Assessing the Work of Wildfires and Identifying Post-fire Management Needs

Science Team

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Funding and Cooperators

"Landscape Evaluations and Prescriptions for Post-Fire Landscapes"

Joint Fire Science Program Project 16-1-05-24

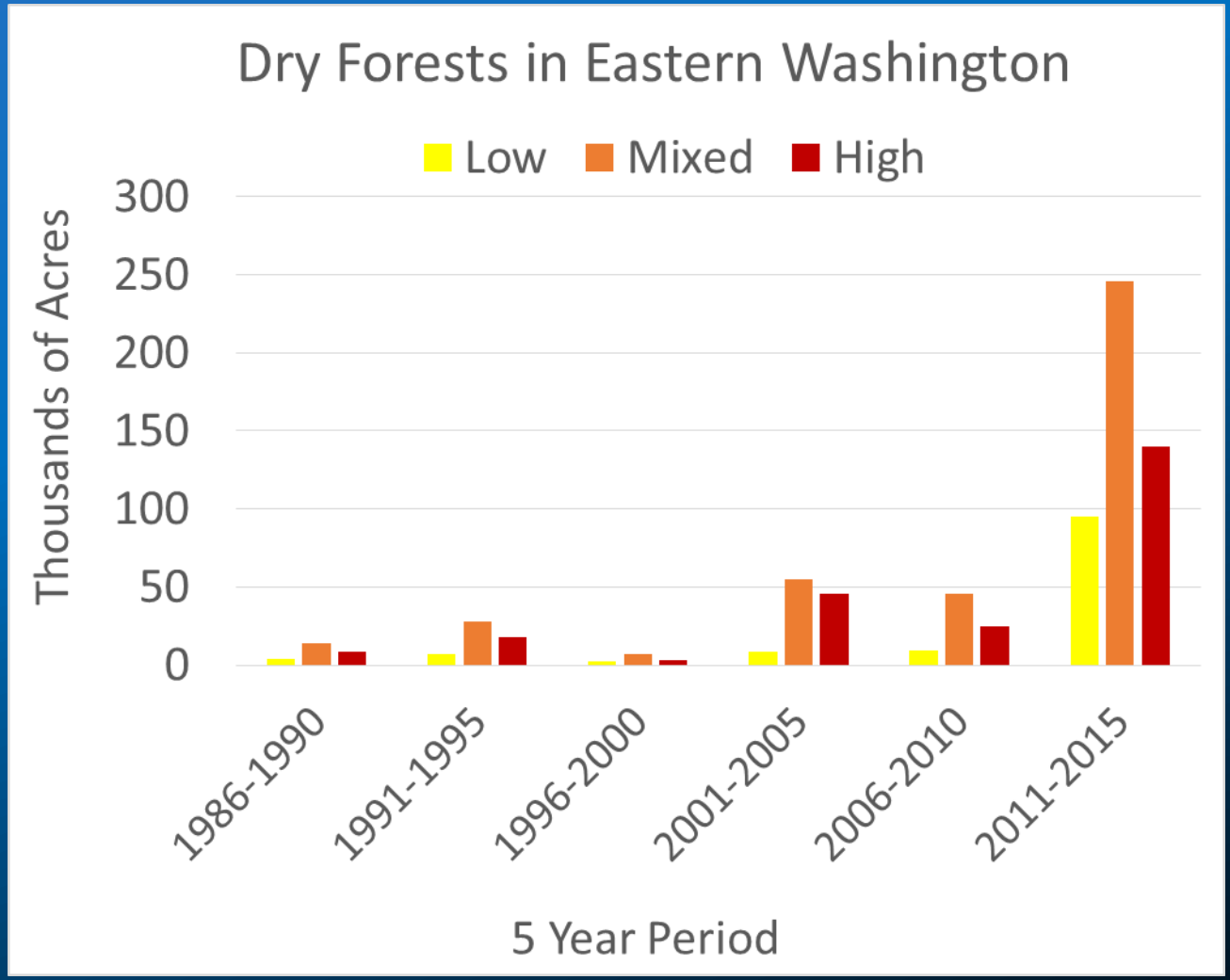
Field sampling

- Colville National Forest
- Okanogan-Wenatchee National Forest

Evaluating the work of wildfires

➔ Wildfires affect far more acres than mechanical & Rx fire.

➔ Burn severity & total acres burned are increasing



Evaluating the work of wildfires

- ➔ Fires are reducing fuels, thinning forests, shifting species composition.
- ➔ Buying us time, advancing progress towards goals

Evaluating the work of wildfires

- ➔ Increasing high-severity patch sizes
- ➔ Loss of dense forest and large trees

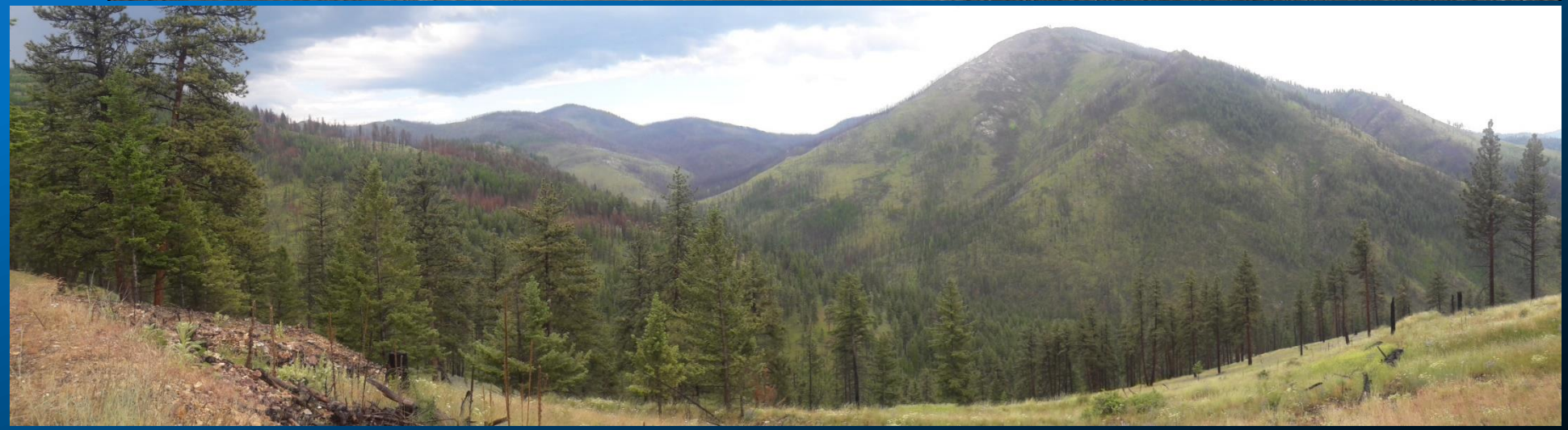
Evaluating the work of wildfires

➔ Are fires restoring mosaics of forest, woodland,& non-forest?

➔ When, where & what is post-fire mgmt. needed to…?

Finish the beneficial work of fire

Correct where fire overshot



Evaluating the work of wildfires

- Landscape restoration principles to evaluate work of wildfire
- Evaluate the drivers of fire severity and post-fire forest development→ Including the role of past management and disturbance
- Demonstrate a landscape evaluation of fire Fx and post-fire landscape Rx
  - Identify the landscape goals to which individual patches contribute
  - Where, if, how and when to treat individual patches

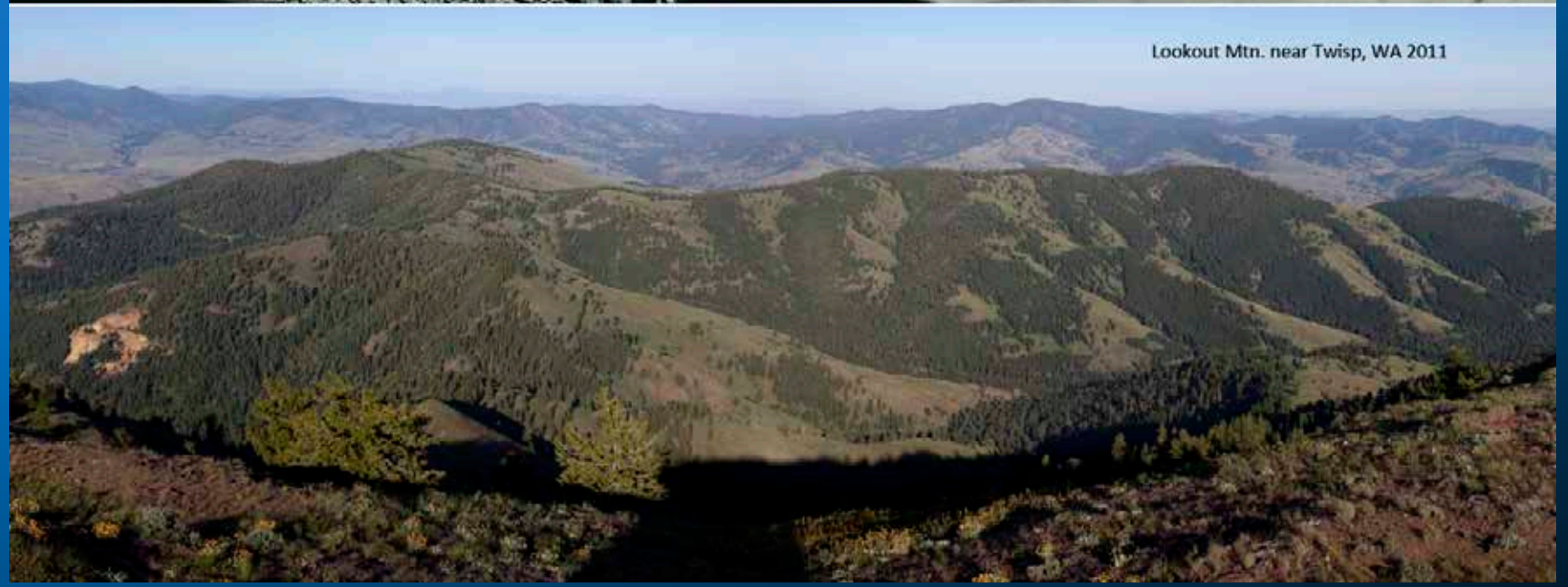
Landscape Principles for Evaluating the **WORK** of Wildfires

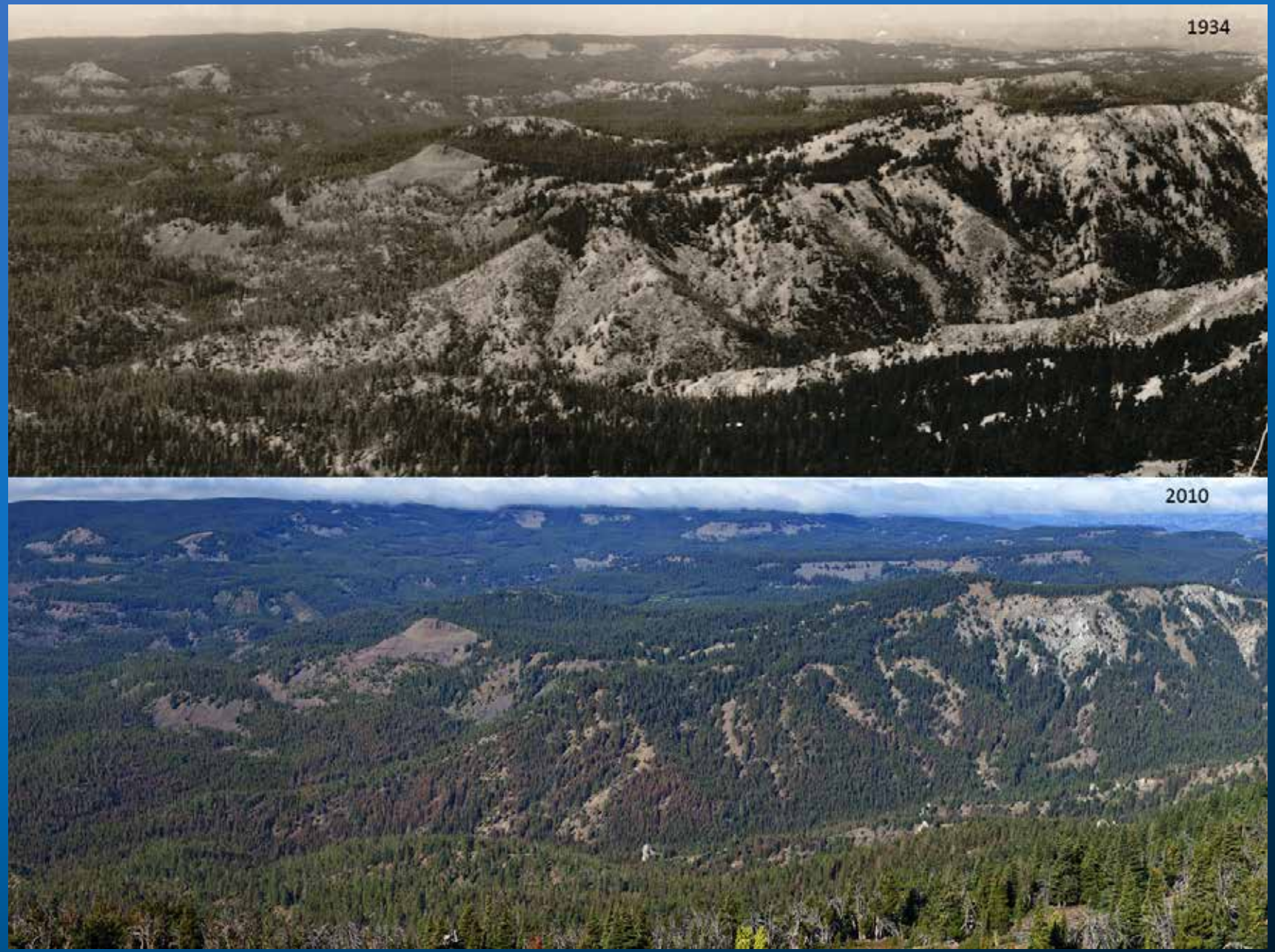
1936

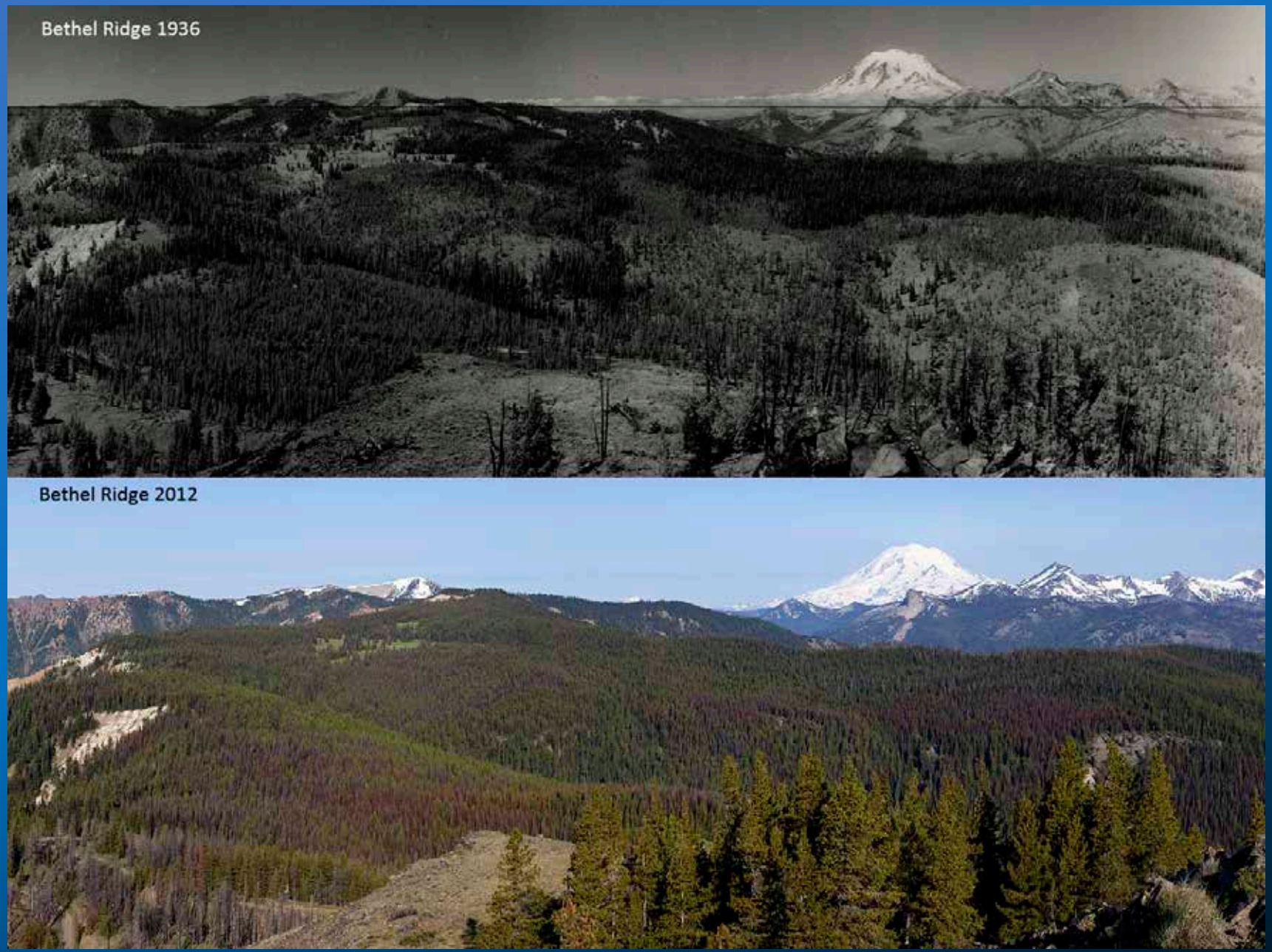
2018

Paul Hessburg, USDA-FS, PNW Research Station


Lookout Mtn. near Twisp, WA
1930


Lookout Mtn. near Twisp, WA 2011


1934
2010


Bethel Ridge 1936
Bethel Ridge 2012

Primary Change Agents:

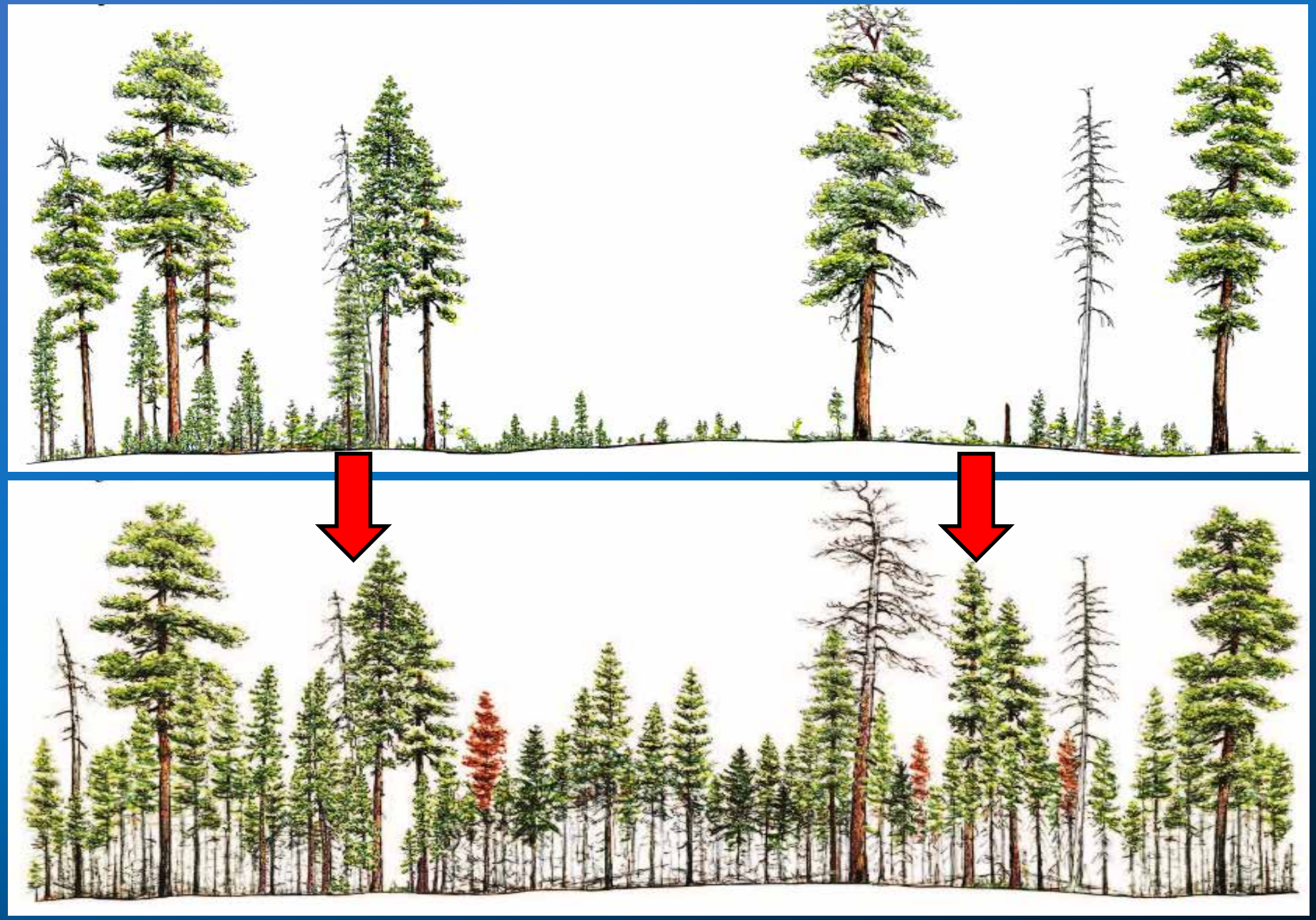
Timber harvest – CC & selection cutting

Fire exclusion – grazing, development, suppression

Climate change – warmer, drier, windier

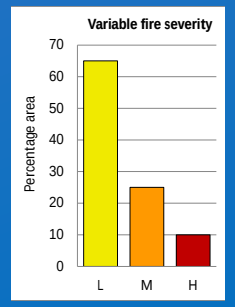
In seasonally dry forests, fires continually thinned out trees, reducing density/fuels, favored larger trees

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



SHIFTING FIRE REGIMES

Historical



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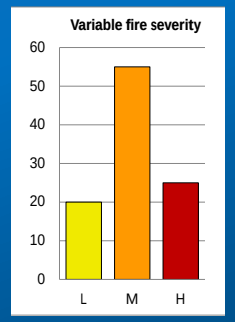
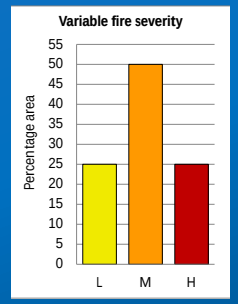
Current



Historical



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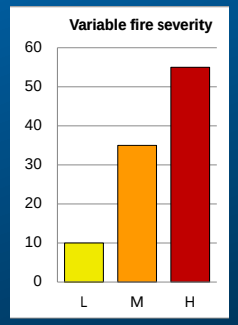
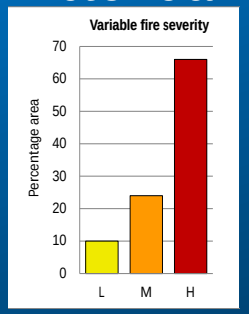
Current



Historical



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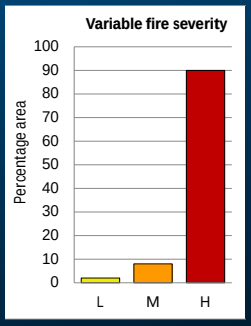
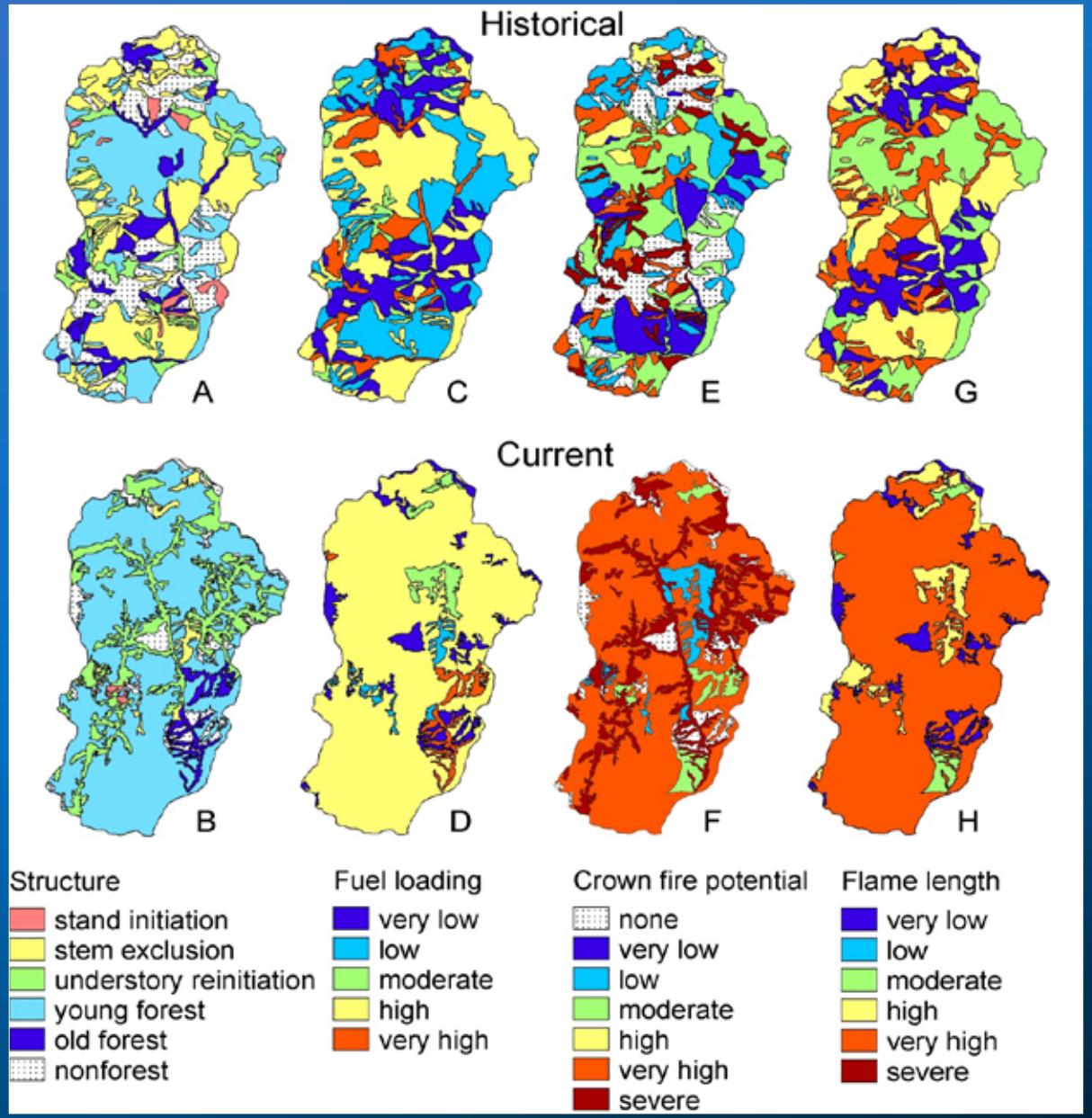
Current



Example from Blue Mtns



Landscape Ecol (2015) 30:1805–1835
DOI 10.1007/s10980-015-0218-0

REVIEW ARTICLE

Restoring fire-prone Inland Pacific landscapes: seven core principles

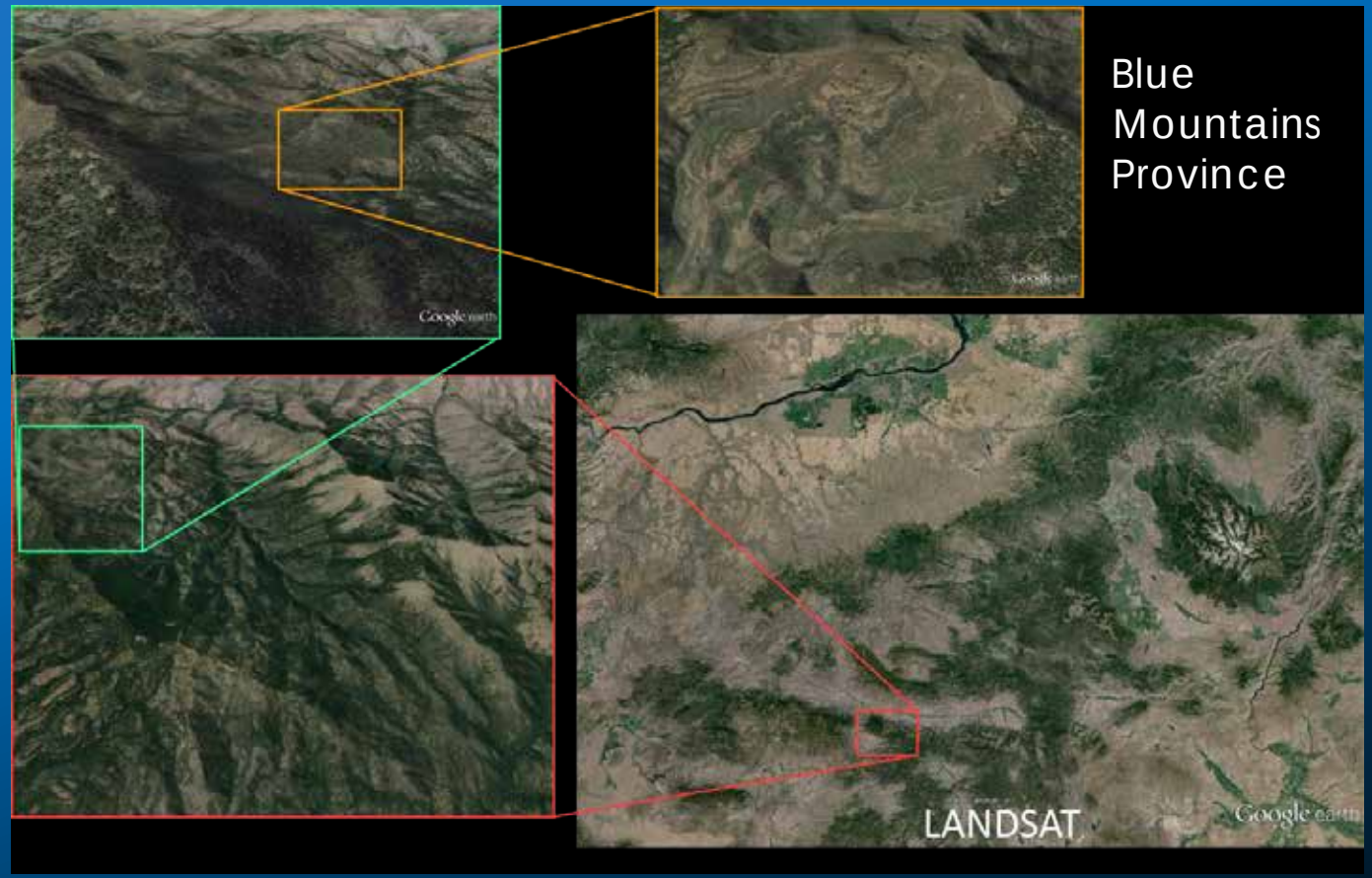
Paul F. Hessburg · Derek J. Churchill · Andrew J. Larson · Ryan D. Haugo · Carol Miller · Thomas A. Spies · Malcolm P. North · Nicholas A. Povak · R. Travis Belote · Peter H. Singleton · William L. Gaines · Robert E. Keane · Gregory H. Aplet · Scott L. Stephens · Penelope Morgan · Peter A. Bisson · Bruce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

Here, we evaluate wildfires as potentially restorative & adaptive treatments, asking – did they do good work? How so?

Landscape Restoration: Principle 1

Resilient regional landscapes exist at several levels of organization

Tree clump & gap patchworks



Forest successional patchworks

Nonforest-forest patchworks

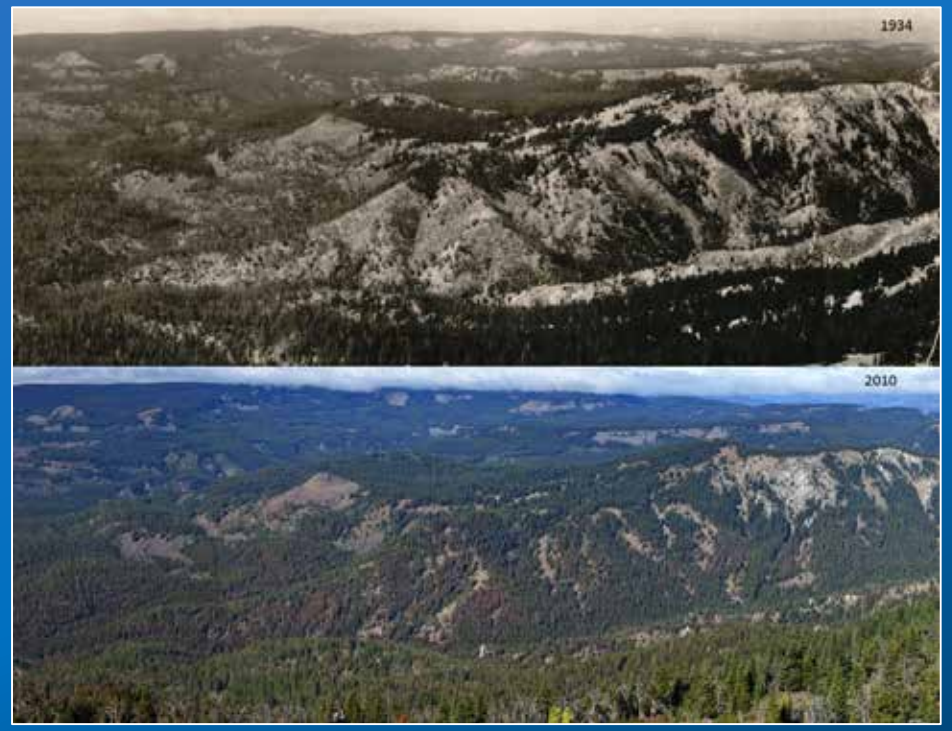
Did wildfires adapt patchworks at each level to the coming climatic & wildfire regimes?

