Restoring Fire-Prone Inland Pacific Landscapes

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REVIEW ARTICLE

Restoring fire-prone Inland Pacific landscapes: seven core principles

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Landscape Ecology (2015) 30: 1805-1835.

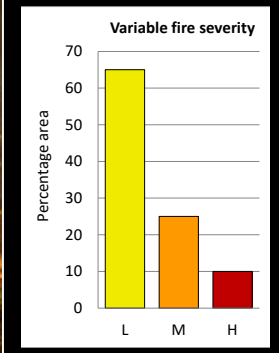
Restoring Fire-Prone Inland Pacific Landscapes: 7 Core Principles

Road Map

- Historical fire regimes, forest succession >> key linkages btw them
- Management alters fire regimes >> structure, composition, patterns of forests
- This changes processes at patch to regional landscape scales
- More hot-dry windy summers + dense, layered forests >> megafires
- Key principles emerging from study of changes & their mgt implications

Restoring Fire-Prone Inland Pacific Landscapes: 7 Core Principles

Historical



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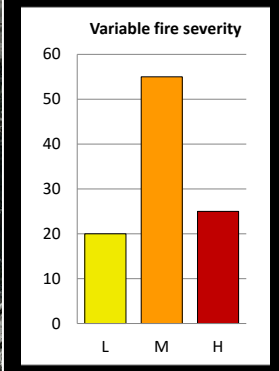
Current



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

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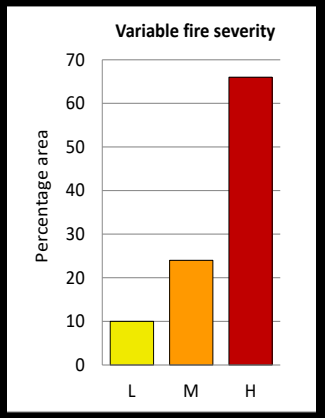

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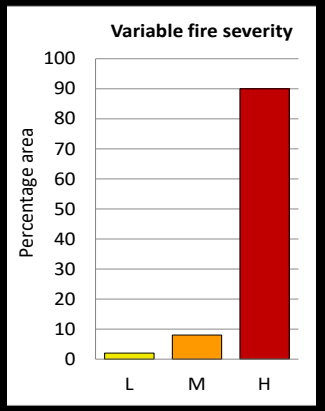

- ✓ High severity fire (HSF): > 70% of the tree cover killed by fire
- ✓ HSFs common in wet & cold forests where fires were infrequent (150-300+ yr)
- ✓ Most fires were HSF, but mild climatic conditions favored milder fires
- ✓ Created variation in fire severity and fire event patch sizes; i.e., a PSD

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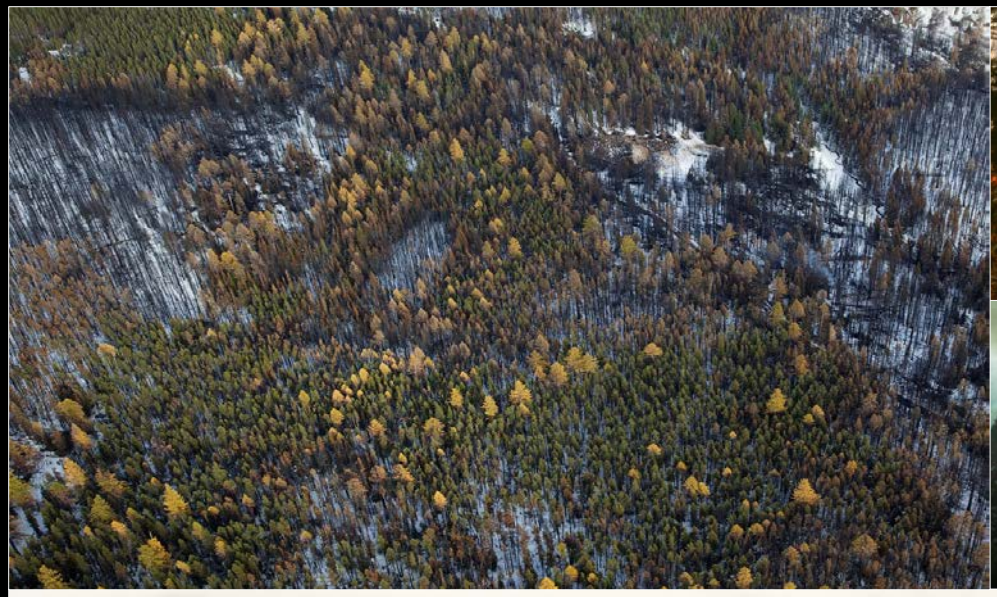
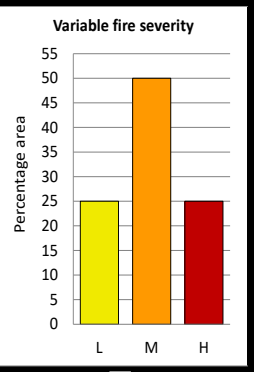


