Restoring Fire-Prone Inland Pacific Landscapes

Paul Hessburg, Forest Service Research, Wenatchee, WA
& The University of Washington, Seattle

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REVIEW ARTICLE

Restoring fire-prone Inland Pacific landscapes: seven core principles

Paul F. Hessburg · Derek J. Churchill · Andrew J. Larson · Ryan D. Haugo · Carol Miller · Thomas A. Spies · Malcolm P. North · Nicholas A. Povak · R. Travis Belote · Peter H. Singleton · William L. Gaines · Robert E. Keane · Gregory H. Aplet · Scott L. Stephens · Penelope Morgan · Peter A. Bisson · Bruce E. Rieman · R. Brion Salter · Gordon H. Reeves

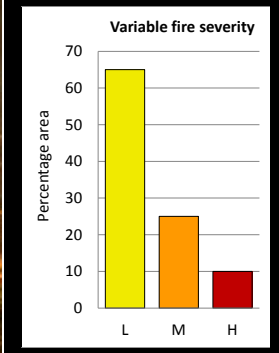
Landscape Ecology (2015) 30: 1805-1835.

Road Map

- Historical fire regimes, forest succession, key linkages btw them
- Management alters fire regimes, structure, composition, patterns of forests
- This changes functioning at patch to regional landscape scales
- Warming climate, megafires: dense, layered forests—hot, dry windy summers
- Key principles emerging from study of changes and their mgt implications

Restoring Fire-Prone Inland Pacific Landscapes: 7 Core Principles

Historical



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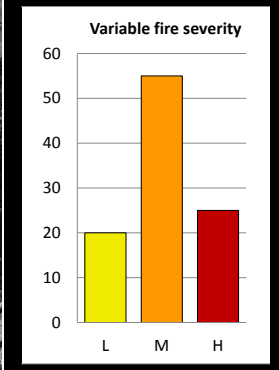
Current



- ✓ Low severity fire (LSF): <20% of the dominant tree cover killed by fire
- ✓ LSFs were common in the driest PP and MC forests, dry topo-edaphic sites
- ✓ Frequent fires occurred every 5-25 yrs, continuously reducing fuels
- ✓ Frequency reinforced LSFs, extreme climatic conditions drove more extreme fires

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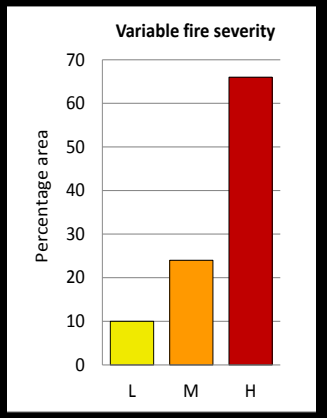
Historical



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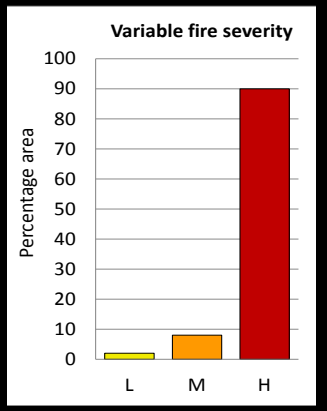
Current



- ✓ High severity fire (HSF): > 70% of the tree cover killed by fire
- ✓ HSFs common in wet & cold forests where fires were infrequent (every 150-300 yr)
- ✓ Most fires were HSF, but mild climatic conditions favored milder fires
- ✓ Created variation in fire severity and fire event patch sizes; i.e., a PSD

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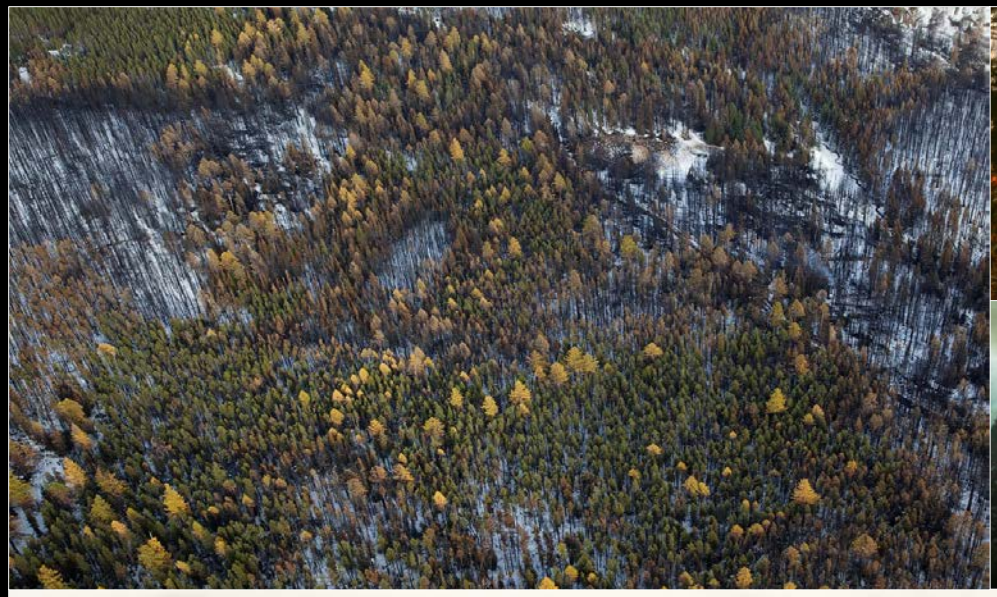
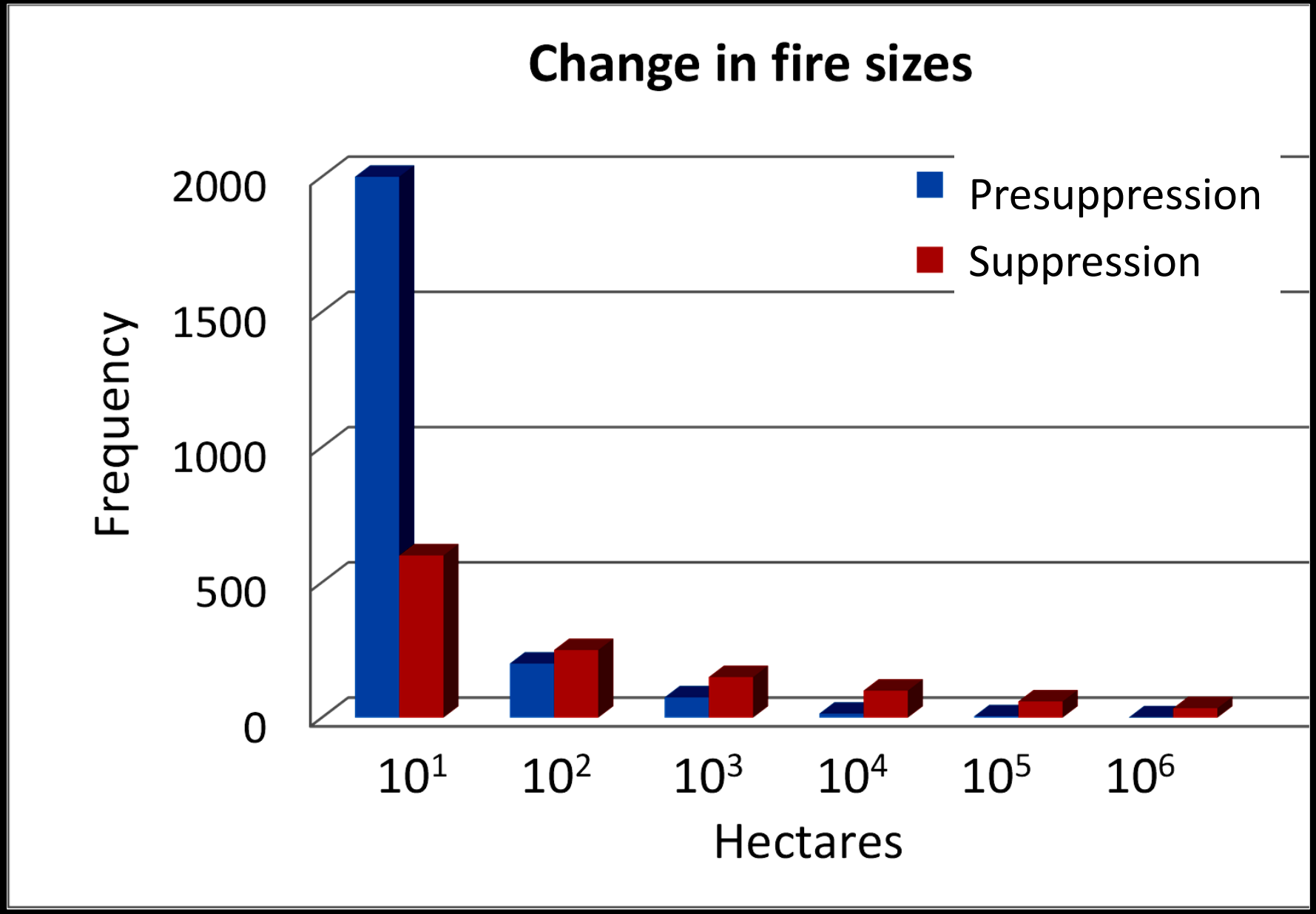