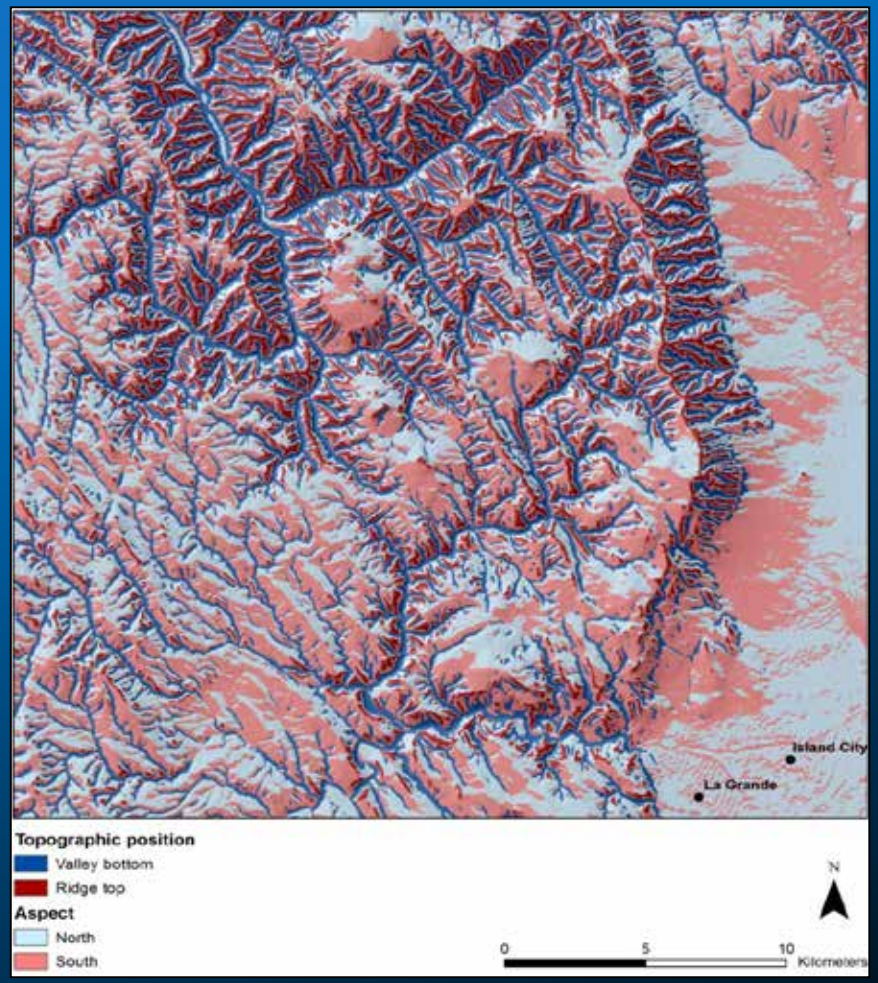
Landscape Restoration: Principle 2

Topography provide a natural template for restoring vegetation & habitat patterns

…soils

…landforms

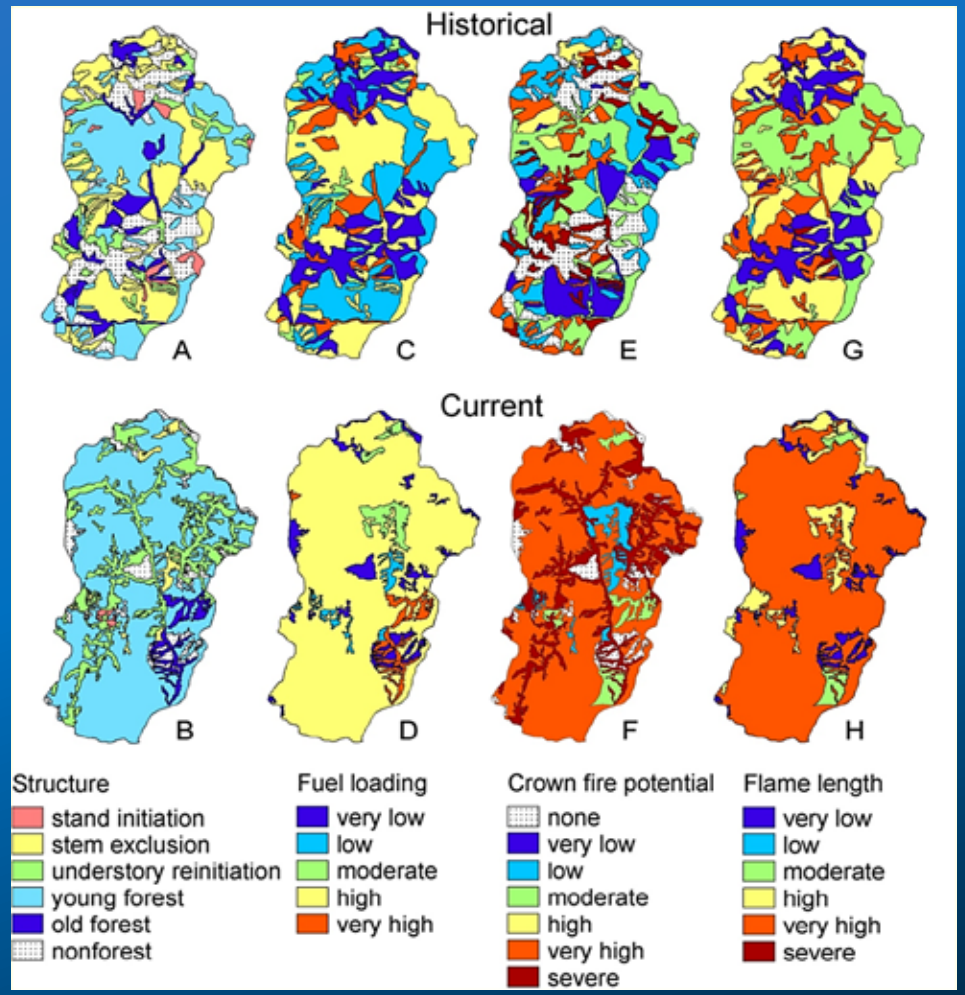




Did wildfires tailor characteristic forest age, species, density, & lifeform patterns to the landscape?

Landscape Restoration: Principle 3

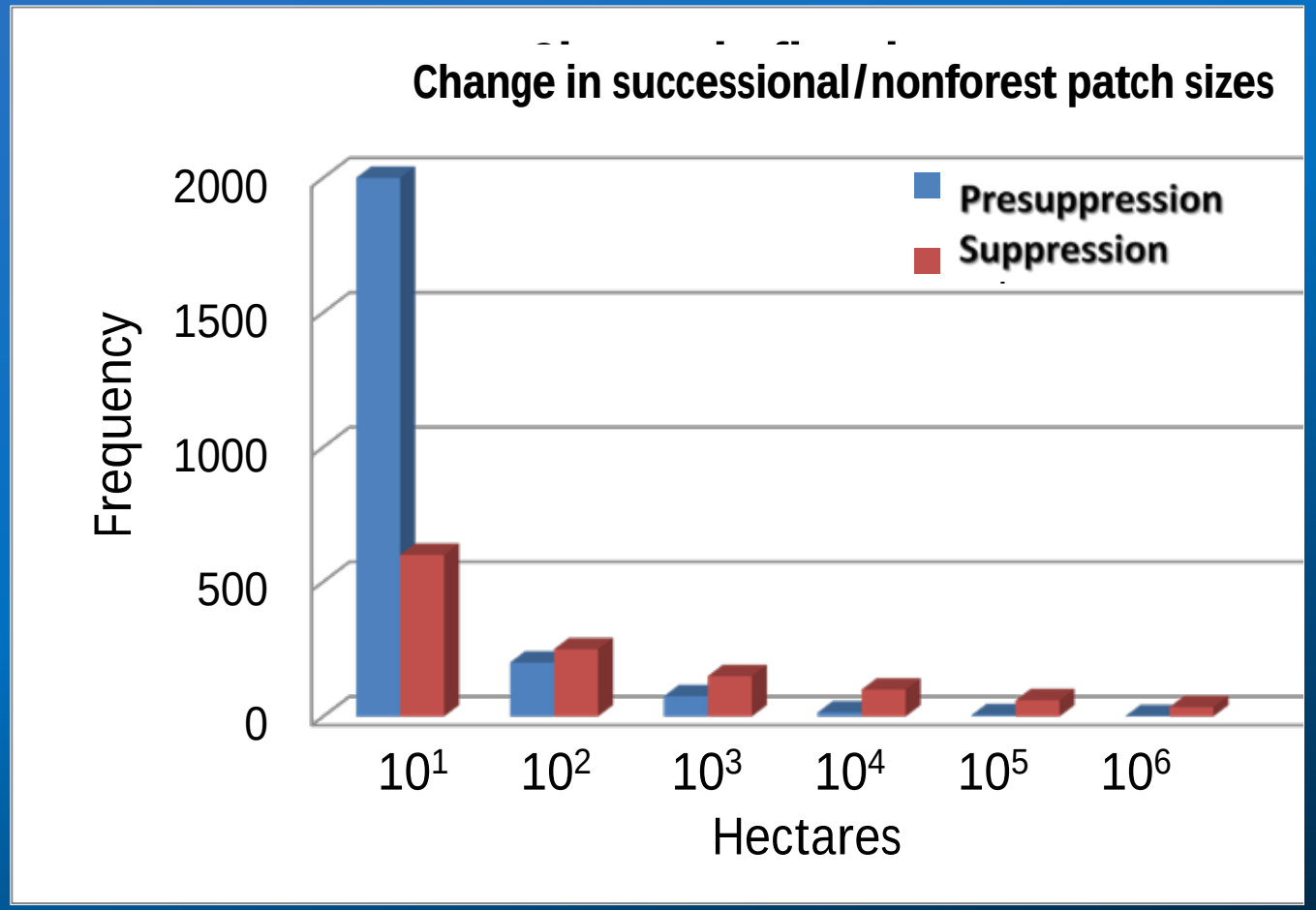
Fire history-forest succession-climate interactions drive the dynamics of the system



Did wildfires re-align successional patterns in support of future climatic/wildfire regimes?

Landscape Restoration: Principle 4

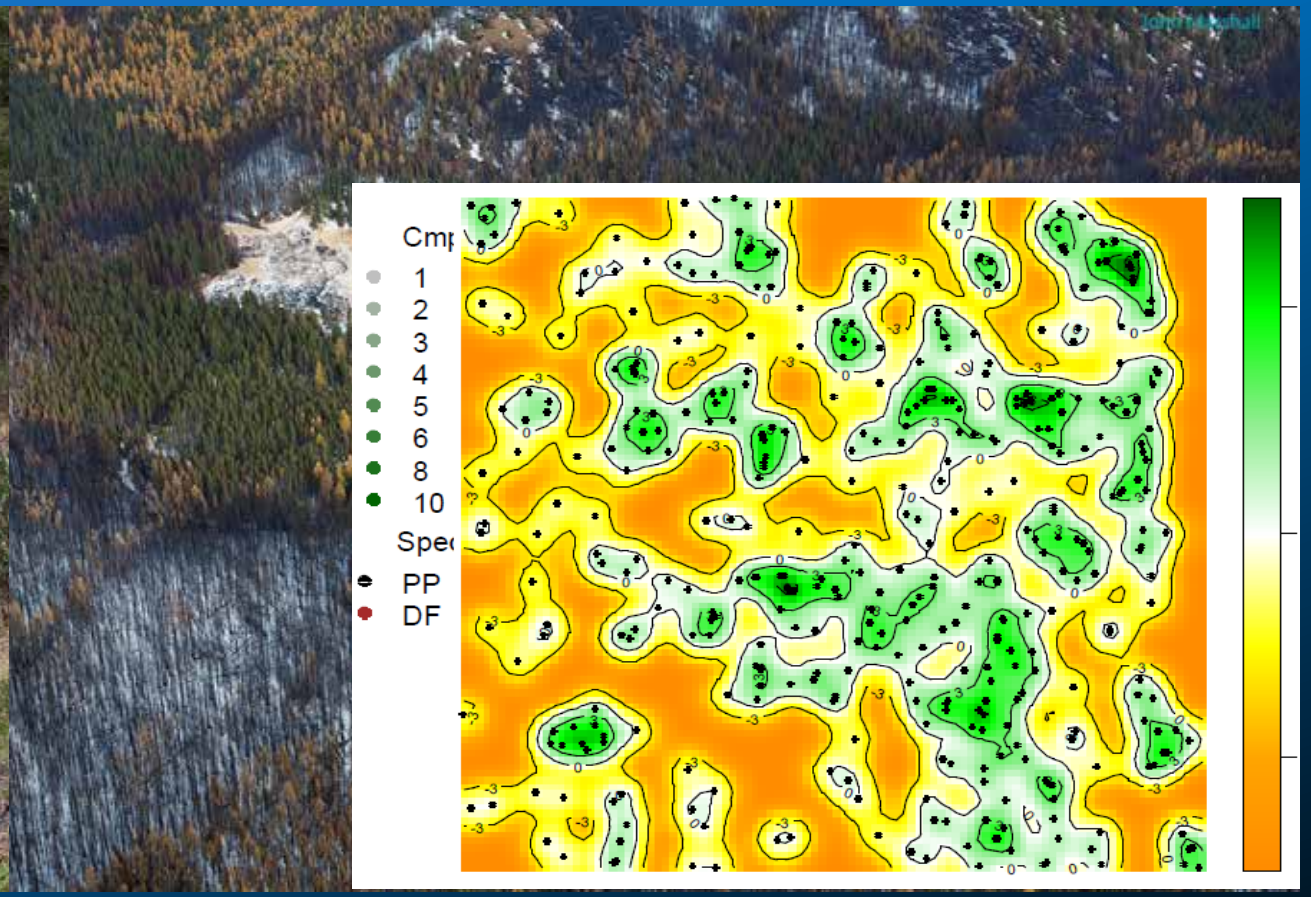
Predictable patch size distributions historically emerged from **climate-fire-topo-veg** interactions



Did the wildfires re-align size distributions of open vs. closed canopy, large vs. small tree, nonforest-forest patches with those that would be expected under changing climatic/wildfire regimes?

Landscape Restoration: Principles 5 & 6

Widely distributed medium & large-sized, older trees provide a critical backbone to seasonally dry mixed-conifer landscapes



Did wildfires thin out smaller trees and restore more characteristic tree clump and gap sizes?

We used these principles as context to evaluate **THE WORK OF WILDFIRES** in NE WA

Thank you!

Acknowledgments
John Marshall (photos)
Brion Salter (maps)
Bob Van Pelt (drawings)

Fire severity & forest structure in Northeastern Washington

First fires, reburns,
& pre-fire and post-fire treatments

Dr. C. Alina Cansler

NEWFIRE Research Questions:

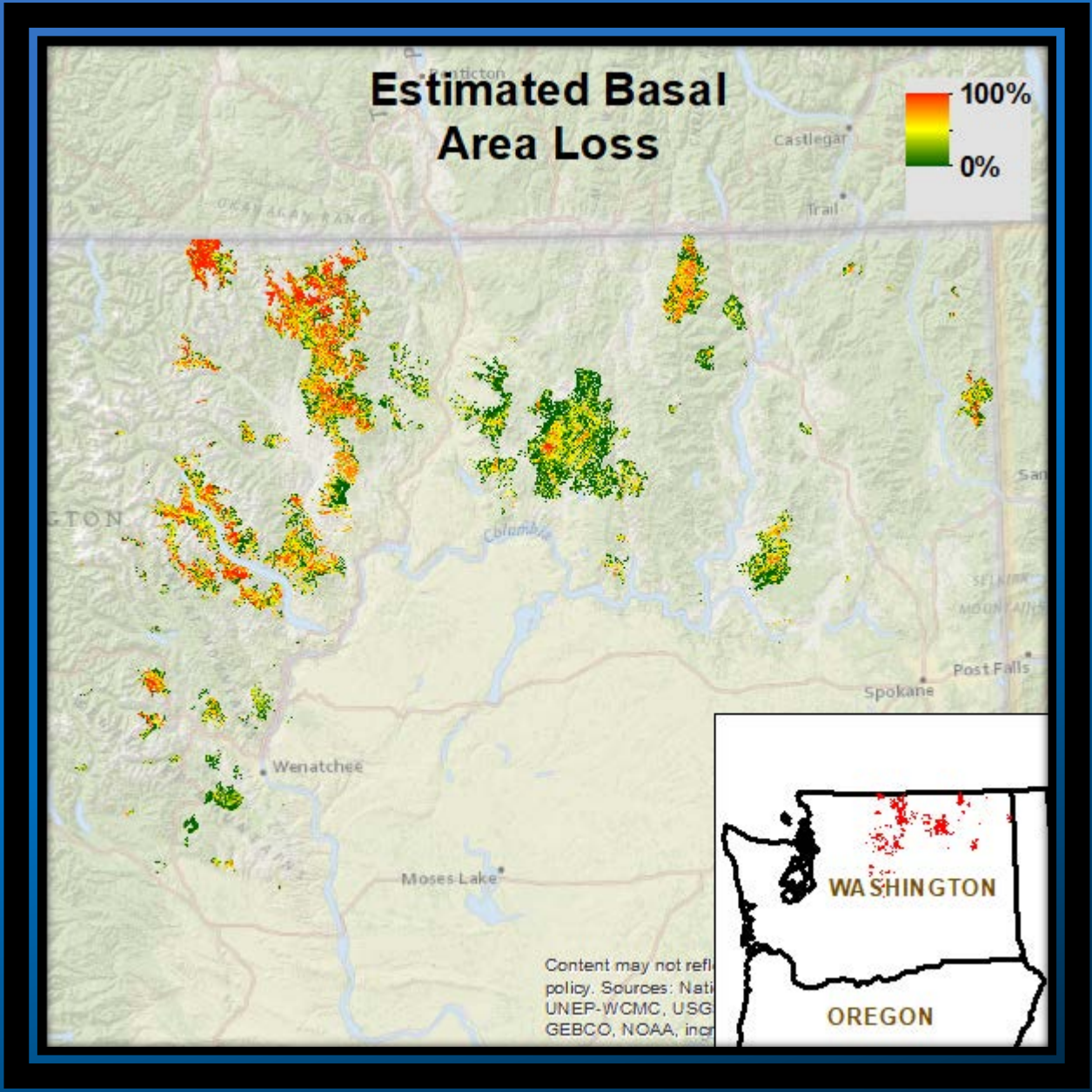
Fire severity

- What controls fire severity in
  - Areas burned once from 2001-2016?
  - Reburns of fires from 1984-2015, that occurred from 2001-2016?
- Do management actions influence fire severity?
  - Pre-fire management?
  - Post-fire pre-reburn management?

Forest structure

- How does forest structure differ by fire severity class?
- Do post-fire treatments—including salvage, thinning, and planting—have different stand structure than burned areas?

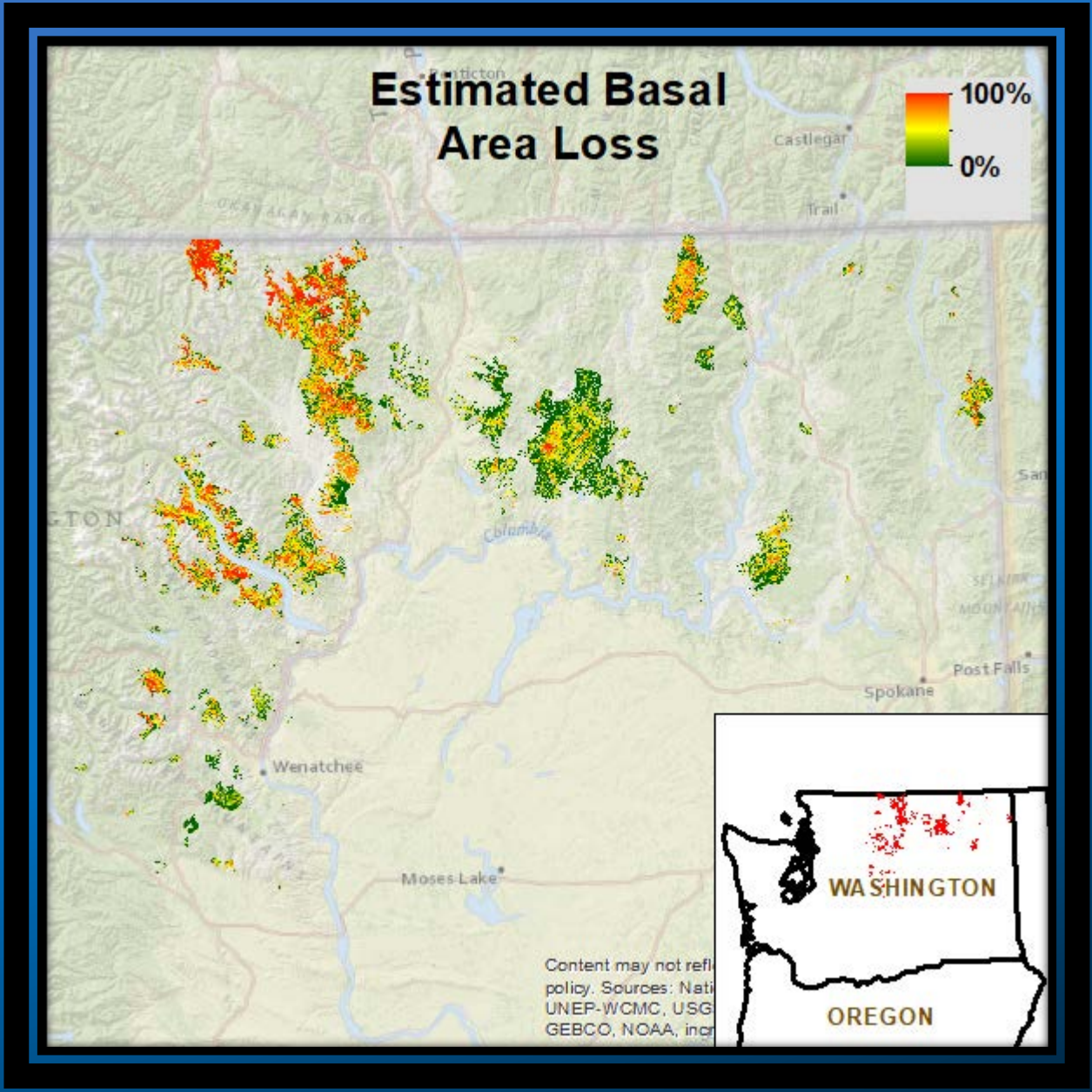
What controls fire severity?



Response data:

- Study area: forests of northeastern Washington state
- We considered all fires >120 ha from 2001-2016
  - 131 unique fires covering 445 thousand hectares
- “First fires”: burned once since 1984
- “Reburns” burned twice since 1984, with second fire after 2001

What controls fire severity?



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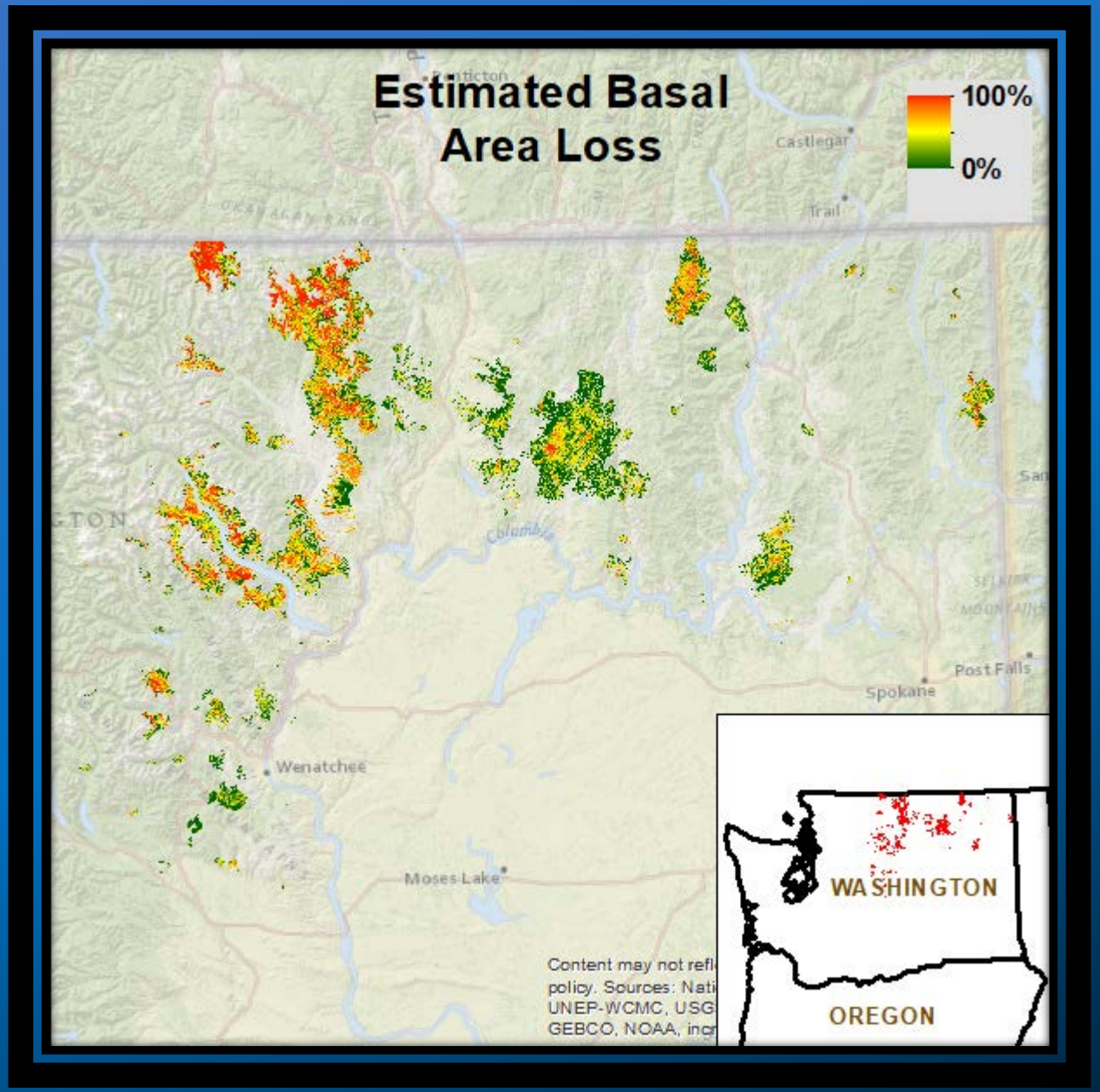
What controls fire severity in “first fires”?

Predictor data: 25 potential covariates

- **Daily fire weather (8)**
  - We used Modis satellite data to estimate day of burning for each location within each fire, in order to use daily weather data (GRIDMET): Wind, VPD, 100 & 1,000 fuel moisture, min humidity, max humidity
- **Yearly climate variability (4)**
  - For antecedent weather, we used weather data from PRISM for the year up to the fire, compared to 30-year normals for that location (PRISM): precipitation, mean temperature, minimum VPD, maximum VPD
- **Biophysical setting (7)**
  - 30-year climate normals (PRISM): climatic water deficit, actual evapotranspiration
  - Topographic metrics: Topographic position index at 500 m and 2000 m scales, aspect, slope
  - “Fire resistance” of conifer species community from Stevens et al. (2019), based on raster of estimated BA of conifer species (Wilson et al. 2013)
- **Forest structure (5)**
  - From GNN (lemma.forestry.oregonstate.edu/data): Basal area, canopy cover, quadric mean diameter, DDI

What controls fire severity in “reburns?



Predictor data

- **Previous fires**
  - Maximum previous BA loss (based on RdNBR)
  - Time since last fire

		First fires			Reburns		
Category	Variable	High	Restorative	Refugia	High	Restorative	Refugia
		Error = 0.23	Error = 0.38	Error = 0.23	Error = 0.23	Error = 0.32	Error = 0.31
Daily fire weather	Energy release component						
	Fuel – 1,000 hr.						
	Vapor pressure deficit						
	Fuel – 100 hr.						
	Min humidity						
	Burning index						
	Max - humidity						
	Wind speed						
Biophysical setting	Climatic water deficit						
	Slope						
	Topo. position index 2000 m						
	Fire resistance						
	Actual evapotranspiration						
	Aspect						
Yearly climate variability	Temperature mean						
	Vapor pressure deficit max						
	PPT						
	Vapor pressure deficit min						
Structure veg.	Basal area						
Previous fires	Maximum previous BA loss						
	Time since last fire						

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Yearly climate variability	Temperature mean						
	Vapor pressure deficit max						
	PPT						
	Vapor pressure deficit min						
Structure veg.	Basal area						
Previous fires	Maximum previous BA loss						
	Time since last fire						

1. High-severity fire is more accurately predicted
2. Daily fire weather, and yearly climate variability were consistently important
    1. Fire weather: ERC, 1000-hr fuel moisture
    2. Yearly climate variability: precipitation
3. Previous fire severity and time since last fire were important in reburns
4. Forest structure variables (GNN) were not useful, with the exception of basal area
5. CWD, AET, and “Fire resistance score” were important, but interchangeable

What controls fire severity in areas burned a second time since 1984?

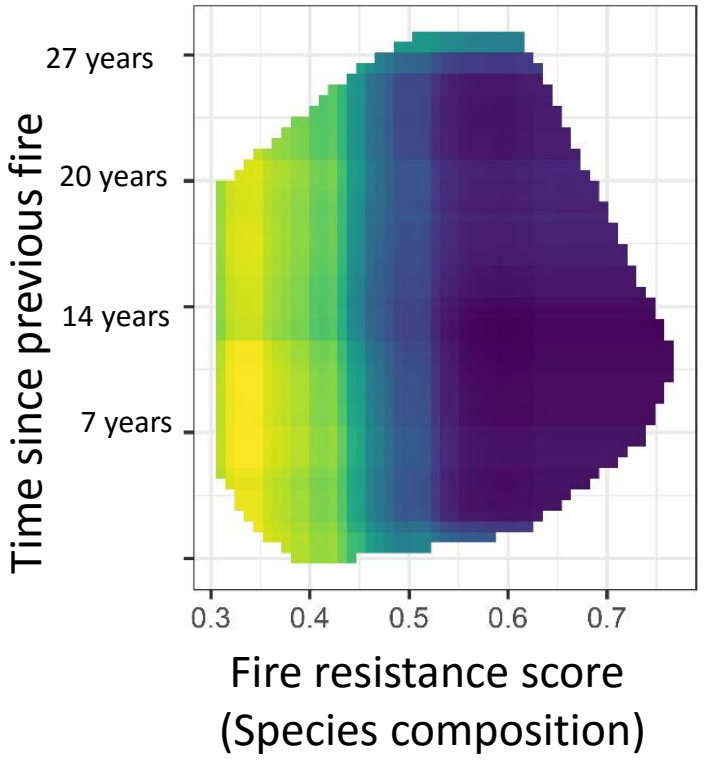
Response data:

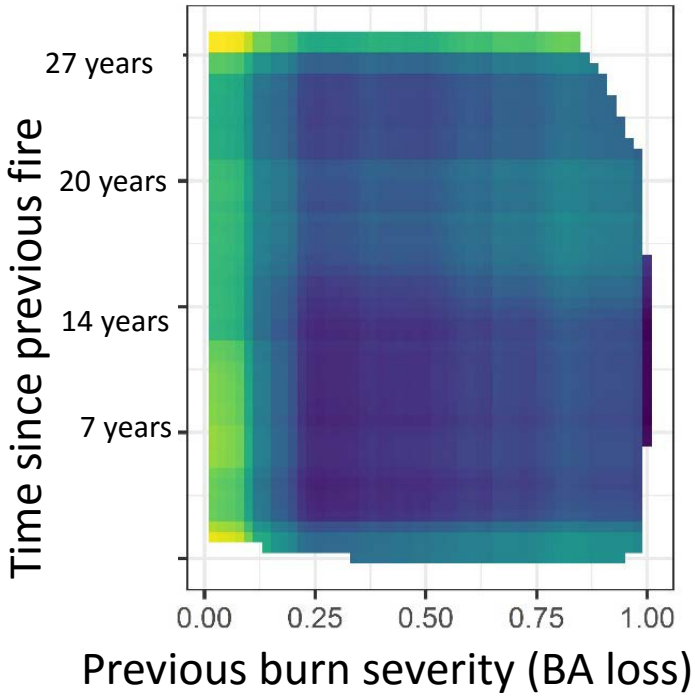
- Areas burned 1984-2015, then reburned 2001-2016
- Predicting severity of second fire

What controls fire severity in areas burned a second time since 1984?

