ICMGP 2024

CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY

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An iterative approach to effectively characterizing a river impacted by a historical mercury mine using a combination of abiotic and biotic media

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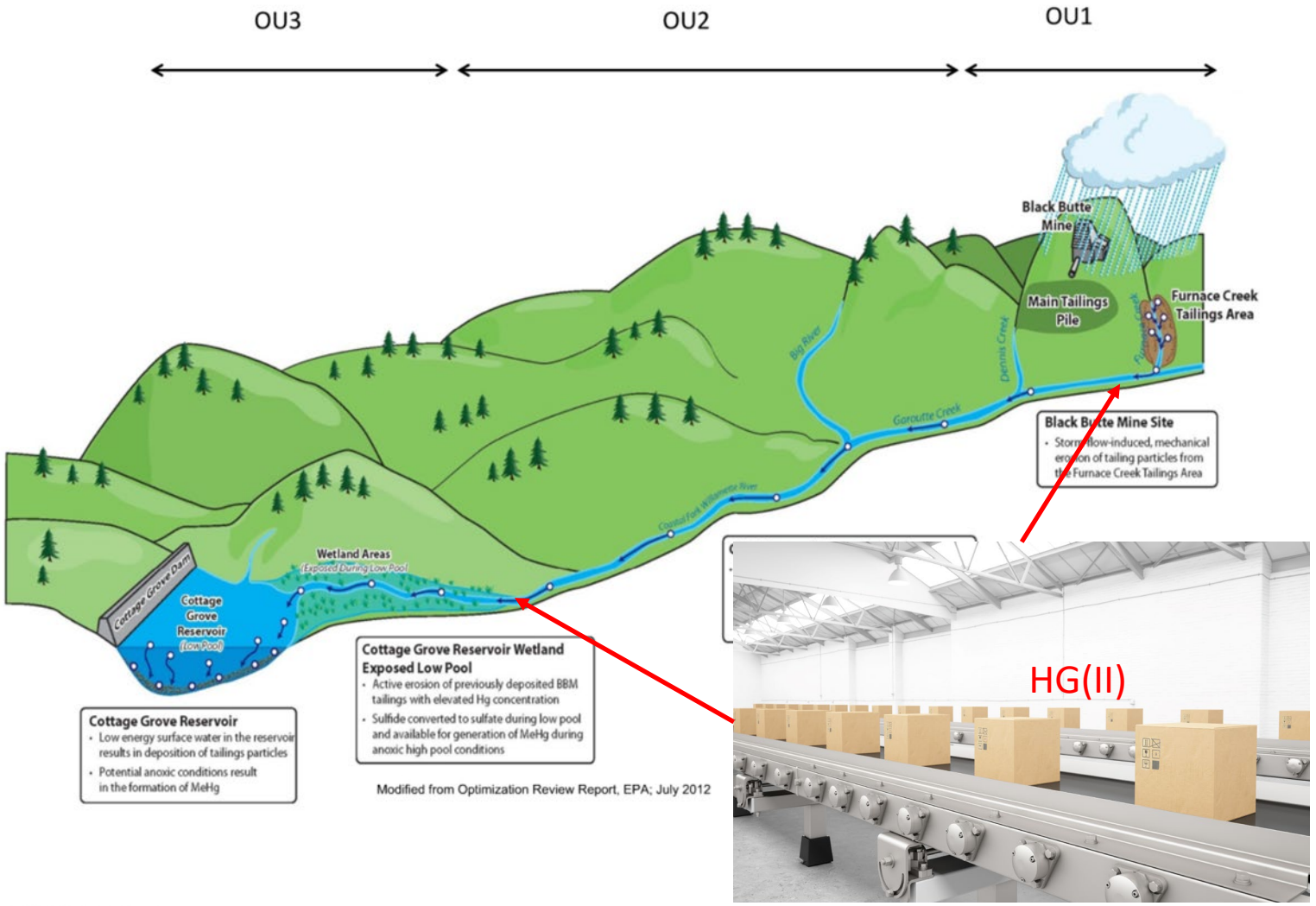
Presentation Itinerary

- Traditional Mercury Fate and Transport Approach
  - Abiotic
  - Biotic
- Lines of Evidence Pointing to Other Methylmercury Sources
- Periphyton Methylmercury Delineation
- Modeling Confirmation
- Summary

