Ecology and Management of Mixed Conifer Forest: Science Synthesis and Management Implications

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Eastside Science Synthesis Team

Thanks To Andrew Merschel, Keith Olsen, Ayn Shlisky

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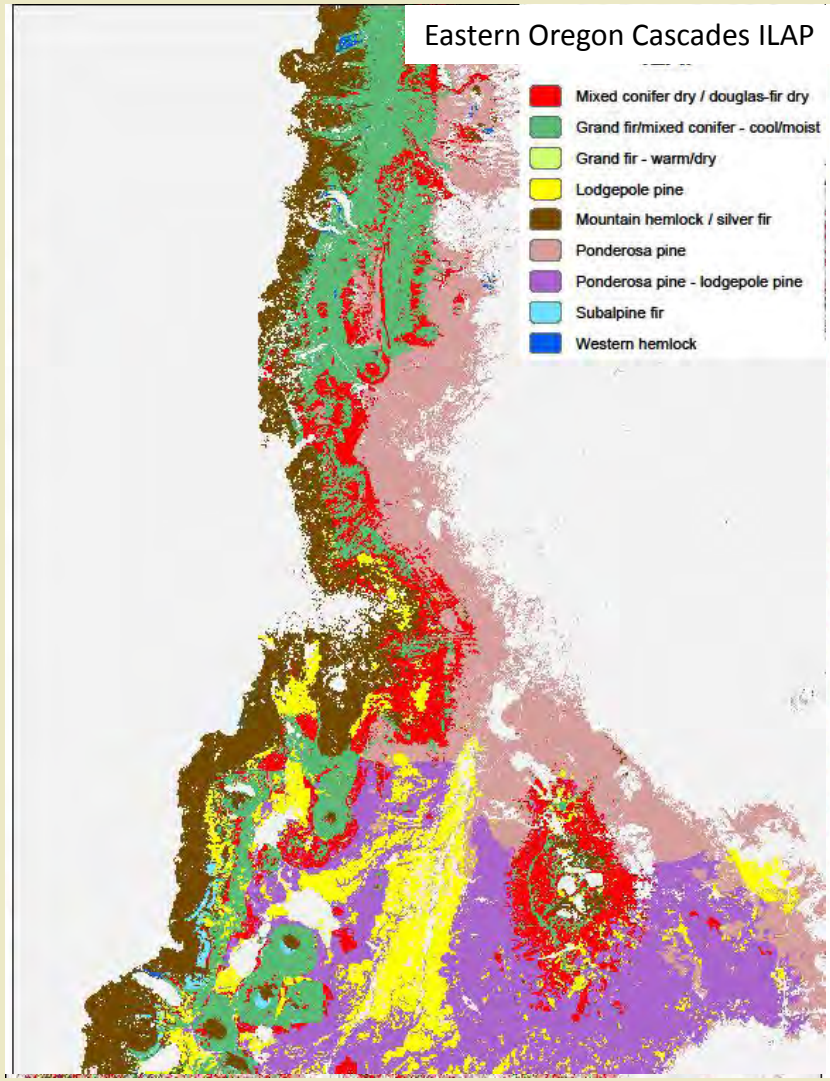
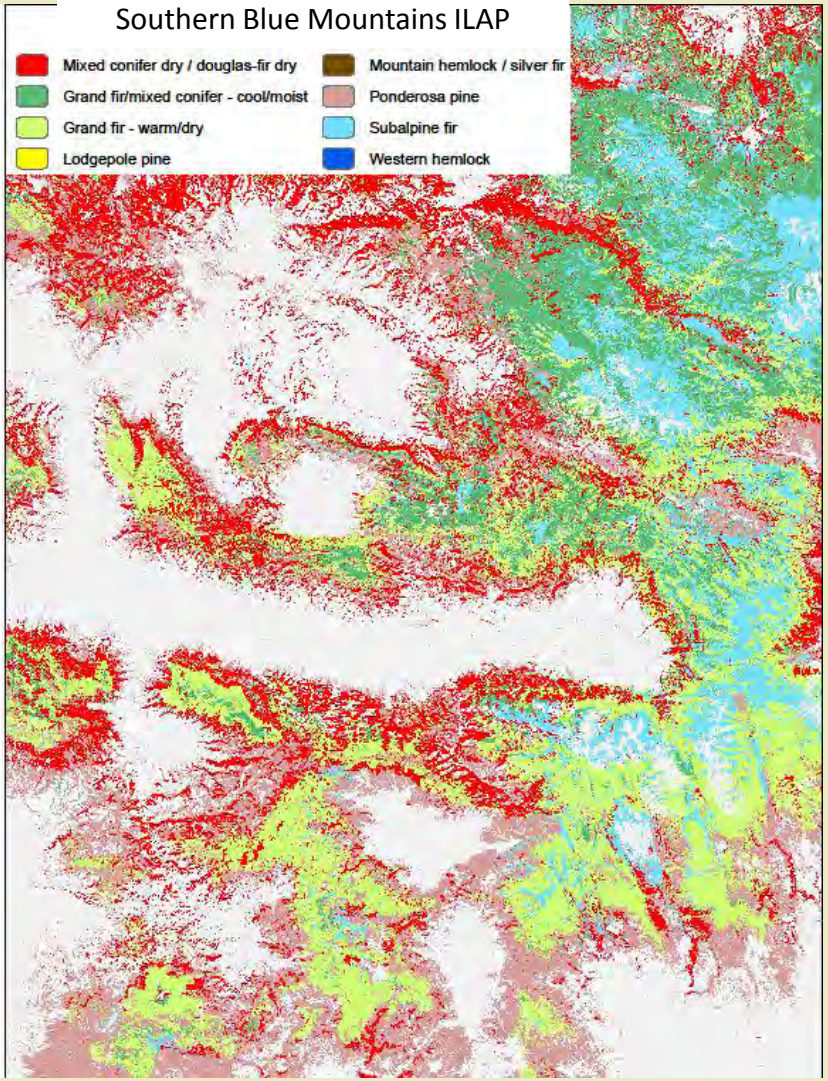
Mixed Conifer Forests 501

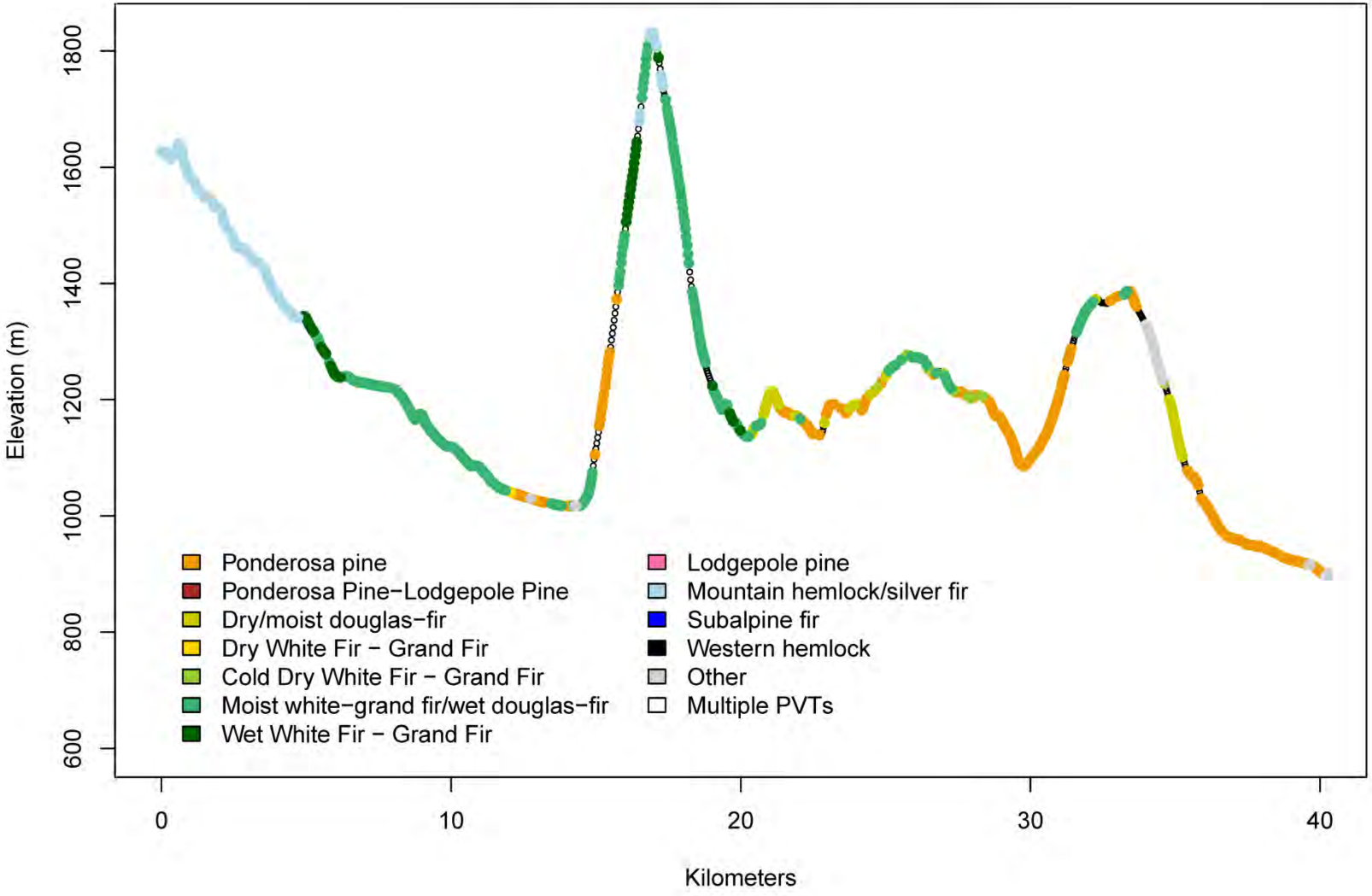
Landscape Diversity
Dynamics
Scale
Challenges in Classification
Human Impacts
Restoration-Resilience
Management Considerations

