24-Hour Characterization of Mercury in Wetland Flora of Sallie's Fen

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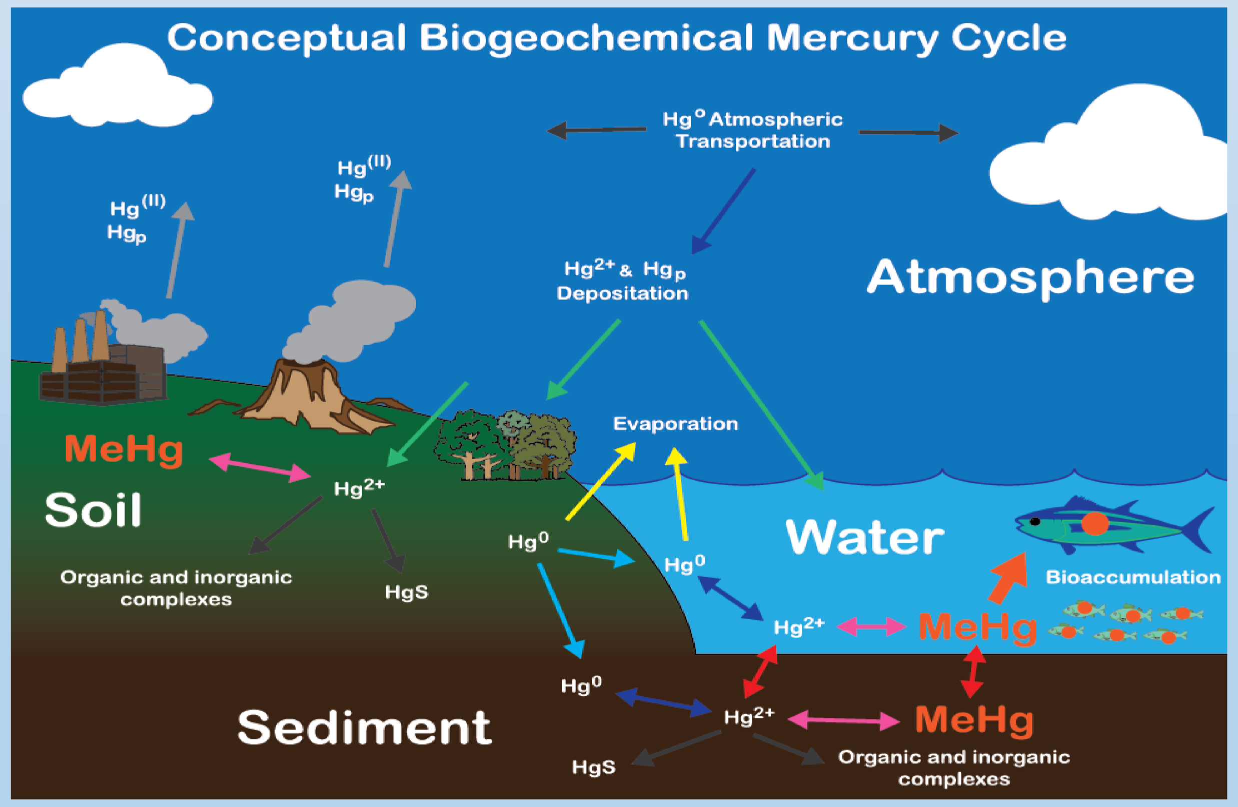
Motivation

- Any amount of mercury is biologically harmful.[1]
- Readily forms a variety of ions and complexes.[1]
- Easily Integrates, transfers, and biomagnifies within and between ecosystems.
- Economic loss due to decreased IQ & productivity: $8.7 billion[2]
- Mercury has been shown to exhibit a diurnal response to solar radiation and temperature, whereby gaseous mercury is released into from the surface of vegetation, soil and bodies of water during peak hours into the atmosphere. Post-peak hours show a depositional effect.