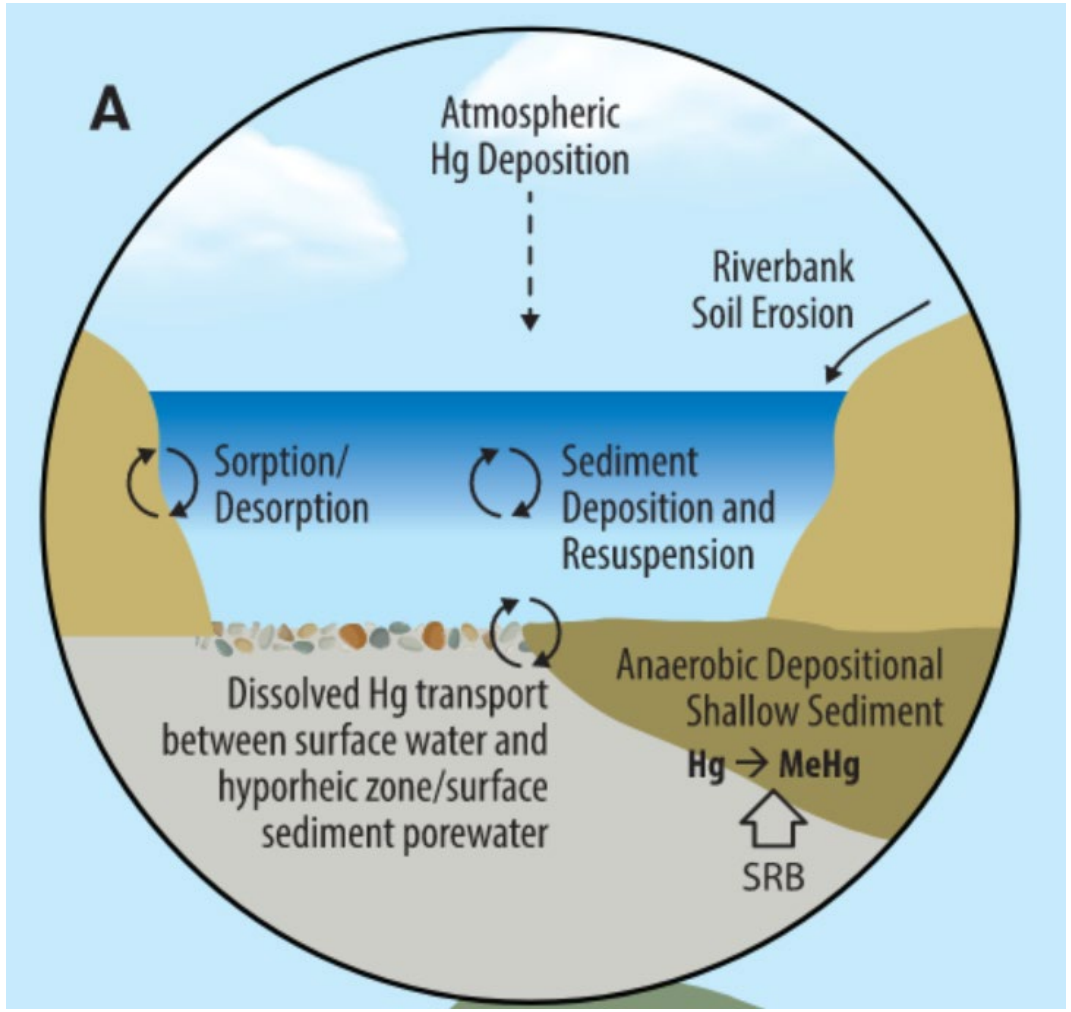
Example Mercury Mine Site



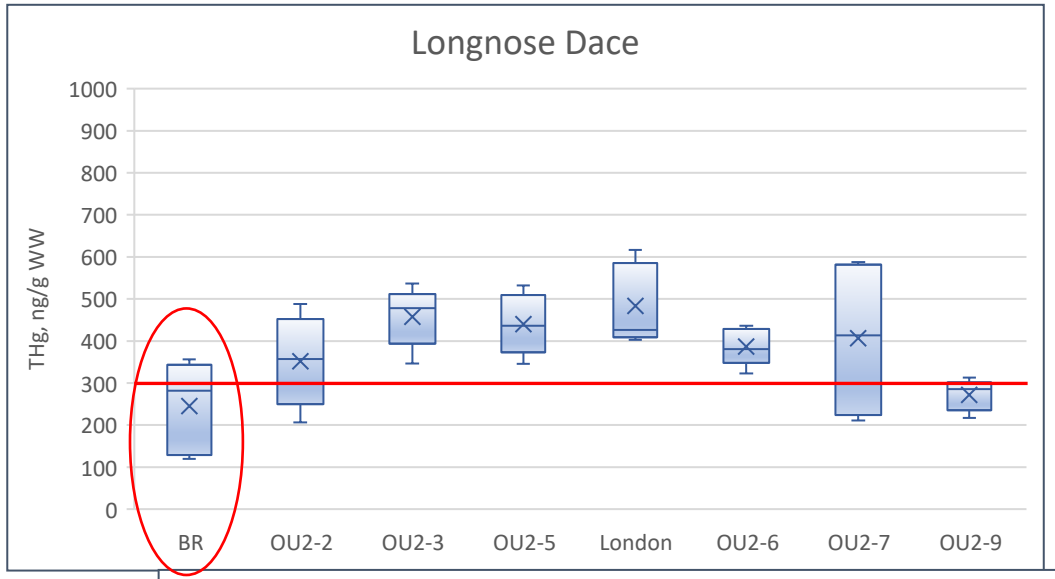
Initial Investigation of Methylmercury Sources

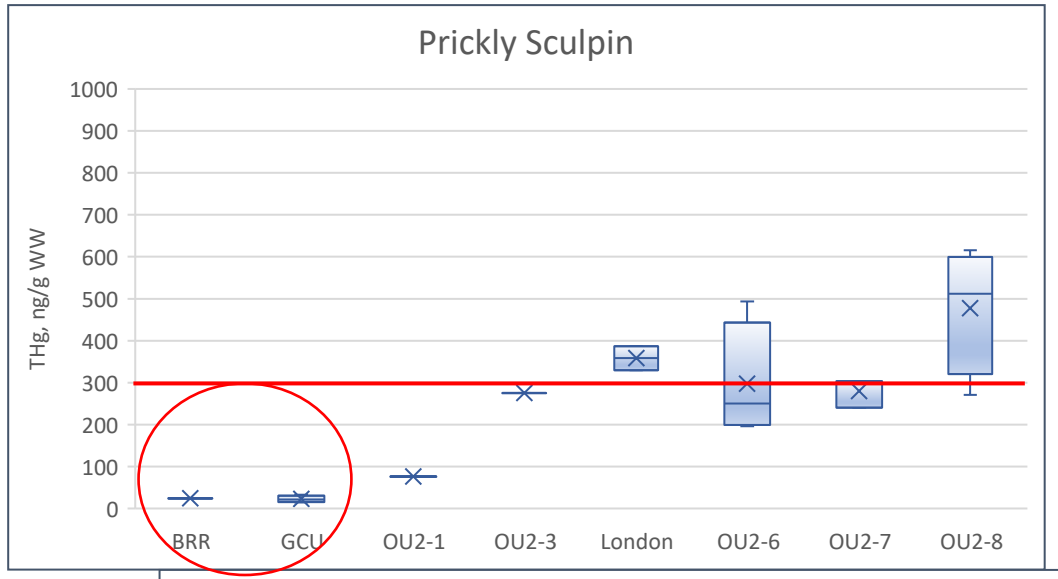
- Abiotic
  - Surface water
  - Sediment/Porewater
  - Hyporheic Porewater
- Biotic
  - Benthic Macroinvertebrates
  - Fish

