Nutrient Stoichiometry and Microbial Activity Across a Permafrost thaw Gradient

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Introduction

Temperatures in the Arctic and sub-Arctic have doubled at twice the rate of the global average, consequently causing a loss of permafrost with cascading effects on vegetation community structure and microbial activity. At the Stordalen mire in Abisko Sweden (Fig. 1), permafrost thaw induces the development of different wetland types (Fig. 2). Research has shown that substantial amounts of nutrients such as N and P are immediately released as permafrost thaws. Here, we explore the potential role of nutrient stoichiometry on carbon cycling controls across four wetland communities representing various stages in permafrost thaw.

Figure 1. Abisko Sweden, 100 miles north of the Arctic circle

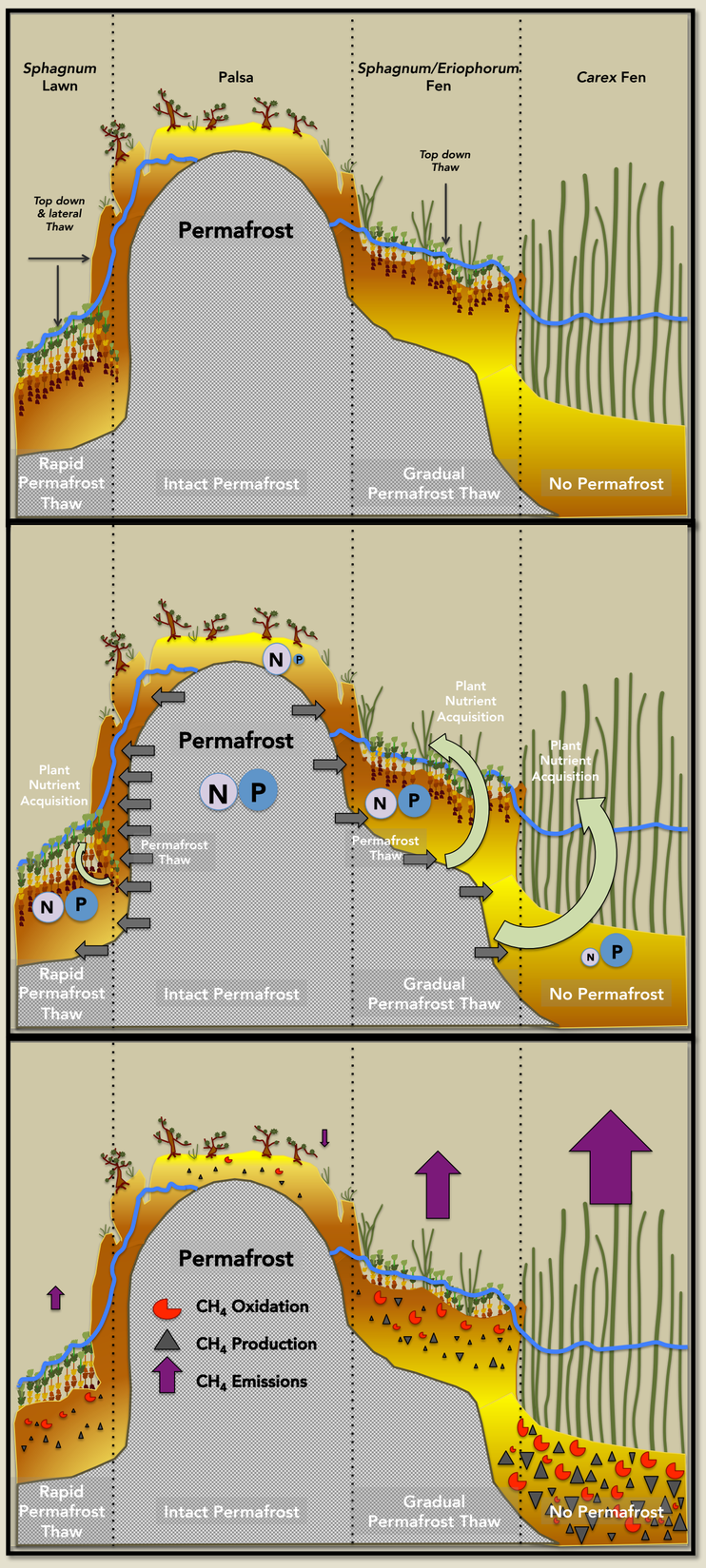


Figure 2. Conceptual diagram of wetland types and nutrient and methane dynamics impacted by permafrost thaw