Yellow = high severity more likely

Blue = high severity less likely



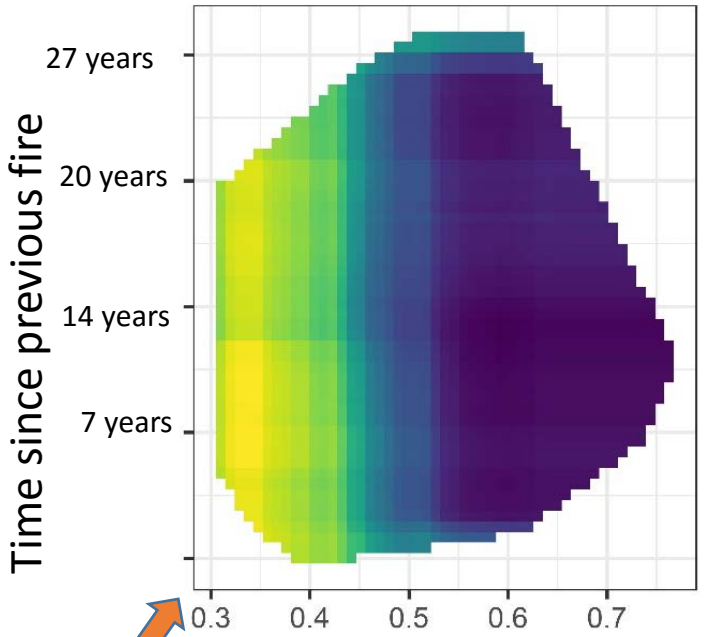


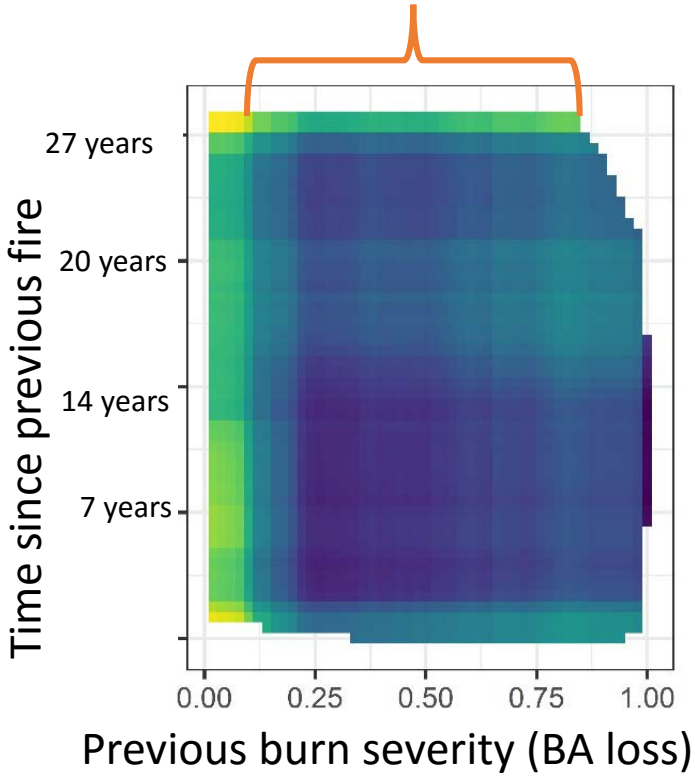
What controls fire severity i burned a second time sinc

Across most previous burn severities, fires decrease severity of subsequent fires for appx. 25 years

Yellow = high severity more likely

Blue = high severity less likely





Previous burn severity (BA loss)

Fire resistance score
(Species composition)

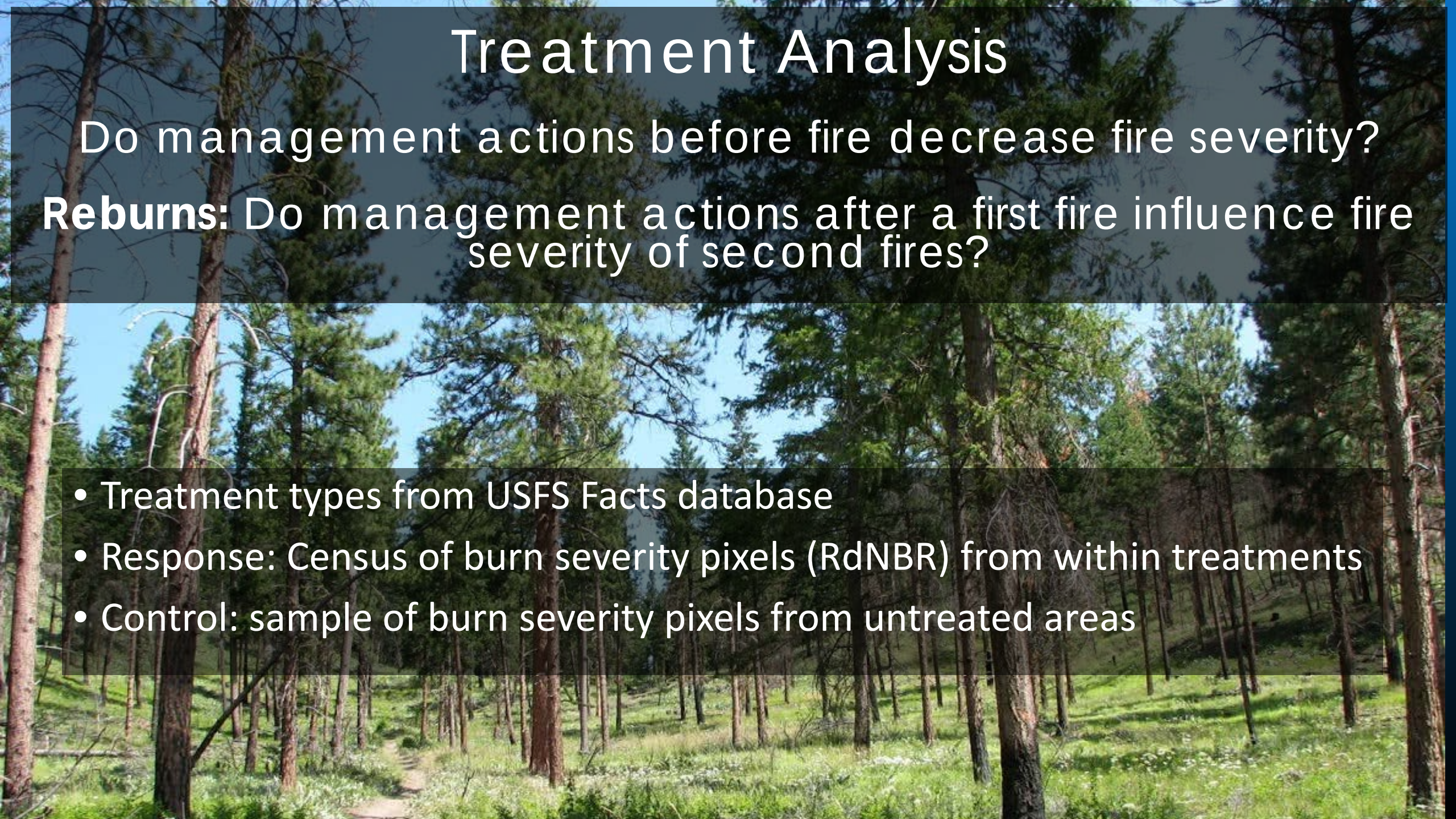
High-elevation forests with very low severity

High-elevation forests almost any time since fire

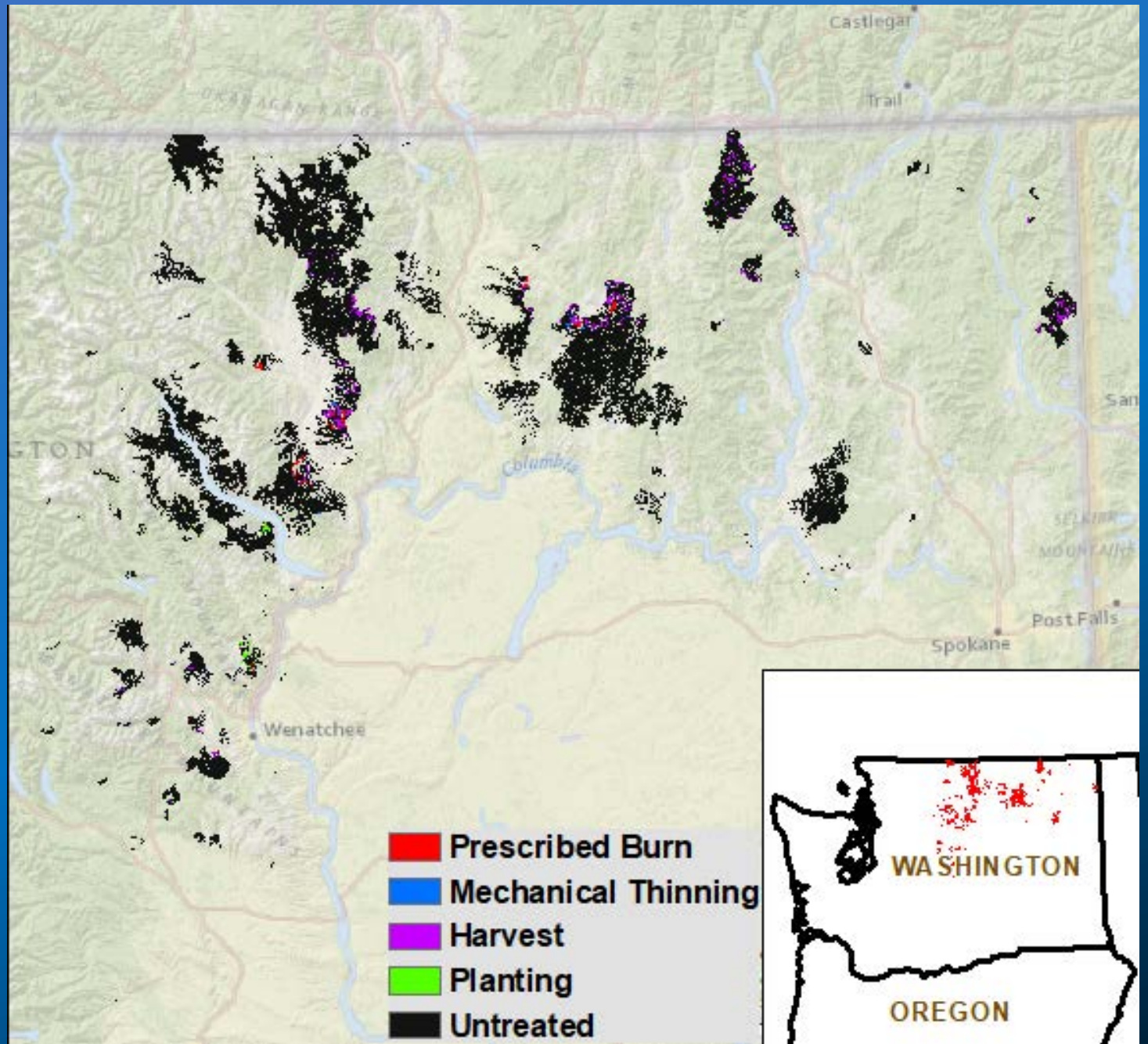
Treatment Analysis

Do management actions before fire decrease fire severity?

Reburns: Do management actions after a first fire influence fire severity of second fires?



- Treatment types from USFS Facts database
- Response: Census of burn severity pixels (RdNBR) from within treatments
- Control: sample of burn severity pixels from untreated areas



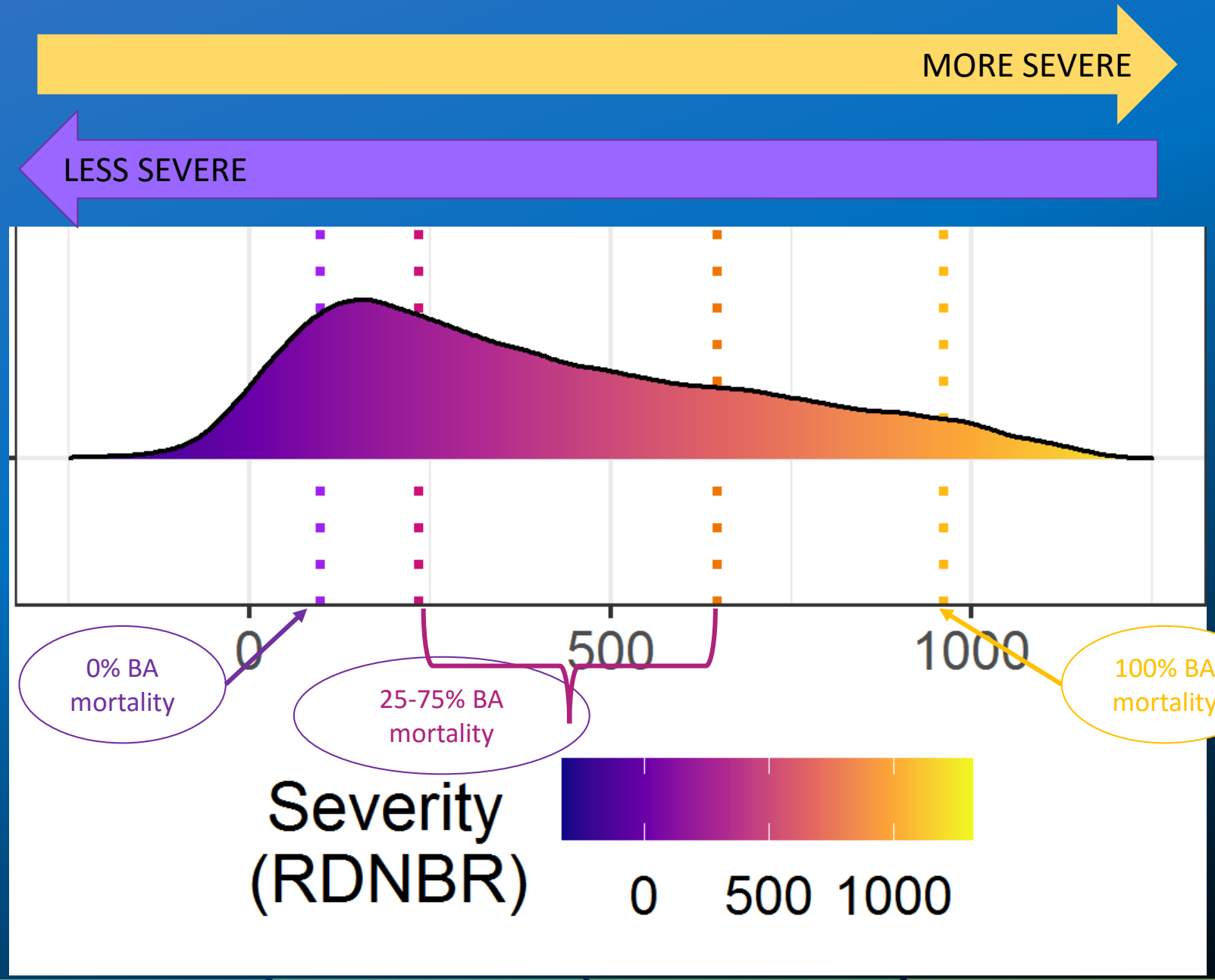
Treatments are relatively rare on the landscape

Only considered treatments with >1,000 pixels (90 ha)

Treatment combinations = separate categories:

- Rx Fire + harvest + planting
- Rx Fire + harvest
- Rx Fire
- Planting
- Harvest + planting
- Harvest
- Thinning
- Untreated

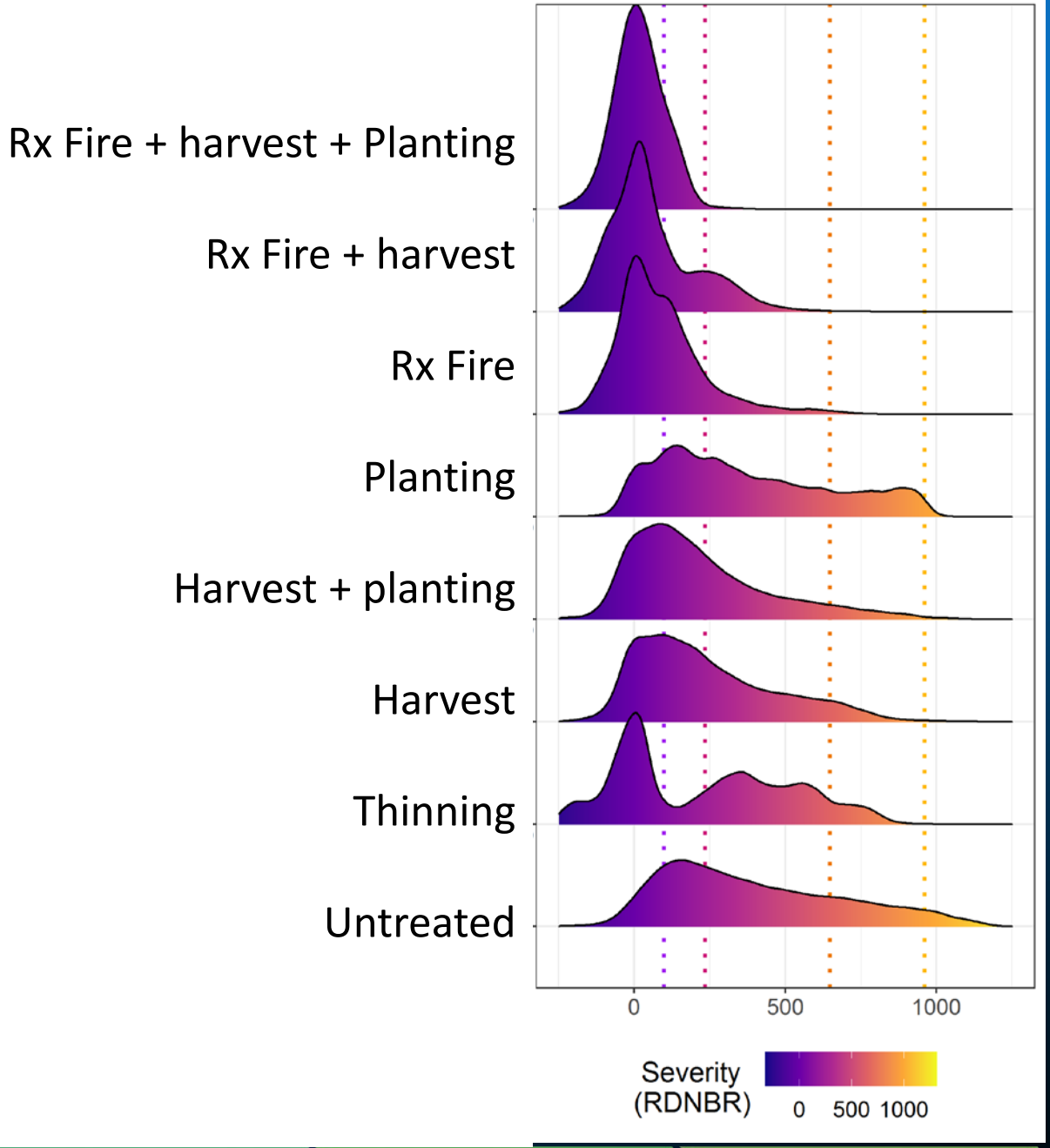
Do management actions before fire decrease fire severity?

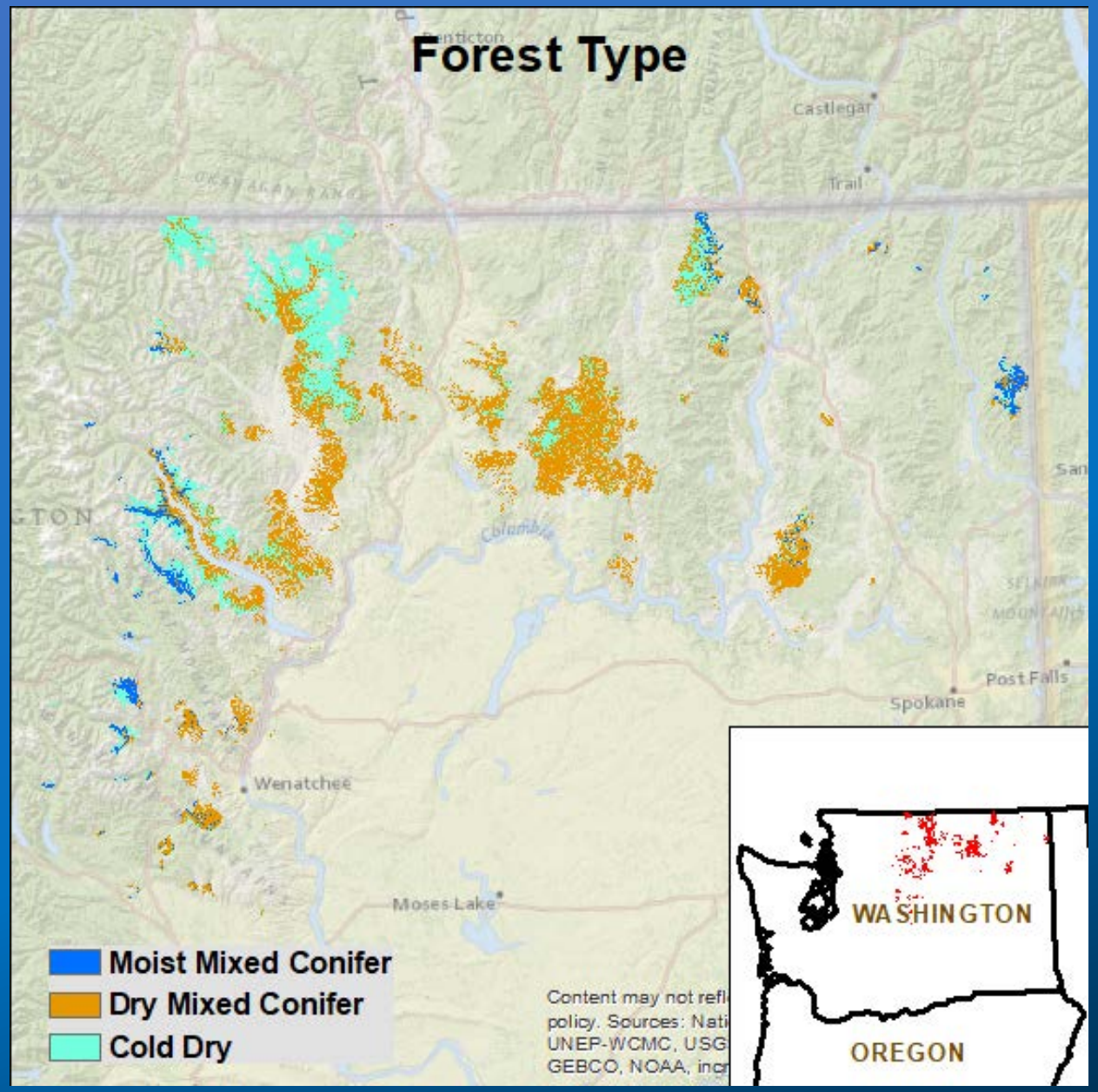


Do management actions before fire decrease fire severity?

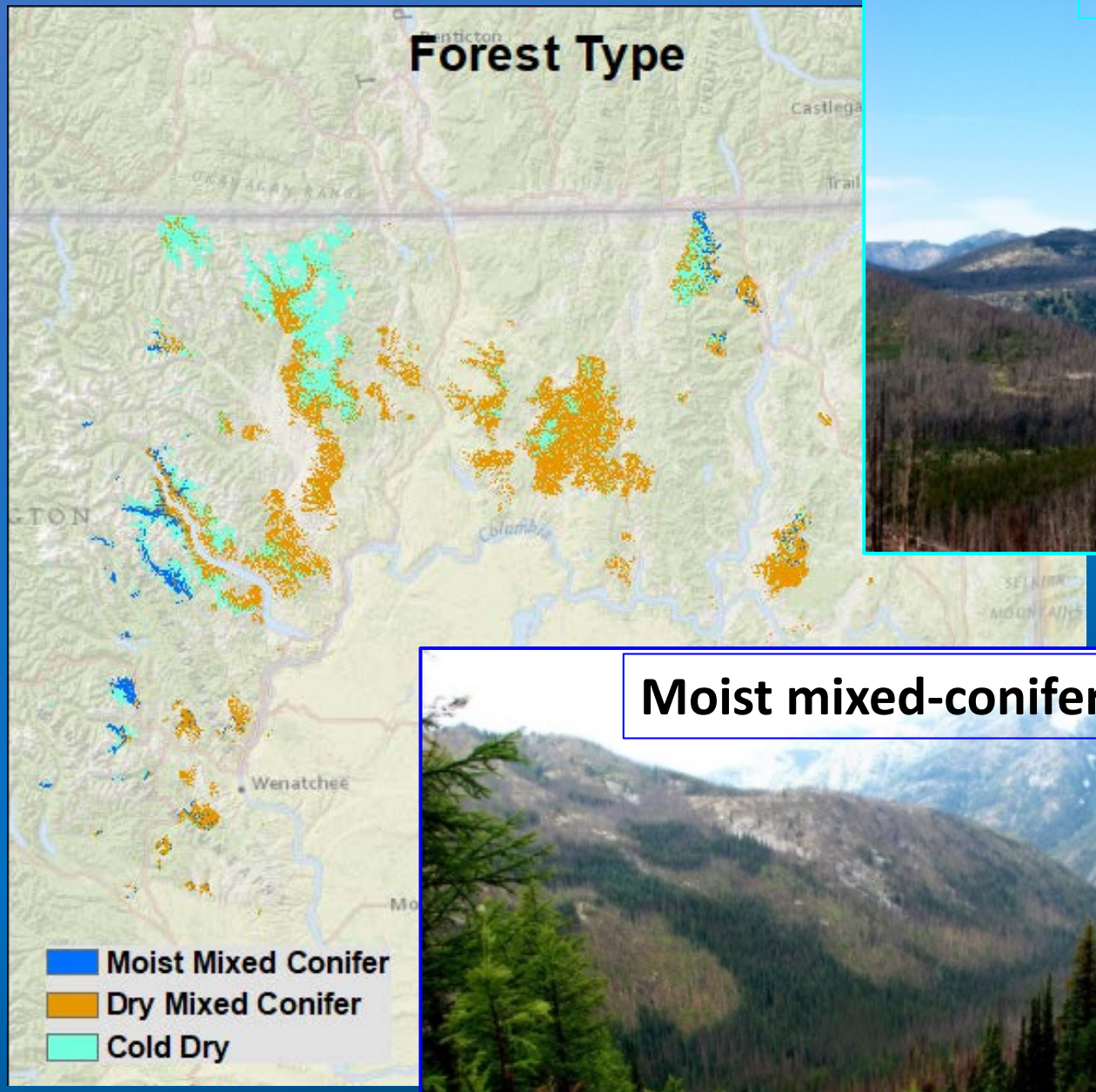
Yes.

- Prescribed fire strongly decreases fire severity
- Plating increase fire severity
- Thinning has mixed effects
  - Perhaps due to differences in surface fuels, or time since treatment





- Our study area is 59% Dry Mixed Conifer, 34% Cold Dry, and 8% Moist Mixed Conifer
- 76% of our treated areas are in Dry Mixed Conifer, 15% in Cold Dry, and 8% in Moist Mixed Conifer



Cold dry forests

59% Dry Mixed
Dry, and 8%
fer

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Dry M
Dry, a
onife

Moist mixed-conifer

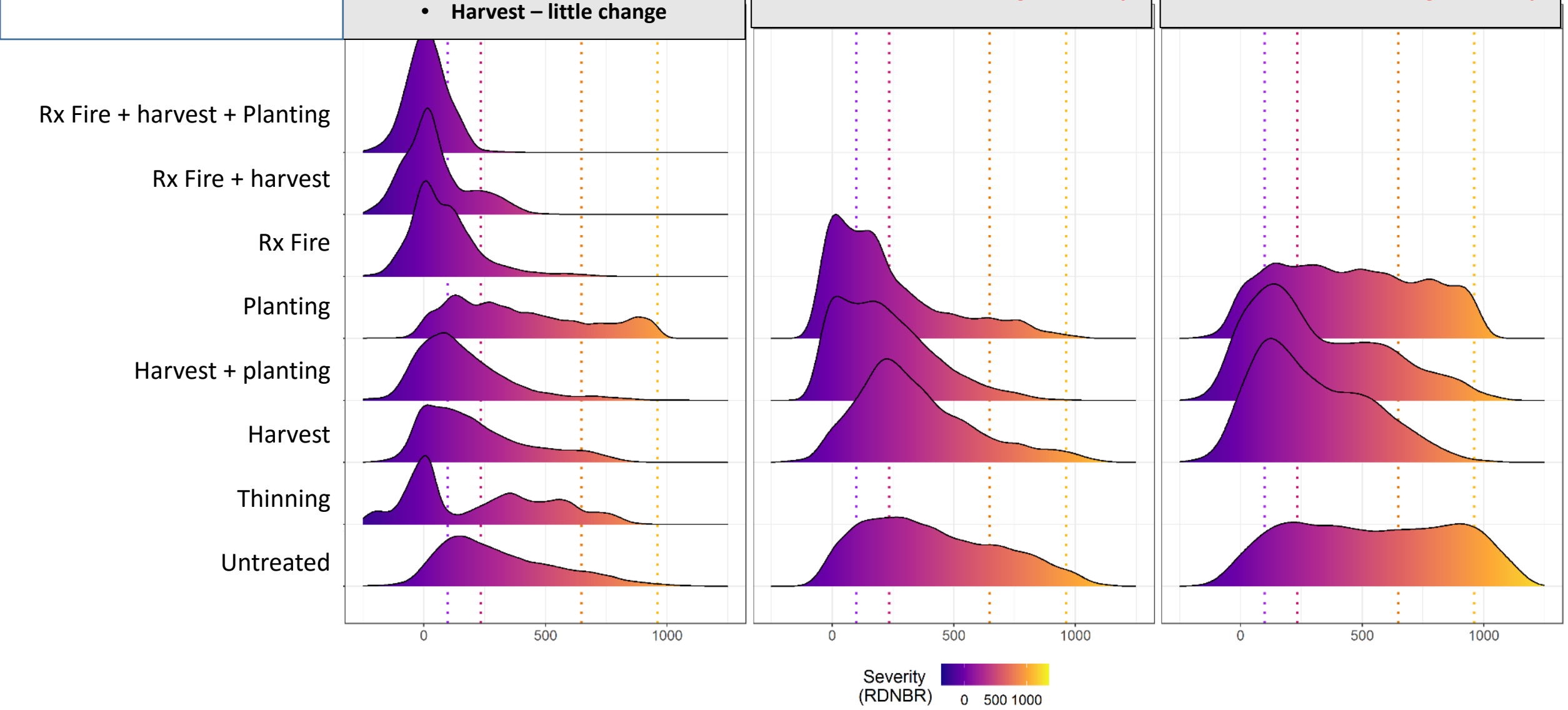
Dry mixed-conifer

Do management actions before fire decrease fire severity?

Dry mixed-conifer:
- Rx fire decrease severity
- Planting increases severity
- Harvest – little change

Moist mixed-conifer:
- Planting decreases severity
- Harvest decreases high-severity

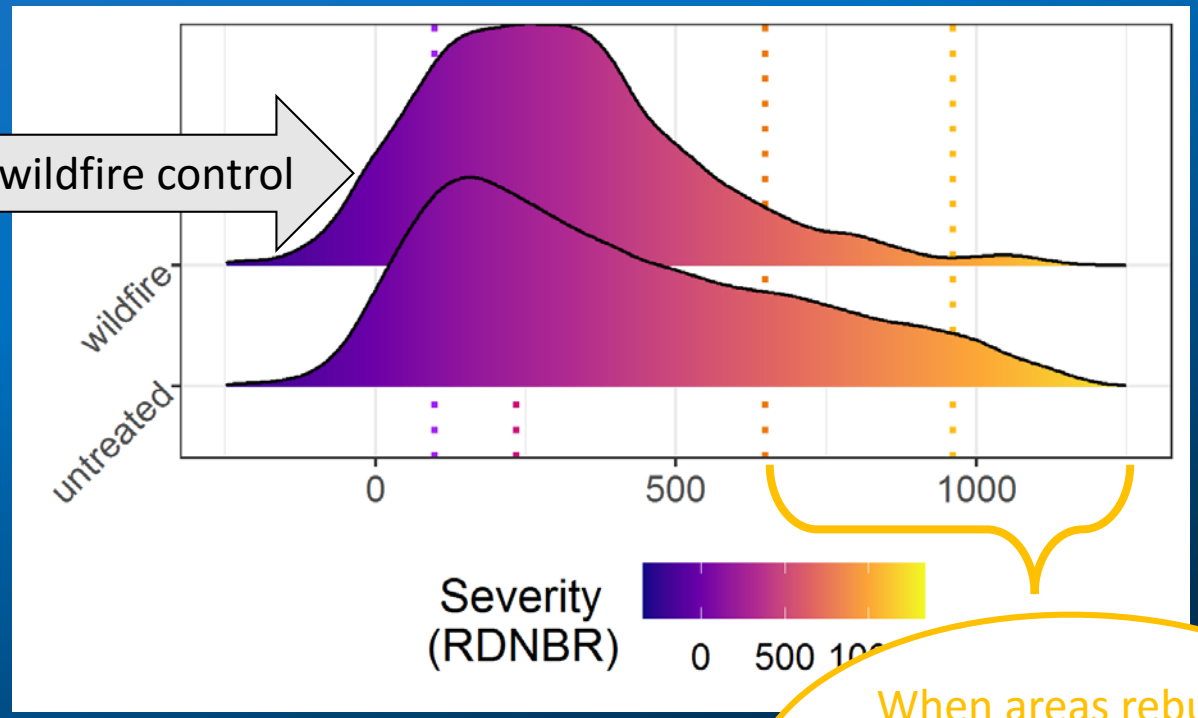
Cold dry forests:
- Planting – little impact
- Harvest decreases high-severity



Reburns: Do management actions after a first fire influence fire severity of second fires?