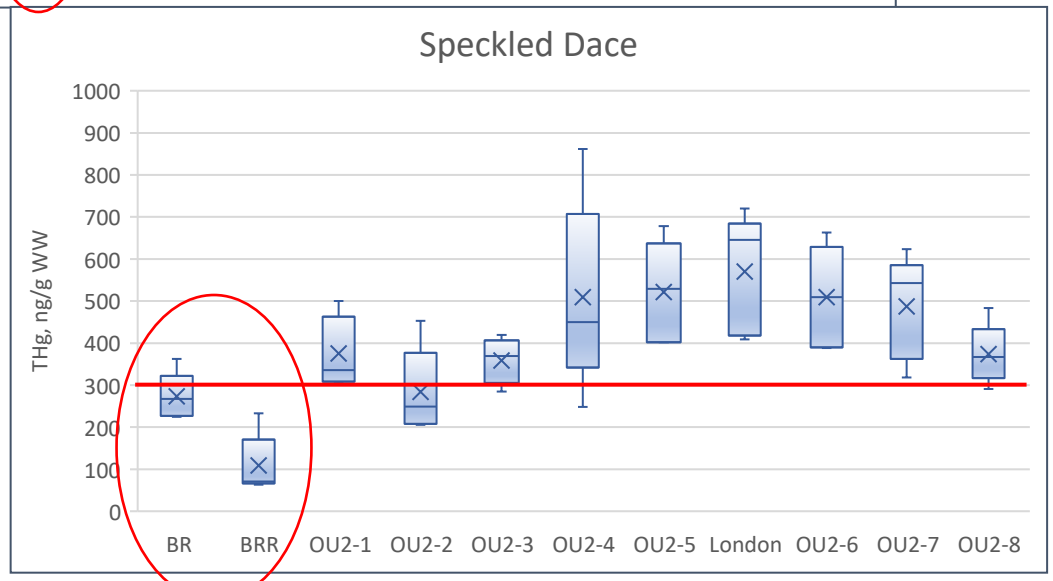
Mercury Cycle in Stream Cross Section

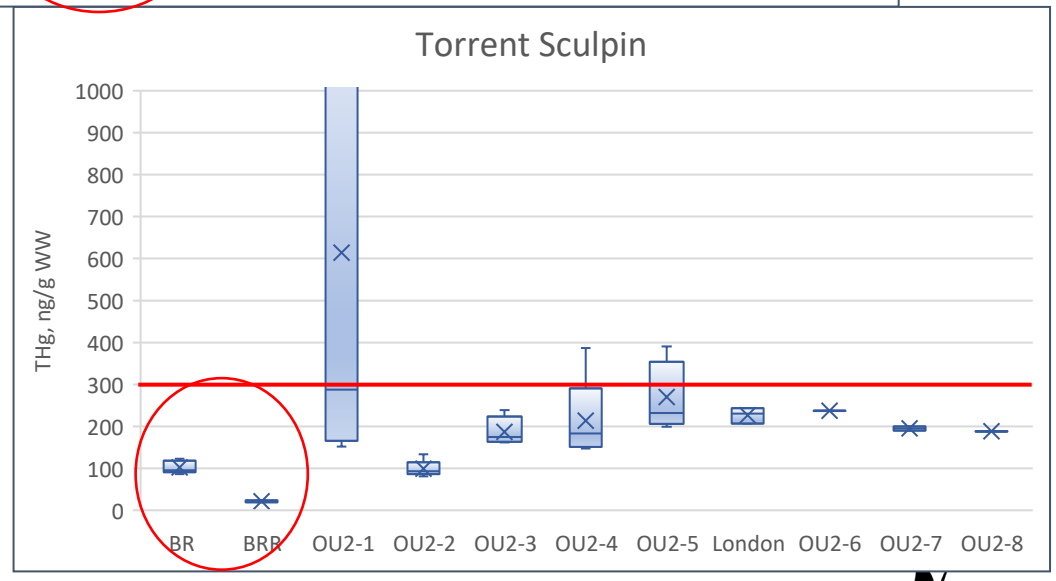


Elevated Mercury in Fish Relative to Background