Historical

⇩

Current

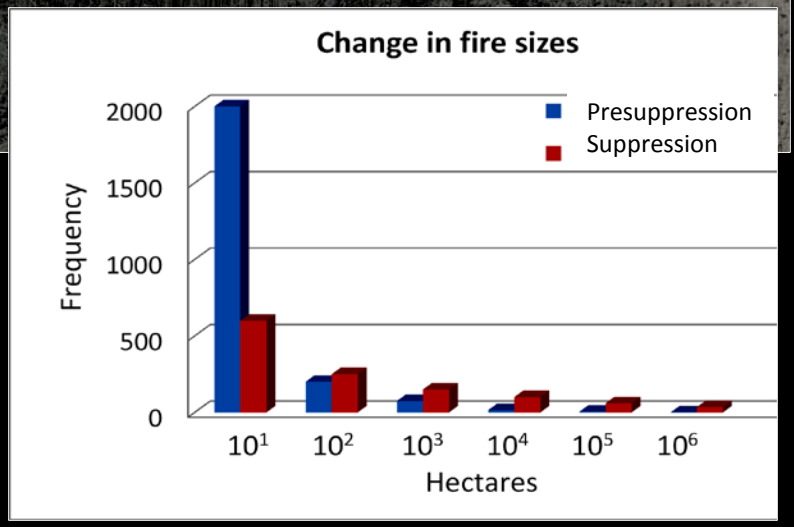
- ✓ Mixed severity fire (MSF): 20-70% of the tree cover killed by fire
- ✓ MSFs were common in dry & moist MC forests w/ PP, DF, GF, WL
- ✓ Fires occurred w/ intermediate frequency, every 30-50+ yrs
- ✓ Occasionally both milder & more severe fires occurred, climate driven


Change in fire sizes
Presuppression
Suppression
Frequency
2000
1500
1000
500
0
10^1
10^2
10^3
10^4
10^5
10^6
Hectares

Wildfire patterns provided a positive landscape-level feedback and a natural resilience mechanism…

Ongoing wildfires maintained patchworks of burned & recovering vegetation in a variety of fuel conditions, seral stages and patch sizes

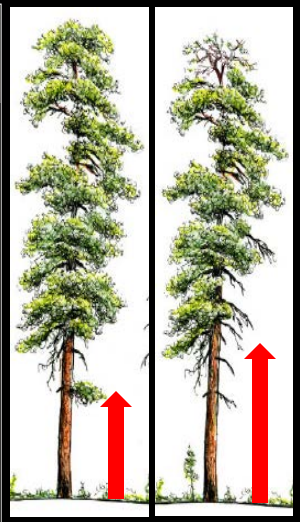
- Patchworks spatially interrupted conditions supporting large fires
- Influenced the frequency, size, & severity of future events
- Insect, disease, & weather disturbances added to this complexity
- Extreme weather events occasionally overrode these spatial controls



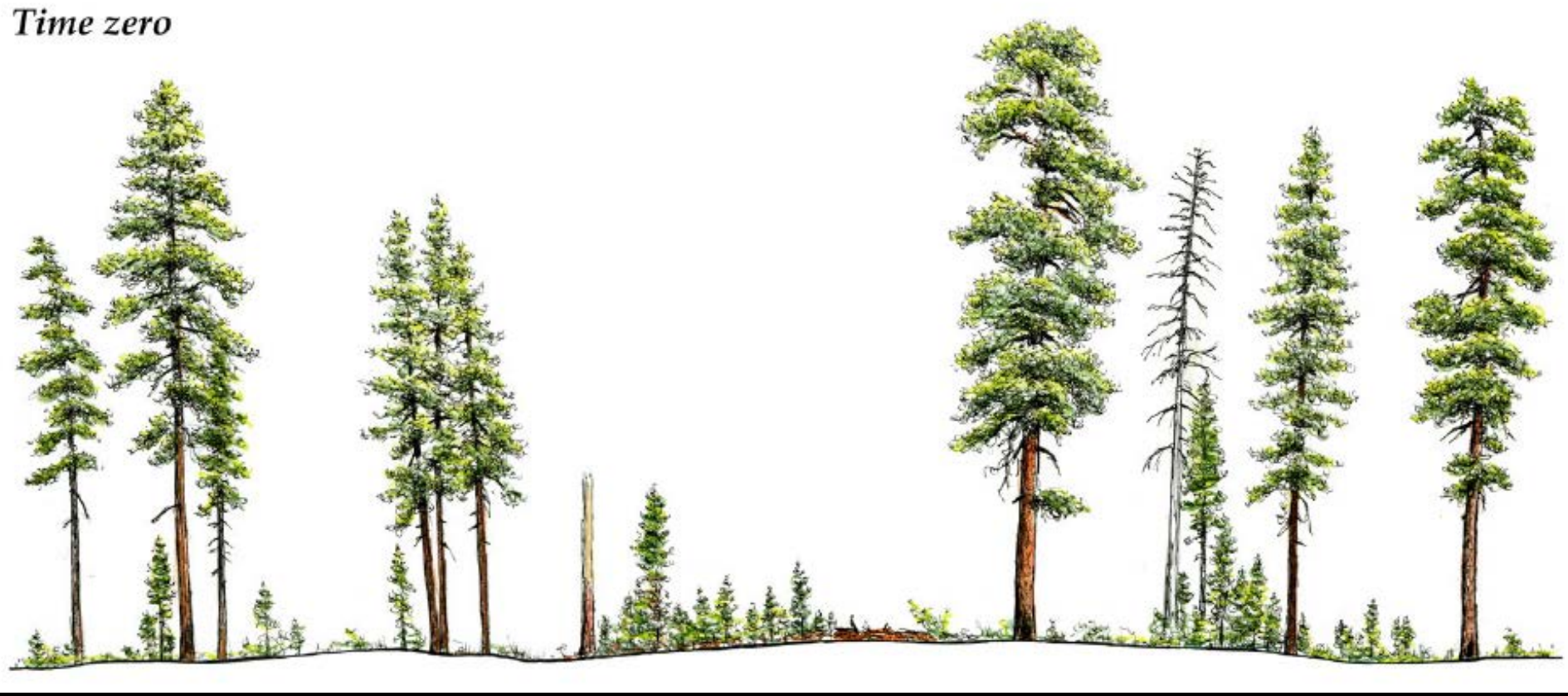
Important positive patch-scale feedbacks too:

Frequent LSFs & MSFs reinforced resilience by:

- ✓ Reducing surface and ladder fuels
- ✓ Increasing the height to live crowns
- ✓ Decreasing crown density
- ✓ Favoring early seral species
- ✓ Favoring medium and large sized, older trees
- ✓ Favoring patchy tree and surface fuel cover

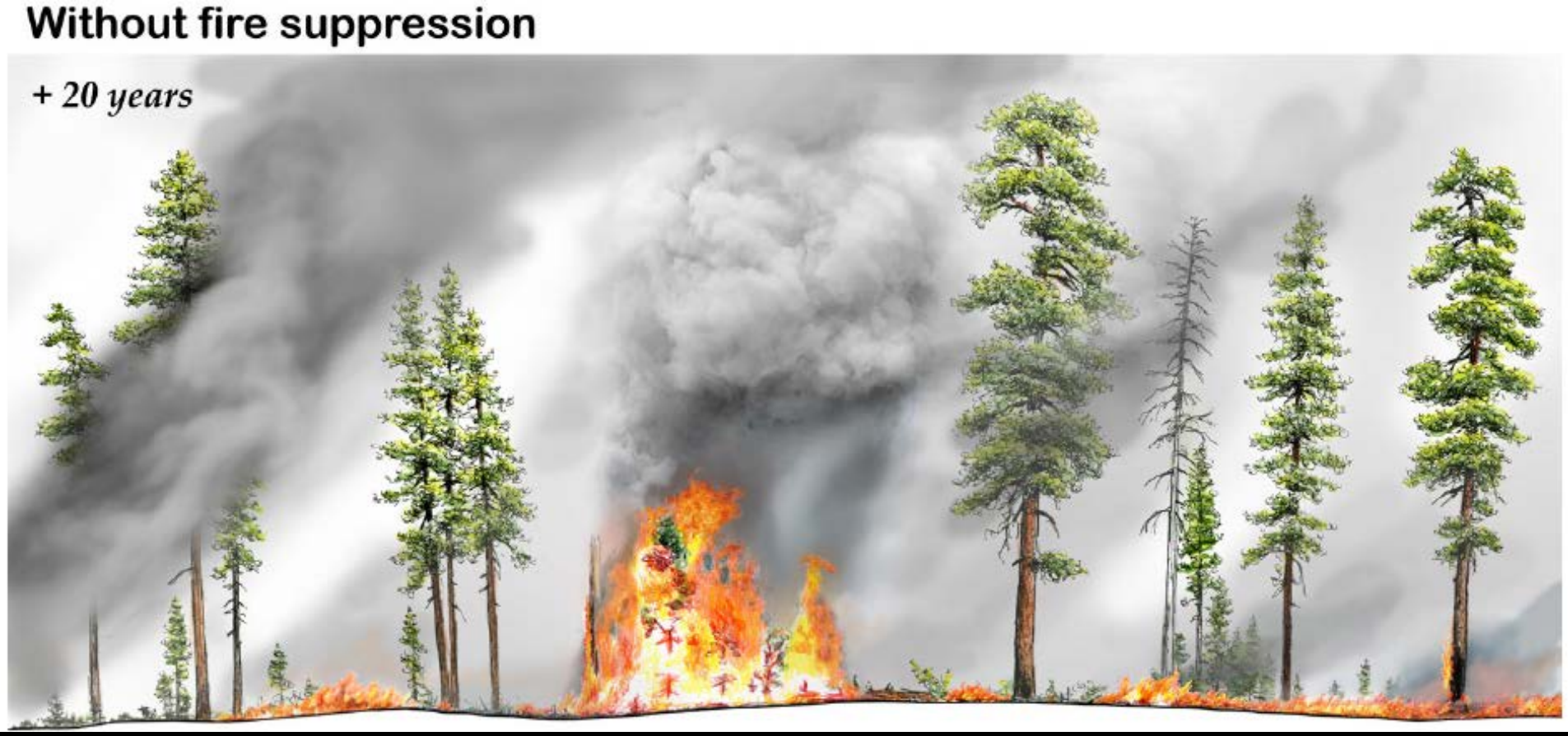


Agee J. K. & Skinner C. N. 2005. Forest Ecology and Management 211(1): 83-96.



How these patch-level feedbacks worked...

Bob Van Pelt drawings...


Without fire suppression
+ 20 years

+ 40 years

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+ 80 years

1) Locally—fires continually thinned forest patches, reducing density and fuels

2) Regionally—fires created variable patchworks of grass, shrub, early, mid, late seral conditions, these patterns spatially controlled future fire size & severity