Two “controls”:

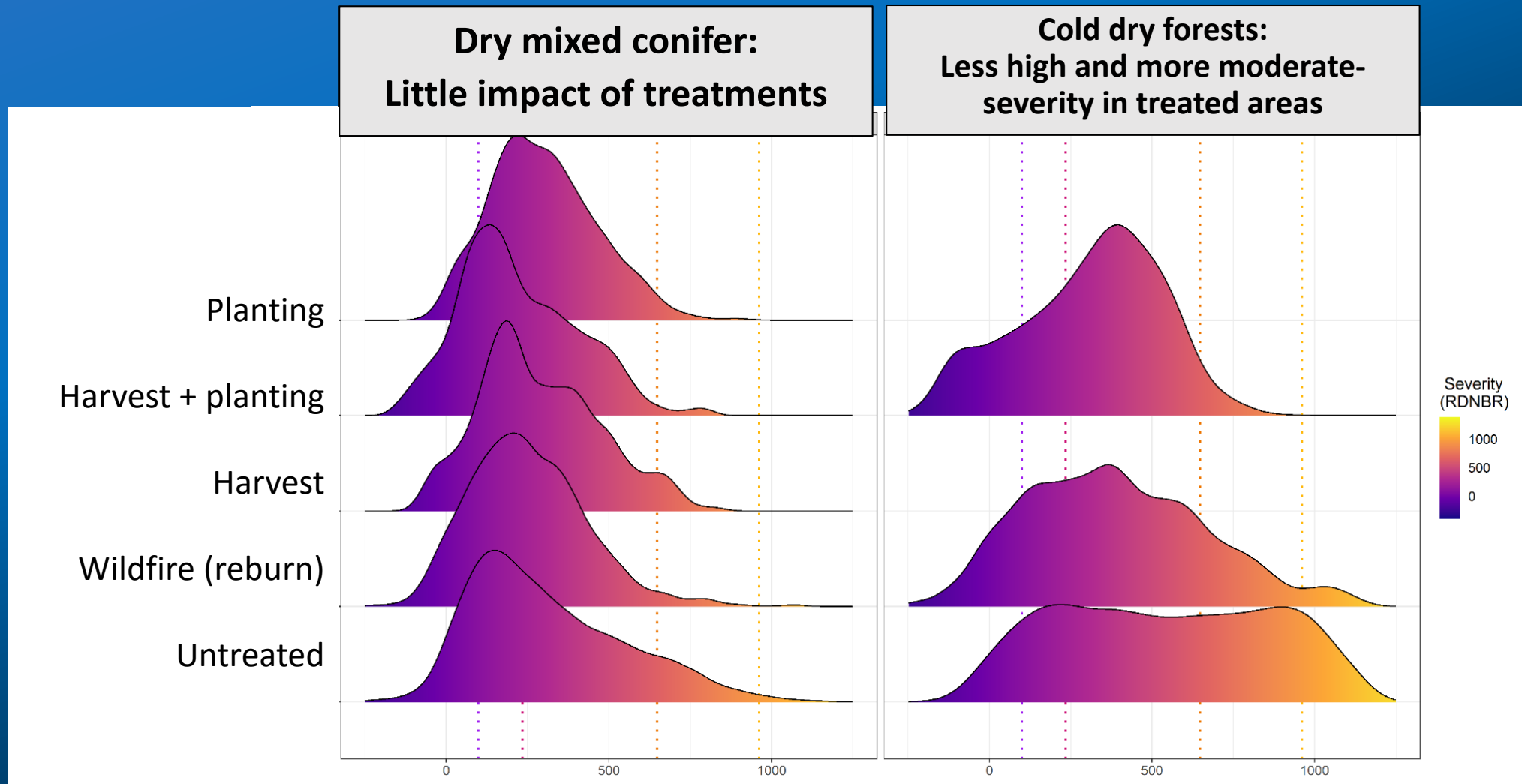
1. Previous **wildfire.** Untreated areas that reburned.
2. **Untreated** areas burned by a “first” fire



When areas reburn, there is less high-severity and stand-replacing fire.

Reburns: Do management actions after a first fire influence fire severity of second fires?

- Yes, but primarily by decreasing the incidence of stand-replacing fire.
- The do not increase “unburned” areas.



Framing Landscape Restoration: Core Principles

Fire-forest succession-climate interactions drive the system

Did wildfires re-align successional patterns in support of more typical/desirable fire regimes?

Yes. In many cases previous fires and/or previous management reduced the severity of subsequent fires

Forest structure – in dry mixed conifer

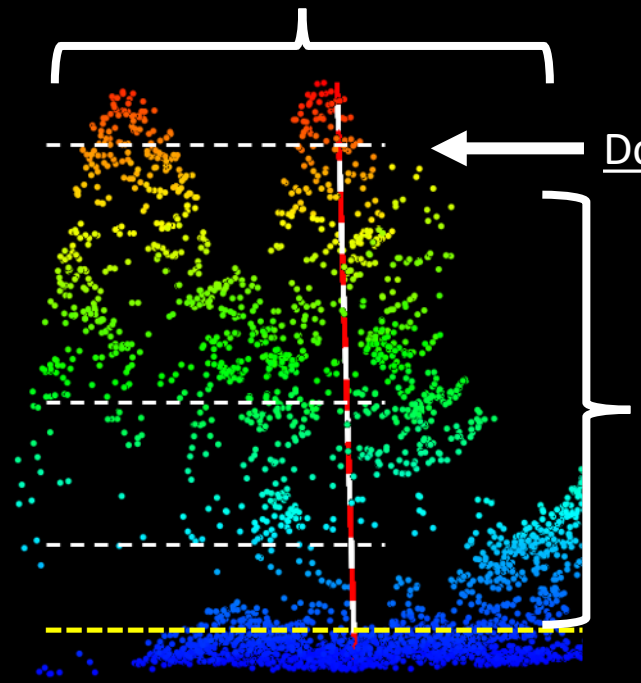
Forest structure

Fires that occurred at least 12 years before LIDAR was acquired

1. How does forest structure differ by fire severity class?
2. Do post-fire treatments have different stand structure than burned areas?

Lidar for Forest Structure & Canopy Tree Detection

Cover – percent of returns > 2m



Dominant height – height of 95 percentiles of returns

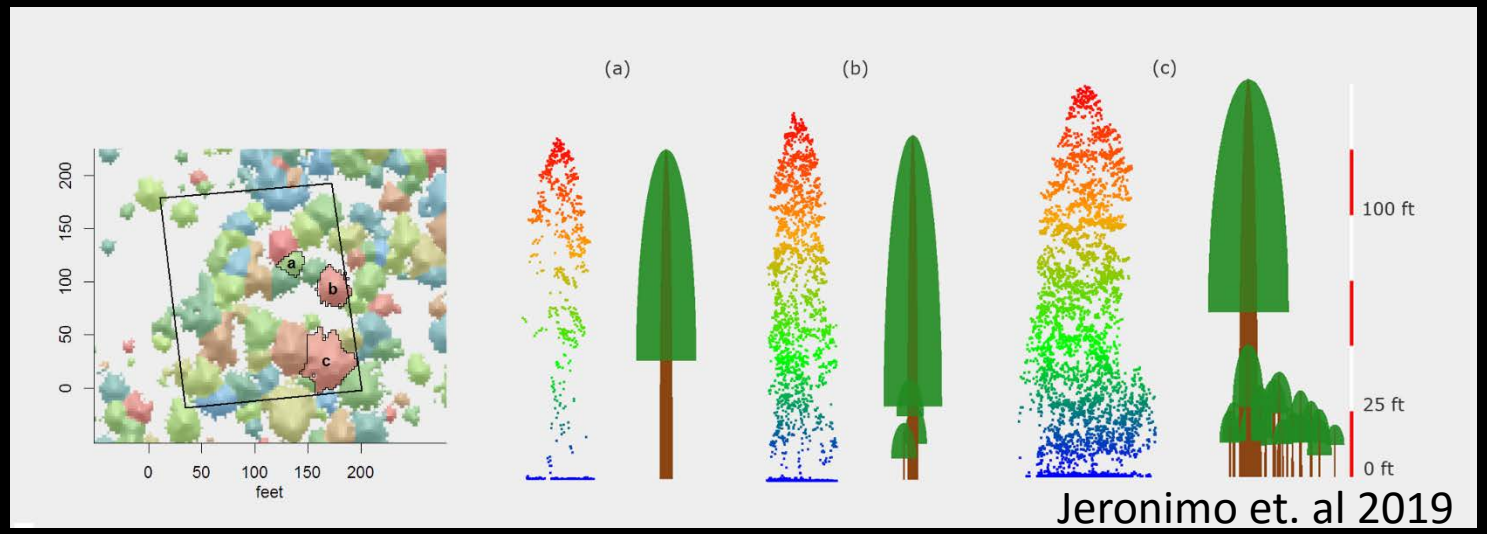
Vertical complexity - Standard deviation of returns

Lidar for Forest Structure & Canopy Tree Detection

Overstory tree identification

→ number dominant trees per clump

→ "ICO" thinning prescriptions



Jeronimo et. al 2019

Landscape Restoration: Principles 5 & 6

Widely distributed medium & large-sized, older trees provide a critical backbone to seasonally dry mixed-conifer landscapes

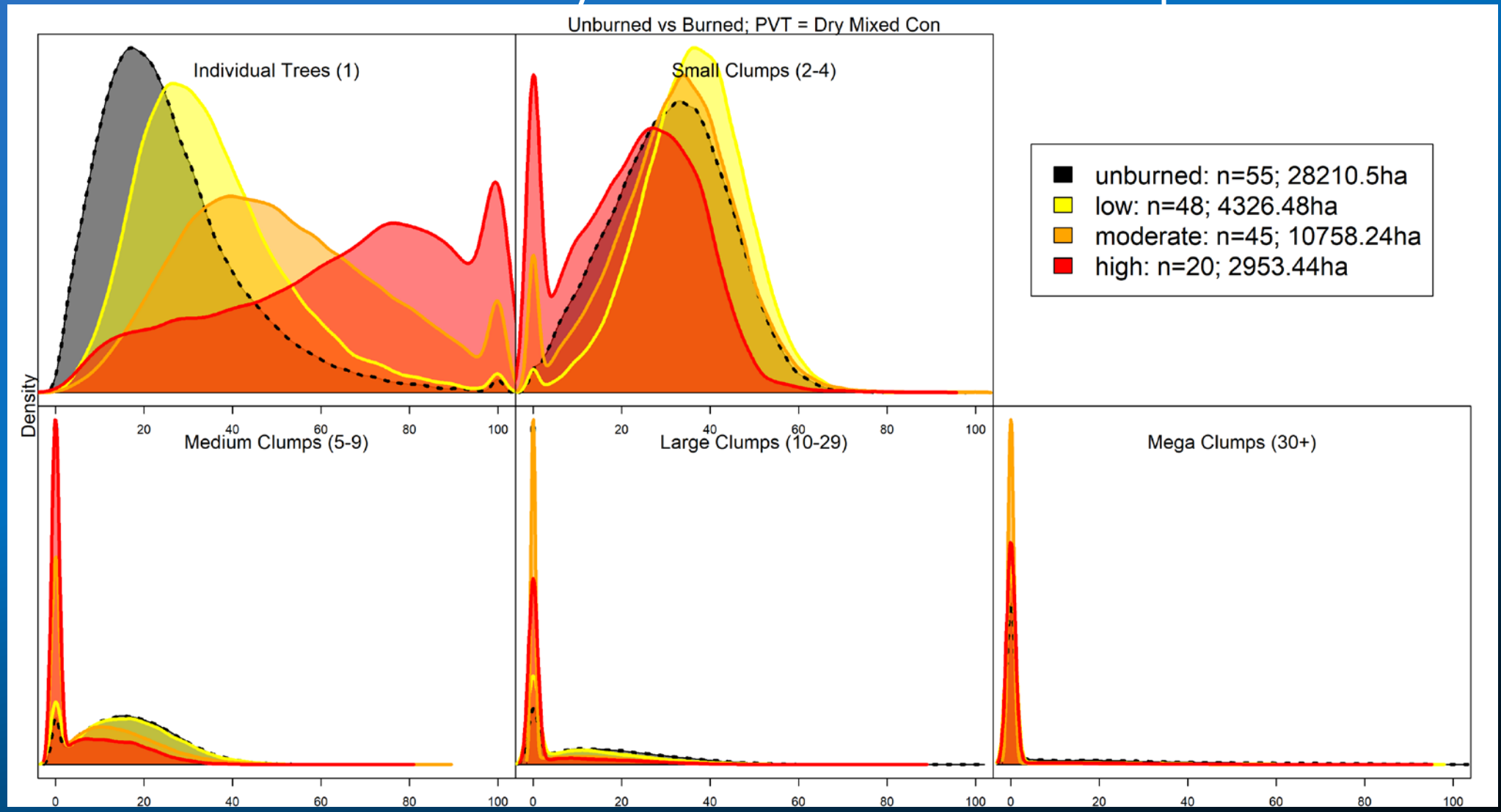
Did wildfires thin out smaller trees and restore more characteristic tree clump and gap sizes?

The effects of fire on forest structure depend on fire severity

- High-severity: *greatly decreases* in dominant height, vertical complexity, and cover
- Moderate severity: *somewhat decreases* in dominant height, vertical complexity, and cover
- Low severity: slight decrease in cover, little change in vertical complexity or dominant height

Lidar metrics by burn severity class

- High severity → many more individual trees, fewer large tree clumps
- Low and moderate severity → more small tree clumps



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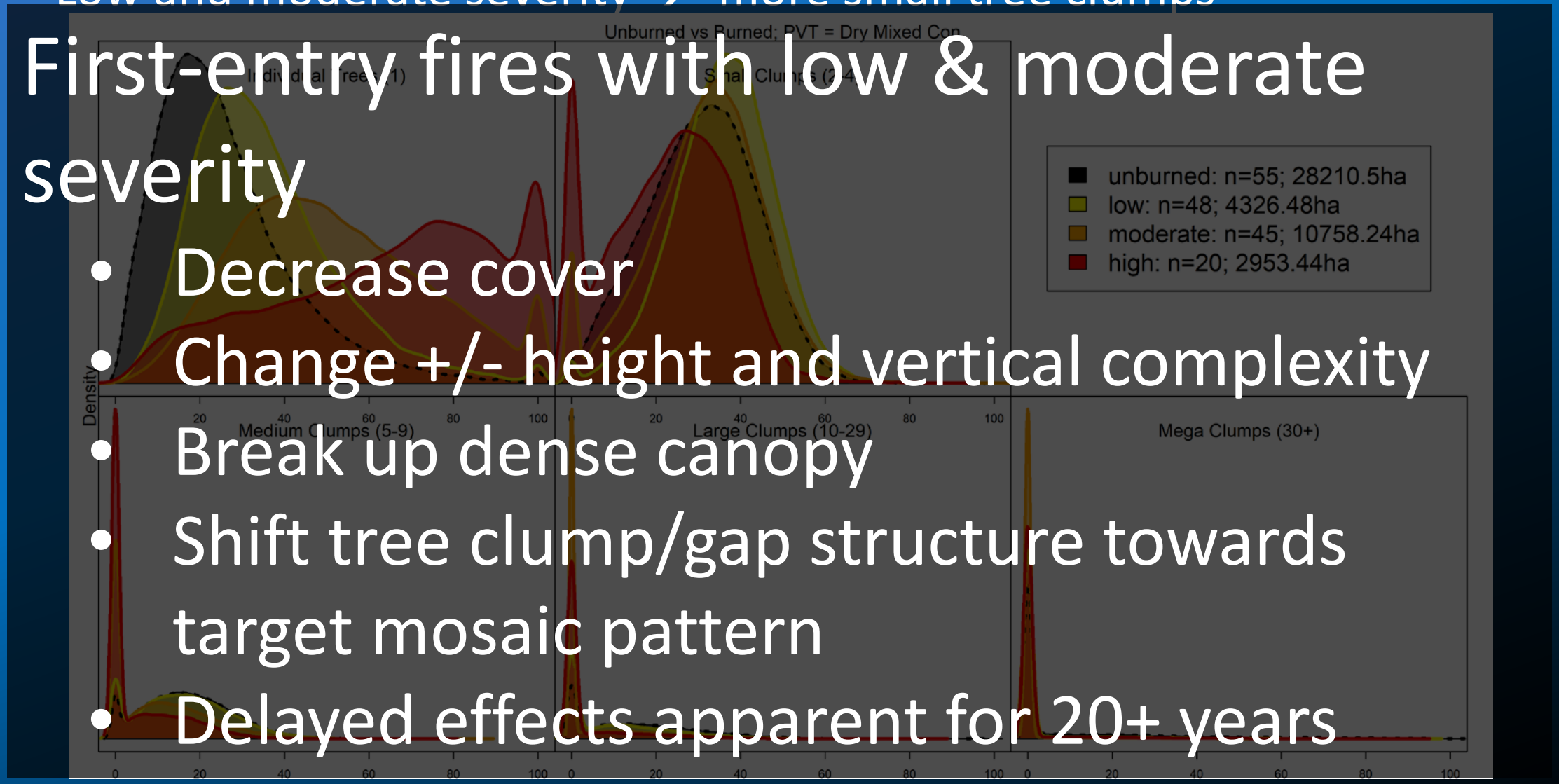


First-entry fires with low & moderate severity

- Decrease cover
- Change +/- height and vertical complexity
- Break up dense canopy
- Shift tree clump/gap structure towards target mosaic pattern
- Delayed effects apparent for 20+ years

LiDAR Conclusions – post-fire treatments in dry mixed conifer forest

- Thinning, or thinning + planting after fire:
  - ↓ dominant tree height
  - ↓ vertical complexity
- Only planting:
  - little difference
- RxFire:
  - ↑ cover
  - ↑ vertical complexity
  - ↓ dominant tree height

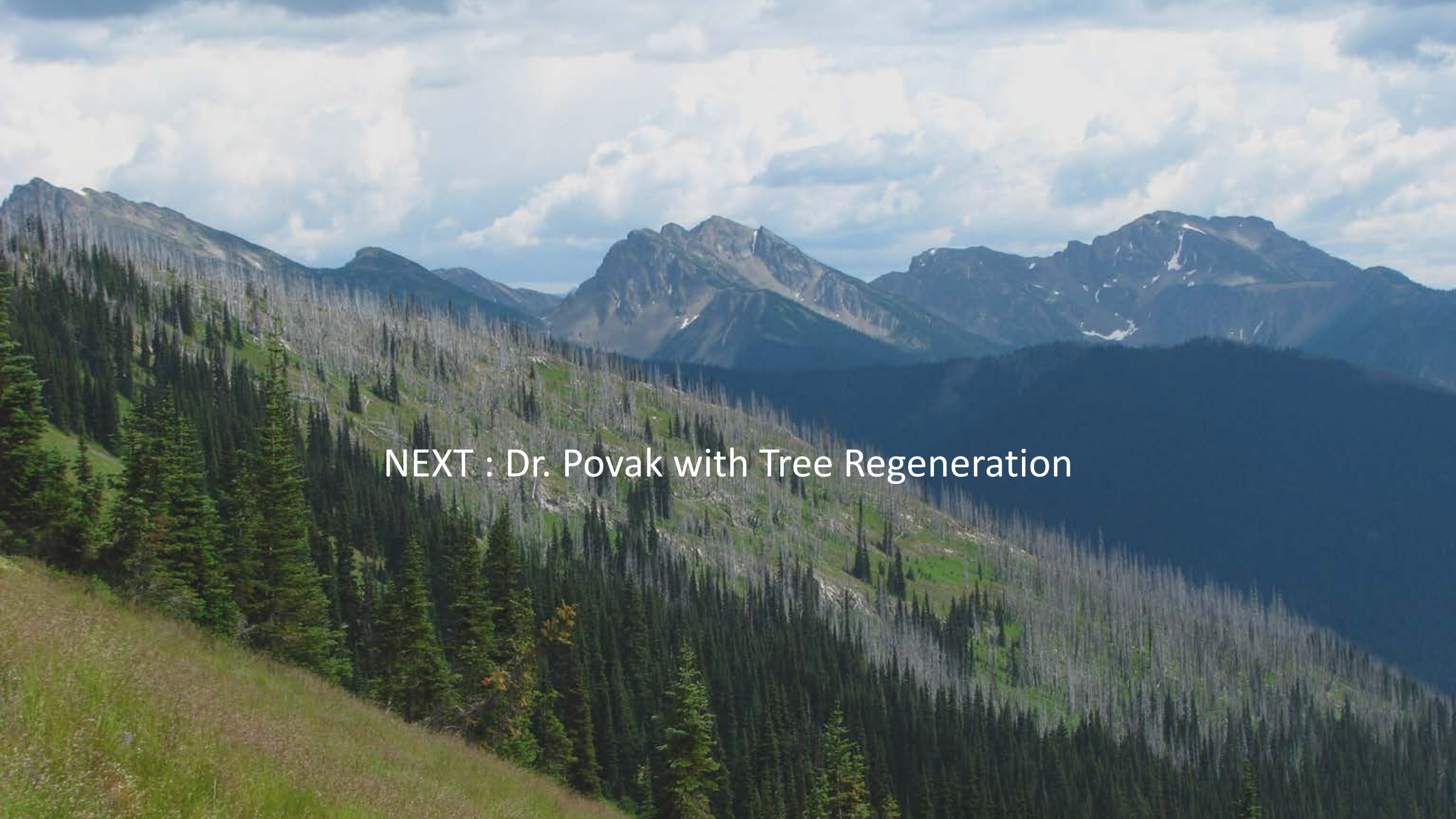
Photo: Phil Chi, 2013 Sisters RD of the Deschutes NF

LiDAR Conclusions – post-fire treatments in dry mixed conifer forest

- Tree clumps → treatment are similar to each other, but there are interactions with previous fire severity:
  - Previous low severity:  individual trees
  - Previous moderate severity: treatments have little impact
  - Previous high severity:  individual trees

Take home points

- Previous fires decrease severity of subsequent fires for ~25 years
  - Interactions between forest type, previous fire severity, and time since fire are important in addition to fire weather and yearly climate
- Prescribed fire is the most effective management action at decreasing fire severity
  - Other management actions usually decrease fire severity, or were neutral, with the exception of planting, which sometimes increase severity
- When fires burn with low & moderate severity, the create ICO patterns made up of individual trees and small clumps (3-5 overstory trees)
- Post-fire management actions had little impact on the severity of subsequent fires
- Post-fire management *did* impact post-fire structural development


NEXT : Dr. Povak with Tree Regeneration

Long-term post-fire regeneration dynamics in eastern Washington

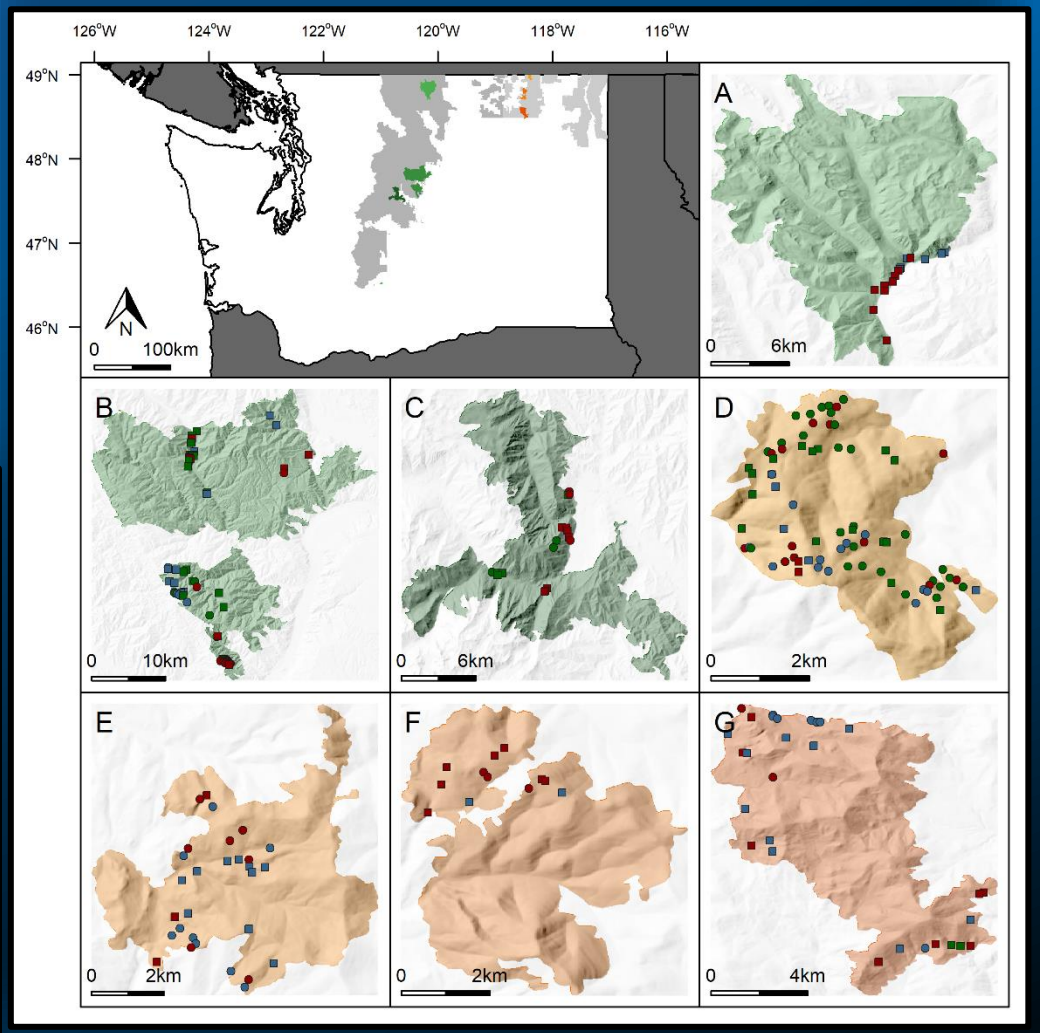
Nick Povak
US Forest Service
Pacific Southwest Research Station

Long-term post-fire regeneration

- Challenges to post-fire regen
- Mgmt limited in extent, need to identify areas of highest concern
- Most studies showing regen failures:
  - Conducted in Rockies, SW & Sierras - *may not apply to PNW*
  - Monitored short-term (<5 yr) response - *may not represent long-term trends*

Research objectives

- Quantify regen 15 – 30 years post-fire
- Factorial study design (2 x 2 x 3 = 12 strata)
  1. Fire severity: moderate | high
  2. Management: Salvage | no mgmt
  3. Forest type: Dry-mixed | moist-mixed | cold-dry
- Species-level modeling



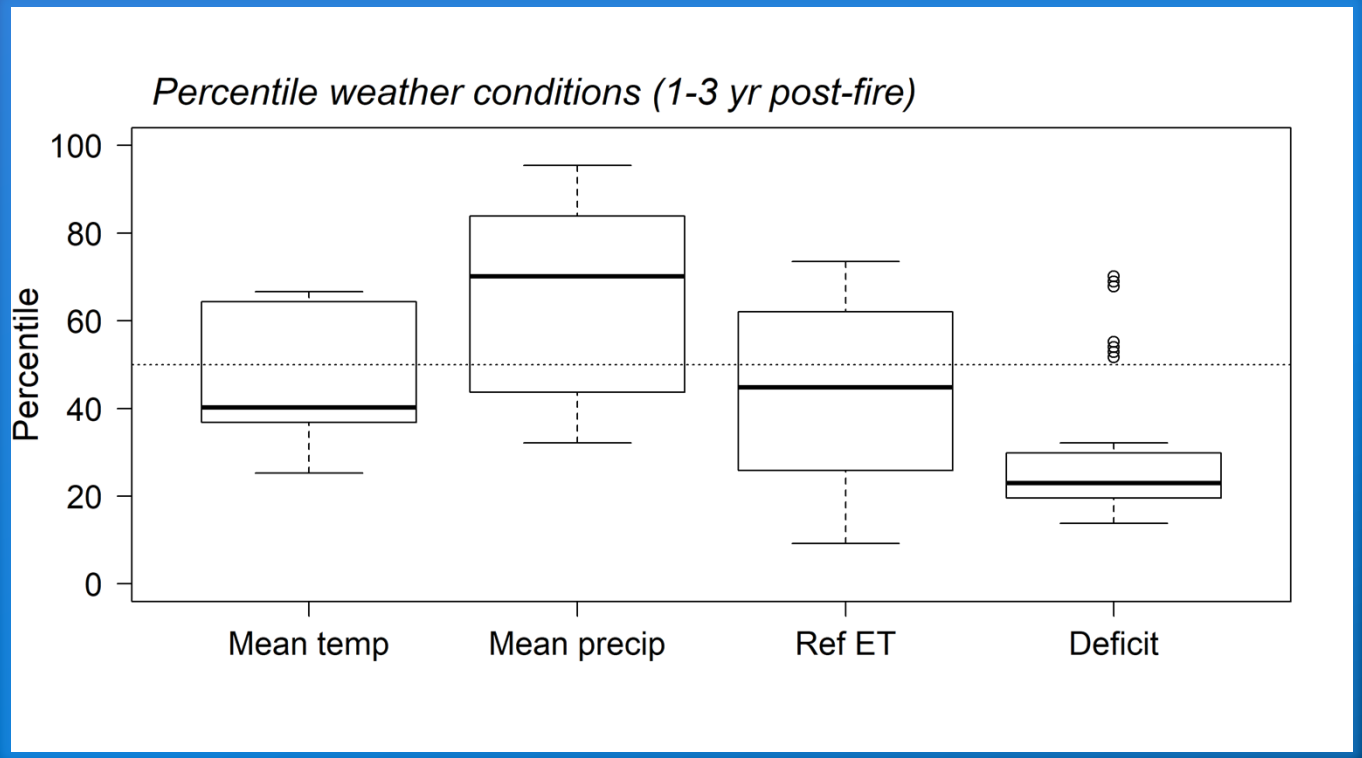
YEAR	FIRE	# plots	# plots salvaged	# plots high severity
1988	White Mountain (CNF) Dinkleman (OkaWen) Sherman (CNF)	76	36	38
1994	Tyee Creek (OkaWen) Hatchery Comp. (OkaWen) Copper Butte (CNF)	73	24	51
2001	Mt. Leona Comp. (CNF) Sleepy Comp. (CNF)	7	2	3
2003	Fawn Peak Comp. (OkaWen) Togo Mountain (CNF) Middle Fork (OkaWen)	92	54	37
Total		**248**	**109**	**116**

- Regeneration was abundant
  - Median: 4,000 TPH
  - Large regen (2-4m): ~700 TPH
- Low incidence of regen failure
  - 2% plots had 0 TPH
  - 15% of plots <350 TPH

Main plot-level results

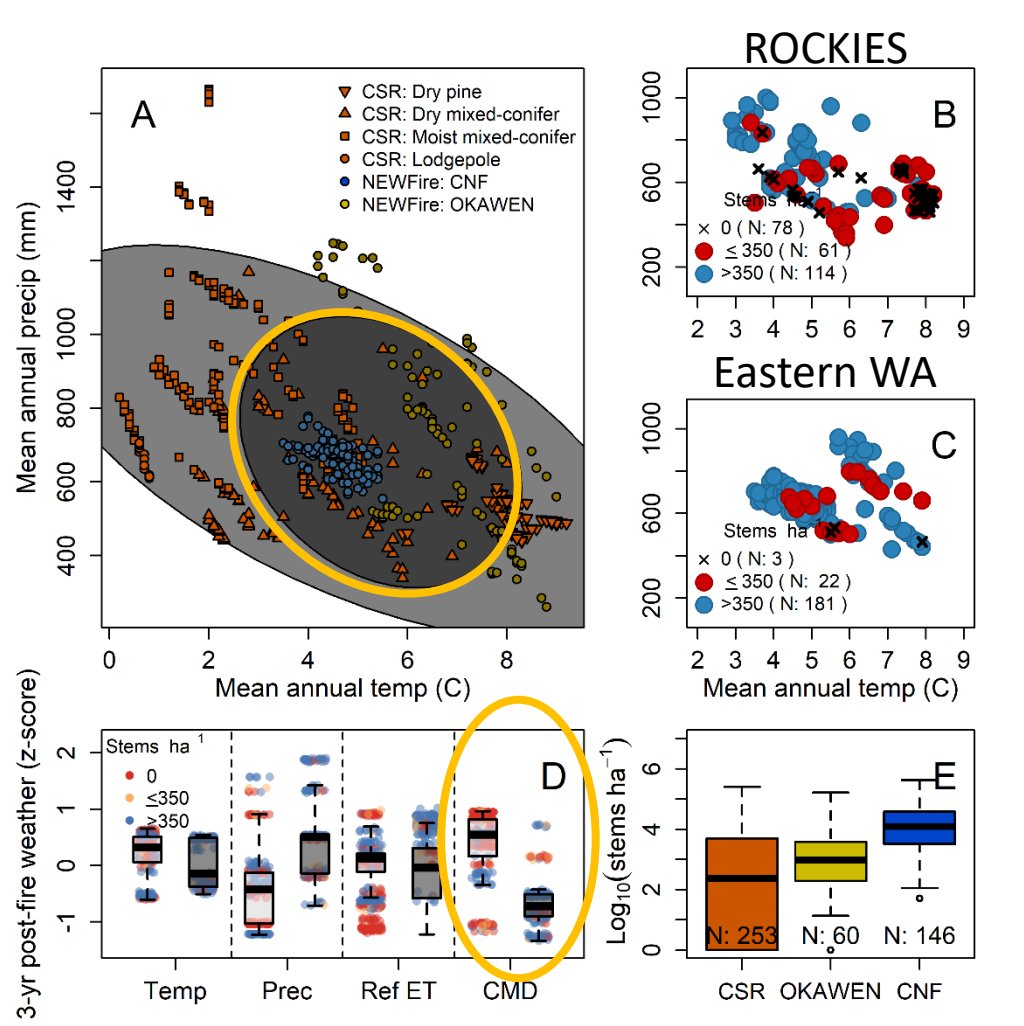
- B/c regen was abundant, statistical significance in study strata was low overall
- Dry forest generally had lower densities
- High severity → increased regen
  - Largely driven by LODGEPOLE
- Salvage harvesting → increased regen densities
  - Mainly at CNF
  - Possibly due to biased sample design

Abundant regen due to favorable post-fire weather



- Cool temps, high precip and low deficit after fire
- How will regen respond to future climate change?

