Bioaccumulation of Methylmercury in Vermont Vernal Pools

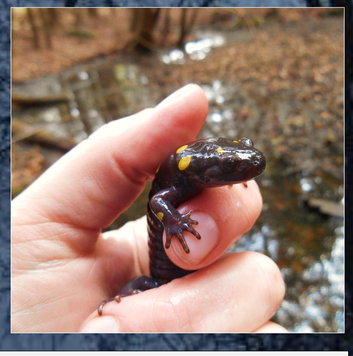
Steve Faccio[1], Kate L. Buckman[2], Vivien Taylor[3], Amanda Curtis[2]

[1]Vermont Center for Ecostudies, PO Box 420, Norwich, VT 05055, sfaccio@vtecostudies.org
[2]Department of Biological Sciences, Dartmouth College, Hanover, NH 03755, Kate.L.Buckman@dartmouth.edu, Amanda.Curtis@darmouth.edu
[3]Department of Earth Sciences, Dartmouth College, Hanover, NH 03755, Vivien.F.Taylor@dartmouth.edu

INTRODUCTION

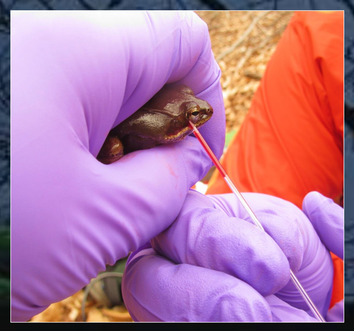
Vernal pools are temporary seasonal wetlands that provide crucial habitat to a variety of amphibians and invertebrate species. In the Northeast, mercury (Hg) contamination in vernal pools occurs through atmospheric deposition, leaf fall, and snowmelt, and is dependent upon a number of landscape variables (forest cover type, land use, pool size, pH, etc). Since vernal pools typically have high organic matter, low pH, and low oxygen levels, they provide ideal conditions for the conversion of mercury to its more toxic and bioavailable form, methylmercury (MeHg). Yet little is known about the presence, cycling, and methylation rates of Hg in vernal pools, its effects on vernal pool fauna, and potential export into terrestrial systems.

We have been investigating the role of land-use and landscape characteristics on the production and transfer of methylmercury in vernal pool foodwebs, from water, soil, and leaf litter, to invertebrates from several trophic levels, and amphibians of all life stages. Here we present preliminary results of methylmercury concentrations in wood frog and spotted salamander eggs, larvae, and adults from six vernal pools in east-central Vermont.



METHODS

- Six pools (3 coniferous and 3 deciduous), were chosen to examine how forest type impacts Hg accumulation and trophic transfer in wood frogs and spotted salamanders
  - Pools were selected using a paired sample design:
    - Podunk deciduous vs. Podunk coniferous
    - Downer deciduous vs. Shen coniferous
    - Mauran deciduous vs. Pomfret coniferous
- Toe-clip (tip of longest toe on hind foot; see figure at right), and blood samples from facial vein were collected from adult wood frogs.
- Tail-tip (ca. 1 cm) and blood samples were collected from adult spotted salamanders.
- Egg masses, and early and late stage larvae/tadpoles were collected from both species.
- MeHg analysis was done by species specific isotope dilution using an automated MERX-M interfaced with an Element 2 ICP-Mass Spectrometer



RESULTS

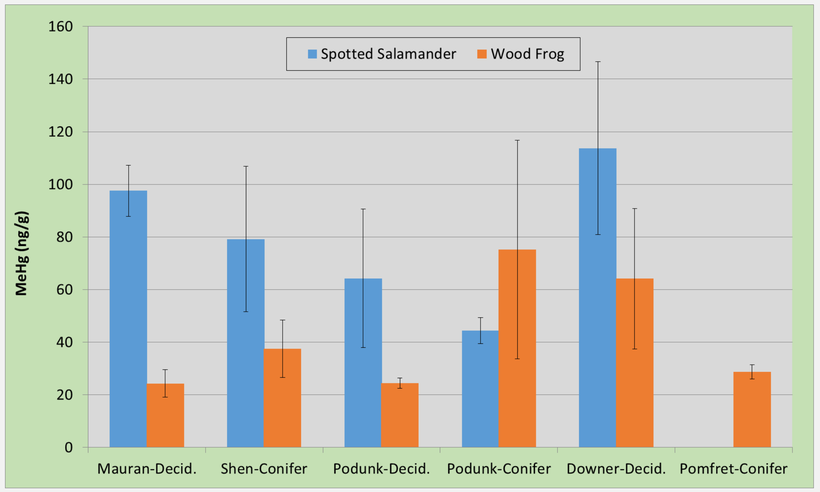


Figure 1. Mean MeHg (ng/g) levels in adult spotted salamander tail-tips (n=18) and wood frog toes (n=23) by pool/habitat. MeHg was significantly higher in salamanders (79.7 ±2.5 SE) compared to frogs (42.0 ±1.85 SE).

