The distribution of wood-boring beetle damage in fire-killed black spruce

David J. Gervais
David F. Greene
Timothy T. Work
Introduction

- Reduced structural complexity
- Warmer, drier
- Abundance of standing snags
Introduction

- Reduced structural complexity
- Warmer, drier
- Abundance of standing snags

Rapidly colonized by insects
Introduction

- Boulanger & Sirois, 2007
  - 8177 beetles
Introduction

- Boulanger & Sirois, 2007
  - 8177 beetles
  - 109 species
Introduction

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  - 8177 beetles
  - 109 species
  - 84 saproxylic species
Life Cycle
1-2 yrs
Introduction

- Fire-killed trees are salvaged for commercial use
- Lumber is downgraded due to presence of holes
Introduction

- Fire-killed trees are salvaged for commercial use
- Lumber is downgraded due to presence of holes
- Heterogeneity in beetle damage
Introduction

- Host selection
- Saint-Germain et al., 2004
  - Landscape-scale factors
  - Tree-scale factors
Introduction

- Host selection
- Saint-Germain *et al.*, 2004
- Fire Intensity
Introduction

- Host selection
- Saint-Germain et al., 2004
  - Fire Intensity
  - Phloem quality
Introduction

- Host selection
- Saint-Germain *et al.*, 2004
  - Fire Intensity – UNCLEAR
- Phloem quality
Objectives

- Model the distribution of damage
  - Fire Intensity
  - Landscape- and tree-level processes
Methods

- 4 Fires
- Burned 2005
- Spring fires
Methods

- Removed bark (1.5 m)
- Counted entry holes

749 trees
Methods

- Host selection
  - Landscape-scale
  - Elevation
  - Distance to unburned forest
Methods

- Host selection
  - Landscape-scale
    - Elevation
    - Distance to unburned forest
  - Tree-scale
    - Tree size
    - Fire intensity (Scorch height)
    - Scorch side
Methods

- Host selection
  - Landscape-scale
    - Elevation
    - Distance to unburned forest
  - Tree-scale
    - Tree size
    - Fire intensity (Scorch height)
    - Scorch side
Methods

- **Hypotheses**
  - Damage will increase with fire intensity
Methods

- Hypotheses
  - Damage will decrease with fire intensity

![Graph showing the relationship between damage and fire intensity](image-url)
- Hypotheses
  - Damage will be highest on trees with medium fire intensity
## Results

<table>
<thead>
<tr>
<th>Model name</th>
<th>$k$</th>
<th>AICc</th>
<th>$\Delta$ AICc</th>
<th>$w_i$</th>
<th>Cumul. $w_i$</th>
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<tbody>
<tr>
<td>Quadratic</td>
<td>12</td>
<td>11058.94</td>
<td>0.0000</td>
<td>0.9935</td>
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Results

Elevation

![Graph showing the relationship between scorch height and number of entry holes per side of tree at different elevations. The graph indicates a curvilinear pattern with higher elevation correlating to a decrease in entry holes at lower scorch heights and an increase at higher scorch heights.](graph.png)
Results

![Elevation Graph](image)

- **Elevation**: 480 m (Bold line = HIGH scorch side)
- **Elevation**: 380 m (Thin line = LOW scorch side)

- **Number of Entry Holes/Side of Tree**
  - **Scorch Height (m)**

- **X-axis**: Scorch Height (m)
- **Y-axis**: Number of Entry Holes/Side of Tree
Results

Elevation

[Graph showing the relationship between scorch height (m) and number of entry holes/side of tree, with lines indicating different elevations (480 m and 380 m).]
Results

Elevation

Tree Size
Results

Elevation

Tree Size
Results

**Elevation**

- Elevation = 480 m
- Elevation = 360 m
- Thin line = LOW scorch side

**Tree Size**

- DBH = 20 cm
- DBH = 10 cm
- Thin line = LOW scorch side
Results
Results

Elevation

Tree Size
Results

Sampling was performed 2 years post-fire.
Results

Scorch Height

Number of Holes

2005

Scorch Height
Results

Scorch Height

Number of Holes

2005

Scorch Height
Results

Scorch Height vs. Number of Holes for 2006
Results

2006

Number of Holes

Scorch Height
Results

Scorch Height vs Number of Holes for 2007
Conclusions

- Damage increases with fire intensity
Conclusions

- Damage increases with fire intensity
- How important is this difference?
Conclusions
Conclusions

- Industry Standards
Conclusions

- Industry Standards

- Greater than 11 holes/1.5m
Conclusions

- Industry Standards
  - Greater than 11 holes/1.5m
  - Downgraded from “Select” to “No. 1”
  - Incurring substantial economic losses
Conclusions

- Recommendations
  - Salvage highly scorched trees first
Conclusions

- Recommendations
  - Salvage highly scorched trees first
  - or
  - Leave highly scorched trees unsalvaged
Thank You!

- David Greene
- Timothy Work
- Michel Saint-Germain
- Maryse Marchand
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- Simon Paradis
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- Mélanie Desrochers
- Marc Mazerolle
- Cory Alder
- Geneviève Gélinas
- CEF