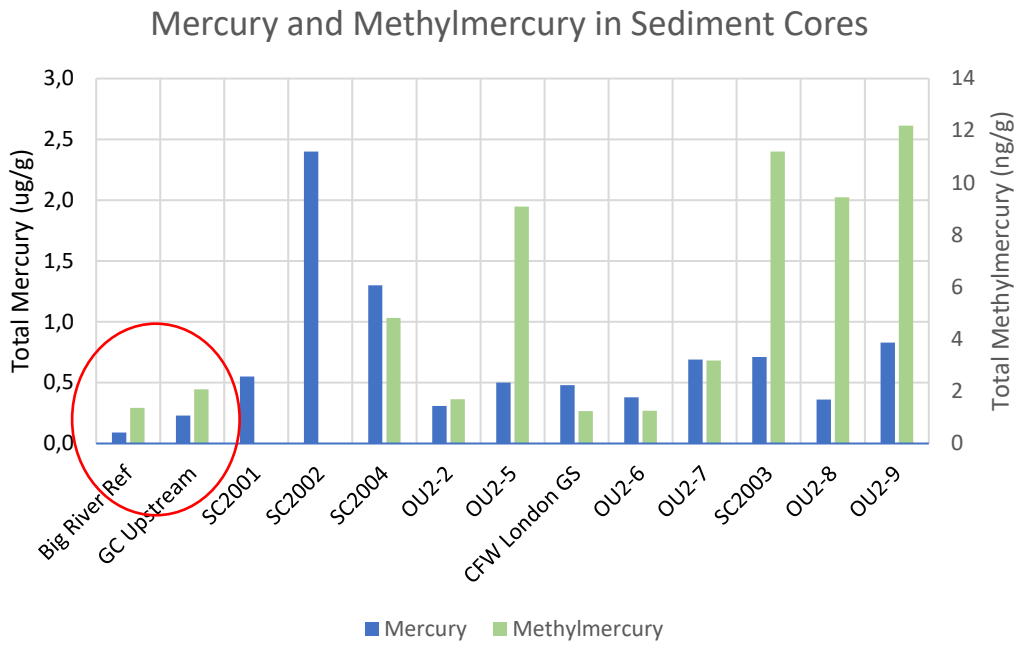


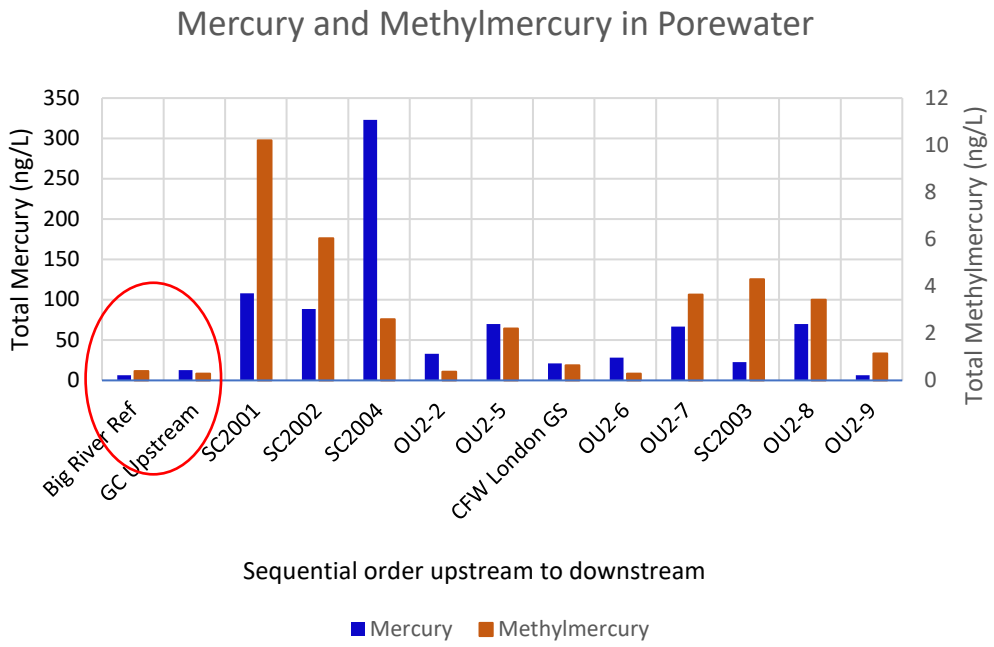




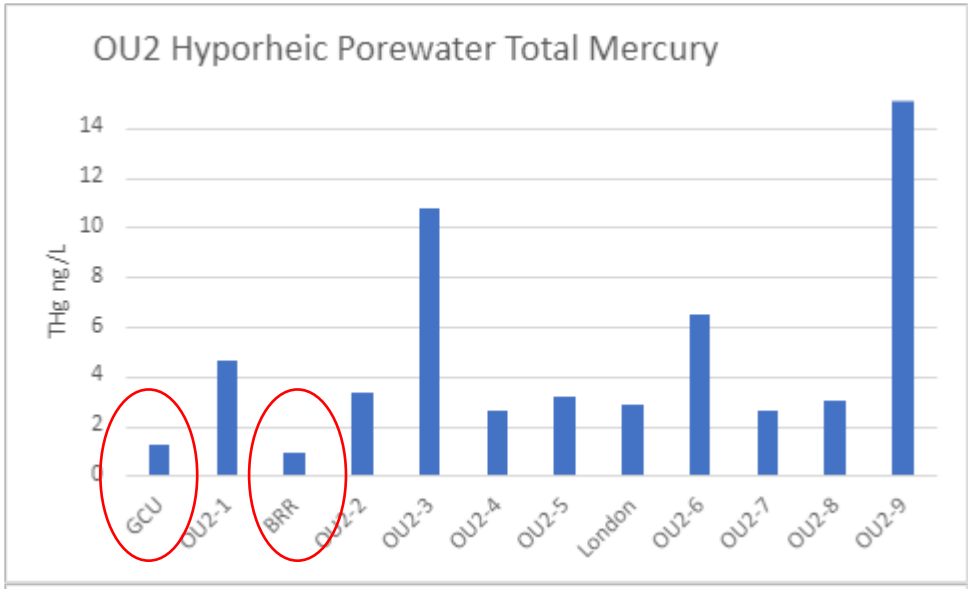
Data Collected by USGS and is Publicly Available

