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2004 EPA STAR Graduate Fellowship Conference *Next Generation Scientists—Next Opportunities*

Explaining plant diversity in wetlands: The role of mosses in fen nutrient dynamics

Overview

Nutrient-limited, mineral-rich fen wetlands support high plant diversity and many rare species, making them critical conservation targets; however, the mechanisms supporting such diversity under nutrient limitation are poorly understood. The moss layer is known to mediate nutrient availability in some peatland systems, but its role in fen nutrient dynamics is unclear. By clarifying the role of mosses in fen nutrient cycling, this research will contribute to the mechanistic understanding of fen diversity essential to effective conservation.

Project goals

- To identify environmental factors that support a dominant moss layer in rich fens.
- To investigate mechanisms by which fen bryophytes obtain and cycle nutrients, particularly phosphorus (P; often limiting in fens).
- To assess implications for the growth and composition of the vascular plant community, and therefore for rich fen diversity and rare plant species.

Campylium stellatum, the dominant species in the moss removal pilot (treatments: moss layer removed, replaced functionally with wood fiber, or replaced with transplanted moss). Photo by F. R. Wesley.

Approach to date

(1) Field surveys to explore bryophyte association with environmental factors (5 sites, 5 plots/site)

(2) Fertilization to assess bryophyte nutrient uptake (7 treatments, 5 plots/tmt)

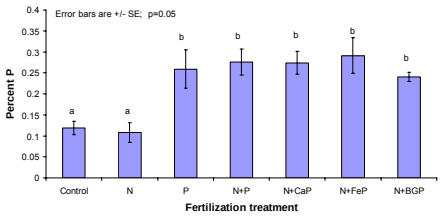
(3) Moss removal to determine moss effects on physical/chemical conditions that influence P availability (5 blocks, 4 treatments)

Initial findings

(1) Fen bryophyte cover in 5 New York fens was positively associated with light availability and vascular plant biomass, negatively associated with litter, and not associated with soil elemental composition (Figure 1).

(2) Regardless of the form of P applied, fertilization in a New York fen increased P concentration in bryophyte tissue (Figure 2).

Figure 2. Effects of fertilization on bryophyte tissue P (Fe-P=iron-bound; CaP=calcium-bound; BGP=organic P).



Mott Rd. Fen South, Kalamazoo Co., MI, Block 1

(3) The moss layer in Michigan fen plots moderated extremes of soil surface temperature but did not affect the average (Figure 3). The moss layer did not affect other variables that could increase P availability (pH – not shown, oxygen level – Figure 4).

Figure 3. Average temperature over time in control plots vs. moss removal treatment.

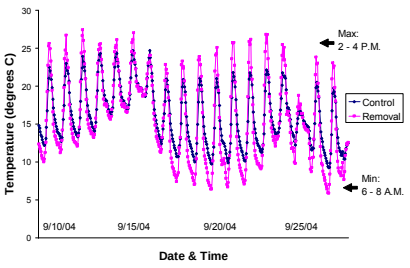


Figure 4. Change in reduced iron (Fe^{2+}) by treatment, post - pre. An increase in Fe^{2+} indicates lower oxygen and potentially higher P availability.

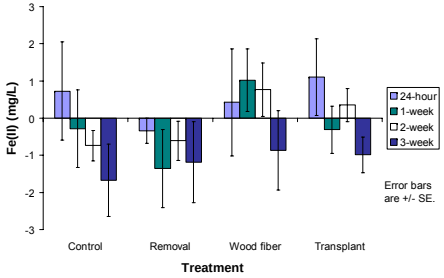
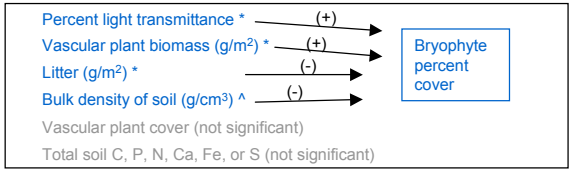


Figure 1. Predictors of fen bryophyte cover (multiple regression in SAS PROC MIXED; * = p<0.05; ^ = p<0.10; (+/-) = direction of relationship)



Implications and future work

- Interactions between vascular and non-vascular plants are likely important in determining fen vegetation composition.
- With fertilization, fen bryophytes may access mineral-bound forms of P not typically available to plants.
- However, the moss layer did not change physical/chemical conditions in ways that might enable bryophytes to access mineral-bound P from shallow soils.
- Bryophyte access to soil nutrients may be local (<1 cm); or, bryophytes may depend on organic or translocated P.
- Future work will explore other mechanisms of nutrient uptake and resulting vascular/non-vascular interactions.
- A clear understanding of these interactions will provide new tools for conservation of these vulnerable wetlands.

Acknowledgements

Coauthors include Barbara Bedford and Eli Perrone (Cornell) and Steve Hamilton (MSU Kellogg Biological Station). For additional funding, I thank the Cornell Program in Biogeochemistry and Environmental Biocomplexity, the National Science Foundation, and The Nature Conservancy. For dedicated work on this project, I thank Sara Alcorn, Kathy Bailey, Anne Bjorkman, Emily Butler, Stephanie Chin, Melanie Hayn, Peter Weishampel, and Ben Wolfe.

This fellow is sponsored by EPA's STAR or Greater Research Opportunities (GRO) Program.