Comparison with Rockies meta-analysis (Stevens-Rumann et al. 2018 - CSR)



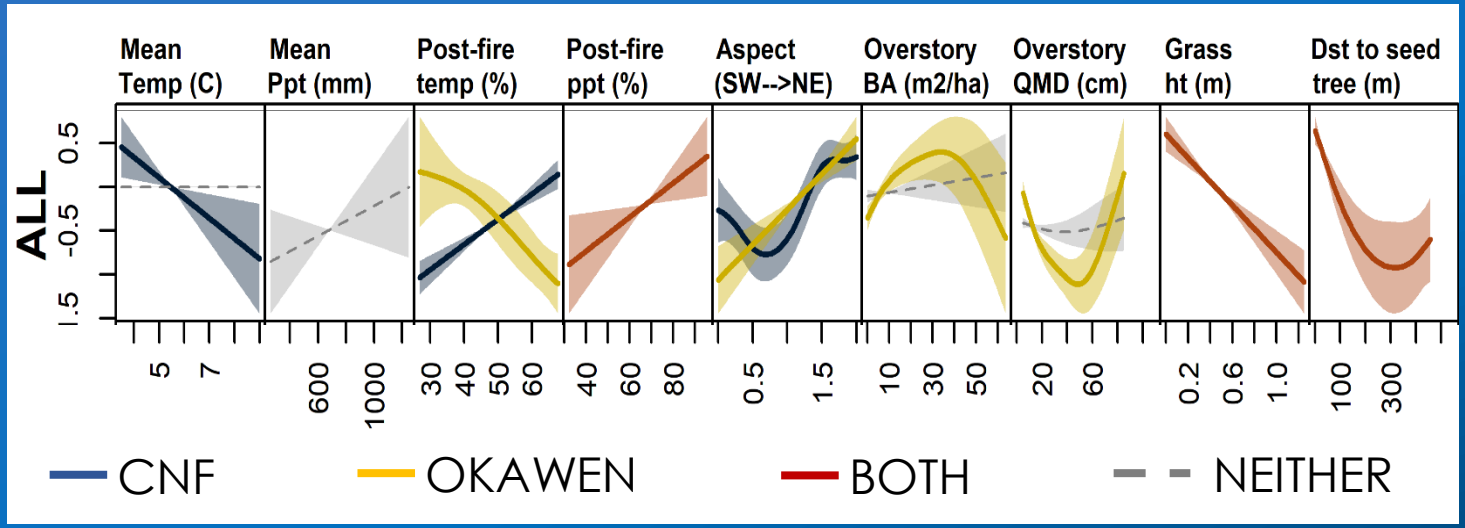
- Compared our results to a western US meta-analysis of post-fire regen
- We selected plots with similar climate and sample years across regions
- Again, cooler, moister post-fire conditions at our sites appear to drive greater regen

Stevens-Rumann, C.S., et al., 2018. Evidence for declining forest resilience to wildfires under climate change. *Ecology letters*, *21*(2), pp.243-252.

Species-level modeling

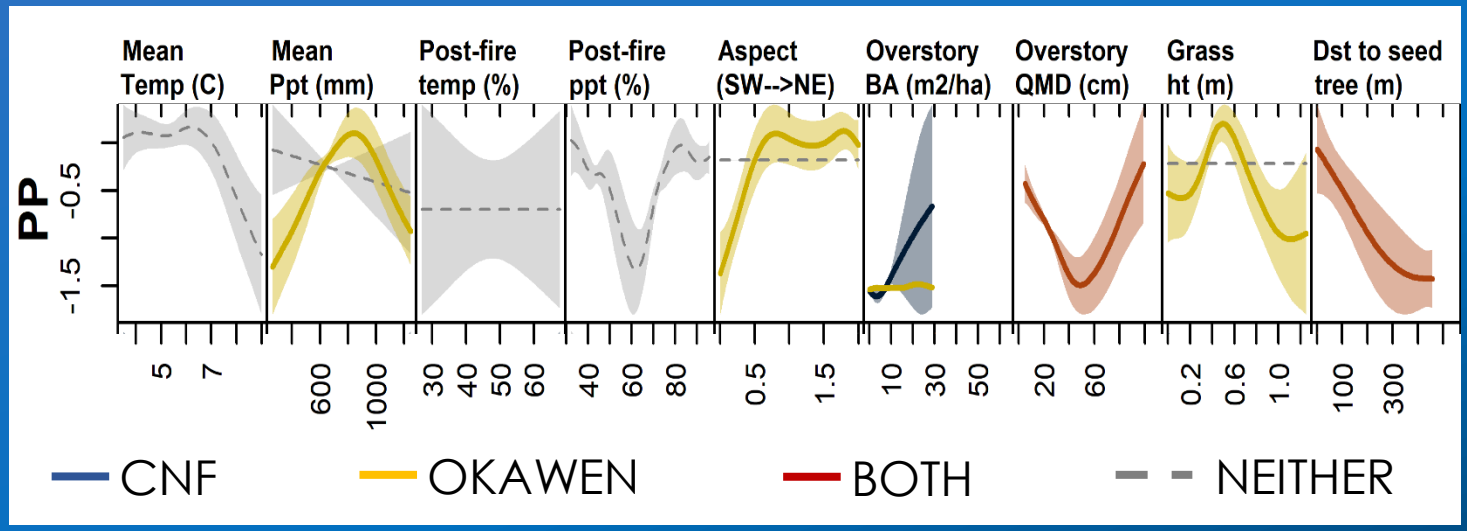
- Response: regeneration density
- Predictors:
  - Residual overstory size, density
  - Climate
  - Post-fire weather
  - Colville vs. OkaWen
  - Years since fire
  - Study strata
    - Forest type
    - Management
    - Fire severity class

Species-level modeling – All species



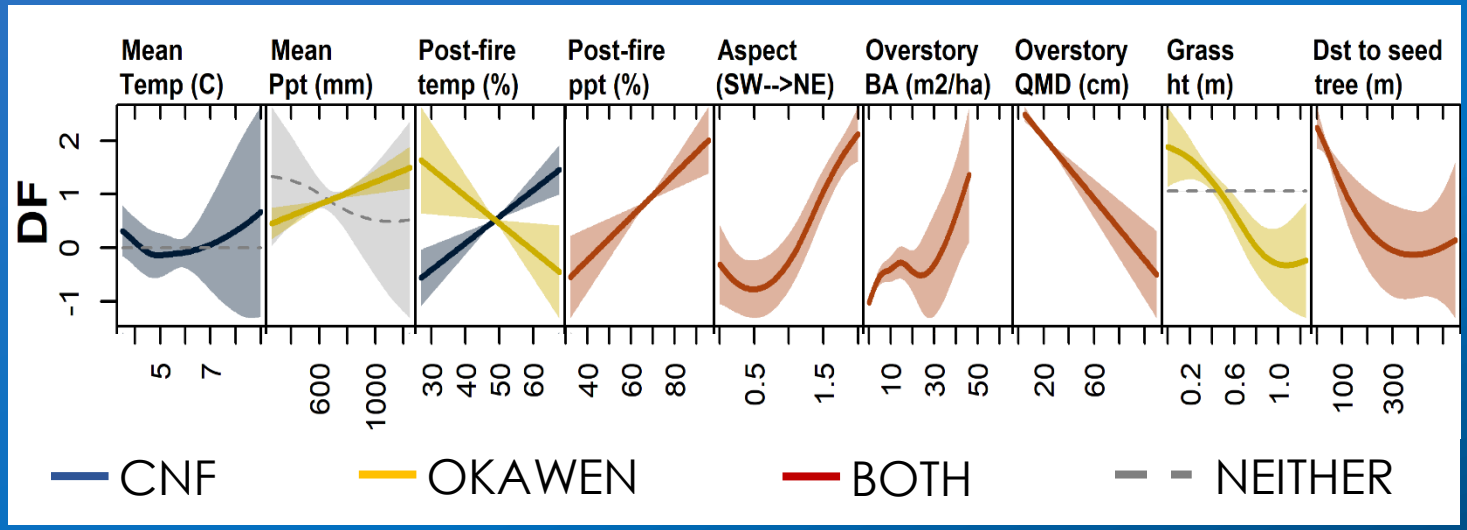
- Responses varied across NFs
  - Fires didn't span the env gradients of interest → partial interps of these relationships.
  - CNF cooler than OkaWen and OkaWen covered broad precip gradient
- Distance to seed source key variable for all species

Species-level modeling – Ponderosa pine



- PIPO not influenced by temp, but favored moderate precip and all but the driest aspects

Species-level modeling – Douglas-fir



- Douglas-fir favored
  - Colville: Warmer post-fire temps
  - OkaWen: Cooler temps
  - Higher post-fire precip

Research questions

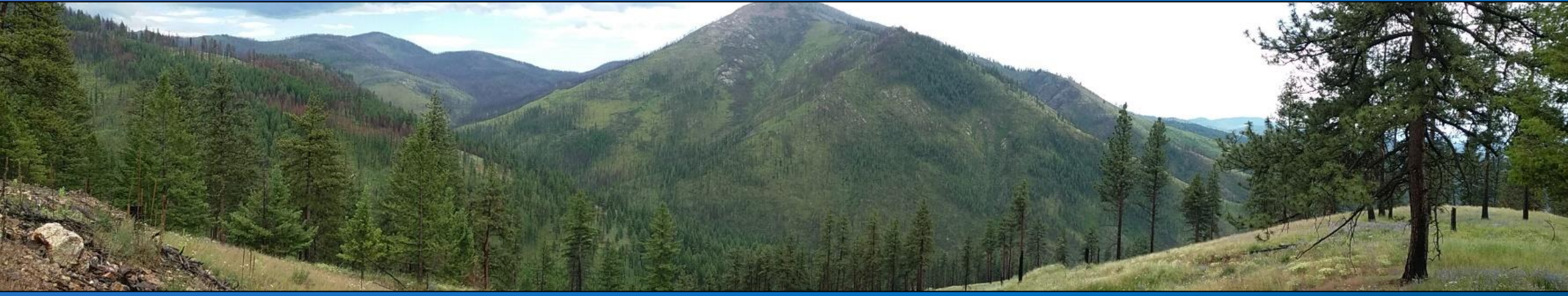
1. Is regen abundant 15-30 yrs post-fire?
    1. Yes, little evidence of regen failure.
2. Does Salvage influence regen densities?
    1. Somewhat. Greater densities, largely on the Colville
3. Does Fire Severity?
    1. Somewhat. Greater densities in high-sev driven by PICO
4. Does Forest Type?
    1. Not significantly, but densities influenced by climate gradient
5. Do species differ in their post-fire response?
    1. Yes, unique responses to climate, topo, weather, and post-fire canopy.
6. Are there climate change implications?
    1. Favorable post-fire weather critical → less likely w/ climate change
    2. Regen abundance and composition likely to change in the future.

Thank you!
Let's take a break…

Results recently published in Ecosphere:

Povak, N.A., Churchill, D.J., Cansler, C.A., Hessburg, P.F., Kane, V.R., Kane, J.T., Lutz, J.A. and Larson, A.J., 2020. **Wildfire severity and postfire salvage harvest effects on long-term forest regeneration**. *Ecosphere*, *11*(8), p.e03199.

nicholas.povak at usda.gov



Integrating the work of wildfires into landscape restoration:

Post-fire landscape Evaluations & Prescriptions.

Derek Churchill
Washington DNR Forest Health Division

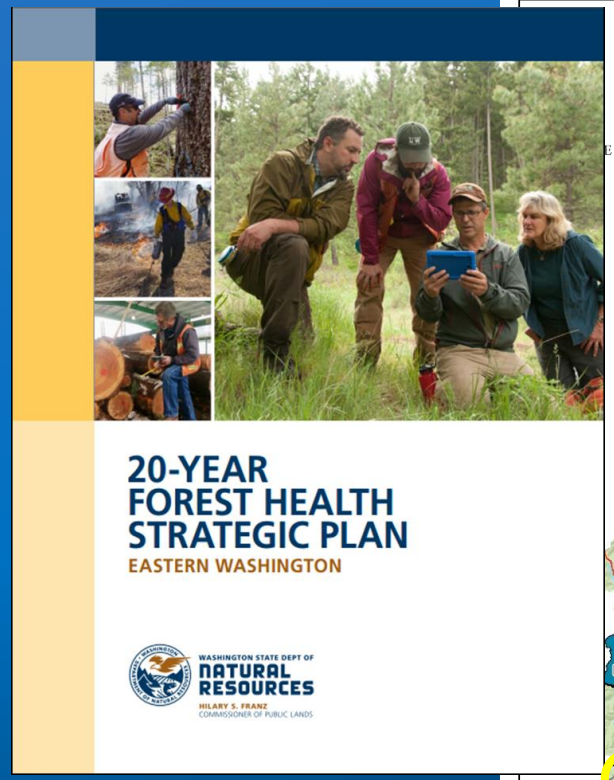
Evaluating the work of wildfires

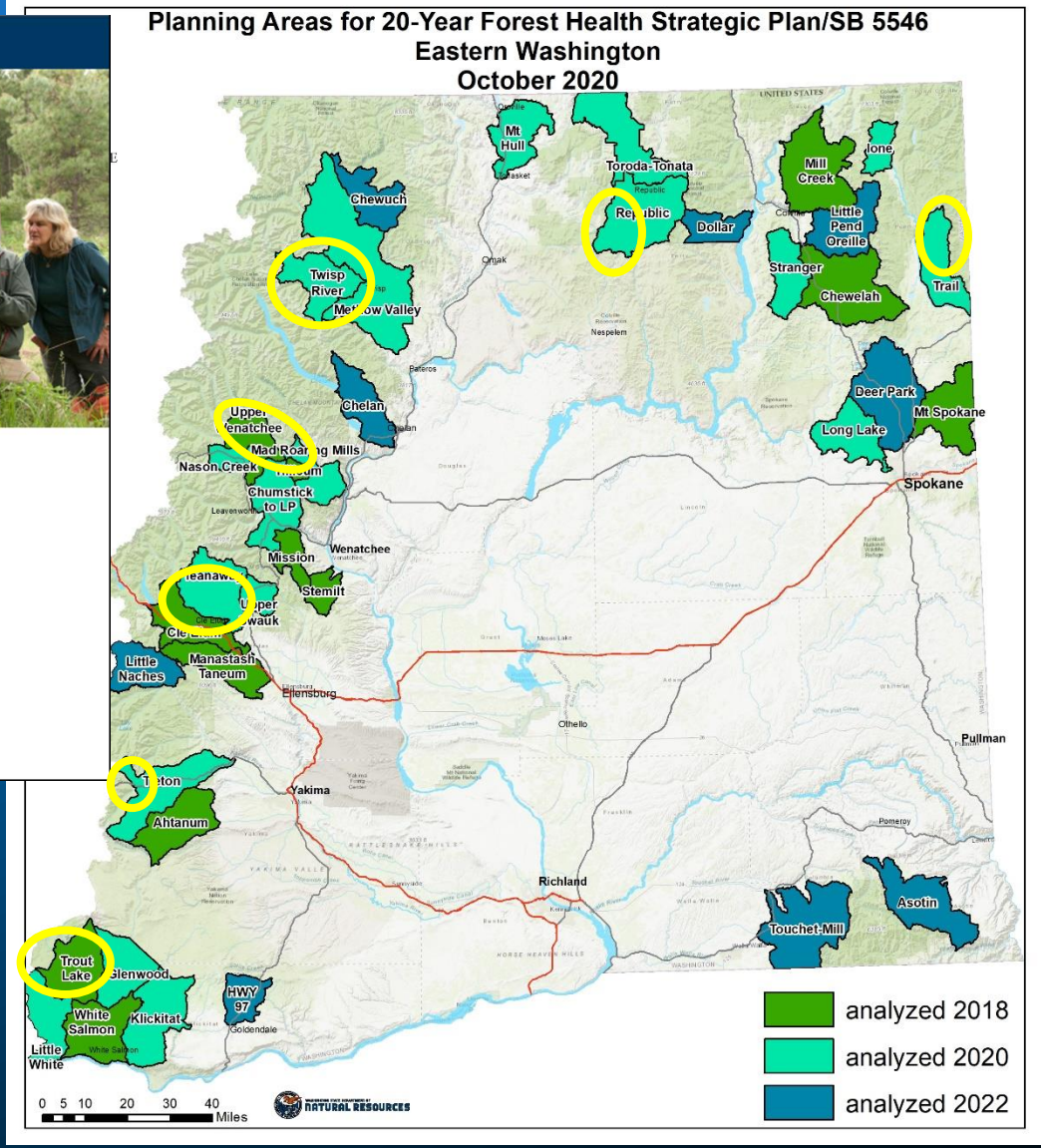
➔ DNR 20 Year Plan: Ambitious adaption goals

➔ Fires occurring during planning & implementation.

➔ We must expect this & have a plan for it

➔ Have to harness fire!





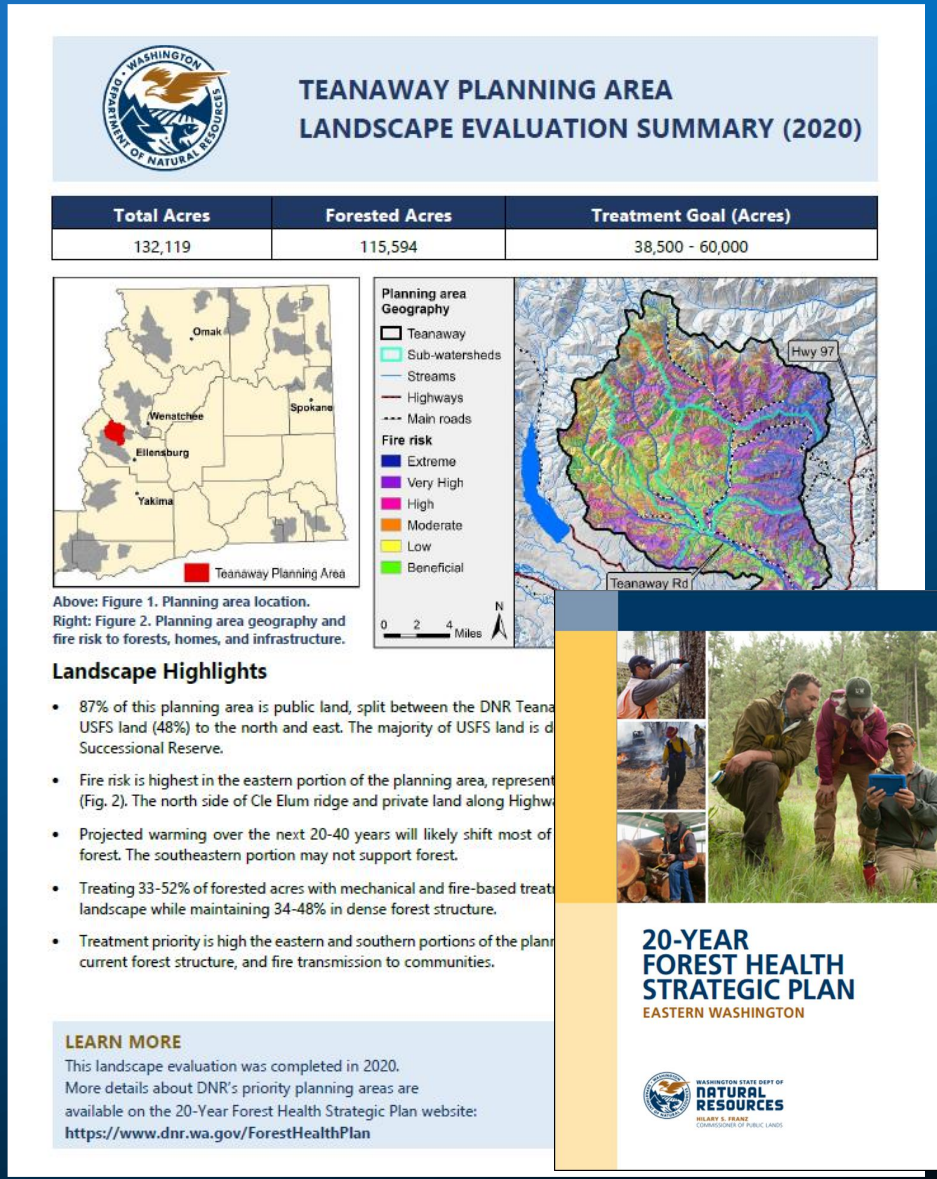
Evaluating the work of wildfires

Post-fire Landscape Evaluation

1. Obtain & analyze fire severity data
2. Obtain and/or infer post-fire veg data for landscape
3. Assess "work" of fire in moving landscape metrics towards climate adapted, resilient conditions

Post-fire landscape Rx

➔ Integrate landscape-level needs with stand level consideration



TEANAWAY PLANNING AREA
LANDSCAPE EVALUATION SUMMARY (2020)

Total Acres	Forested Acres	Treatment Goal (Acres)
132,119	115,594	38,500 - 60,000

Above: Figure 1. Planning area location.
Right: Figure 2. Planning area geography and fire risk to forests, homes, and infrastructure.

Landscape Highlights

- 87% of this planning area is public land, split between the DNR Teana… USFS land (48%) to the north and east. The majority of USFS land is d… Successional Reserve.
- Fire risk is highest in the eastern portion of the planning area, represent… (Fig. 2). The north side of Cle Elum ridge and private land along Highwa…
- Projected warming over the next 20-40 years will likely shift most of… forest. The southeastern portion may not support forest.
- Treating 33-52% of forested acres with mechanical and fire-based treat… landscape while maintaining 34-48% in dense forest structure.
- Treatment priority is high the eastern and southern portions of the plan… current forest structure, and fire transmission to communities.

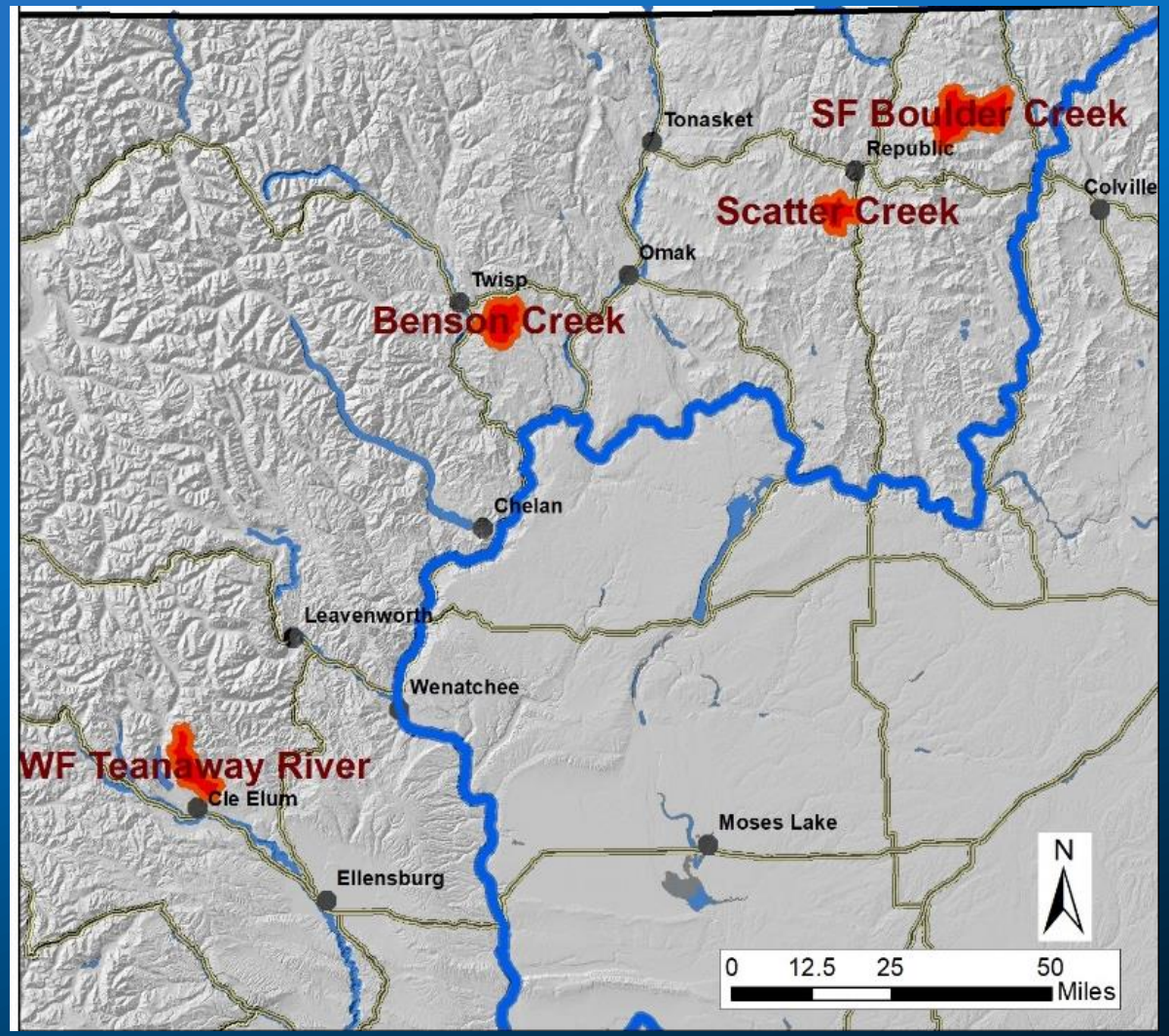
LEARN MORE
This landscape evaluation was completed in 2020.
More details about DNR's priority planning areas are available on the 20-Year Forest Health Strategic Plan website:
https://www.dnr.wa.gov/ForestHealthPlan

20-YEAR FOREST HEALTH STRATEGIC PLAN
EASTERN WASHINGTON

WASHINGTON STATE DEPT OF NATURAL RESOURCES
HILARY S. FRANZ
COMMISSIONER OF PUBLIC LANDS

Post-fire Landscape Evaluation

NEWFIRE: Assessed 4 fires in 4 sub-watersheds



Post-fire Landscape Evaluation

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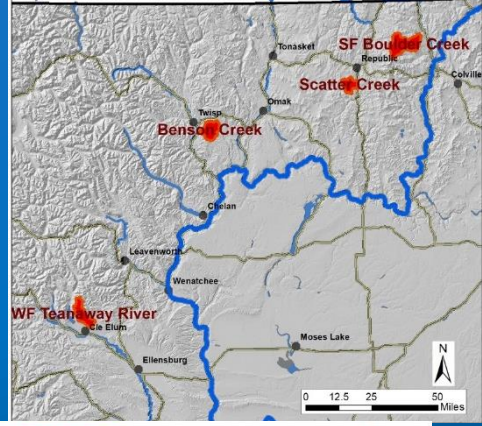
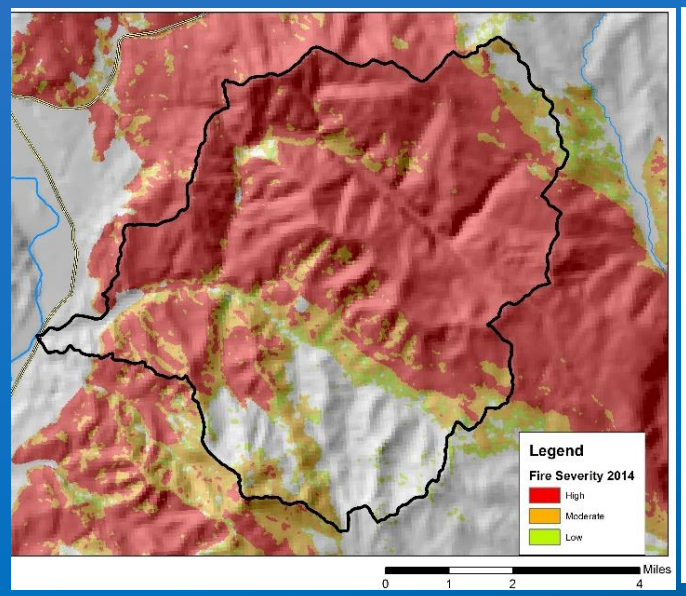
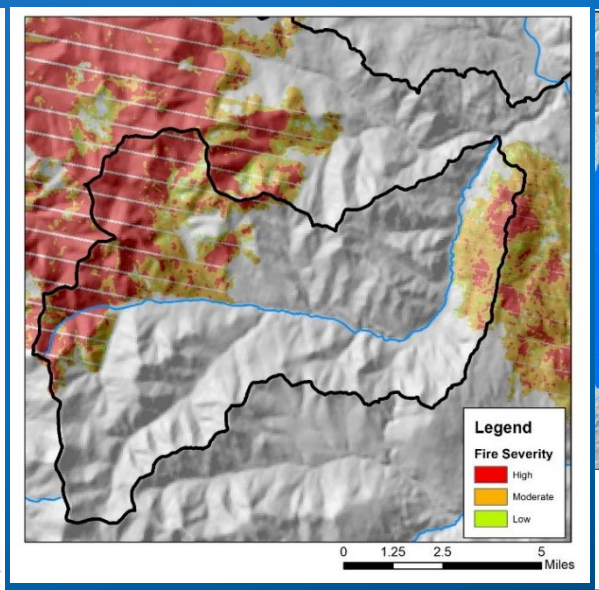
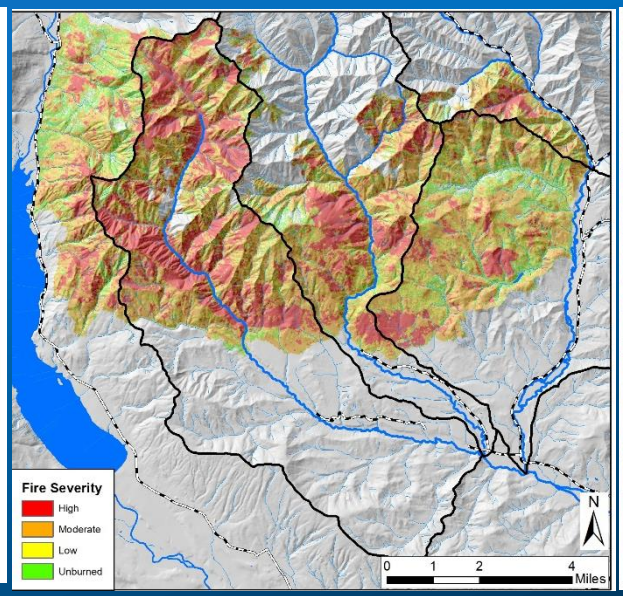




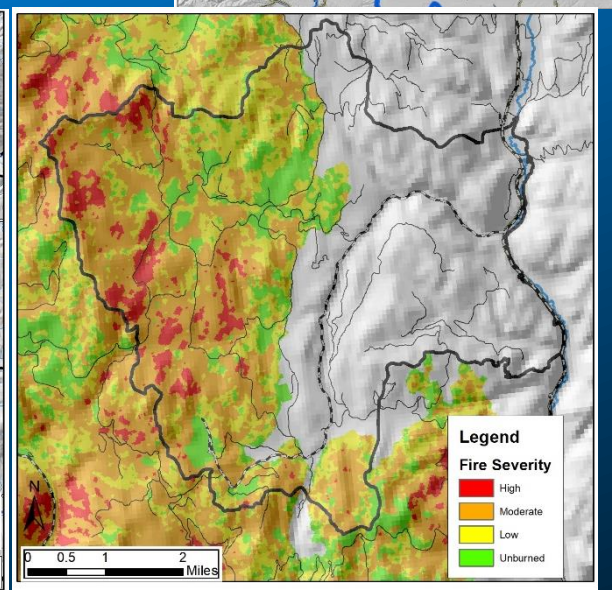
Carlton Complex: 2014
Benson Creek Watershed



Stickpin – Renner 2015
SF Boulder Creek



Jolly Mountain: 2017
West Fork Teanaway



Northstar 2015
Scatter Creek

High Severity,
large patches

Low-Mod Severity,
Medium-Small patches

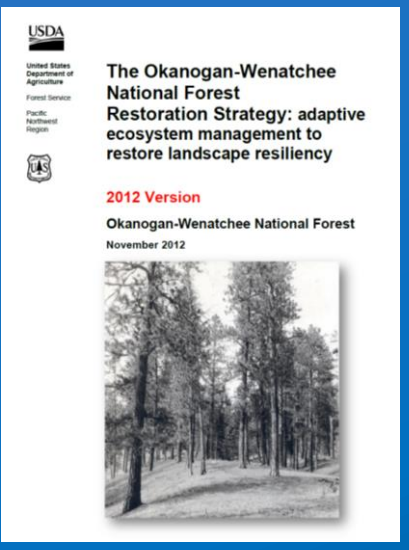
Are fires moving landscape towards more climate adapted & resilient conditions?

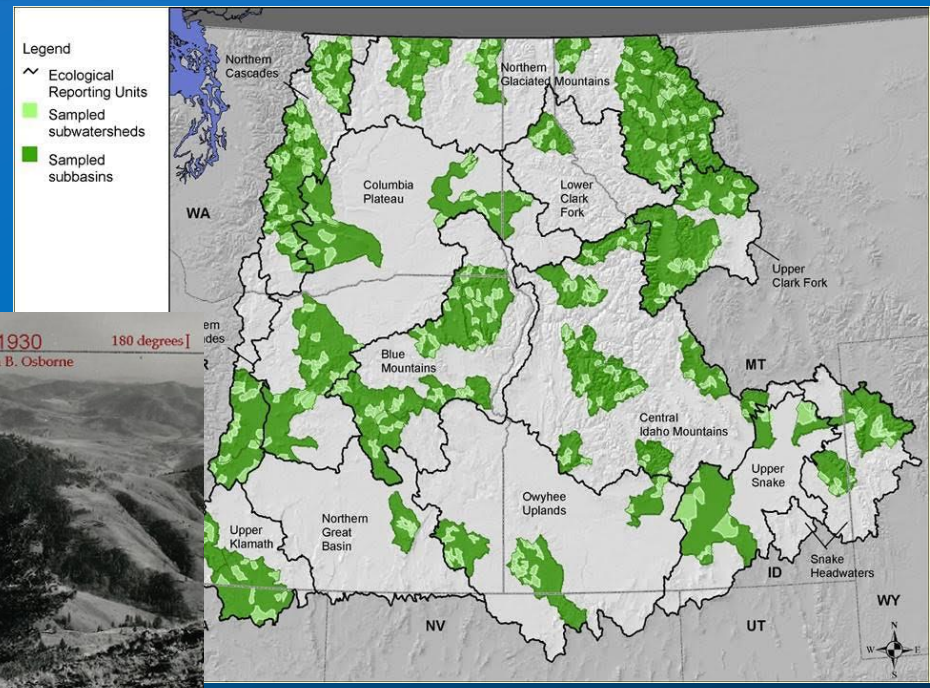
Evaluation Questions ➔ Landscape Restoration Principles	Fire Severity	
	Low – Mod.	High
1. Reset amounts & patterns of closed forest, open forest, & non-forest (shrub – herb)		
2. Align amounts & patterns of structure & fuels with future climate & fire regime		
3. Shift species composition towards more climate adapted, fire tolerant species		
4. Sustain patches with large/old trees		

Post-fire Landscape Evaluation

Methods:

- Pre and post-fire photo-interpretation (PI)
- Reference data from the Interior Columbia Basin Ecosystem Management Project.

