



## Current vs. Historical Conditions in Moist Mixed-conifer Forests

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## Outline

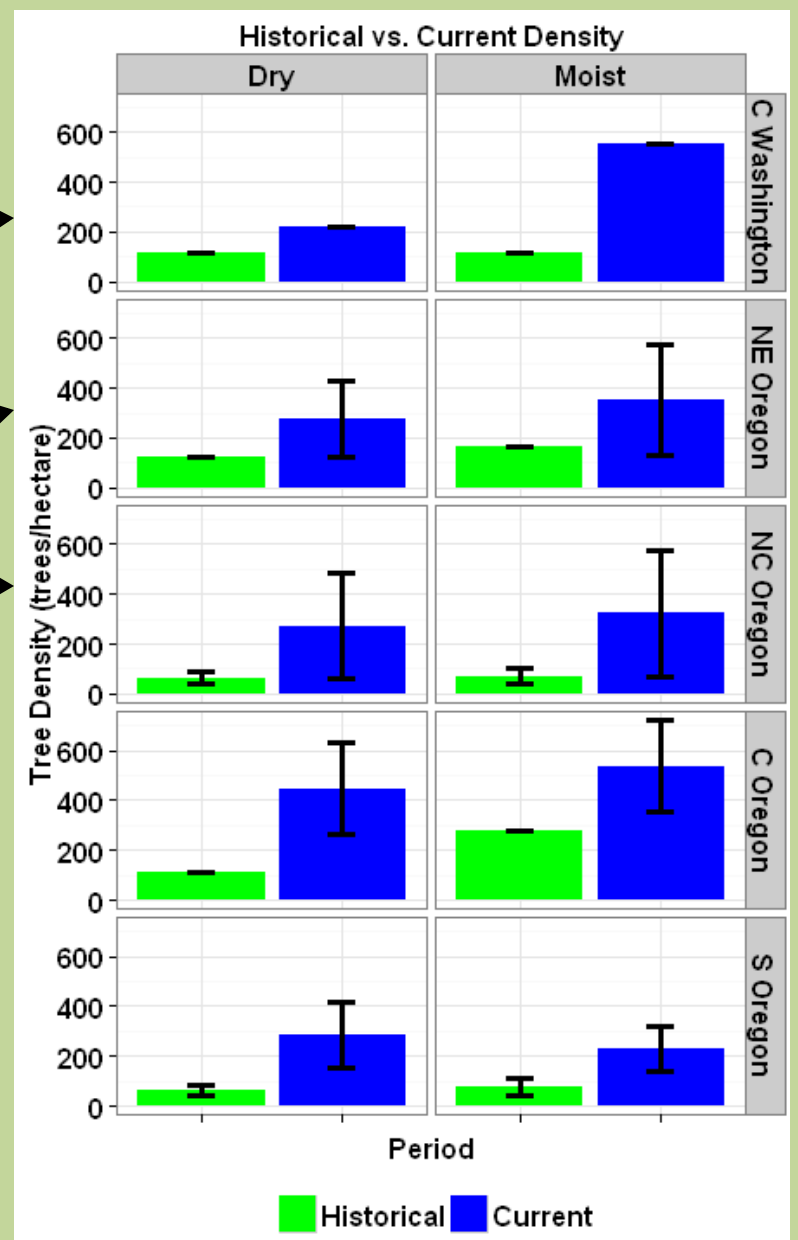
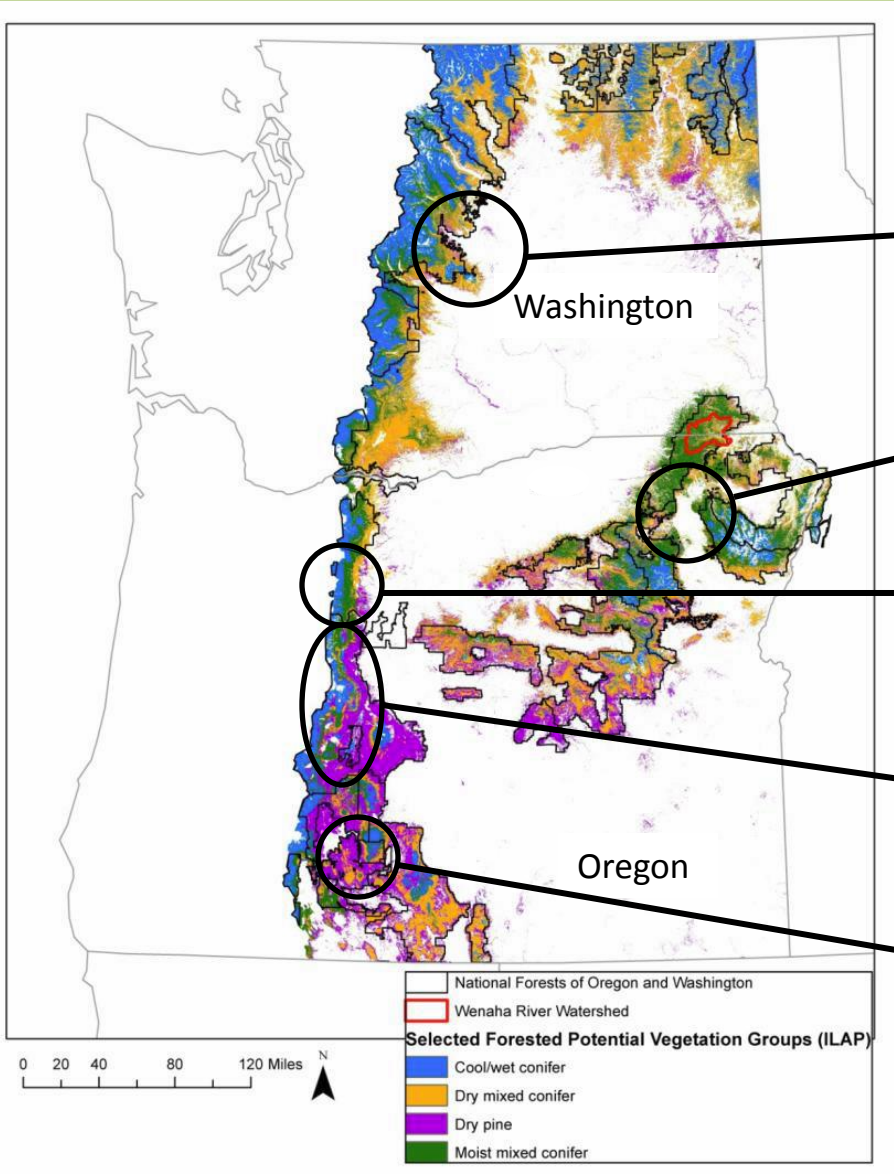
1. What changes have occurred in Dry and Moist mixed-conifer?
2. What mechanisms led to those changes?
3. How do changes vary in “Dry” vs. “Moist” mixed-conifer
4. What does current structure and composition tell us about historical conditions in mixed-conifer forest?

## Terms to Know

- Large Trees = Trees >21 inches or ~50 cm
- Small Trees = Trees 4-21 inches or 10-50 cm
- Historical Period - Prior to land use changes ~1900  
(Survey Records, Tree Ring Reconstructions)

# Changes in Structure and Composition

## Total Stand Density



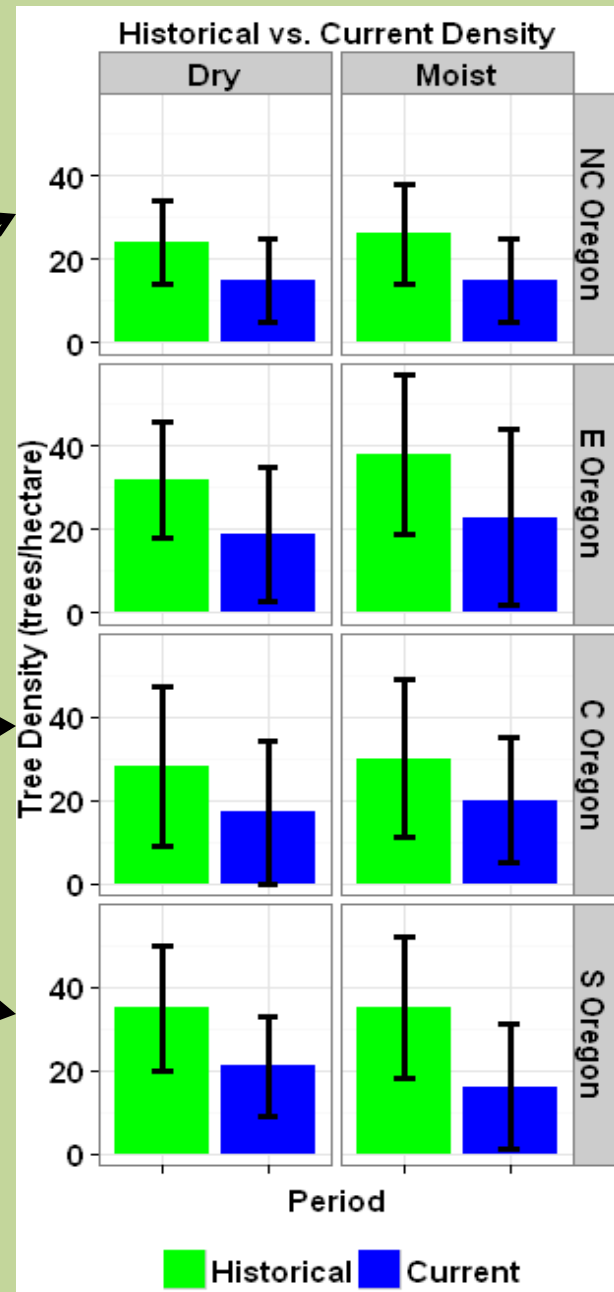
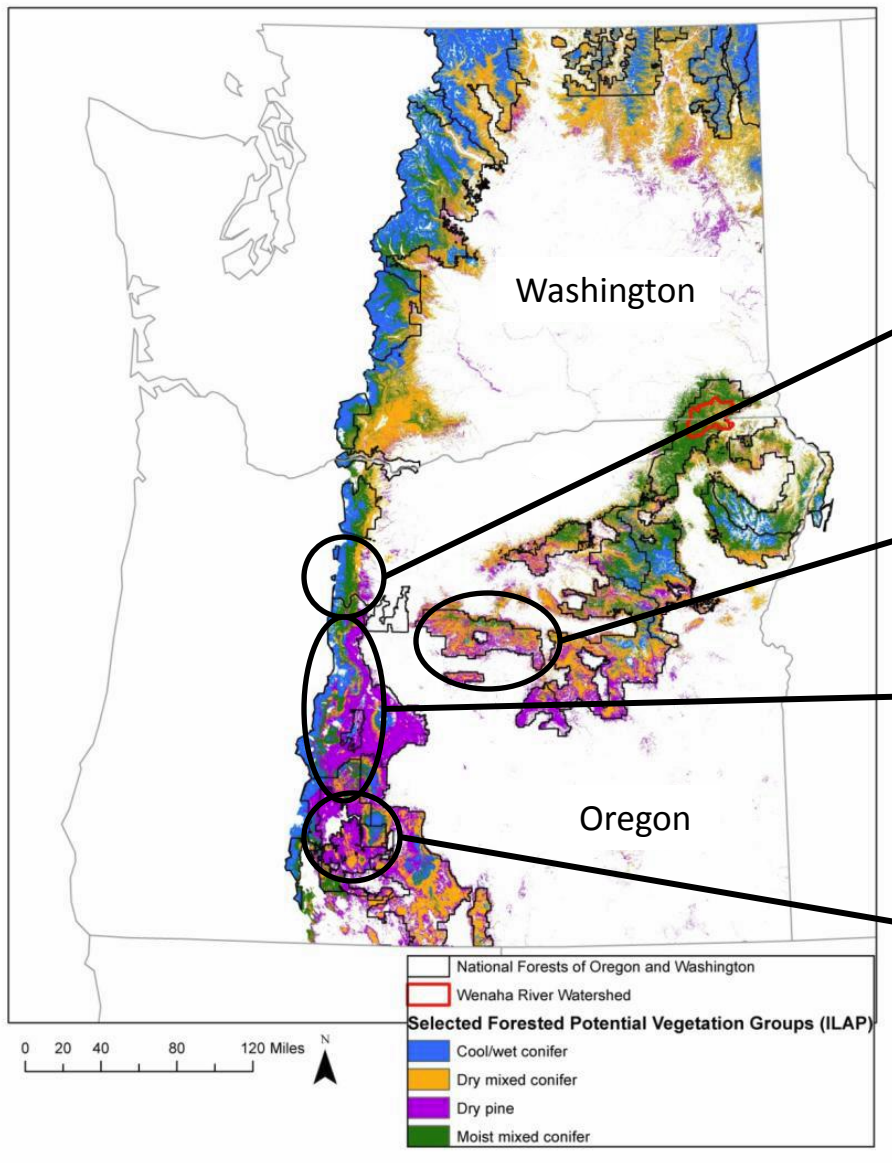
Mixed-Conifer Forest Map

