Fig. 1. Historical distribution of mountain pine beetle (Safranyik et al. 2010; adapted from Logan & Powell 2001)
Fig 2. Approximate historical (light grey and mottled grey) and current (light grey and black) extent of mountain pine beetle range in North America.


https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0176269
Bark-beetle impacted forests: Do they bug visitors?

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STUART COTTRELL, PhD. Colorado State University
Drs. PAUL GOBSTER, STEPHANIE SNYDER, ROBERT C. VENETTE, USDA Forest Service
4 Stages of MPB

0.8 to 3 yr

3 to 15 yr

15 to 20 yr

Edburg et al 2012
Visitor responses
Purpose & questions

• Explore visitor perceptions of BB impact: experience interference? Displaced?

• Assess relative impact of factors influencing visitor experiences and intended displacement
Results preview

• Impacts interfere? Yes! Up to 80%

• People not visit? Yes! Up to 70%

• Significant factors
  • Foreground appearance
  • # visitors
Methods: 2 study sites with varied levels of beetle impact

Colorado State Forest State Park

Lake Bemidji State Park
Methods: Onsite visitor surveys w/photos
Visitors respond to photos that varied 6 attributes: 3 biophysical
Visitors respond to photos that varied 6 attributes: 3 social

# trail users - User composition
Dogs & dog-walker behavior
Interfere with your recreation experience?
Would you return for a visit?
Analysis

• Yes/no choice

• Relative importance of the 6 attributes
Overview: Questionnaire results

• Impacts interfere? Yes! Up to 80%

• People not visit? Yes! Up to 70%

• Significant & reliable models
  • At least 4 of the 6 attributes significant in each model
  • Dogs-never significant
  • Foreground key
Foreground & # visitors most important to visitor interference

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Interference contribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest foreground</td>
<td>31.57</td>
</tr>
<tr>
<td># visitors</td>
<td>13.63</td>
</tr>
<tr>
<td>Forest mid-ground</td>
<td>7.34</td>
</tr>
<tr>
<td>Visitor composition</td>
<td>6.55</td>
</tr>
<tr>
<td>Background view</td>
<td>4.90</td>
</tr>
<tr>
<td>Dogs on/off leash</td>
<td>3.06</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
<tr>
<td>$Rho^2$ *( .2 to 4 good)</td>
<td>.57</td>
</tr>
</tbody>
</table>
2 foreground scenarios most contributing to interference

- Collapse – only dead wood
- Clearcut/logging
- Multi-layered mixed forest
### Foreground most important to visitor displacement

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Displacement Contribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest foreground</td>
<td>39.08</td>
</tr>
<tr>
<td># visitors</td>
<td>8.58</td>
</tr>
<tr>
<td>Forest mid-ground</td>
<td>8.37</td>
</tr>
<tr>
<td>Visitor composition</td>
<td>4.04</td>
</tr>
<tr>
<td>Dogs on/off leash</td>
<td>2.62</td>
</tr>
<tr>
<td>Background view</td>
<td>.79</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

*Rho² ( .2 to 4 good) : .66*
3 foreground scenarios most influence displacement

- Collapse – only dead wood
- Clearcut/logging
- Beetle impact on spruce/pine
Site differences: Rejuvenation > - in MN
Discussion: Mixed/mono >> least – visitor responses; 

# visitors relative importance lower than
Model difference discussion:
# visitors 2x important to interference
Site difference discussion: MN > - rejuvenation
2: Historical overview Logan and Powell 2001); Safranyik et al 2010


https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0176269


6: Edburg et al 2012

7. Explore Minnesota Tourims


11. Colorado Department of Natural Resources, Minnesota Department of Natural Resources

12. Alex Schuleter

26. Stuart Cottrell

27. https://carleton.ca/phdhums/

29. Hannah Foslien, Getty Images
Extra slides if/as needed
Questionnaire Analysis

• Discrete choice
  • Total of 128 photos, rotated
  • Visitors viewed 16 photos: 4 sets of 4
  • Binomial logit model
    • Rho² statistic (.2-.4 good)
    • Parameter estimates >+ . pref

• Latent Gold Choice software
2 foreground scenarios most influential to interference

1. Spruce mono culture
2. Beetle impact spruce only
3. Beetle impact pine/spruce
4. Collapse – only dead wood
5. Clearcut/logging traces
6. Planted rejuvenation: spruce
7. Natural rejuvenation mixed
8. Multi-layered mixed forest
3 Foreground scenarios most influential to displacement

1. Spruce mono-culture
2. Beetle impact spruce only
3. Beetle impact pine/spruce
4. Collapse – only dead wood
5. Clearcut/logging traces
6. Planted rejuvenation: spruce
7. Natural rejuvenation mixed
8. Multi-layered mixed forest
Foreground contributors to displacement
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>State Forest State Park (Colorado)</th>
<th>Harz National Park (Germany)</th>
<th>Lake Bemidji State Park (Minnesota)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>71,000 ac</td>
<td>61,034 ac</td>
<td>1,728 ac</td>
</tr>
<tr>
<td>Visitation</td>
<td>426,272 (2013)</td>
<td>4 million to park area...</td>
<td>147,163 (2013)</td>
</tr>
<tr>
<td>Campsites</td>
<td>219</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cabins/yurts available</td>
<td>Yes</td>
<td>Yes - Hut resort</td>
<td>Yes</td>
</tr>
<tr>
<td>Hiking trails</td>
<td>90 miles</td>
<td>372 miles</td>
<td>11 miles</td>
</tr>
<tr>
<td>Mountain biking trails</td>
<td>130 miles</td>
<td>90 to 372 miles</td>
<td>5 miles</td>
</tr>
<tr>
<td>Conifer species of interest</td>
<td>Lodgepole pine (<em>Pinus contorta</em>)</td>
<td>82% Spruce (<em>Picea Abies</em>)</td>
<td>Red pine (<em>Pinus resinosa</em>)</td>
</tr>
<tr>
<td></td>
<td>Ponderosa pine (<em>Pinus ponderosa</em>)</td>
<td>Broadleaf (Beech)</td>
<td>White pine (<em>Pinus strobus</em>)</td>
</tr>
<tr>
<td></td>
<td>Limber pine (<em>Pinus flexilis</em>)</td>
<td></td>
<td>Jack pine (<em>Pinus banksiana</em>)</td>
</tr>
</tbody>
</table>
Life Cycle of Mountain Pine Beetle, *Dendroctonus ponderosae*

- **Start**: Beetles mate and burrow through bark of the tree, depositing eggs in brood chambers in the tissues.

- **Adult**: Beetles migrate to nearby healthy trees to begin cycle again.

- **Pupa**: Larvae pupate and leave the dying tree, producing distinctive "shotgun" exit holes in the bark.

- **Larva**: Adults and larvae create horizontal chambers, and introduce mold into the tree's soft tissues. This slowly kills the tree over the course of a year.

The tree's leaves redded, then turn yellow as the tree dies.
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