Dry Forest Resistance, Gone but not Forgotten: An Ecological Perspective on Living with Fire

Andrew Merschel, Peter Beedlow, Henry Lee, Steve Cline, Randy Comeleo, Dave Woodruff, Dave Shaw, Keala Hagmann, Matthew Reilly

Photo: Will Downing
Imagine You Just Bought a House in Bend…
What Should You Know About Dry Forests?

Historical Conditions, Fire Regimes, and Resistance

Changes in Structure and Composition

Contemporary Conditions and Disturbance Dynamics

Realistic Expectations for Fire, Disturbances, and Mitigation in the 21st Century

What Should We Do?
Dry Forests in Oregon and Washington

Includes forest where ponderosa is common and rare.
Records of Historical Fire Regimes and Dynamics

Reconstructions 2,000 - 205,000 acres

- Innaha
- Tucannon
- South Deep
- Swauk
- Teanaway
- Green Ridge
- Wanoga
- Dugout
- Quartz
- Nile
- McKay Creek
- Baker
- Black Bear
- Klamath
- Twenty
- Lytle
- Frosty
- Entiat

- Hot-Dry, Flat
- Cool-Wet, Rugged
- Cool-Wet, Rugged
- Hot-Dry, Flat

Point Reconstructions

- Elder
- Grayback
- Briggs
- Taylor
- Lava Cast
- Evans
- Big Butte
- Mosquito
- Trail
- Star
- Emigrant
- Deerborn
- Dry Cabin
- North Fork
- Crane
- Canyon
- Elliot
- Lake
- Reynolds
- Malheur
- Myrtle
- Sunk
- Jugow
- Metolious
- Thompson

Year
1600 1700 1800 1900 2000
Historical Disturbance Rates and Extent

For a 205,000 acre area

Fires > 50,000 acres occurred every 9.5 years

Fire Rotation was **15 years!**
Resilience – Is the capacity of an ecosystem *to respond* to a disturbance *recovering* ecosystem structure and function

Resistance – The property of an ecosystem to remain essentially unchanged when subject to disturbance. Ecosystem structure and function is *maintained* when disturbance occurs.
Ecosystem Resistance in Dry Forests with Frequent Fire

**Structure**
- Low-density with large, fire and drought resistant trees
- **No “Stands”** - Multiple successional phases (seedling sapling, stem exclusion, old-growth, early seral, etc.) occurred in a small area and are maintained over time

**Dynamics**
- Tree mortality and establishment was a fine-scale process
- This produced fine-scale variability in forest structure and many tree age classes

**Resistance**
- Ecosystem resistance operated at scales < 2 acres
Vast Areas of Resistant Forest Conditions

Stands with low tree densities and dominance of large-diameter ponderosa pines characterized the inventoried forests across all vegetation zones from xeric ponderosa pine to moist mixed-conifer.
Densification

Early 1900s

Density of Trees > 6 inches DBH

1920 = 28 trees/acre
2014 = 95 trees/acre

Hagmann et al. 2014
Loss of Large Trees > 21” DBH

Early 1900s

Large trees made up 86% of basal area
Density of large and small trees was nearly equal! (44% to 56%)

Contemporary

Large trees make up 30% of basal area
9 in 10 trees are small

Hagmann et al. 2014
Mesophication – A Shift to Fire and Drought Sensitive Trees

Grand fir: 84%
Douglas-fir: 8%
Western larch: 2%
Lodgepole pine: 6%
Ponderosa pine: <1%

Historical fire frequency = 12-21 years

Johnston 2017
Mesophication – A Shift to Fire and Drought Sensitive Trees

<table>
<thead>
<tr>
<th>Historical</th>
<th>Contemporary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shade intolerant</td>
<td>61%</td>
</tr>
<tr>
<td>Shade tolerant</td>
<td>39%</td>
</tr>
<tr>
<td>Shade intolerant</td>
<td>4%</td>
</tr>
<tr>
<td>Shade tolerant</td>
<td>96%</td>
</tr>
</tbody>
</table>

Johnston 2017
Contemporary Forest Composition & Historical Fire Frequency

Mean Fire Return Interval from 1650 – 1910 = 17 years

Mean Fire Return Interval from 1690 – 1860 = 6 years!