Historical



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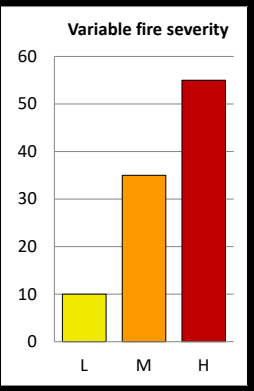
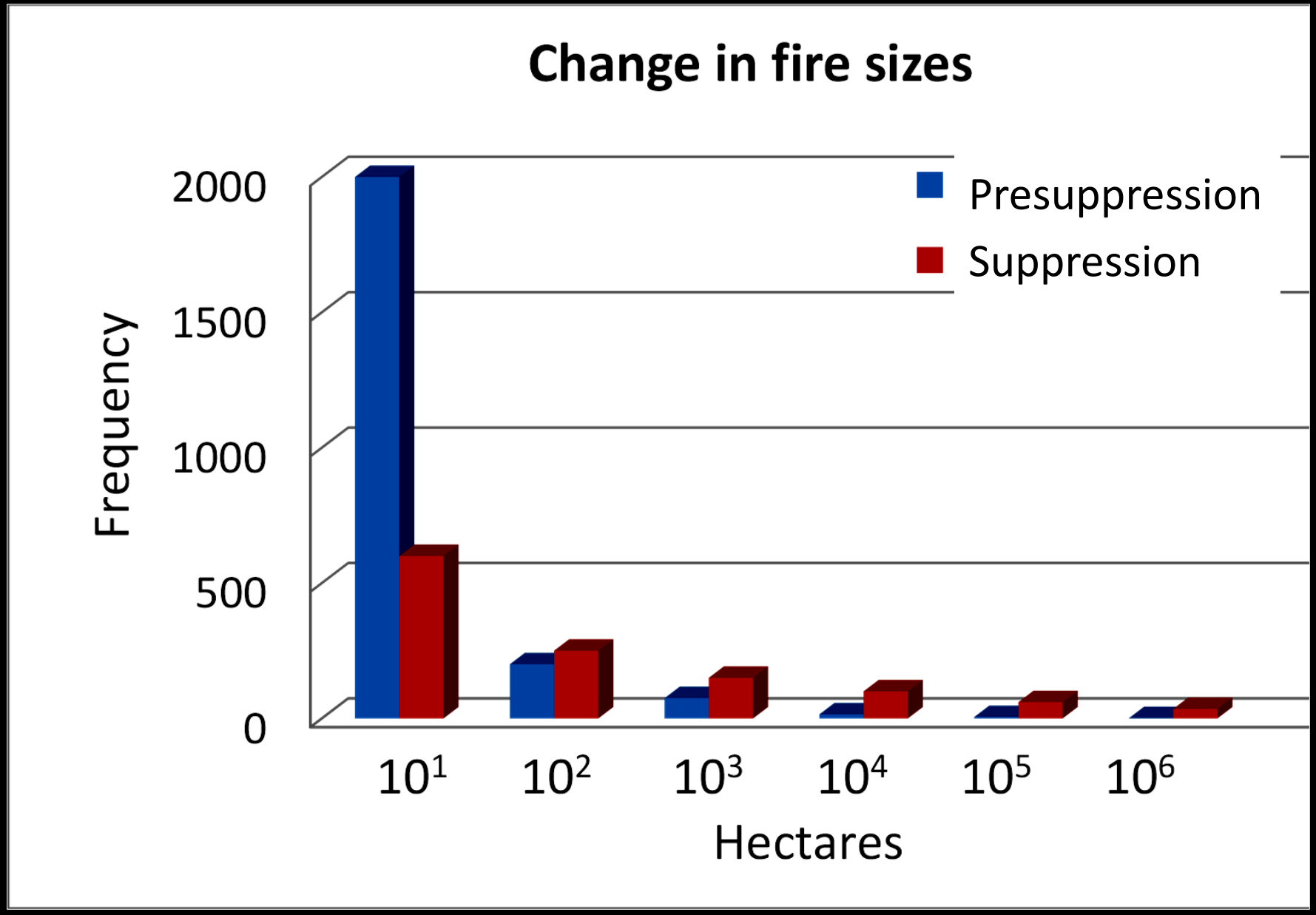
Current



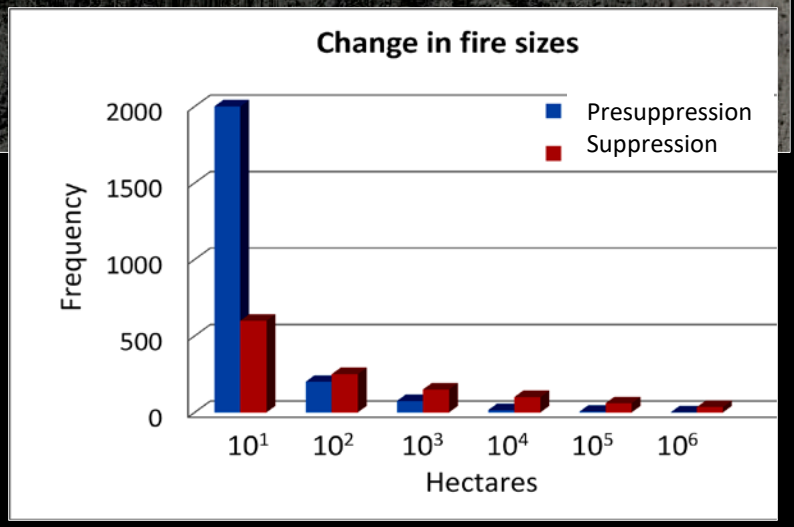
- ✓ Mixed severity fire (MSF): 20-70% of the tree cover killed by fire
- ✓ MSFs were common in dry & moist MC forests w/ PP, DF, GF, WF, WL
- ✓ Fires occurred w/ intermediate frequency, every 30-50+ yrs
- ✓ Occasionally both milder & more severe fires occurred, climate driven


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

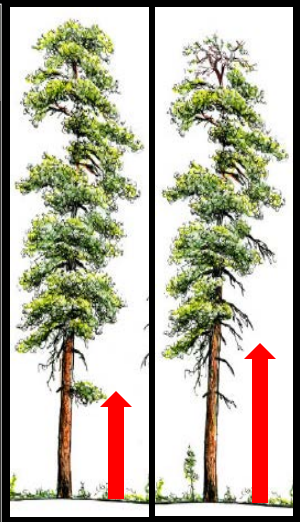
- Patchworks spatially interrupted conditions supporting large fires
- Influenced the frequency, size, & severity of future events
- Insect, disease, & weather disturbances added to this complexity
- Extreme weather events overrode these spatial controls
- "Power in the patchwork" & PSDs



Important positive patch-scale feedbacks too:

Frequent LSFs & MSFs reinforced resilience by:

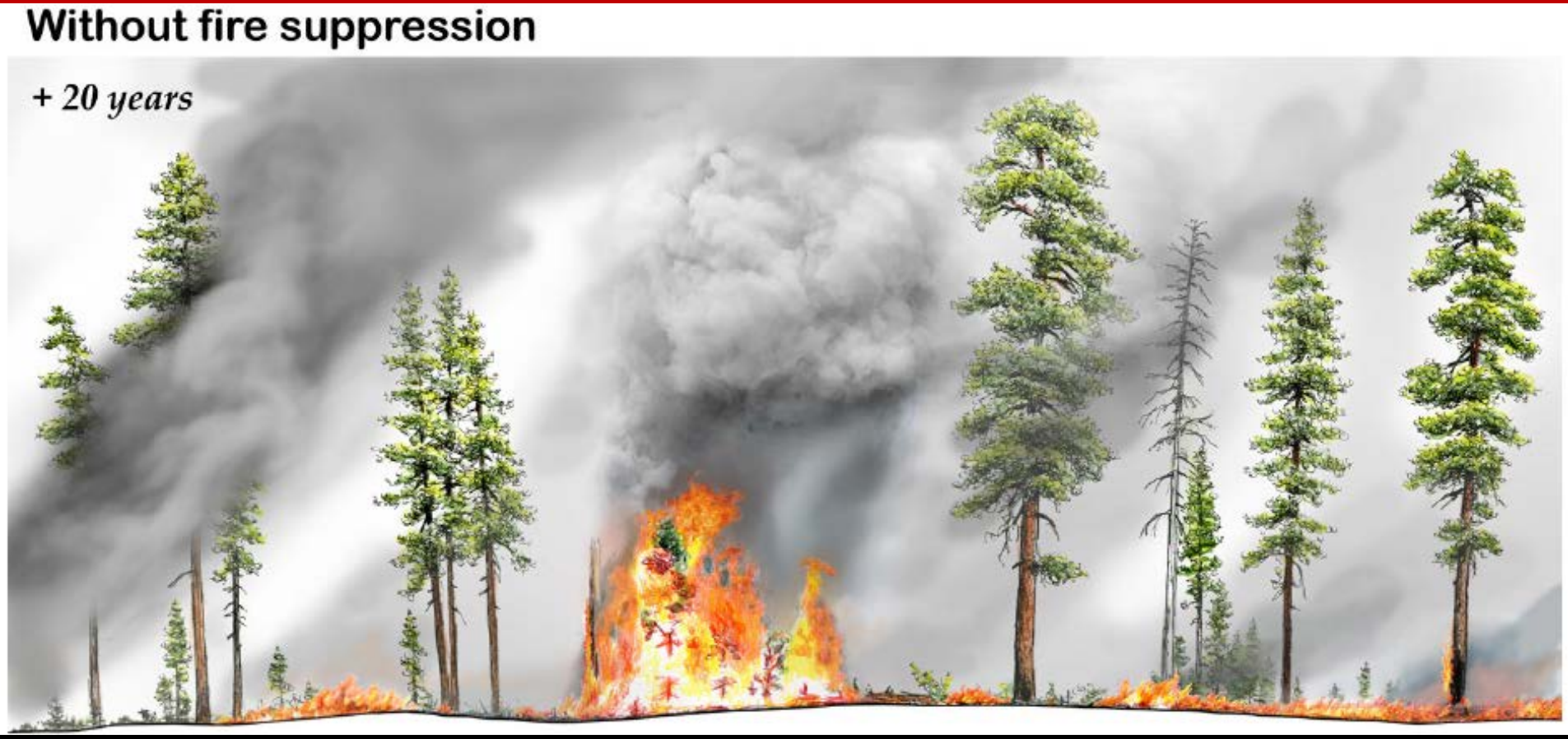
- ✓ Reducing surface and ladder fuels
- ✓ Increasing the height to live crowns
- ✓ Decreasing crown density
- ✓ Favoring early seral species
- ✓ Favoring medium and large sized, older trees
- ✓ Favoring patchy tree and surface fuel cover