Map Credit: Ann Shlisky



# Changes in Structure and Composition

## Large Tree Density



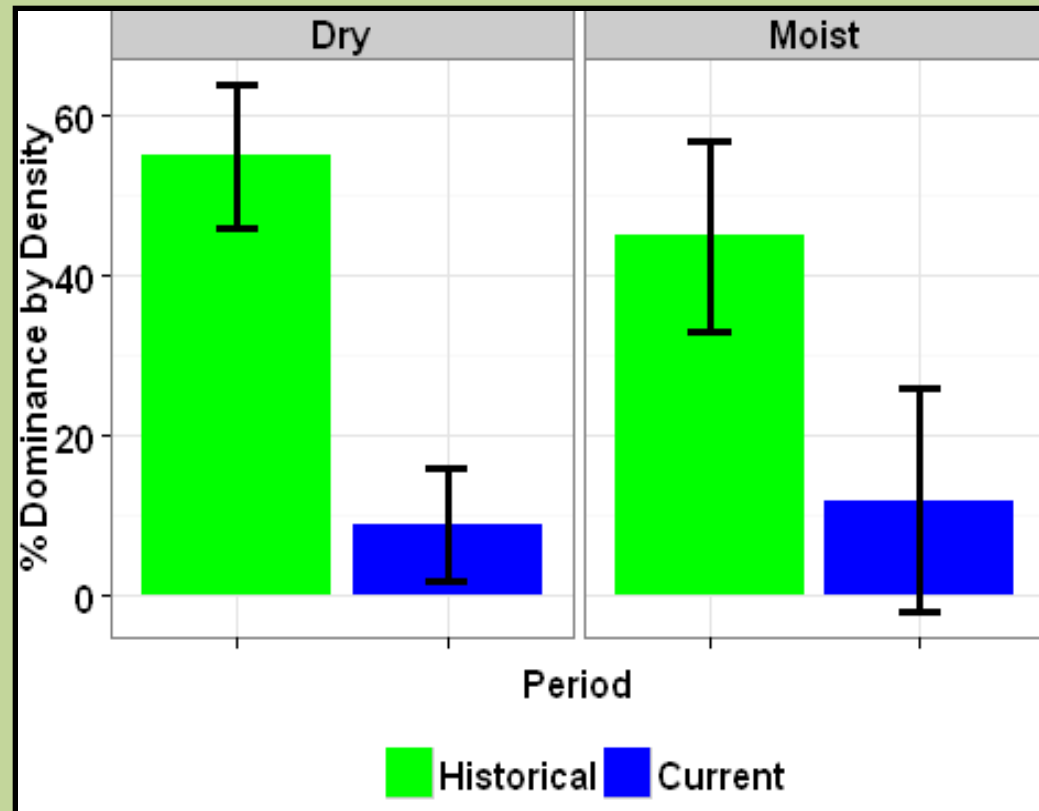
Mixed-Conifer Forest Map

Map Credit: Ann Shlisky

# Changes in Structure and Composition

## *% Dominance by Density of Large Trees*

Eastern Cascades of Southern Oregon

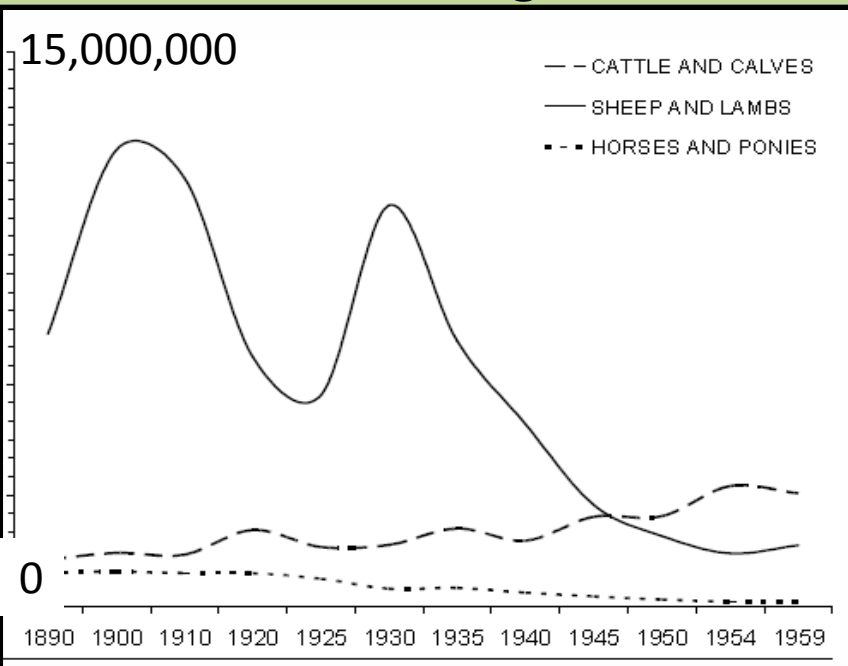


Source: Hagmann et al. 2013



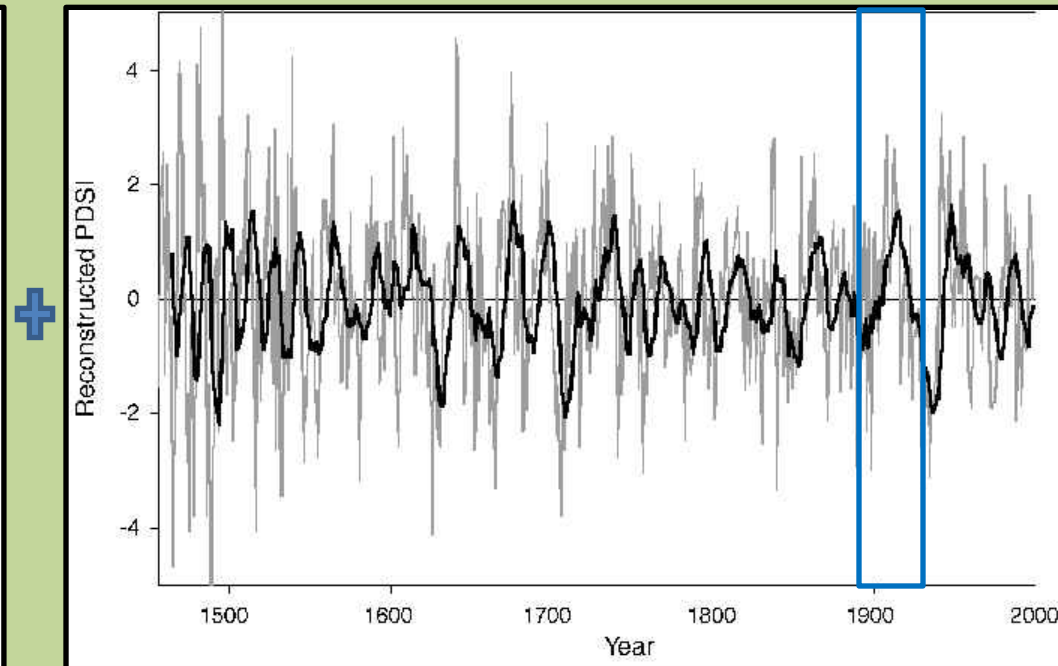
# Mechanisms of Change

## Grazing



Source: Powell 2008

## Cool/Wet Climatic Period



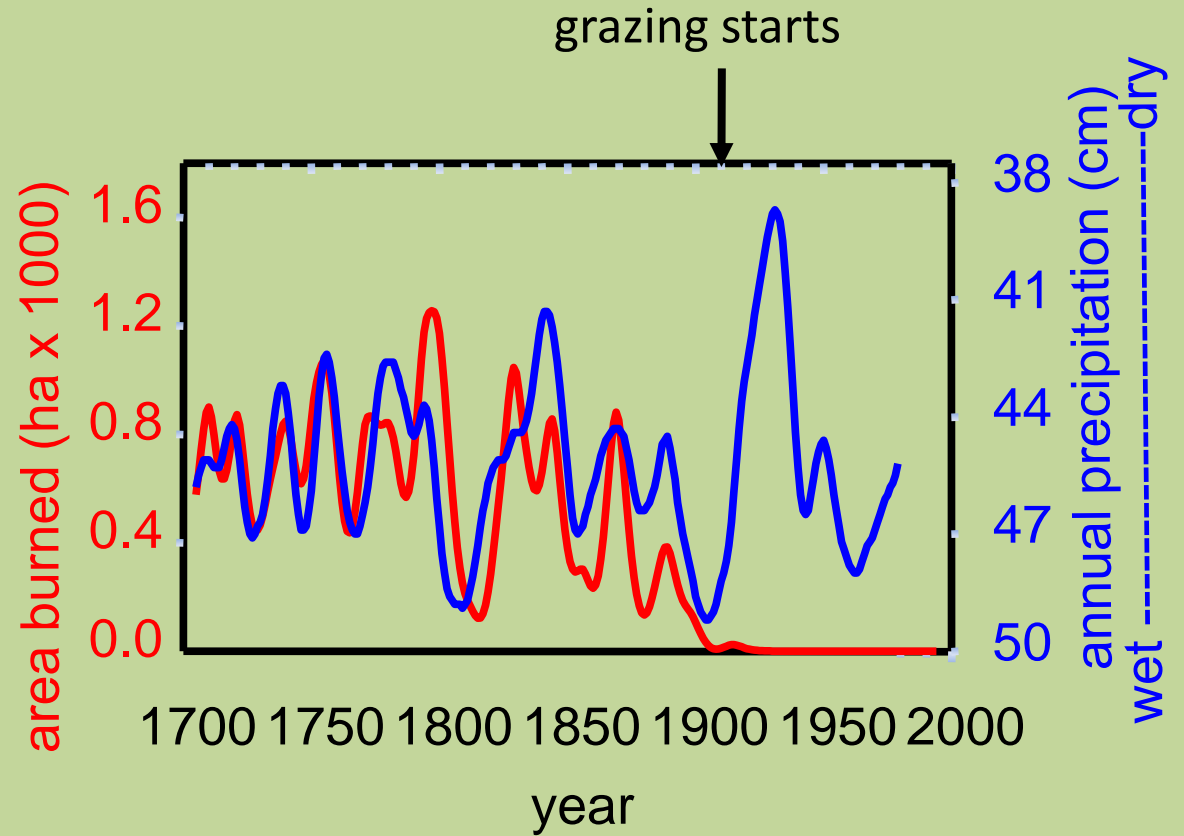
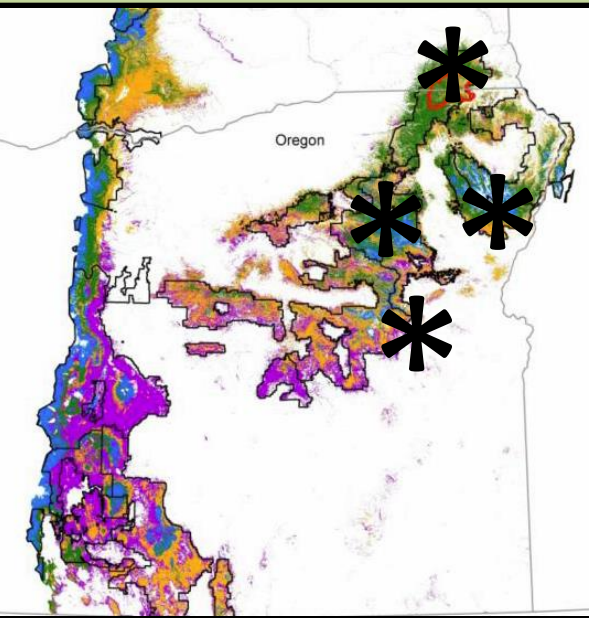
+

