# PFAS and Oxidative Damage within Dreissenid Mussels as Indicators of Stress in Great Lakes Coastal Wetlands

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# Background:

- Master's student at CMU studying contaminant accumulation in tissue in invasive mussels.
- 5 years with the Institute of Great Lakes Research (IGLR).
- Coastal Wetland Monitoring Project (CWMP).
- Introduction to my thesis work.



## The Issue: wetlands

- Our Great Lakes coastal wetlands are facing increased anthropogenic pressures.<sup>1</sup>
  - Climate change<sup>2</sup>
  - Urban development<sup>3,4</sup>
  - Pollution<sup>5</sup>



#### THE GREAT LAKES BASIN



Photo courtesy of: theweathernetwork.com

Photo courtesy of: Chicago Sun Times

MLive.com

PFAS levels rise in Michigan drinking water from Lake Erie Municipal water systems in Monroe and Frenchtown Township recorded a surprise increase in PFAS levels in water drawn from Lake Erie in ... 1 day ago

#### 6 WECT

#### DEQ release results of PFAS testing in groundwater wells

Julie Harper gets her water from a well that's among many where PFAS were detected. The results make her feel fearful. "You don't know the ... 1 day ago



- One particular pollutant: per- and polyfluoroalkyl substances (PFAS).
  - PFAS are an organic contaminant prevalent in the media.<sup>3</sup>

#### NC North Carolina Health News

#### Chemours vows to be the 'best' at controlling PFAS

People living near the plant, many of whom drink bottled water because Chemours polluted their wells and the Cape Fear River with PFAS, ... 2 days ago



#### MLive.com

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Family poisoned by PFAS: 'We don't know what our future holds'



Belmont, MI faces the effects of drinking water

#### state won't test milk

Some Michigan dairy cows are contaminated with toxic PFAS, but the state agency charged with regulating farms isn't testing their milk. 1 day ago



N.H.'s New PFAS Limits Face Swift Lawsuit From Local Water Handlers, 3M

New Hampshire was hit with a lawsuit over its new limits on PFAS chemicals in drinking water on the same day the new regulation took effect. 2 days ago



#### The 100 U.S. Military Sites With the Worst PFAS Contamination

Many of the nation's highest levels of groundwater contamination with PFAS highly toxic fluorinated chemicals linked to increased risk of ...



#### nental Working Group

dy Confirms High PFAS Blood Levels Among ers

ntific review finds "unequivocal evidence" that firefighters using foams made with the fluorinated chemicals known as PFAS have ... 2 days ago









10 hours ago

• PFAS are widespread, nonvolatile organic carbon-chain molecules that are mobilized by water and persist indefinitely in the environment.<sup>5,6</sup>



Photo courtesy of: Nipsect



- PFAS sorb to sediments.<sup>15</sup>
- PFAS can be mobilized by runoff.<sup>16,17</sup>
- PFAS can be suspended in the air as dust.<sup>18</sup>
- One study estimates that there are greater than 200 tonnes of PFAS in Great Lakes sediments.<sup>19</sup>

Photo courtesy of: Michigan Radio

- USEPA states:
  - PFAS can affect the immune system.<sup>7</sup>
  - PFOS may be linked thyroid hormone disruption.<sup>7</sup>
  - PFOA may be linked to cancer.<sup>7</sup>
- Accumulate in tissues.<sup>8</sup>
  - Half lives vary from 2 weeks to 9 years.<sup>9,10</sup>



# Study objective:

- Use PFAS in dreissenid mussels as an indicator of ecosystem stress.
- Compare dreissenid tissue PFAS conc. to two measures of oxidative stress.



# Methods: study organisms

**Dreissena polymorpha** – the zebra mussel



**Dreissena rostriformis bugensis** – the quagga mussel



### Methods: site selection

- 20 sites
- Sites maintained a hydrologic connection to a known wetland polygon.<sup>11</sup>
- Sites were selected from the 2019 list of wetlands to be sampled, provided by the GLCWMP.<sup>12</sup>

![](_page_9_Picture_4.jpeg)

### Methods: PFAS sample collection

- At least 2 g of entire mussels (6 g total) were collected from 3 reps.
- Dreissenids were massed in field to ensure the minimum sample size ≈ 2 grams of tissue (excluding the shell, which accounts for approx. 65% of total wet mass).

![](_page_10_Picture_3.jpeg)

# Methods: PFAS sample analysis

- Mussels were placed in prewashed containers and bags.
- 13 PFAS congeners will be quantified using LC-MS/MS.<sup>13</sup>

![](_page_11_Picture_3.jpeg)

# Methods: site chemistry

- Three replicates of surface water chemistry data were collected using a YSI multiparameter sonde.<sup>12</sup>
  - Temperature (°C)
  - Dissolved Oxygen (mg/L, % saturation)
  - pH
  - Total Dissolved Solids (g L<sup>-1</sup>)
  - Specific Conductivity (µS cm<sup>-1</sup>)
  - Turbidity (NTU)
  - Oxidation-Reduction potential (mV)
  - In situ Chlorophyll *a* (μg/L)
- A composite water sample was collected and will be analyzed for the following:
  - Total N, P
  - NH<sub>4</sub>
  - NO<sub>3</sub>
  - SRP
  - Chloride ions
  - Chlorophyll a

![](_page_12_Picture_17.jpeg)

![](_page_13_Picture_0.jpeg)

# Study objective:

- Use PFAS in dreissenid mussels as an indicator of ecosystem stress.
- Compare dreissenid tissue PFAS conc. to two measures of oxidative stress.

![](_page_14_Picture_3.jpeg)

#### Methods: oxidative stress sample collection

- An additional 12 mussels (4 per rep) were collected from each site and flash frozen on dry ice in the field.
- Mussels are currently stored in a -80 °C freezer awaiting analysis.

![](_page_15_Picture_3.jpeg)

Photo courtesy of: ResearchGate

### Methods: oxidative stress sample processing

 Oxidative stress assays for superoxide dismutase (SOD) and DNA damage will be performed on mussels collected.<sup>14</sup>

![](_page_16_Picture_2.jpeg)

# Subsequent analyses:

- Principal Components Analysis (PCA) of sites based on water quality and site average PFAS concentrations.
- Correlations or groupings between principal components for WQ and site average PFAS values.
- Correlation between site average oxidative stress measures and site average PFAS concentrations.

![](_page_17_Picture_4.jpeg)

## Goal:

 Relate tissue PFAS concentrations and multiple measures of wetland site stress.

![](_page_18_Picture_2.jpeg)

## Acknowledgements:

![](_page_19_Picture_1.jpeg)

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# QUESTIONS?