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

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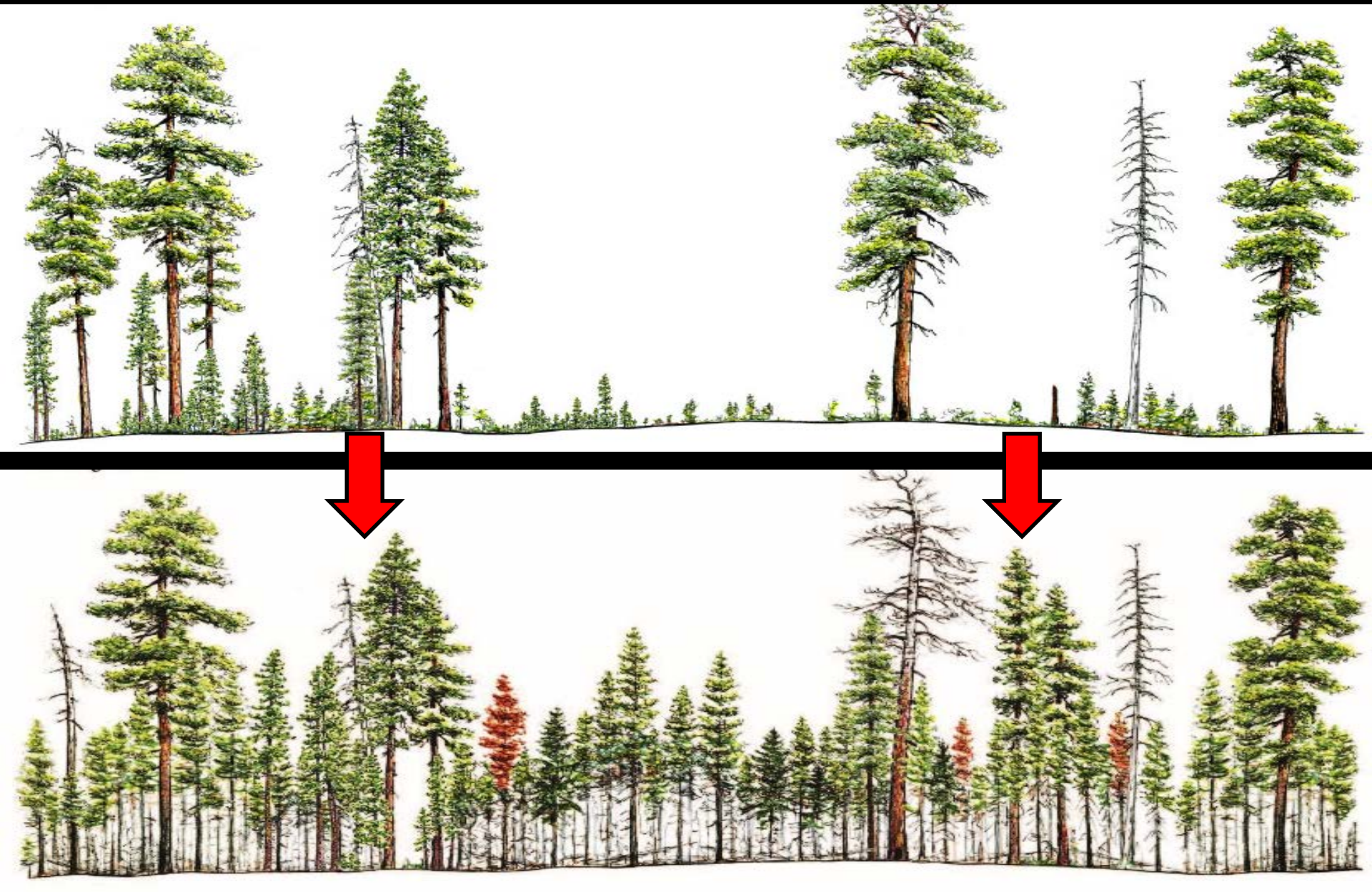