Mosaic of Potential Vegetation Types

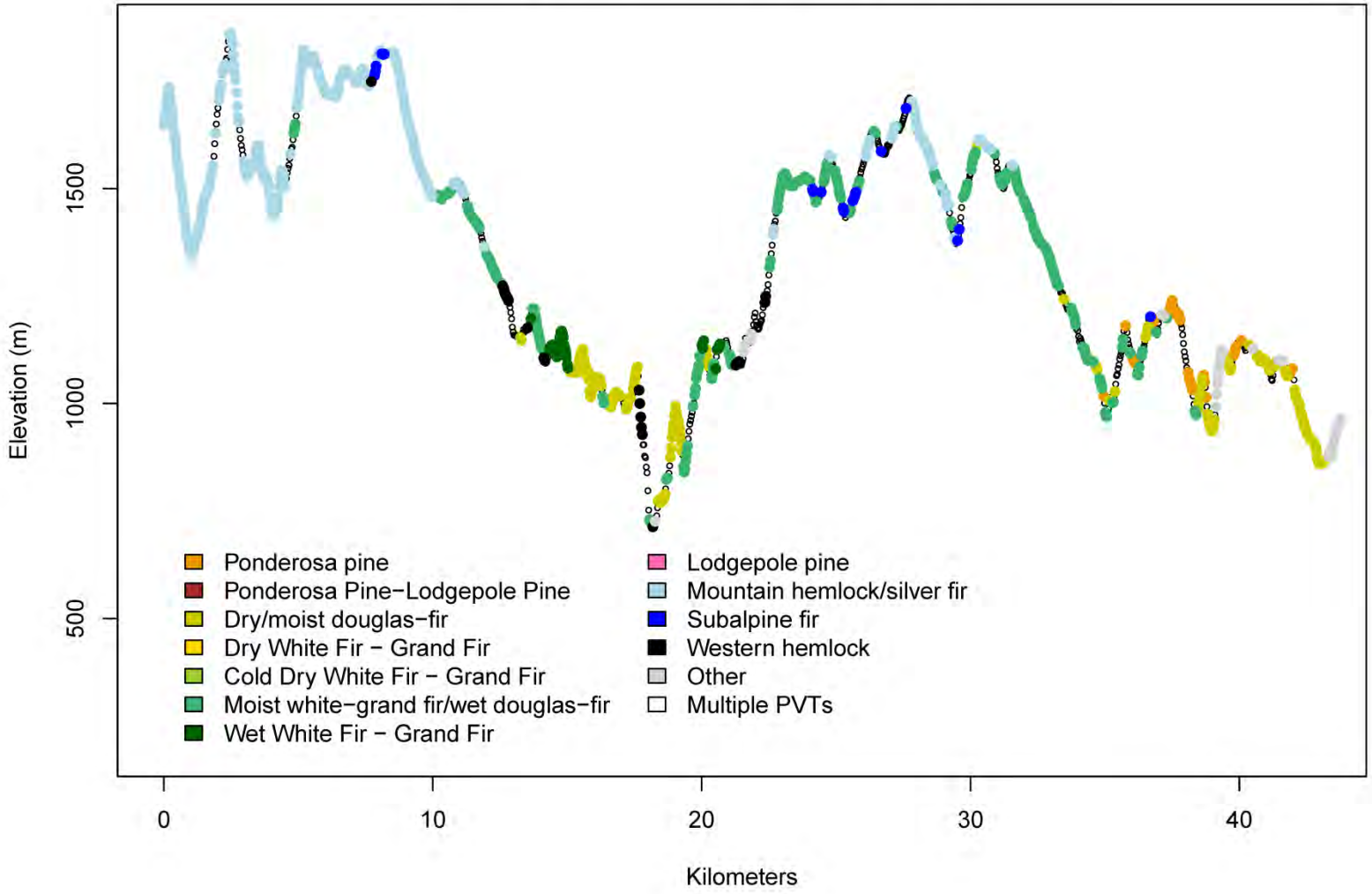




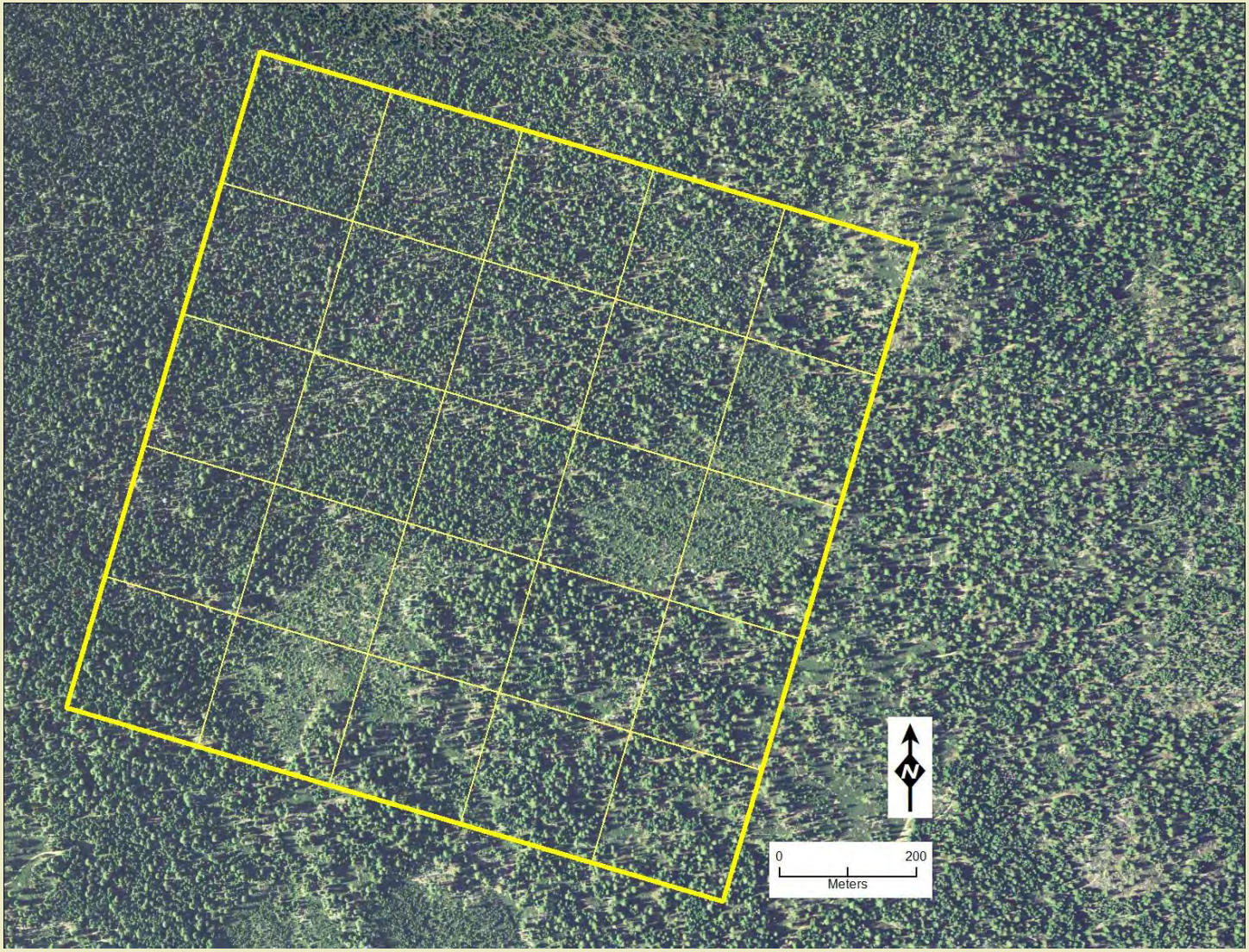
Eastern Cascades Oregon



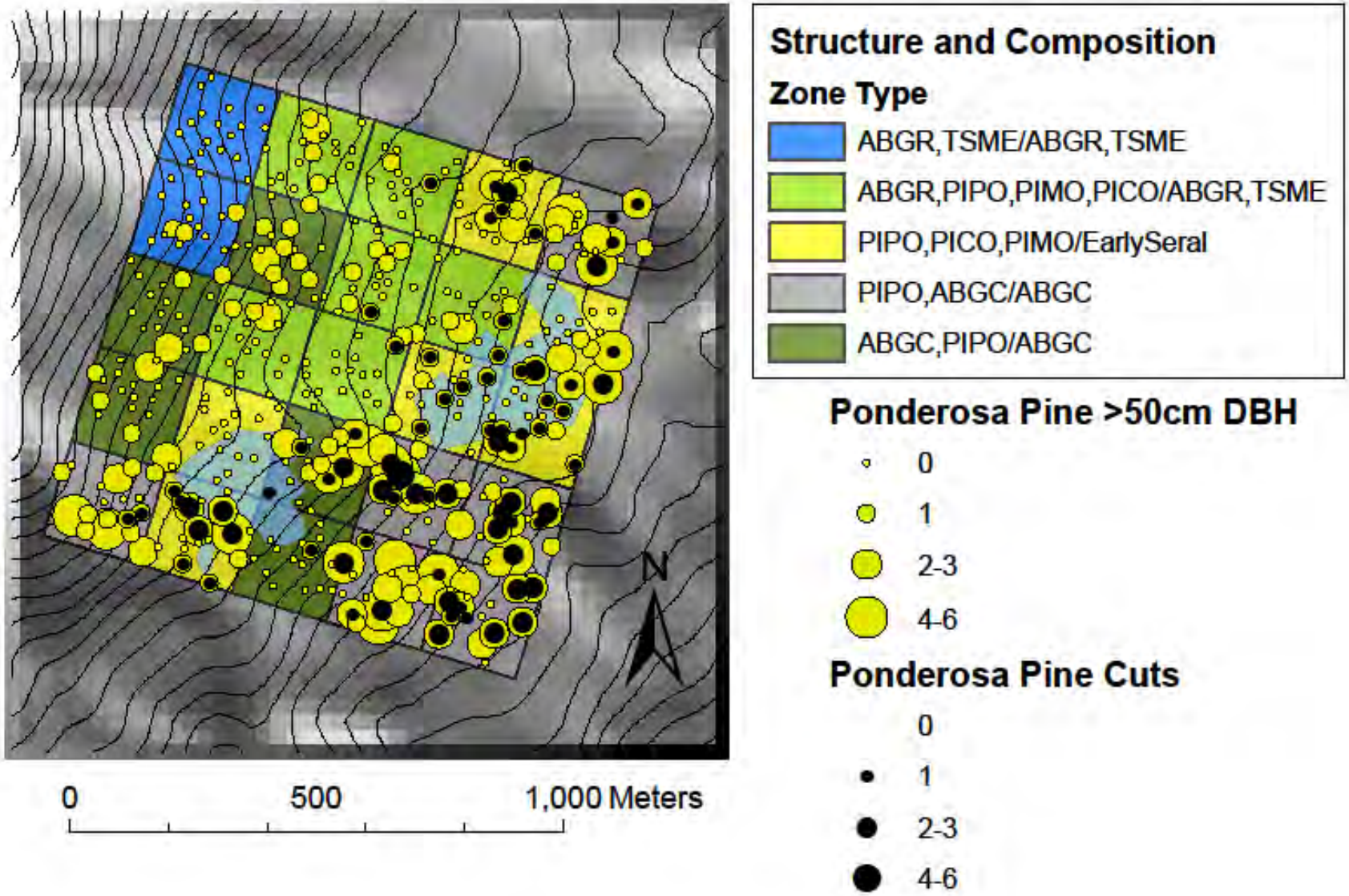
Eastern Washington Cascades

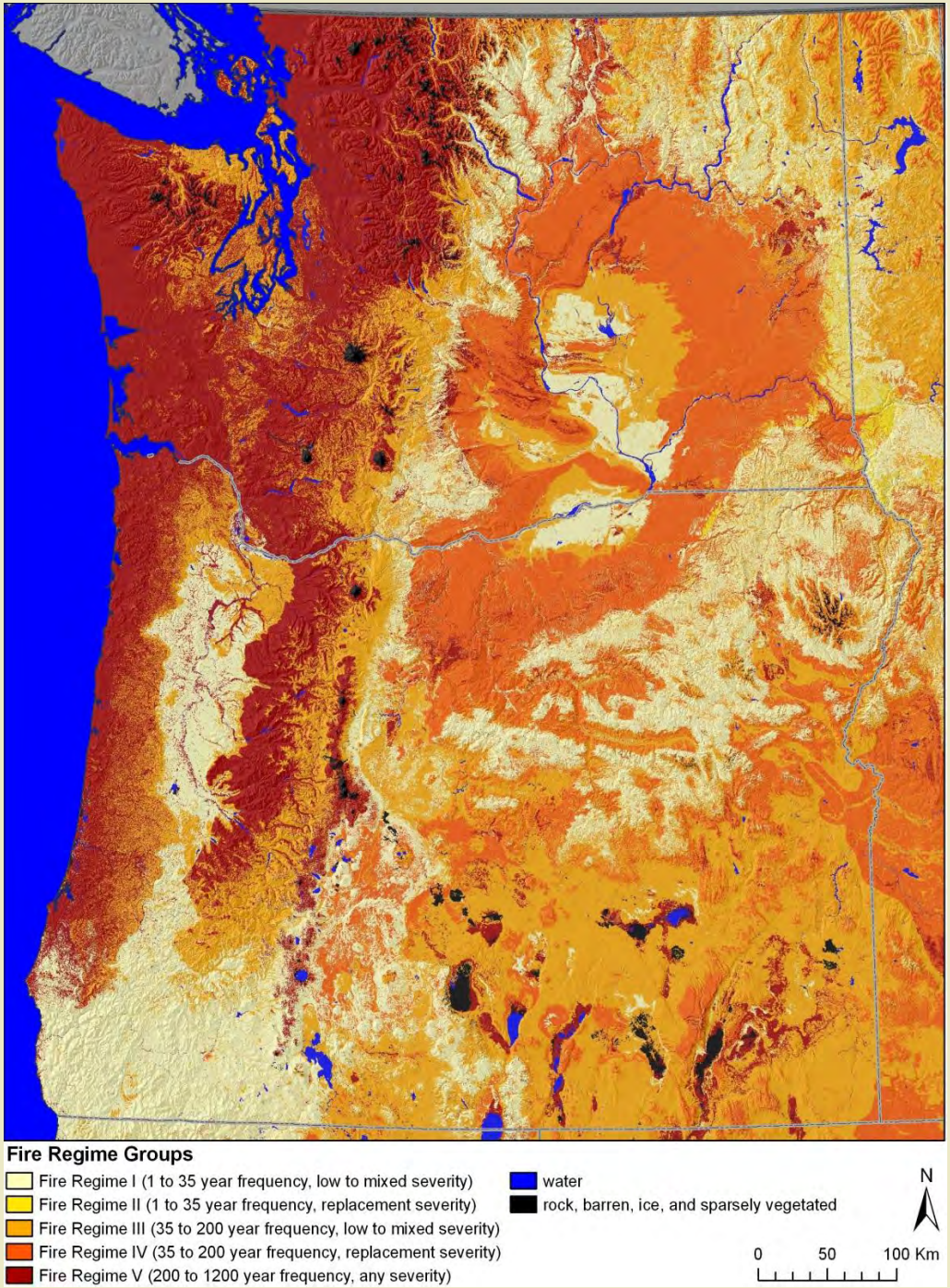


Mt Sheridan Intensive Plot



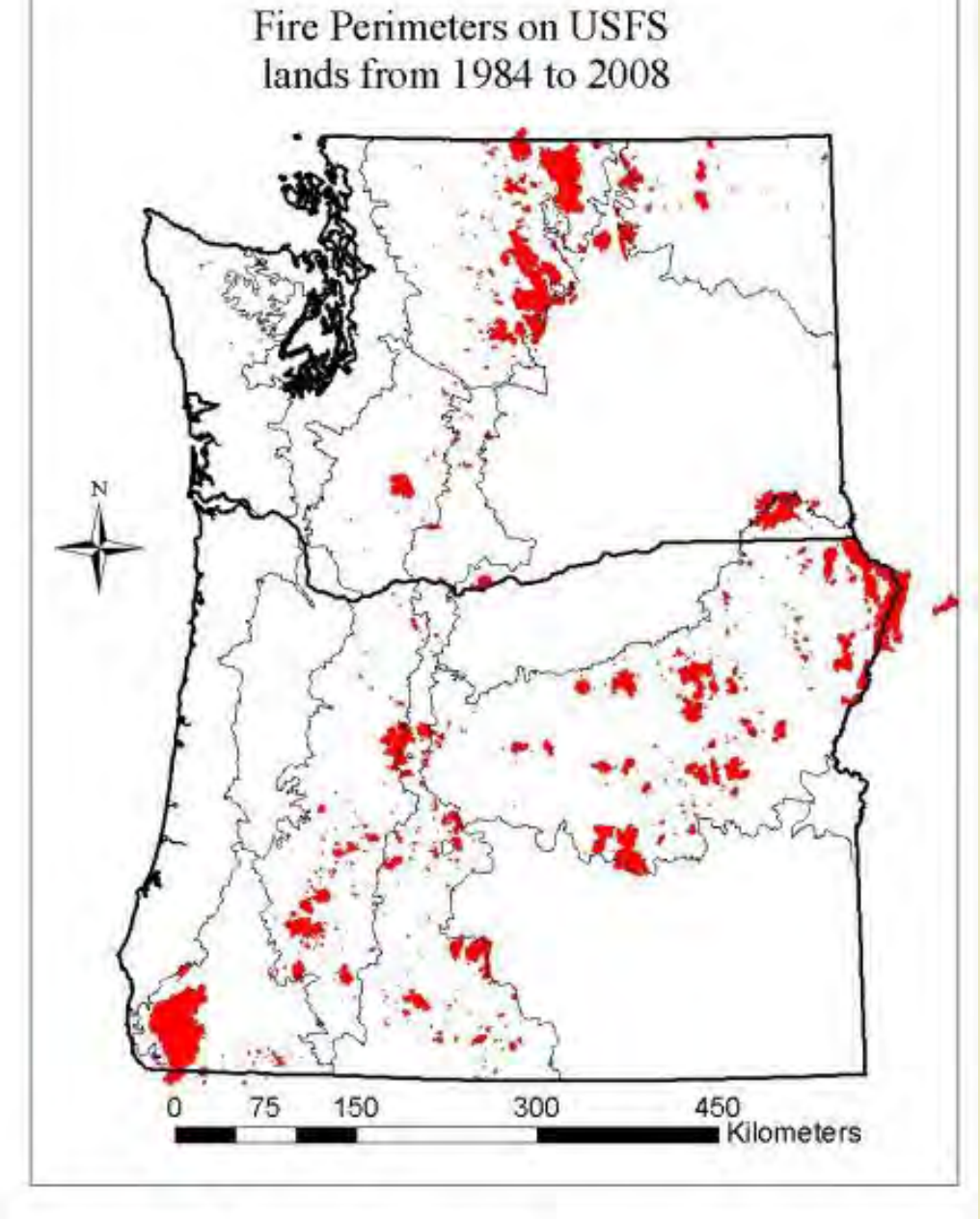
Mt. Sheridan Intensive PIPO Distribution





