Shoreline Spiders as Sentinels of Mercury Contamination of the Trinity River

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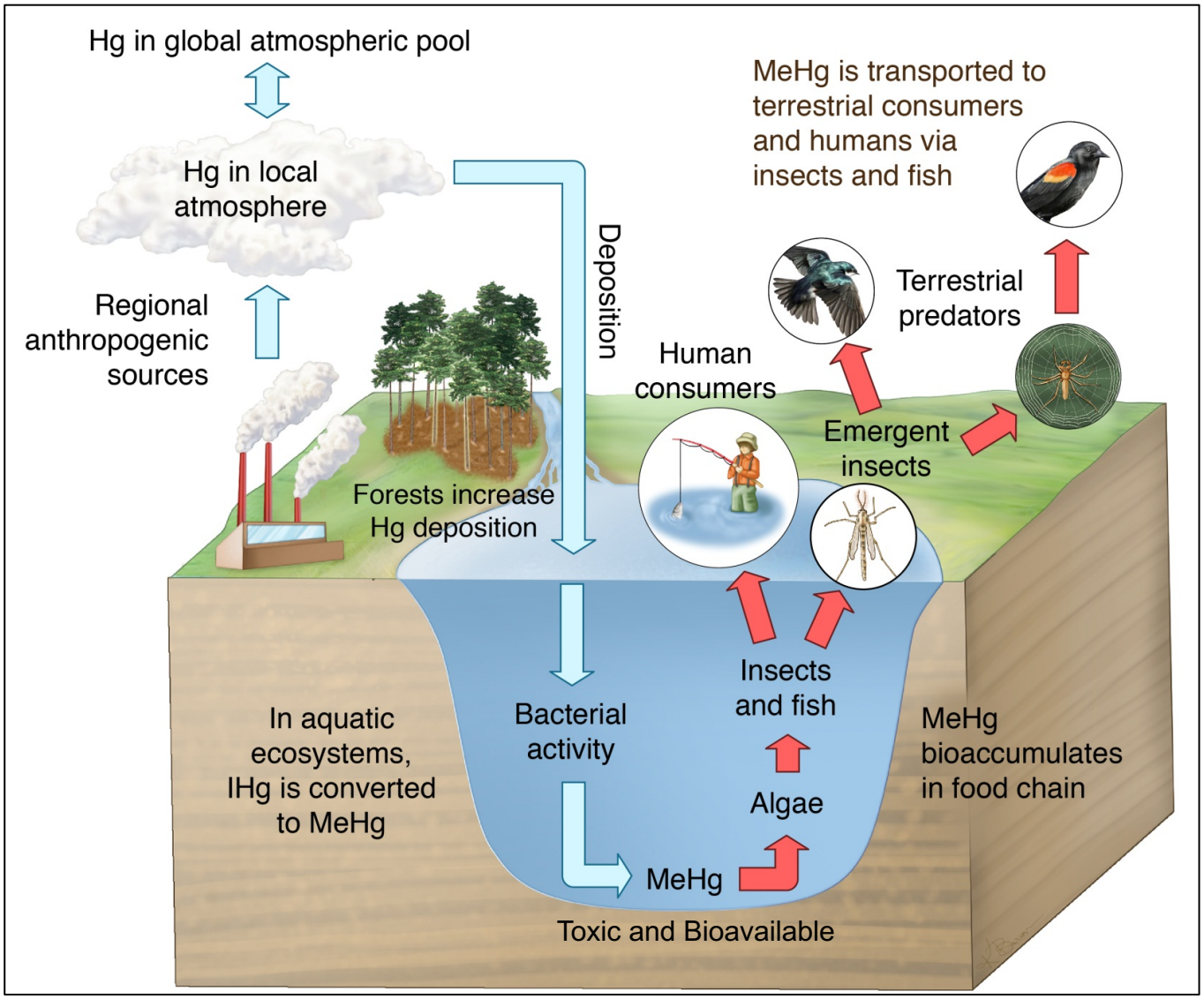
Methylmercury Hazard to Vertebrates

