Long-Term Impact of Mountain Pine Beetle on stand dynamics in Waterton and Kootenay National Parks

Pacific Forestry Centre Victoria, B.C.

Funded by BC Forest Innovations Investment Research Program
Project R2003-0111
STUDY OBJECTIVE
Rrelationships between stand structure, beetle susceptibility and fire hazard

It is getting HOT in here!!!
Fire and MPB over the Range of Lodgepole Pine

Fire Cycle, Size, Intensity
- Long
- Large
- High
- Short
- Small
- Low

MPB Life Cycle
- Outbreak
- Return
- Interval

Stand Structure
- Simple
- Complex

Stand Structure
- Simple
- Complex

Long

Short
1-3 years after MPB

6-8 years after MPB

14 years after MPB

10 years after MPB

58-68 years after MPB

14 years after MPB

22 years after MPB
Chilcotin - Stems per ha

1987

- Live: 1181
- Beetle kill: 230
- Other mortality: 94

2001

- Live: 967
- Beetle kill: 114
- Other mortality: 121

Diameter class (cm)

Stems per hectare

Live P. contorta

Beetle kill

Dead P. contorta
(Non-beetle kill)

Hardwoods

P. menziesii

P. glauca

2001

STAND 126
PLOT 2
1987 Chilcotin - Volume (m³) per ha 2001

Volume (m³) per hectare

- Live: 88.7
- Beetle kill: 48.1
- Other mortality: 4.7

- Live: 81.2
- Beetle kill: 16.1
- Other mortality: 4.3

Diameter class (cm)

- Beetles kill
- Dead *P. contorta* (Non-beetle kill)
- Live *P. contorta*

Diameter class (cm)

- Hardwoods
- *P. menziesii*
- *P. glauca*
Chilcotin Regeneration

Species

- Lodgepole pine
- Douglas-fir
- Subalpine fir
- Spruce
- Aspen
- Willow

Seedlings/ha

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>1987</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lodgepole</td>
<td>4547</td>
<td>3386</td>
</tr>
<tr>
<td></td>
<td>Douglas-fir</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subalpine fir</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Spruce</td>
<td>200</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Aspen</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Willow</td>
<td></td>
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</tr>
</tbody>
</table>

- 97.2% in 1987
- 85.6% in 2000

Percentage of seedlings remaining
## Chilcotin Saplings >2.0 m height per hectare - 2001

<table>
<thead>
<tr>
<th>Species</th>
<th>&lt; 4.0 cm diameter</th>
<th>4.0 - 7.0 cm diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. contorta</em></td>
<td>720</td>
<td>314</td>
</tr>
<tr>
<td><em>P. menziesii</em></td>
<td>35</td>
<td>81</td>
</tr>
<tr>
<td><em>Picea spp.</em></td>
<td>81</td>
<td>33</td>
</tr>
<tr>
<td><em>Juniperus spp.</em></td>
<td>100</td>
<td>0</td>
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<tr>
<td><em>P. tremuloides</em></td>
<td>708</td>
<td>51</td>
</tr>
<tr>
<td><em>Salix spp.</em></td>
<td>175</td>
<td>0</td>
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</table>
Waterton National Park 1980 MPB Impact Plot Locations

Status of MPB Attack in 1982
Rob Watt’s map
Methods - Waterton Stand Structure

1980: 5 MPB study stands established (B. Moody, CFS-NoFC)
- stands affected by the late 1970’s - early 1980’s MPB epidemic
- prism plots, 5 per stand
- tree height, dbh, status, regeneration

2002: Stands relocated and re-sampled
- in addition to remeasurements, fuel loading characteristics were sampled.
- Increment cores collected from host and non-host trees in each stand to detect growth release
Waterton National Park Fuel Loads

[Image of forested area with trees and fallen branches]

[Image of forested area with trees and fallen branches]
Fuel Loads in Waterton National Park Stands, 2002
Kootenay National Park 1935-42
MPB impact plots
Dr. George Hopping, CFS Vernon
Entomology Lab
MAP OF KOOTENAY NATIONAL PARK

Bark Beetle Infestations For 1935

--- Park Boundary

--- Highway

- Active Infestation

- Old Infestation

SCALE 1" = 5 MILES. HAR
Plot location and yearly plot re-measurement data 1935-1942 in KNP

**Plot V**
5-1 mi. N. Meadow Cr. Bridge

<table>
<thead>
<tr>
<th>Year</th>
<th>Dead</th>
<th>Fresh</th>
<th>Total</th>
<th>Not Att. or recovered</th>
<th>Total</th>
<th>Trees down</th>
<th>Trees removed</th>
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<tbody>
<tr>
<td>1934</td>
<td>--</td>
<td>5</td>
<td>5</td>
<td>260</td>
<td>265</td>
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<td>0</td>
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<tr>
<td>1935</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>260</td>
<td>265</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1936</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>260</td>
<td>265</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1937</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>260</td>
<td>265</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1938</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>260</td>
<td>265</td>
<td>0</td>
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<tr>
<td>1939</td>
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<td>0</td>
<td>5</td>
<td>260</td>
<td>265</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1940</td>
<td>5</td>
<td>117</td>
<td>122</td>
<td>143</td>
<td>265</td>
<td>0</td>
<td>0</td>
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<tr>
<td>1941</td>
<td>122</td>
<td>73</td>
<td>195</td>
<td>70</td>
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<tr>
<td>1942</td>
<td>131</td>
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<td>137</td>
<td>128</td>
<td>265</td>
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</table>