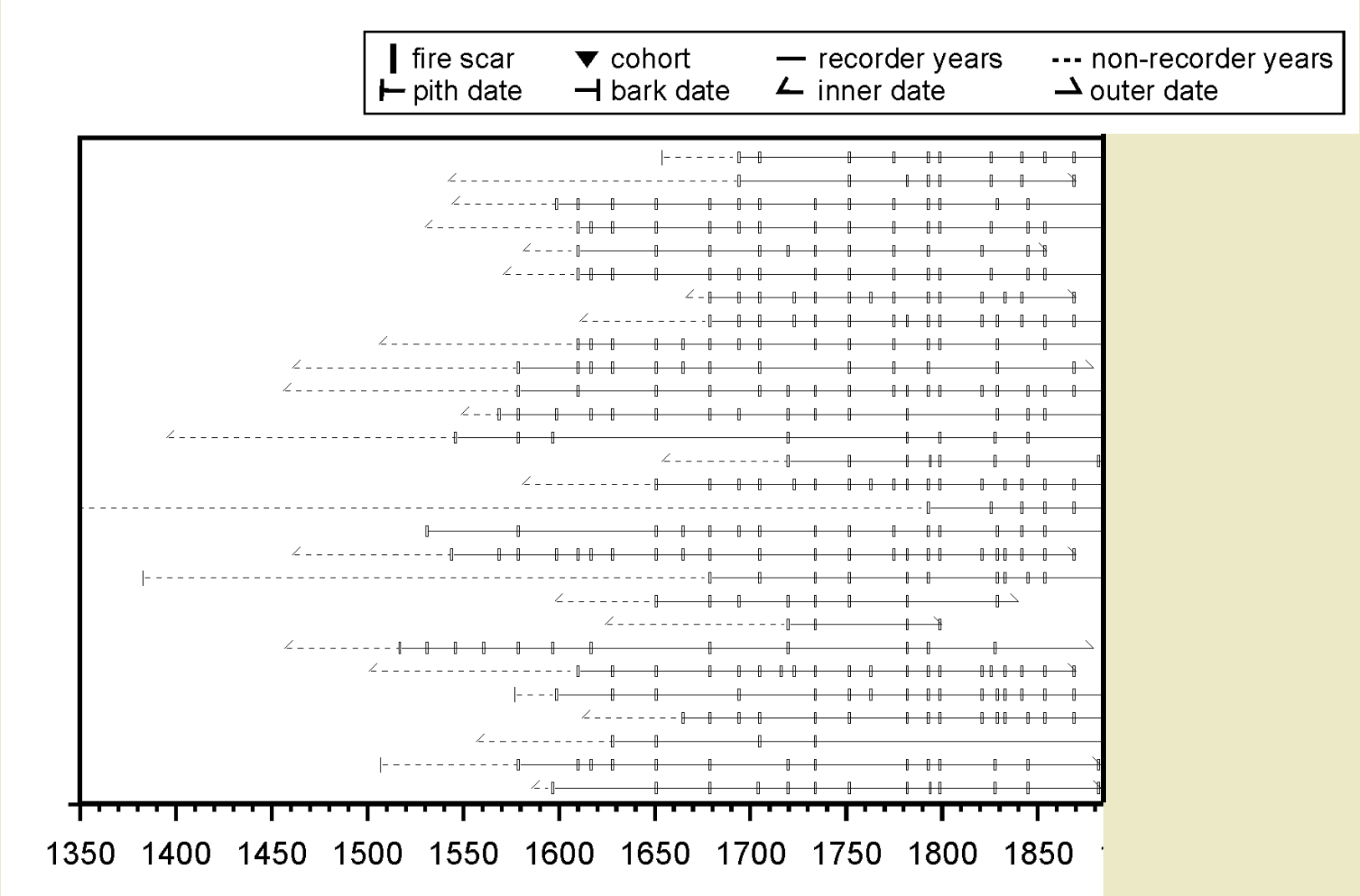
Pre Euro-American Fire Regimes

Landfire



Recent Wildfire

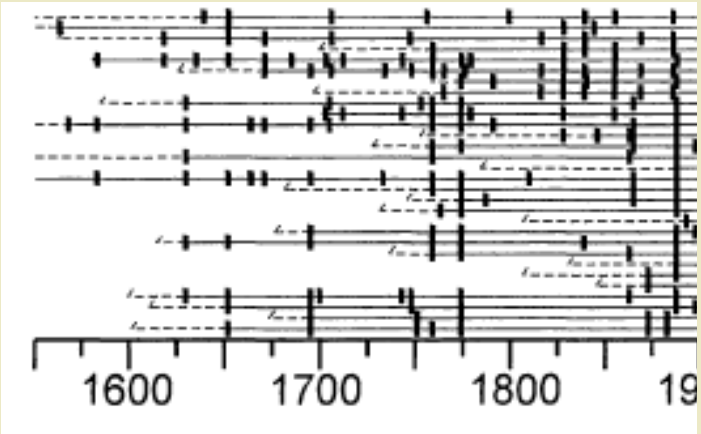
Fire History 1500-1900
Eastern Ochoco Mountains



Emily Heyerdahl Unpublished

Fire History 1687-1900 Blue Mts

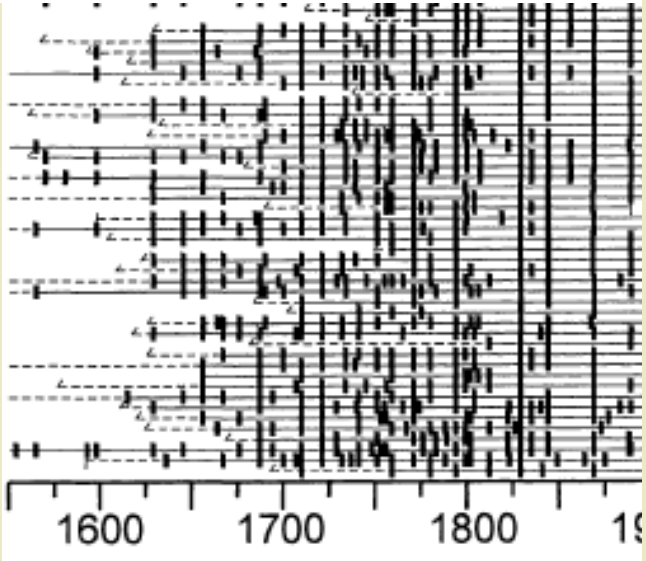
Two Watersheds



Tucannon
Mainly "Mesic"
ABLA/ABGR

Median Freq = 30 yrs

Range $_{10\text{-}90\%}$ = 21-85 yrs



Dugout
Mainly "Dry"
ABGR/PSME/PIPO

Median Freq = 14 yrs

Range $_{10\text{-}90\%}$ = 11-19 yrs

Heyerdahl and Agee 2001

Historical Dynamics of Fire in Ponderosa Pine

0 yrs

Without Fire Suppression

20 yrs

40 yrs

60 yrs

80 yrs

Fire Suppression

80 yrs

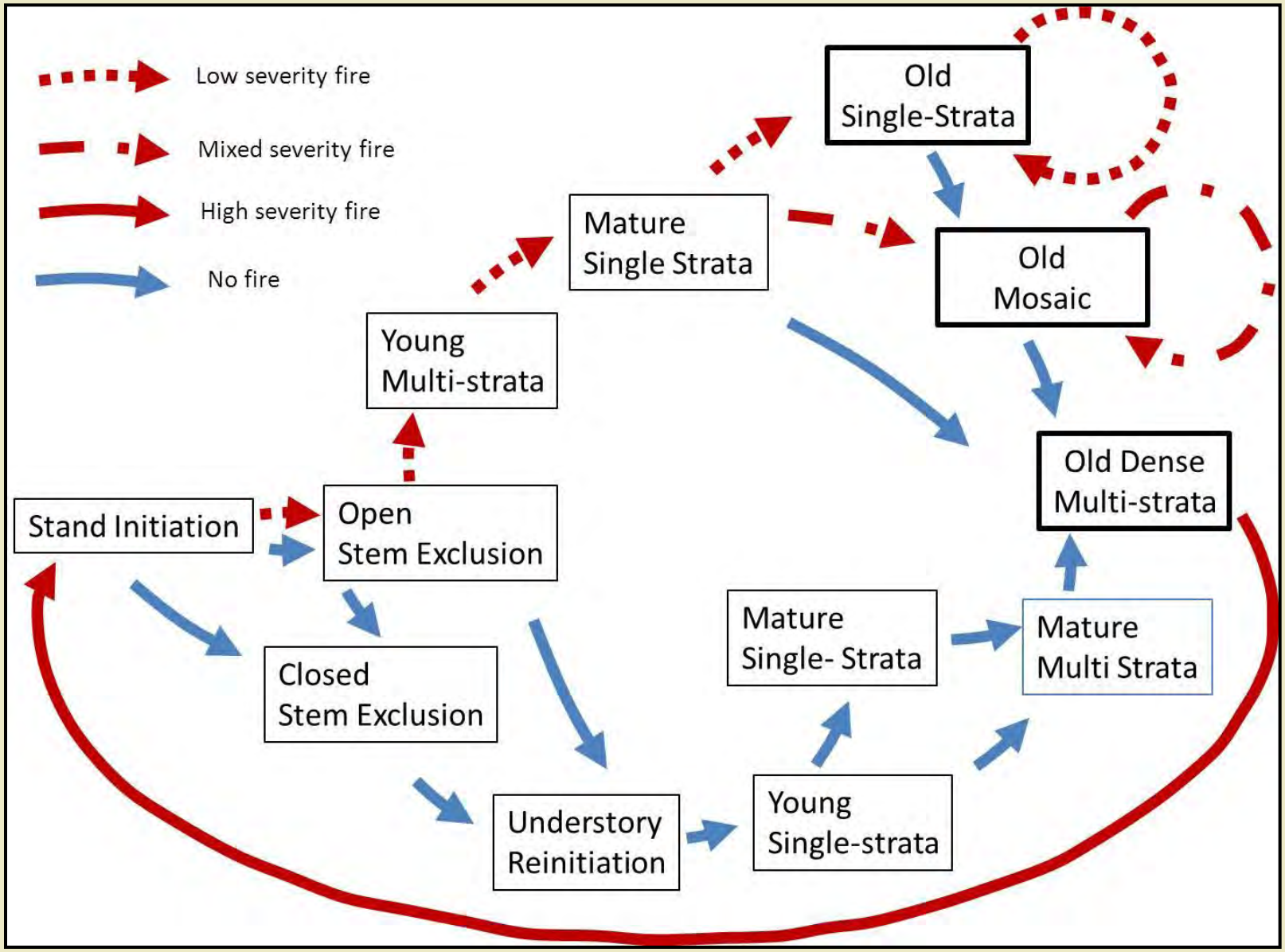
Graphic by R. Van Pelt

Mixed Conifer
Sierra Nevada

Ponderosa Pine
Oregon

Drawings by R. Van Pelt

Successional Pathways in Mixed Conifer Forests Across Eastern Oregon and Washington