1) Locally—fires continually thinned forest patches, reducing density and fuels

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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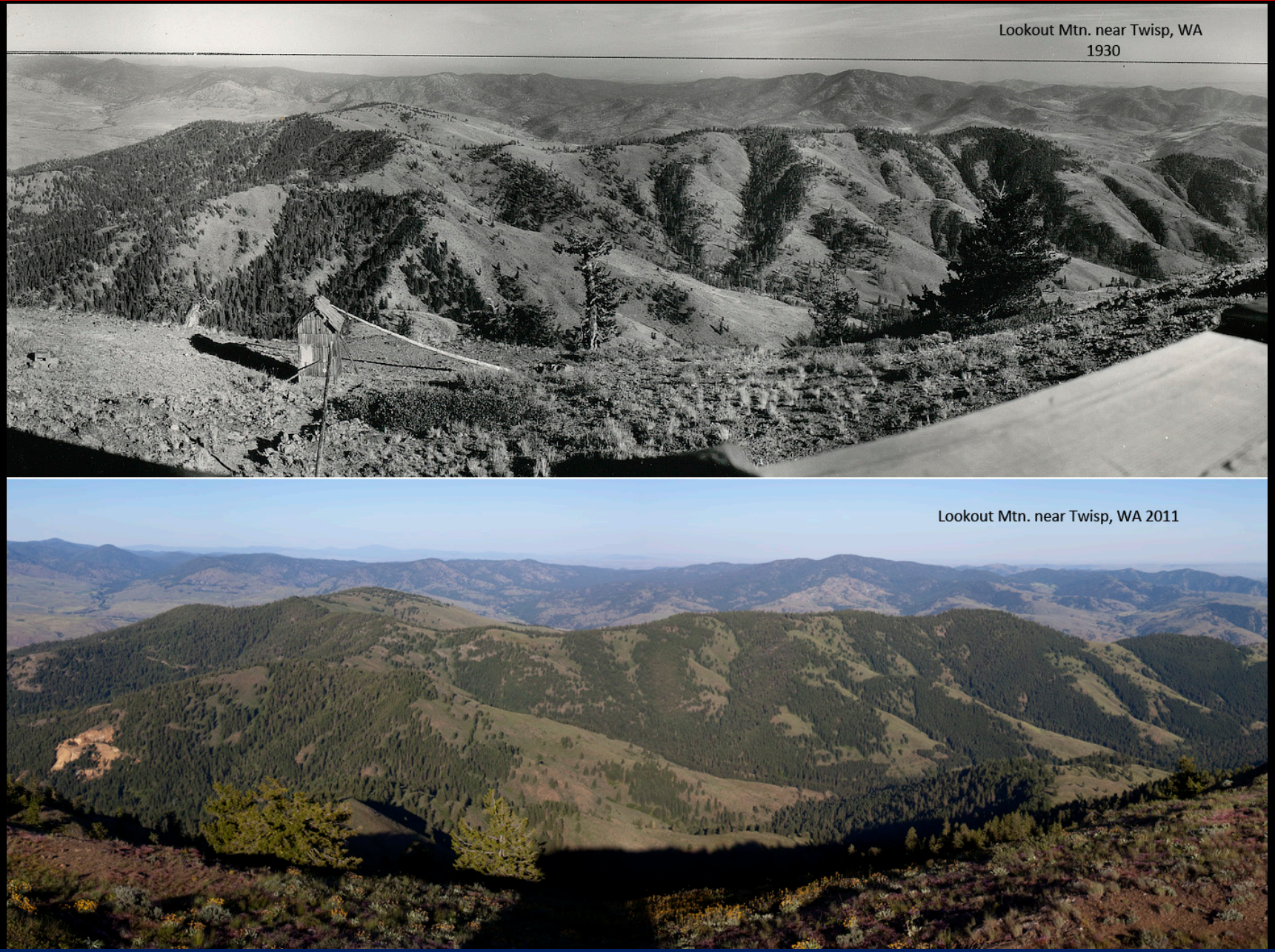

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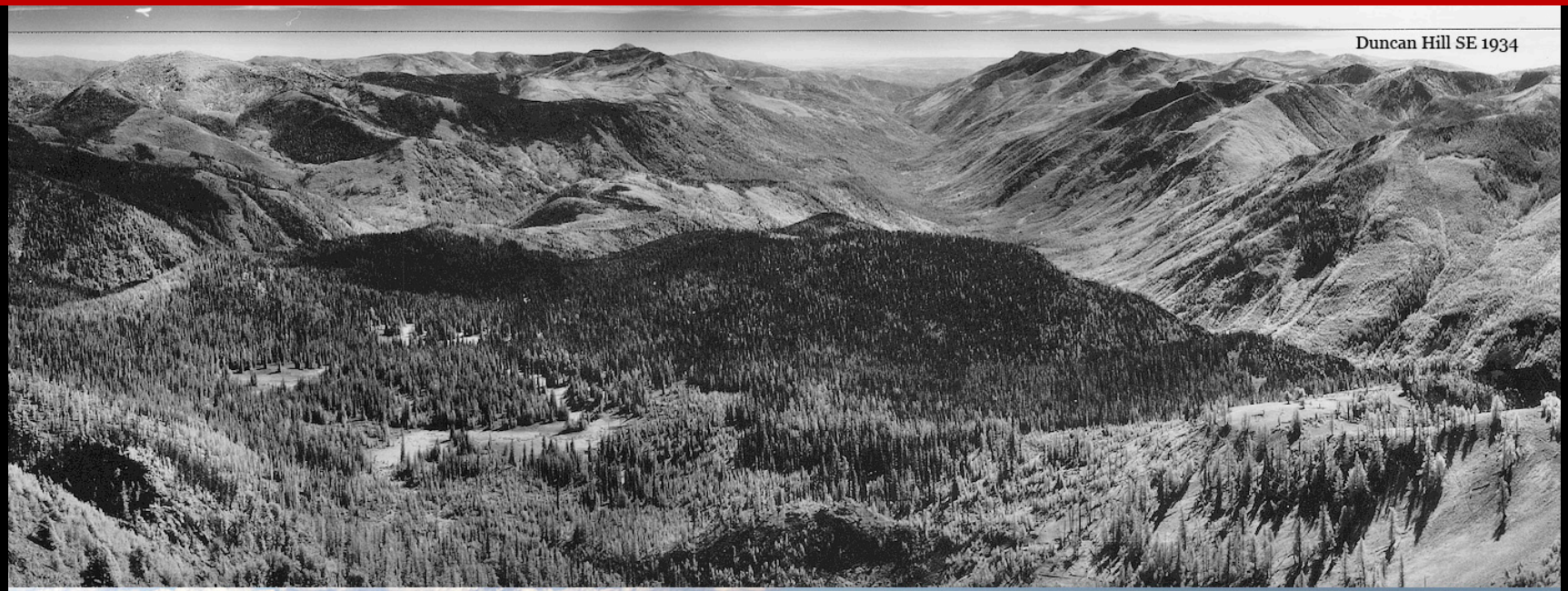

