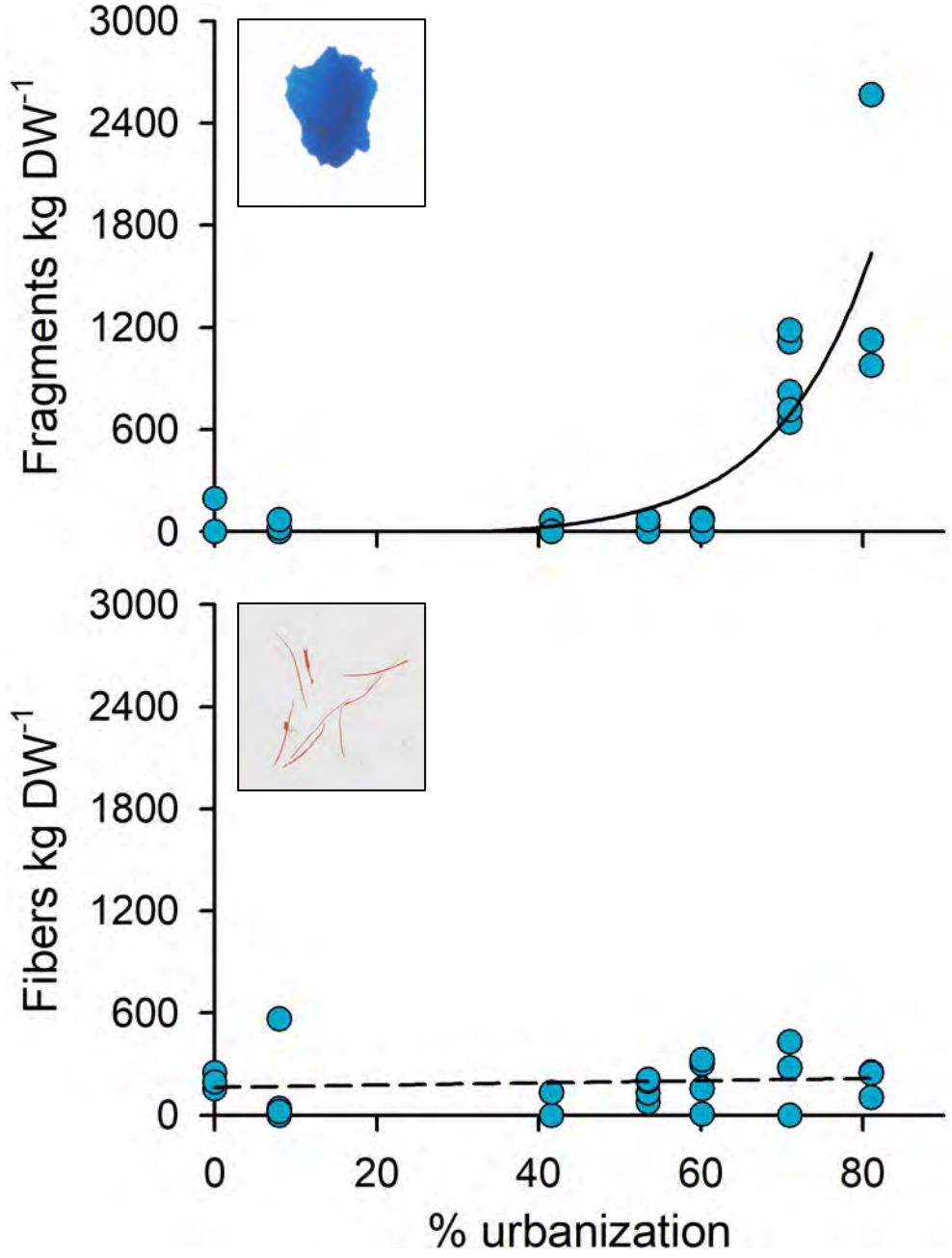


Does urbanization affect microplastic accumulations?



