Fire Risk in Westside Forests of the Pacific Northwest

Matt Reilly
USFS PNW Research Station Corvallis, Oregon
Westside Fire

Large wildfires between 2001–2015

Davis et al. 2017
Ignition

Spies et al. 2018
Regional Bioclimatic Setting

Summer Temperature

Summer Precipitation

Summer Drought

Reilly et al. 2018
Historical Fire Regimes

Spies et al. 2018
Historical Fire Regimes

Adapted from Agee 1998
Historical Fire Regimes

Adapted from Agee 1998
Historical Fire Regimes

Adapted from Agee 1998
Historical Fire Regimes

- **High** Proportion of total area burned
- **Low** Proportion of total area burned

- **Low**
  - Ponderosa Pine
  - Western Hemlock
- **Mixed**
  - Western Hemlock
- **High**
  - Subalpine

Adapted from Agee 1998
Frequent, Low Severity

- More typical of the dry forest east of the Cascades but characteristic of low elevation oak woodlands
- Numerous fire scar studies
- Conditions for burning are common, but fuels usually limit fire behavior and effects
• More typical of the dry forest east of the Cascades but characteristic of low elevation oak woodlands
• Numerous fire scar studies from ponderosa pine
• Conditions for burning are common, but fuels usually limit fire behavior and effects

Illustration by Bob Van Pelt
Frequent, Low Severity

- Long period of fire exclusion
- Increased density and changes in composition
- Increased potential for uncharacteristic fire behavior and effects
- Loss of old legacy trees

Illustration by Bob Van Pelt
• Increases in importance towards the south where ignitions and summer drought become more prominent
• Limited number of fire scar studies
• More complex and less well understood
Mixed Severity

- Increases in importance towards the south where ignitions and summer drought become more prominent and productivity is relatively high.
- Limited number of fire scar studies.
- More complex and less well understood.

Morrison and Swanson 1991
Mixed Severity

% of Trees with Fire Scars or Charred Bark

Biogeographic dividing line

Spies et al. 2018
• Strong “bottom-up” controls on fire behavior and severity
• Forest structure and topography are important
• Occasional large patches of high severity-fire in weather driven fires
Fine and Coarse Scale Mosaic

**Fire Severity**
- Low
- Moderate
- High

**Vegetation Zone**
- Non-forest
- Other Forest
- Ponderosa Pine
- Douglas-fir
- Grand Fir/ White Fir
- Western Hemlock
- Silver Fir
- Mountain Hemlock
- Subalpine
Infrequent, High Severity

- Long time periods between stand-replacing fires
- Evidence for pre-settlement ecological role
- Primarily in wet or cool forest types

Illustration by Bob Van Pelt
Historical Fire Regimes

Spies et al. 2018
Coarse Scale Mosaic

**Fire Severity**
- Low
- Moderate
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[Map showing different fire severity and vegetation zones]
Oregon Coast Range
Fire History (1850 to 1940)

1850
1890
1920
1940

*Salem

Salem
Salem
Salem

LEGEND
- 200+ Years
- 100-199 Years
- 50-99 Years
- 0-49 Years
- Recently Burned

Teensma et al. 1991
Large, High Severity Fires are the Norm

Figure 11  Tillimook Fire, August 25, 1933  Courtesy of National Archives
Large, High Severity Fires are the Norm

1) Ignition

Figure 11 Tillimook Fire, August 25, 1933  Courtesy of National Archives
Large, High Severity Fires are the Norm

1) Ignition
2) Very dry conditions

Figure 11  Tillimook Fire, August 25, 1933  Courtesy of National Archives
Large, High Severity Fires are the Norm

1) Ignition
2) Very dry conditions
3) East wind event

Figure 11  Tillimook Fire, August 25, 1933  Courtesy of National Archives
East Wind Events