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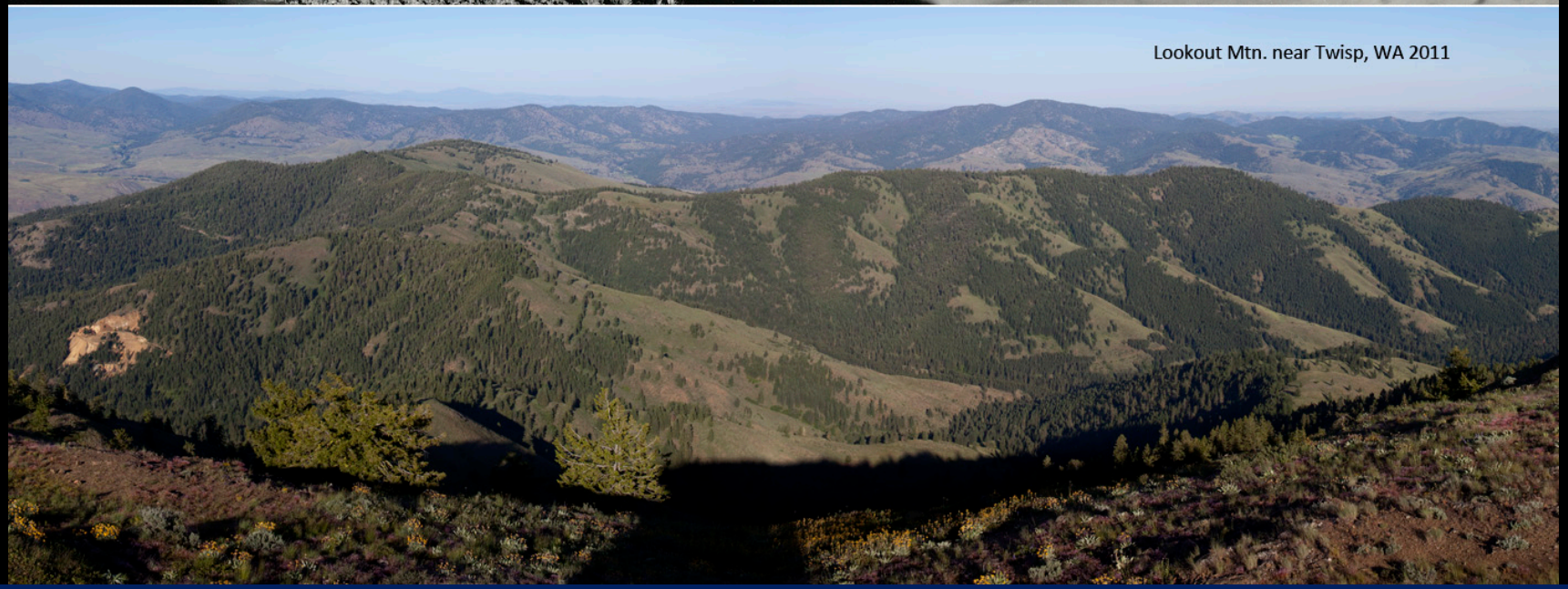

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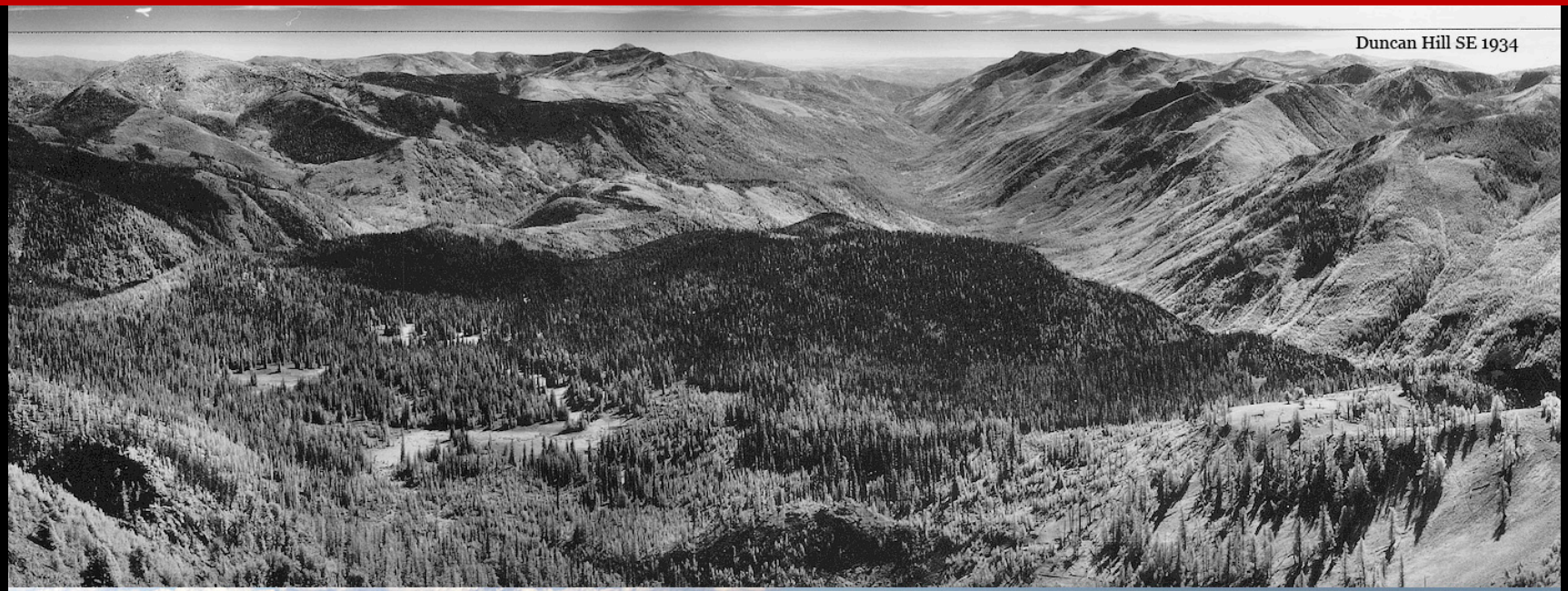

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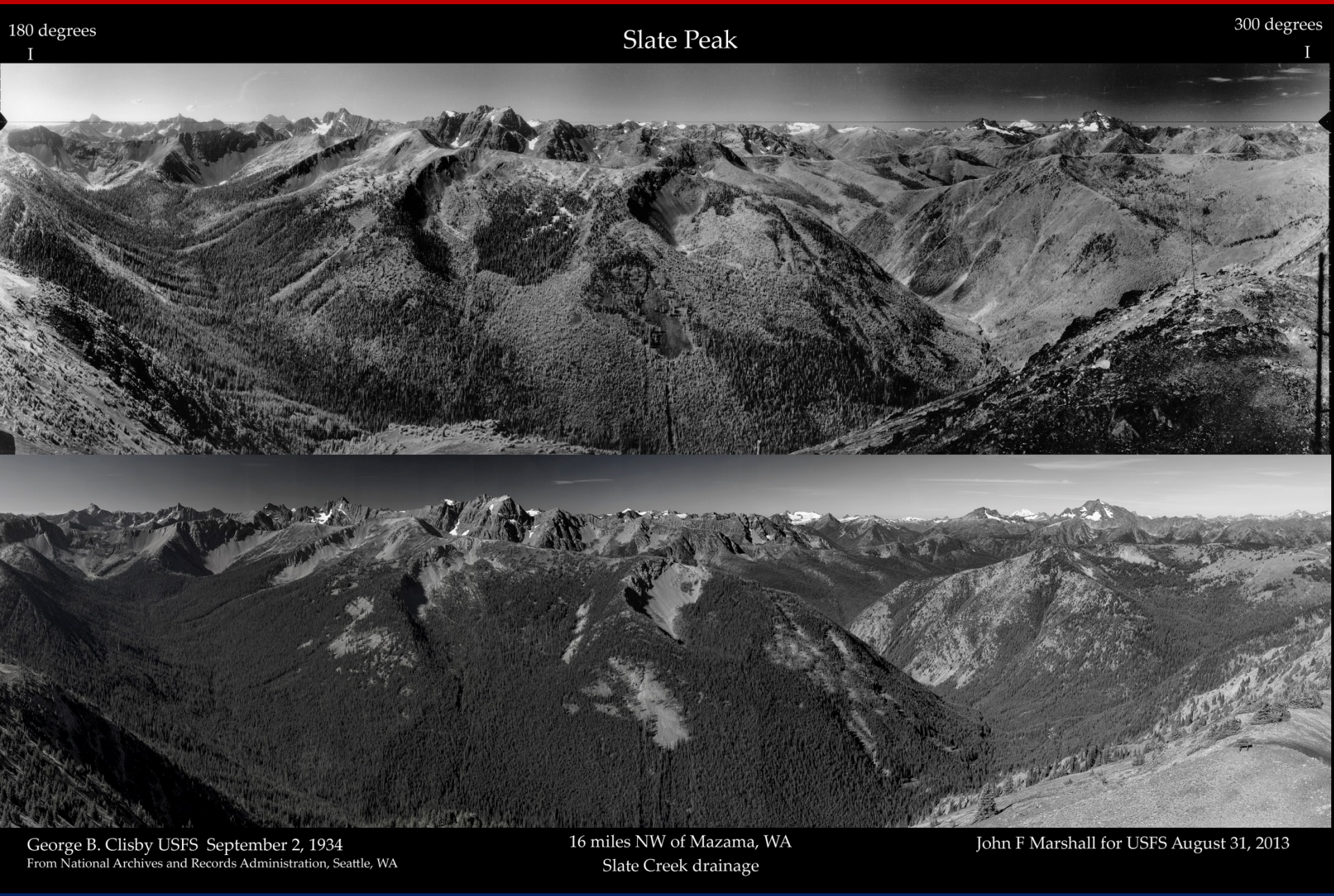