Pohl et al. 2002

Grazing and Increased Moisture = Tree Establishment

# Mechanisms of Change

## *Fire Exclusion*

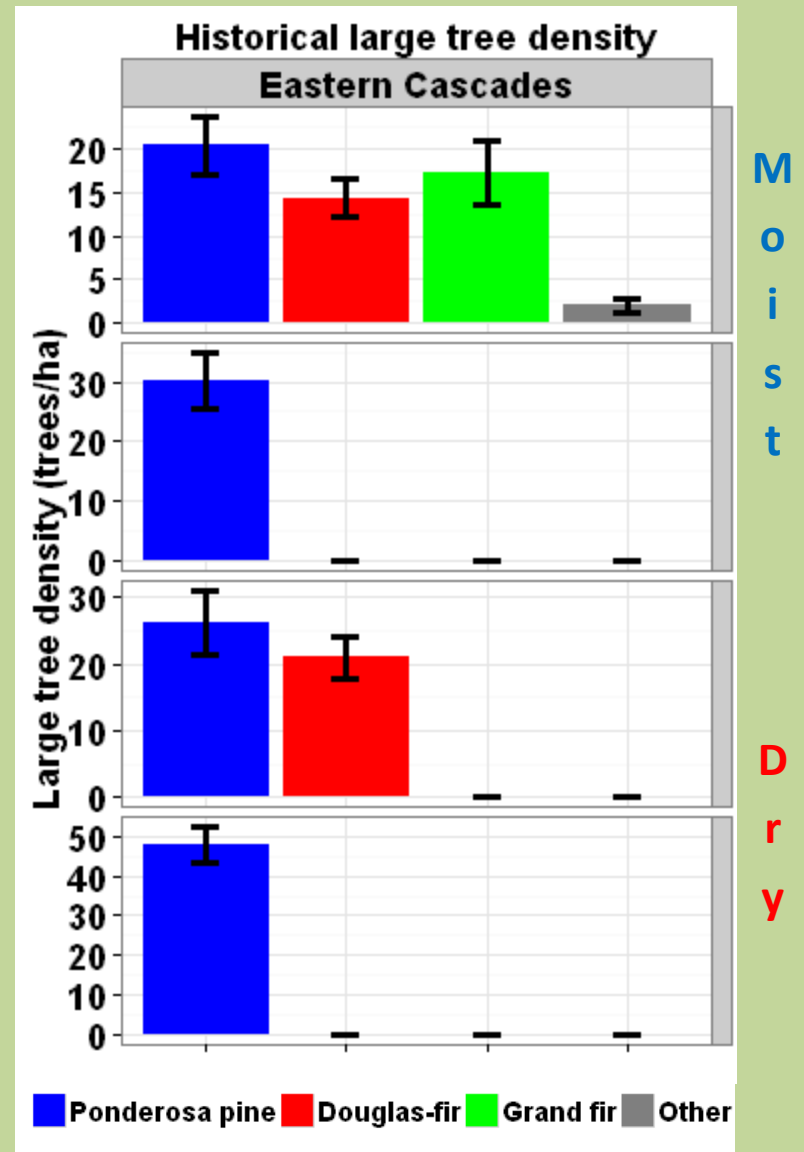
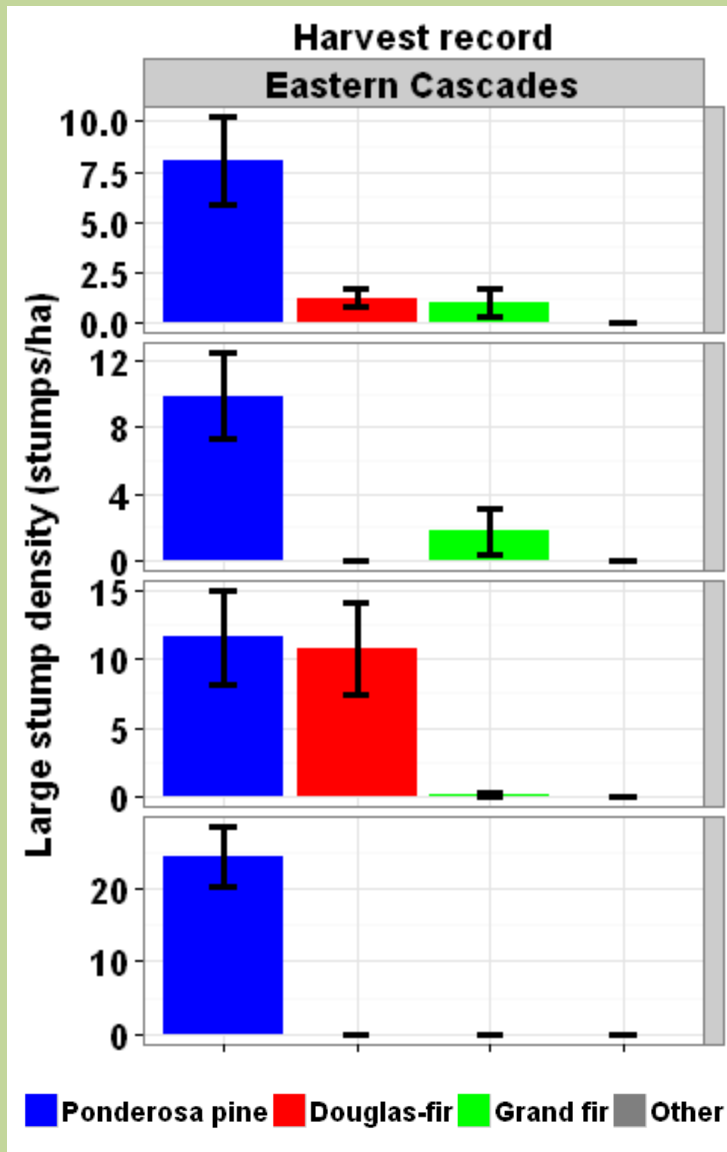