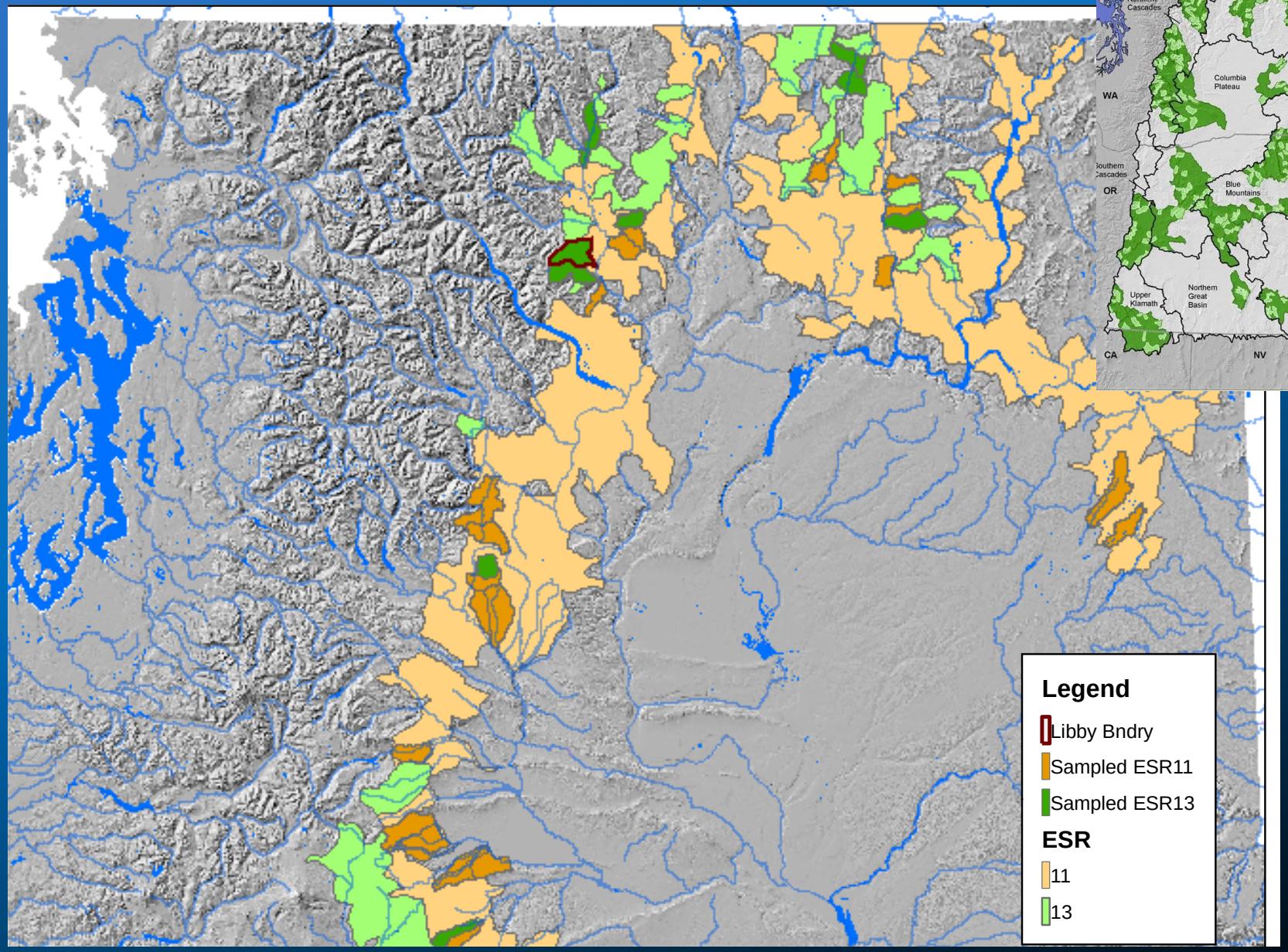


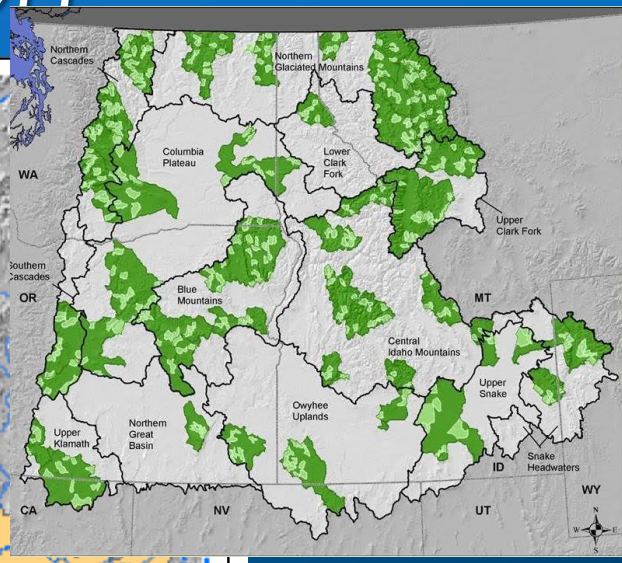


Post-fire Landscape Evaluation

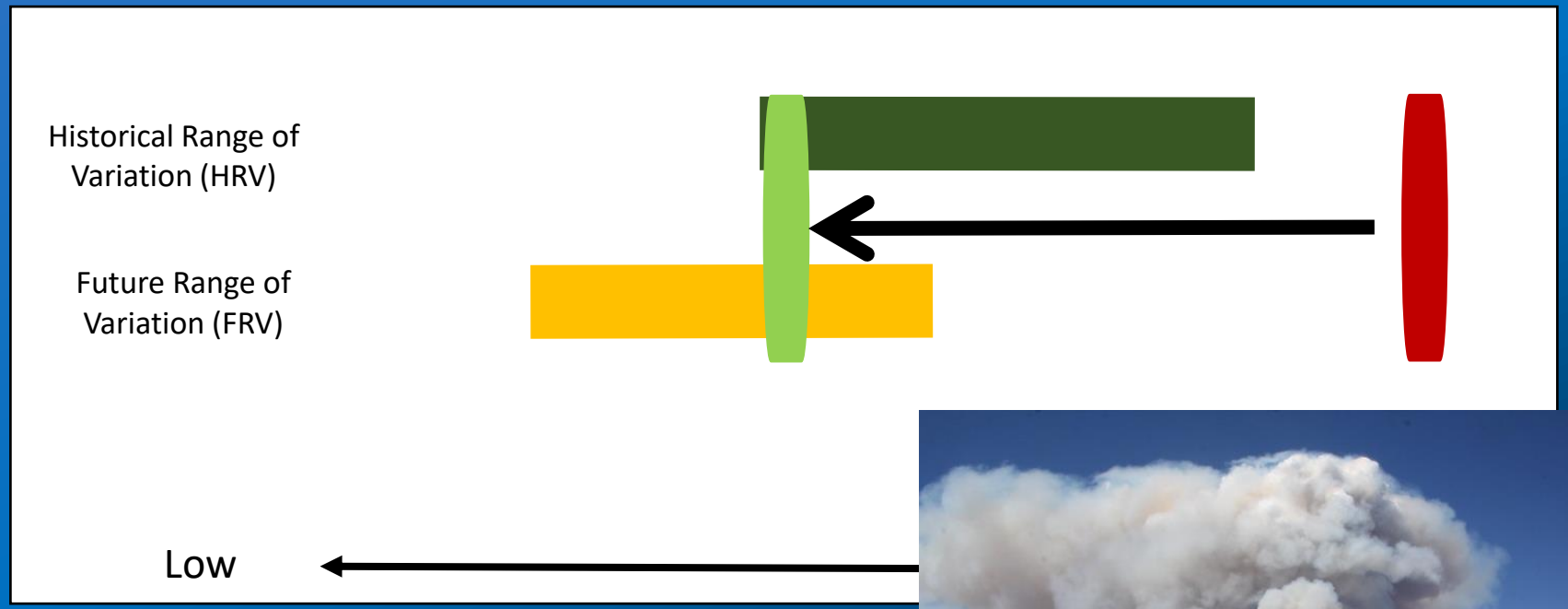
Methods:

- Compare pre and post-fire to HRV & FRV





Reference Conditions and Management Targets



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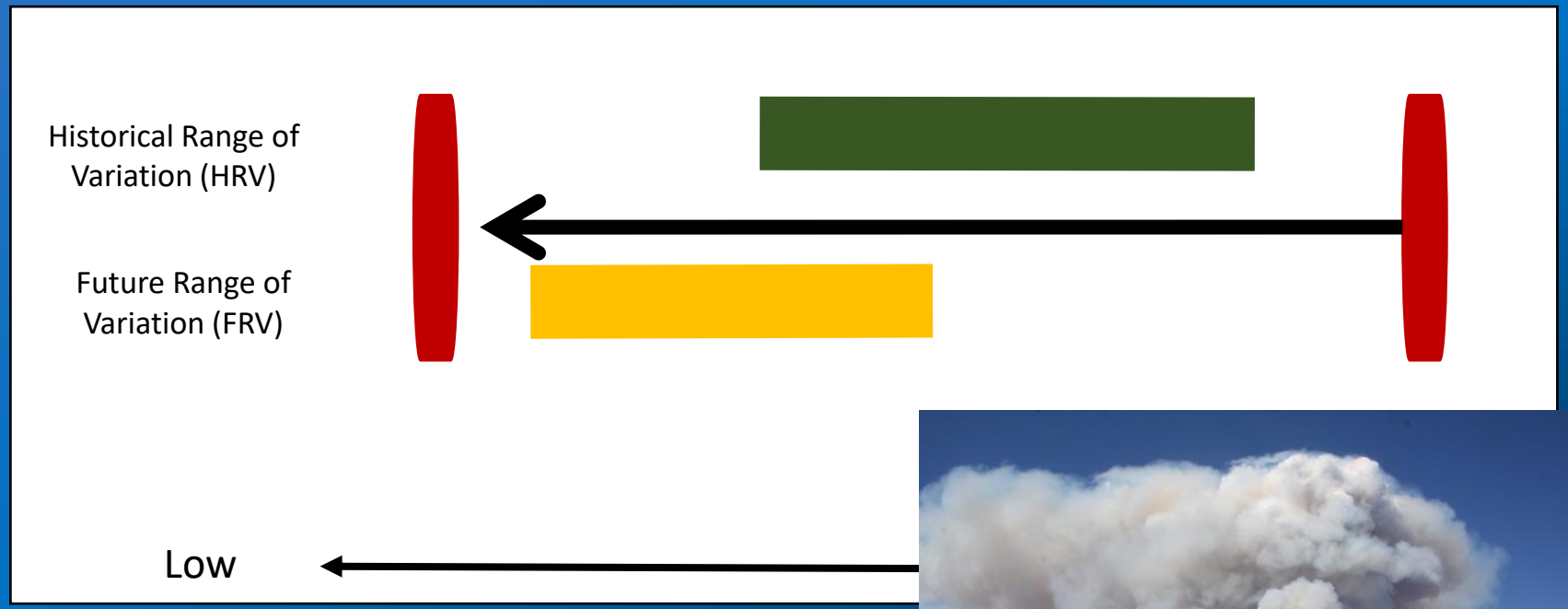
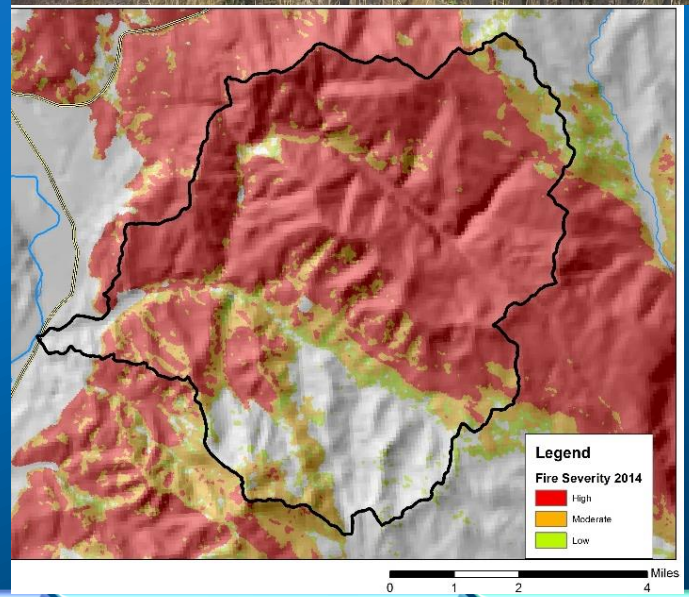
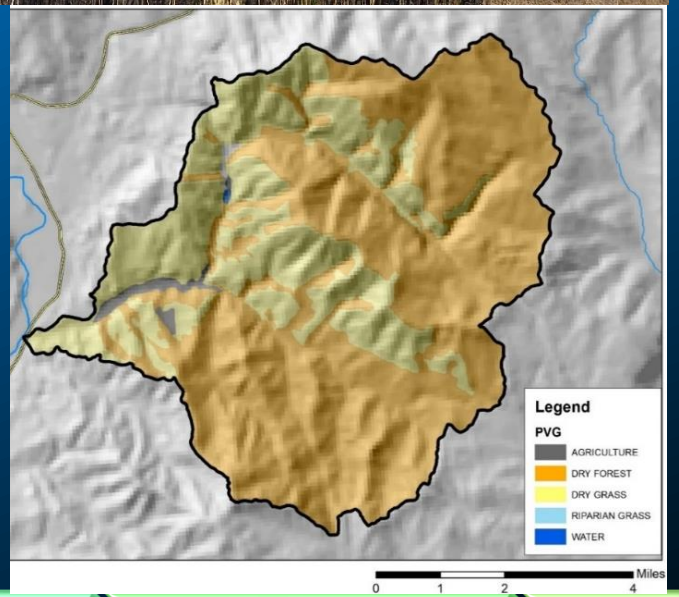


Landscape Restoration Principles	Low – Moderate Severity Fire	High Severity Fire
1. Reset amounts & patterns of closed forest, open forest, & non-forest (shrub – herbland)		



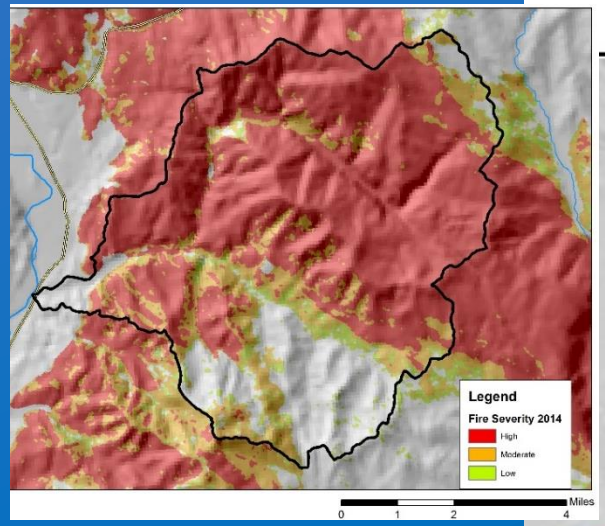
Carlton Complex
High Severity
Very Large Patches
Dry Forest

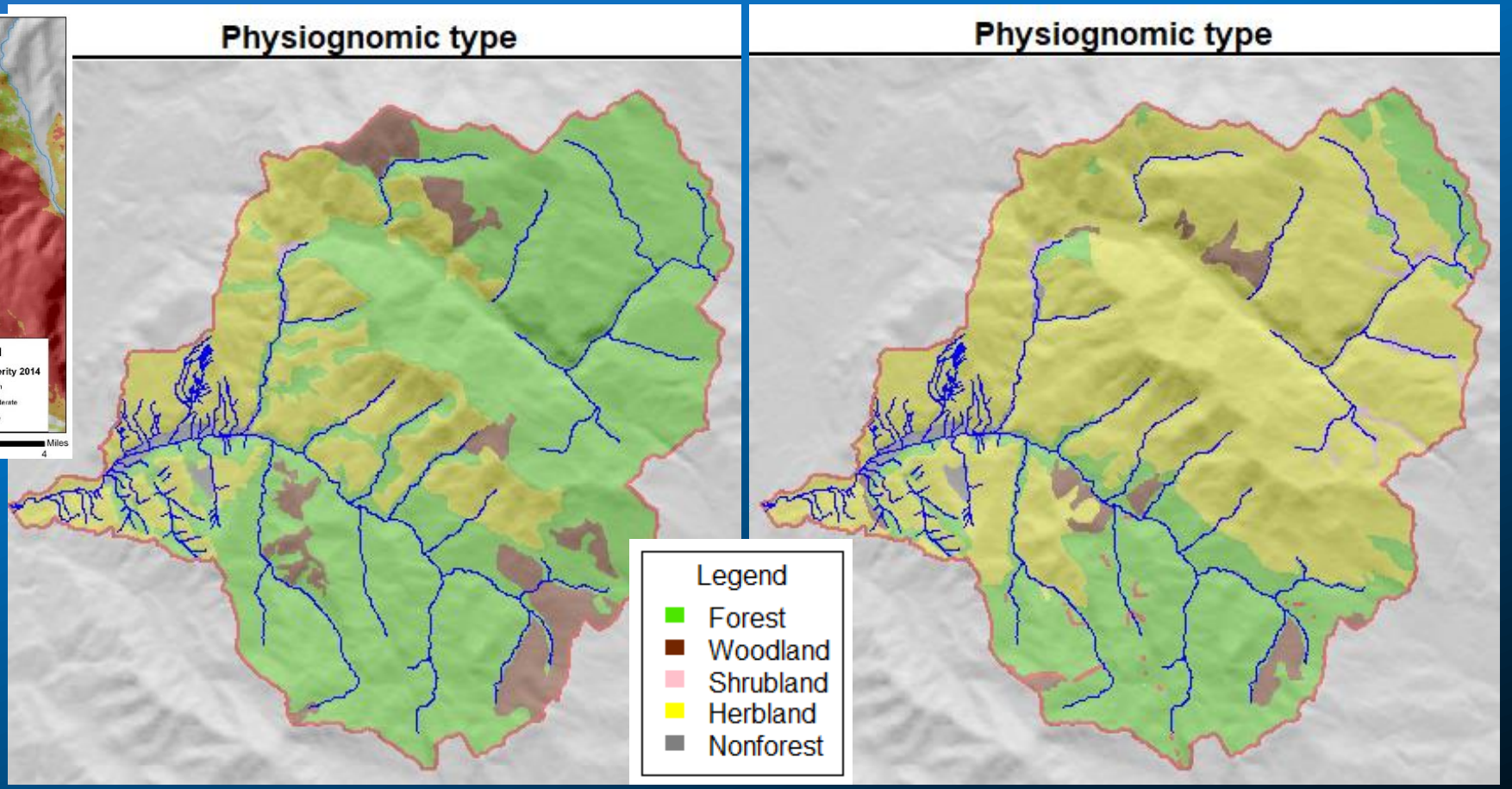


Landscape Restoration Principles	Low – Moderate Severity Fire	High Severity Fire
1. Reset amounts & patterns of closed forest, open forest, & non-forest (shrub – herbland)		↑ Create non-forest patches ↓ Too much NF, lose forest?

Pre Fire

Post Fire





Landscape Restoration Principles	Low – Moderate Severity Fire	High Severity Fire
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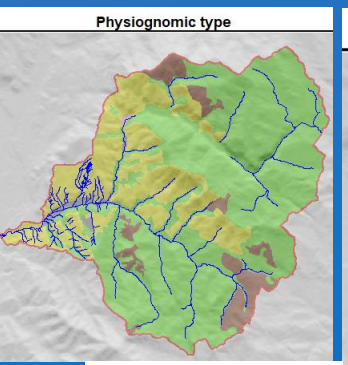
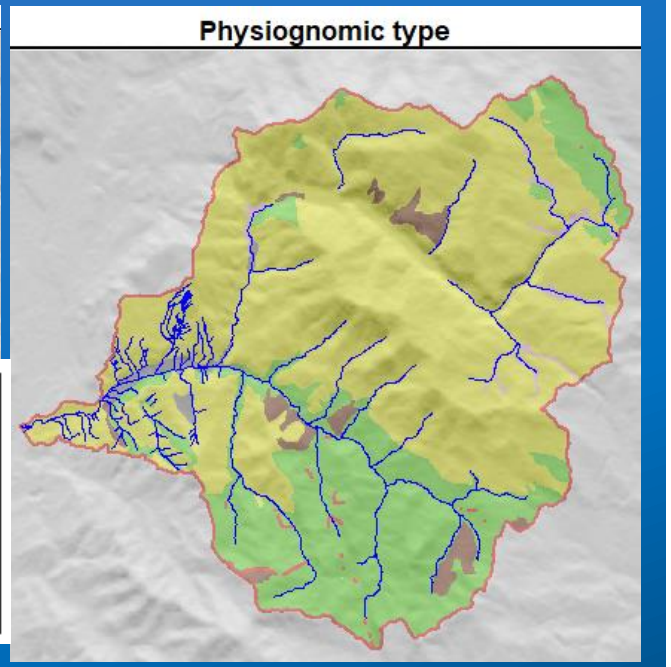
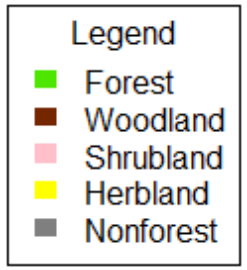
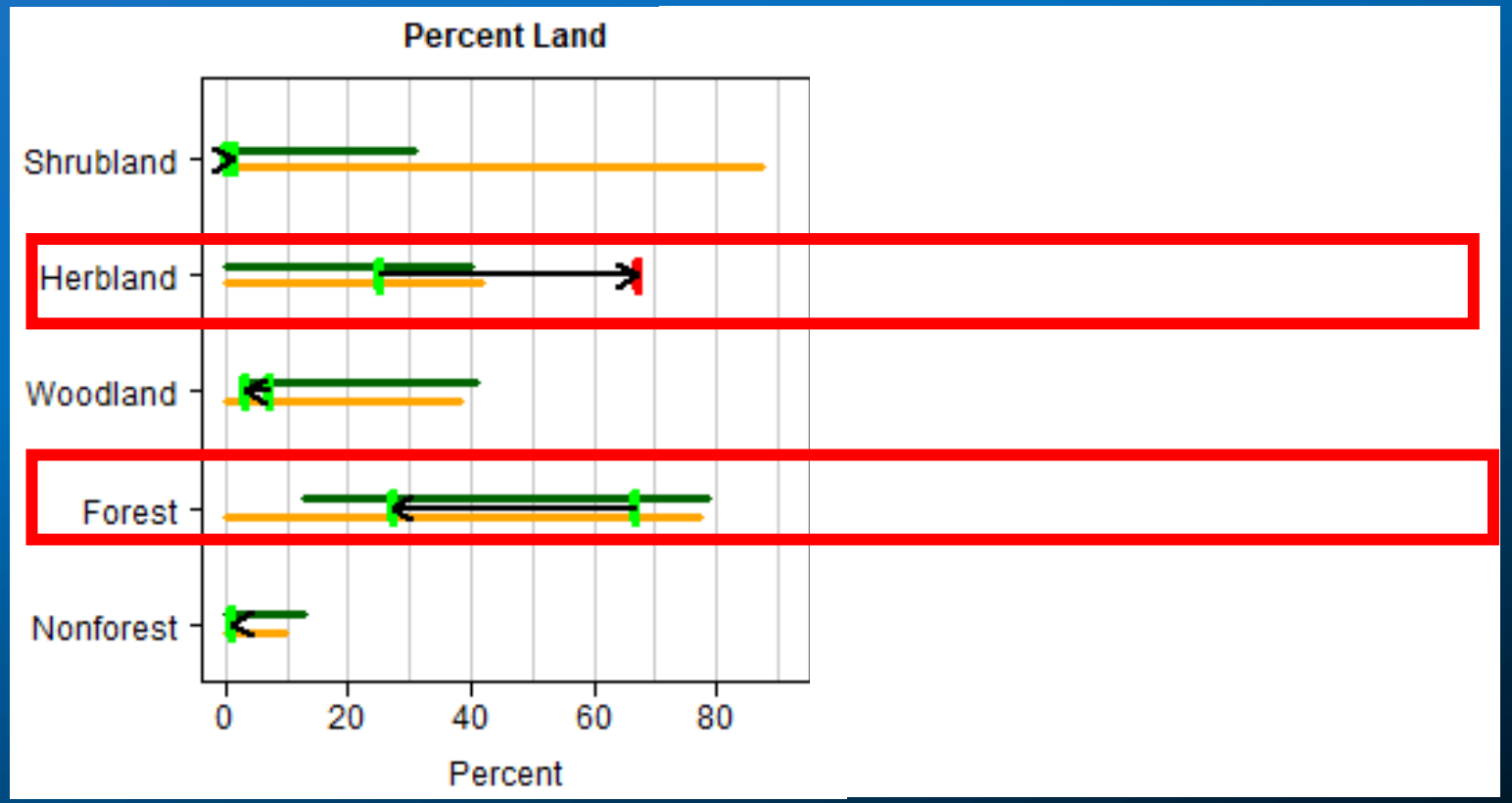
Pre Fire

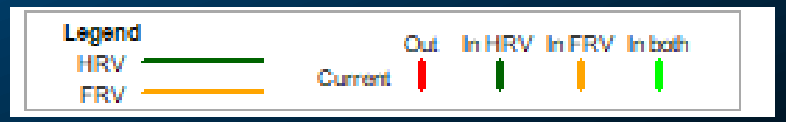


Post Fire

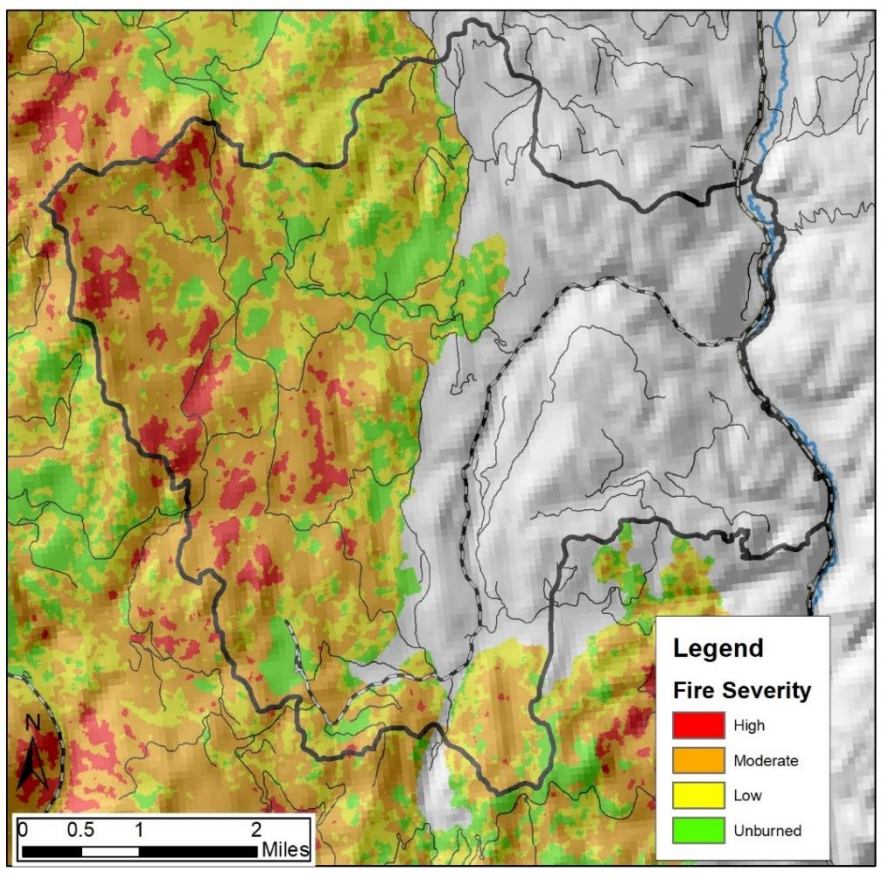




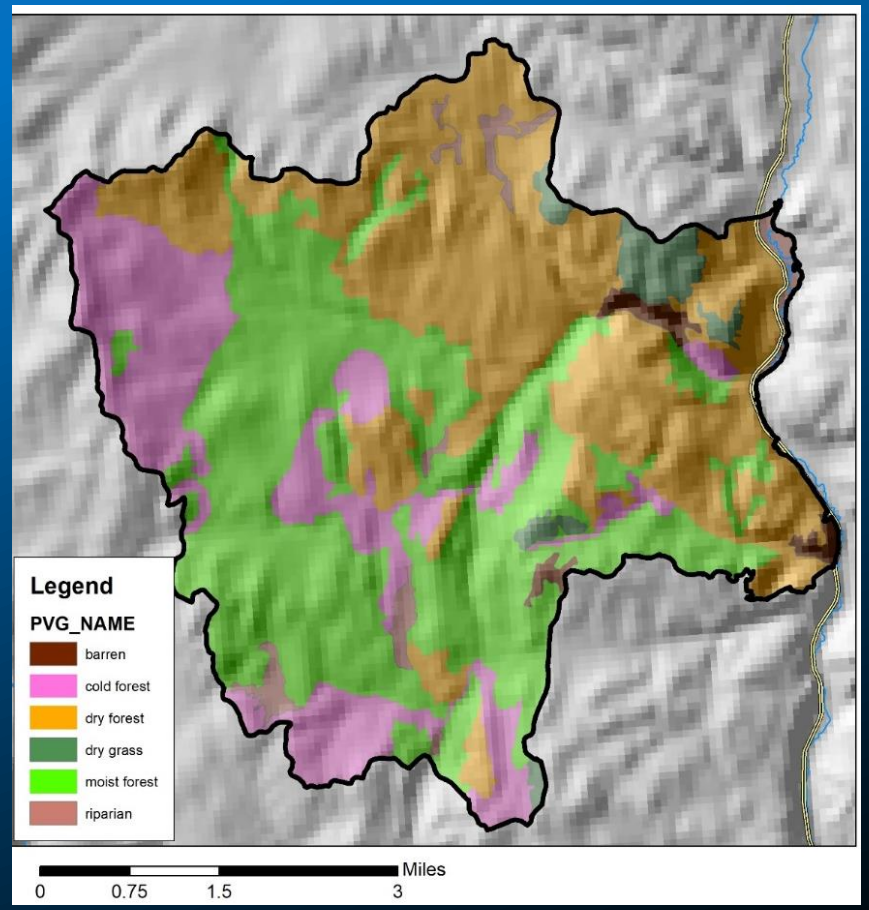




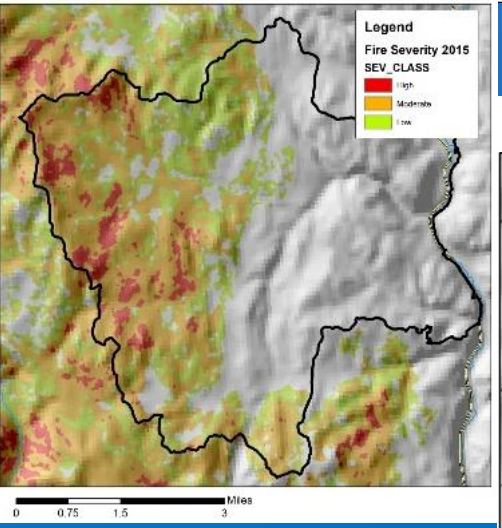
Landscape Restoration Principles	Low – Moderate Severity Fire	High Severity Fire
2. Align amounts & patterns of structure & fuels with future climate & fire regime		



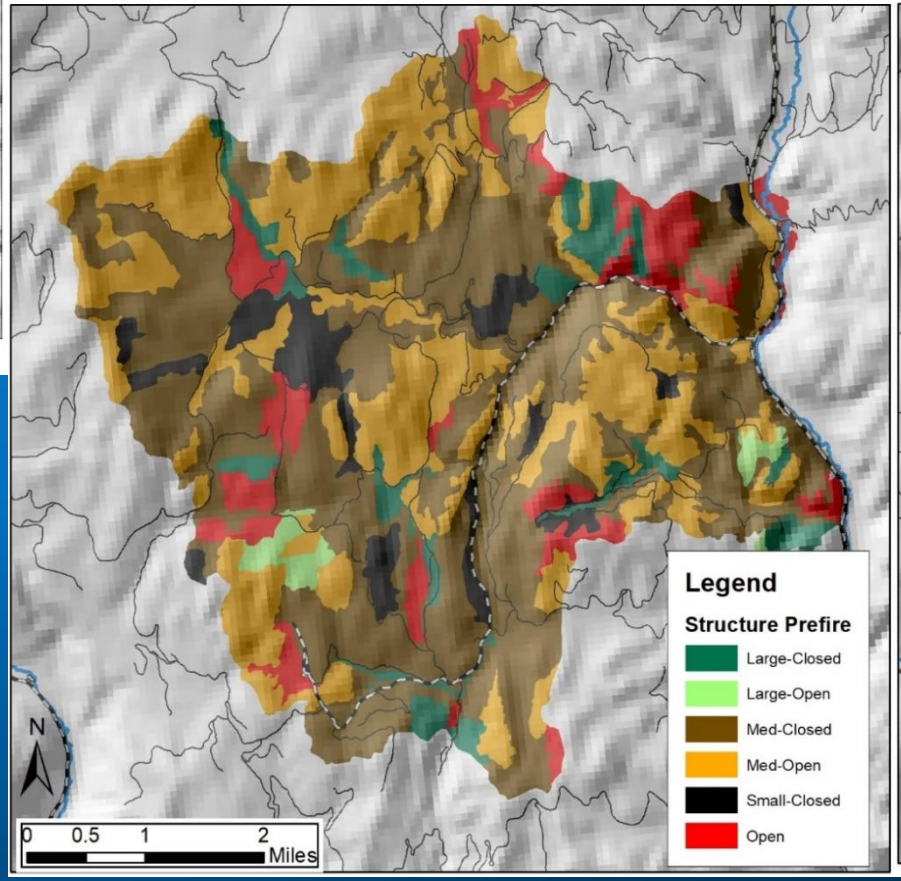
Northstar Fire
Moderate-Low Severity
Patches of high severity
Moist, cold, & dry forest