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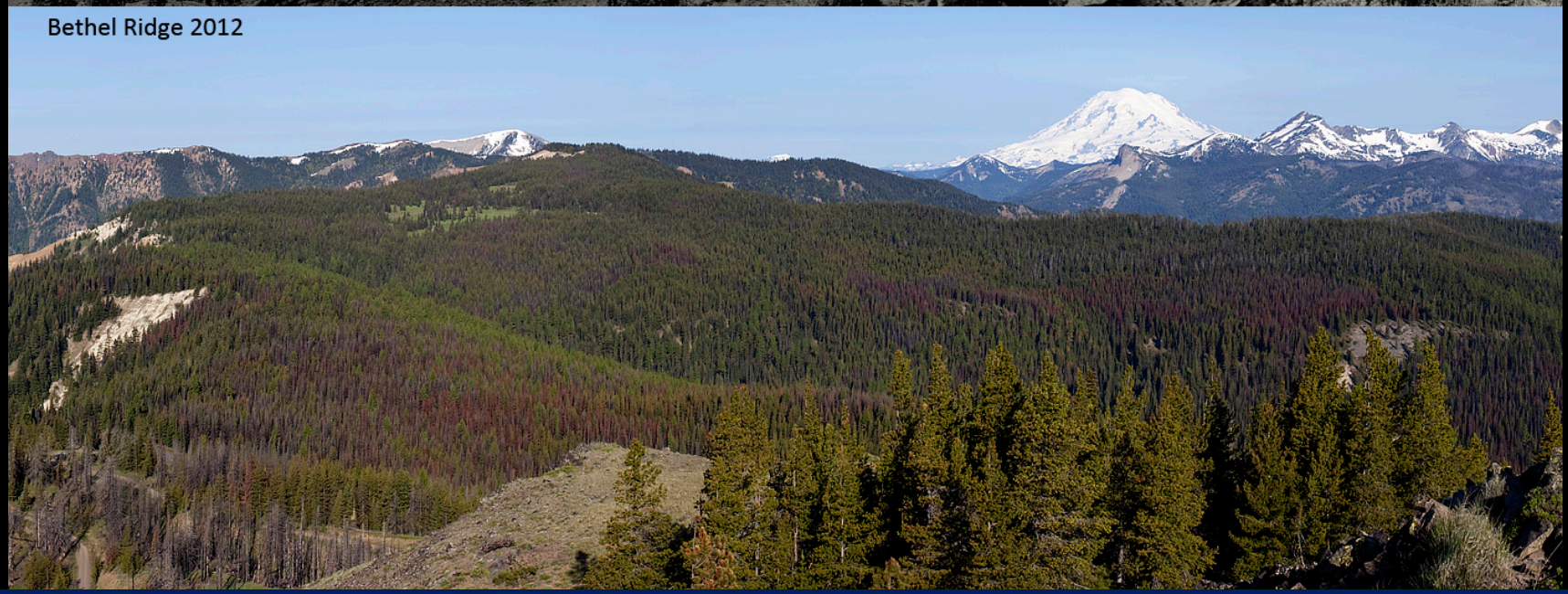
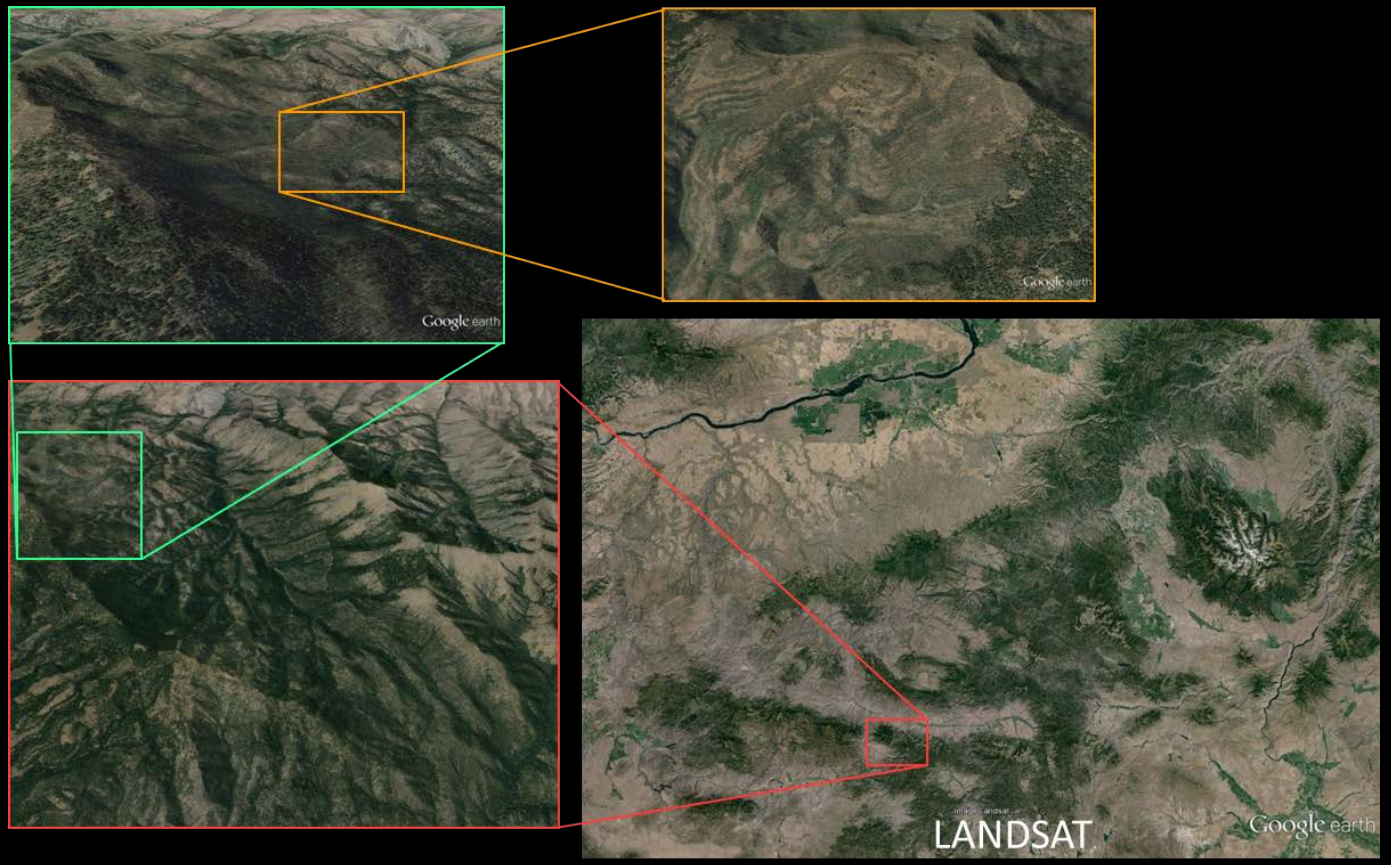