Source: Heyerdahl et al. 2001



# Mechanisms of Change

## Logging





# Variation in Change in Mixed-Conifer Forest

## *Current Structure Composition Types*



Persistent Ponderosa Pine



Recent Douglas-fir



Recent Grand Fir



Persistent Shade Tolerant



# Structure-composition types are strongly associated with climatic setting



Persistent Ponderosa Pine

Recent Douglas-fir

Recent Grand Fir

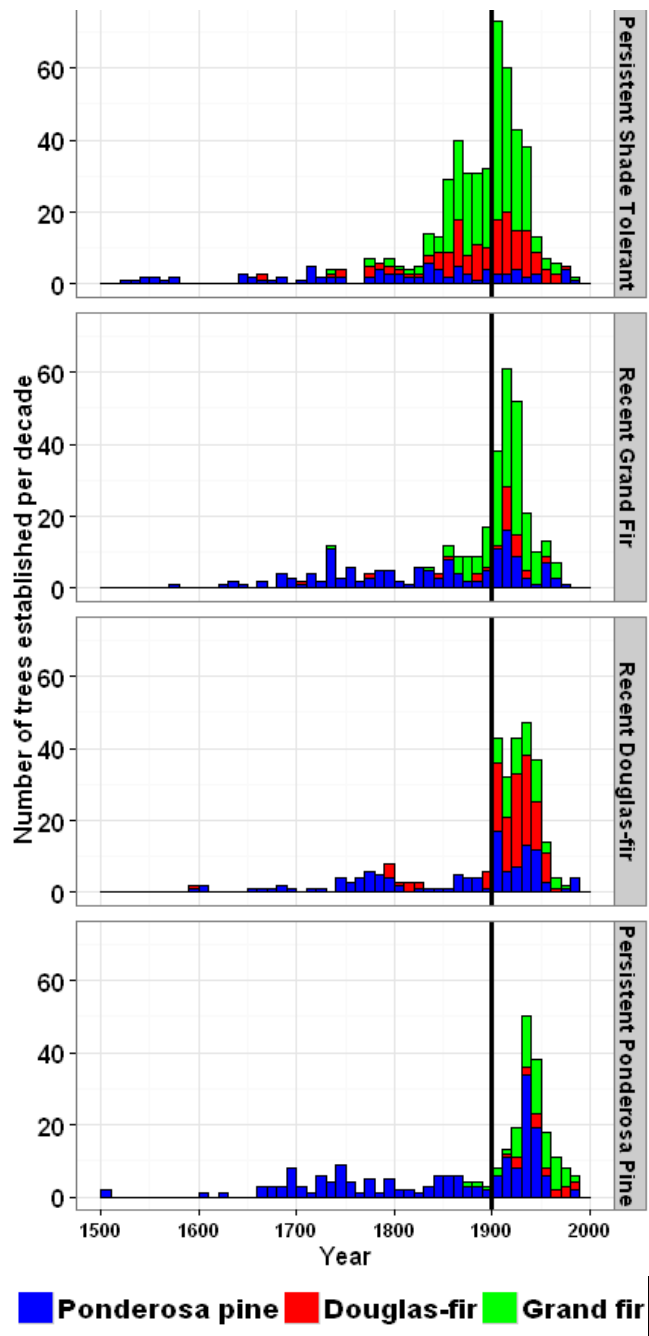
Persistent Shade Tolerant

***Precipitation and Elevation***

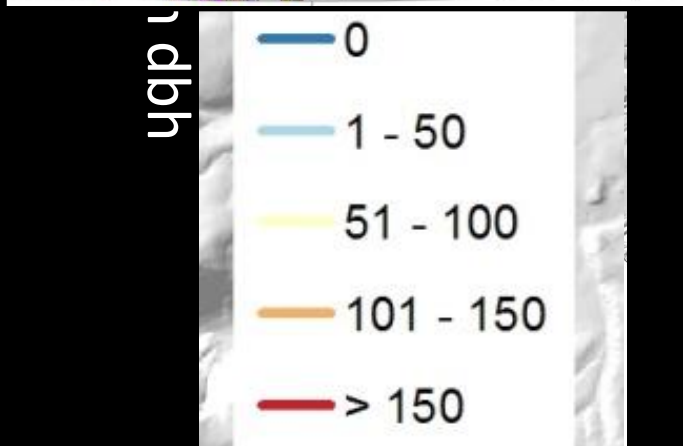
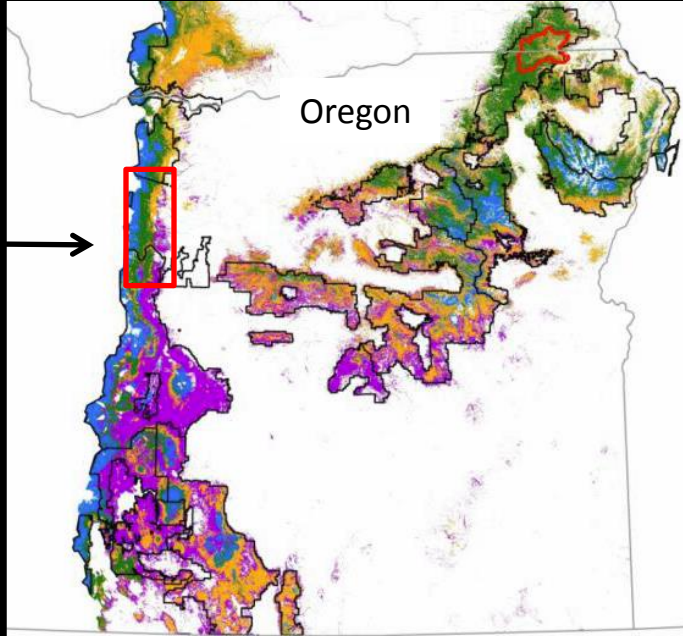
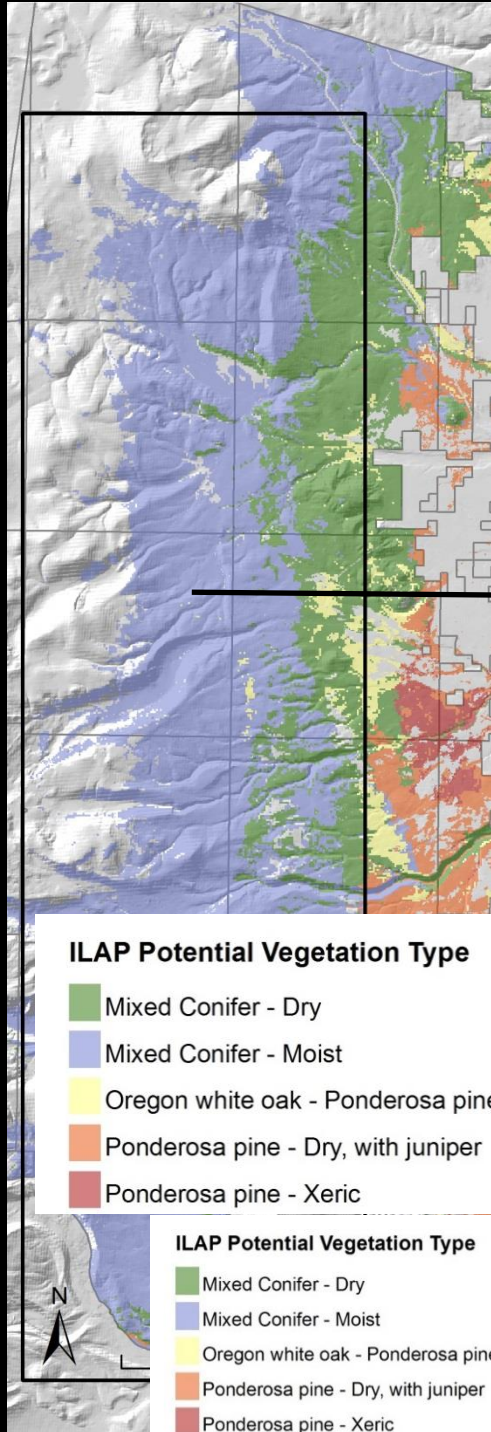
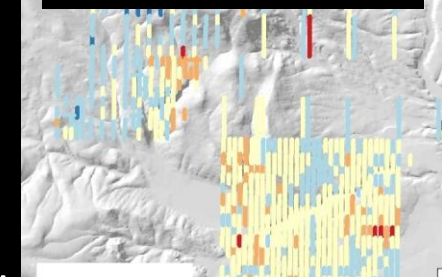
***Average Maximum Temperature***