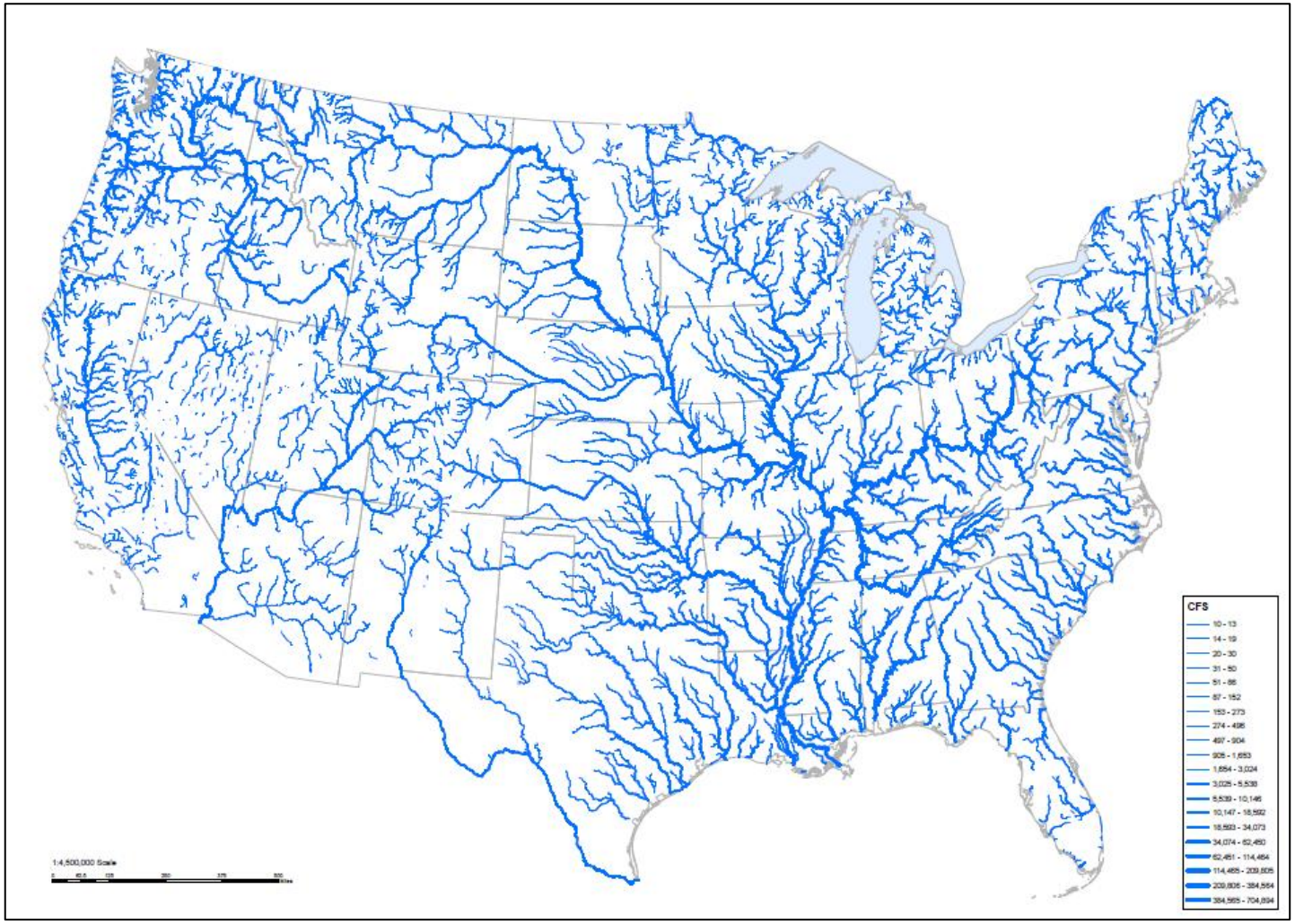
Methylmercury (MeHg) is a neurotoxin in the environment that reduces the reproductive success of vertebrates.