Framing Landscape Restoration: **Core Principle 1**

Regional landscapes function as multi-level, cross-connected, patchwork hierarchies

Restore connectivity and processes across multi-level landscapes



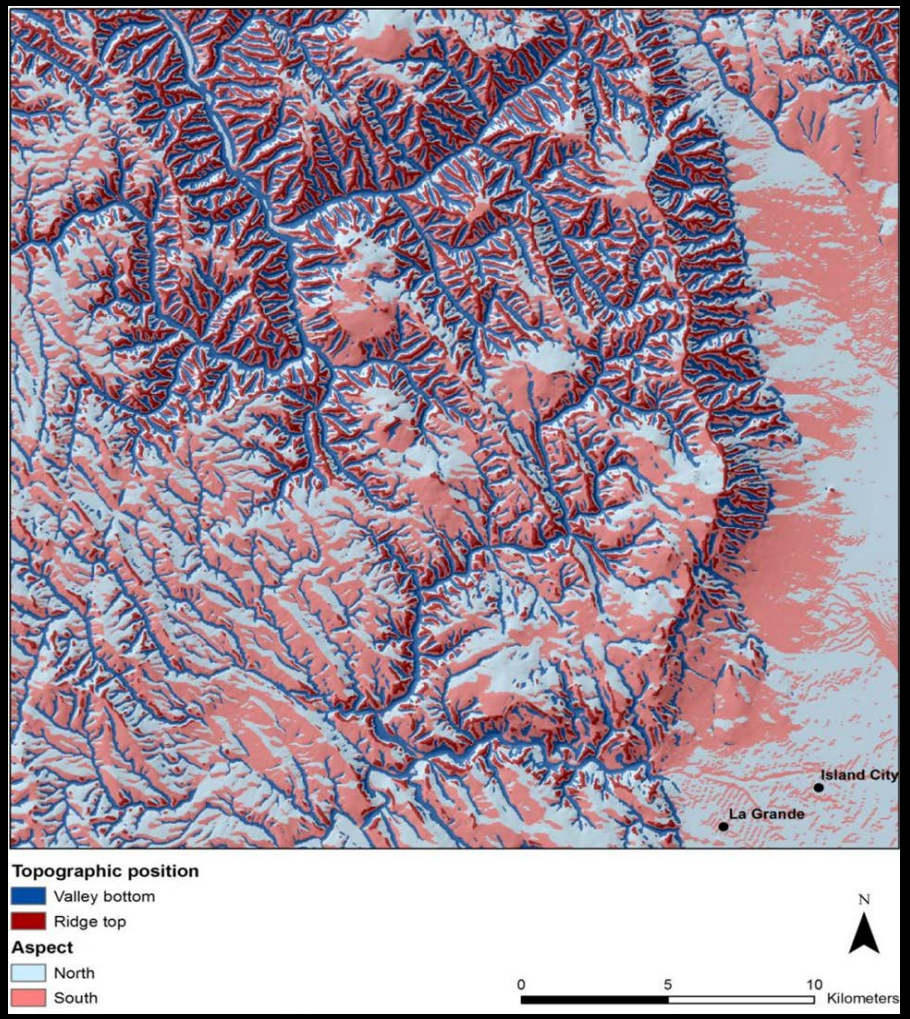
Blue Mountains Province

Wu J., & Loucks, O. L. 1995. Quarterly Review of Biology, 439-466
O'Neill 1986, Urban et al. 1987, Holling 1992, Wu & David 2002

Framing Landscape Restoration: **Core Principle 2**

Topography provides a natural template for vegetation & habitat patterns

Use topography and soils as a successional & environmental template for fitting more characteristic successional patterns to the landscape



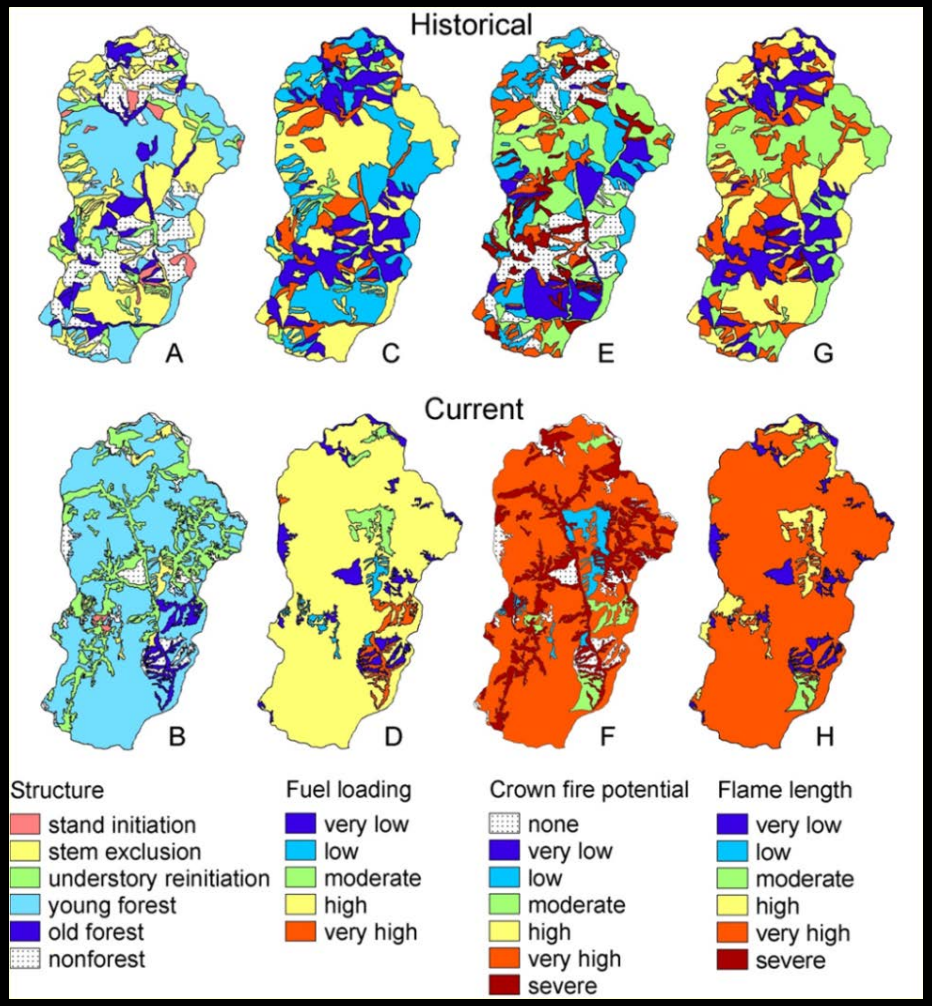
Perry et al. (2011) For Ecol & Mgt 262:703

