Diversity of saproxylic fungi and wood decay

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Ecological functions of deadwood

Key role by maintaining diversity and supporting many ecological process essential to the ecosystem functioning

• Carbon and nutrient cycling
• Regenerative substrate
• Diversity (insects, birds, mosses and fungi)

→ Habitat and source of energy and nutrient
Why do we study fungi on deadwood?

Fungi are major wood decomposers (lignin and cellulose)

- Nutrient exchange
- OM recycled
- Finland: 4000-5000 saproxylic species and 40% of threatened species are saproxylics

Pionneer fungal species composition influence establishment of later fungal colonizers and decompositions rate.

Pholiota sp.

Bisporella citrina (yellow fairy cup)
Partial harvesting

• Goals include
  – Increasing diversity in tree species and size classes
  – Growth shade-tolerant species
  – Altering rotation length
  – Maintenance of ecosystem functions

• Con
  – Reduce CWD
  – Reducing diversity of saprophytic fungi
Objective of the study

• How forest management (disturbance) impacts diversity and activity of pioneer saproxylic fungal communities in stands of different successional status and composition.
Study area

1760 (mixed post budworm outbreak)

1910 (mixed aspen)

1923 (aspen)
<table>
<thead>
<tr>
<th>Stand</th>
<th>Bloc</th>
<th>Treatments</th>
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</thead>
<tbody>
<tr>
<td>Aspen, 1923</td>
<td>Bloc 1</td>
<td>Uncut control</td>
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<td></td>
<td>Bloc 2</td>
<td>Partial cut (1/3, 2/3)</td>
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<td>Bloc 3</td>
<td>Control burn</td>
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<td>Mixed aspen, 1910</td>
<td>Bloc 1</td>
<td>Uncut control</td>
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<td></td>
<td>Bloc 2</td>
<td>Partial cut (gap harvesting, regular harvesting)</td>
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<td>Mixed post budworm outbreak, 1760</td>
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Incubation

Balsam fir (240 blocks) and trembling aspen (240 blocks)

Collected in spring and fall for 30 months
Methodology: other variables

- Respiration
- Species richness
- Shannon diversity
- Cellulose and Lignin
- Carbon and nitrogen
- Wood density
- Trembling aspen, paper birch, coniferous basal area
- Deadwood volume
- Disturbance intensity
- Time of incubation
Methodology: Molecular analyses

DNA extraction

PCR amplification (Fungi)

Electrophoresis
Methodology: DGGE

Block 1
Block 2

Gradient
Low
High

Fungus A
Fungus B
Methodology: fungal activity analyses

Respiration analyses
Statistical analysis

• Linear mixed-model for diversity, species richness, respiration and decomposition variables (model averaging)

• In some models, H' and S were used as explanatory rather than response variables.
Hypothesis

1. Harvesting intensity
2. Effect of time
3. Interaction between intensity and time
4. Stand successional stage
5. Total deadwood volume
6. Global model 1 (1-5)
7. Diversity
8. Global model 2 (global 1 + diversity)
Dermateaceae
## Model analysis (AIC)

<table>
<thead>
<tr>
<th>Models</th>
<th>Diversity</th>
<th>Respiration</th>
<th>Decomposition</th>
<th>C/N</th>
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<td>Harvesting intensity</td>
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<td>Balsam</td>
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<td>Effect of time</td>
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<td>Aspen</td>
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<td>Global model 1</td>
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Results: diversity

We found a total of 35 different OTUs with a maximum of 14 OTU per block (12 months in cut stands for trembling aspen wood blocks).

Balsam fir
- Shannon index: 2.4% / 6 months

Trembling aspen
- Species richness: 2% / 6 months

Results: respiration

Balsam fir
2% / 6 months

Trembling aspen
2.5% / 6 months
Balsam fir blocks (disturbance: uncut)
Results: decomposition rate

- **Density**: Ø
- **LCI**: Ø
- **Balsam fir**: Low decomposition (aromatic compounds)
- **Trembling aspen**: High mineralization rate

Time
Results: effect of disturbance

- Disturbance enhance decomposition of trembling aspen but slow down balsam fir decomposition.

- In burned vs uncut, disturbance faster in disturbed stands

- Balsam fir density

- Trembling aspen C:N ratio
Competition Vs Decomposition

- Diversity parameters
- Respiration
- Decomposition parameters
- Competitive interactions on balsam fir
- Decomposition on trembling aspen
• Richness and diversity of early fungal colonizers were not affected by stand disturbance or substrate quality but respiration was.
• Differences in decomposition rate between aspen and balsam fir may be linked to competition between fungal species under different conditions of resources availability.
• Respiration increased with time in both wood species but this may reflect two different processes: decreased competition in balsam fir wood and increased mineralisation in aspen wood.
• Forest dynamics in the boreal mixed woods (including highly disturbed stands) may sustain a continuous supply of deadwood from a diversity of tree species and foster pioneer generalist fungi assemblage in a position to colonize rapidly and indiscriminately fresh fallen wood.

Photo: Manuella Strukelj-Humphery
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