Average # of Dry East Wind Days

data from Cramer 1957
East Wind Events

Average # of Dry East Wind Days

# of Days

Month


window of vulnerability

data from Cramer 1957
Average and Max # of Dry East Wind Days

- **Average # of Days**
- **Maximum # of Days**

Window of vulnerability

Data from Cramer 1957
Daily Fire Spread 1933

Weather

<table>
<thead>
<tr>
<th>Date</th>
<th>Max Temp</th>
<th>Min R.H.</th>
<th>Wind Direction</th>
<th>Wind Speed</th>
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</thead>
<tbody>
<tr>
<td>Aug 14</td>
<td>90-97</td>
<td>20-30%</td>
<td>NNE</td>
<td>18-23mph</td>
</tr>
<tr>
<td>Aug 15</td>
<td>100-105</td>
<td>15-25%</td>
<td>E shift to W</td>
<td>15-20mph</td>
</tr>
<tr>
<td>Aug 16</td>
<td>70-75</td>
<td>35-45%</td>
<td>E-SE</td>
<td>5-10mph</td>
</tr>
<tr>
<td>Aug 17</td>
<td>unknown</td>
<td>40-50%</td>
<td>West</td>
<td>5-10mph</td>
</tr>
<tr>
<td>Aug 18</td>
<td>unknown</td>
<td>45-55%</td>
<td>West</td>
<td>5-10mph</td>
</tr>
<tr>
<td>Aug 19</td>
<td>unknown</td>
<td>45-55%</td>
<td>West</td>
<td>5-10mph</td>
</tr>
<tr>
<td>Aug 20</td>
<td>unknown</td>
<td>40-50%</td>
<td>North</td>
<td>10-15mph</td>
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<tr>
<td>Aug 21</td>
<td>unknown</td>
<td>25-35%</td>
<td>East</td>
<td>15-25mph</td>
</tr>
<tr>
<td>Aug 22</td>
<td>unknown</td>
<td>20-30%</td>
<td>East</td>
<td>20-25mph</td>
</tr>
<tr>
<td>Aug 23</td>
<td>unknown</td>
<td>20-30%</td>
<td>East</td>
<td>10-15mph</td>
</tr>
<tr>
<td>Aug 24</td>
<td>unknown</td>
<td>25-35%</td>
<td>E-NE</td>
<td>10-15mph</td>
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<tr>
<td>Aug 25</td>
<td>unknown</td>
<td>20-25%</td>
<td>East</td>
<td>25-35mph</td>
</tr>
<tr>
<td>Aug 26</td>
<td>unknown</td>
<td>Rising to 60%</td>
<td>E shift to W</td>
<td>20-28mph decreasing</td>
</tr>
</tbody>
</table>
Preparing for climate change through science-management collaboration

Current Fire in the West Cascades

Area Burned (ha)

- Very Low/ Unburned
- Low
- Moderate
- High
- Very High

Oregon Western Cascades
Eagle Creek Fire
Eagle Creek Fire
Eagle Creek Fire
Preparing for climate change through science-management collaboration

Eagle Creek Fire

% of Area Burned

- Unburned/Very Low
- Low
- Moderate
- High

% of Area Burned

0%
25%
50%
75%
100%
Current Fire Severity

Oregon Western Cascades

- Western Hemlock
- Pacific Silver Fir
- Mountain Hemlock
- Douglas-fir/Grand Fir

% of Area Burned

- Very Low/Unburned
- Low
- Moderate
- High
- Very High
# Future Fire Activity

<table>
<thead>
<tr>
<th>Study</th>
<th>Geographic Extent</th>
<th>Projected Change from Current</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stavros et al. 2014</td>
<td>OR, WA, N. CA</td>
<td>+</td>
<td>Large fire occurrence</td>
</tr>
<tr>
<td>McKenzie et al. 2004</td>
<td>OR, WA, N. CA</td>
<td>+</td>
<td>Area burned</td>
</tr>
<tr>
<td>Littell et al. 2010</td>
<td>WA</td>
<td>+200 to 300%</td>
<td>Area burned</td>
</tr>
<tr>
<td>Turner et al. 2015</td>
<td>Willamette Valley – OR</td>
<td>+300 to 900%</td>
<td>Area burned</td>
</tr>
<tr>
<td>Krawchuck et al. 2009</td>
<td>Global</td>
<td>+</td>
<td>Fire probability</td>
</tr>
<tr>
<td>Fried et al. 2004</td>
<td>N. CA</td>
<td>-8%</td>
<td>Area burned</td>
</tr>
<tr>
<td>Barr et al. 2010</td>
<td>Klamath Basin - OR and N. CA</td>
<td>+11 to 22%</td>
<td>Area burned</td>
</tr>
<tr>
<td>Liu et al. 2012</td>
<td>continental US</td>
<td>no</td>
<td>Fire potential 2</td>
</tr>
<tr>
<td>Westerling et al. 2011</td>
<td>N. CA</td>
<td>+100%</td>
<td>Area burned</td>
</tr>
<tr>
<td>Rogers et al. 2011</td>
<td>OR, WA</td>
<td>+76 to 310%/ +29 to 40%</td>
<td>Area burned/ Severity</td>
</tr>
<tr>
<td>Sheehan et al. 2015</td>
<td>OR, WA</td>
<td>-82% to 14%</td>
<td>Mean Fire Interval</td>
</tr>
</tbody>
</table>

**Projected Increase in Area Burned**
- 600% to 700%
- 500% to 600%
- 400% to 500%
- 300% to 400%
- 200% to 300%
- 100% to 200%
- Not modeled

Mote et al. 2014
Things To Consider

- Patch Size
- Seasonality
- Productivity
- Post-fire climate
- Invasive species
- State changes
## Pre-fire Management Options

<table>
<thead>
<tr>
<th>Pre-fire management options</th>
<th>Low Severity Regimes</th>
<th>Mixed Severity Regimes</th>
<th>High Severity Regimes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic stand-level fuel reduction (thinning, surface fuels, ladder fuels)</td>
<td>✓</td>
<td>?</td>
<td>✗</td>
</tr>
<tr>
<td>Promote species and structural diversity within and across stands, include hardwoods</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Reduce other ecosystem stressors (invasives, fragmentation)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Limit human ignitions</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Aggressive wildfire detection</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Develop post-fire response strategies</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Post-fire Management Options

<table>
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<tr>
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<th>Mixed Severity Regimes</th>
<th>High Severity Regimes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess fire impacts relative to management objectives (can be + or - )</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Leverage natural regeneration - inexpensive, diverse, can't replant everywhere</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Planting: promote species and structural diversity within and across stands, consider hardwoods</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Coordinate post-fire activities with adjacent landowners</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Use events as learning opportunities (research, monitoring, trials, adaptive mgt.)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Questions?