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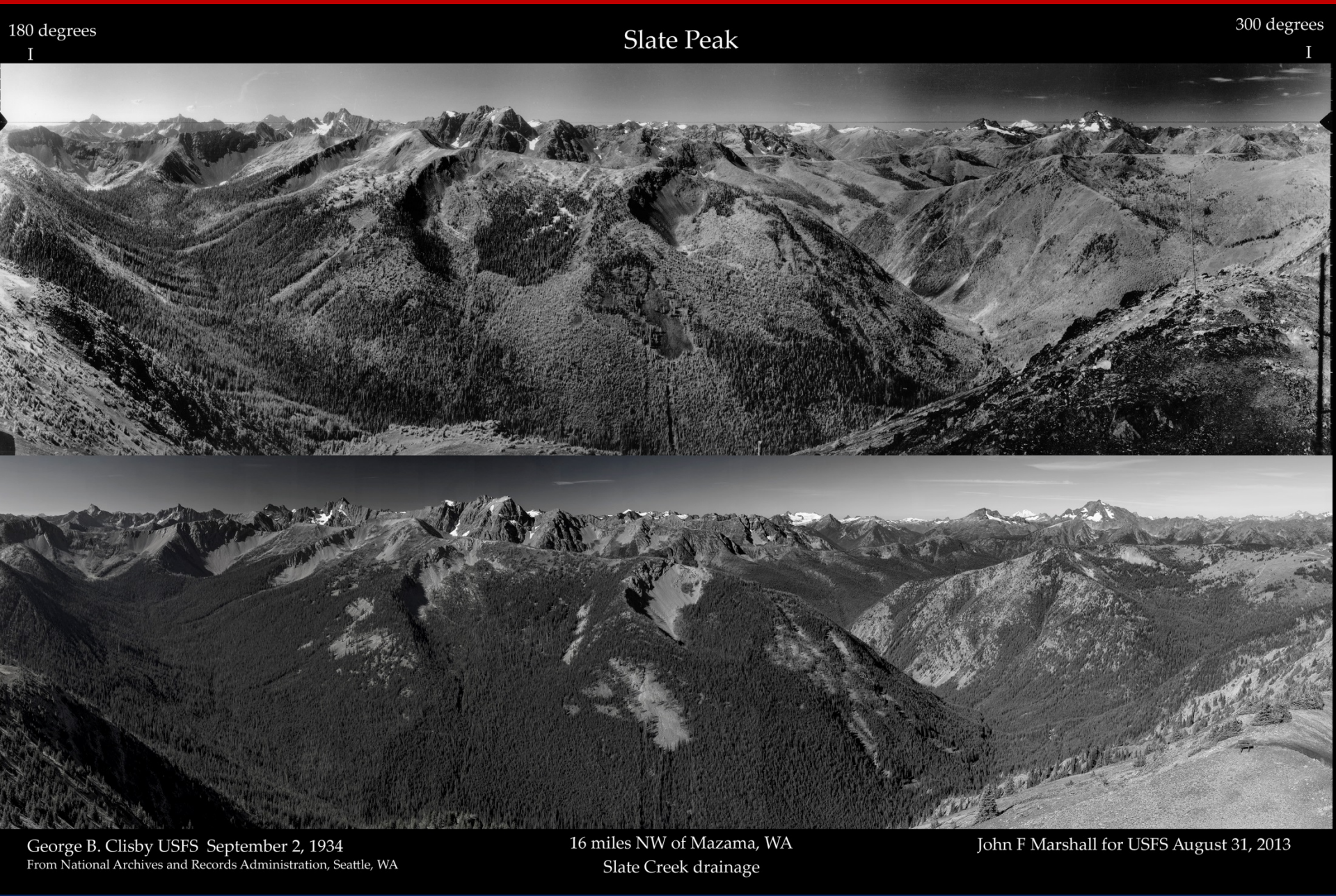