Mercury in Wetlands

- Have the ability to acquire, store & release significant amounts of mercury. Specifically, methyl mercury (the most toxic form).
- Transfers mercury to and from the atmosphere, hydrosphere, and various levels of the food chain.

Research Questions

- Does Hg content in leaves fluctuate predictably over a 24-hour period?
- Do evergreen leaves accumulate additional mercury as they age through the years?
- What is the nature of the mercury content that is released daily and subsequently redeposited? Is there measurable deposited Hg that can be washed off the leaf?

Methods

Leaves were sampled from the dominant wetland vegetation species, stored in individual bags and chilled for transport.

Sample were split & one half was rinsed (first half of the sample remains unmodified)

Frozen (24 hours)
Vacuum freeze dried (minimum 24 hours)
Ground into near-homogeneous sample.

Total Mercury analysis via thermal decomposition using DMA-80.

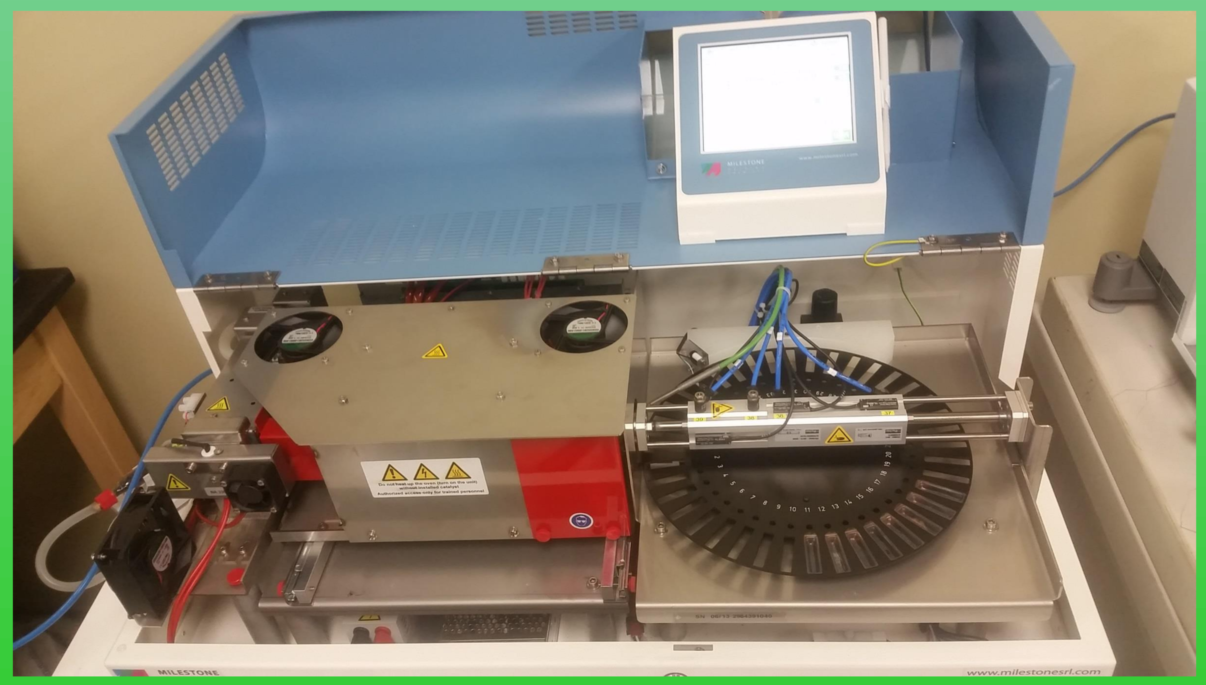