Interaction of disturbance, successional pathway and classification

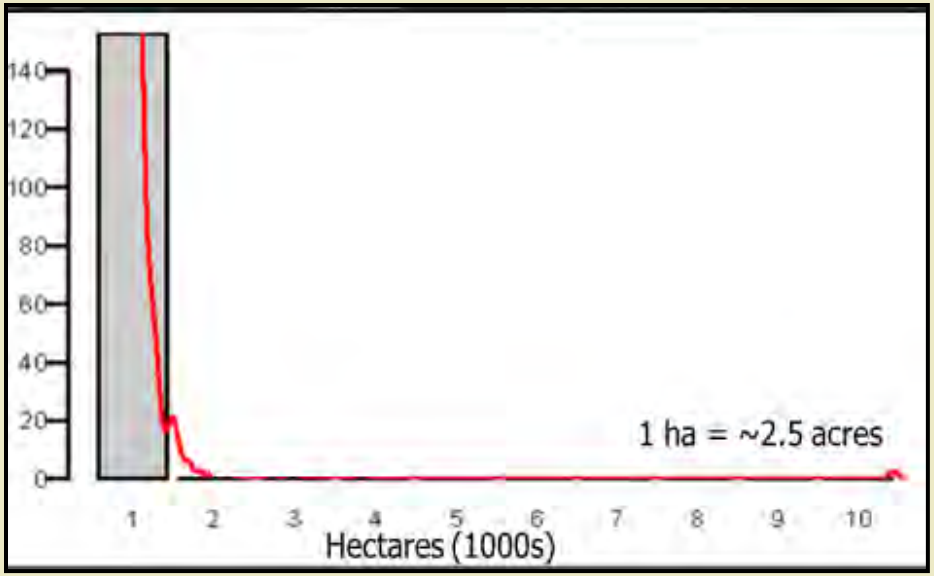
- Series based on “climax” or late successional tree species for a site e.g. grand fir vs ponderosa pine
- With long periods of fire exclusion, grand fir populations and seed sources increase across landscapes
- Grand fir can more easily invade sites that would have been PIPO sites under more frequent fire regime (“mass effects”)
- Classifications of PVT based on presence of grand fir in understory reflect disturbance history as much as environmental conditions
- Use age rather than composition to sort out sites that were historically PIPO or Grand fir

Effects of Wildfire

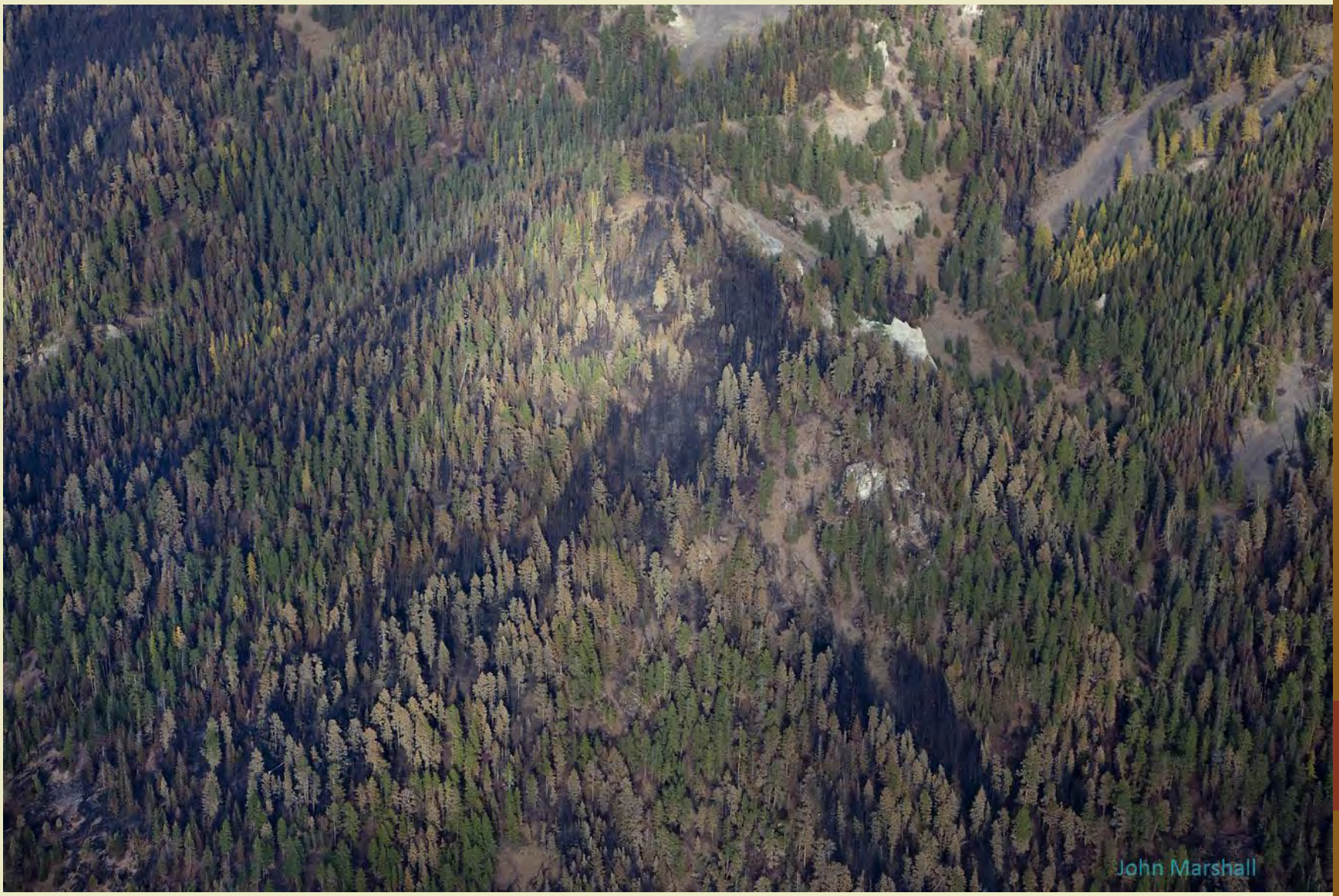
- Small (1-50 ha) to medium-sized (100-5,000 ha) fire events represented 85-95% of fires
- Broke-up patterns of surface and canopy fuels across the landscape

- Interrupted the flow of larger fires, often limiting their spread

- Large fires (>5000 ha) were much rarer, but accounted for most of the burned area (75-95%)

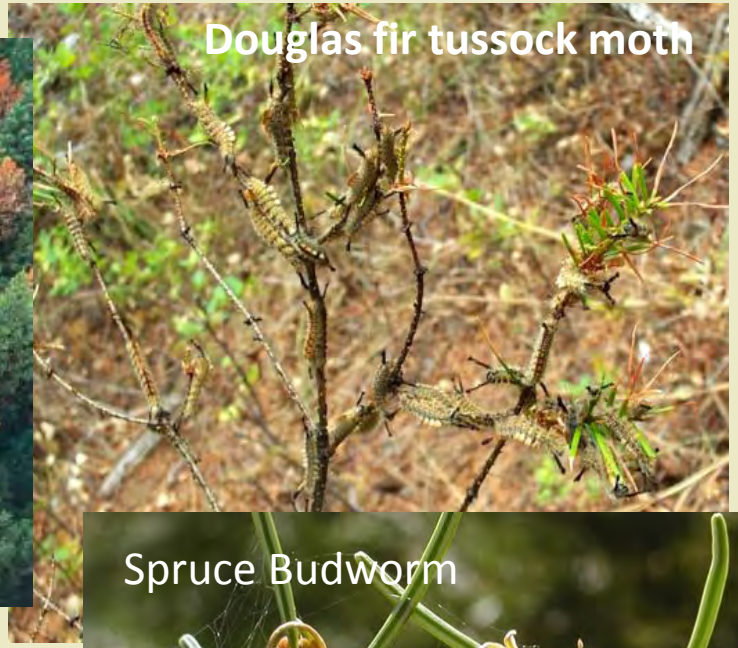


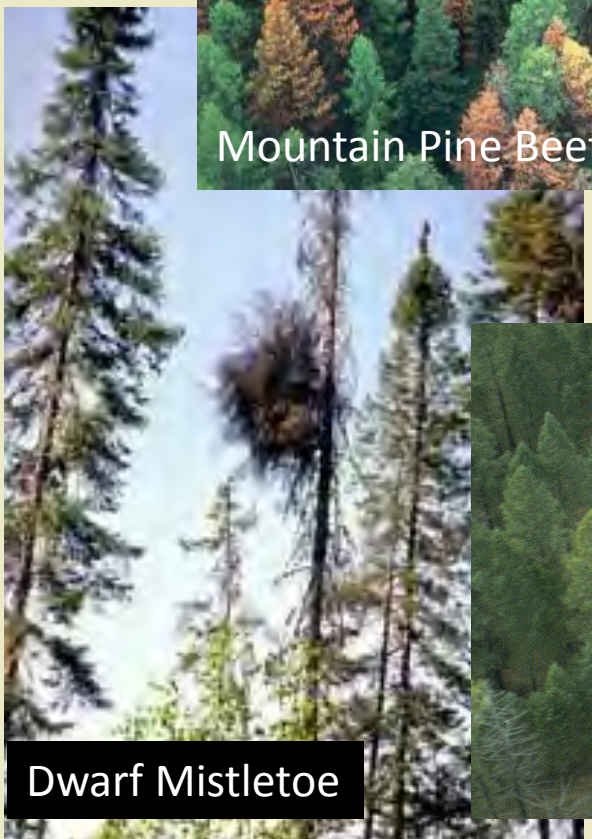
Heterogeneity is the Key



Insects and Disease

Mountain Pine Beetle

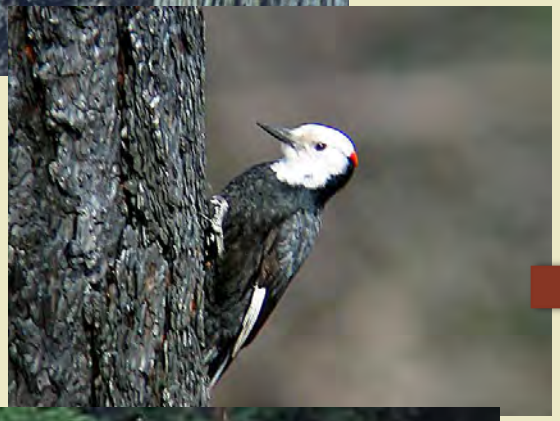

Douglas fir tussock moth


Dwarf Mistletoe

Spruce Budworm

Armillaria root disease

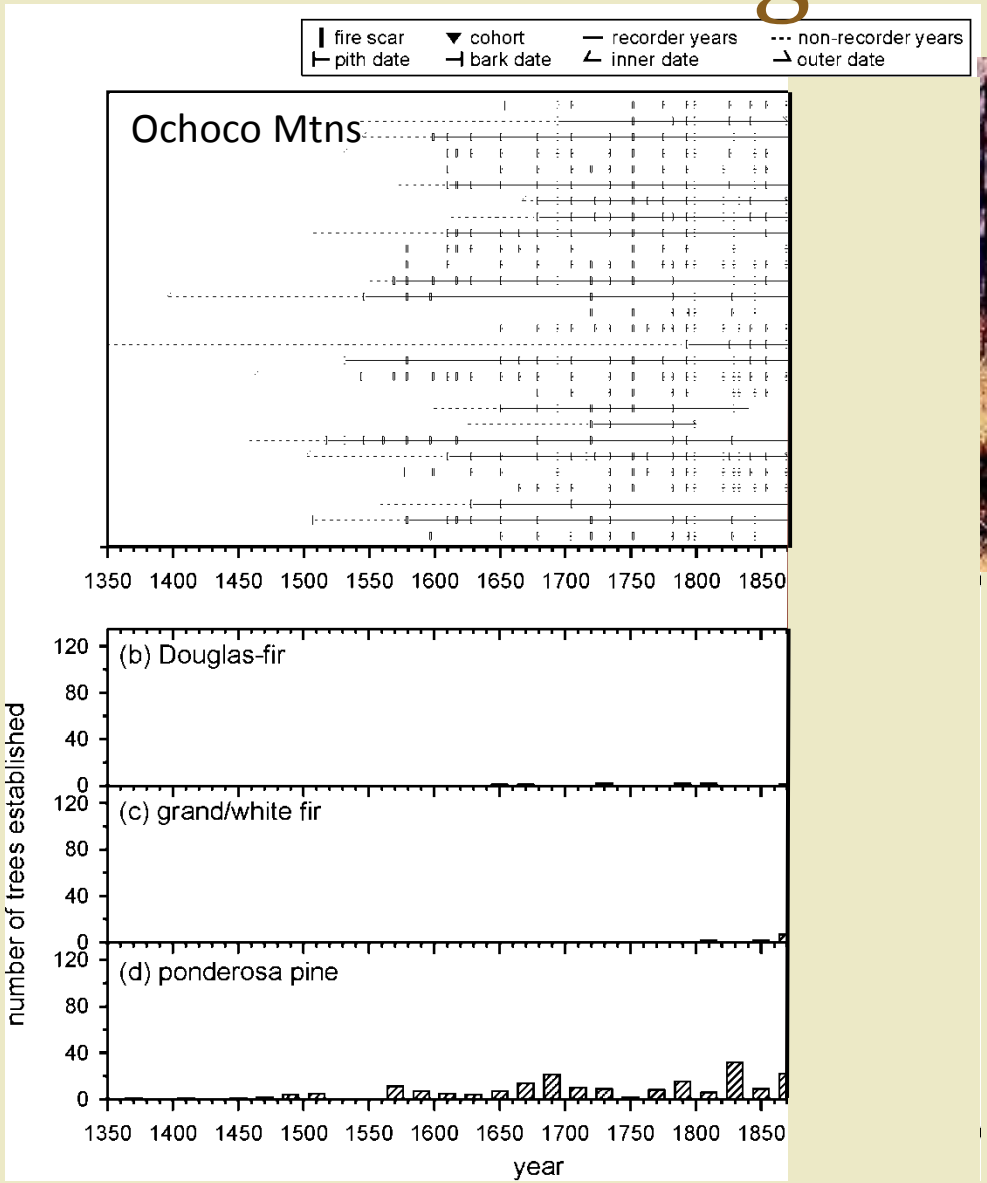
Wildlife habitat



How have Euro-Americans humans changed this landscape?