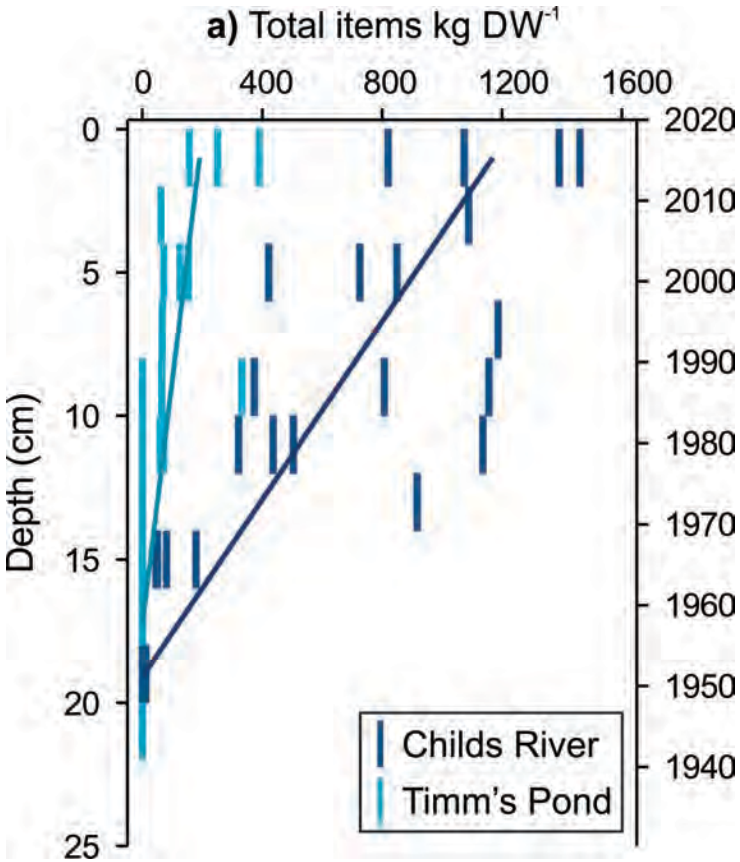
- Microplastic numbers in marsh sediments increased with level of urbanization
- Microplastic abundances increase dramatically after a 50% development threshold.

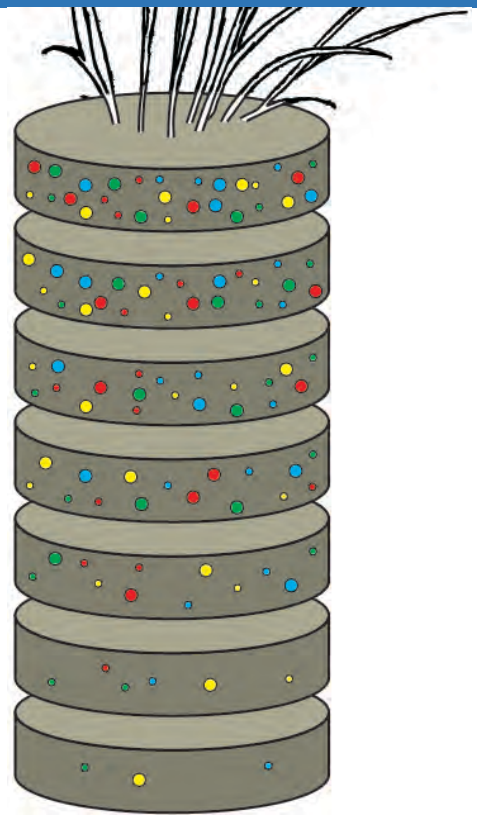
Does urbanization affect microplastic accumulations?



- Microplastic numbers in marsh sediments increased with level of urbanization
- Microplastic abundances increase dramatically after a 50% development threshold.
- Fragments respond to the level of development of the land while fibers do not.
- Fragments have a local origin while fibers come from elsewhere.
- Different origin, transport mechanisms has implications for management

What's the history of microplastics in these marshes?