Mergler et al. 2007, Scheuhammer et al. 2007

Mercury Cycle



Challenge of Monitoring Bioavailable MeHg Contamination

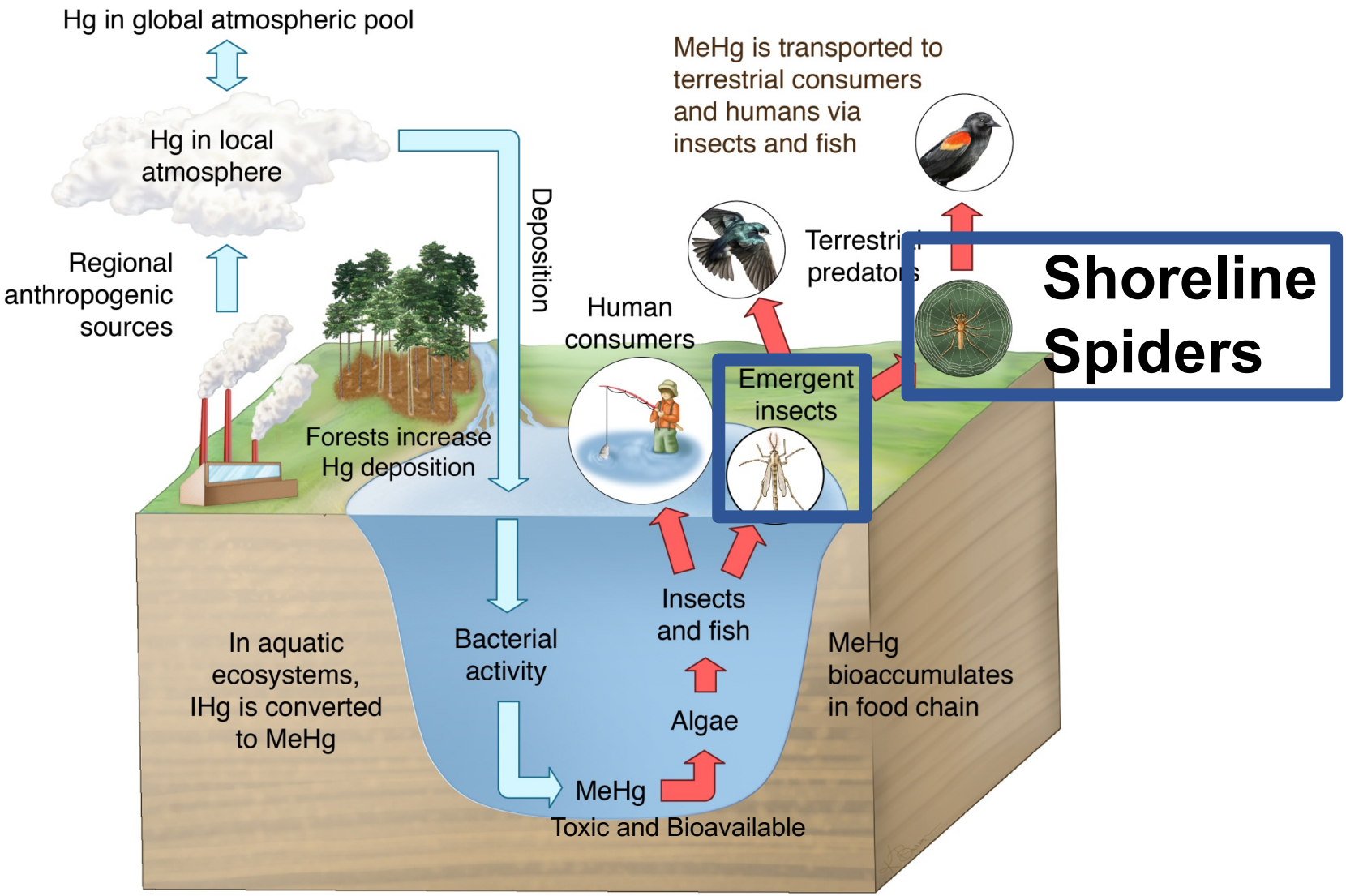


Sentinels

Species that serve to map the bioavailable fraction of pollution in an ecosystem by retaining the pollutants in their tissues.