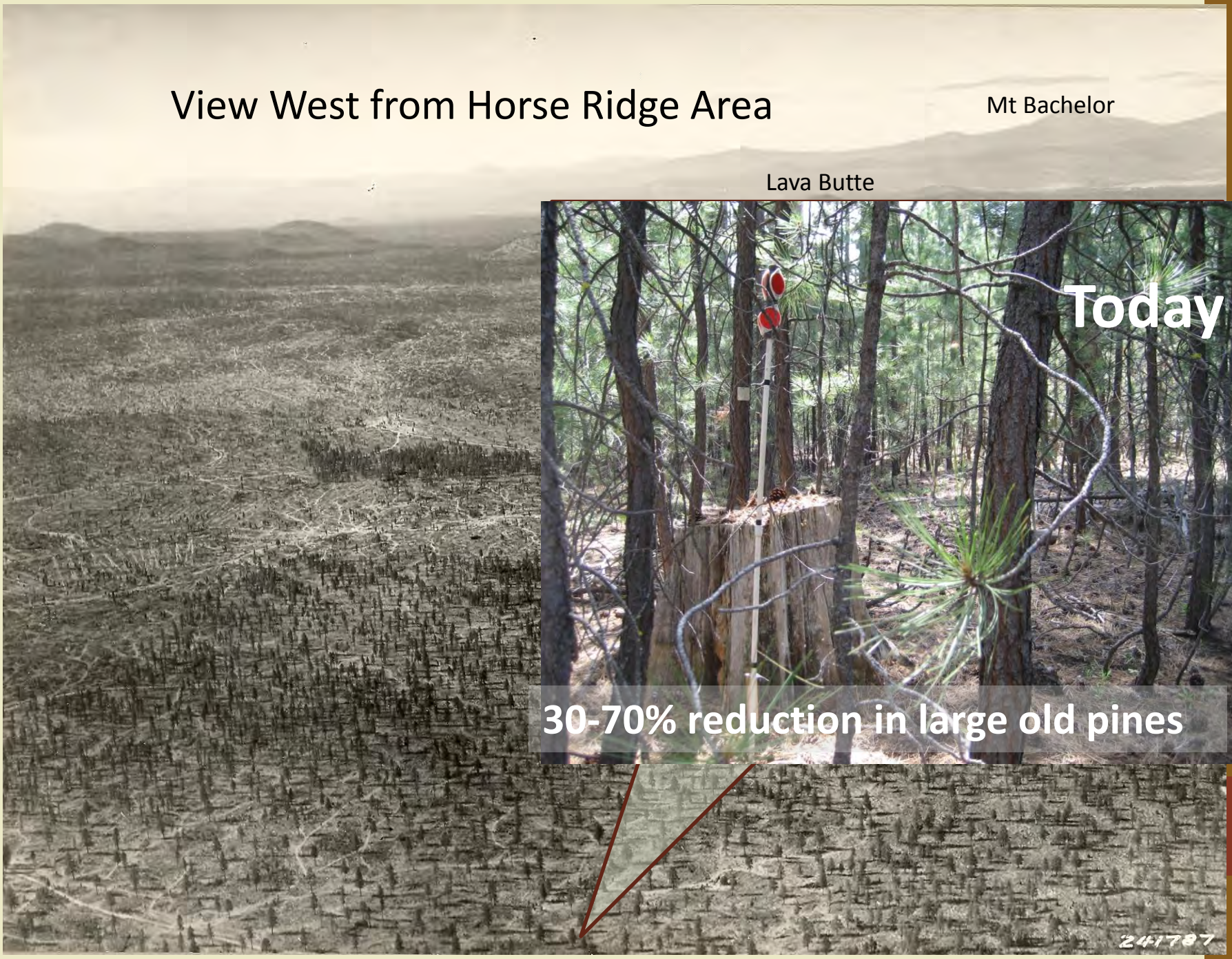
- Grazing
- Collapse of Indian burning
- Logging
- Roads
- Fire Suppression
- Development
- Invasive species
- Recreation sites and activities

Altered landscapes and fire regimes



Heyerdahl, unpublished

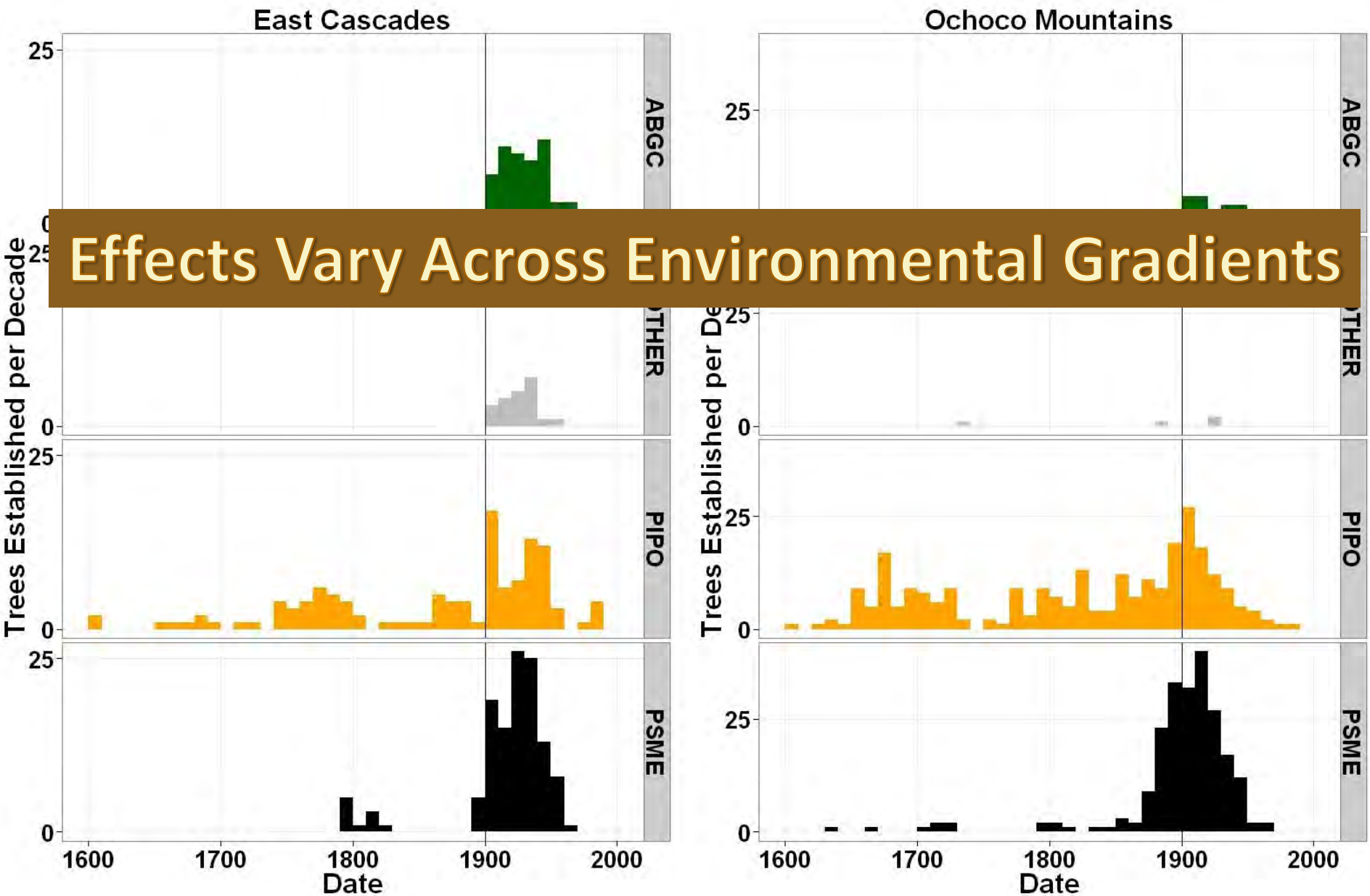
View West from Horse Ridge Area



Current Conditions

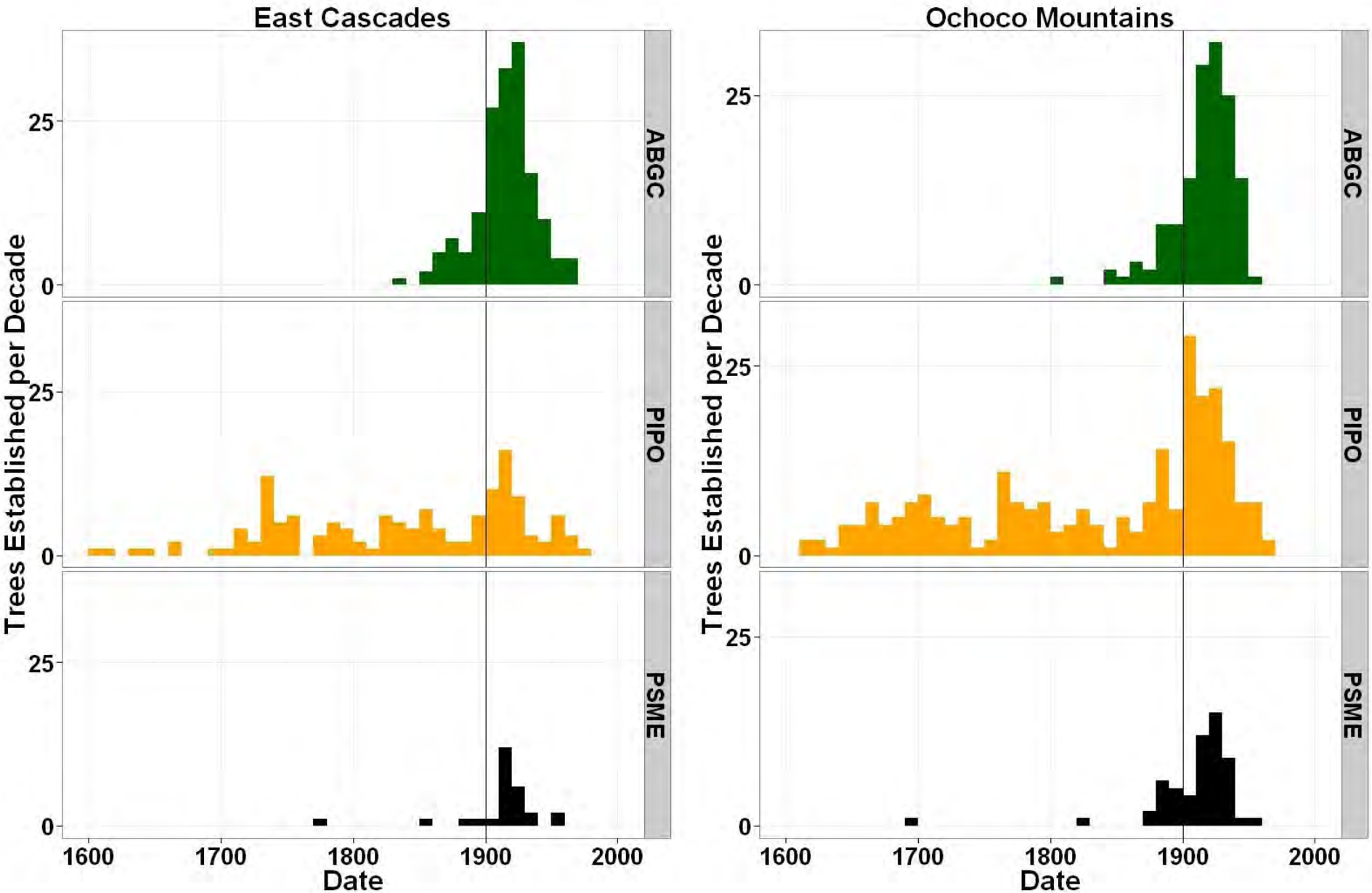
- Contemporary western mixed conifer forests are:
  - Overly Dense
  - Selectively logged
  - Clear cut
  - Contain invasive species
  - Expanding disease and insect infestations
  - High severity fires
  - Stressed by changing climate