- The number of microplastics decreased with depth (age) of the sediments and were more abundant in Childs River (urbanized)
- We did not find any microplastics below 20 cm of depth (≃1950)

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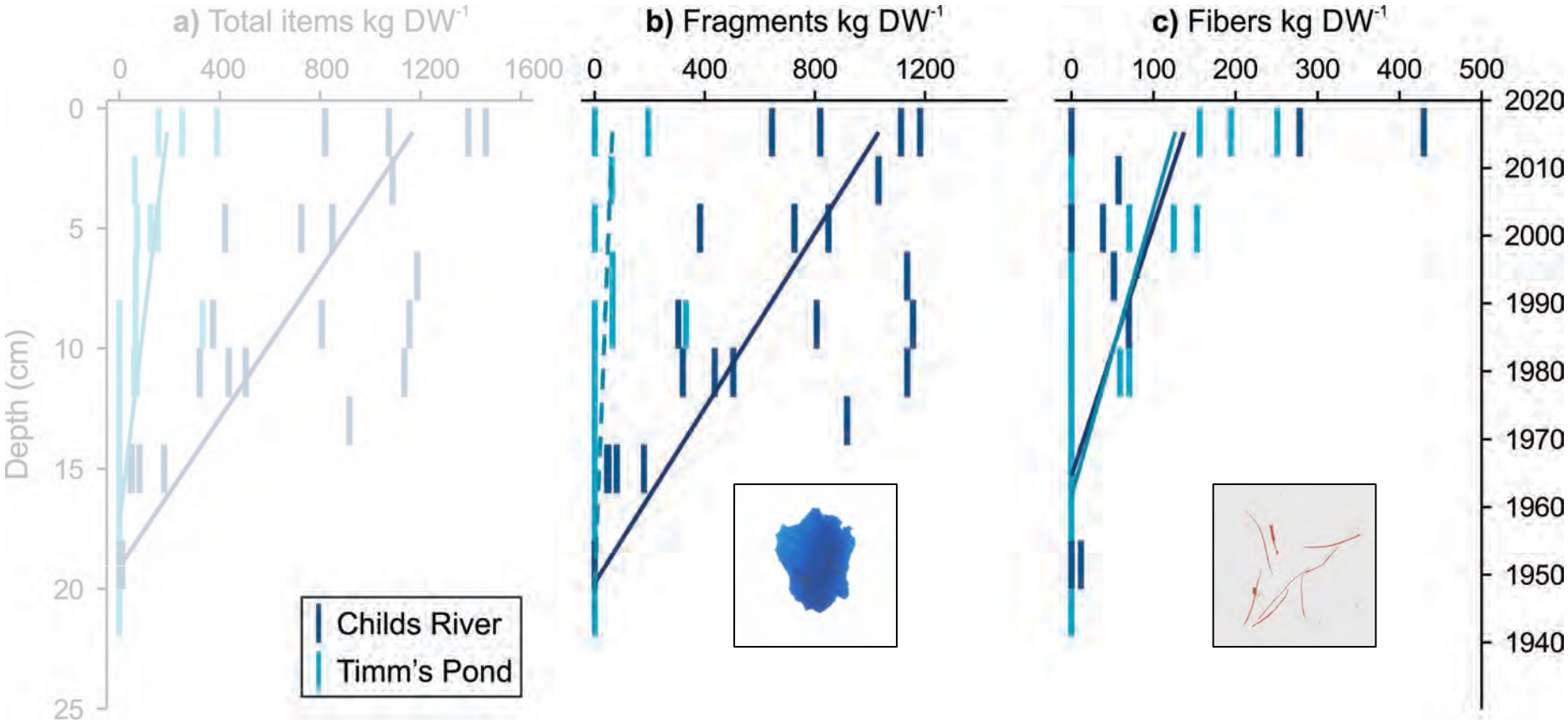

- The number of microplastics decreased with depth (age) of the sediments and were more abundant in Childs River (urbanized)
- We did not find any microplastics below 20 cm of depth (≃1950)
- Again, fragments did respond to the level of urbanization while fibers showed the same decadal trends in both estuaries

Conclusions

- Salt marsh sediments are sinks for microplastics in the marine environment.
- Microplastics have contaminated salt marsh sediments on Cape Cod since the 1950s, and their numbers have increased in recent decades due to increases in urbanization and plastic use.
- Urbanization (>50%) causes large increases in the number of microplastic fragments, but fibers are common everywhere.
- Effective management should take into consideration the information on different urbanization thresholds, microplastic origin and transport mechanisms.

Questions?