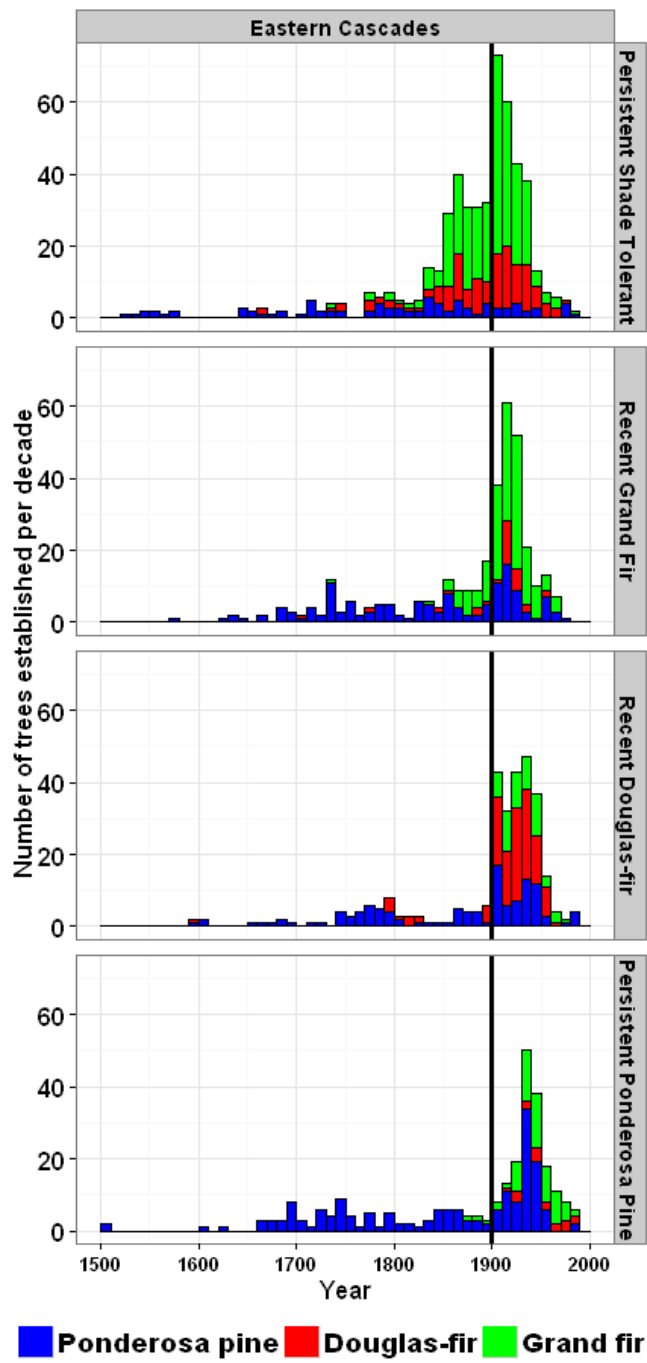
# Current Age Structure



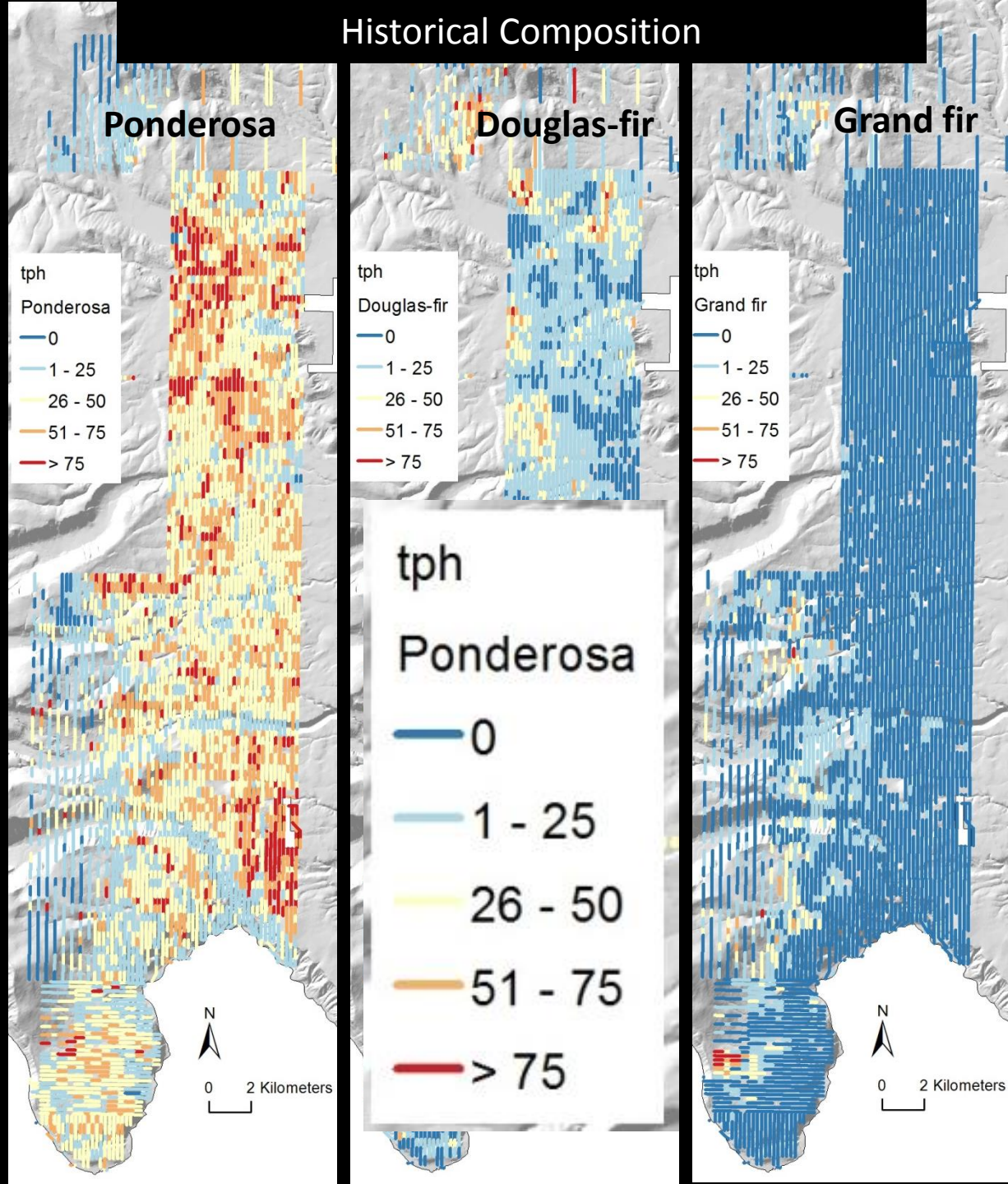
# Historical Density





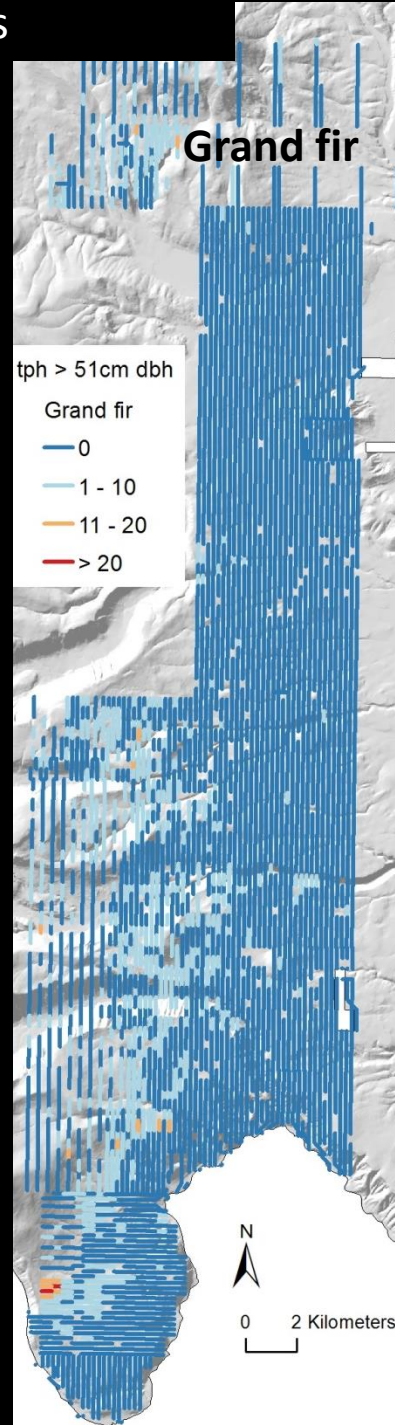
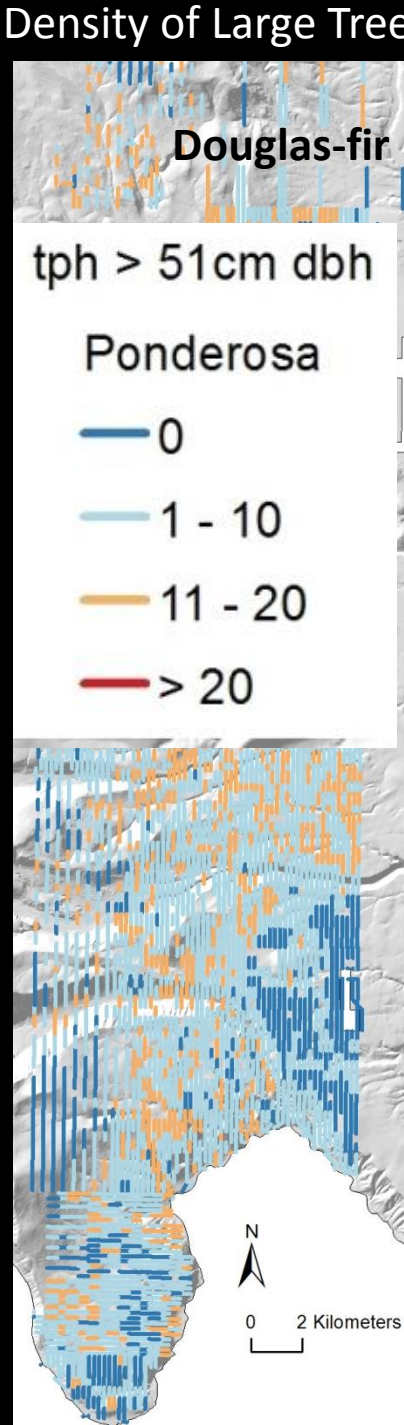
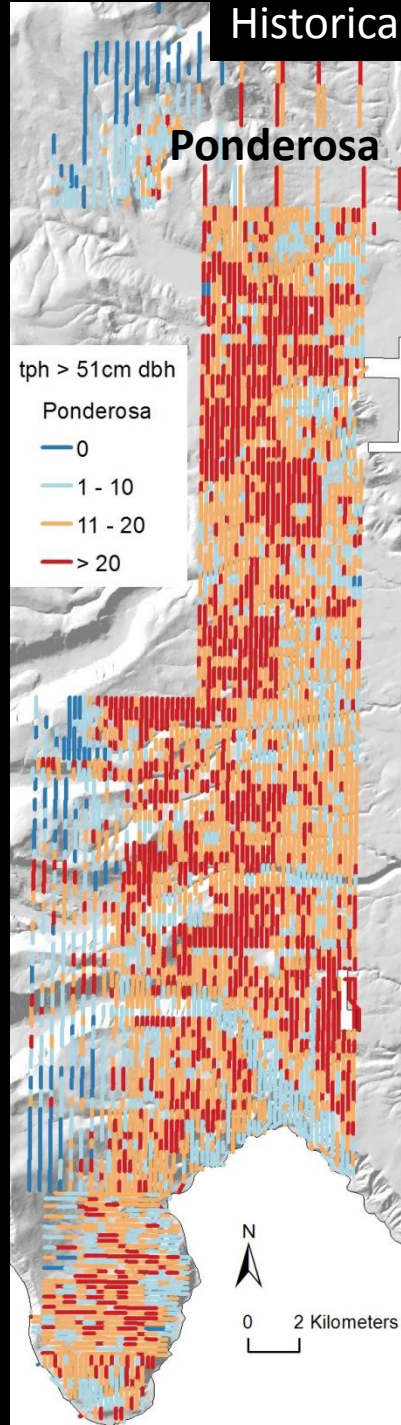
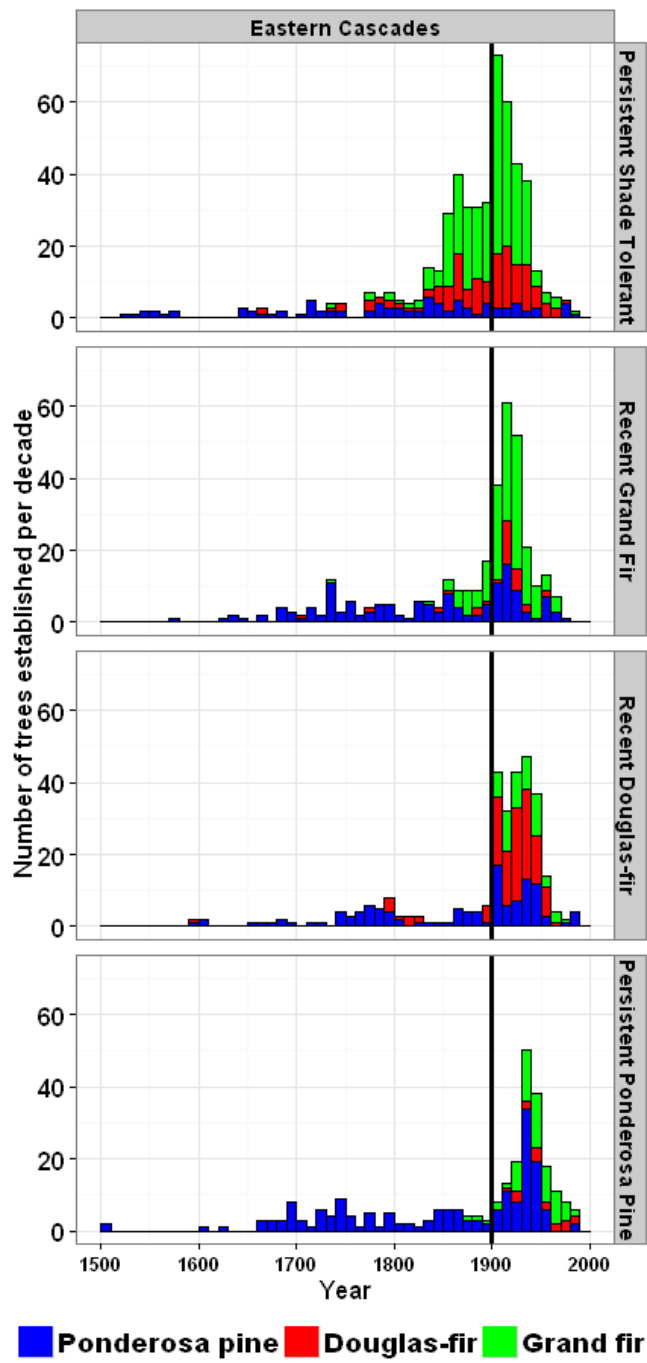


■ Ponderosa pine ■ Douglas-fir ■ Grand fir





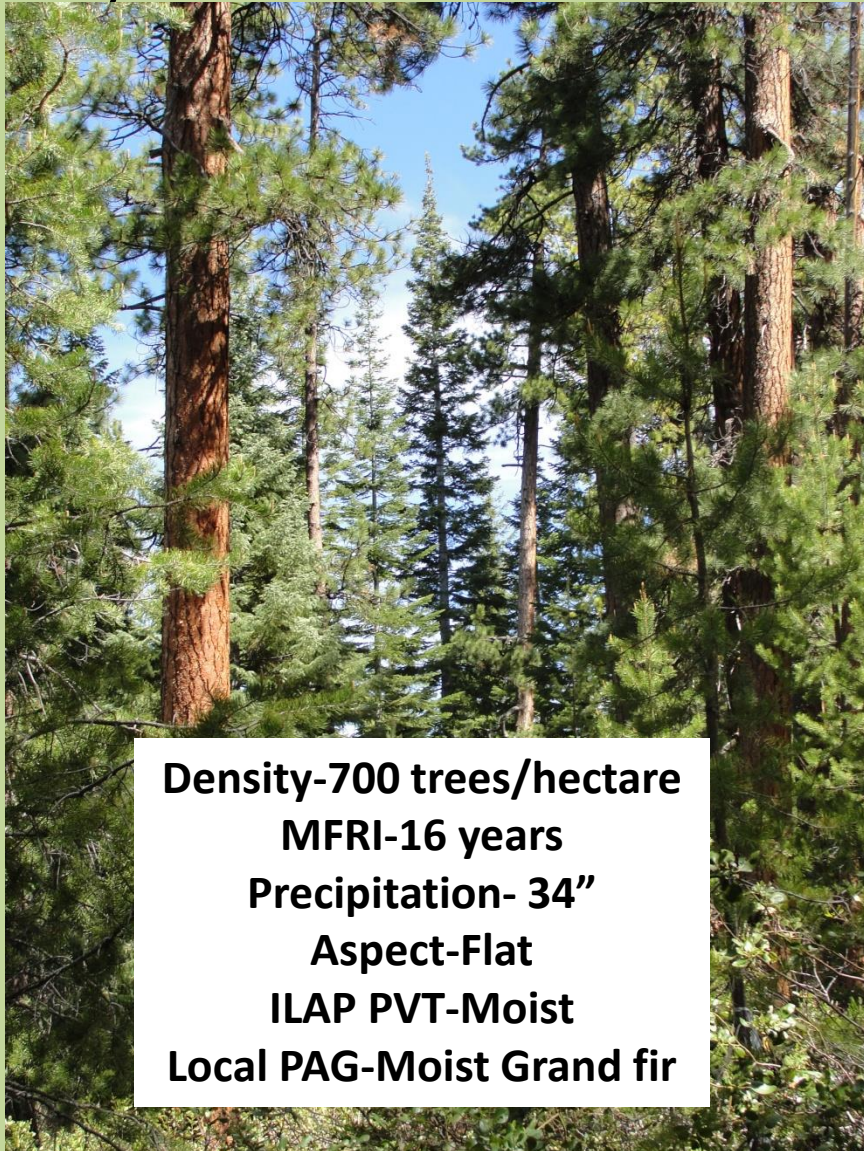
# Historical Density of Large Trees





# Variation in Change in “Dry” vs. “Moist”

## “Dry” Persistent Ponderosa Pine



**Density-700 trees/hectare**  
**MFRI-16 years**  
**Precipitation- 34”**  
**Aspect-Flat**  
**ILAP PVT-Moist**  
**Local PAG-Moist Grand fir**

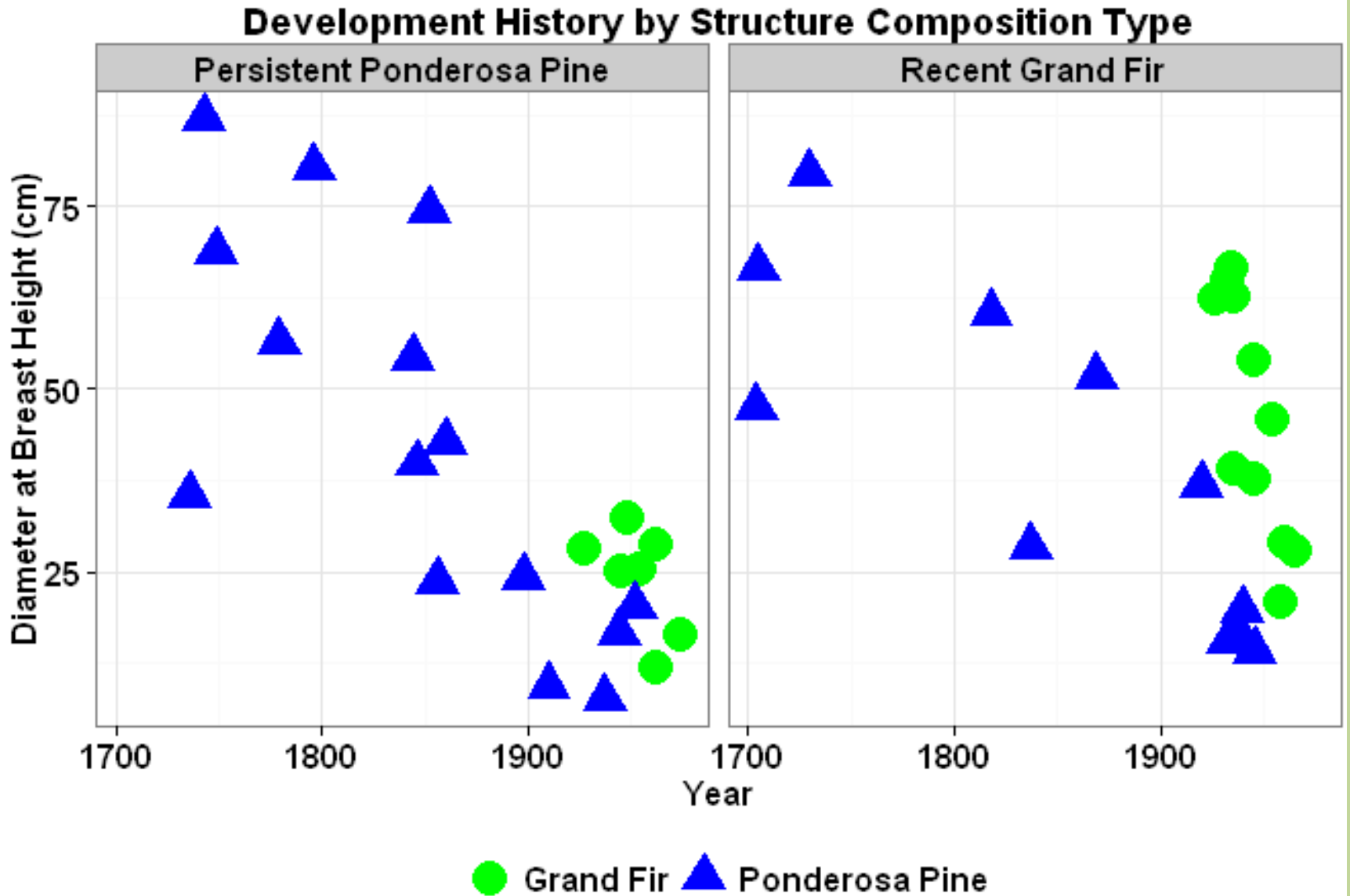
## “Moist” Recent Grand Fir



**Density-500 trees/hectare**  
**MFRI-15 years**  
**Precipitation- 30”**  
**Aspect-North**  
**ILAP PVT-Moist**  
**Local PAG-Moist Grand fir**