Dry Mixed Conifer Age Structure

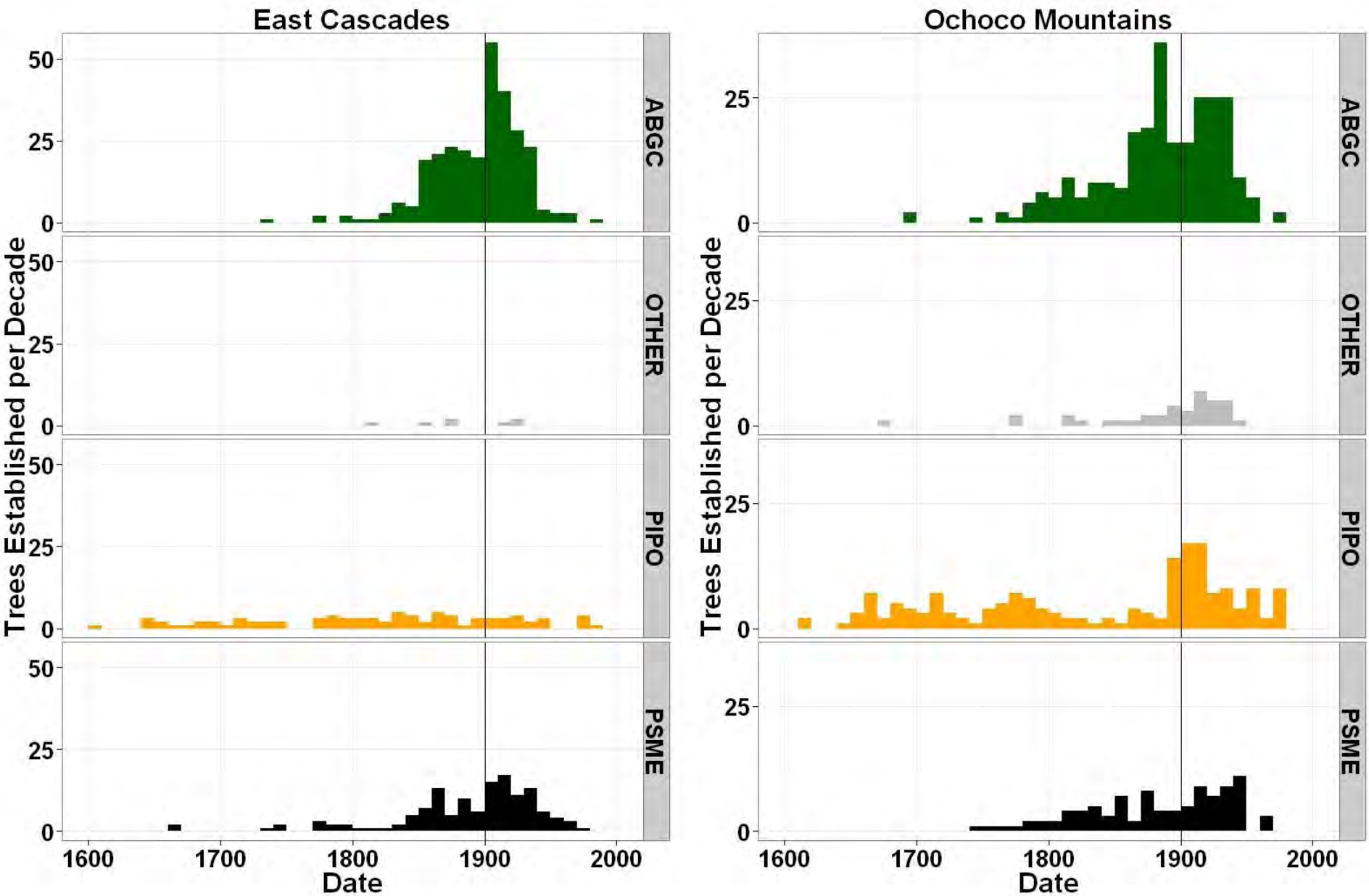


Effects Vary Across Environmental Gradients

Moist Mixed Conifer Age Structure



Wet Mixed Conifer Age Structure



Historical and Current Mixed Conifer Densities (TPHectare)

Historical Densities

- 68 TPH Hagmann et al. Submitted
- 136-152 TPH (Munger 1917)
- 219-275 Dry mixed conifer Eastern Cascades Oregon (Baker 2012)

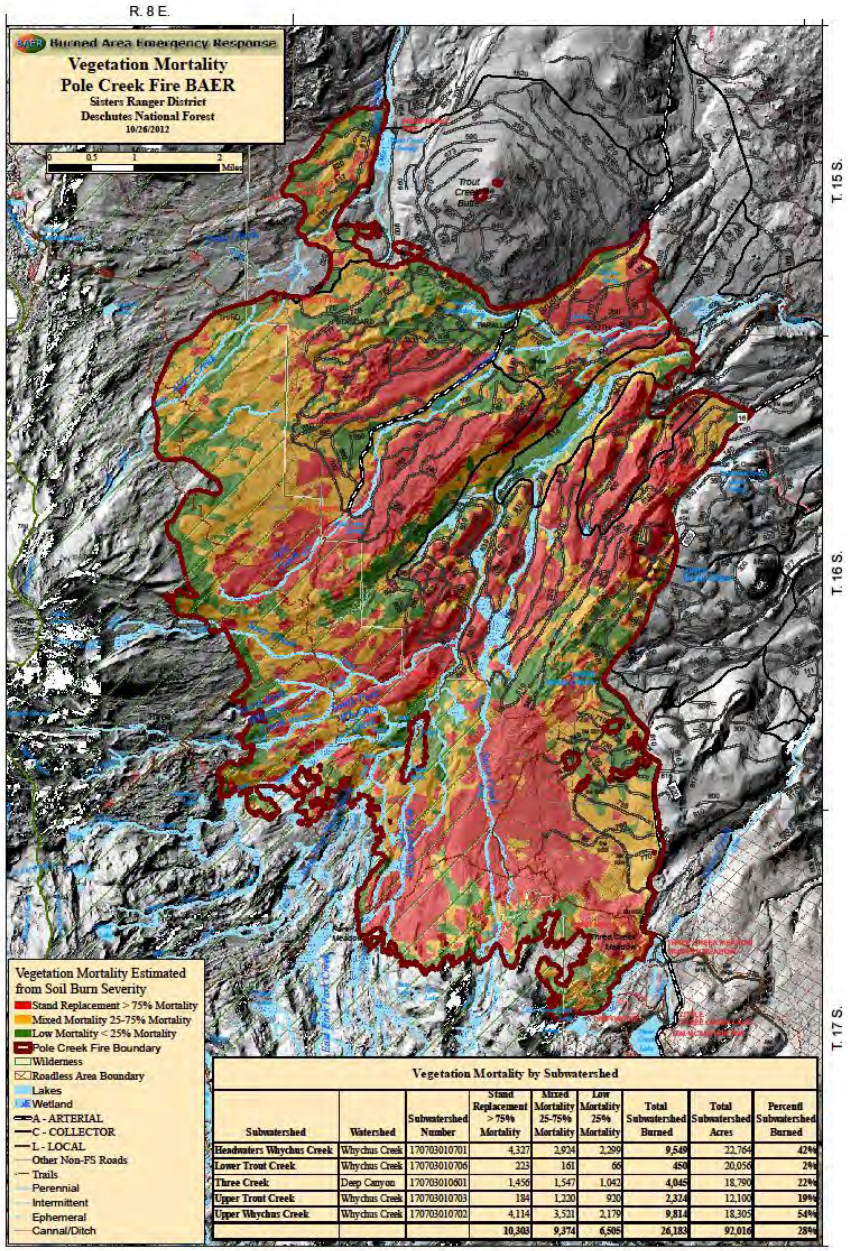
Current Densities

- 234 TPH PIPO and Dry Mixed Conifer, south central Oregon (Hagmann et al. submitted)
- 425-553 Dry to Moist Mixed conifer Eastern Cascades Oregon, (Merschel et al. unpublished)

Current Landscapes

Fire Exclusion, High Severity Fire, Plantations

Pole Creek Fire 2012 Deschutes NF



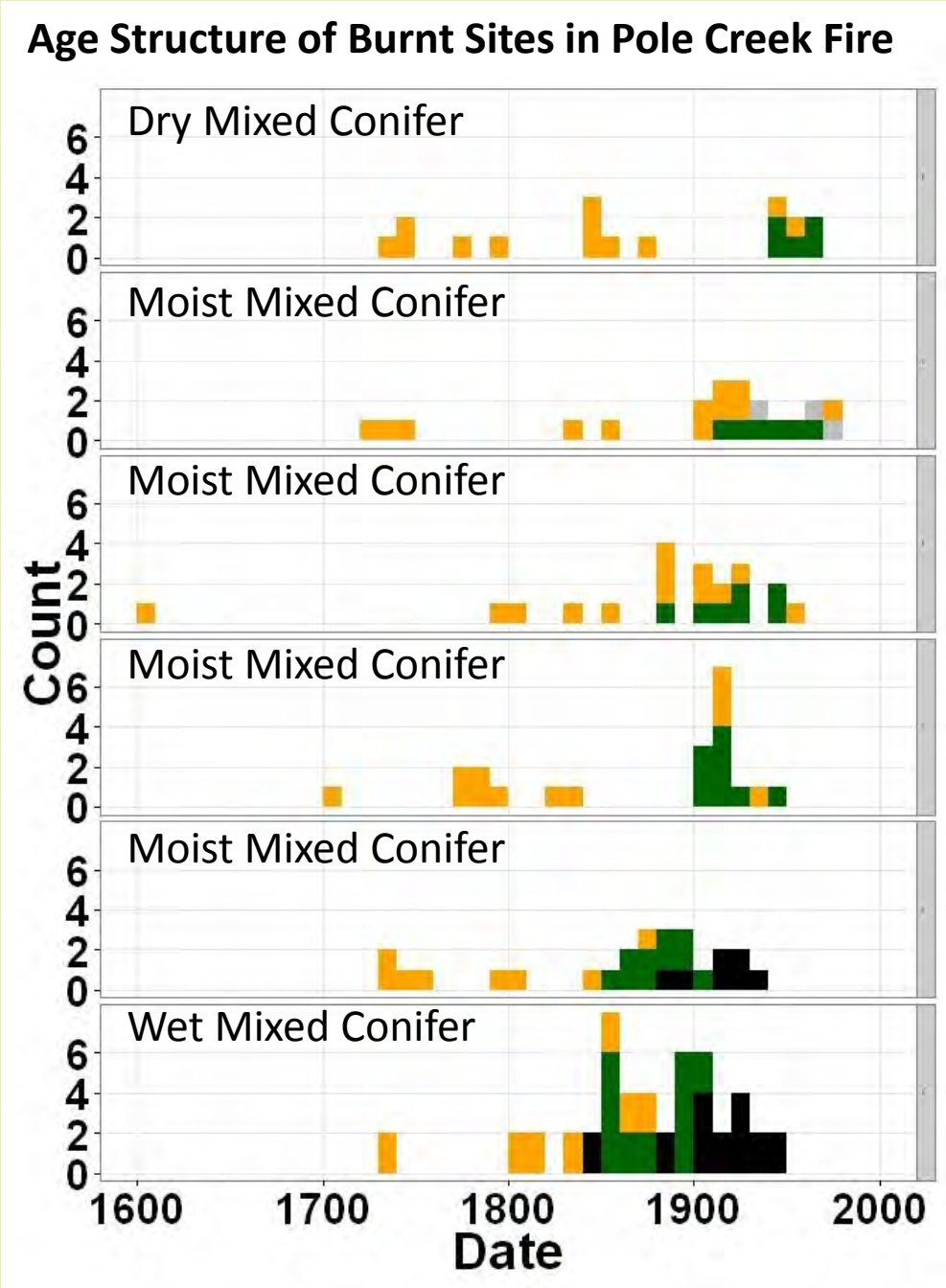
Vegetation Mortality by Subwatershed

Subwatershed	Watershed	Subwatershed Number	Stand Replacement > 75% Mortality	Mixed Mortality 25-75% Mortality	Low Mortality 25% Mortality	Total Subwatershed Burned	Total Subwatershed Acres	Percent Subwatershed Burned
Headwaters Whychus Creek	Whychus Creek	170703010701	4,327	2,924	2,299	9,549	22,764	42%
Lower Trout Creek	Whychus Creek	170703010706	223	161	66	450	20,056	2%
Three Creek	Deep Canyon	170703010601	1,456	1,547	1,042	4,045	18,780	22%
Upper Trout Creek	Whychus Creek	170703010703	184	1,220	920	2,324	12,100	19%
Upper Whychus Creek	Whychus Creek	170703010702	4,114	3,521	2,179	9,814	18,305	54%
			10,303	9,374	6,505	26,183	92,016	28%

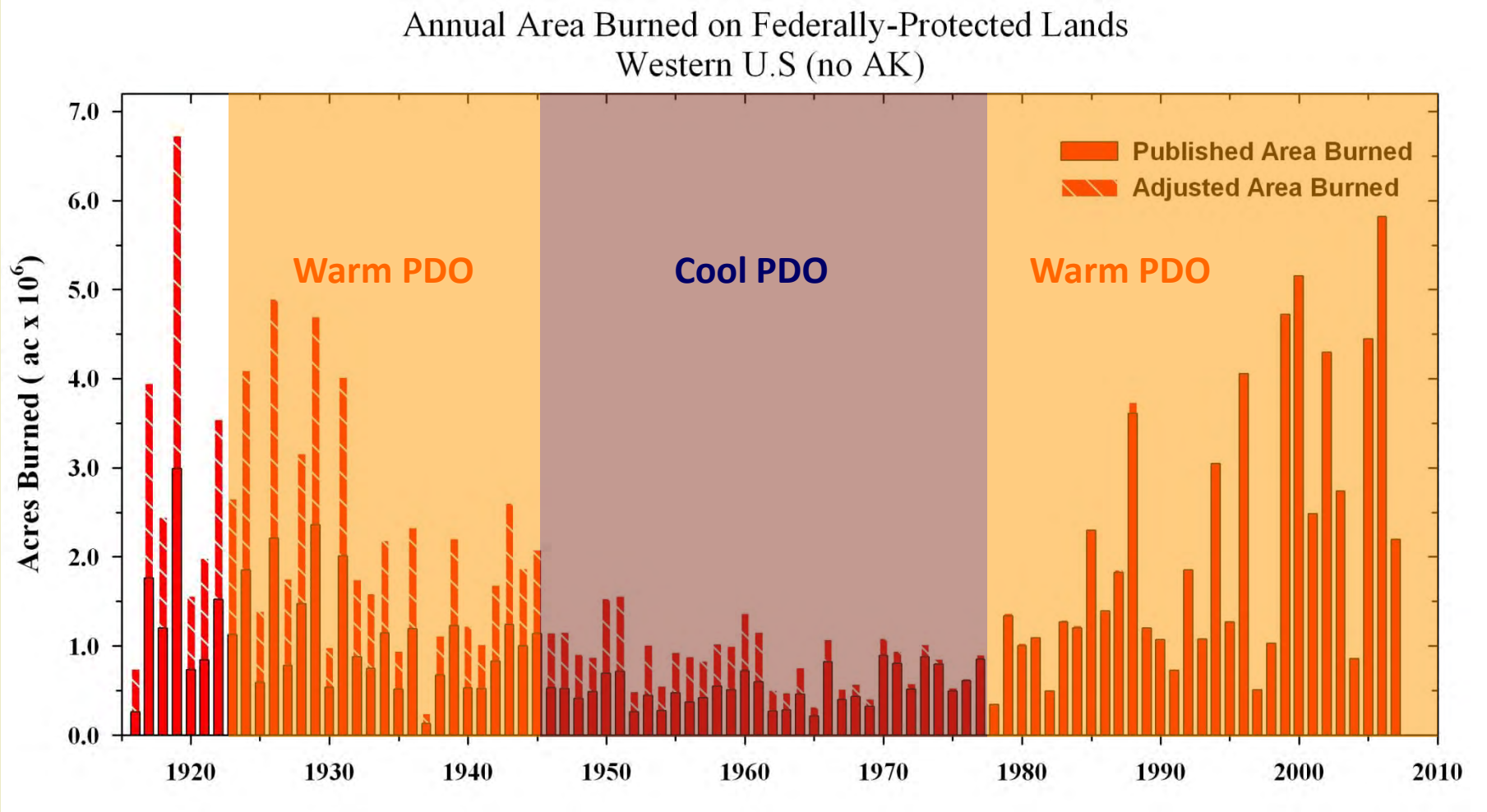
Site 2059 (Dry)

