Colorado’s Bark Beetle Outbreak

Last Year – Tree Water Use, Stream Nutrients
This Year - Forest Structure Change, Growth Responses, Fuels and Fire

CO State Forest
Willow Ck, Parks RD
Gore Pass, Yampa RD
Fraser Expt Forest
Amount of Mortality - Depends on Forest Composition & Structure

Basal Area Loss

Old Growth
- 73-83% LPP loss
- 39 - 41% total loss

Mixed Age/Managed
- 50-70% of LPP
- 20-25% of total
Loss of lodgepole pine basal area = 80-90%

Residual live 15-35% of total stand BA.

*24 pine-dominated stands at 4 MPB projects
* Trees >10 cm (4”) DBH
Growing Stock in MPB Forests

*Residual Live & New Trees*

**Overstory**
- 310 t/ha (126 t/acre)
- 71% LPP; 17% AS; 7% SF

**Understory Trees**
- 445 t/ha (180 t/Ac)
- 68% LPP; 12% AS; 15% SF

**New Recruits**
- 1820 t/ha (736 t/Ac)
- 54% LPP; 19% AS; 25% SF

*Stocking Levels*
- 370 t/ha (150 t/Ac)
Response to Management

Tree Recruitment

Harvesting stimulates new pine seedlings and aspen sprouts.

5 times more pine, aspen compared to uncut stands

Fir recruitment is promoted in uncut stands

*Cut stands meet minimum stocking requirements (i.e., > 150 t/acre)

*8 paired sites at Fraser

(Collins et al. 2010b)
Assessed 123 cores in 4 basins
35% of trees grew > 25% faster since the infestation than the previous decade
16% of trees grew faster than ever before.
LPP more likely to respond that ES
Radial Growth Response

Change in ring width was unrelated to winter precipitation during the post-MPB period.

Decline in overstory basal area explained 10-20% of variability in radial release.
40% of trees added > 2X more height in ‘01 as in ’07. Proportionally, fir was most likely to double height; spruce was least likely.

Loss of basal area explains 13 - 23% of height increment. Pine most sensitive to BA; spruce least sensitive.
Annual height growth of Fir & Pine has doubled since infestation beneath the dead overstory, but neither has responded in cuts.

<table>
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<tr>
<th>Year</th>
<th>Foliar N (%)</th>
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<tr>
<td>Yr 1</td>
<td>0.6</td>
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<tr>
<td>Yr 2</td>
<td>1.2</td>
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Foliar N more than doubled following loss of neighboring trees.
Stand Species Composition Varies with Management

Forest Recovery
Projections based on stand-level measurements

MPB-killed stands recover to pre-MPB basal area in 80 - 105 yr

Uncut & Partial Cut Stands
Dominated by fir

Clear Cut Stands
Similar to pre-MPB stands
Dominated by pine

(Collins et al. 2010b)
Harvesting adds
~4X fine fuels (1 + 10 hr)
~3X total surface fuels

The increase in surface fuels may result in greater flame lengths (i.e., under extreme weather conditions: 2.3 vs 1.7 m compared to 5m).
   1.2 m - halt direct-attack
   2.5 m - halt dozers

Windthrow will increase the surface load in uncut areas
~1.4x higher than cut areas
Post Treatment Fire Behavior

Recovery of the forest canopy determines fire behavior in future stands.

Risk of crown fire is low and will differ little between treated & uncut stands until new stands develop (~20 yrs).

More fir in uncut stands increases canopy BD, crown base height and flame length.

Green Stands - Risk, intensity of crown fire is greater:
* 6m total flame length
* Crowning Index 55 km/hr (34 mph - moderate risk)
Take Home Messages

Tree regeneration is abundant in beetle-infested stands

Growth of residual overstory & understory trees are responding to loss of lodgepole

Harvesting leads to development of different stand types - with likely implications on future fire potential and effects
Many Thanks!

PROJECT SUPPORT
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USFS AR, MBR, WR National Forests
USFS Sulphur Ranger District – Upper Fraser
Project ID team
Colorado State Forest Service
Colorado Water Conservation Board
Joint Fire Science Program
Colorado Forest Restoration Institute
Denver Water

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