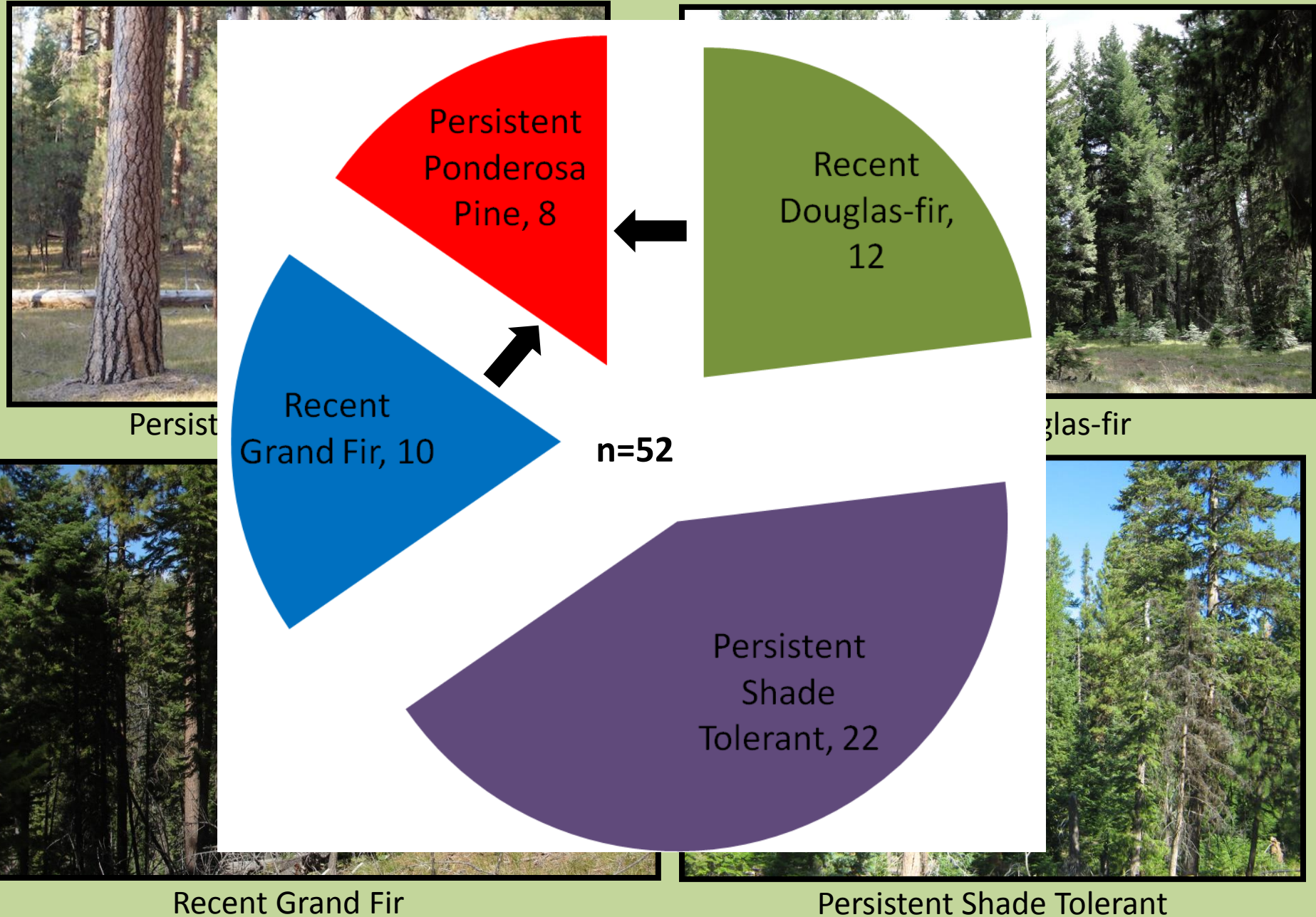


# Variation in Change



# Variation in Change in "Moist" Mixed-Conifer Forest

## *Current Structure Composition Types*





# Is there a growth response to changes in density and composition?



Photo: James Johnston



# Changing Relationship between Tree Growth and Climate

## Mt. Sheridan Study Site (Deschutes National Forest)



ILAP PVT: Moist Mixed Conifer

Species: Ponderosa Pine, Grand fir, Western white pine, Lodgepole pine

Precipitation: 43-50 inches

Elevation: 5100 ft / 1560 meters



## Conclusions / Key Messages

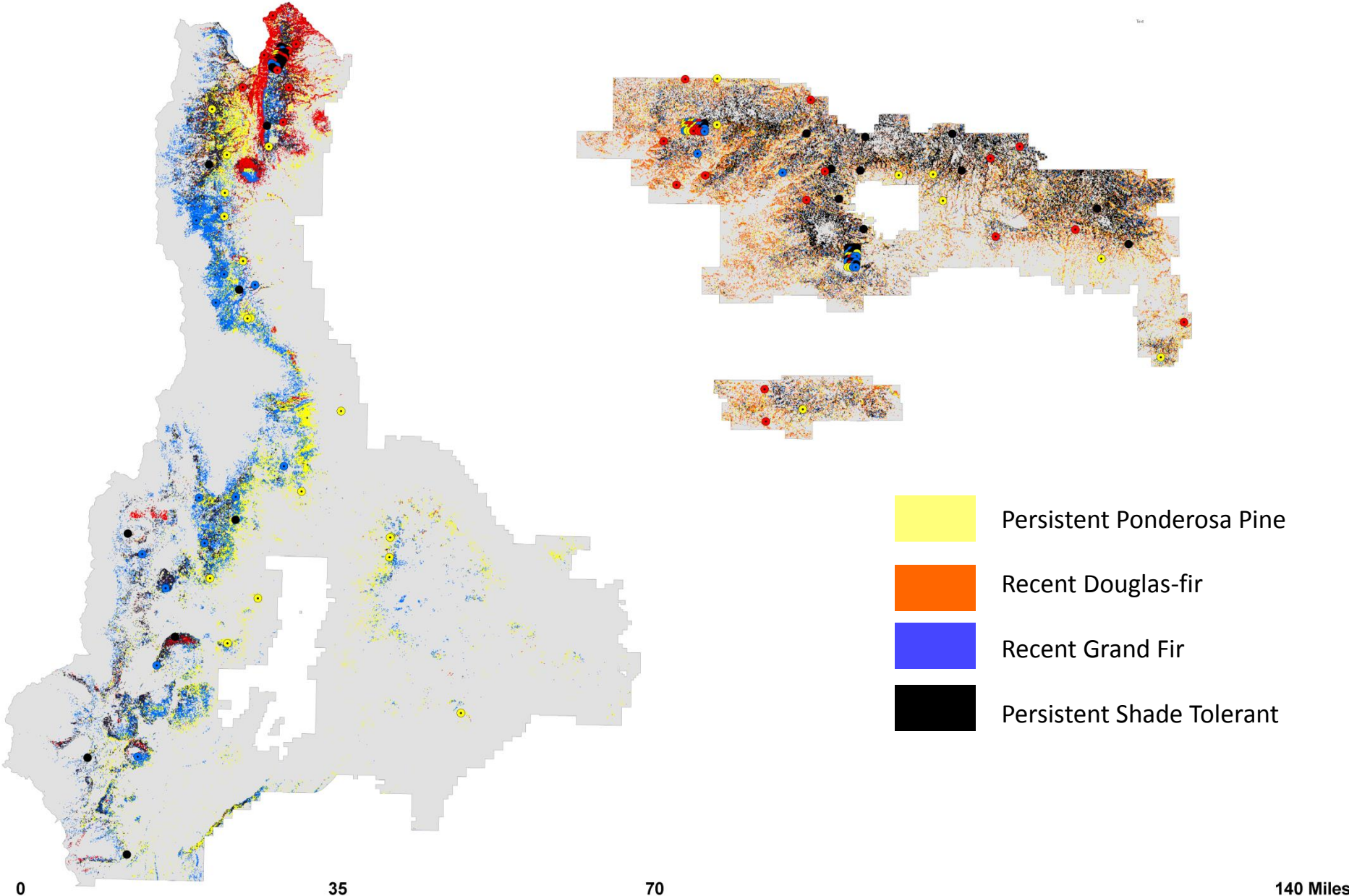
- *Changes in structure are similar in both dry and moist mixed-conifer forests*
- *PVTs may be a poor surrogate for historical disturbance regime and associated structure and composition*
- *Current structure and composition indicates historical conditions and departure*
- *Changes in composition are greatest in “moist” productive environments*
- *Decreased growth and sensitivity to climate suggest decreased resiliency to future drought and disturbance*

# End (Questions)

## Works Cited

1. Camp 1999; Age structure and species composition changes resulting from altered disturbance regimes on the eastern slopes of the Cascades Range.
2. Baker, W. L. 2012. Implications of spatially extensive historical data from surveys for restoring
3. dry forests of Oregon's eastern Cascades.
4. Everett et al. 2007; Development of current stand structure in dry fir-pine forests of eastern Washington.
5. Hagmann et al. 2014 (*IN PRESS*)
6. Hagmann et al. 2013; Historical Structure and Composition of Ponderosa Pine and Mixed-Conifer Forest in South-Central Oregon
7. Hessburg et al. 2007; Re-examining fire severity relations in pre-managment era mixed conifer forests: inferences from landscape patterns of forest structure
8. Heyerdahl et al. 2001; Spatial Controls of Historical Fire Regimes; A Multiscale Example From the Interior West, USA.
9. Heyerdahl et al. 2013; Fire Regimes in Mixed-Conifer Forest in Central Oregon
10. Merschel et al. *Accepted*; Mixed-conifer forests of central Oregon: Effects of logging and fire exclusion vary with environment
11. Perry et al 2004. Forest structure and fire susceptibility in volcanic landscapes of the Eastern High Cascades, Oregon.