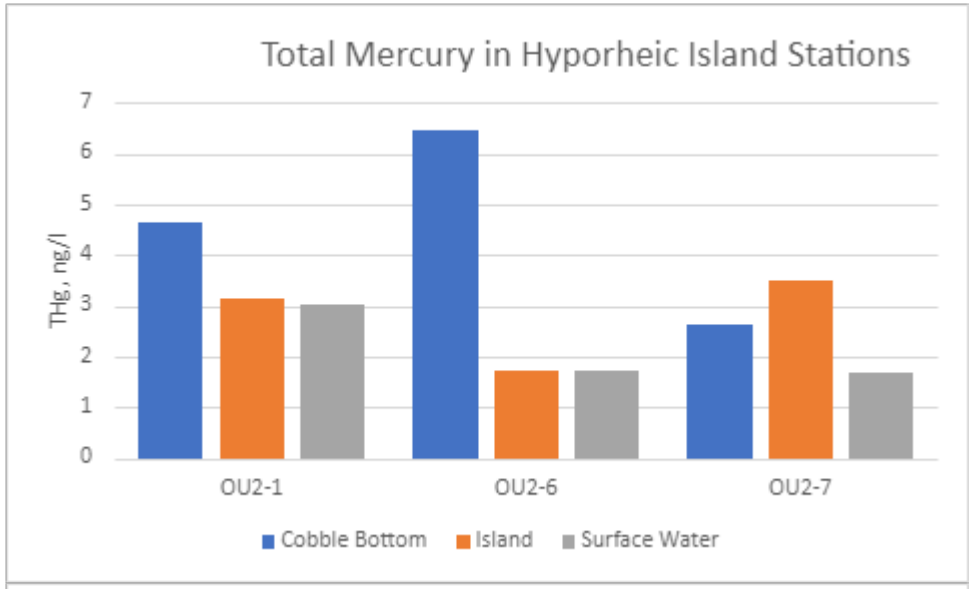
OU2 Sediment and Porewater Hg and MeHg

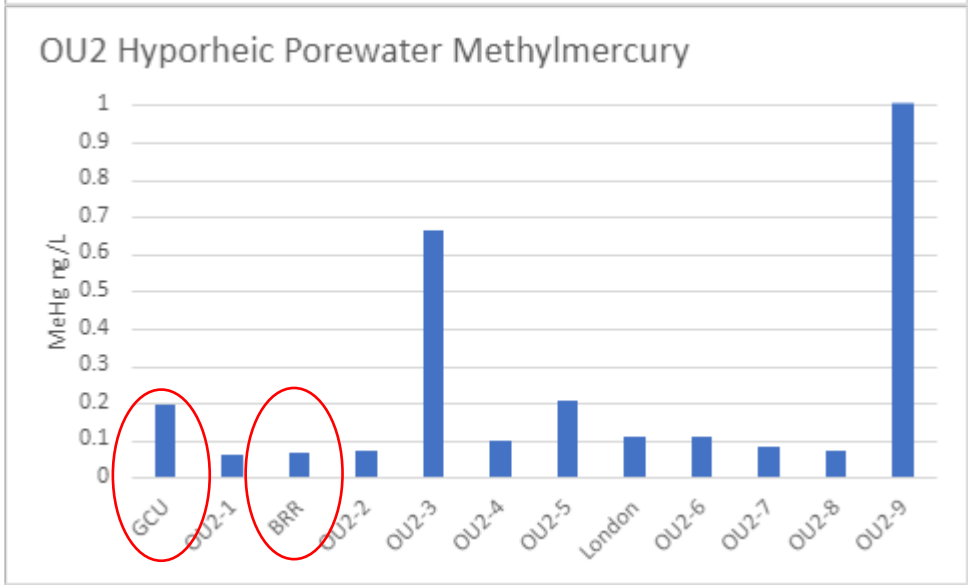


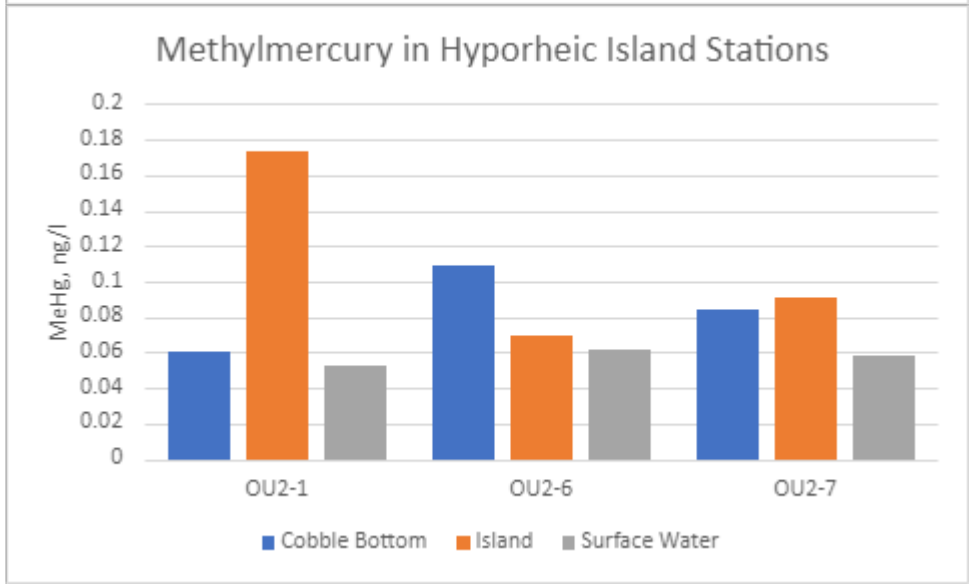


OU2 Hyporheic Porewater Hg and MeHg









Mapping Results

- Yellow = cobbles
- Red = bedrock
- Blue = sediment
- Green = island or sand bar
- White = not accessible