Nutrient Stoichiometry

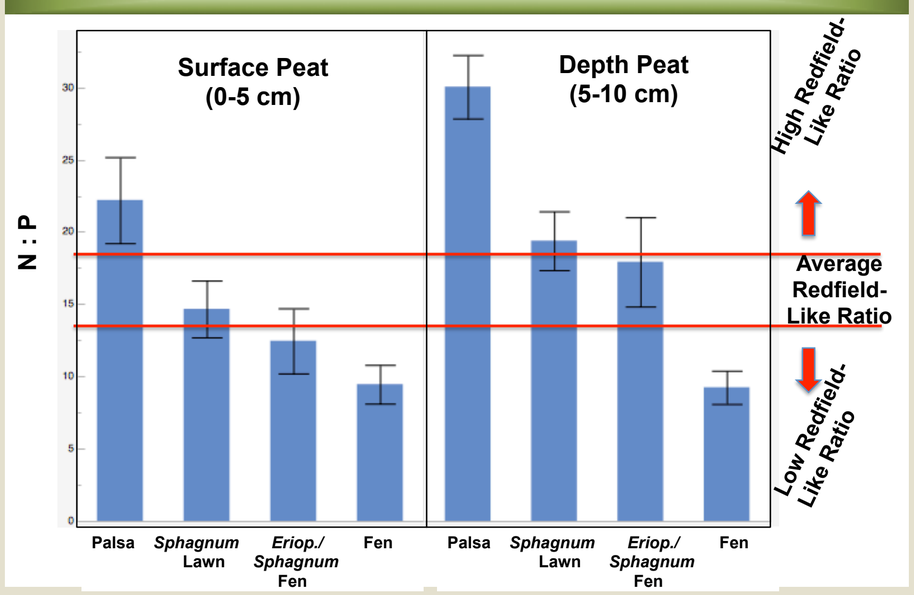
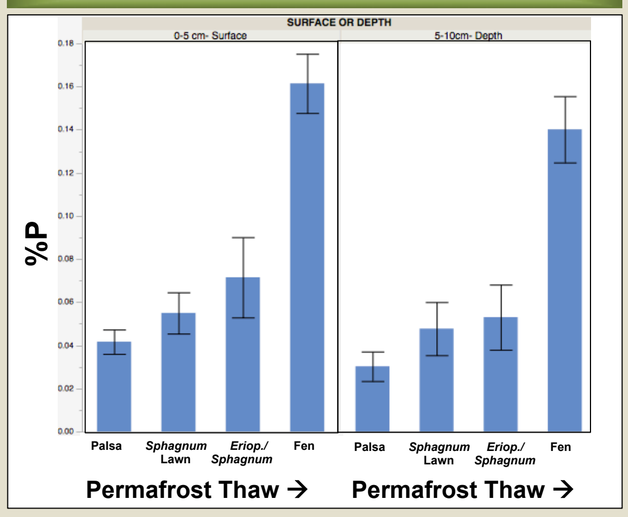


Figure 3. N:P indicates N and P limitation across wetland types impacted by permafrost thaw

Nutrient concentrations



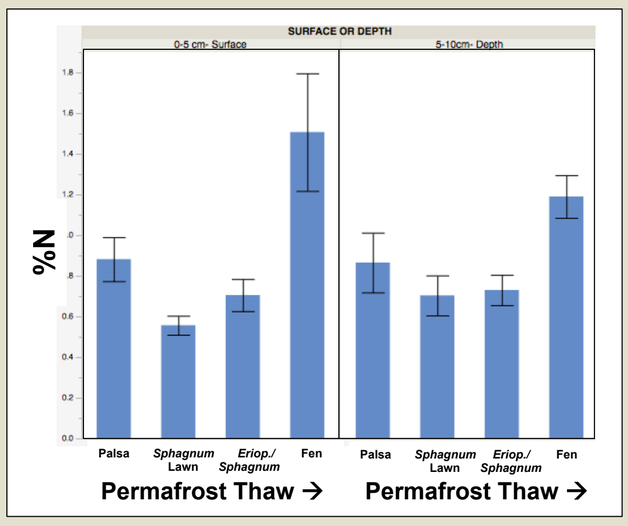


Figure 4. % N and %P across four wetland Community types across a permafrost thaw gradient

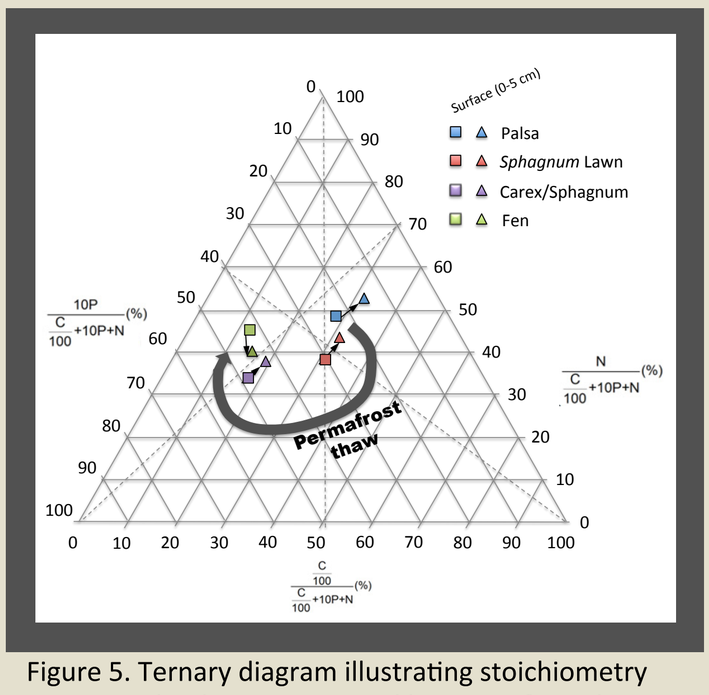


Figure 5. Ternary diagram illustrating stoichiometry across wetland types impacted by permafrost thaw