# Current Structure-Composition Types in Mixed-Conifer Forest in the Deschutes and Ochoco National Forests

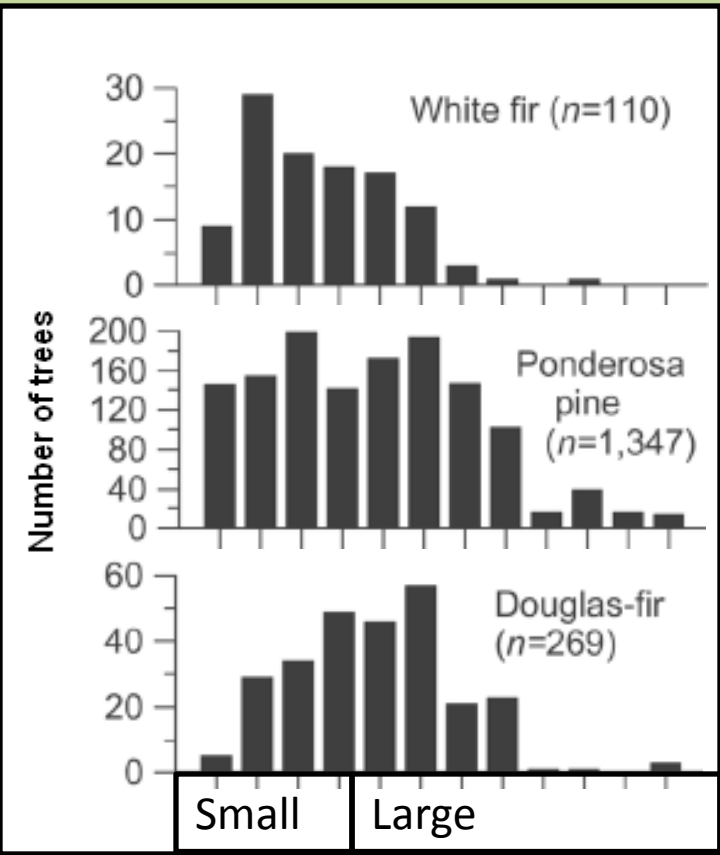




# Changes in Structure and Composition

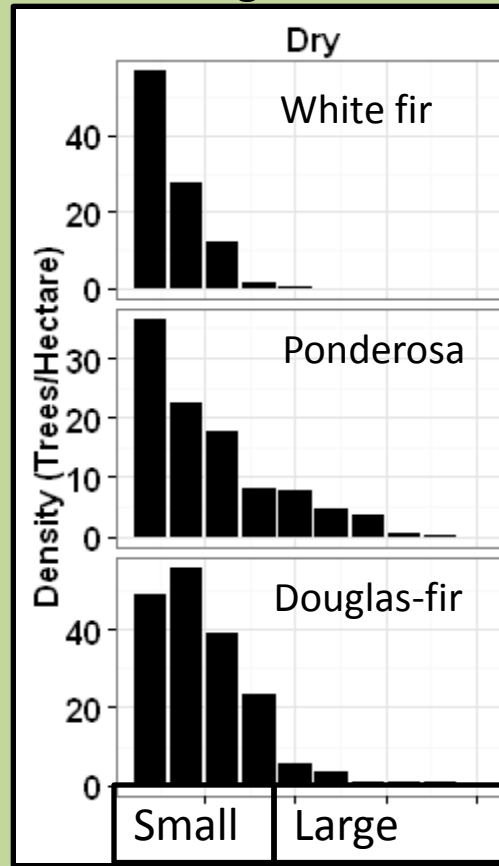
## *Diameter Distribution*

Historical (40% Large Trees)

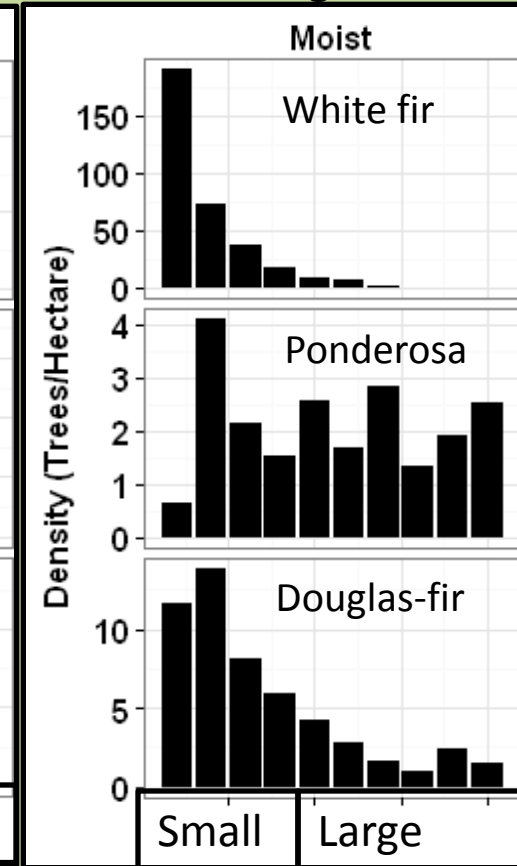


Current

7% Large Trees



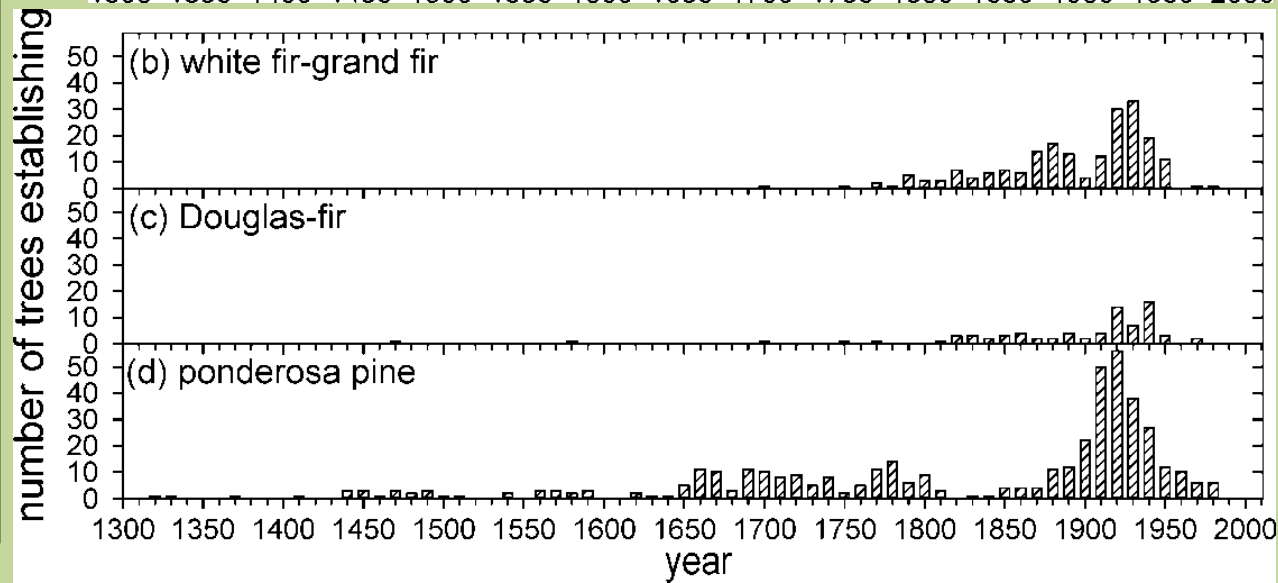
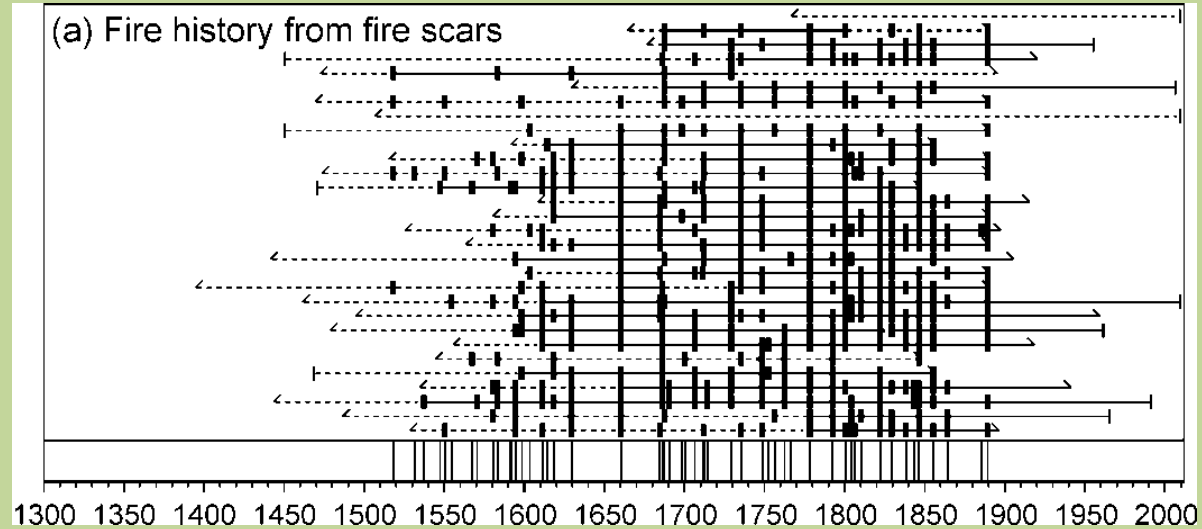
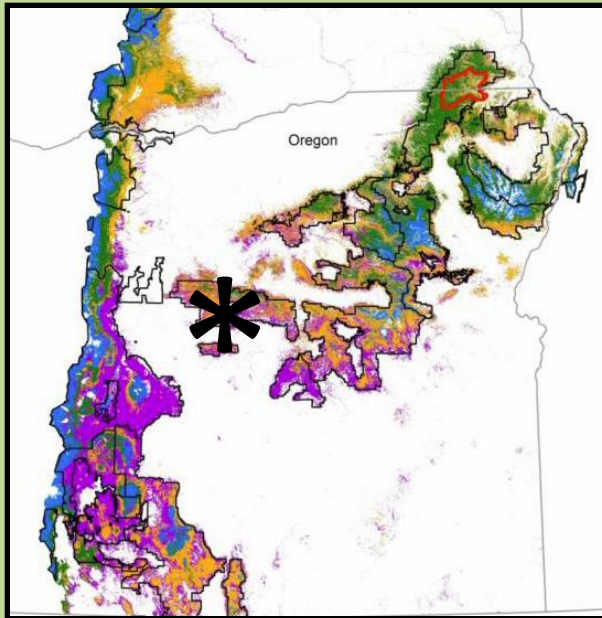
10% Large Trees



Source: Baker et. al 2012

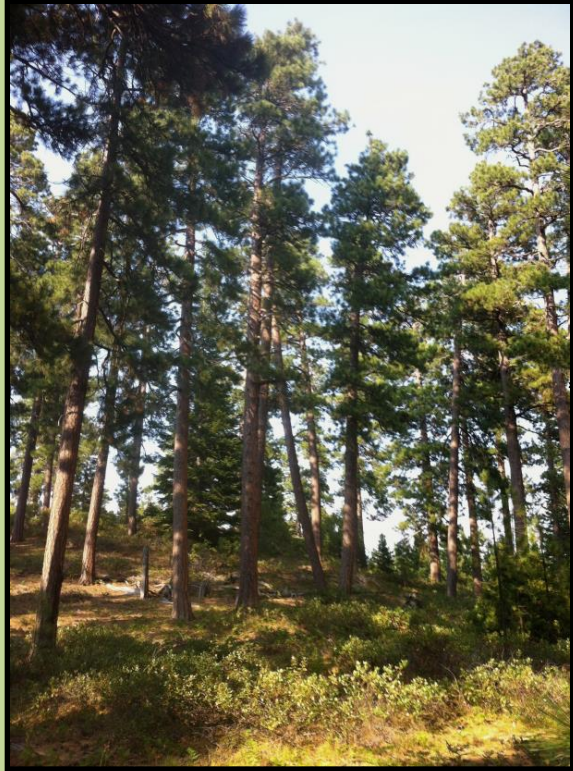
# Mechanisms of Change

## Fire Exclusion

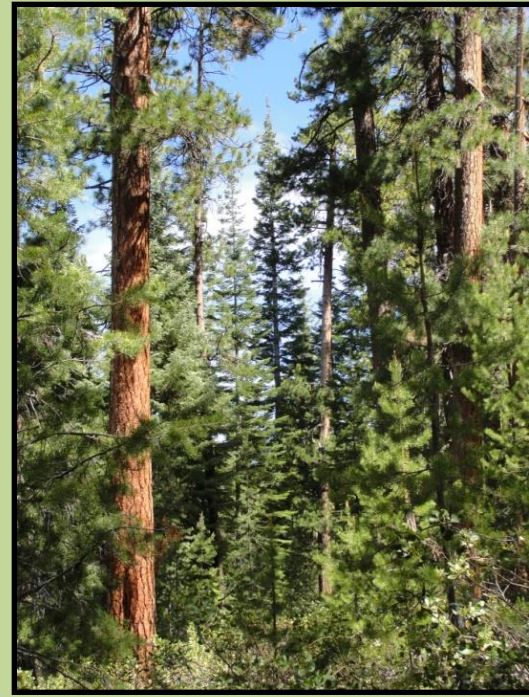


Source: Heyerdahl et al. 2001





“Dry”