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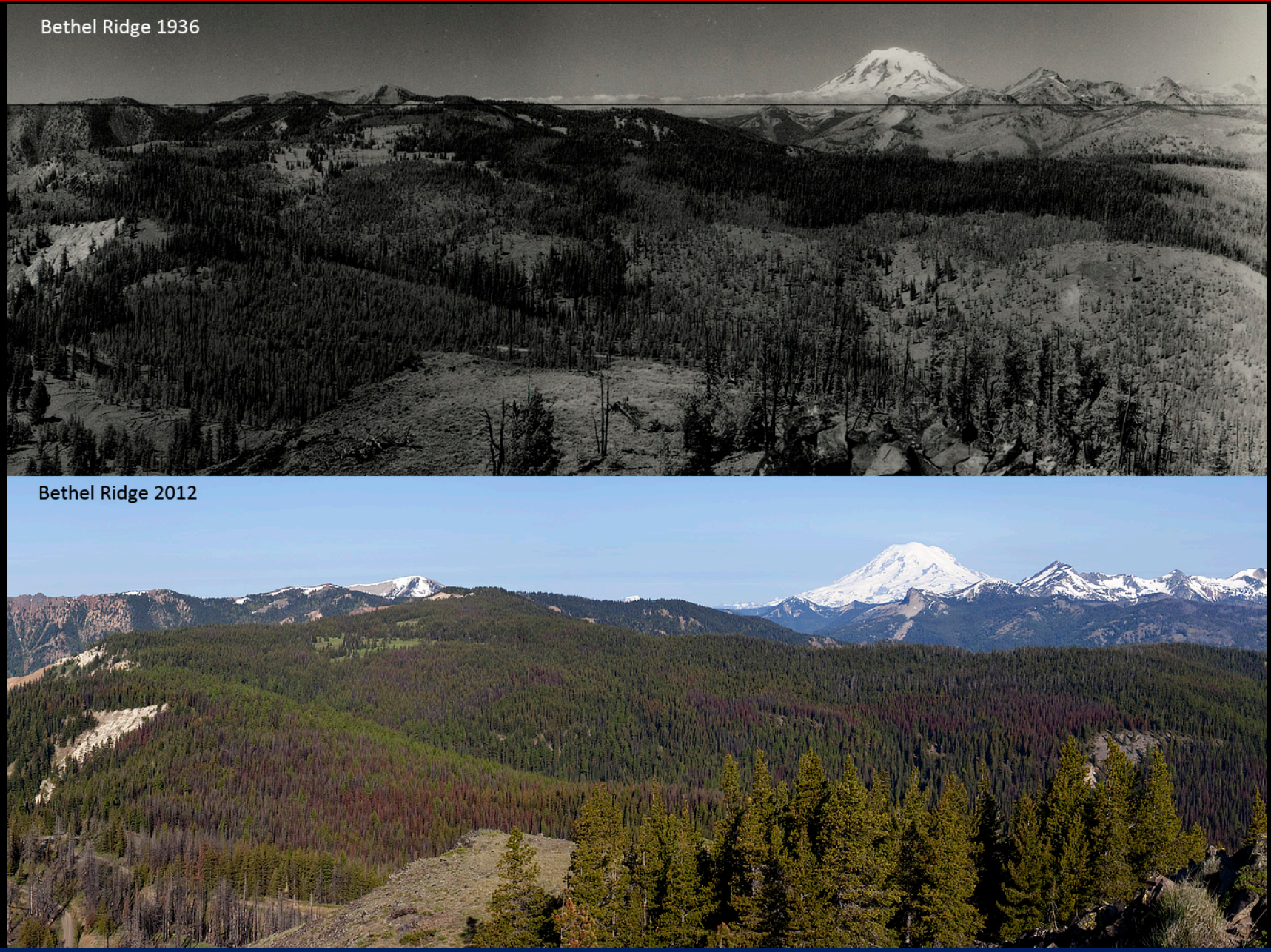
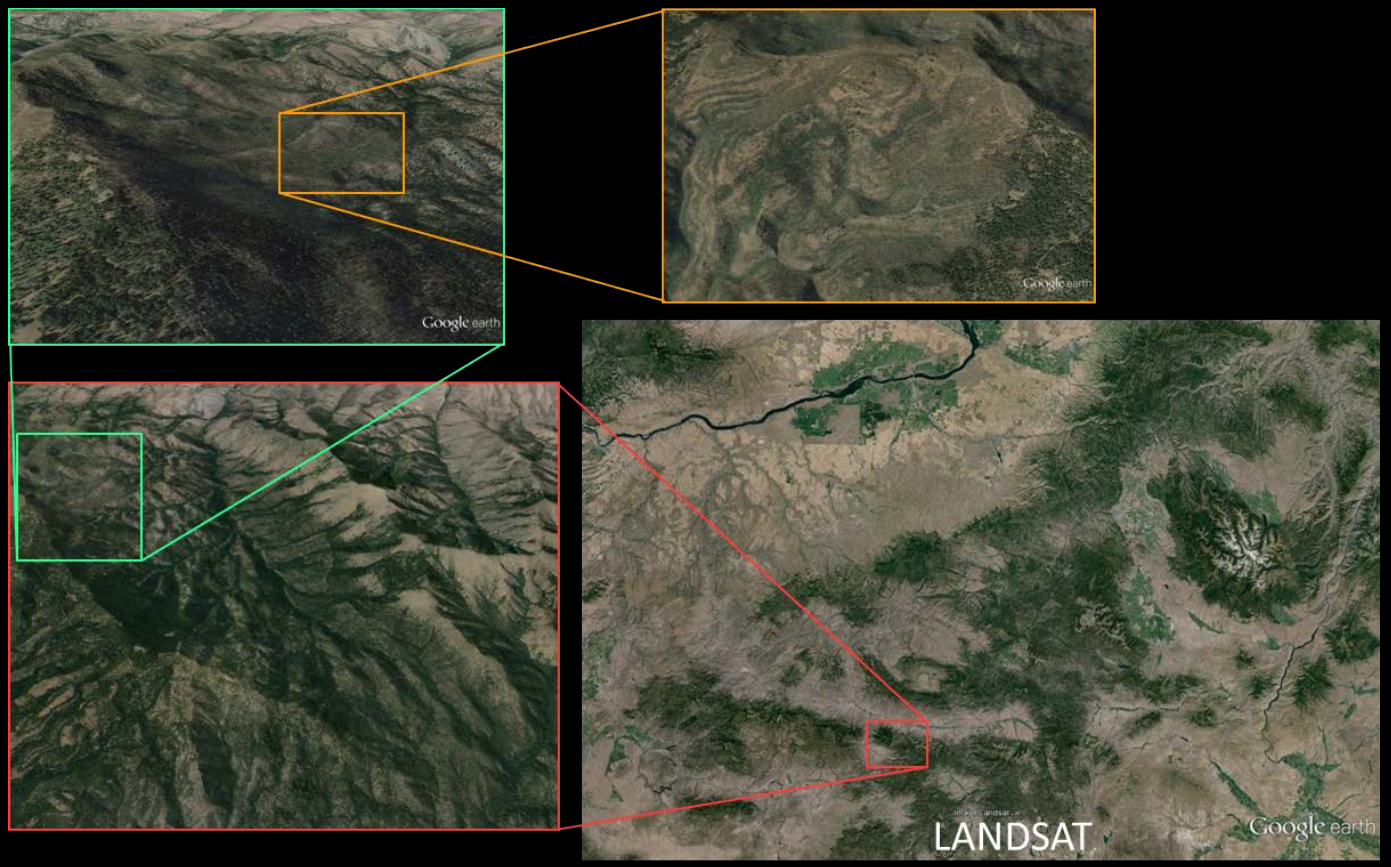