Figure 1: Box Alder - Comparison of [Hg] in Rinsed Versus Non-Rinsed Samples

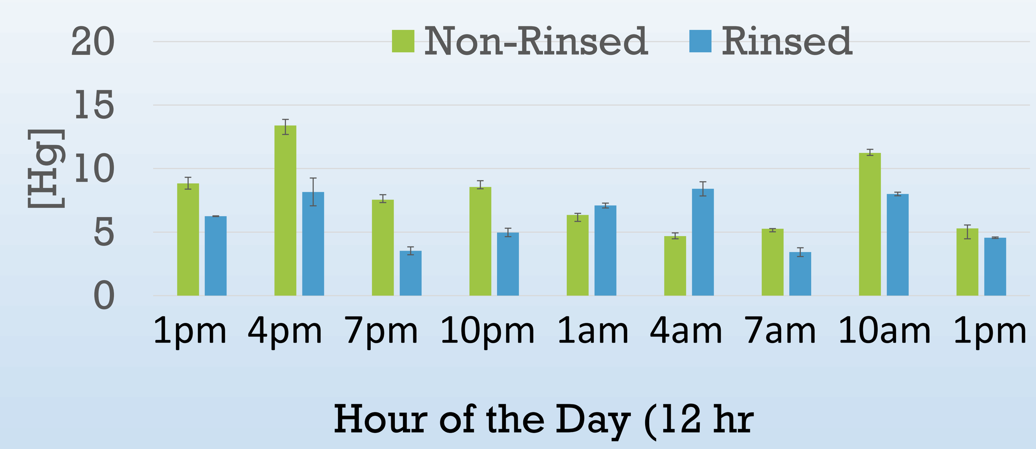


Figure 2: Red Maple - Comparison of [Hg] in Rinsed Versus Non-Rinsed Samples

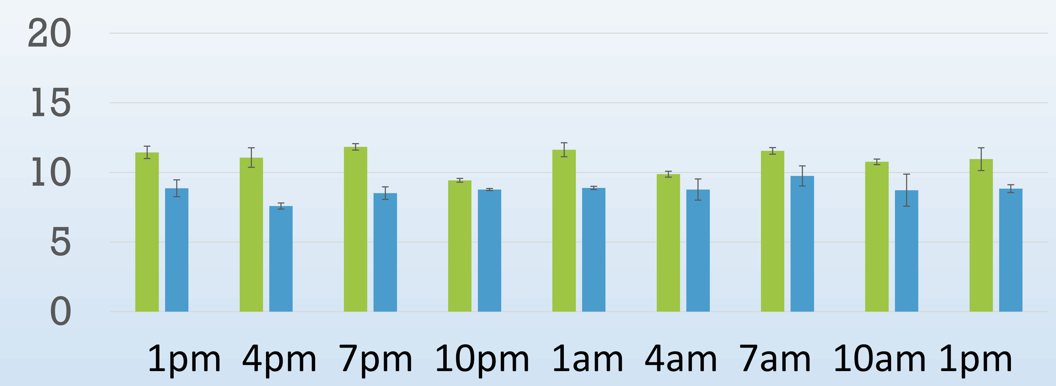


Figure 3: Sedge - Comparison of [Hg] in Rinsed Versus Non-Rinsed Samples

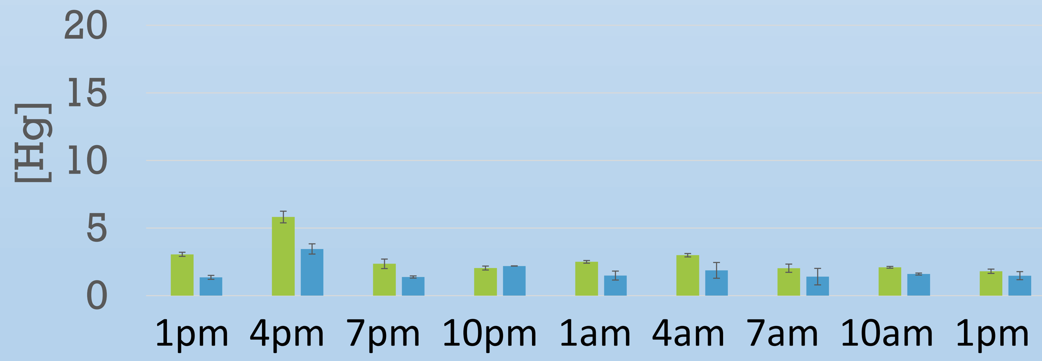
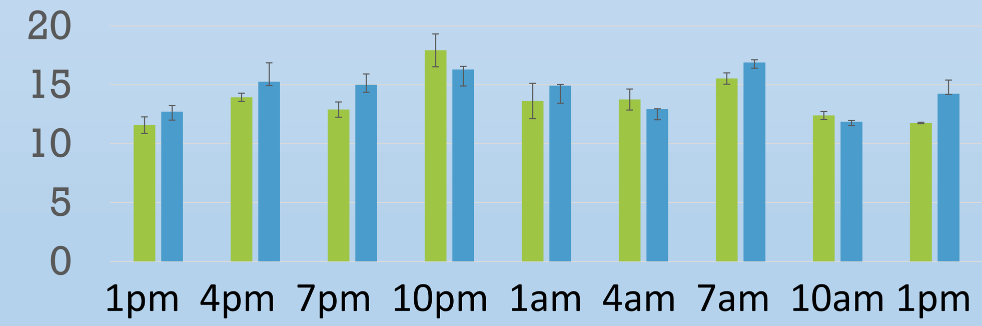


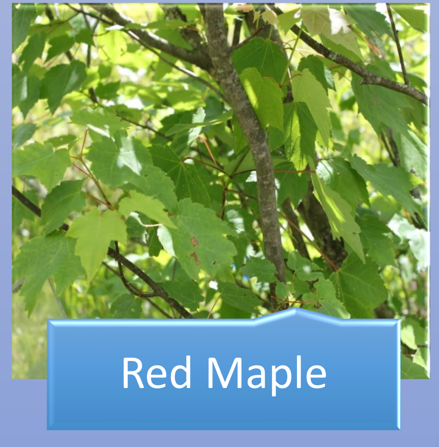
Figure 4: Sphagnum - Comparison of [Hg] in Rinsed Versus Non-Rinsed Samples



