Session D, 2017 First Place: Under the Sphagnum: An Observational Analysis of the Relationship Between Distance and Ectomycorrhizal Morphotype Diversity in Larix laricina Within Wetland Ecosystems

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“Under the Sphagnum: An Observational Analysis of the Relationship Between Distance and Ectomycorrhizal Morphotype Diversity in *Larix laricina* Within Wetland Ecosystems

By Max Hermanson, Silus Weckel, Alex Kozisky, and Kyle Kozlowski
Mycorrhizal Fungi

- Form symbiotic relationships with plants
  - Attach to host roots
  - Increase host’s water & nutrient uptake
  - Fungi gains access to carbs

- Ecto vs. Endo
Introduction

• What are ectomycorrhizal fungi?

• Associated with woody plants
  – Betulaceae, Fagaceae, Pinaceae
Inspiration

• Distance from woodland edge in old fields affects EMF colonization
• Roots of adjacent trees can act as sources for fungal colonization among different tree sp.
• EMF diversity is higher in uplands than wetlands
• Higher root density has been correlated with higher EMF diversity
Hypothesis

• $H_0$ - There will be no relationship between EMF morphotype diversity and distance from the edge of the wetland.

• $H_a$ - There will be a negative relationship present on the morphotype diversity of EMF as the distance from the edge of the wetland increases.

• **Independent Variable**: distance from the edge of the wetland

• **Dependent variable**: morphotype diversity of EMF
Presence of Larch

Wetland Interior

Wetland Exterior

Upland
Importance of Study

• Examines relationship between distance and EMF diversity in wetlands
• First CLBS project to study EMFs
• Not much EMF research with *Larix laricina*
Methods

Experimental Design:

• Experimental unit: the three wetlands

• Sample Unit: trees within wetlands
  – Subsample unit: root tips

• The study was replicated in 3 wetlands, with 9 trees sampled from each wetland
Sampling

- Random Tree Selection
- Tree size: DBH less than 3cm
- 10 root tips per tree
- Roots taken from depth of 0-0.25m
Digging for Roots
Root Processing & Morphology

• Dissecting microscopes
• EMF’s were classified based on morphological differences
  – Shape
  – Color
  – *Staining*
• Morphotypes compared to photographs of known EMF associates of *Larix laricina*

^“White Deer”
Results

• Distance into wetland vs. morphotype diversity $p=0.031$, $F=7.22$, $R^2=50.77$
• Comparing 3 sections of each transect $p=0.012$, $F=10$, $DF=2$
• Tukey: Exterior – A, Intermediate – B, Interior – B
<table>
<thead>
<tr>
<th></th>
<th>Shannon-Weiner Diversity Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wetland Exterior</td>
</tr>
<tr>
<td>Fen</td>
<td>0.655</td>
</tr>
<tr>
<td>Forsaith's</td>
<td>0.650</td>
</tr>
<tr>
<td>Lost Pond</td>
<td>0.772</td>
</tr>
</tbody>
</table>
y = -0.0213x + 0.7018
$R^2 = 0.5077$
$p = 0.031$
Mean Diversity

- Wetland Exterior: A
- Wetland Intermediate: B
- Wetland Interior: B

F2 = 10
p = 0.012
## Morphotype Abundance

<table>
<thead>
<tr>
<th>Morphotype</th>
<th>Abundance</th>
<th>Percent of colonization</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Deer</td>
<td>97</td>
<td>52.4</td>
</tr>
<tr>
<td>Mold Deer</td>
<td>31</td>
<td>16.8</td>
</tr>
<tr>
<td>White Pyramid</td>
<td>5</td>
<td>2.7</td>
</tr>
<tr>
<td>Cinnamon Bulge</td>
<td>6</td>
<td>3.2</td>
</tr>
<tr>
<td>Black Fuzzy</td>
<td>32</td>
<td>17.3</td>
</tr>
<tr>
<td>Shroom</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Worm</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Grey Deer</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>Wrinkle Pickle</td>
<td>7</td>
<td>3.8</td>
</tr>
<tr>
<td>Cob Web</td>
<td>3</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>185</strong></td>
<td></td>
</tr>
</tbody>
</table>
Discussion

• Possible explanations for results
  – Larches on border between wetland and upland had root contact with upland trees
  – Moisture levels
    • Soil moisture levels were higher in the wetland interior
    • Plants farther from edge benefit less from mycorrhizal relationship
  – Tree density, nitrogen

• The use of morphotypes for EMF validation
Ways to Improve

• Use more similar wetlands
• Larger sample sizes
• Genetic Analysis
• N, P, K test
• Account for tree age
• Take surveys of surrounding vegetation
• Upland tree surveys along boundaries
Ectomycorrhizae

Hyphae do not penetrate root cells
Future Studies

• The effect of wetland size on diversity
• Correlation between moisture levels and diversity
• Compare pure stands of *Larix laricina*, *Picea mariana*, and mixed stands
Conclusion

• We rejected the null hypothesis (p=0.031)
• There was a relationship between EMF morphotype diversity and distance from the edge of the fen.
Questions?
Acknowledgements

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References

• Agerer, R. (n.d). Exploration types of ectomycorrhizae - A proposal to classify ectomycorrhizal mycelial systems according to their patterns of differentiation and putative ecological importance. Mycorrhiza, 11(2), 107-114.