Framing Landscape Restoration: **Core Principle 1**

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

Restore connectivity and processes across multi-level landscapes



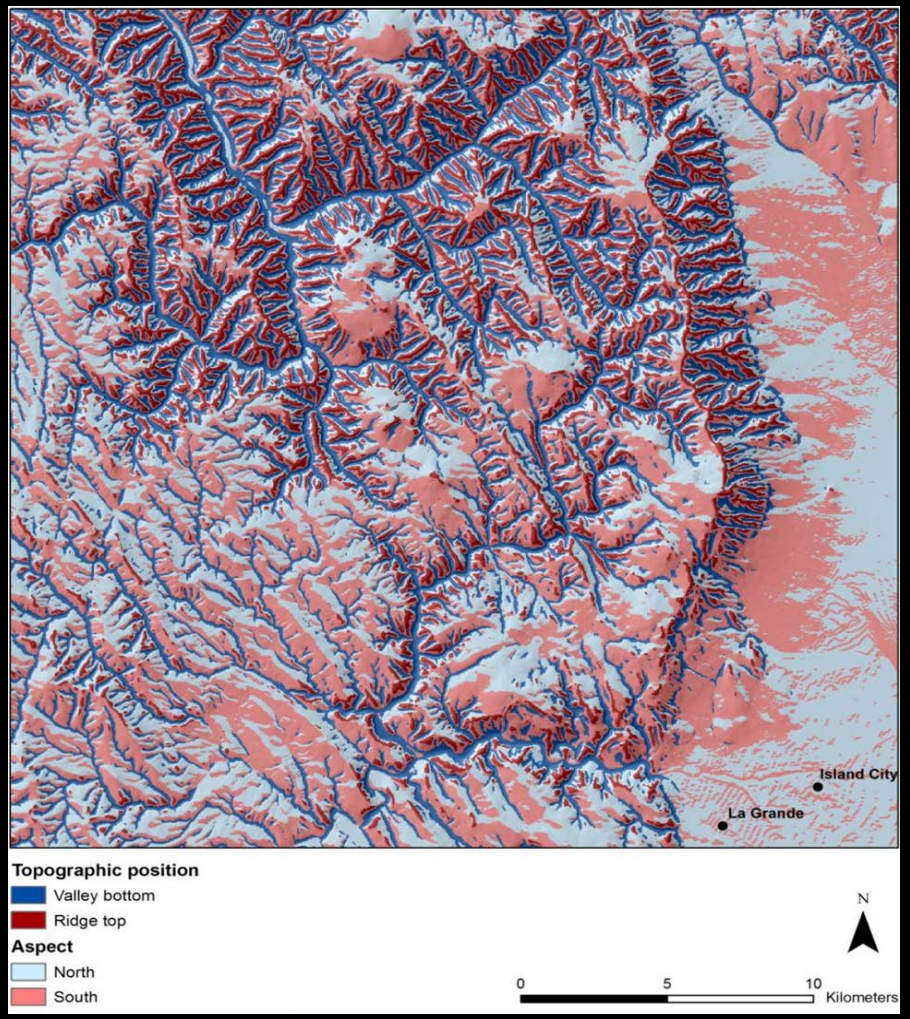
e.g., Blue Mountains Province

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



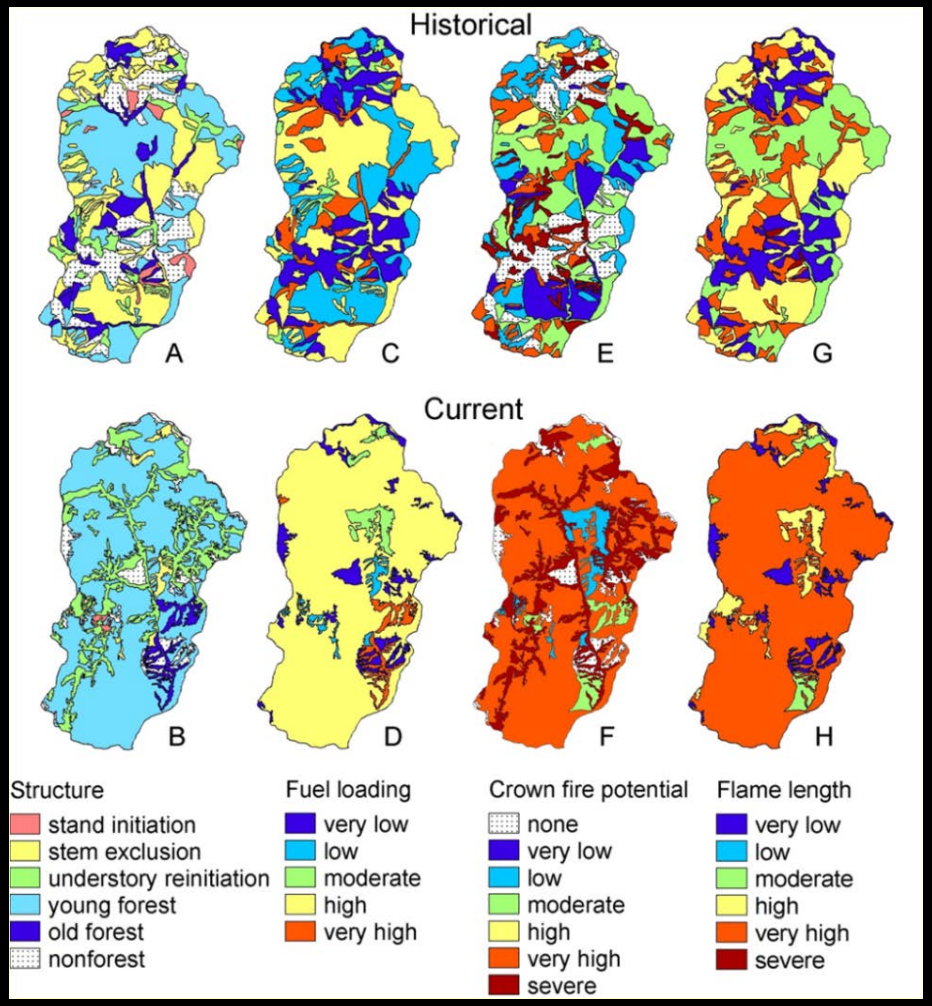
Perry et al. (2011) For Ecol & Mgt 262:703

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

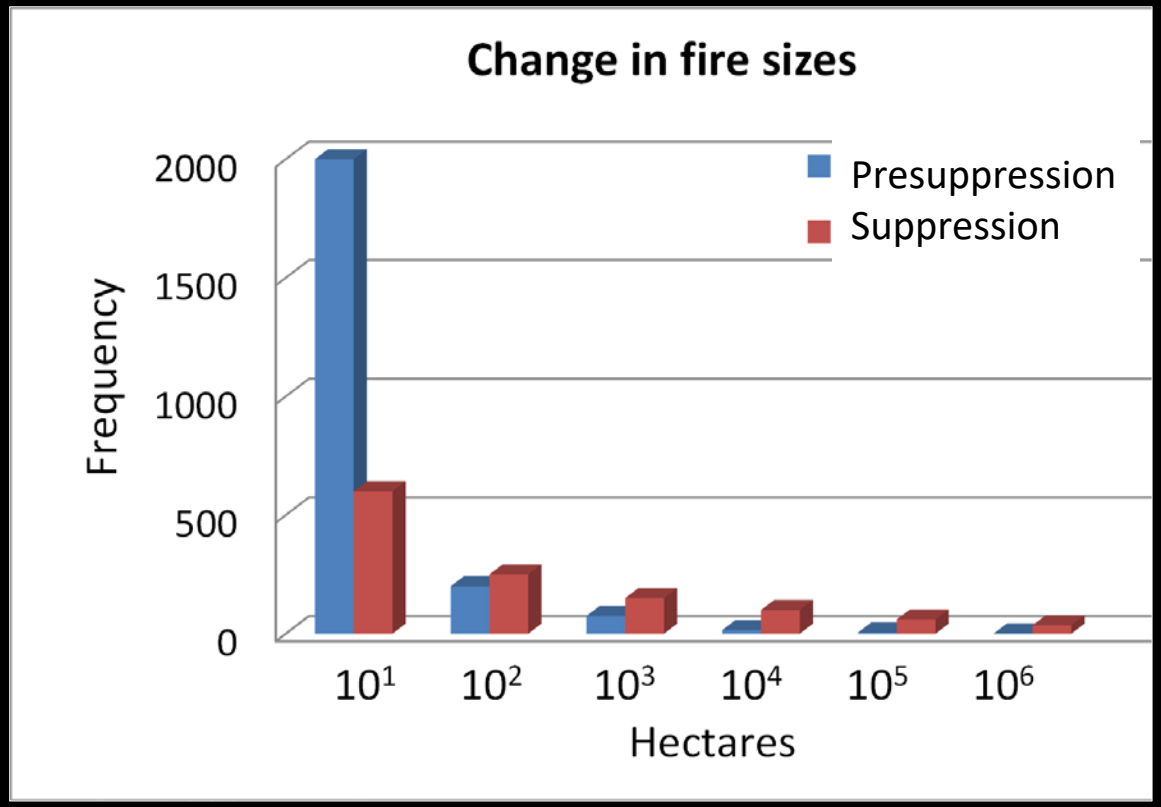


Keane et al. (2009) For Ecol Manage 258:1025-1037
Bisson et al. (2009) Ecol & Soc 14(1), 45;
Collins et al. 2009, Parks et al. 2015;
McGarigal & Romme 2012;
Wiens et al. (2012) Hist. Env Variation… Wiley-Blackwell