Reach 1

Reach 2

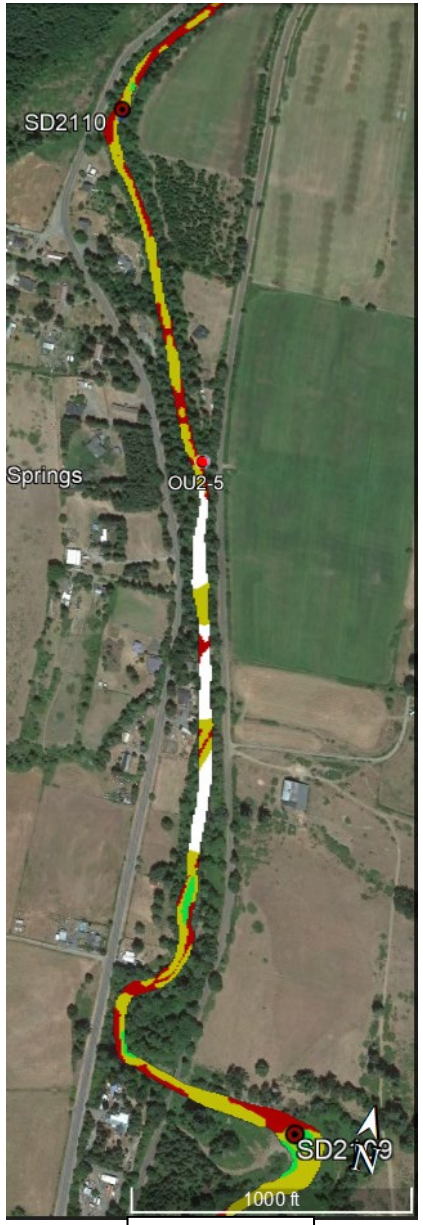
Reach 3

Mapping Results

Streambed Type	% Total Area
Depositional Sediment	2.9
Cobbles	65.7
Bedrock	24.6
Island/sand bar	4.9
Not Accessible to map	2.0

Very small footprint of methylation zones.

