Regeneration Dynamics in Stands Impacted by the MPB: Lessons from Studies in Northern BC and the 1978-82 Flathead Epidemic

Dave Coates
Bulkley Centre for Natural Resources
Research and Management
and
British Columbia Forest Service
Smithers, BC
dave.coates@gov.bc.ca
Regeneration Dynamics After Disturbance

• Two dominant mechanisms for development of a new tree layer and subsequent canopy recruitment
  – Pulse of new post-disturbance recruitment
  – Existing seedling/sapling bank that survives disturbance
Two Studies

  – 244 plots in 36 pine-leading stands
  – Each plot referenced to distance to major “non-pine seed-source”
  – Local overstory characterized for each plot

• Flathead area with MPB epidemic 1978-1980
  – Stands originated from large wildfire in early 1900s
  – Selected 22 stands with variability in attack intensity
  – Established 5 random plots per stand, 50 m apart on a transect
  – Two nested plots at plot centre
    • DBH and species of all live trees >1.3 m in a 7.99 m radius plot
    • tallied all MPB killed trees on ground originating in 7.99 m radius plot
    • regeneration in a 3.99 m radius plot, plus cores taken from all trees >7.5 cm DBH
    • all trees 7.5 cm and less destructively sampled in 3.99 m radius plot
  – Cores and discs sent to UBC, Lori Daniels lab, for analysis
Red-attack 2-3 year old MPB attack
Grey-attack 8-9 year old MPB attack
Natural Regeneration in Northern Forests

- Generally a function of
  - Favorability of seedbed substrates
  - Canopy condition
  - Parent tree size, proximity and abundance

LePage et al. 2000, CJFR 30:415-427
Greene et al. 2004 J. Ecol. 92:758-766
Post-MPB Recruitment - Substrate Distribution

1-4 years post-MPB attack

5-9 years post-MPB attack
Recruitment of Subalpine Fir

![Graph showing the relationship between seed source basal area and seedlings/50 m² at different distances.](A)
Recruitment of Lodgepole Pine and Interior Spruce

![Graph showing the relationship between seedlings/50 m² and total local overstory basal area (m²/ha).]

- **Seedlings/50 m²** on the vertical axis.
- **Total local overstory basal area (m²/ha)** on the horizontal axis.
- Two curves: one for Pine (solid line) and one for Spruce (dotted line).

The graph illustrates the decline in seedlings with increasing overstory basal area.
Recruitment of Subalpine Fir

![Graph showing the relationship between Subalpine fir overstory basal area (m²/ha) and seedlings/50 m².](image)
Percent of plots with post-MPB regeneration by species and age of attack

<table>
<thead>
<tr>
<th># of plots</th>
<th>Age of Attack</th>
<th>Subalpine fir</th>
<th>Spruce</th>
<th>Pine</th>
</tr>
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<tbody>
<tr>
<td>10</td>
<td>0</td>
<td>0%</td>
<td>0%</td>
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<td>44</td>
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<td>3%</td>
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<td>0%</td>
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<td>51%</td>
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<td>7</td>
<td>48%</td>
<td>24%</td>
<td>14%</td>
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<tr>
<td>0</td>
<td>8</td>
<td></td>
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<tr>
<td>18</td>
<td>9</td>
<td>61%</td>
<td>17%</td>
<td>22%</td>
</tr>
</tbody>
</table>
Northern Study Summary

- Seedbed substrates still dominated by moss up to 10 years post-beetle attack
- Moss is a lousy substrate
- Not a lot of post-MPB recruitment observed, subalpine fir dominated
- Subalpine fir present in 11% of plots, spruce in 6% and pine in 5%
- Subalpine fir recruitment increased strongly with proximity to a major seed source and increased further with a local seed source
- Pine and spruce were limited by total local overstory basal area
Flathead Study
SITE 9
YEAR OF ATTACK: 1980
% PI MORTALITY: 68.3
% PI: 100.0

Flathead: MPB 1978-1982
SITE 17
YEAR OF ATTACK: 1979
% PI MORTALITY: 68.9
% PL: 99.5
Understory Tree Response
10-year Pre/Post Attack
Pine Regeneration Growth Response

Radial Growth Ratio

Sample Site
10-year Pre/Post Attack
Spruce Regeneration Growth Response

Radial Growth Ratio

Sample Site
10-year Pre/Post Attack
Douglas-fir Regeneration Growth Response
Tree Growth History

SITE 3
YEAR OF ATTACK: 1980
% PI MORTALITY: 78.5
% PI: 83.5

SITE 4
YEAR OF ATTACK: 1980
% PI MORTALITY: 89.2
% PI: 89.4

SITE 5
YEAR OF ATTACK: 1978
% PI MORTALITY: 41.8
% PI: 98.5

SITE 6
YEAR OF ATTACK: 1979
% PI MORTALITY: 64.7
% PI: 91.4

Tree-ring index

Year
Growth Response of Residual Pine

Percent response vs. Diameter at Outbreak (cm)
Growth Response of Residual Spruce

Percent response vs. Diameter at Outbreak (cm)
Growth Response of Residual Subalpine Fir

Percent response vs. Diameter at Outbreak (cm)
Conclusions

• Regeneration in northern MPB-disturbed forests was sparse and patchy up to 10 years post disturbance
  – Subalpine fir dominated but was clearly seed-source limited
  – Pine and spruce were limited by overstory shading, especially pine
  – Recruitment dynamics have not substantially changed from conditions prior to MPB disturbance

• After the 1978-1980 Flathead epidemic
  – Percent basal area killed by beetles varied from 42 to 100%
  – Limited seedling bank in some stands at time of attack
  – A major pulse of post-MPB recruitment 10-20 years post disturbance
  – Recruitment of new seedlings has slowed considerably since 2000

• Residual understory and overstory trees generally released well in the Flathead

• Several stands have recovered their pre-MPB basal area since attack
Acknowledgements

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