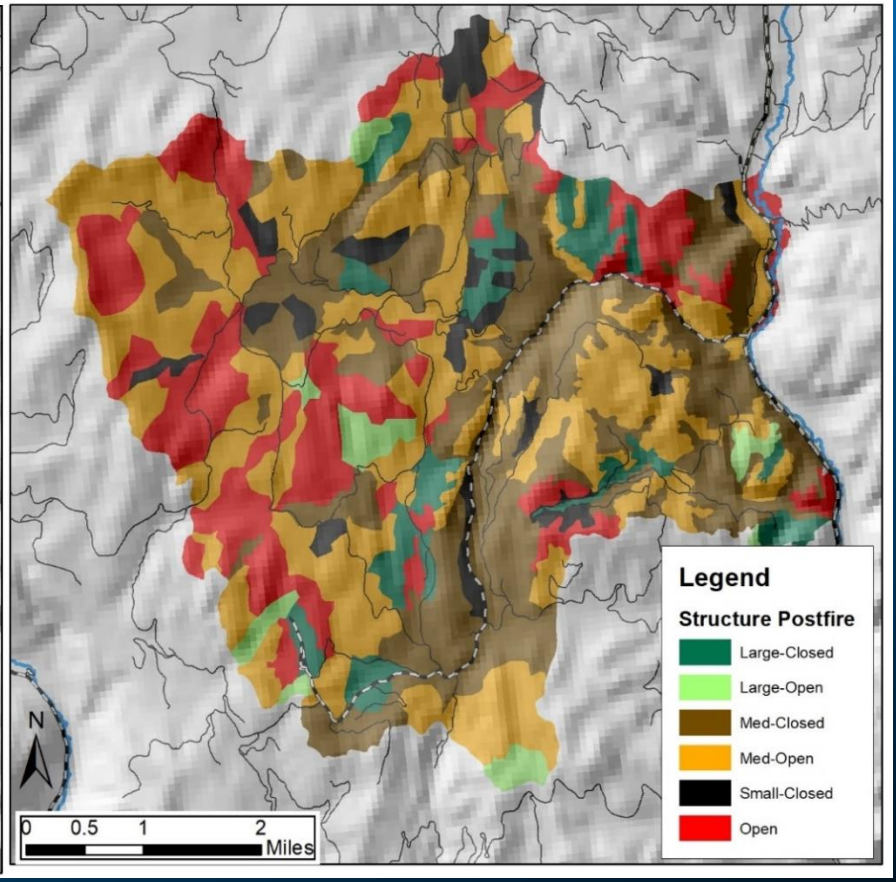
Landscape Restoration Principles	Low – Moderate Severity Fire	High Severity Fire
2. Align amounts & patterns of structure & fuels with future climate & fire regime	↑ Reduce density, closed forest ↓ Further fragment	



Pre-fire



Post-fire



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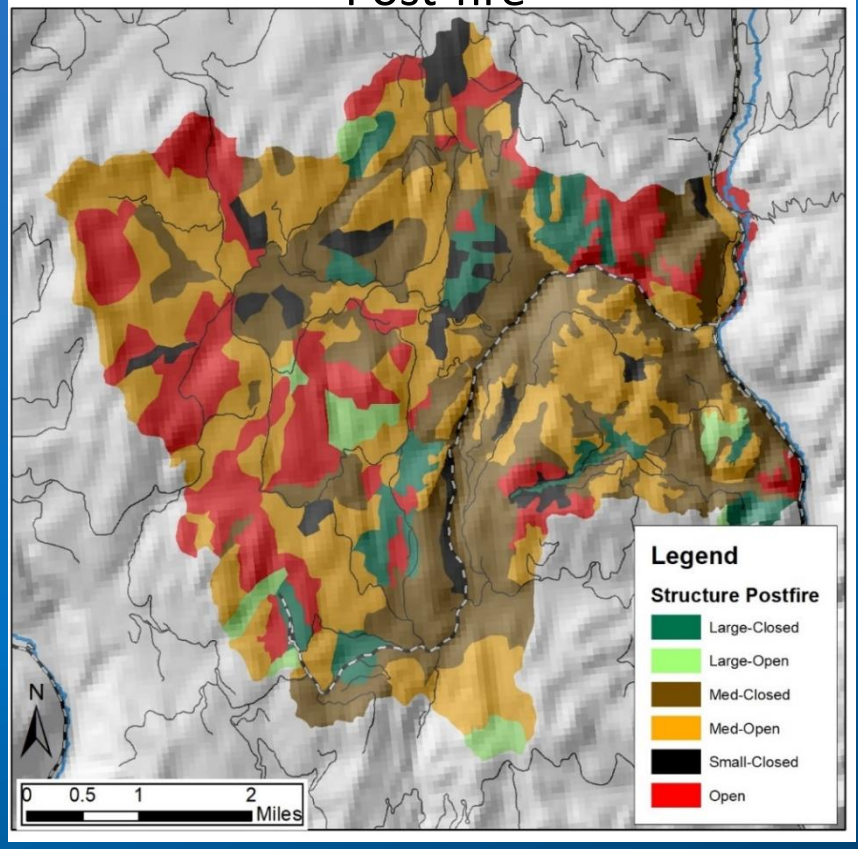

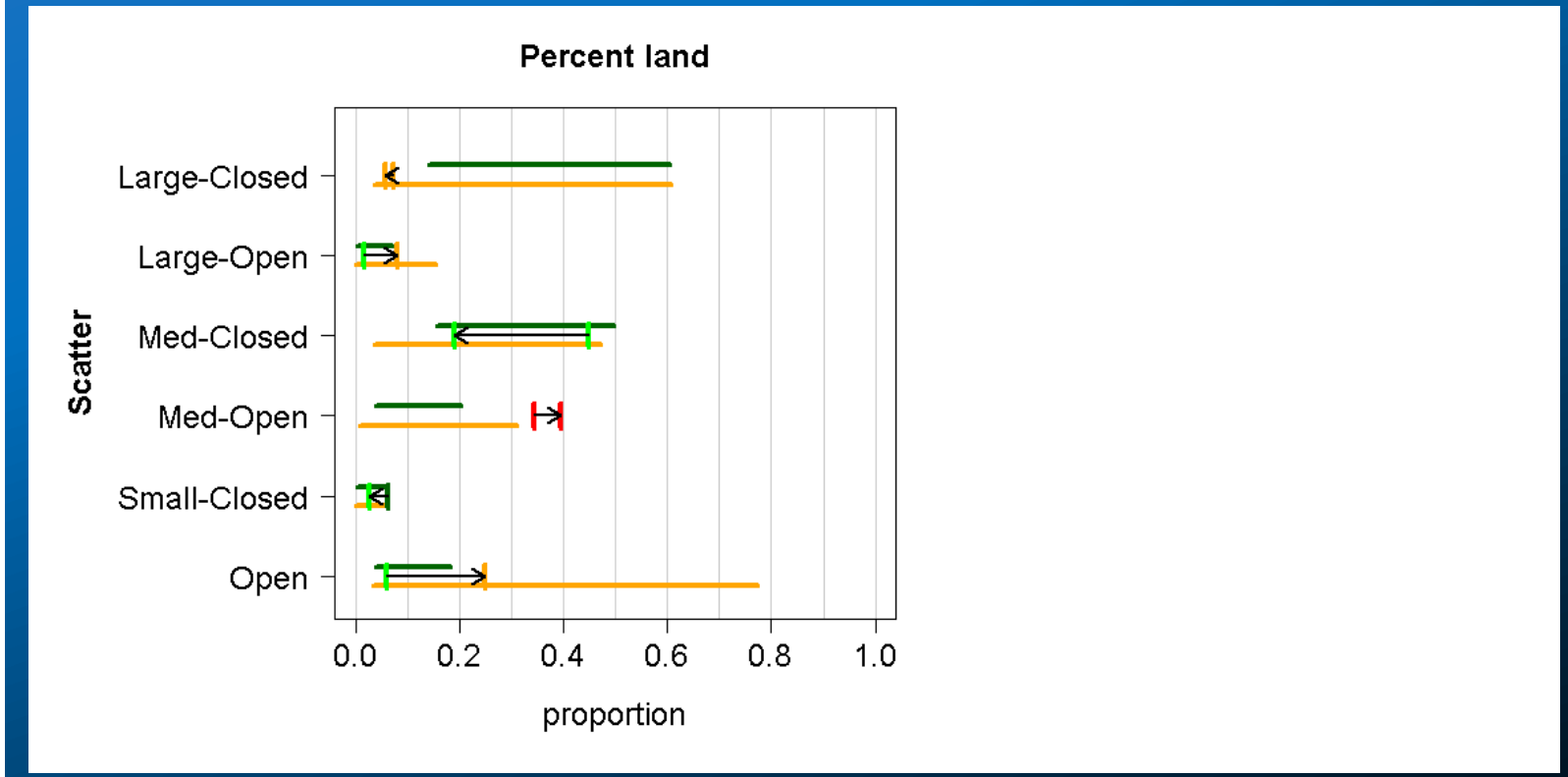

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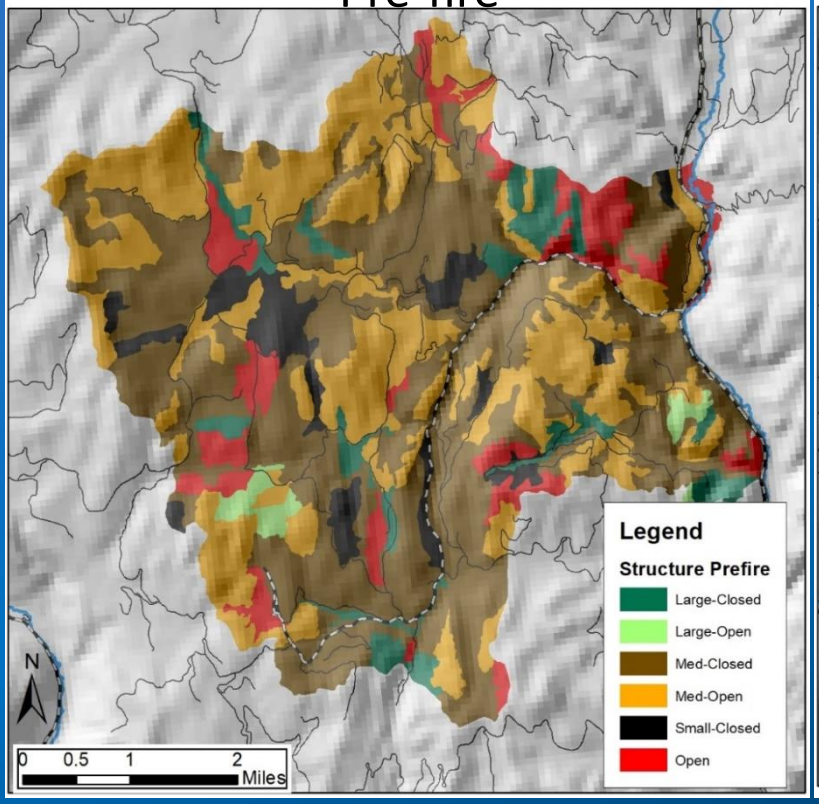
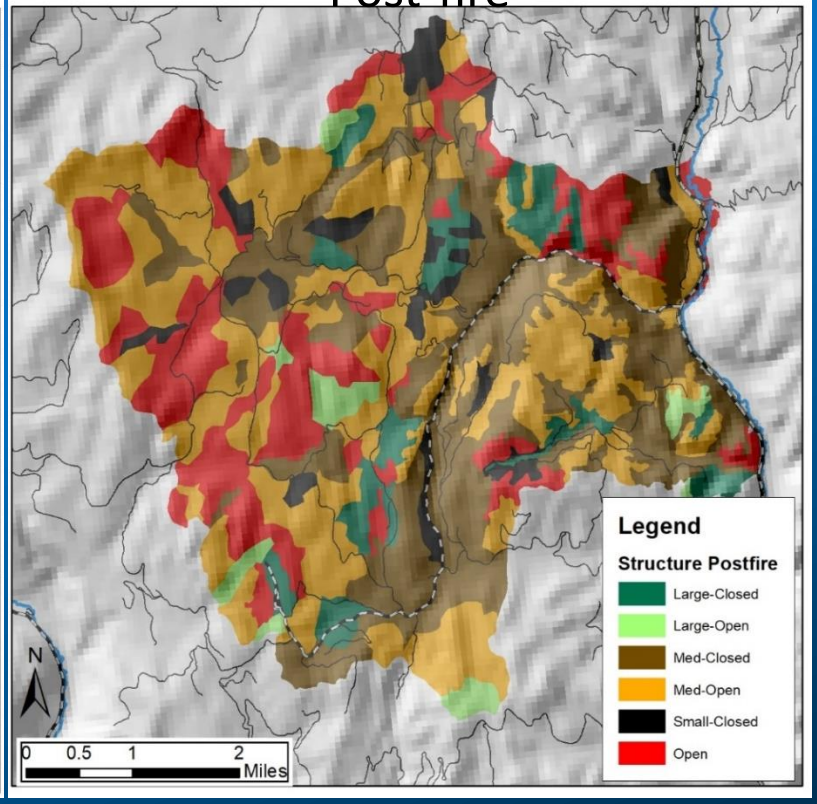
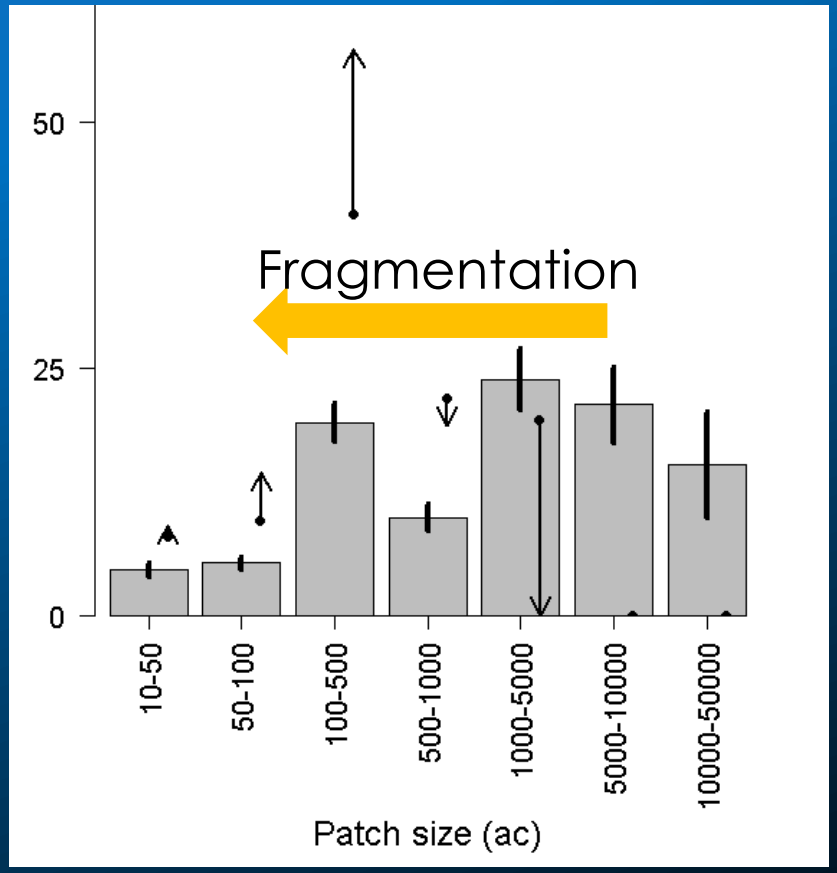


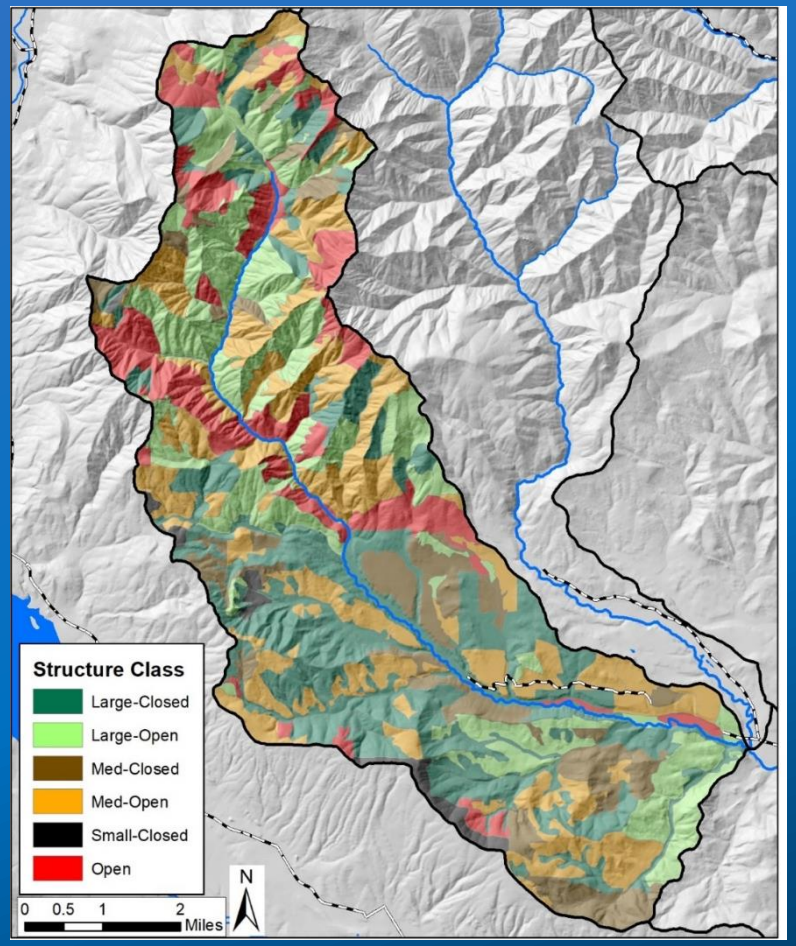
Post-fire

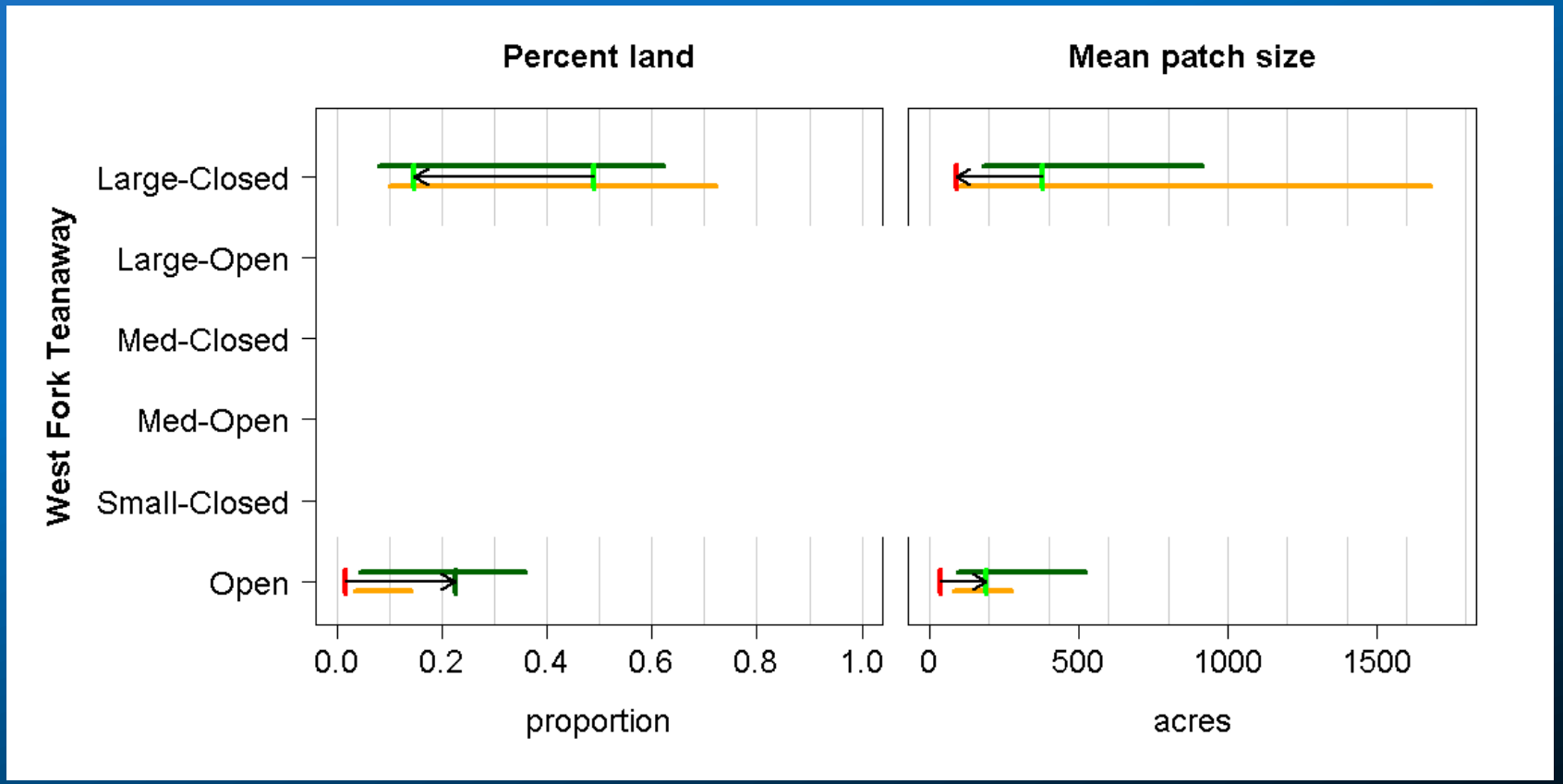




Landscape Restoration Principles	Low – Moderate Severity Fire	High Severity Fire
4. Sustain patches with large/old trees		High mortality Lose option to treat around

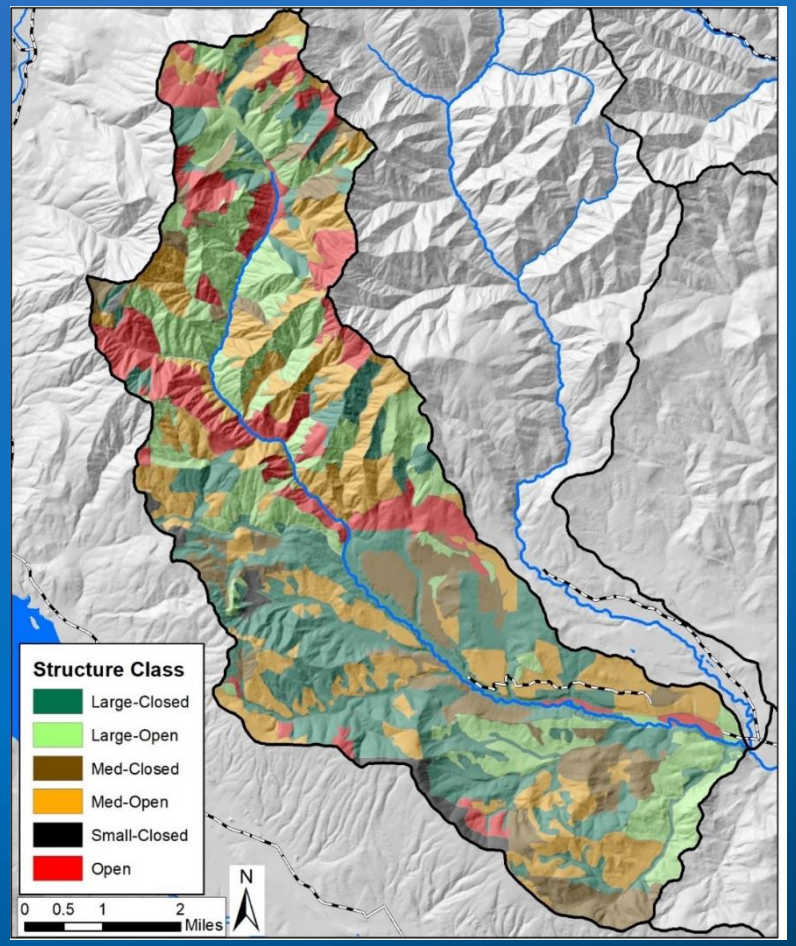
Post Fire

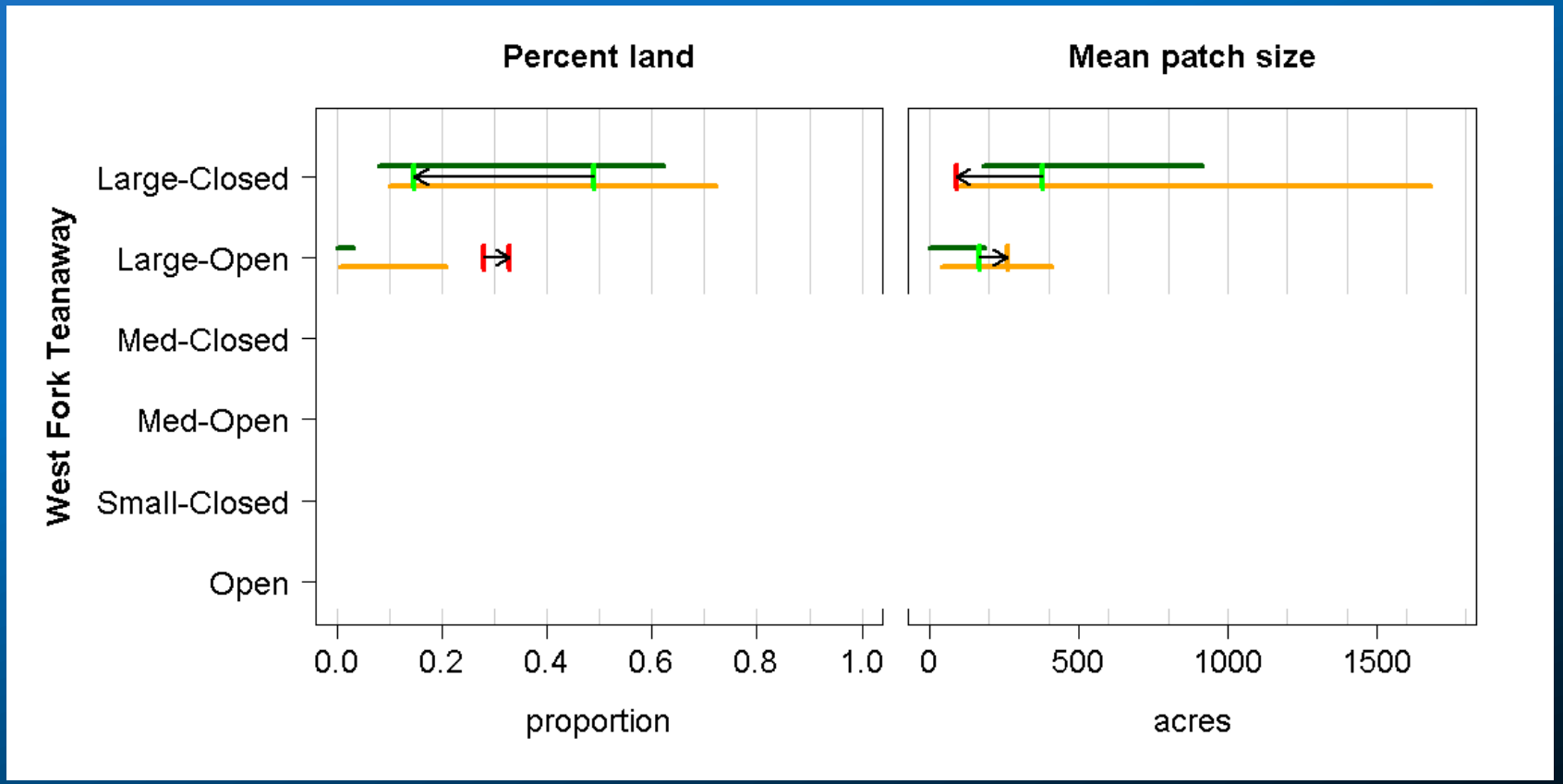




Landscape Restoration Principles	Low – Moderate Severity Fire	High Severity Fire
4. Sustain patches with large/old trees	↑ Release large trees ↑ Retains most large-closed	↓ High mortality Lose option to treat around

Post Fire

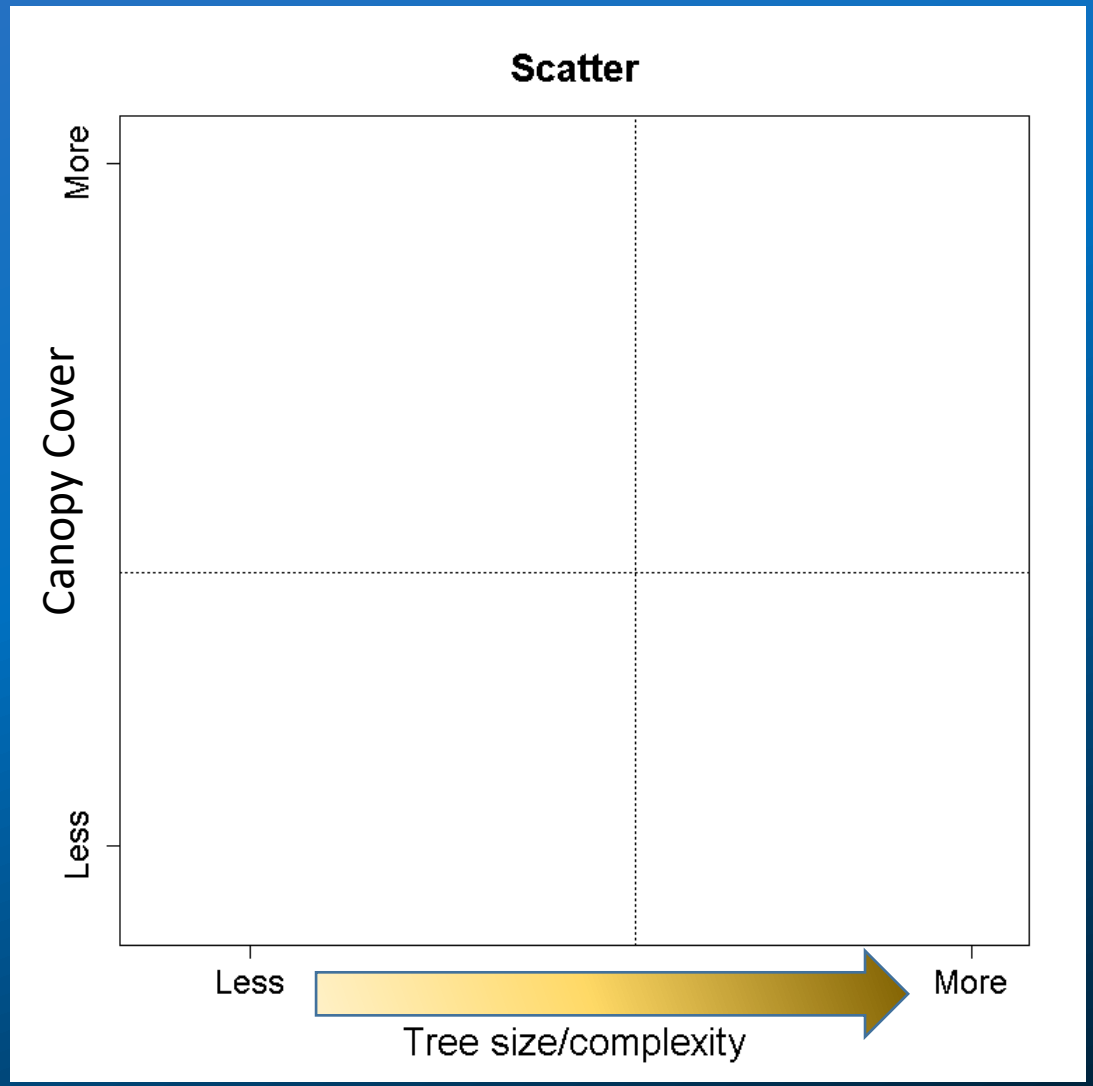




Are fires moving landscape towards more climate adapted & resilient conditions?

Landscape Restoration Principles	Low – Moderate Severity Fire	High Severity Fire
1. Reset amounts & patterns of closed forest, open forest, & non-forest (shrub – herbland)	↑ Open forest = Little effect on non-forest	↑ Create non-forest patches ↓ Too much NF, lose forest?
2. Align amounts & patterns of structure & fuels with future climate & fire regime	↑ Reduce density, closed forest ↓ Further fragment	↑ Reset pattern: large patches ↓ Overshoot on patch sizes
3. Shift species composition towards more climate adapted, fire tolerant species	↑ Can shift to fire tolerants = Little change in overstory	↓ Kills all species! ↑ Opportunity for new species
4. Sustain patches with large/old trees	↑ Release large trees ↑ Retains most large-closed	↓ High mortality Lose option to treat around

Are fires moving landscape towards more climate adapted & resilient conditions?