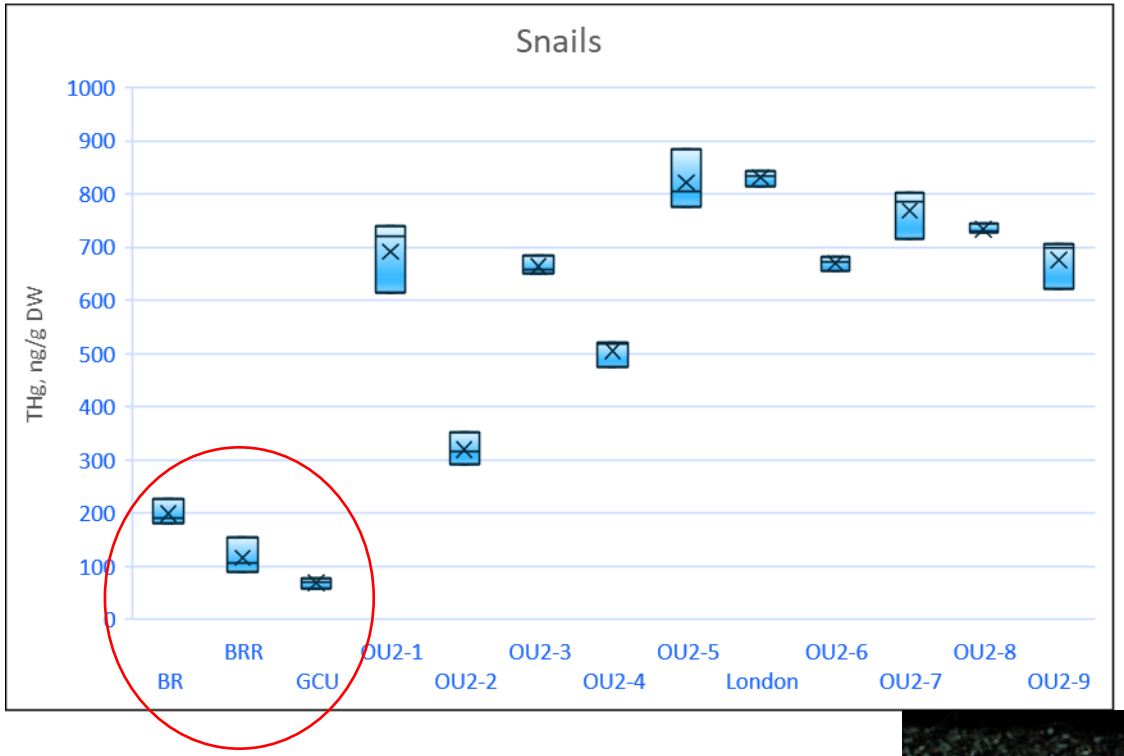
Reach 4

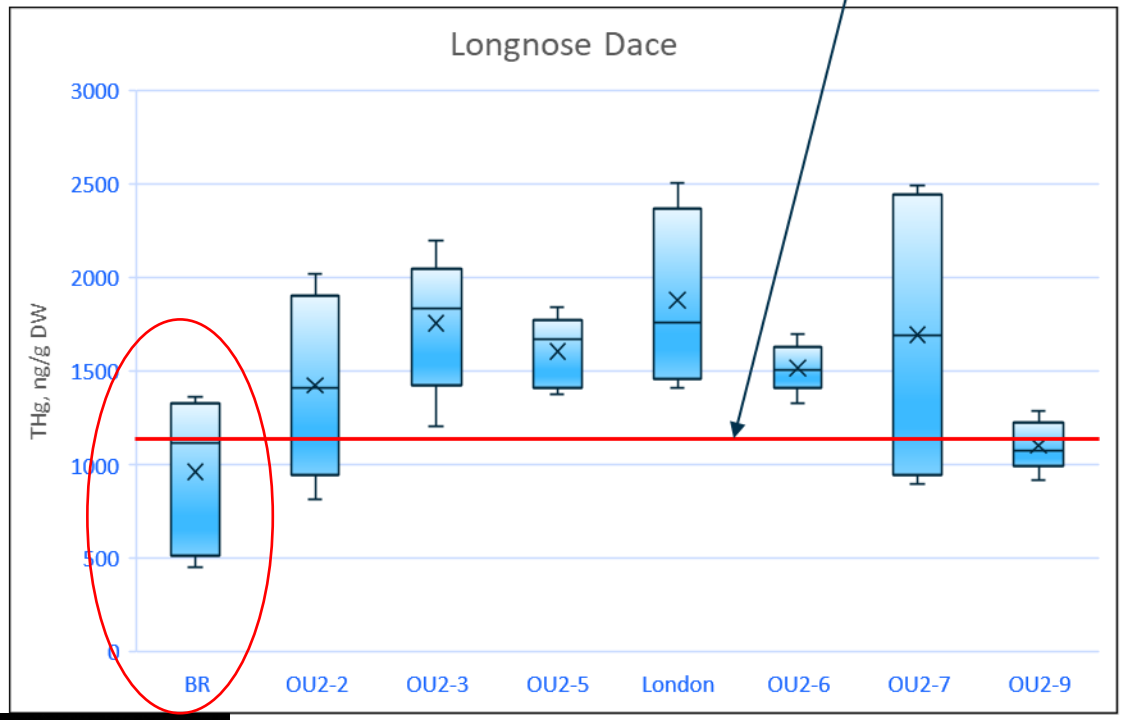


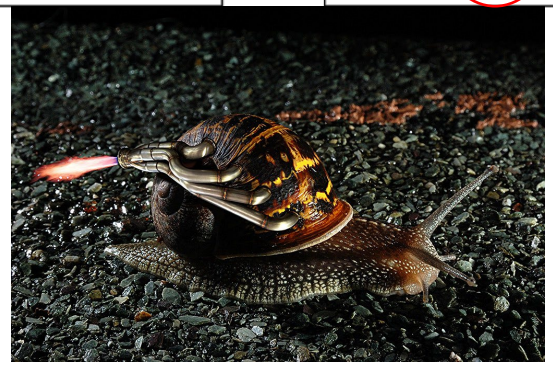
Reach 5

Reach 6

A Look into Grazers







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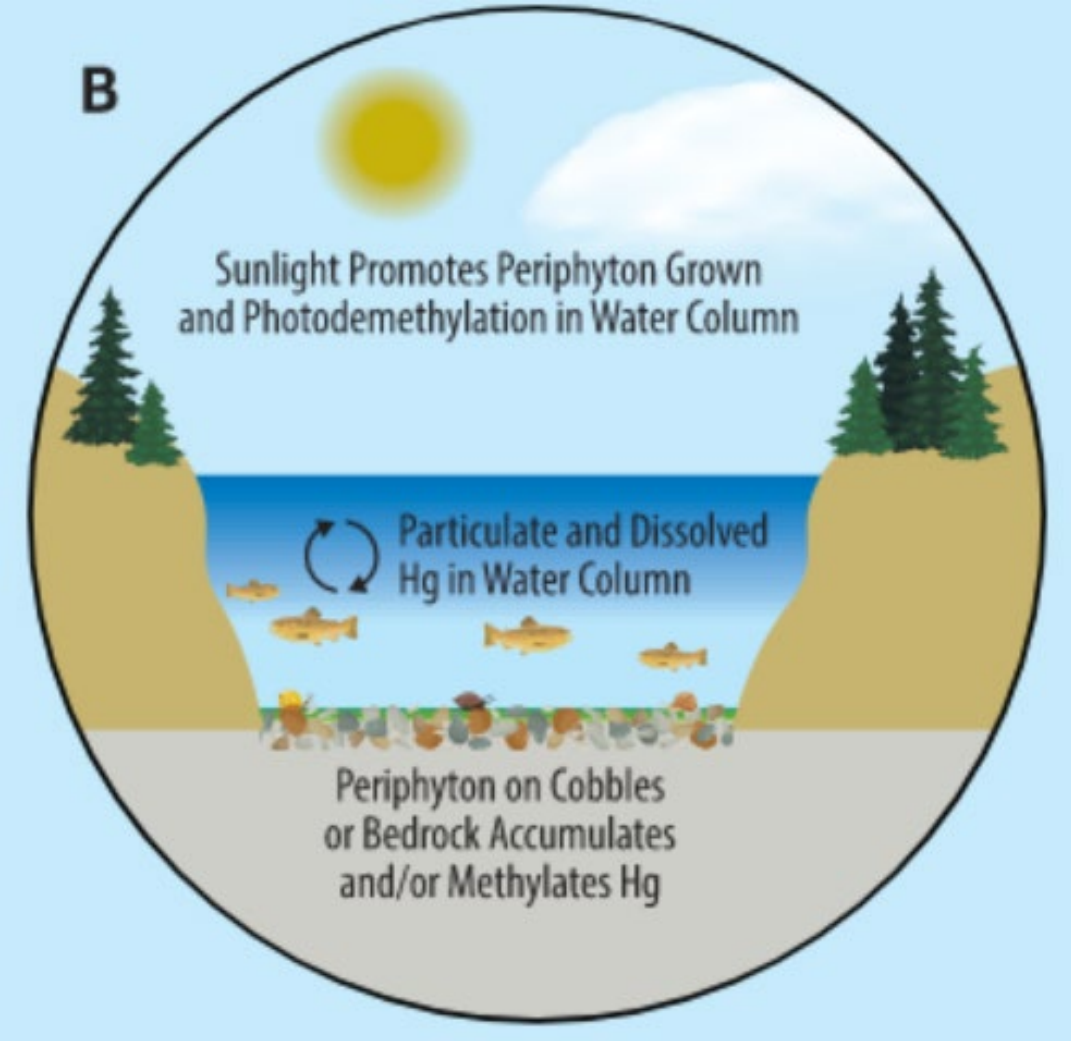
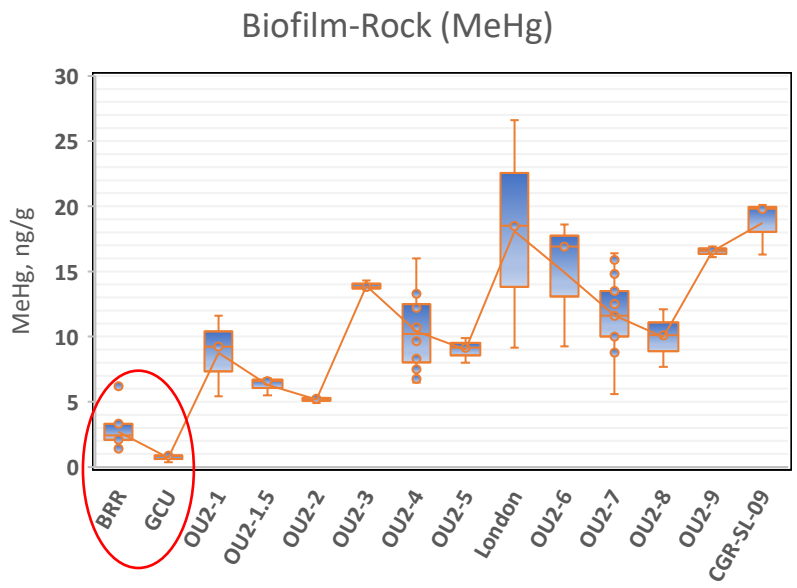
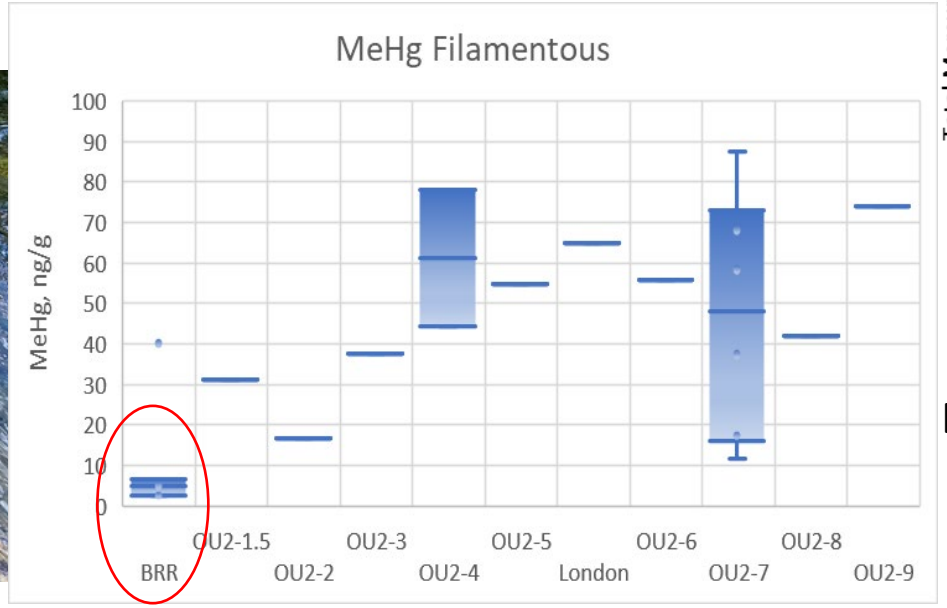
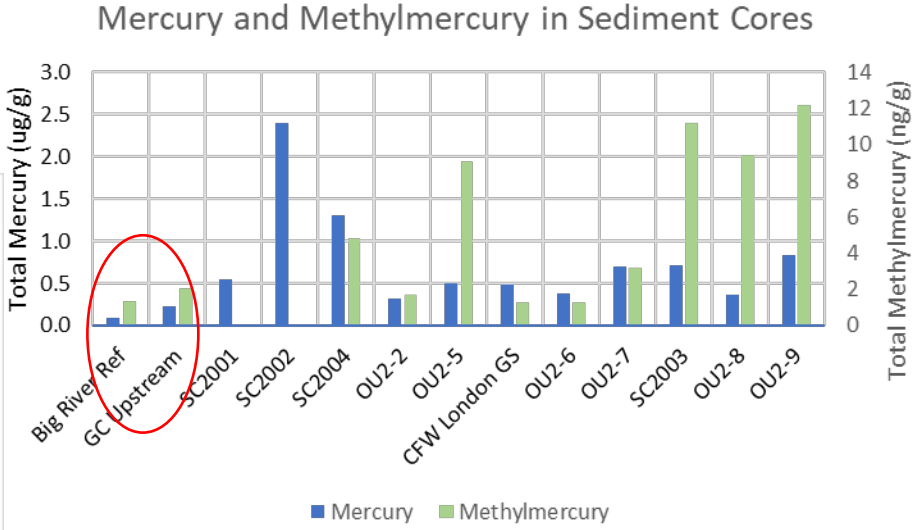
Periphyton Influences



Periphyton Methylmercury







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Use of Mechanistic Model to Simulate Mercury Fate and Transport

- Water Quality Analysis Simulation Program (WASP8)
  - Simulated **elemental**, **inorganic**, and **methylmercury** transport and transformations.
  - Focused on study question "***What is the potential importance of periphyton as a possible source for MeHg formation***?"
- Model Results
  - Methylmercury in surface water generally **underpredicted** relative to measured aqueous concentrations and methylation rates in all simulations.
  - Periphyton could potentially explain the **missing link** between model results and actual measurements.

Summary

- Methylmercury elevated in food web in river downstream of the mercury mine.
- Methylmercury production observed within patches of depositional sediment.
  - Footprint of methylating sediment likely too small to account for observations in food web.
- Snails (grazers) were particularly elevated.
- Subsequent investigation in periphyton revealed a large reservoir of methylmercury within the river channel.
- Model results provide a line of evidence that abiotic data alone does not account for methylmercury in surface water, which may be due to contributions from periphyton.


Questions

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