Lyderson & North (2012) Ecosystems 15: 1134

Framing Landscape Restoration: **Core Principle 3**

Fire and forest succession are the **engine** that drives the system

Restore the fire regime and supportive successional patterns, and the other disturbance regimes will follow

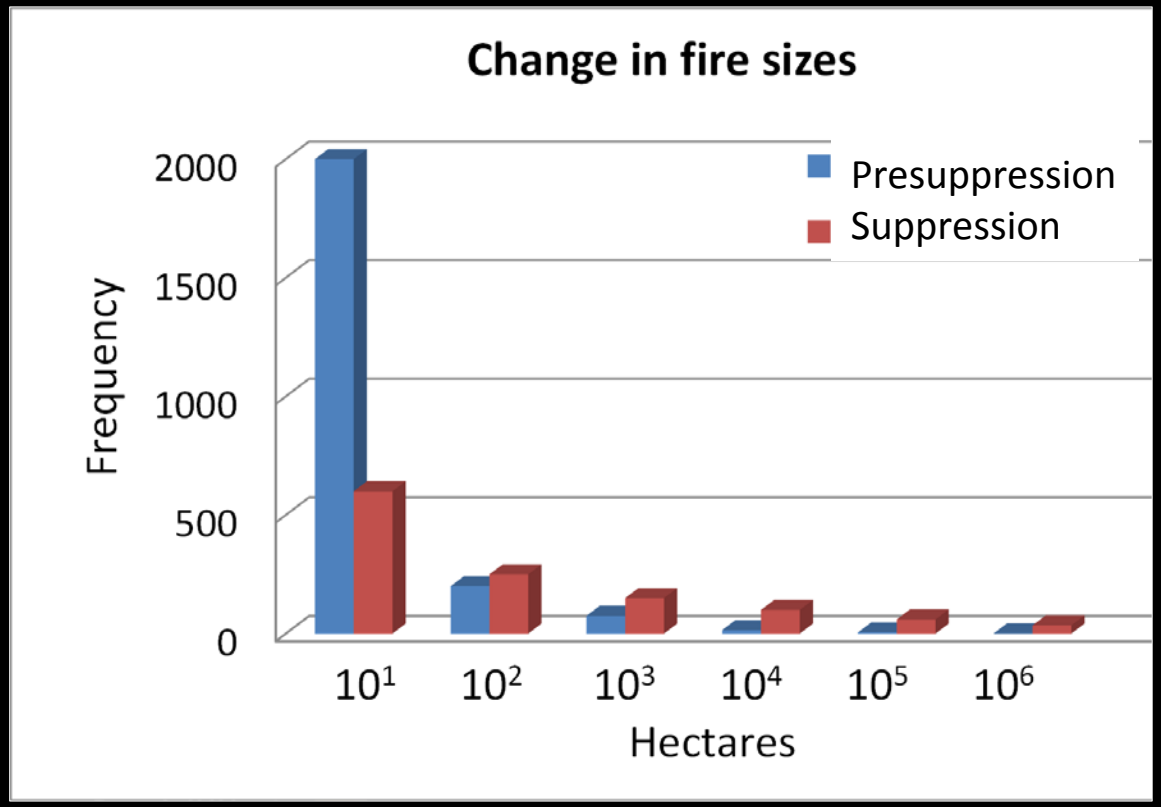


Keane et al. (2009) For Ecol Manage 258:1025-1037
Bisson et al. (2009) Ecol & Soc 14(1), 45;
Collins et al. 2009, Parks et al. 2015;
McGarigal & Romme 2012;
Wiens et al. (2012) Hist. Env Variation… Wiley-Blackwell

Framing Landscape Restoration: **Core Principle 4**

Predictable patch size distributions historically emerged from linked climate-disturbance-topography-vegetation interactions

Restore size distributions of successional patches & allow changing climate & disturbance regimes to adapt them



Moritz et al. 2011. Landscape Ecology of Fire, Springer.

Perry et al. 2011. Forest Ecology and Management 262: 703-717.

Framing Landscape Restoration: **Core Principle 5**

Widely distributed medium and large-sized, old trees provide a critical backbone to dry pine and dry + moist mixed conifer landscapes

