Fire behaviour in insect damaged stands

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In Canada 2 insects get the most attention:

**Spruce Budworm**
- across Canada but major epidemics in eastern
- Stocks (1987) describes test burns toward FBP fuel types

**Mountain Pine Beetle**
- BC and Alberta (so far)
- No FBP fuel type development
  ? How many have experience?

Rest of presentation will focus on pine beetle
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>0</td>
<td>Green attack in summer, tree dies</td>
</tr>
<tr>
<td>1</td>
<td>Needles turn orange following spring</td>
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<tr>
<td>1–3</td>
<td>Needles turn red summer following attack</td>
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<td>Needles fall over 2-3 yrs</td>
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<tr>
<td>3–10</td>
<td>Small branches fall over 3-10 yrs</td>
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<tr>
<td>10–20</td>
<td>Dead boles fall in 10-20 yrs.</td>
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<td>Large surface fuel accumulation</td>
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<td>Regeneration of residual stand</td>
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Spatial extent

Observed Percentage of Pine Killed* by 2009
* red- and grey-attack phase

0 % of pine volume killed
< 1%
1 - 10%
11 - 30%
31 - 50%
51 - 70%
71 - 100%
Forested with no Pine
Non Forest
Fresh Water

Mountain Pine Beetle Aerial Survey 2009
Red Attack
Green Attack or Fading

Government of Alberta
• Think about it as 20 metre standing grass, that responds to changes in moisture very quickly
• Influenced primarily by humidity and FFMC
• 91 FFMC threshold

Does not need a ground fire, can spot from crown to crown.
Spotting to 300m on the first candle is common.
Red Attack – Archer Lake

Burns 1-3
Burns 4-7
Burns 8 and 10
2008 burn

FFMC 88.9 – 92.7
ISI 5.6 – 10
BUI 45 – 70 (132 in 2008)
FWI 14.2 – 32
Temps 21 – 26 C
Rh 25 - 45
Red Attack – Archer Lake

- 25 – 40% needles gone in 2009 (ocular estimate).
- Red needle moisture similar to litter
- Duff moisture higher in red stands
Red Attack – Archer Lake

Video clip
Several studies suggest post red attack crown fire behaviour may not be worse (compared to unaffected stands)

**Evidence:**
- Decrease in canopy fuel load due to needle cast
- No overall fuel build up effect detected in empirical data

**Estimates:**
- Fire behaviour models indicate higher surface fire ROS but less active crown fire

- Page and Jenkins (2007)
- Simard et al (in press)

? Is Active crown fire a useful definition for grey attack fires – with little crown material?
Grey stages: Years 3 – 10
Grey stages: Years 3 – 10

Taylor and Hawkes comparison with C3

ROS changes operationally significant?
Grey stages: Years 10-20

- stem fall increases surface woody fuel loading
- increase in surface fire intensity and flame length understory
- vegetation (grass, herbs, shrubs) and residual trees may be released due to increased light levels and reduced competition.

Waterton National Park 20 years following MPB attack
Photo: Canadian Forest Service
Grey Stage – Mitchell Ridge (Parks Canada)
Moderate to steep slopes (30 deg used in fire behaviour calcs)

Heavy surface fuels from MPB 20 years ago.
Spring burn (early June)
FFMC = 91, BUI = 42
ROS variable, affected by spot fires. 27m/min used for intensity calcs
Grey Stage – Mitchell Ridge (Parks Canada)
Wrap up

• Drier fuels (needles, standing dead, dead and not all the way down)
• Head fire ROS does not seem to be a lot different.
• Head fire intensity is greater.
• Ember transport = BAD, Bark flakes in grey stage = REALLY BAD
  – Accelerate ROS (equilibrium prior to head fire arrival)
  – New fires
  – Critical for Community/Structure protection.
• Relaxed debris management rules make problem worse
Wrap up

• What happens in grey at high BUI’s?
  – Soil degradation?
  – Greater carbon release?

• As a PB person I recommend more burns at low intensities (e.g. Mitchell Ridge)!

• Do we need to develop new fuel types or does ember transport override?