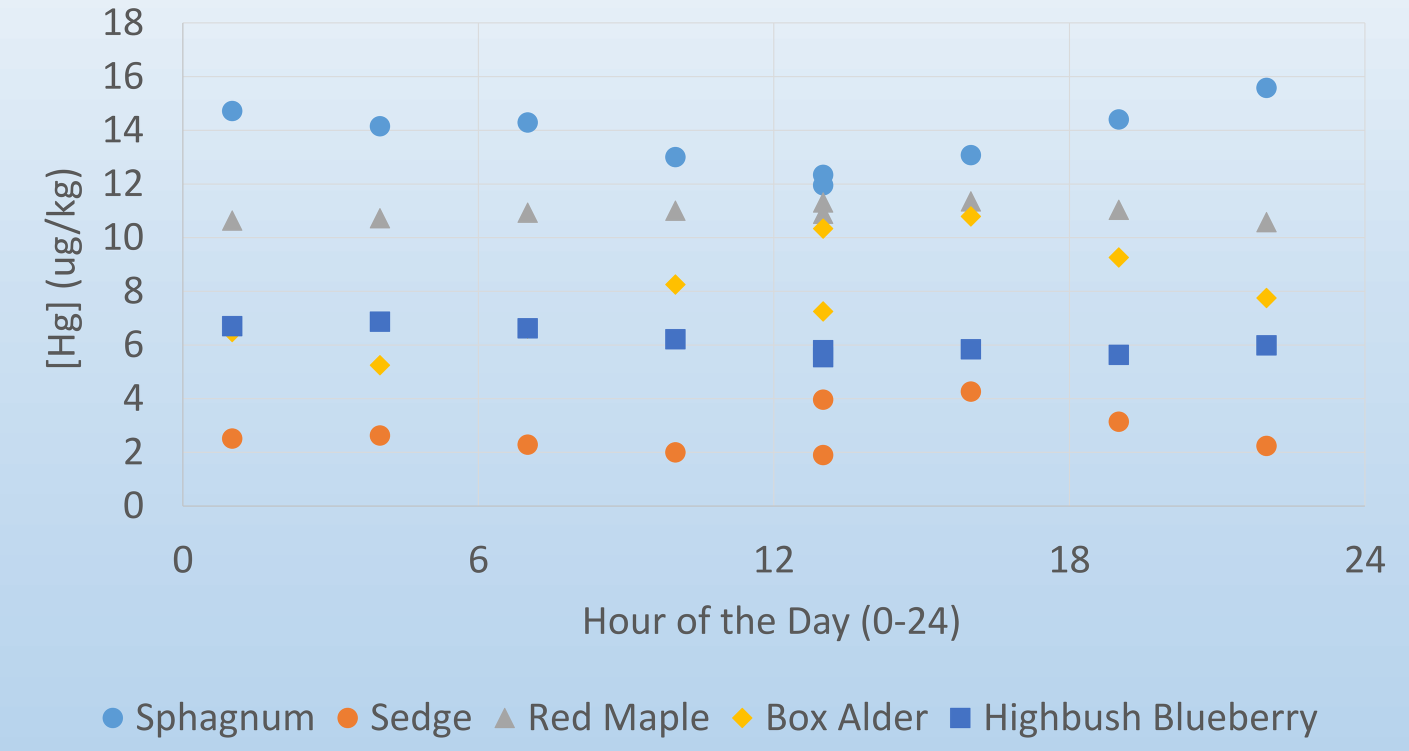
Error bars denote 1 sigma

- The *Sphagnum* stores the largest amounts of mercury whereas the Sedge stores the least.
- The Box Alder and the Sedge may be showing the strongest response to diurnal mercury release but more work is needed to determine strength of these relationships.
- Red Maple and Box Alder were the wide leaf sites but Red Maple showed little variation throughout the sampling period. It is difficult to determine whether the Box Alder's variation throughout the day is due to poor control for old vs. young leaves or if the Maple's lack of variability is due to a lack of significant measurable diurnal response.
- Rinsing resulted in 23 samples showing a net mercury loss, five samples showing a net gain and eight samples showing no change when rinsed.
  - Summary: Net [Hg] change (all samples): -38.33 μg/kg; Average [Hg] change (per sample): -1.06 μg/kg

Meet The Plants



Summary of Results: 3-pt (.25-.5-.25) Weighted Average [Hg] vs Hour of the Day (non-rinsed only)



Conclusions/Implications

- Rinsing samples may be a useful method for estimating percentage of easily removable mercury. However, it may be counterproductive for *Sphagnum*.
- It is likely that the amount of mercury that is released and redeposited daily due to photochemical reactions is very small compared to the total mercury in the leaves, thereby making the measurements of that change very difficult. Nevertheless, some sites showed the predicted response.
- Understanding the distribution of mercury in vegetation both its variation by species and throughout the day-time is critical for those working to scale-up from the plot size level to the regional or global level using remote sensing techniques.

Future Work

- Future sampling should control for new leaves versus old leaves, time of the year (time within the growing season), and time of the day as well as identifying differences in stomatal density and leaf surface area.

Sources:

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(4) Schofield WB, (1985) *Introduction to Bryology*. Macmillan Publishing Company, New York.
(5) McLelland JK and Rock, CA (1988) Pretreating landfill leachate with peat to remove metals. Warer Air Soil Poll 37: 203-215
(6) R. Azevedo, E. Rodriguez (2012) Phytotoxicity of Mercury in Plants: A Review

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