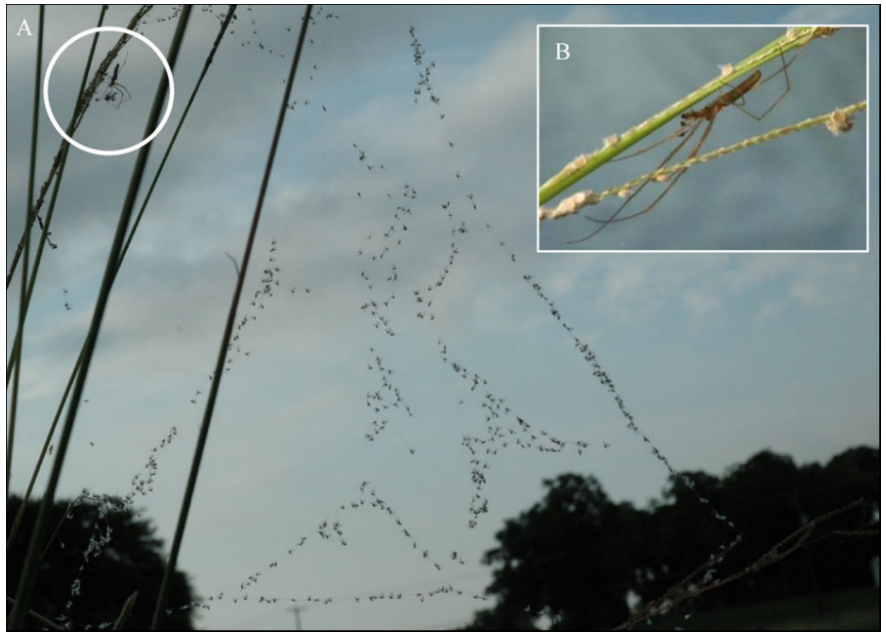
Beeby 2001

Shoreline Spiders as Sentinels of Methylmercury Contamination



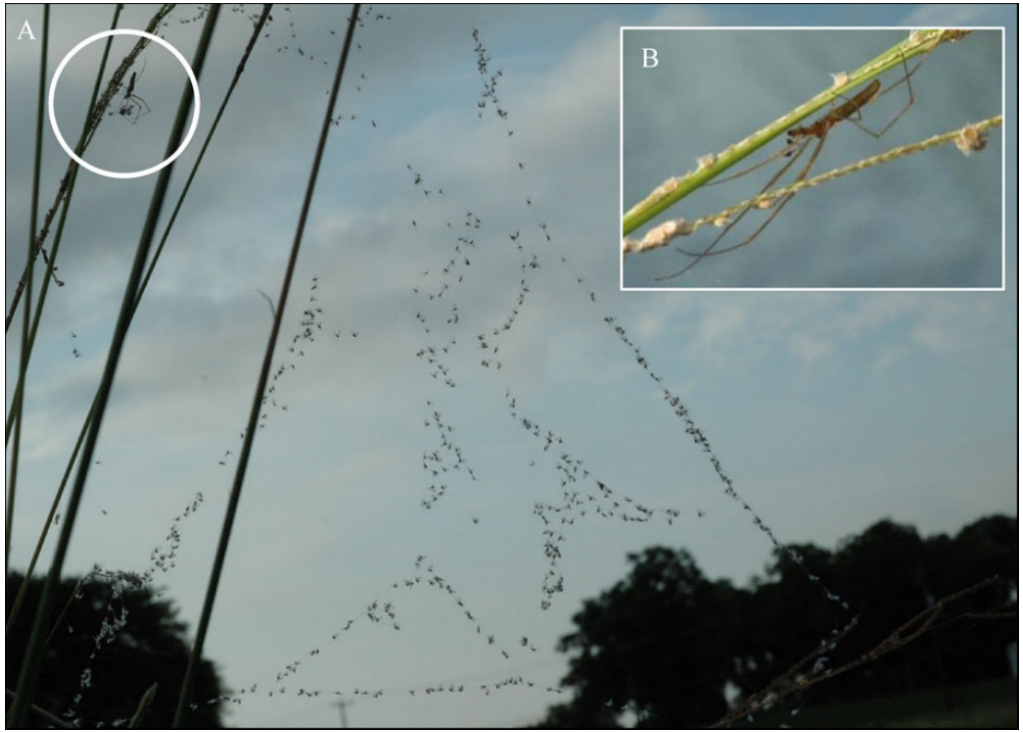
Traits of Shoreline Spiders as Sentinels

- **Contaminated with aquatic pollutants due to their diet**
- **Widely distributed**
- **Highly abundant**
- **Easily sampled**