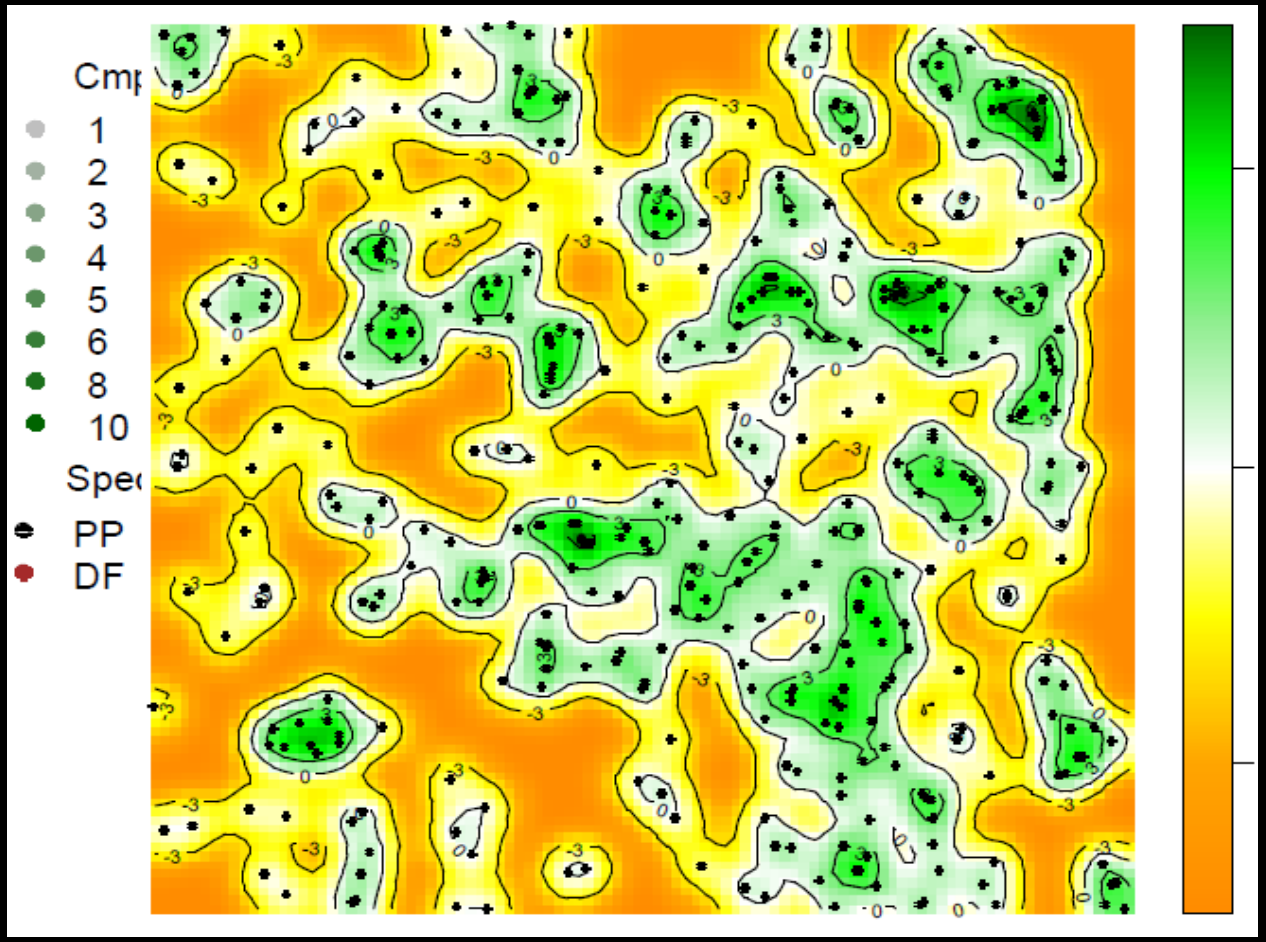
Retain and expand on existing relict trees, old forests, and post-disturbance large snags and down logs in these types

Lutz et al. (2009) For Ecol Manage 257: 2296-2307
Hagmann et al. (2013) For Ecol Manage 304: 492-504; (2014) For Ecol Manage 330: 158-170.
Larson & Churchill (2012) For Ecol Manage 267:74-92

Framing Landscape Restoration: **Core Principle 6**

Successional patches are “landscapes within landscapes”

In PP & MC patches, restore characteristic tree clump & gap variation

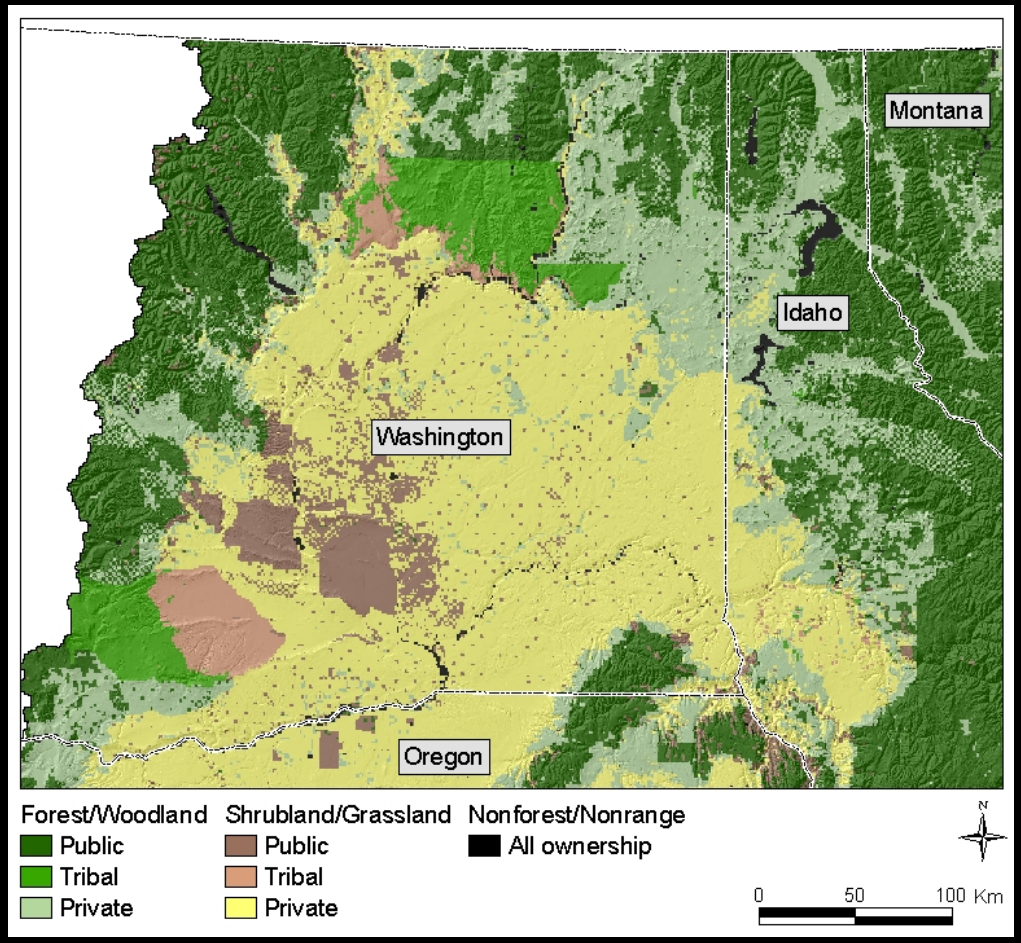


Larson & Churchill (2012) For Ecol Manage 267: 74-92
Churchill et al.(2013) For Ecol Manage 291: 442-457
Lydersen et al. (2013) For Ecol Manage 304: 370-38

Framing Landscape Restoration: **Core Principle 7**

Land ownership, allocation, management and access patterns disrupt landscape and ecosystem patterns

Work collaboratively across ownerships to develop restoration projects



Cheng & Sturtevant (2012) Env Mgt 49:675-689

Rieman et al. (2015) Fisheries, 40:124-135

Summary

- We live in landscapes that were continuously shaped by fire.
- Our nearby forests and rangelands need to and will burn. We can influence how often, how severe, how large.
- Historical fire suppression & exclusion have created high fuel loads, a fire deficit in forests, and high contagion of crownfire behavior.
- Consequently, today's wildfires burn hotter and larger than most historical fires.
- Our climate and weather are changing, becoming more extreme.
- Extreme weather is increasing fire size & severity in most interior forest types.
- Restoration of forest successional & fuel patterns is needed if your mgt goal is to recalibrate fire, insect, and pathogen disturbance regimes.
- The resulting patterns of successional and fuel conditions are vitally important to processes and species.
- These principles can guide your work.

Acknowledgments

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Brion Salter (maps)

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