“Moist”





# Distribution in Moist Mixed Conifer Forest (Eastern Cascades)



Ponderosa Pine



Recent Douglas-fir

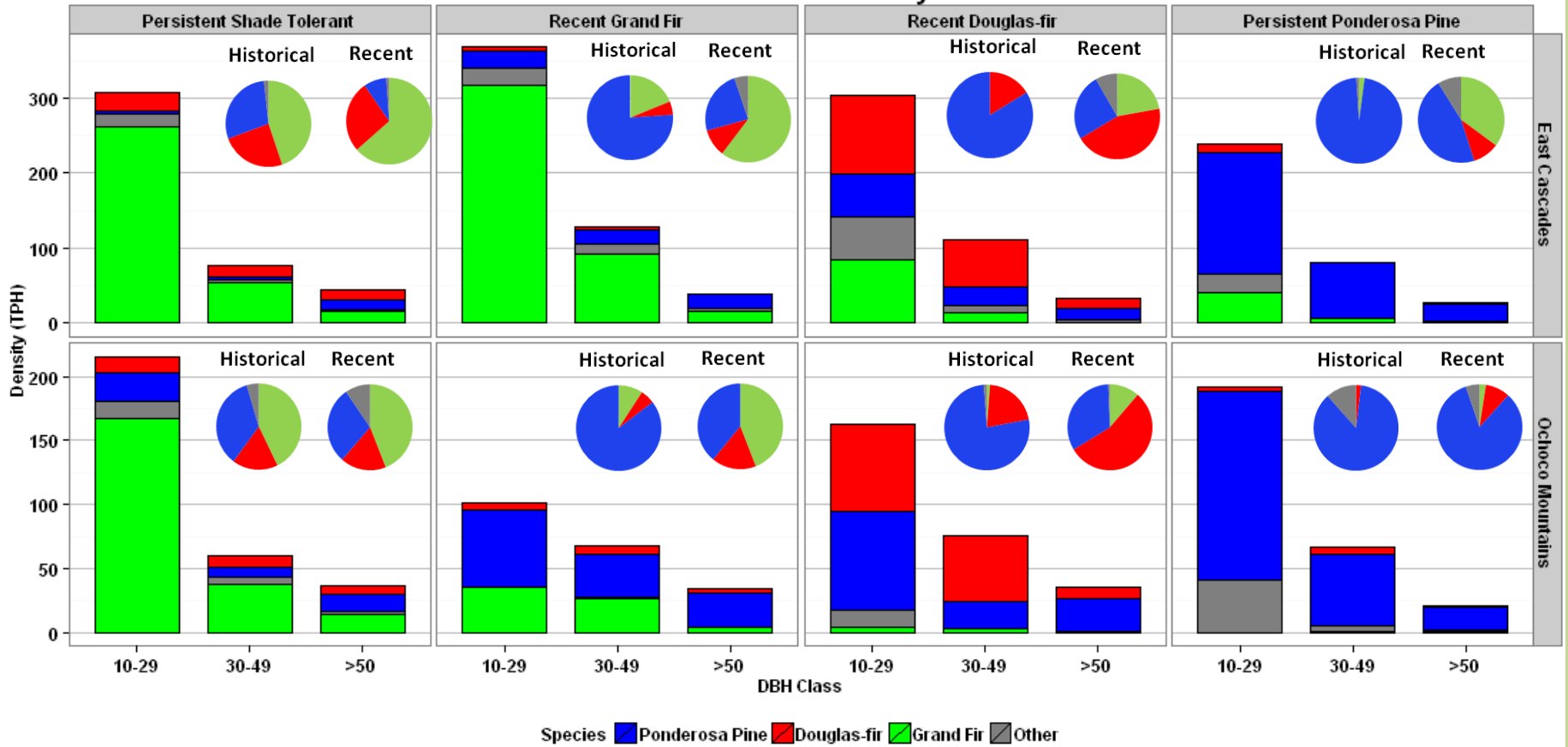


Recent Grand Fir



Persistent Shade Tolerant

### Current Tree Density





# Distribution of Current Structure-Composition Types among Existing Potential Vegetation Types

**Table 3. Current Structure Composition Types vs. ILAP Potential Vegetation Types - East Cascades**

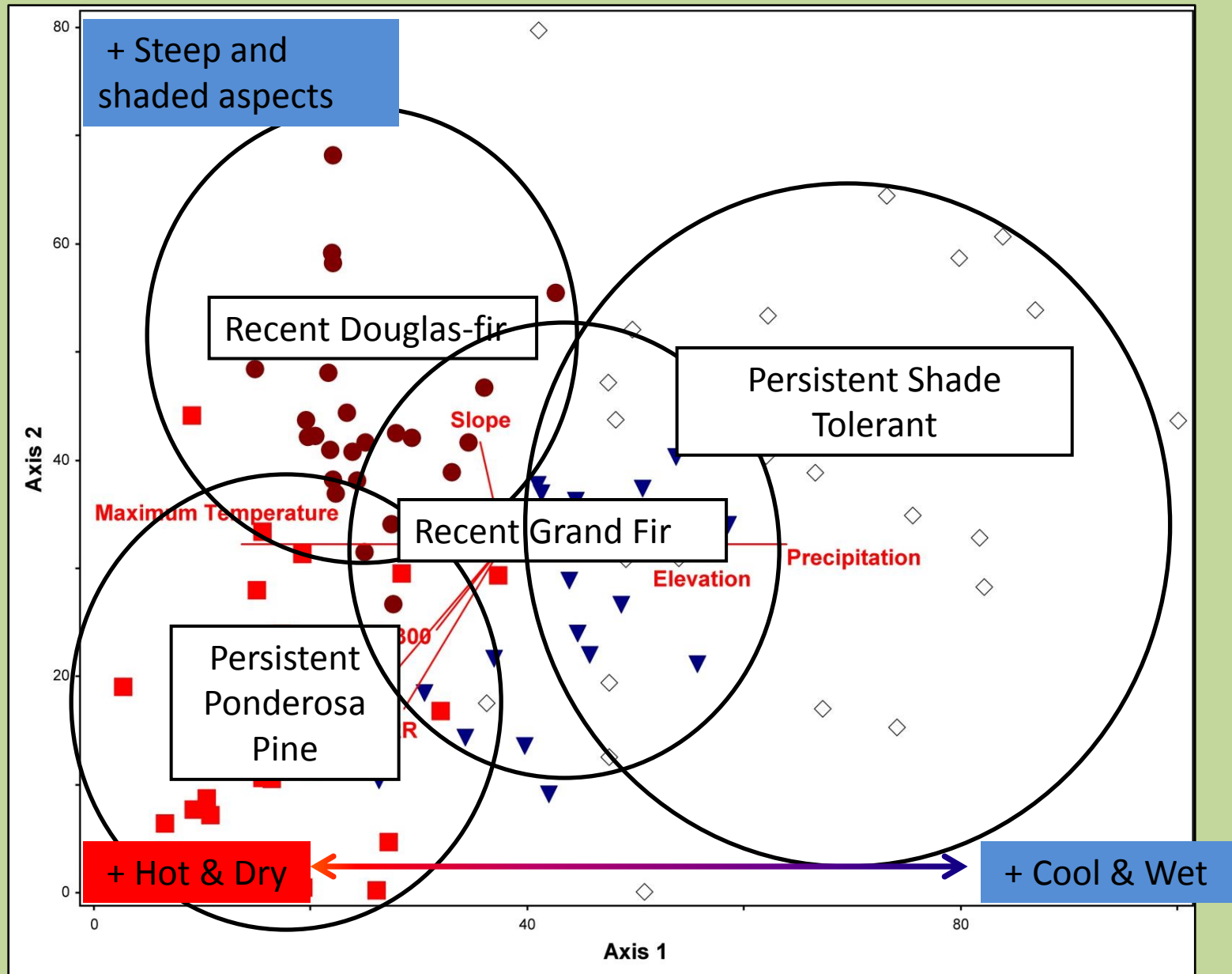
ILAP PVT → Current Forest Type ↓	Ponderosa pine - Dry, with juniper	Ponderosa pine - Lodgepole pine	Mixed Conifer Dry	Mixed Conifer Moist	Mountain hemlock Cold/Dry	Total By Current Forest Type ↓
Ponderosa Pine	1	2	7	8	0	18
Recent Douglas-fir	0	0	2	12	0	14
Recent Grand fir	0	0	5	10	1	16
Persistent Shade Tolerant	0	0	1	22	1	24
<b>Total By ILAP PVT →</b>	<b>1</b>	<b>2</b>	<b>15</b>	<b>52</b>	<b>2</b>	<b>72</b>

**Table 4. Current Structure Composition Types vs. ILAP Potential Vegetation Types - Ochoco Mountains**

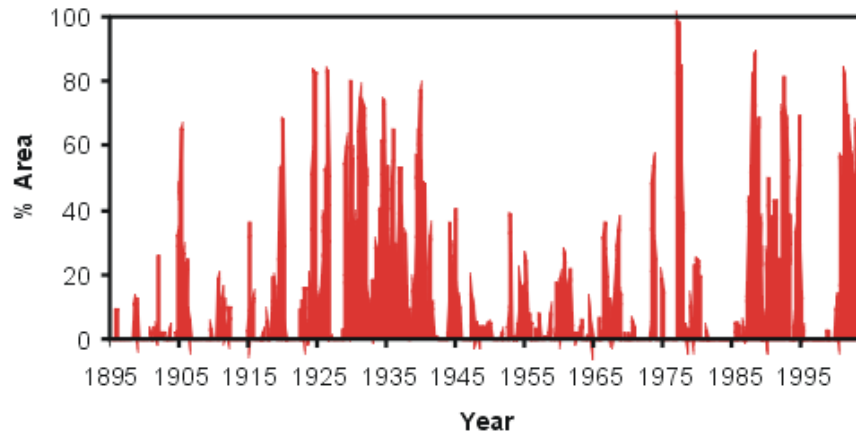
ILAP PVT → Current Forest Type ↓	Ponderosa pine Dry, with juniper	Ponderosa pine Xeric	Douglas-fir Dry	Grand fir Warm/Dry	Grand fir Cool/moist	Total By Forest Type
Ponderosa Pine	4	8	6	5	0	23
Recent Douglas-fir	2	6	10	6	2	26
Recent Grand Fir	5	3	2	7	2	19
Persistent Shade Tolerant	0	3	2	18	3	26
<b>Total By ILAP PVT</b>	<b>11</b>	<b>20</b>	<b>20</b>	<b>36</b>	<b>7</b>	<b>94</b>

Tables 3 and 4 demonstrate the range of existing structure and composition within ILAP potential vegetation types. Structure-composition types are not intended to overlap with classifications based on potential vegetation.

# Mixed-Conifer Stand Types and Environmental Setting



### Percent Area of the Pacific Northwest Basin Experiencing Severe to Extreme Drought January 1895–March 2004



Source: National Drought Mitigation Center



# Current vs. Historical Conditions in Eastside Moist Mixed-Conifer Forest

Andrew Merschel: Oregon State University

## Overall Goals for the Conference

- Review the latest research findings on moist mixed-conifer forests using the Science Synthesis as a framework
- Determine areas of agreement and disagreement and identify further studies to fill knowledge gaps.

## Goals for my session

- Determine departure from historical conditions in moist mixed-conifer forest and potential consequences of these changes
- What scale and types of treatments will emphasize ecological benefits and restore “proper function” in moist mixed conifer forest

Definition of Moist Mixed-Conifer Forest-. Moist mixed-conifer forests cover a large area east of the Cascade where grand fir and Douglas-fir are the dominant late successional tree species. The moist mixed-conifer forest can be considered intermediate between drier conifer forests where pine was dominant and fire was typically frequent and low in severity, and wetter or cooler mixed-conifer forests where fire was less frequent and burned at higher severities.