Ecological impacts of the Mountain Pine Beetle on the Foothills of Alberta

René Alfaro, Brad Hawkes, Lara van Akker and Bill Riel  Pacific Forestry Centre, Victoria, BC, Canada

Jodi Axelson  Dept Geography, University of Victoria

Ian Cameron  Azura Informetrics
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- Disturbances: drivers of ecosystem change
- Need for establishing baselines
- Need for forecasting growth and yield and flow of ecosystem services following MPB
- Work in the BC and Alberta
- Forest transformation by MPB actual and stand simulations
- Knowledge gaps and opportunities
- Conclusions
Ecology of lodgepole pine: a fire regenerated species
Life after fire
The mountain pine beetle
Forest management, climate change

- Fire suppression and selective harvesting for species other than pine during previous century, created large forests of pine
- Beetle survival has improved over much of western Canada during recent decades due to global warming, allowing populations to invade areas formerly unsuitable for MPB
Probable range of the MPB

A very plastic insect = High potential for invasion

US Distribution from McCambridge and Trostle 1970

Canada Distribution: from Alberta and BC sources
Largest pine beetle outbreaks in BC and Alberta in recent history

Aerial surveys begin

History of beetle outbreaks in BC
Ecological and timber impacts

BC Montana Border 31 years later
The Cariboo-Chilcotin Plateau plots
Established 1987, remeasured in 2001 and 2008

- 3 biogeoclimatic zones
- Mixed-severity fire regime
- Stands dominated by PI
East Slopes sites

New range

Historic range
20 Years after MPB in Waterton National Park
Methodology: Establishing beetle disturbance baselines

1. Past distribution of MPB outbreaks and return interval
2. Understanding impacts. Timber and ecosystem

Dating coarse woody debris

Dating regen. cohorts

Dating canopy layers
Disturbance history in “even” and uneven aged stands
Results: Stand development after beetle

- MPB is a natural thinning agent
- Promotes increased growth among the surviving trees
- Allows for the establishment of seedlings in understory
- Creates coarse woody debris
History of the canopy layers of an “even-aged” Ip stand
Logan Lake, Kamloops

Beetle and stand dynamics: Bull Mtn. Study

Heath and Alfaro 1990 (re-surveyed in 2001)

Overstory

Understory

Tree ring widths (mm)
Chilcotin: Growth release after 1970-80’s outbreak
Beetle history of in BC and Alberta
Bull Mountain 2001:
A 320 year old tree: outbreaks every 52 years (40 years for entire BC)

Douglas-fir
Beetle creates advance regeneration
From simple post-fire stand structure...  

To multiple cohort structure
Beetle creates coarse woody debris

CWD from the 1970’s-80’s outbreak
Beetle creates coarse woody debris

CWD from the 1930’s outbreak
Fire interactions Chilcotin

Year of scarring
Number of detected fire scars (N=22)

Fire control implemented
Brad plays with fire
Resiliency of the Chilcotin Forest after two outbreaks
## Resiliency of the Chilcotin Forest after two outbreaks

### Live pine in 2008 after 1970’s and 2000’s outbreak

<table>
<thead>
<tr>
<th>Layer</th>
<th>Density (stems/ha)</th>
<th>Volume (m³/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Overstory</strong> (&gt;7.0cm DBH)</td>
<td>413</td>
<td>84</td>
</tr>
<tr>
<td><strong>Understory</strong> (&lt;7.0cm DBH, taller than 1.5m)</td>
<td>1035</td>
<td>168</td>
</tr>
<tr>
<td><strong>Regeneration</strong> (shorter than 1.5m)</td>
<td>4709</td>
<td>1429</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6157</td>
<td></td>
</tr>
</tbody>
</table>
3 cohorts

Initial conditions 2008
2041 (immediately prior to light outbreak)
2041 Light outbreak removes 30% BA
2058 New cohort is born
2074 (immediately prior to outbreak)
2074 Massive outbreak kills 70% BA
2083
2108 New cohort is born
Results: Waterton National Park

Pine is mostly down
Forest dominated by shade tolerant
History of beetle at Waterton

Outbreaks

1920’-1930’s

1970’6-1980’s

Stand 1
Stand 2
Stand 3
Stand 4
Stand 5

Results: Waterton

- Marked decline in lodgepole pine density
- Increase in non-host species such as spruce and fir from 1981 to 2010
- With the exception of stand 1, sapling and seedling densities have increased in all stands from 2002 to 2010
  - High degree of variability in stocking between stands
  - Composition made up almost entirely of shade tolerant species
Conclusion: Stand dynamics cycle in BC
Conclusion: Stand dynamics cycle in Alberta
Conclusions

- Stand-replacing fires initiate even-aged lp stands
- Reduced fire in 20th century: MPB directs stand dynamics
- MPB transform stands into multiple age cohort forests, initiated by repeated beetle thinning.
  - Or transition to other stand types
- Long term impacts: alleviated by the presence of a sub-canopy, and advance regeneration layers which will form reasonably well stocked forests in the future.
Impacts on timber and ecosystem services

- Timber production is heavily impacted
- Ecological impacts or ecosystem services:
  - If disturbance is part of cycle, business as usual
  - In novel habitats: transition to different ecosystems
- Caveat: climate change will alter natural disturbance regimes.
“I’ll be back”

Dendroctonus ponderosanegger
Questions?