C:P & Methane Oxidation

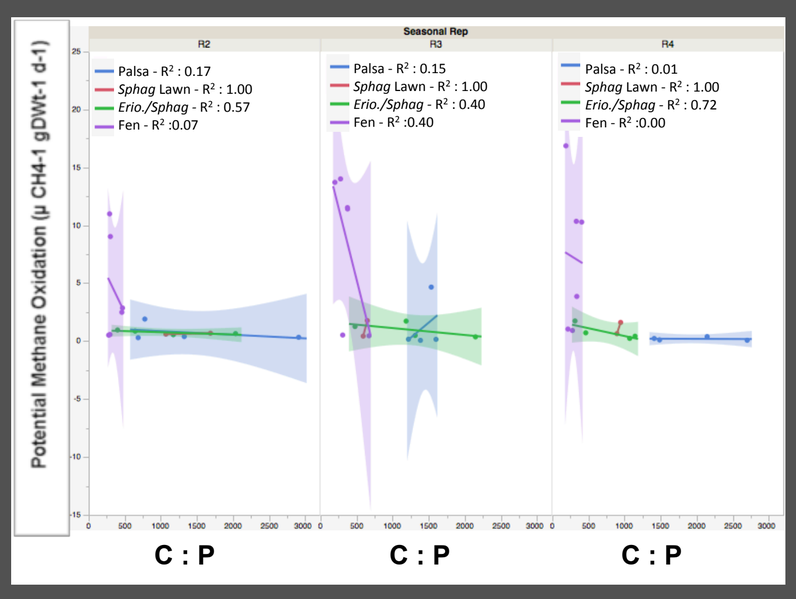


Figure 6. C:P ratio and potential methane oxidation indicate strong correlations depending on seasonality and wetland community type

Enzyme Activities

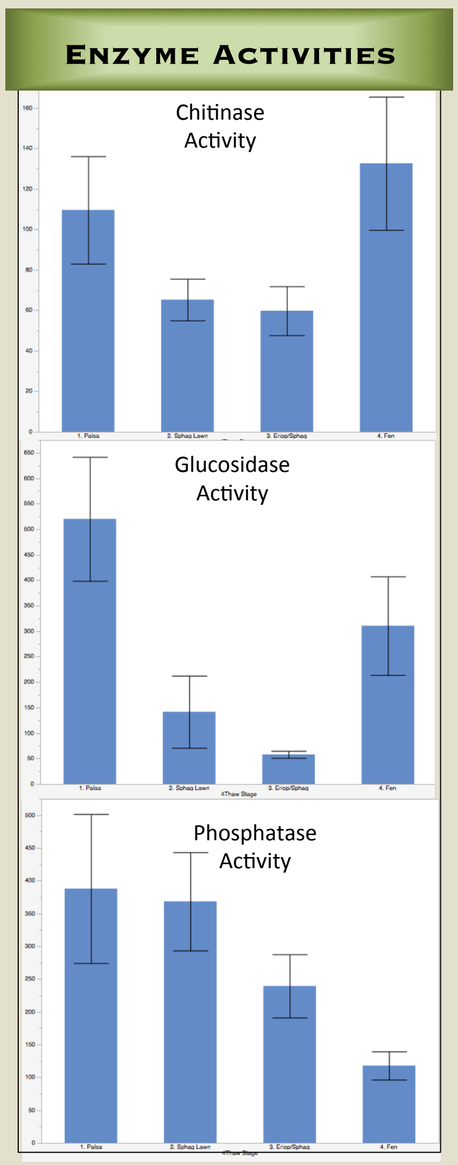
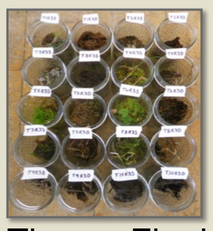


Figure 7. Chitinase, glucosidase, phosphatase enzyme activity across four wetland community types across a permafrost thaw gradient

Methods

Peat surface and depth cores were investigated for potential CH_4 oxidation rates using 4000 ppm CH_4 incubation techniques. Cores of varying vegetation were assessed through the 2015 Field season (n=3).



Peat cores were dried, ground, and analyzed for % Nitrogen (N), % Carbon (C), ^{13}C, and ^{15}N using ThermoFinnigan Delta Plus mass spectrometer, coupled with Costech elemental analyzer.

Peat cores were also acid digested and analyzed for Phosphorus (P) using inductively coupled plasma mass spectrometer (ICP).

Phosphatase, chitinase, and glucosidase activities were investigated using a BMG Fluorostar Microplate reader (Fig. 3.)

Conclusions

- Nutrient stoichiometry changes across the different wetland types induced by permafrost thaw.
- Peat in the palsa illustrate low P limitation while fen communities are strongly N limited
- Strong correlations in certain wetland types may indicate that nutrient stoichiometry may play a role in microbial processes

Acknowledgments

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