Microbial community structure and function in fens: responses to climate change

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Presentation structure

• Project introduction
• Methods
• Preliminary results
• Conclusions
• What comes next
Introduction of the projects

- Response of peatlands to climate change - crucial for global C cycle
- Complexity of organic-mineral layered soil
- Aboveground-belowground traditionally considered isolated
- Microorganism-plant interactions still unclear
Aboveground and belowground feedbacks for nutrient acquisition in fens

Vascular plants

Plant roots

Peat

Bryophytes

Plant litter

Soil microorganisms
Enzymatic activity in upper peat layer and below lying mineral layer of fens

- Phenol oxidase
- β-glucosidase
- Phosphatase
- Chitinase
- Leucine aminopeptidase

- 3 to 8 cm
- 20 to 25 cm
Introduction

• Mineral-rich fens (*Caricion davallianae*)

• *C. flava*, *C. panicea*, *C. flacca*, *Parnassia palustris*, *Potentilla erecta*

• *Palustriella commutata*, *Scorpidium cossonii*
Introduction

- 4 sites along the altitudinal gradient (815 to 2080 m a.s.l.)
- pH 6.5 to 8
- Conductivity 80 to 120 µS.cm\(^{-1}\)
Hypotheses

• (i) Microbial biomass is higher at lower altitudes which is reflected in higher enzymatic activities.

• (ii) Nutrient uptake by microbes decreases with altitude and soil depth.

• (iii) Microbial enzymatic activity is inversely correlated with the microbial nutrient biomass for each specific nutrient.
Study sites
Enney 815 m a.s.l.
Queue de Perche (1700 m a.s.l.)
Marais de la Lia 2080 m a.s.l.
Methods

• Enzymatic activity: extraction of peat samples
  - Phenol oxidase: spectrophotometrically by using 10 mM L-dopa (dihydroxyphenylalanine) solution as substrate according to Pind et al. (1994)
  - Hydrolase activities: using fluorescent substrate according to Freeman et al. (1995)
Methods

• Total microbial nitrogen: Shimadzu TOC-TN analyzer
• Microbial biomass: Phospholipid fatty acid analysis (PLFA)
## Results

Microbial biomass (PLFA) in November

<table>
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<tr>
<th>Site</th>
<th>Layer</th>
<th>Gram +</th>
<th>Gram-</th>
<th>Bacteria (Gram + &amp; Gram -)</th>
<th>VAM</th>
<th>Fungi</th>
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µmol (FAME).g⁻¹ dry soil
## Results

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µmol (FAME).g⁻¹ dry soil
Results

Enzymatic activity of phenol oxidase

μmol dicq g⁻¹ h⁻¹

November January March April
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
Altitude: 815 m a.s.l.
Altitude: 1700 m a.s.l.
*
Results

Enzymatic activity of β-glucosidase

µmol MUF g⁻¹ min⁻¹

November January March April

Altitude: 800 m a.s.l.
Altitude: 1700 m a.s.l.

Organic layer
Results

Enzymatic activity of leucine aminopeptidase

µmol MUF g⁻¹ min⁻¹

November January March April

Altitude: 800 m a.s.l.
Altitude: 1700 m a.s.l.

Organic layer
Results

Enzymatic activity of phosphatase

![Bar chart showing enzymatic activity of phosphatase at different altitudes and months. The x-axis represents months (November, January, March, April) and the y-axis represents µmol MUF g⁻¹ min⁻¹. The chart compares activity at 800 m a.s.l. and 1700 m a.s.l. with significance indicated by **.](chart.png)

Organic layer
Results

Total microbial nitrogen

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* Organic layer
Results

Total microbial nitrogen

Altitude: 1700 m a.s.l.
Conclusions

• (i) Microbial biomass is higher at lower altitudes which is reflected in higher enzymatic activities.

• True for microbial biomass, not true for all enzymes in winter
Conclusions

• (ii) Nutrient uptake by microbes decreases with altitude and soil depth.

• True for soil depth, not true for altitude in winter
Conclusions

- (iii) Microbial enzymatic activity is inversely correlated with the microbial nutrient biomass for each specific nutrient.

- More data needed
What comes next

Vascular plants

Plant roots

Peat

Bryophytes

Plant litter

Soil microorganisms
Thank you for your attention...

SCIEX projects NUTRIF and ENZYFEN