Douglas-fir, incense-cedar, grand fir - Umpqua National Forest
Effects of Densification and Mesophication

Increased host abundance, susceptibility, and dispersal for biological disturbance agents

Increased competition and susceptibility to drought
Losing Resistance

YOU'RE NOT THAT KIND OF FIGHTER..
Drought in the past 20 years is unprecedented in historical records

https://www.drought.gov/drought/states/oregon

Drought in Oregon 2000-2020
Contemporary Dynamics
Balancing Disturbances and Growth

1984

2010

Structural Class
- Non-Forest
- Sparse
- Open w/ Small Trees
- Open w/ Medium Trees
- Open w/ Big Trees
- Closed w/ Small Trees
- Closed w/ Medium Trees
- Closed w/ Big Trees
Contemporary Fire Regimes 1985 - 2012

- Fire rotation is still ~20x longer than it was historically!

Reilly et al. 2018
Contemporary Dynamics 1985-2017
Densification Continues

All Oregon and Washington

Canopy Cover Class

Acres

<20  20 - 40  40 - 60  60 - 80  >80

1985  2017
Expansion of the Wildland Urban Interface and Fire
Forecast for Living with Fire & Dry Forests

- Large Mixed-Severity Fires with Substantial Local Impacts
- Increased Prescribed Fire and Wildfire Use
- MORE Smoke
- Episodic mortality from Biological Disturbances Agents Triggered by Drought
Mitigation of Fire Effects on Humans and Property

Property damage is determined by conditions on private property, even if the surrounding forest has been treated.

Responsibility lies with property owners not public land managers.

Kramer et al. 2019, Calkin et al. 2014
Mitigation and Planning for Smoke

Smoke-Ready Toolbox for Wildfires

Wildland fires produce an air pollution that impacts people’s health and other aspects of daily life. The increased frequency and intensity of wildfires in the United States are adversely affecting air quality and putting more people at a health risk from exposure to smoke. Public health officials and others can use the resources in the Smoke Ready Toolbox to help educate the public about the risks of smoke exposure and actions people can take to protect their health.

Smoke & Your Health

- FAQs
- Smoke Advocates
- The and Your Health
- Frequently Questions
- Smoke Ready App
- Smoke Ready: Wildfire Resource and Recovery
- Smoke Ready: Burn and after a Wildfire (PDF, PDF)

Current Fires

- Current Fires
- Current Incident Information System
- Obama, Smoke Announcement Tool
- WTOA’s Fire Weather Outlook
- SMOKE/Incident Support
- Smoke and Smoke Testing
- National Interagency Coordination Center
- National Interagency Fire Center

Wildland Fire Publications, Fact Sheets, and Other Resources

- Fact Sheets
  - Reduce Your Smoke Exposure
  - Protect Children from Wildfire Smoke and Ash
  - Smoke Protection
  - Protect Your Pets from Wildfire Smoke
  - Protect Your Livestock and Livestock
  - Wildfire Smoke Guide
  - Information on Burn Health Risks from Wildfire Smoke & Fire
  - Smoke Ready Fire Resources

For Health Professionals

- Online Resources
  - Smoke Ready Guide for Public Health Officials

Featured Resources

- New resources are always on our website:
  - SmokeReady Toolbox
  - Smoke Ready App
  - SmokeReady: Wildfire Resource and Recovery
  - Smoke Ready: Burn and after a Wildfire (PDF)

JUNIPER BURNING PLANNED

WILDFIRE UPDATE

CENTRAL OREGON FIRE INFORMATION

ODF - Oregon State Fire Marshal - US Forest Service - BLM - City of Bend - Deschutes County - Red Cross

https://www.epa.gov/smoke-ready-toolbox-wildfires
Final Thought(s)

Our dry forests were more prepared for disturbances exacerbated by climate change/drought in 1900 than they are today.

Unprecedented Droughts and Climate Change are a catalyst for uncharacteristic mortality from disturbances, but forest conditions ultimately determine how a changing climate will impact dry forest ecosystems.

We can’t stop drought or climate change, but we can change how we manage and use wildfire in a way that restores resistance in dry forests.
If it is decided to permit such species as white fir to come in under mature ponderosa pine, how much of the public’s money are foresters justified in spending in trying to keep fire out?

Even with unlimited funds, personnel, and equipment, can they give reasonable assurance that they can continue to keep such extremely hazardous stands from burning up?

Will the timber products of such stands justify the high protection costs and fuel hazards?