Long-jawed orb weaver spider

Utilization of Long-Jawed Orb Weavers



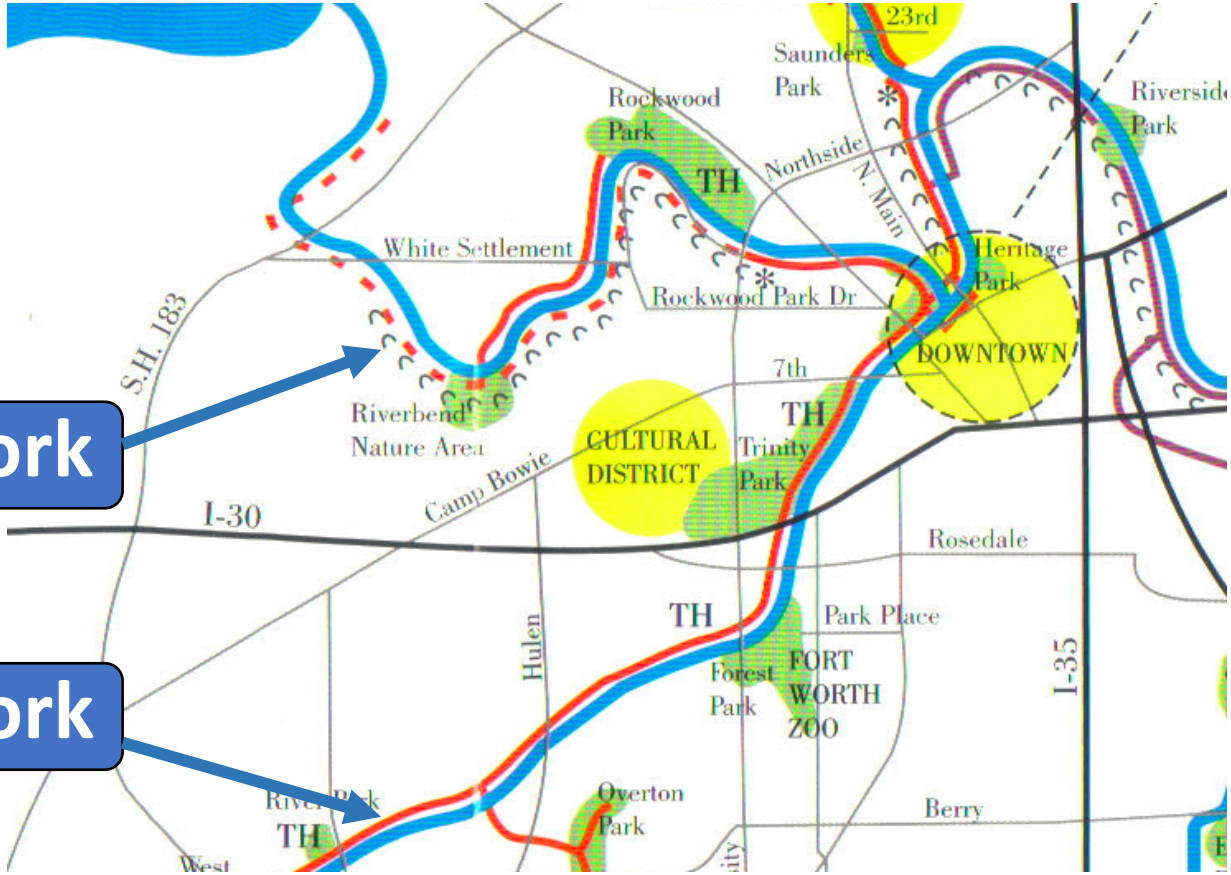
Long-jawed orb weaver spider

- Over 30 studies have measured levels of environmental contaminants in long-jawed orb weavers
- However, no studies to date have used long-jawed orb weavers as sentinels to explore levels of contamination in unmonitored environments

Objective

Test the hypothesis that long-jawed orb weavers can be used as sentinels to evaluate MeHg contamination of river food webs

Trinity River



- Previous study showed mercury contamination in both forks
- Results suggested the Clear Fork may be more contaminated than the West Fork - sample size not large enough to confirm

The Question

Do the two forks of the Trinity River have different levels of mercury contamination?

Approach

Conduct a study of Hg in spiders and fish in the Clear Fork and the West Fork of the Trinity River