*Error in tallying 3 green trees as dead in 1941.*

**Plot VI**
3.6 mi. N. Meadow Cr. Bridge

<table>
<thead>
<tr>
<th>Year</th>
<th>Dead</th>
<th>Fresh</th>
<th>Total</th>
<th>Not Att. or recovered</th>
<th>Total</th>
<th>Trees down</th>
<th>Trees removed</th>
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<tbody>
<tr>
<td>1934</td>
<td>--</td>
<td>3</td>
<td>3</td>
<td>240</td>
<td>243</td>
<td>0</td>
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<tr>
<td>1935</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>237</td>
<td>243</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1936</td>
<td>6</td>
<td>2</td>
<td>8</td>
<td>235</td>
<td>243</td>
<td>0</td>
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<tr>
<td>1937</td>
<td>7</td>
<td>8</td>
<td>15</td>
<td>228</td>
<td>243</td>
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<tr>
<td>1938</td>
<td>15</td>
<td>24</td>
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<td>1939</td>
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<td>1940</td>
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<tr>
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**Plot VII**
1.5 mi. S. Meadow Cr. Bridge

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<th>Year</th>
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<th>Total</th>
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<th>Total</th>
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<th>Trees removed</th>
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<tbody>
<tr>
<td>1934</td>
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<td>32</td>
<td>32</td>
<td>89</td>
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<td>1935</td>
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<td>13</td>
<td>26</td>
<td>95</td>
<td>121</td>
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<td>0</td>
</tr>
<tr>
<td>1936</td>
<td>19</td>
<td>7</td>
<td>26</td>
<td>95</td>
<td>121</td>
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<td>0</td>
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<tr>
<td>1937</td>
<td>25</td>
<td>9</td>
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<td>87</td>
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<td>0</td>
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<tr>
<td>1938</td>
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<td>6</td>
<td>34</td>
<td>87</td>
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<td>0</td>
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<tr>
<td>1939</td>
<td>34</td>
<td>0</td>
<td>34</td>
<td>87</td>
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<td>2</td>
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<tr>
<td>1940</td>
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<td>2</td>
<td>37</td>
<td>84</td>
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<td>2</td>
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<tr>
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<td>77</td>
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<td>9</td>
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<tr>
<td>1942</td>
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<td>54</td>
<td>101</td>
<td>20</td>
<td>121</td>
<td>9</td>
<td>14</td>
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</table>
Kootenay National Park MPB Infestation, 1930-2002

1993 Dr. Malcom Shrimpton
- 1935 plots
- 1942 plots
- 1993 Dr. Terry Shore Stands (Located)

1994-2002 MPB Infestation
1947-1993 Infestation
1930-1946 MPB Infestation

Legend:
- Green circle: 1935 plots
- Black circle: 1942 plots
- Yellow circle: 1993 Dr. Terry Shore Stands

Scale: 0 - 10,000 Meters

North Arrow
1935 - seven 1 acre fixed area plots established logging to reduce fire hazard next to highway summary data in annual reports relocation difficult - distances along old highway

1942 - three additional plots (0.5, 0.25, 0.0625 acre) established. summary data in annual reports. relocation difficult

1993 - in general area of 1935 plots (Nixon - Dolly Varden Creeks) four areas consisting of 10 prism plots summary data available in report exact plot locations unknown but field notes might be located

1993 - Dog Lake - 4 lines of 10 plots Settler Road – 1 line of 10 plots Data available Relocation possible (already have found plots)
Possible Future Work

• Summary of original plot data and re-measurements from Waterton NP
• Examine growth release in surviving trees
• Model the effects of MPB on stand structure and subsequent fire hazard
• Re-measurement of Kootenay National Park plots
• MPB scar sampling and analysis in KNP
Summary of inferred release periods with fire and beetle scars

YEAR


Stand 103
Stand 104
Stand 105
Stand 107
Stand 113
Stand 116
Stand 118
Stand 119
Stand 121
Stand 124
Stand 125
Stand 126
Stand 128
Stand 129
Stand 130
Stand 205
Stand 302
Stand 304

Fire Scar
Beetle Scar
Future Work

MPB Scars in Chilcotin

Fire Scars in Chilcotin

Number of Scars

Year

1750 1800 1850 1900 1950 2000

Number of Scars

1750 1800 1850 1900 1950 2000
This is not “Mickey Mouse” Research