Site 2208 (Moist)

Site 2047 (Wet)



Area burned – Western U.S., 1916 - 2007



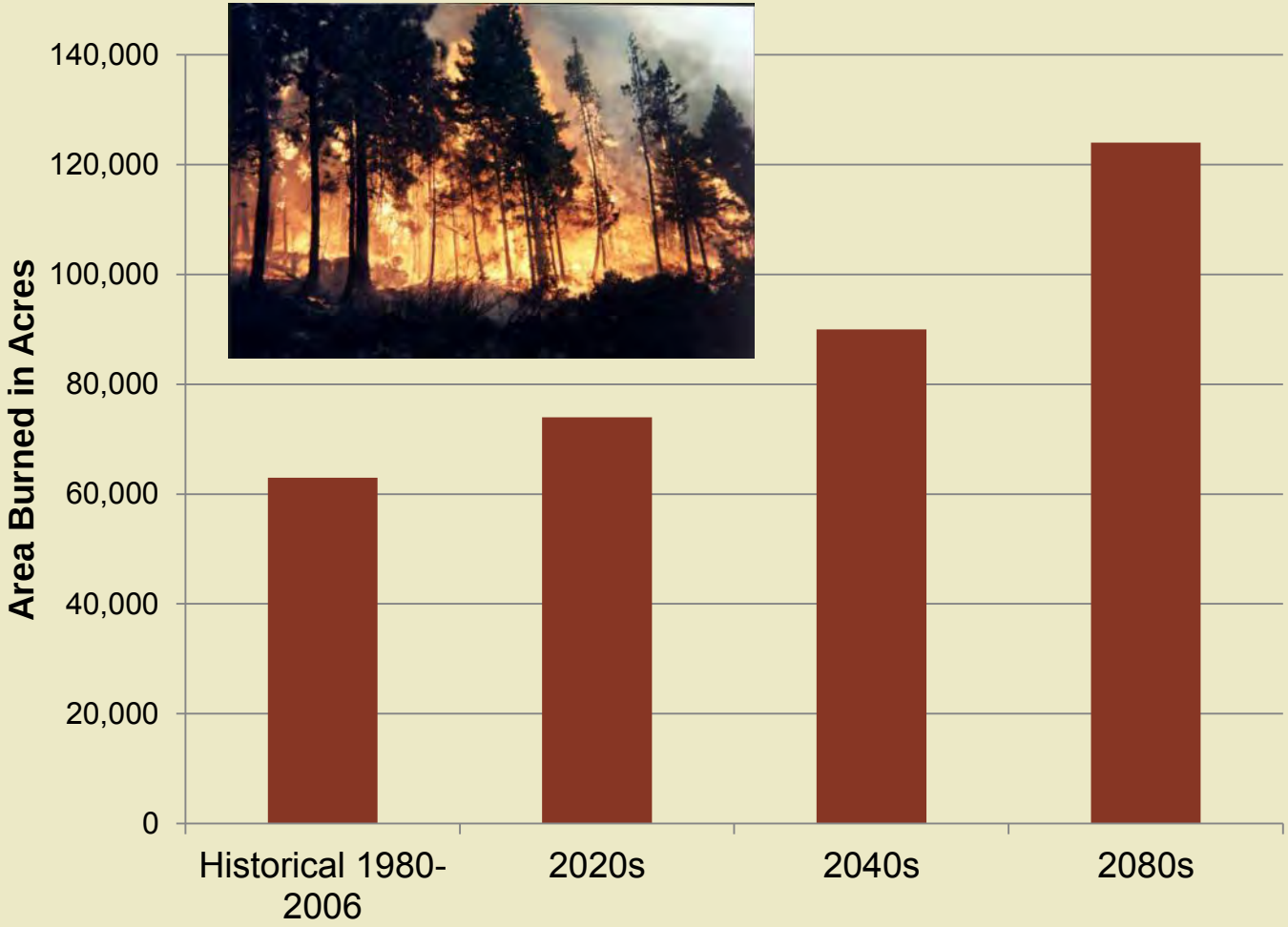
Fire suppression → Fire exclusion → Fuel accumulation

Lots of fire → Much less fire → Lots of fire

Courtesy of David Peterson

Climate Change and Fire

Projections of Future Area Burned (average of A1, A1B Scenarios) for Eastern Cascades of Washington



Littell et al. 2009

In Summary

- Diversity in composition and structure was the rule
- Disturbance a key driver; native insect, disease, wildfire, and abiotic disturbance processes
- Human activity has significantly altered disturbance regimes and structure and composition

Funk Mountain, Okanogan County, Washington

What does Restoration Mean?

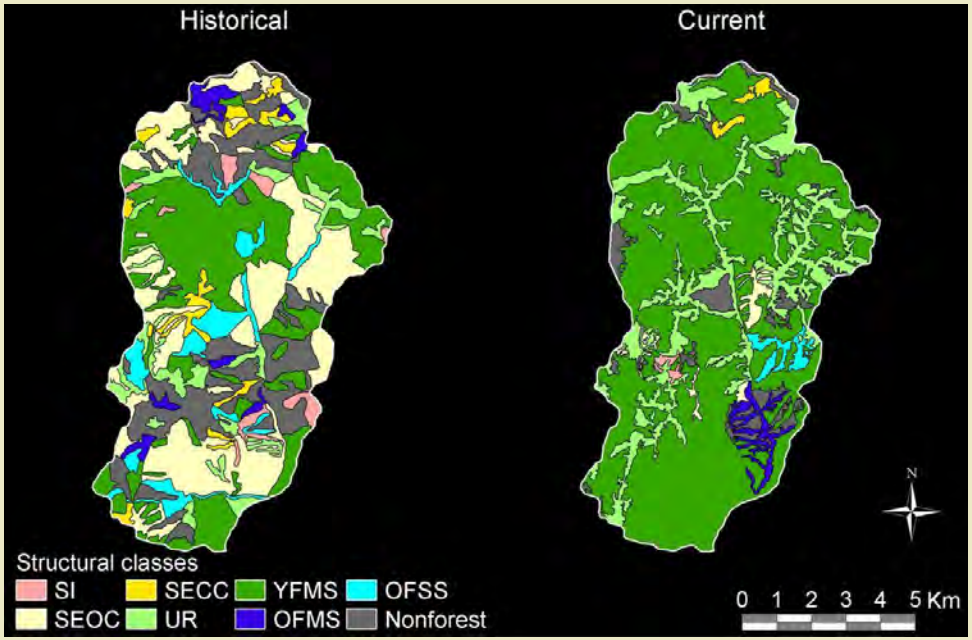
USDA Forest Service:

"Restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on **re-establishing the composition, structure, pattern, and ecological processes** necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future conditions."

Restoration

Re-establish the self-organizing, self-maintaining, and adaptive capacities of ecosystems.

This is done by restoring ecological patterns and processes.



Grand Ronde Watershed, NE Oregon
si=stand initiation, seoc=stem exclusion open canopy, secc=stem exclusion closed canopy, ur=understory re-initiation, yfms-young forest multi-story, ofms=old forest multi-story, ofss=old forest single story

Goal of healthier, more resistant, more resilient ecosystems, even if they are not exactly the same systems as before.

What do we Restore? Ecosystem Composition, Structure, and Function

- Composition:
  - Conifers (pines, firs), some hardwoods, shrubs, openings, and a diverse array of fauna
- Structure
  - different seral stages, densities of vegetation, individual trees and logs (cavities, platforms, etc.)
- Function
  - Processes that drive systems, e.g. fire, climate, flooding

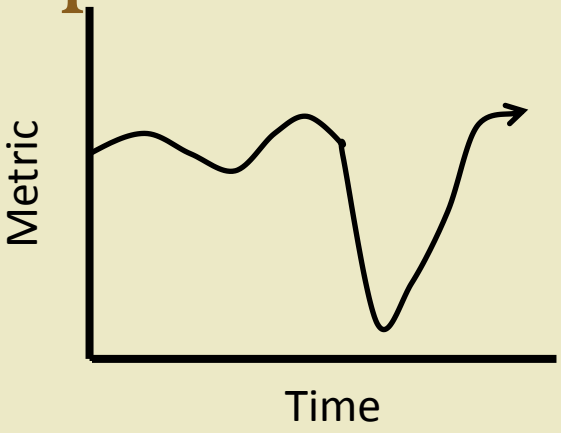
Reference Conditions
IS HRV DEAD?

- Historical Range of Variation (HRV)
  - Restoration of conditions that may have occurred in the past *under certain circumstances.*

For Most Landscapes it is Impossible to Return them to their Past Conditions

Resilience to the Rescue? Evolving Scientific Perspectives

- Engineering Resilience



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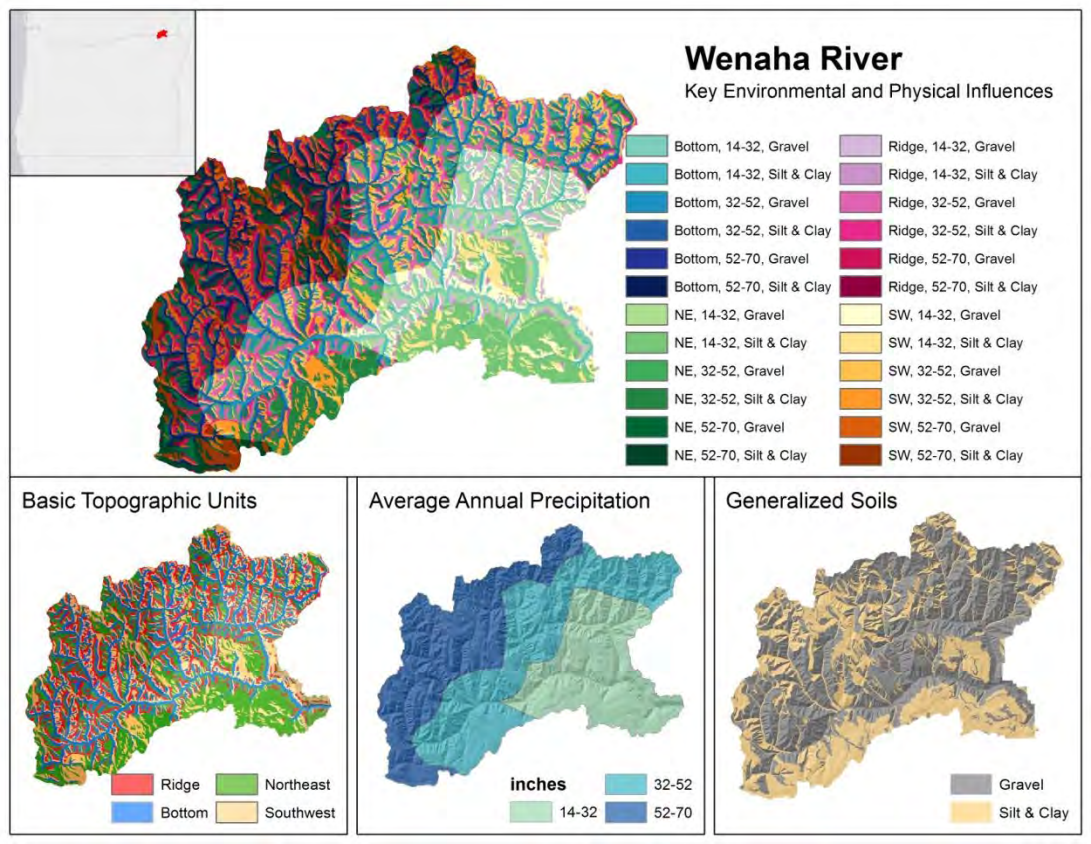
Path to Resilience:

- **Through Iterative steps** that allow for changing socio-ecological system and knowledge
- **Overcome Inertia to restorative change** because of alterations of pattern and process—e.g. abundant seed sources of grand fir
- **Deal with Hysteresis--**can't simply reverse the process—e.g. just add fire back in need to reduce fuels first