Study of Long-Jawed Orb Weavers in the Two Forks

Total of 1,150 spiders collected

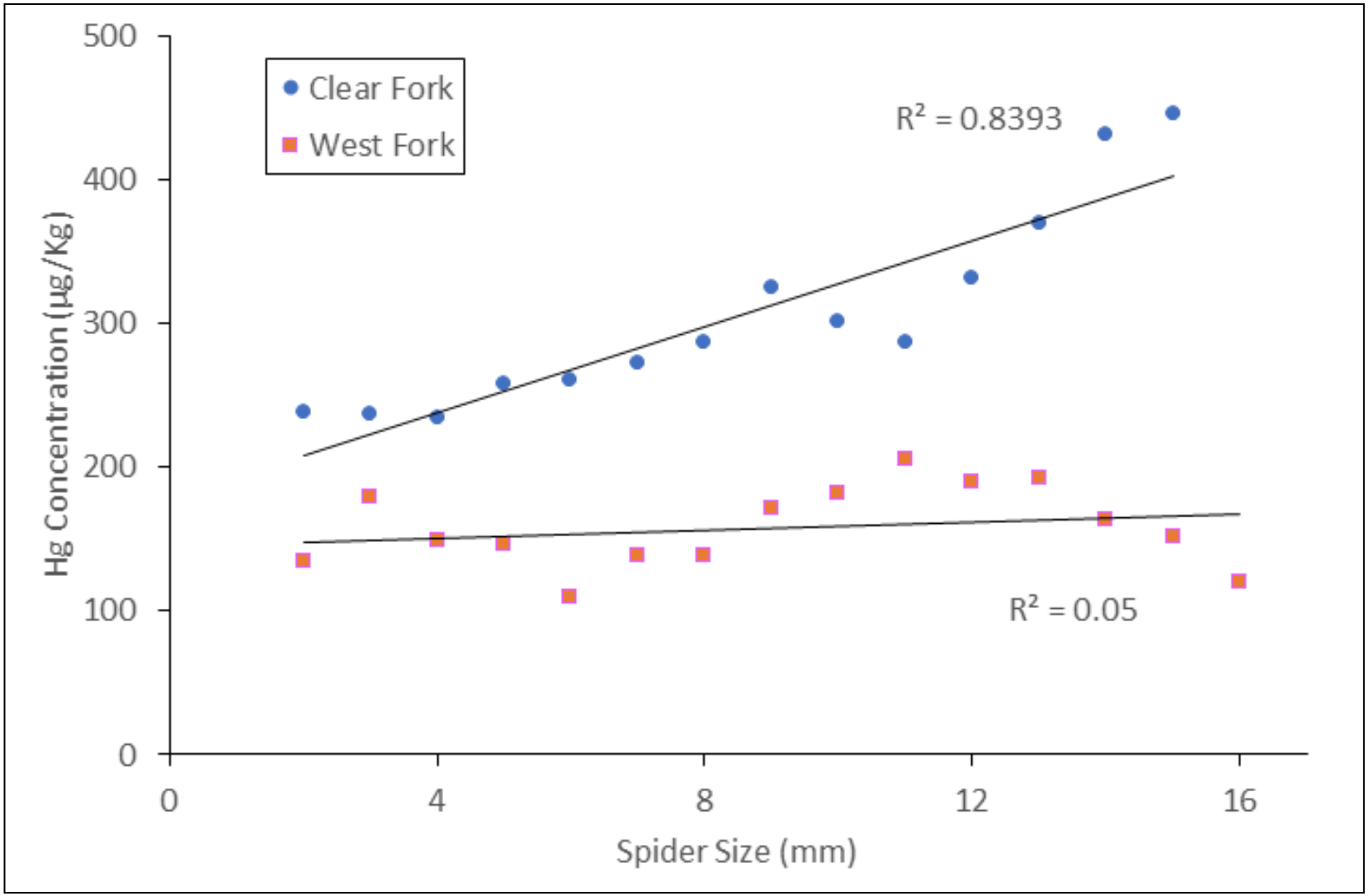
June – August 2019

Spider Mercury Analysis

- Spiders collected and preserved in 95% ethanol
- Leg length measured
- Sorted by leg length into different size categories
- Dried and composited
- Mercury analyzed using direct Hg analysis

Total Hg (THg) = DMA-80 at TCU
%-MeHg = Value derived from literature

Results


Clear Fork
West Fork
R² = 0.8393
R² = 0.05
Hg Concentration (µg/Kg)
Spider Size (mm)
500
400
300
200
100
0
0
4
8
12
16

