White Pine Blister Rust and High Elevation White Pines in California

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Geographic distribution of five-needle white pines in California

Source:
Hydrologic functions

Wildlife habitat

Biological diversity

Important food resource

Photo: Deems Burton
Western white pine distribution
(*Pinus monticola*)
and incidence
of white pine blister rust
(*Cronartium ribicola*)
in California

WPBR incidence (%)

- **0**
- **1 - 10**
- **11 - 20**
- **21 - 30**
- **31 - 50**
- **51 - 70**
- **> 71**

Western white pine distribution

Source:
Whitebark pine distribution
(*Pinus albicaulis*)
and incidence
of white pine blister rust
(*Cronartium ribicola*)
in California

WPBR incidence (%)
- Blue: 0
- Turquoise: 1 - 10
- Green: 11 - 20
- Yellow: 21 - 30
- Orange: 31 - 50
- Red: 51 - 70
- Magenta: > 71

Source:
Foxtail pine distribution (Pinus balfouriana) and incidence of white pine blister rust (Cronartium ribicola) in California.
Great Basin bristlecone pine distribution
*Pinus longaeva*
and incidence
of white pine blister rust
*Cronartium ribicola*
in California

WPBR incidence (%)
- **0**
- **1 - 10**
- **11 - 20**
- **21 - 30**
- **31 - 50**
- **51 - 70**
- **> 71**

GB bristlecone pine distribution

Source:
U.S. Geological Survey,
1999, Digital representation of
"Atlas of United States Trees"
by Elmer L. Little, Jr.
Limber pine distribution
(*Pinus flexilis*)
and incidence
of white pine blister rust
(*Cronartium ribicola*)
in California

WPBR incidence (%)

- Blue dot: 0
- Light blue dot: 1 - 10
- Dark blue dot: 11 - 20
- Green dot: 21 - 30
- Light green dot: 31 - 50
- Orange dot: 51 - 70
- Red dot: > 71

Limber pine distribution

Source:
Environmental and Biological Correlates to white pine blister rust in high elevation forests of California

Source of inoculum
Low elevation mixed-conifer forests

High elevation subalpine woodland

Climate (PRISM)

- May relative humidity (+) (moist spring)
- Mean September minimum temperature (+) (warm fall)

Biotic correlate

- Distance to nearest lower montane mixed-conifer forest (-).

Genetic information lacking but essential:
Determine levels/frequency of resistance (or lack of).

Photo: Malcolm North
Demographics: Regeneration

Regeneration

High Elevation Species

- Bristlecone
- Limber
- Foxtail (south)
- Foxtail (north)
- Whitebark
- Western white

WPBR absent
WPBR present
Demographics: Reproductive output

Reproductive Output

High Elevation Species

- Bristlecone
- Limber
- Foxtail
- Whitebark
- Western white

WPBR absent
WPBR present
Mountain pine beetle (MPB)

In high elevation forests we see evidence of MPB and mortality but at low levels and often associated with protracted drought periods.

California climatic regime - relatively **drought tolerant** - higher threshold before susceptible?

**A numbers game** - lack extensive LPP forests for large outbreaks to spillover into high elevations forests.

50-60% of all plots show signs of MPB activity

<table>
<thead>
<tr>
<th></th>
<th>Western white</th>
<th>Whitebark</th>
<th>Foxtail</th>
<th>Limber</th>
<th>Bristlecone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean (incidence %)</strong></td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0-32</td>
<td>0-32</td>
<td>0-6</td>
<td>0-10</td>
<td>0</td>
</tr>
</tbody>
</table>

**Mortality = 1.5%; range: 0-49%**
Forest tree species response?
Pest responses?
2030

Whitebark Pine

votes for species presence

Bioclimatic models courtesy of Warwell, Crookston and Rehfeldt
votes for species presence

Western White Pine

Bioclimatic models courtesy of Warwell, Crookston and Rehfeldt
Western White Pine

Bioclimatic models courtesy of Warwell, Crookston and Rehfeldt
votes for species presence

90 - 100
80 - 89
70 - 79
60 - 69
50 - 59

Bioclimatic models courtesy of Warwell, Crookston and Rehfeldt
Bioclimatic models courtesy of Warwell, Crookston and Rehfeldt
Future directions and studies

- Cone collections - seedbanking
- Genetic analyses
- Demographic studies (population dynamics)
- Determine effects and interactions of multiple stressors/threats
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