Collaborators:

Rut Pedrosa
Claire McGuire
Nicole Vandal
Ruby Rorty
Miriam Ritchie
Ivan Valiela
Kelsey Chenoweth

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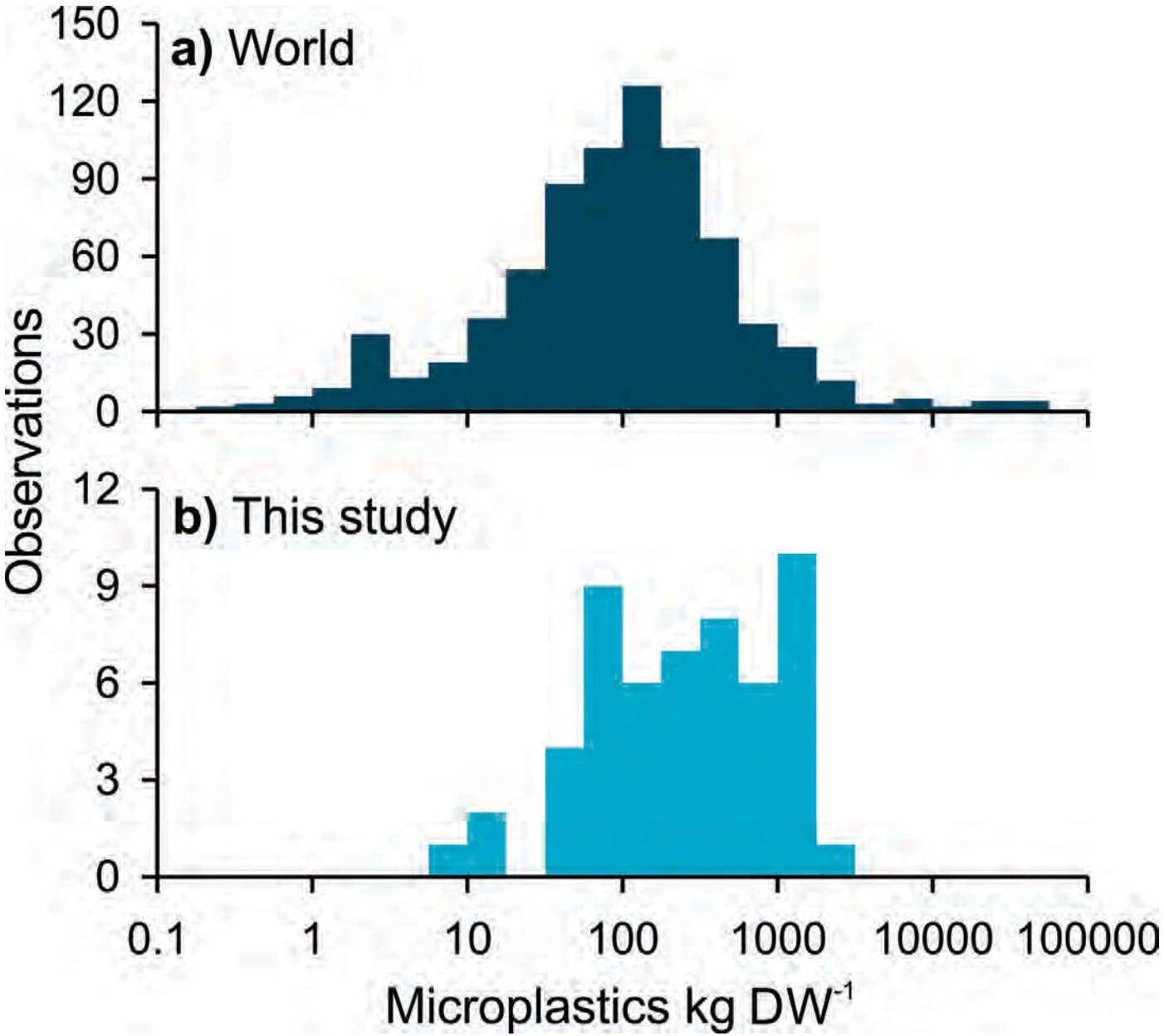
Semester in Environmental Science