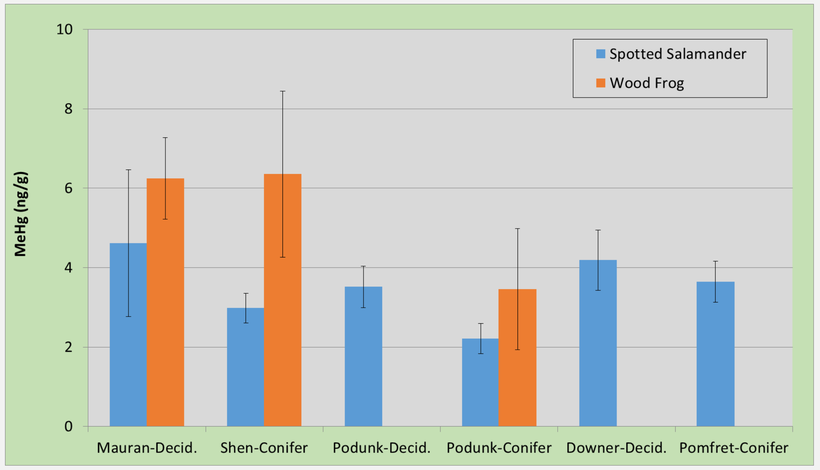


Figure 2. Mean MeHg (ng/g) levels in spotted salamander (n=24) and wood frog (n=12) egg masses by pool/habitat.

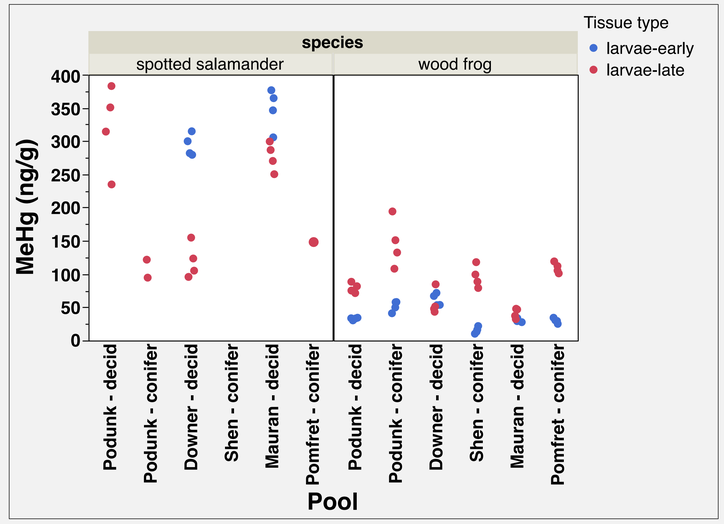


Figure 3. MeHg (ng/g) levels in spotted salamander larvae (n=23) and wood frog tadpoles (n=48) by pool/habitat.

PRELIMINARY CONCLUSIONS

Adults (Figure 1):

- Preliminary data indicate that cover type did not influence adult MeHg concentration.
- MeHg concentrations in salamanders was nearly twice that of frogs.
- Analytical issues using frog toe-clips (e.g. very small biomass with bone included), much better to use blood (easy to sample with less impact to individuals).

Eggs (Figure 2):

- Concentrations of MeHg in eggs were low with no indication of tree cover influence.
- MeHg was higher in wood frog eggs, but not all samples analyzed to-date.

Larvae/Tadpoles (Figure 3):

- Mean MeHg concentrations were significantly higher in salamander larvae (252.21) compared to frogs (62.48).
- Late-stage salamander larvae in deciduous cover had higher MeHg concentration compared to those in coniferous (but sample sizes were small).
- MeHg concentration in frog tadpoles increased with age at coniferous pools, while no consistent trend was evident at deciduous sites.

Future Directions:

- Include additional samples collected in 2016.
- Examine MeHg concentrations of invertebrate samples from all trophic levels.
- Examine effects of water chemistry and land use on Hg/MeHg concentrations in fauna (amphibians and invertebrates), water, soil, and leaf litter across pools.

ACKNOWLEDGEMENTS

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