Study of Hg in Fish in the Two Forks

June – August 2019

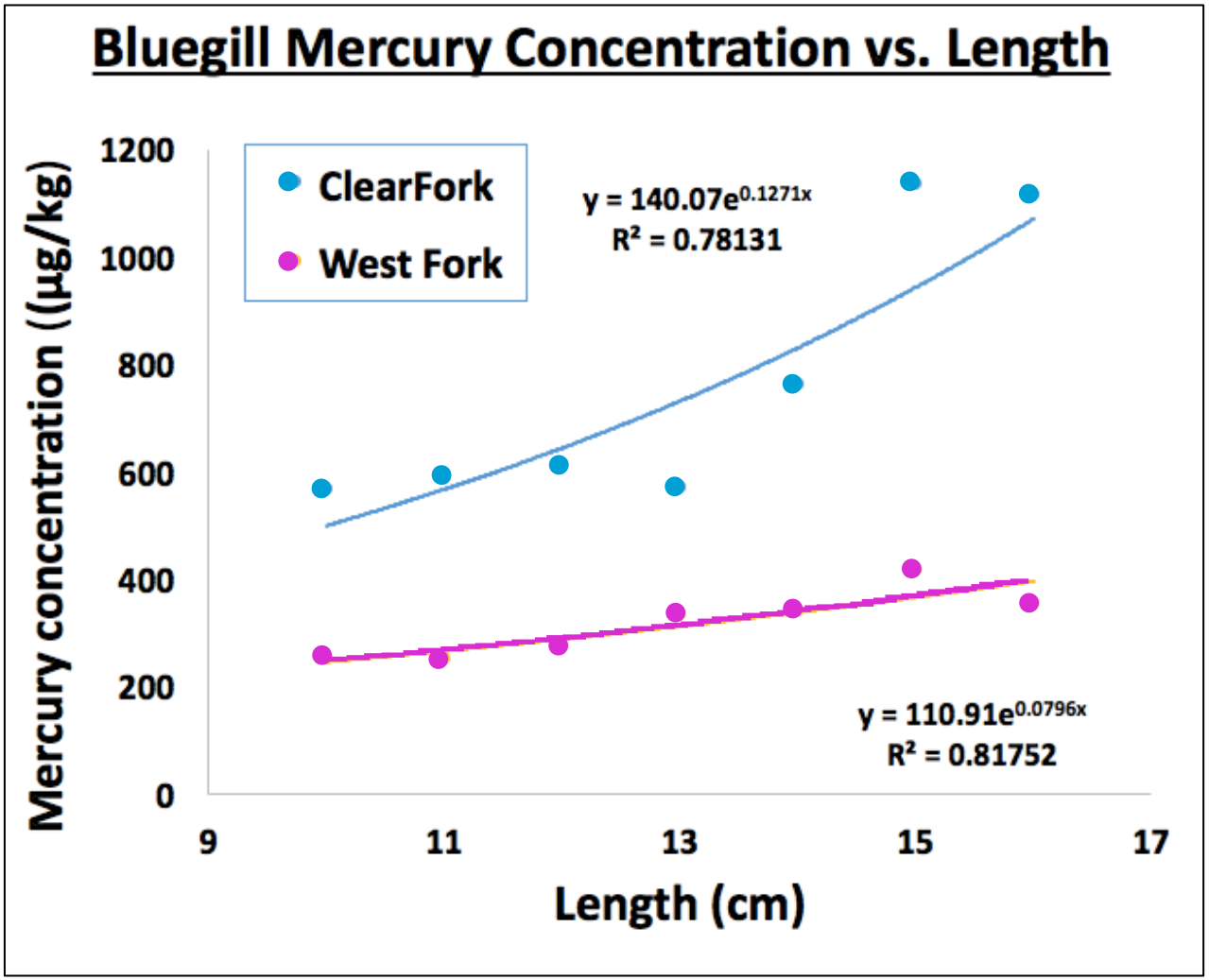
60-75 bluegill caught from each fork

Bluegill Mercury Analysis

- Euthanized fish in bucket of MS-222
- Total length measured
- Sorted into size categories by total length
- Dried and composited
- Mercury analyzed using direct Hg analysis