University of Chicago Jeff Metcalf Summer Internship Program

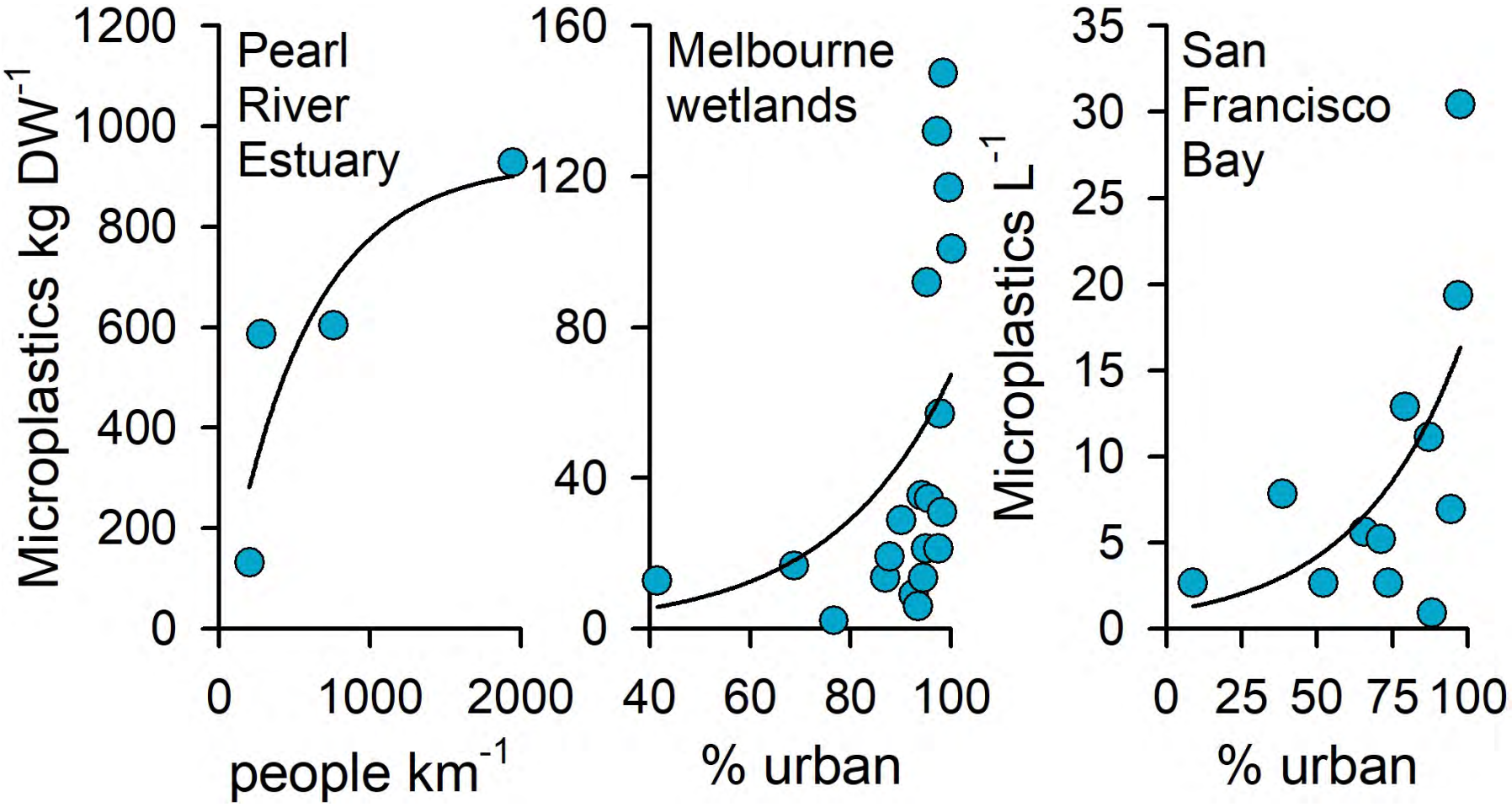
NSF-REU Program “Biological Discovery in Woods Hole”

MBL ECOSYSTEMS CENTER

Extra Graphs



Extra Graphs



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