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

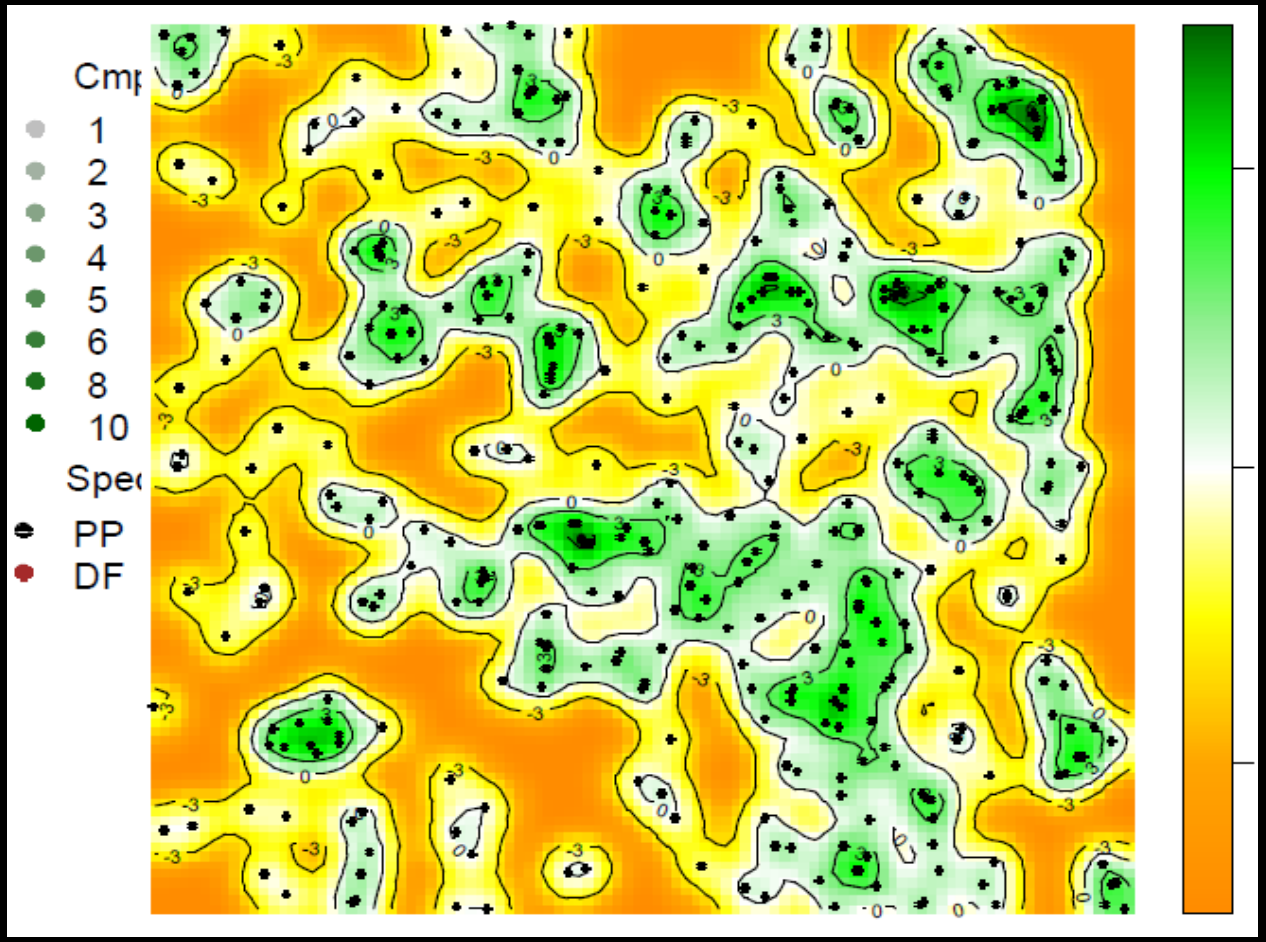
Retain and expand on existing relict trees, old forests, and post-disturbance large snags and down logs in these types

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

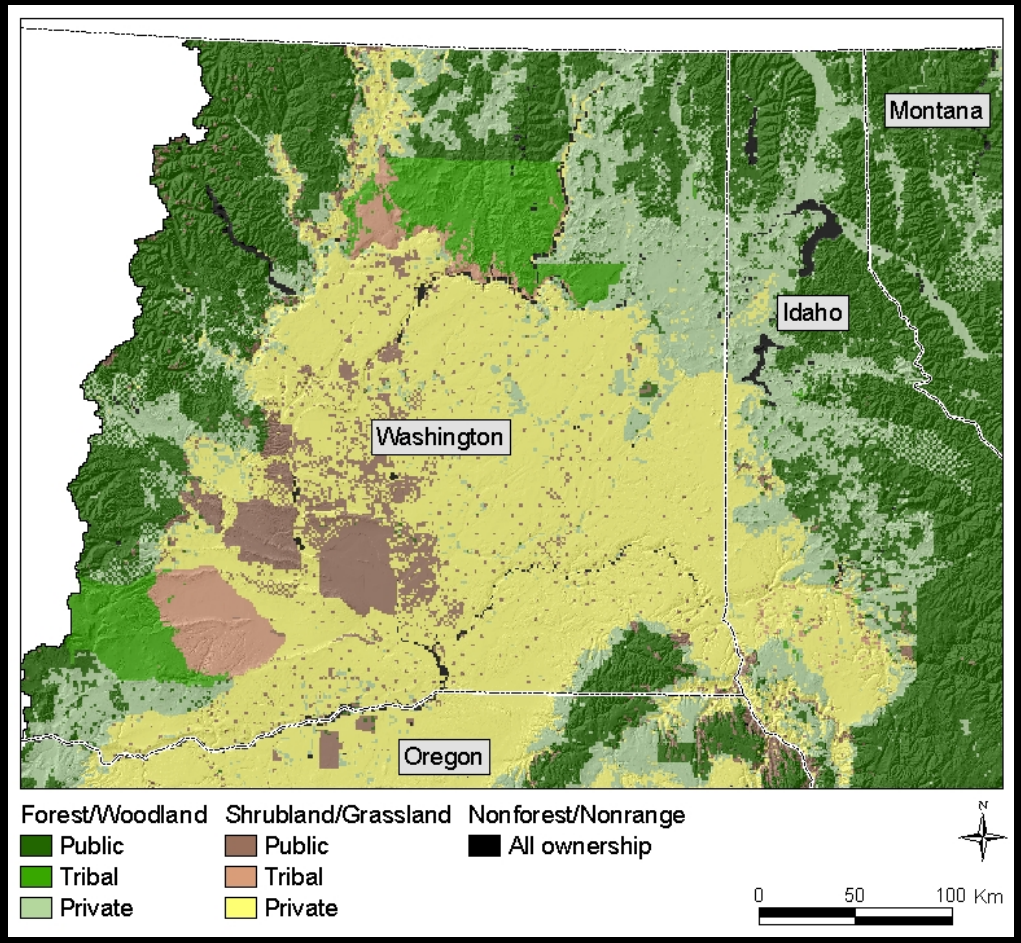
Churchill et al.(2013) For Ecol Manage 291: 442-457

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 (US: 50-100MM ac/yr)
- Our nearby forests and rangelands need to and will burn. We can influence how often, how severe, how large.
- Historical fire suppression & exclusion, + numerous other factors have created high fuel loads, a fire deficit in forests, & high contagion of crownfire behavior.
- Consequently, today's wildfires burn hotter and larger than most historical fires.
- Our climate & weather are changing, becoming more bipolar & 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 habitat arrangements.
- These principles can guide your work.

Acknowledgments

John Marshall (photos)

Brion Salter (maps)

Research Support: