Use of Experimental Stream Mesocosms to Assess Mercury Uptake in Periphyton

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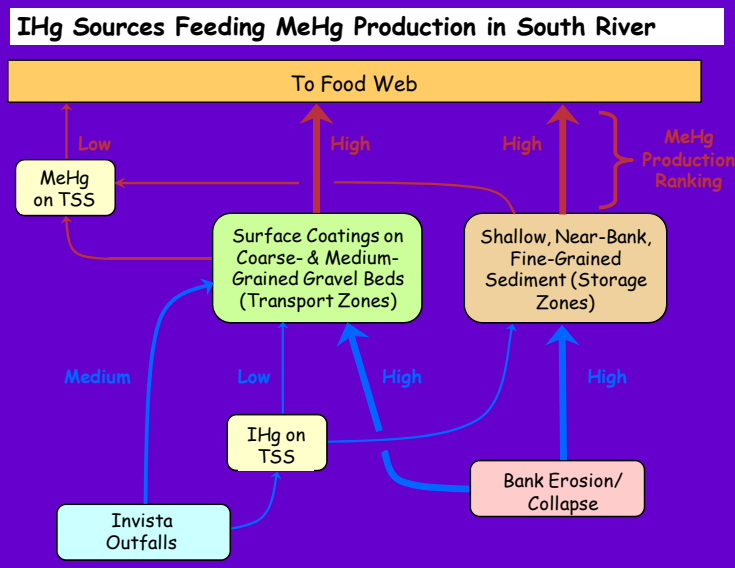
Why a Mesocosm?

- Growing need for manipulative experimentation
  - Test elements of working conceptual model
  - Test potential remedial strategies
- Mesocosms provide an appropriate platform for performing manipulative experiments
  - Level of environmental realism, while still allowing control of critical variables



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Objectives

1. Design a mesocosm system that can reasonably approximate the South River
2. Test the relative importance of waterborne or sediment-derived mercury in determining uptake into the biological community
3. Test the relative importance of hyporheic flow in determining Hg uptake

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Mesocosm Design

- Six, 8-ft PVC channels
- Loaded with
  - 1 kg depositional sediment
  - 8 kg sand/gravel
  - 1 kg guzzled sediment
  - 80 rocks

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Experiment #1

- Experiment #1 – Field testing of mesocosm design
  - Is Hg uptake in mesocosm periphyton similar to river periphyton?

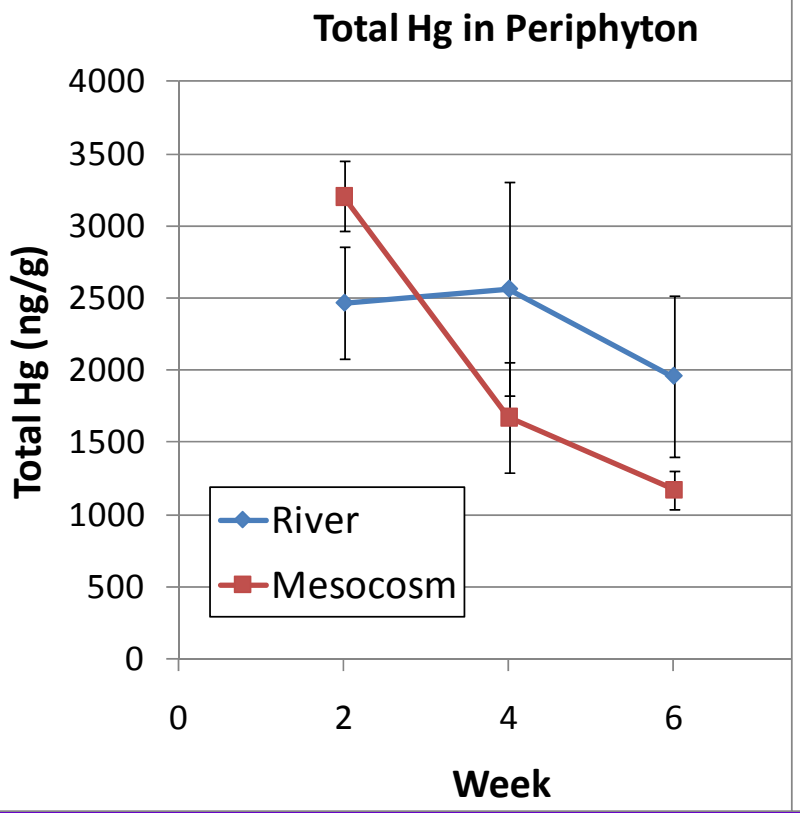
5 Rock Trays In River

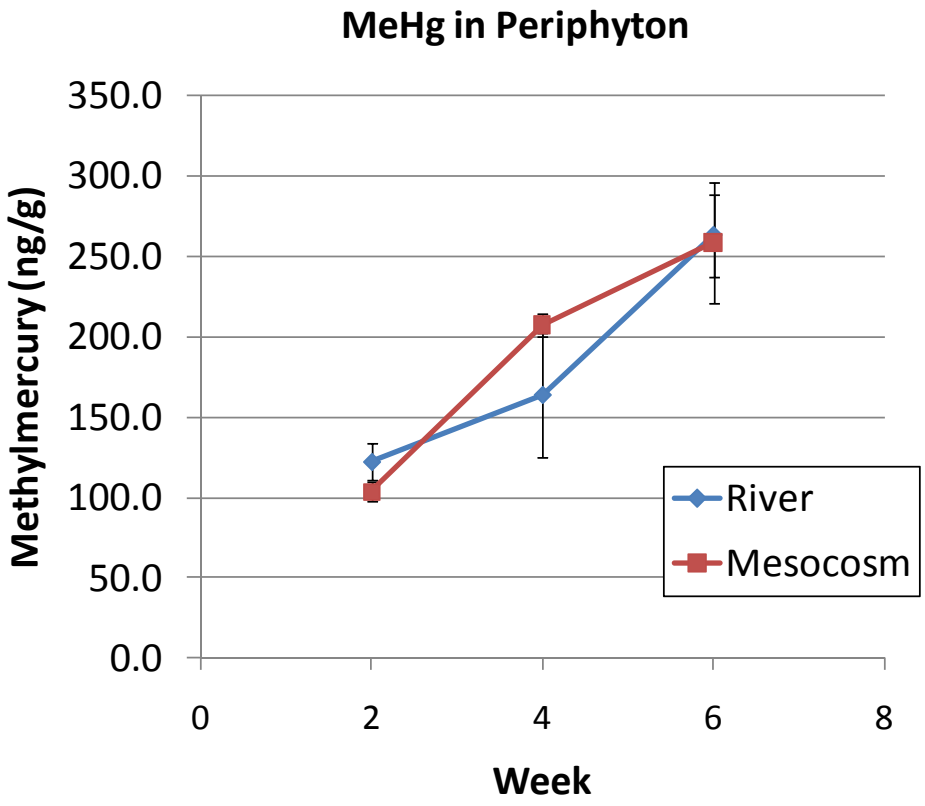
Vs.

5 Mesocosm Channels

Experiment #1

- Experiment #1 – Field testing of mesocosm design
  - Periphyton was sampled at 2, 4, and 6 weeks of colonization



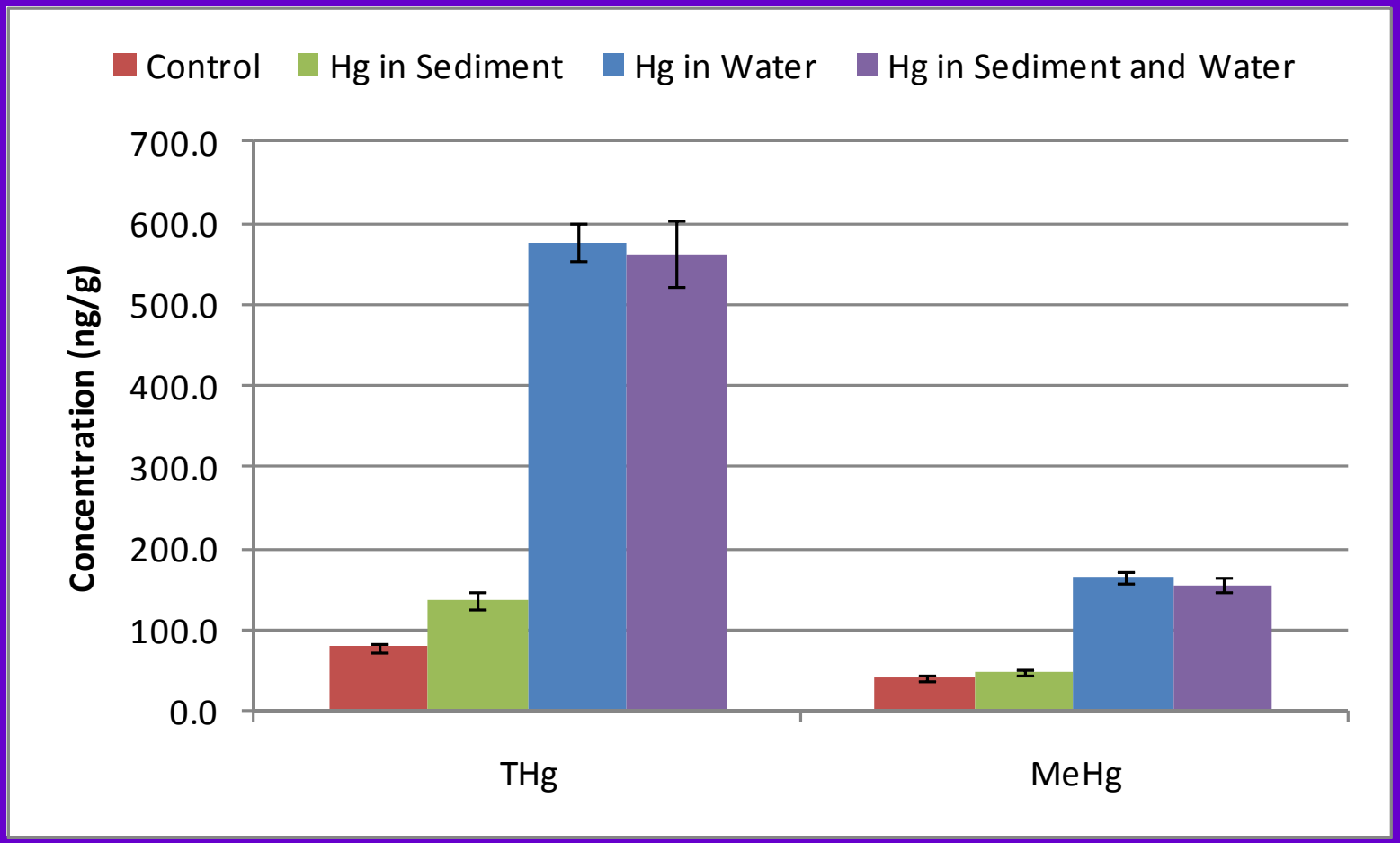


Experiment #2

- What is the relative importance of waterborne or sediment-derived mercury in determining uptake into the biological community?
- 2x2 experimental design with clean/contaminated water and clean/contaminated sediment

		Sediment Source	
		North River (14 – 17 ng/g Hg)	South River (5200 – 8000 ng/g Hg)
Water Source	North River (1.2 ng Hg/L)	Control	Hg in Sediment
	South River (47 ng Hg/L)	Hg in Water	Hg in Sediment and Water

Experiment #2



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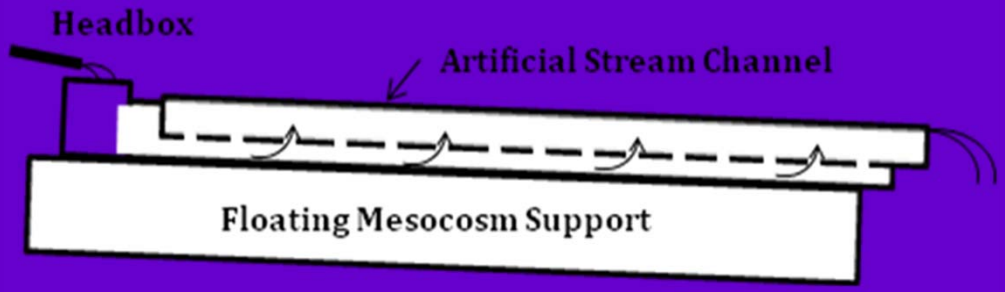
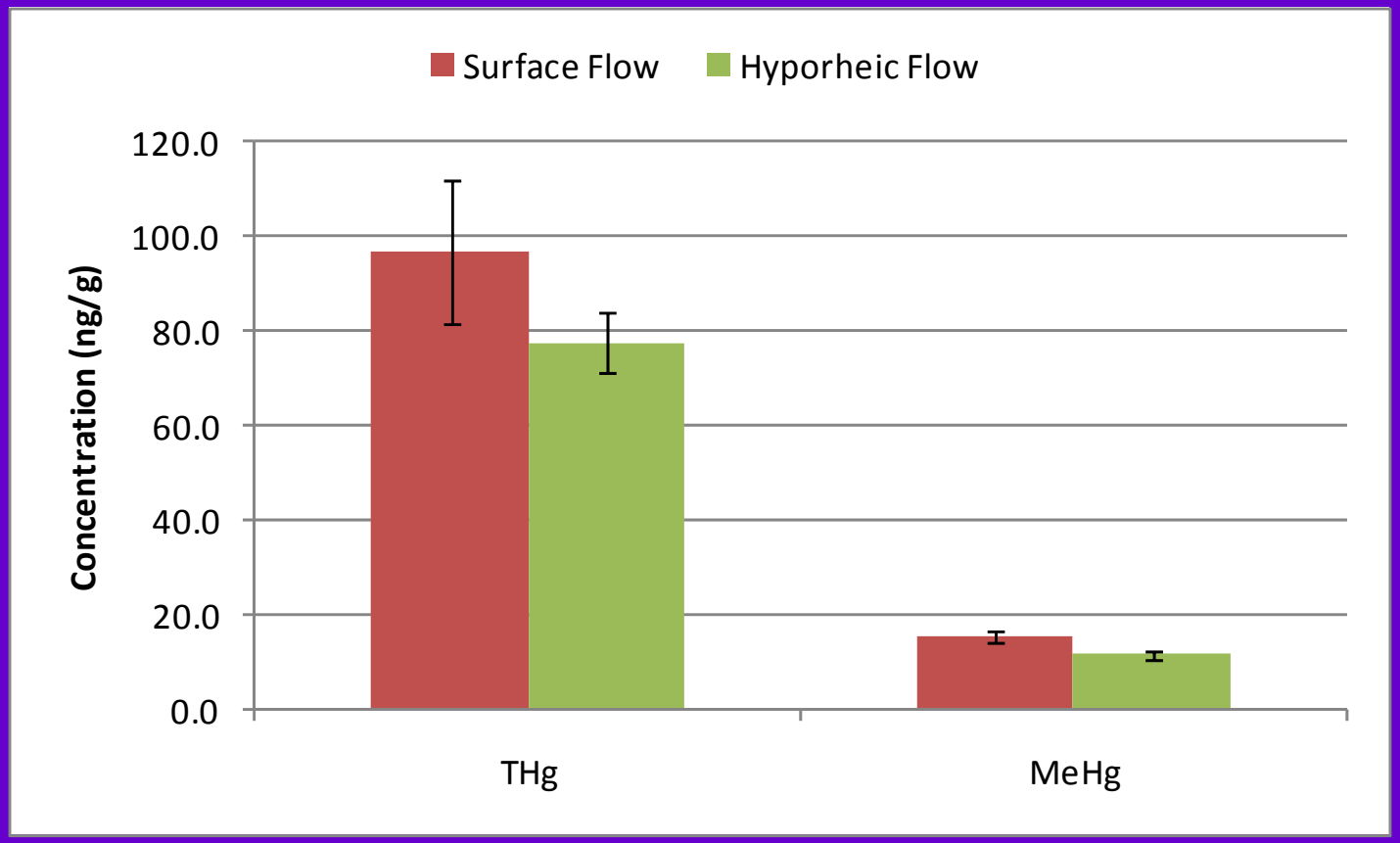
Experiment #3

- What is the relative importance of hyporheic flow in determining Hg uptake into the biological community?
- Similar set-up to previous experiment, but with and without hyporheic flow



		Sediment Source	
		South River	
Water Source	North River	Hyporheic flow	Surface flow

Experiment #3



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Findings

- The mesocosm design provides a relatively inexpensive, useful tool for experimentation in the South River
  - Provides a level of environmental realism not easily achieved in the laboratory
  - Provides an opportunity to experiment that is not easily achieved in the river
  - For periphyton Hg uptake, mesocosm provides a reasonable surrogate to the river