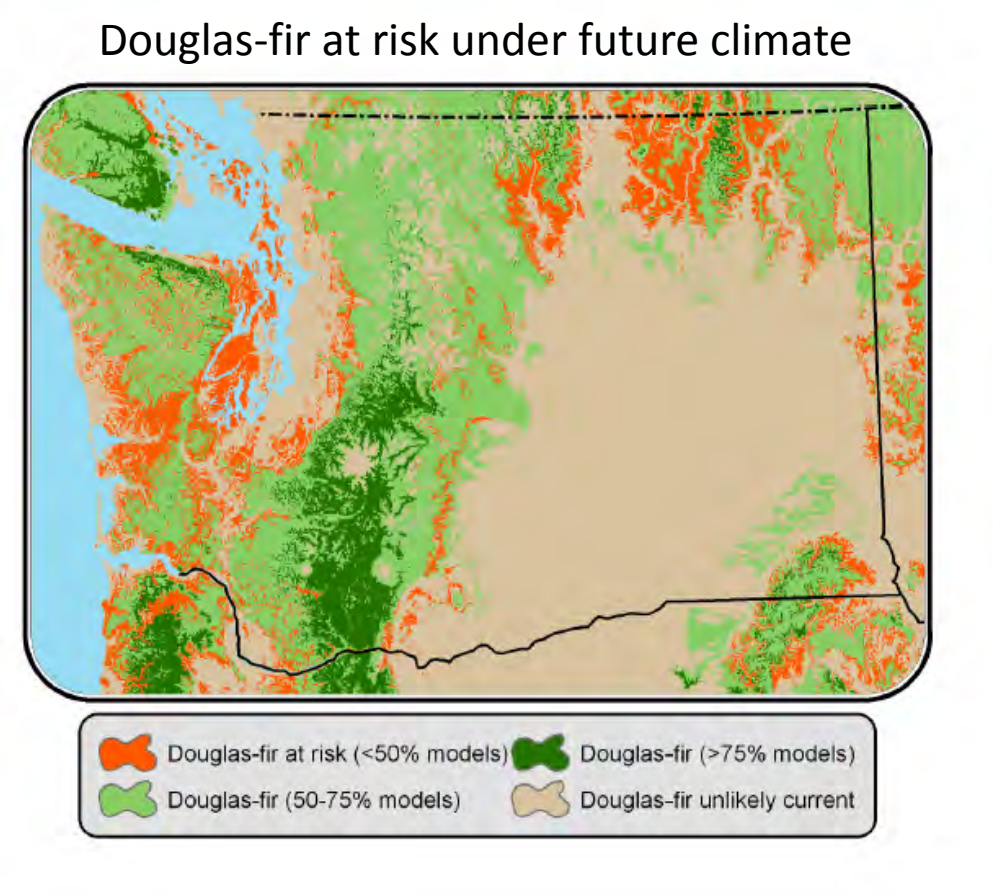
Landscape Heterogeneity as Framework for creating Restoration/Resilience

- Ecosystems are controlled by **spatial and temporal heterogeneity of patterns and processes.**
- Heterogeneous landscapes: **more likely that disturbances in are brief and spatially confined.**



Future Range of Variation (FRV)

Focus on reestablishing the resilience and adaptive capacity of conifer ecosystems within the context of current and future landscape and climatic conditions.



Littell et al. 2009

Climate Change

Adaptation and mitigation approaches may be divided into short- and long-term options.

The "5-R strategies“

- increase resistance,
- promote resilience,
- enable response,
- encourage re-alignment, and
- implement practices to reduce the human influence on climate.

Restoration of Habitat for Old Forest Dependent Species; Nesting/Denning/Resting Habitat (fine scale view)

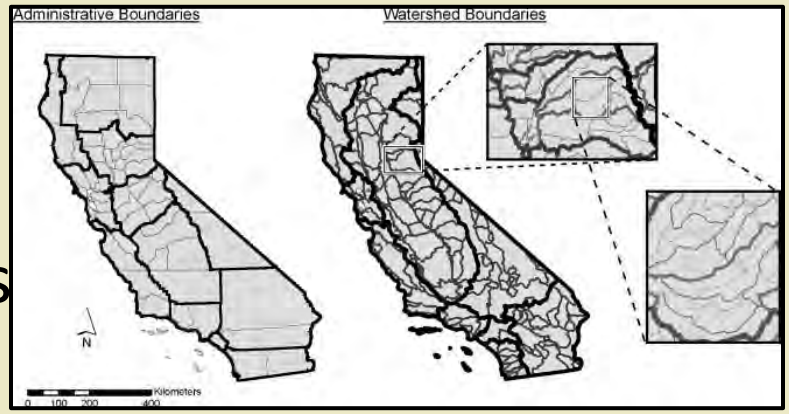
Nesting/denning/resting sites are crucial

- suitable structures (platforms, cavities, large snags and logs) are key
- These features have been significantly reduced over the last 100 years
- Movement corridors (cover from predators, access to food)—riparian areas appear to be heavily used

Spatial Framework for Restoration/Resilience

Nested Landscape Units; Patches, Watersheds, and Landscapes

- A regional landscape can be viewed as a hierarchy of mosaics;



- Watersheds as organizing units within which work is designed and executed, and evaluated

Landscape Context Evaluation An Initial Checklist

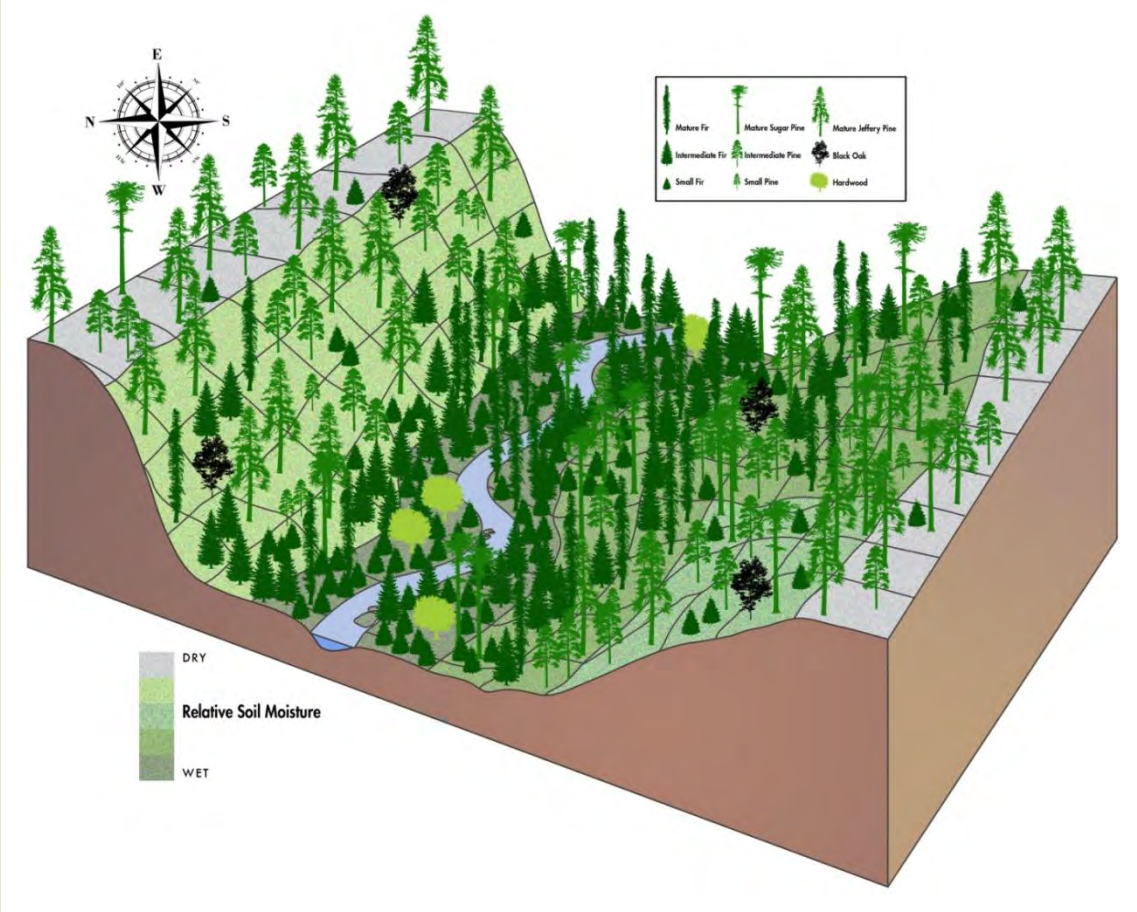
- ✓Current patterns and departures of vegetation structure and composition;
- ✓Spread potential for wildfires, insect outbreaks, and disease pandemics across stands and landscapes
- ✓Interactions with road, trail, and stream networks;
- ✓Wildlife habitat abundance, distribution, and sustainability;
- ✓Minimum roads analysis (*i.e.*, which of the existing system roads are essential and affordable)

Use Topography

Use topographic factors such as slope, aspect, and slope position.

Ridgetops typically have the lowest stem density, midslope forest density and composition varies with aspect.

Bottoms of drainages support riparian forest with high canopy cover.



Silviculture for Achieving Landscape Resilience

- Connect patch/stand-level and landscape level assessments
- Stand-level is the operational level to meet landscape objectives
- Reducing density and enhancing stand complexity will be a central silvicultural objective in most landscapes

How do we Manage for Heterogeneity?

- **Thinning trees**
  - Emphasis on smaller trees
  - Create patches; focus on some areas more than others
- **Rebalance the species composition**
  - More fire tolerant species
  - Many fewer shade tolerants
- **Allow fires to burn where safe and feasible**
  - Wildfire
  - Prescribed fire
- **Understand and emulate the inherent patchiness of landscapes**

Vegetation Guidelines

- Maintain/restore backbone of medium to large old and fire tolerant trees
- Ditto for snags > 15”
- Diameter limits without regard to species and age limit scope for ecological restoration
- Use PVT, topography, disturbance regime to prioritize stand level treatments
- Not all mixed conifer sites need the same level or type of restoration

Old Clearcuts/Plantations

- May need restructuring
  - Variable density thinning
  - Regeneration harvest

- Promote growth of fire tolerant trees and spatial heterogeneity

Land Management Decisions Must Address both Risk and Uncertainty

- Research can help characterize risks, uncertainties and tradeoffs
- Social acceptability a critical dimension for management and social science research

Information Needs

- Disturbance and succession history of mixed conifer (MC) forests
- Variation in MC structure, composition and disturbance regime at multiple scales
- Guidelines for prioritizing restoration activities
- Tradeoffs between active and passive approaches to restoration
- Landscape-scale framework for whole-landscape planning and management
- Future Range of Variability

Conclusions

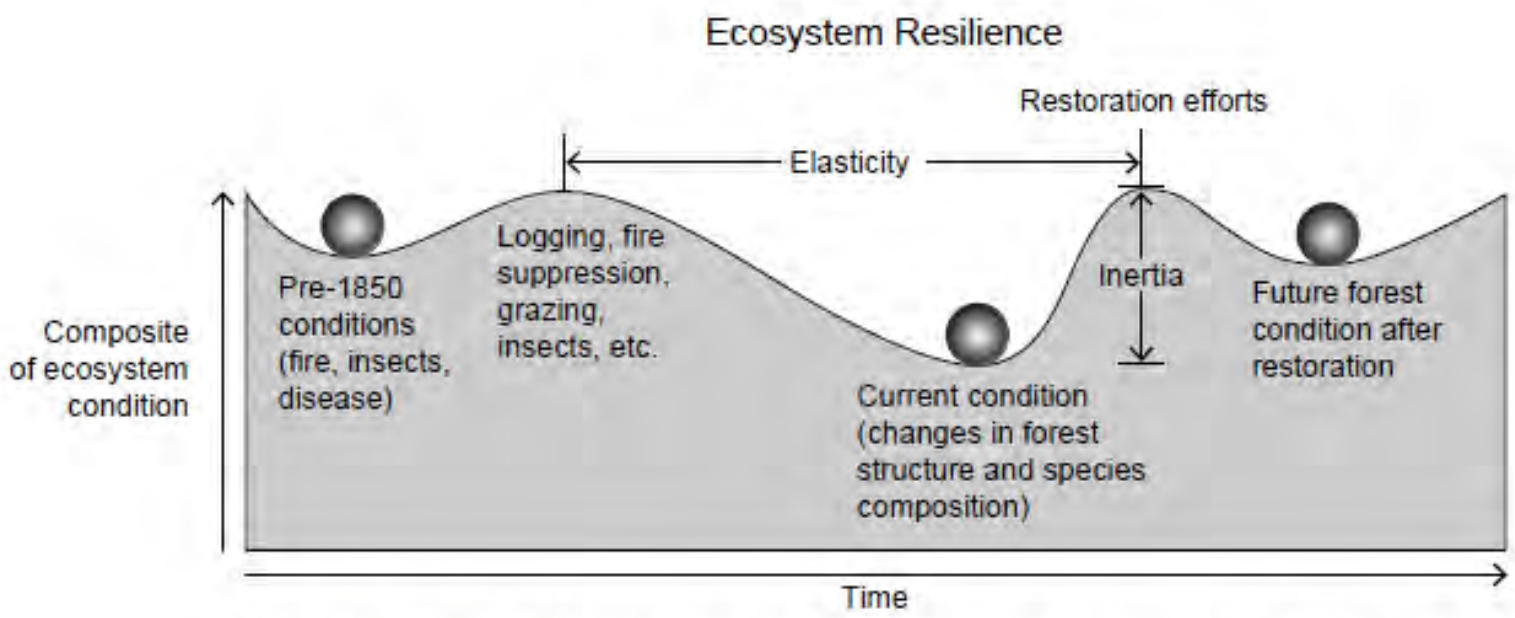
- Mixed conifer forest are ecologically diverse at multiple spatial scales-ecoregion to landscape to stand
- Low to mixed severity fire regimes were key
- Euro-American activities have altered patterns and processes in different ways with many undesirable outcomes

Conclusions

- Restoration is needed but challenging for many reasons
- Resilience frameworks needed to recognize dynamics and interactions of both ecological and social realms
- Management-research-stakeholder partnerships needed to translate knowledge into action and to adapt to new information

Research-Management Collaboration

- Pick right people, build personal relationships
- Identify roles, responsibilities and constraints
- Joint planning
- Joint investment
- Short and long-term products
- Capture and share lessons learned

"C'mon, Sylvia … where's your spirit of adventure?"

Restoraton-Resilience Concepts