Total Hg (THg) = DMA-80 at TCU
%-MeHg = Value derived from literature

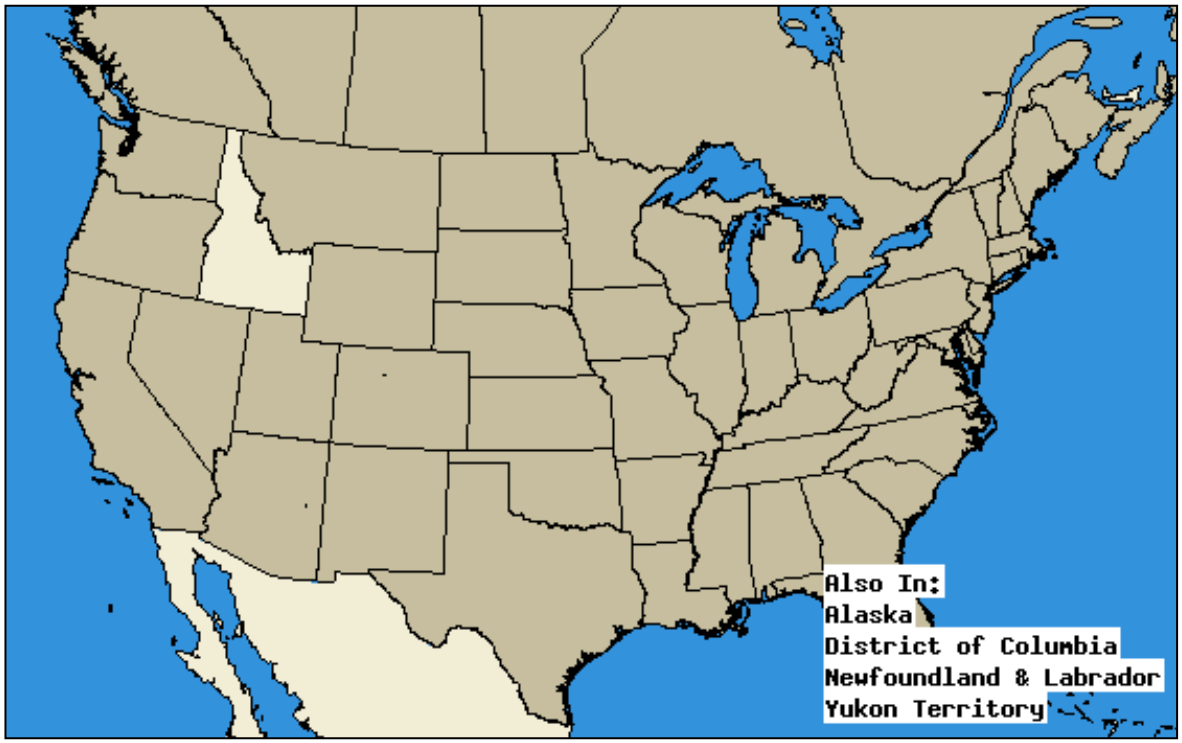
Relationship between Bluegill Length and Hg Concentration



Discussion

- **Mercury concentrations in long-jawed orb weavers accurately predicted that methylmercury contamination was higher in the Clear Fork than the West Fork, as confirmed by study of bluegill**

Conclusion



This is one of the first studies to show that shoreline spiders can be used as sentinels of mercury contamination of river systems

Acknowledgements

- **Honors Committee Members Dr. David Minter and Dr. Eric Simanek**
- **Garrett Wallace, Amal Khan and Paxton Shorow**
- **TCU SERC Funding**


Questions?

MeHg Availability and Between-Year Water Level Fluctuation

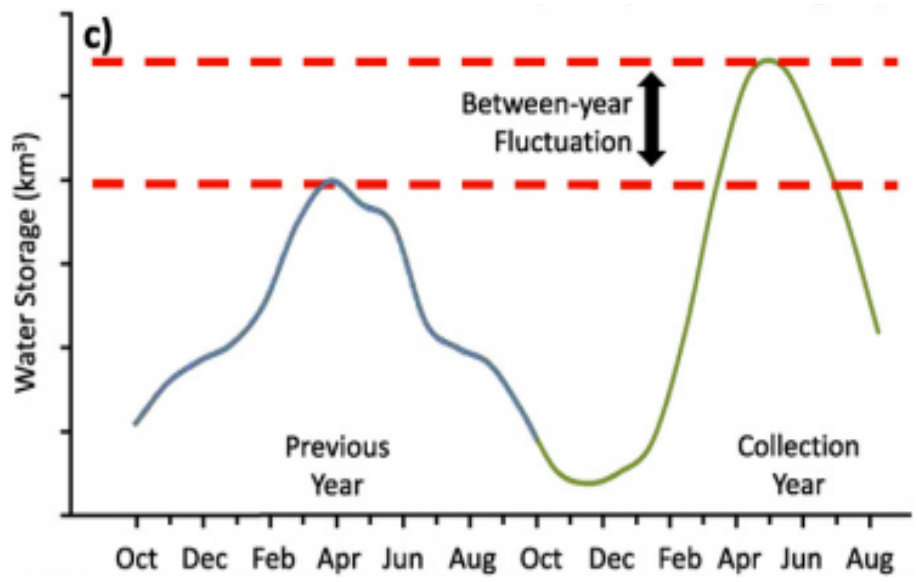


Fig. 1. Conceptual diagram detailing the calculation of three water management parameters: a) timing of minimum water storage; b) within-year change in water storage; and c) between-year change in water storage. All three parameters were averaged over the five-years preceding each fish collection.

Willacker et al. 2016

Water level fluctuations increase:

1. **Hg methylation in the sediments**
2. **MeHg contamination of the food web**

Benbrook Lake

Flood control reservoir that has <u>high</u> between-year fluctuations in water levels (maximum 35ft)

Lake Worth

Flow-through reservoir (not designed for flood control) and has low between year fluctuations in water levels (Maximum 7ft)