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Findings

- Under the mesocosm conditions, waterborne mercury played a much larger role in biological uptake than sediment-derived mercury
  - Obviously upstream sediment can contribute to downstream water column
- Advective flow through contaminated sediment didn’t increase biological uptake in mesocosm experiments

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Options for Next Steps

- Address Conceptual Model Questions
  - Mercury speciation
  - Impact of bank soils
- Test Remediation Options
  - Amendments
  - Treatment approaches

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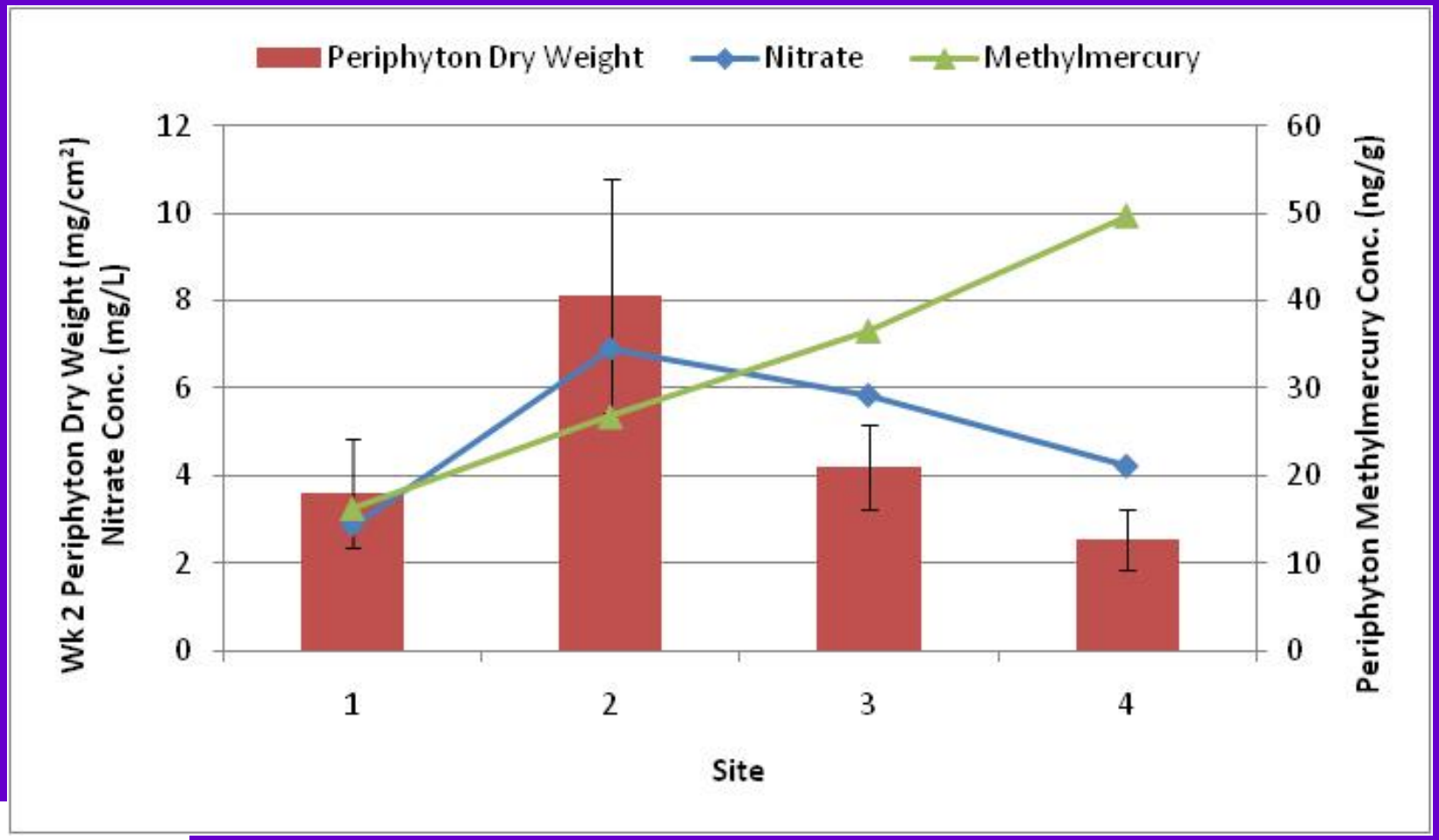
Pre-Upgrade Preliminary Results



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