Forensic Forestry: Reconstructing Historic Conditions for Forest Restoration

24 April 2014

Kerry L. Metlen, Darren Borgias, and Derek Olson
The Nature Conservancy
Perspectives on Forest Management

- Fire behavior
- Wildlife habitat
- Economics
- Ecological restoration

Photo: Marko Bey
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• Mean summer temperature up 5-7° F
• Summer precipitation down by 20%  
  Climate Wizard - Model Ensemble Average SRES emission scenario A2 for 2080
• Climate change will increase drought and fire frequency  
  Whitlock et al. 2003, Westerling et al. 2006
Increasing Wildfire Size and Severity with Changing Climate

Correlation between large (>400 ha) fire frequency and spring summer temperature.

Westerling et al. 2006
Ecological Departure in Frequent Fire Forests

Klamath and Siskiyou Mountains

Work needed on 1 million acres of closed forest of Southwestern Oregon
Historic dry fire-maintained forests

- Burn intervals of 8-35 years
- Dominated by large drought and fire resistant species
- Multi-aged
- Low densities
- Trees clumped or random but rarely distributed uniformly

Patterns Generated by Frequent Fire

1. Fire behavior
2. Habitat heterogeneity
3. Understory & regeneration
4. Insect/pathogen dynamics
5. Snow retention

Reference spatial patterns were resistant to fire & sustainable over time
Restoration Requires Reference Forest Conditions

- **Function**
  - Fire regimes

- **Forest Structure**
  - Species composition
  - Size class distribution
  - Tree density
  - Spatial patterns within stands
Charcoal and sediment records
Broad fluctuations in fire

Colombaroli & Gavin 2010
Frequent Fire in Southwest Oregon

17 years between fires

Cascades

Siskiyous

Mid-Coast Range

Sensenig 2013
Many fire scars - one tree
Fires do not scar every tree
Variation across a watershed - Ashland HUC 6 – 16,000 ac

Carl Skinner
– FS PSW Research Station

Photo: Sean Bagsha
Fire Scars on Individual Trees

- 91 samples, 161 fires between 1600 and 1920 CE
- A fire every 3 years somewhere in the watershed
Ashland Fire Return Intervals

Median FRI 11 years
44% scarred >3 sites
Regional Fire Return Intervals

Median FRI 9 years
Incredibly frequent fire
Mix of lighting and human ignitions
Stand reconstructions from 50 small plots (0.25 acre)

Living and dead trees, snags, logs, and stumps > 4 inches DBH
Cored a sample of living trees across species, sizes, and settings
Fifty 0.25 acre density plots
Four 7.4 acre mapped plots
2011 current condition
Trees > 4 inches DBH

Trees per acre

Diameter at 4.5 ft (inches)

- White fir
- Pacific madrone
- Douglas-fir
- Black oak
- Sugar pine
- Ponderosa pine
1911 reconstructed stands
Trees > 4 inches DBH

Trees per acre

Diameter at 4.5 ft (inches)
## Ashland Watershed Forest Densities

**Trees >4 inches DBH**

<table>
<thead>
<tr>
<th>Year</th>
<th>Basal area (ft²/acre)</th>
<th>Trees/acre</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Range</td>
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<tr>
<td>1911</td>
<td>81</td>
<td>(13-225)</td>
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<tr>
<td>2011</td>
<td>194</td>
<td>(63-339)</td>
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## Reference Forest Conditions Across the West

<table>
<thead>
<tr>
<th>Pub</th>
<th>Data Type</th>
<th>Precip (inches)</th>
<th>Forest Type</th>
<th>Geography</th>
<th>Size threshold</th>
<th>Basal Area (ft²/acre)</th>
<th>Trees per acre</th>
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<tbody>
<tr>
<td>5</td>
<td>Reconstruction</td>
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<td>Ponderosa Pine</td>
<td>East Cascades</td>
<td>&gt;4 inches</td>
<td>73</td>
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<td>60</td>
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<td>4</td>
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<td>7</td>
<td>Intact fire regime</td>
<td>24</td>
<td>Ponderosa Pine</td>
<td>San Bernardino</td>
<td>&gt;4 inches</td>
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<td>77</td>
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<td>PIPO-PICO</td>
<td>East Cascades</td>
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<td>4</td>
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<td>Mixed Conifer</td>
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<td>Stand Inventory</td>
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<td>Reconstruction</td>
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<td>&gt;2 inches</td>
<td>224</td>
<td>27</td>
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How are the trees arranged???

Mapping all trees > 10 inches DBH on 7.4 acre plots
1865

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<th>Trees &gt;10 in DBH</th>
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<tbody>
<tr>
<td>Trees/acre</td>
<td>27</td>
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<tr>
<td>Basal area (ft²/acre)</td>
<td>94</td>
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<tr>
<td>Gap (%)</td>
<td>32</td>
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2011

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<tr>
<td>Trees &gt;10 in DBH</td>
<td></td>
</tr>
<tr>
<td>Trees/acre</td>
<td>85</td>
</tr>
<tr>
<td>Basal area (ft²/acre)</td>
<td>193</td>
</tr>
<tr>
<td>Gap (%)</td>
<td>&lt;1</td>
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</table>
Trees > 10 inches diameter at breast height:

- **White fir**
- **Ponderosa pine**
- **Incense cedar**
- **Sugar pine**
- **Douglas-fir**

*Trees Scaled by Diameter*
White fir, Midslope, Warm Insolation Setting

Reference-1911

Contemporary-2011

White Fir
Douglas-fir
Madrone
Chinquapin
Sugar Pine
Incense Cedar
Ponderosa Pine

Tree points scaled by diameter

Clump Size

0 125 250 500 Feet

N
S
Ashland Forest Resiliency

- Fire prone and at risk
- History of controversy and mistrust
- Municipal Watershed
- 7,600 acre project area
Collaborative Forestry

- Grounded in ecology
- Opportunities for dialogue
- Cooperative project design and implementation
- Multiparty monitoring
Surface and Ladder Fuels — 2,300 acres
Commercial Fuels Treatments — 1013
Pile burning — 1,388 acres
Underburning — 150 acres

Photo: Marko Bey
Ecological Restoration Commercial Byproducts

- 1,000 log truckloads
- 3.2 million board feet
- $1.3 million for continued work
We could have thinned more...

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<th>Ashland Watershed</th>
<th>Trees per acre</th>
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<td>81 (13-225)</td>
<td></td>
</tr>
<tr>
<td>Ashland Forest Resiliency Targets</td>
<td>199 (67-415)</td>
<td>144 (87-255)</td>
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Building on Success

- 3,900 acres remaining
- Forest Restoration Off of Federal Lands
- Investment from the City of Ashland
- Exporting AFR model to other places
In Forests of Southwestern Oregon

- Fire incredibly frequent and widespread
- Fire exclusion promotes high density shade tolerant, fire sensitive trees
- Forest spatial patterning has homogenized and gaps have been lost
Thank you

• Pacific Southwest Research Station
  – Carl Skinner and Eric Knapp

• Collaborators
  – Anna Vandervlugt
  – Amy Waltz

• Field Crews and Volunteers

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