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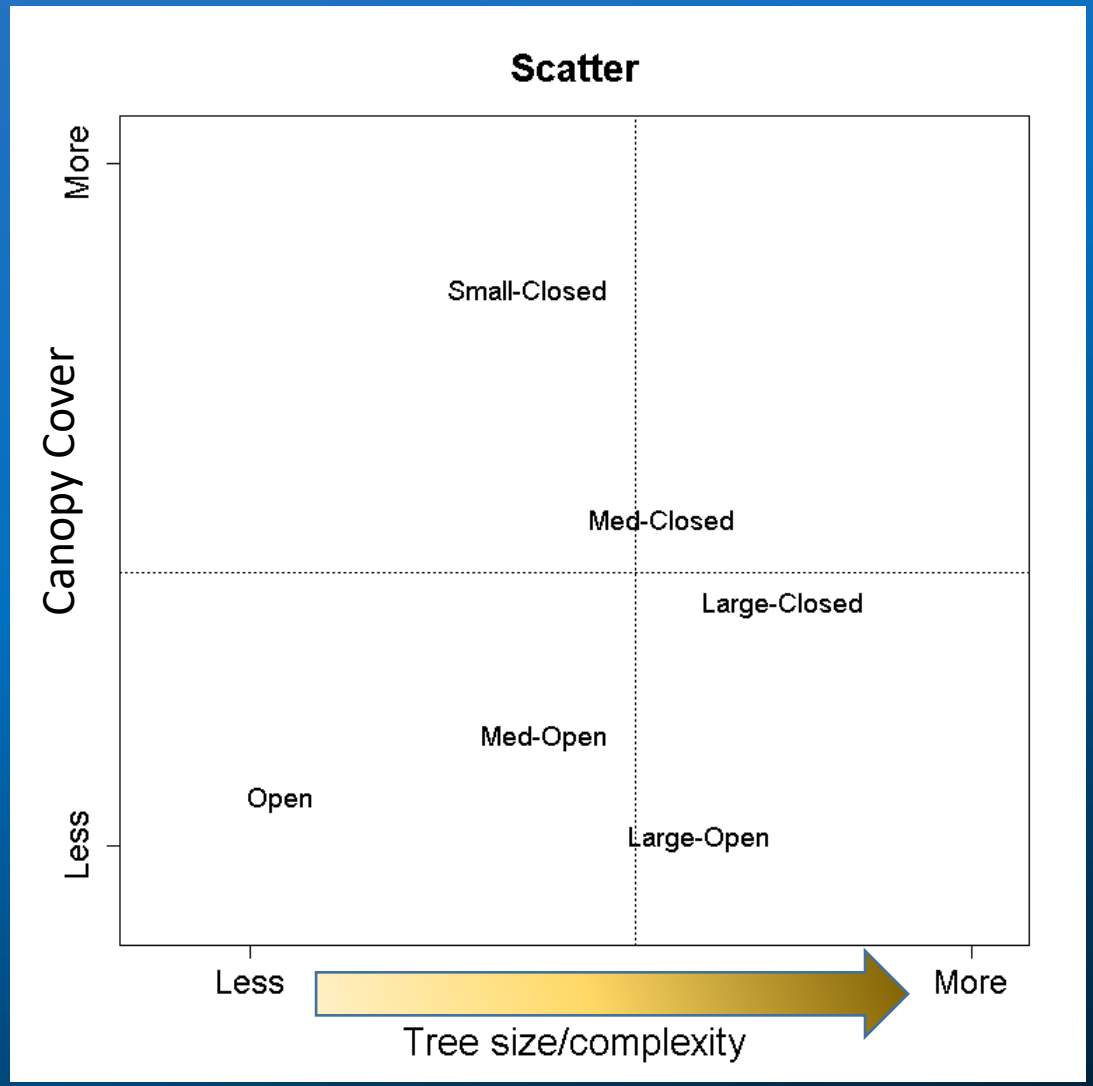

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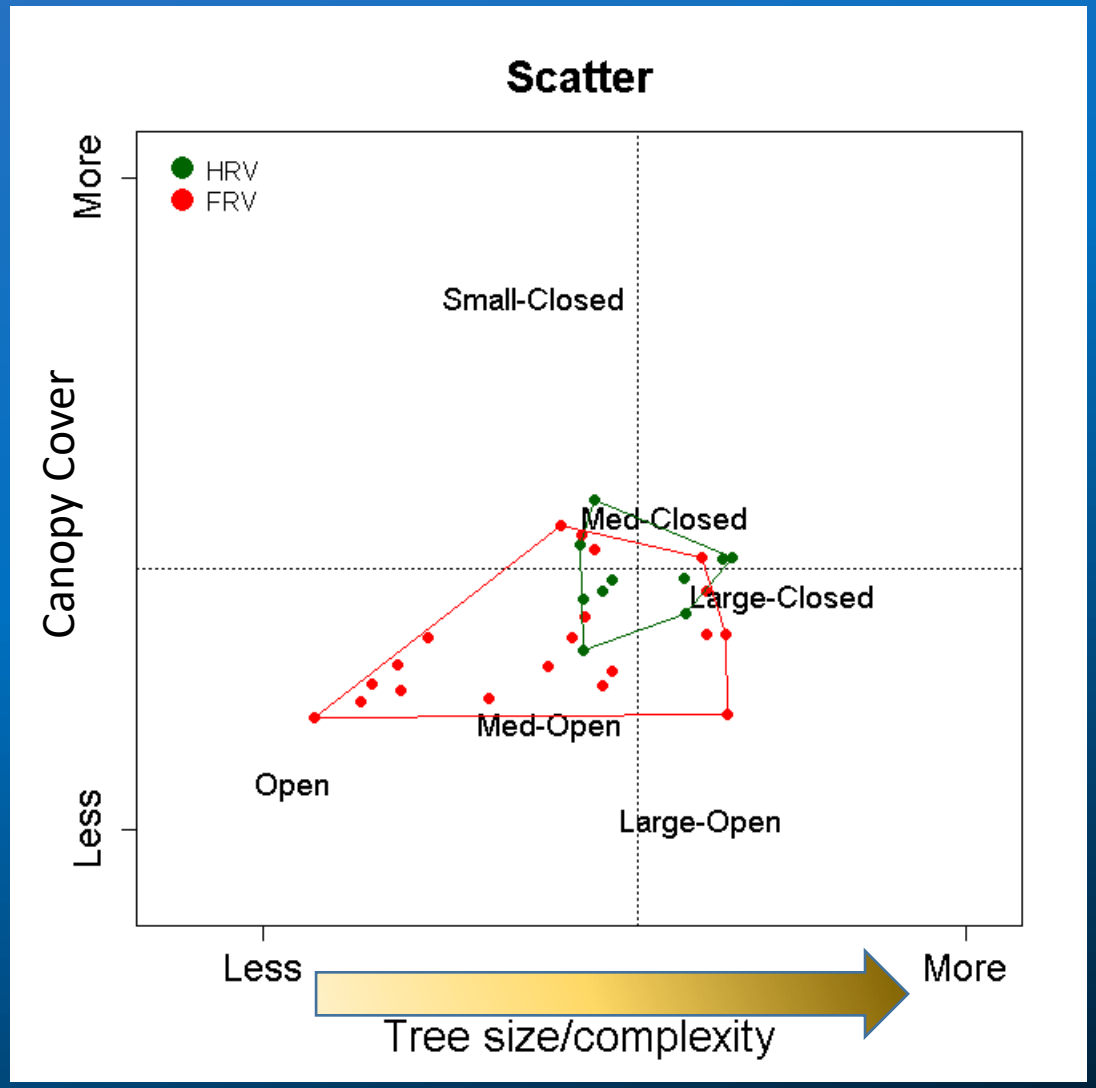
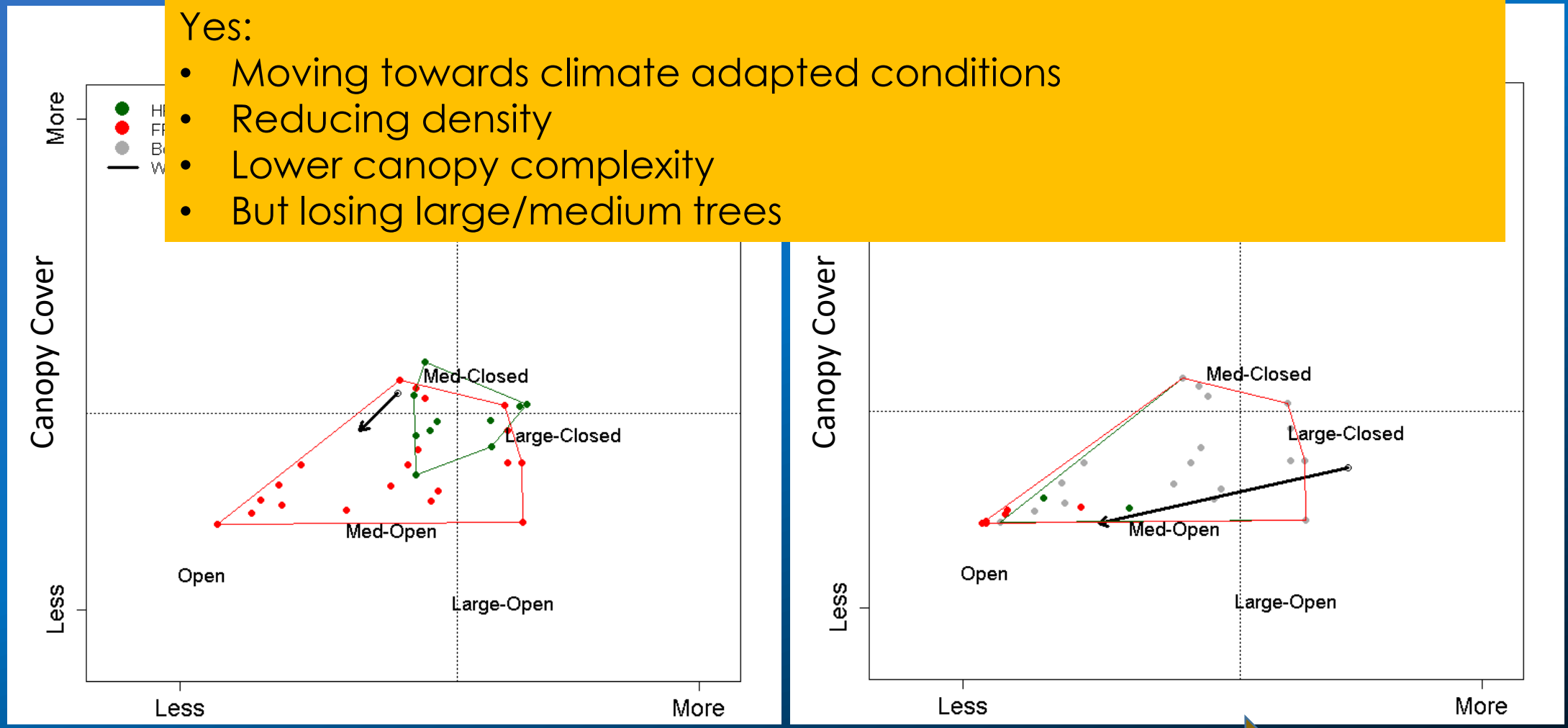


Are fires moving landscape towards more climate adapted & resilient conditions?

Yes:

- Moving towards climate adapted conditions
- Reducing density
- Lower canopy complexity
- But losing large/medium trees

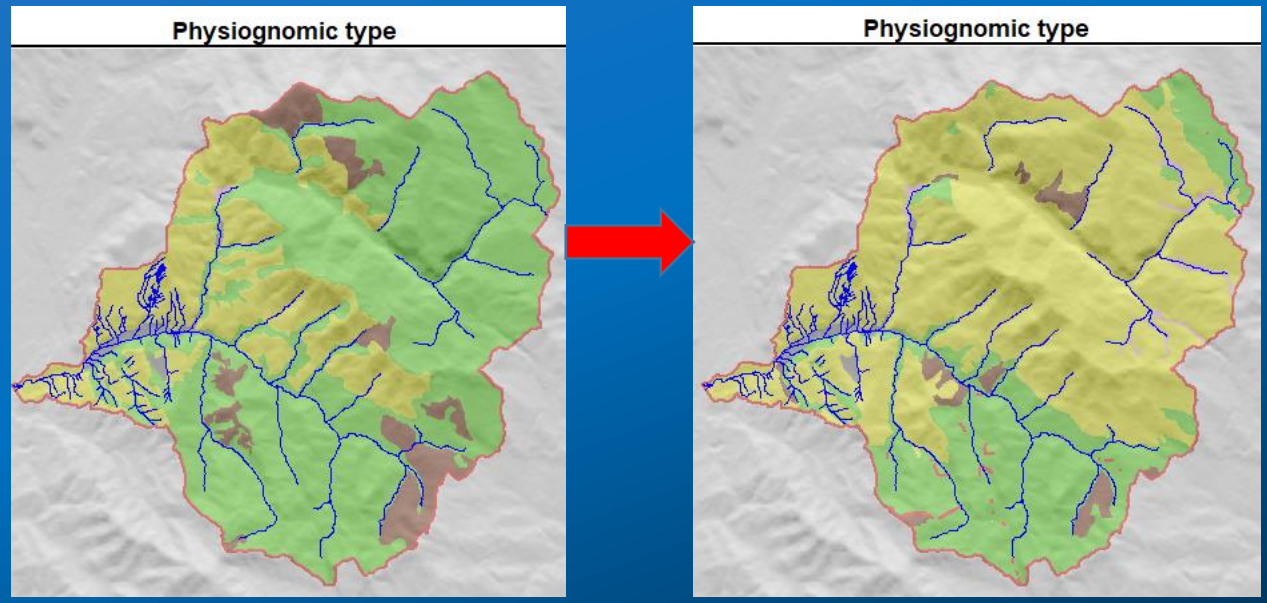


Tree Size/Complexity

Are fires moving landscape towards more climate adapted & resilient conditions?

➔ But, wildfire is a blunt tool.

- Overshoot on patch sizes
- Further fragment, losing all large patches
- Lose large/old trees
- Future fuels remain high



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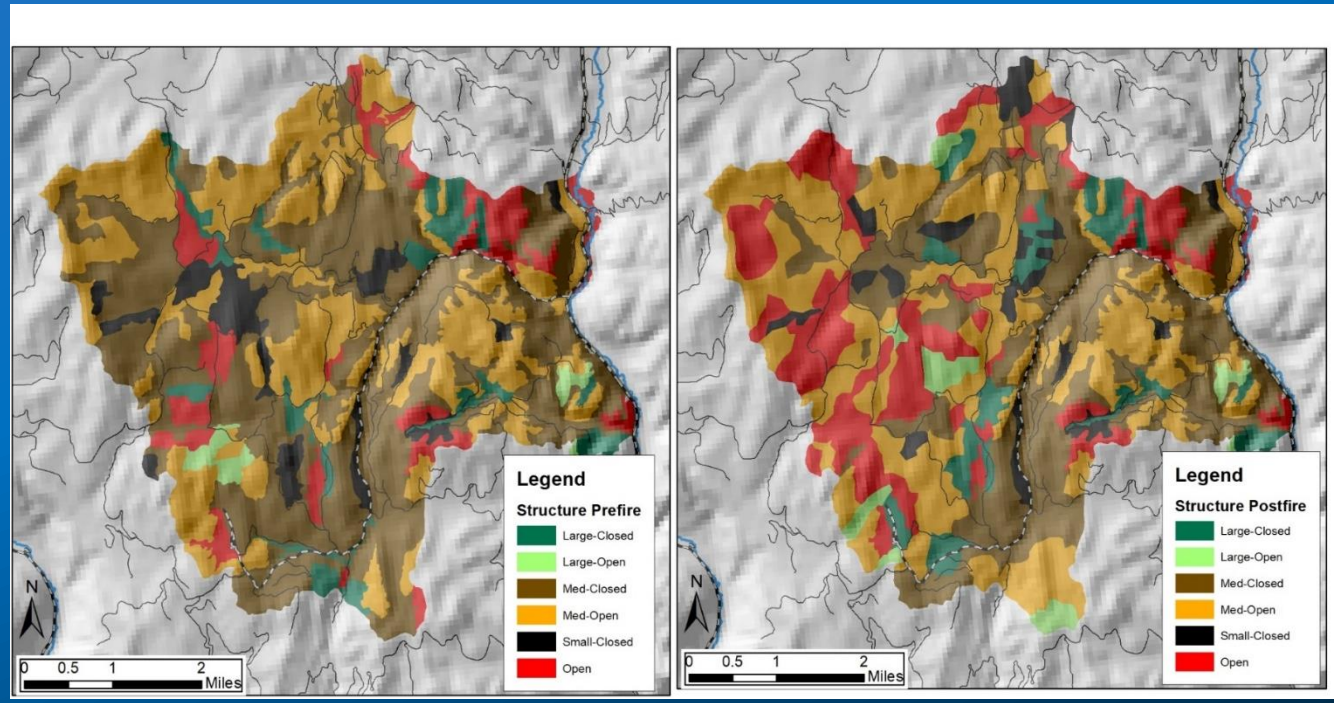

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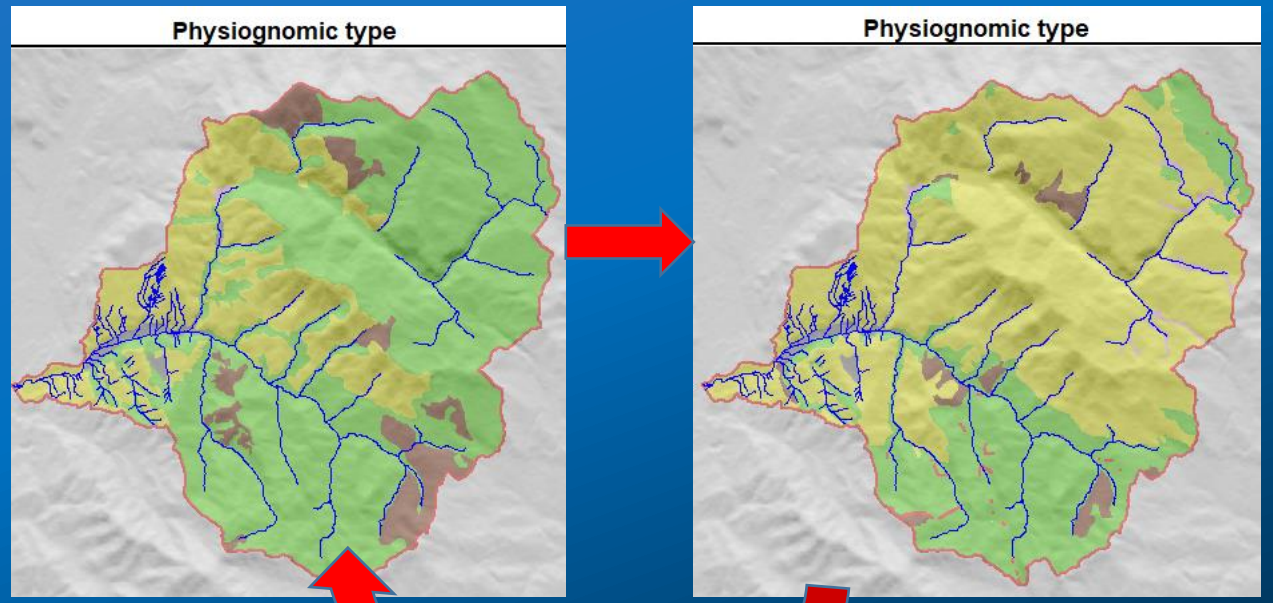


➔Pre-fire pattern ➔ post-fire pattern ➔ Next fire

➔ Better outcomes if landscape is treated beforehand.

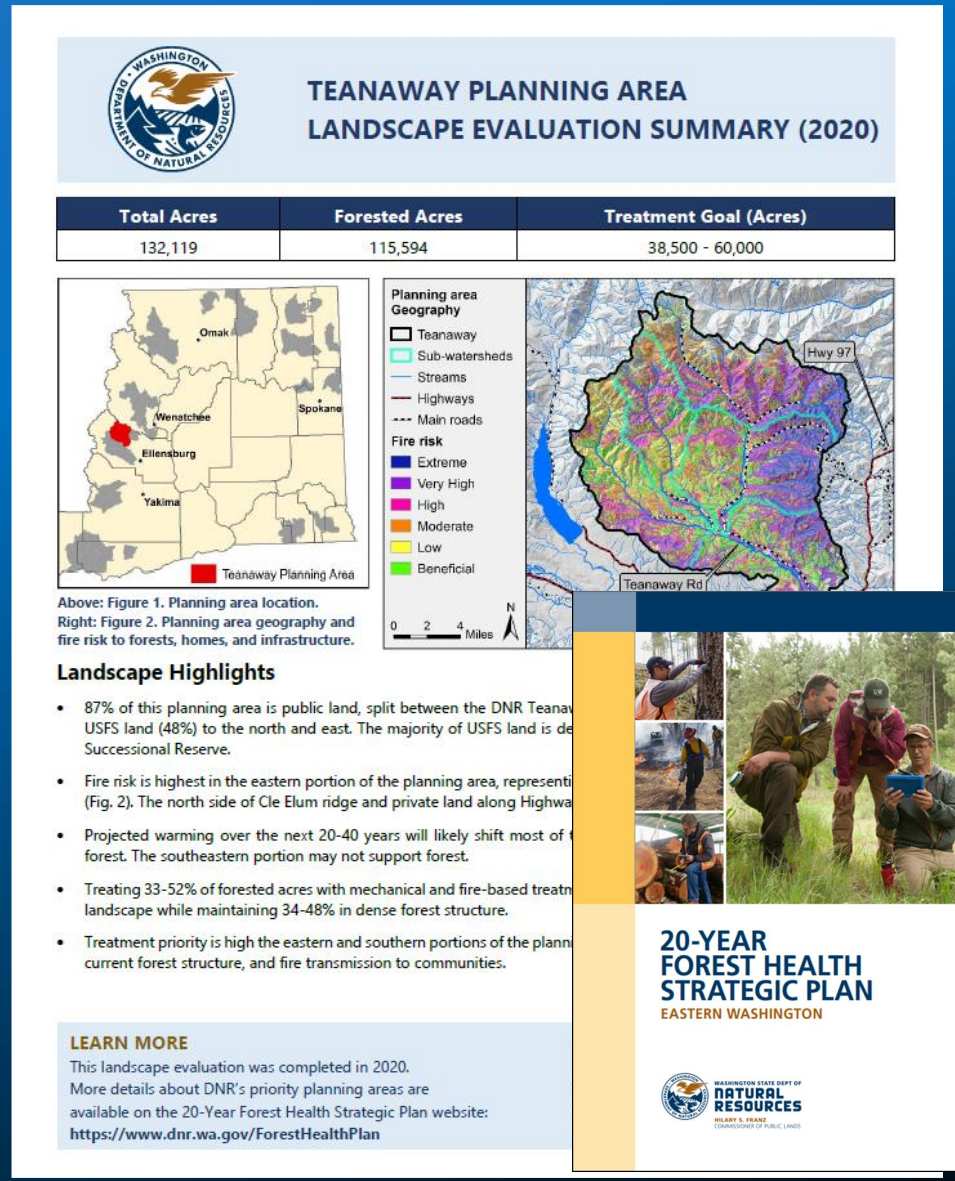
➔ Landscape Rx building off work of wildfire to shift trajectory

Evaluating the work of wildfires

Post-fire Landscape Evaluation

1. Obtain & analyze fire severity data
2. Obtain and/or infer post-fire veg data for landscape
3. Assess "work" of fire in moving landscape metrics towards climate adapted, resilient conditions

Post-fire Landscape Prescription



TEANAWAY PLANNING AREA
LANDSCAPE EVALUATION SUMMARY (2020)

Total Acres	Forested Acres	Treatment Goal (Acres)
132,119	115,594	38,500 - 60,000

Above: Figure 1. Planning area location.
Right: Figure 2. Planning area geography and fire risk to forests, homes, and infrastructure.

Landscape Highlights

- 87% of this planning area is public land, split between the DNR Teanav USFS land (48%) to the north and east. The majority of USFS land is de Successional Reserve.
- Fire risk is highest in the eastern portion of the planning area, representi (Fig. 2). The north side of Cle Elum ridge and private land along Highwa
- Projected warming over the next 20-40 years will likely shift most of t forest. The southeastern portion may not support forest.
- Treating 33-52% of forested acres with mechanical and fire-based treatn landscape while maintaining 34-48% in dense forest structure.
- Treatment priority is high the eastern and southern portions of the planni current forest structure, and fire transmission to communities.

LEARN MORE
This landscape evaluation was completed in 2020.
More details about DNR's priority planning areas are available on the 20-Year Forest Health Strategic Plan website:
https://www.dnr.wa.gov/ForestHealthPlan

20-YEAR FOREST HEALTH STRATEGIC PLAN
EASTERN WASHINGTON

WASHINGTON STATE DEPT OF NATURAL RESOURCES
HILARY S. FRANZ
COMMISSIONER OF PUBLIC LANDS

Post-fire landscape Rx

Postfire Landscape Rx treatment need:

- From landscape evaluation

Landscape locations for desired/needed forest structure & non-forest

➔ Based on current & future deficit/climate, topography, soils, fire probability:

- Open, fire resistant vs. Closed canopy, large tree, dense
- Herbland, shrubland, & early seral forest
- Transitioning to non-forest/woodland

Patch-level fire severity & future trajectory

- On right pathway?
- Low/Mod severity: did the fire kill enough trees?
- Regeneration of climate adapted species likely?
- Are future fuel loads in line with desired future fire behavior/severity

Patch level operational considerations

- Is a Rx fire operationally feasible, what about managed wildfire?
- Does landowner have economic objectives?
- Road access, logging system, negative soil/harvest impacts?
- Is a treatment commercially viable or will it cost $.

Post-fire landscape Rx

Protect/ Maintain

1. Where did fire do good work?

- No treatment, future maintenance burns

Post-fire landscape Rx

Protect/ Maintain

Restore Resilience

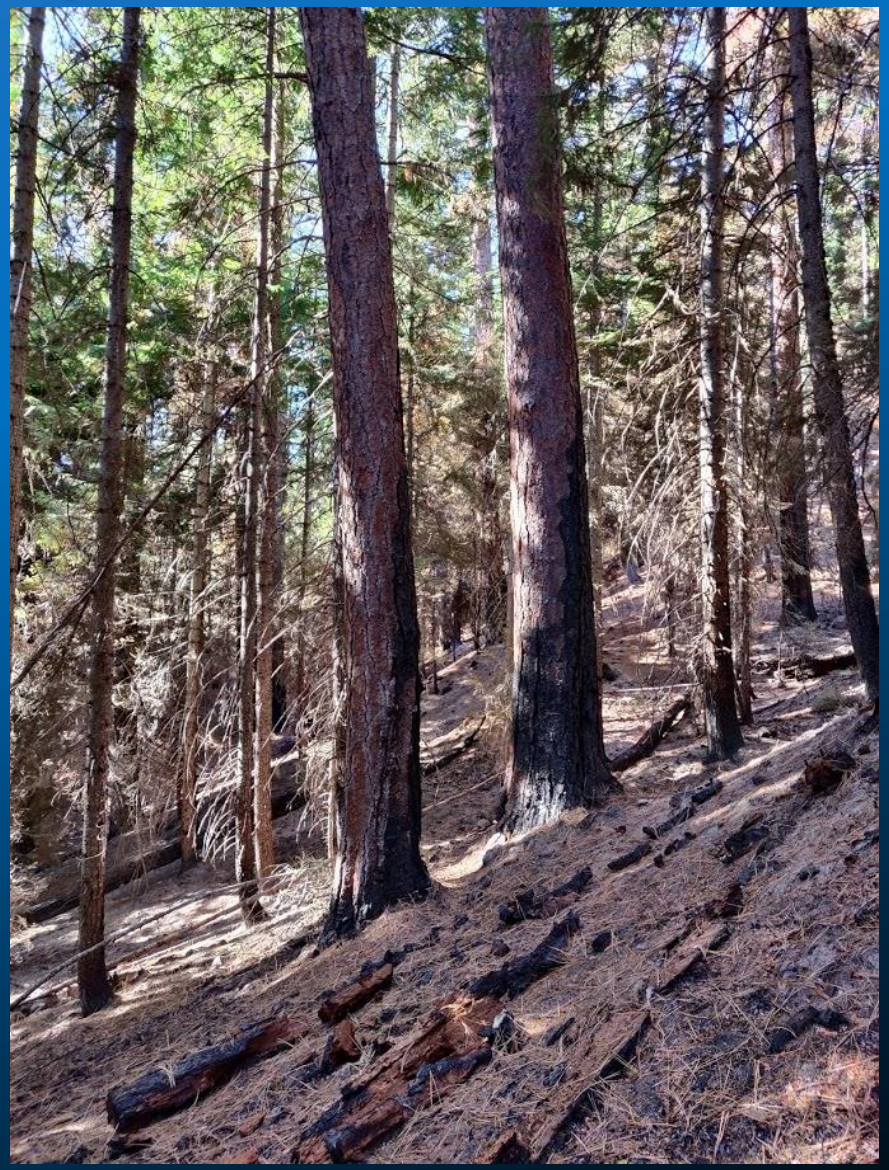
2. Where did fire do good work, but more is needed?

- Mechanical thinning of green & dead trees

  + activity fuel reduction (Rx fire)

- Low-moderate intensity reburns 10-20 years post-fire

➔**Rx fire or managed wildfire.**



Post-fire landscape Rx

3. Where did fire overshoot?

- Plant climate adapted species where forest is desired & is possible.
- Or accept transition to non-forest veg type
- If needed, reduce fuels to restore fuel beds.

➔ Reburn 5-20 years

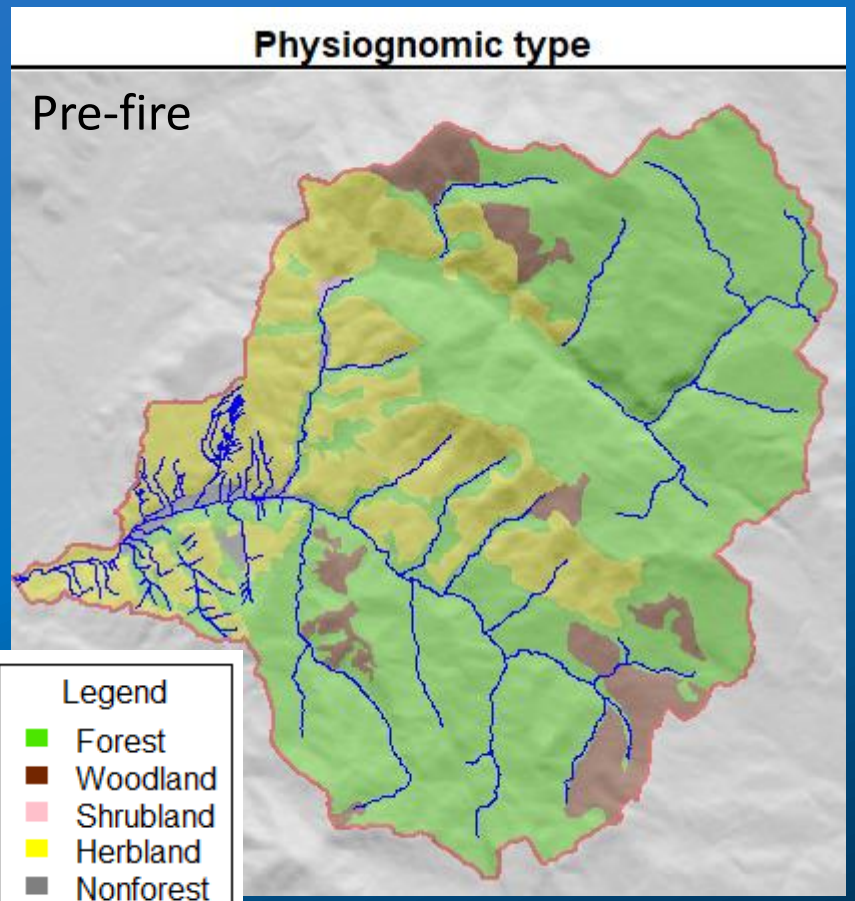
➔ **Rx fire or managed wildfire**

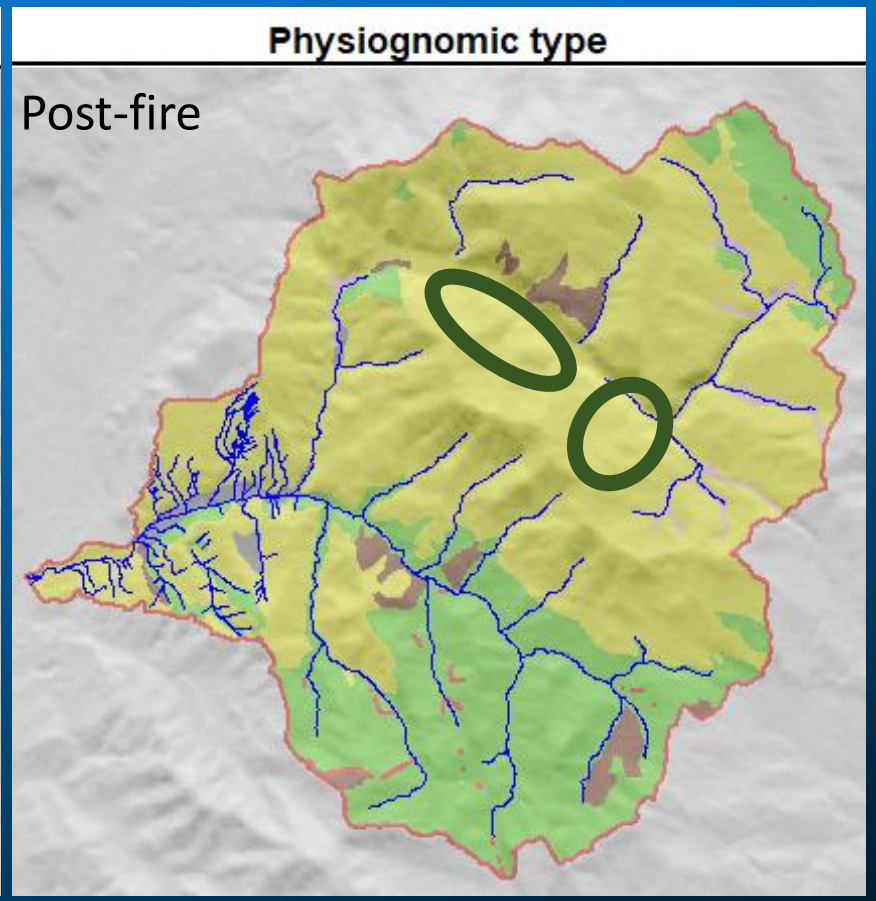
➔ Mechanical removal of dead trees + activity fuel reduction (Rx fire)

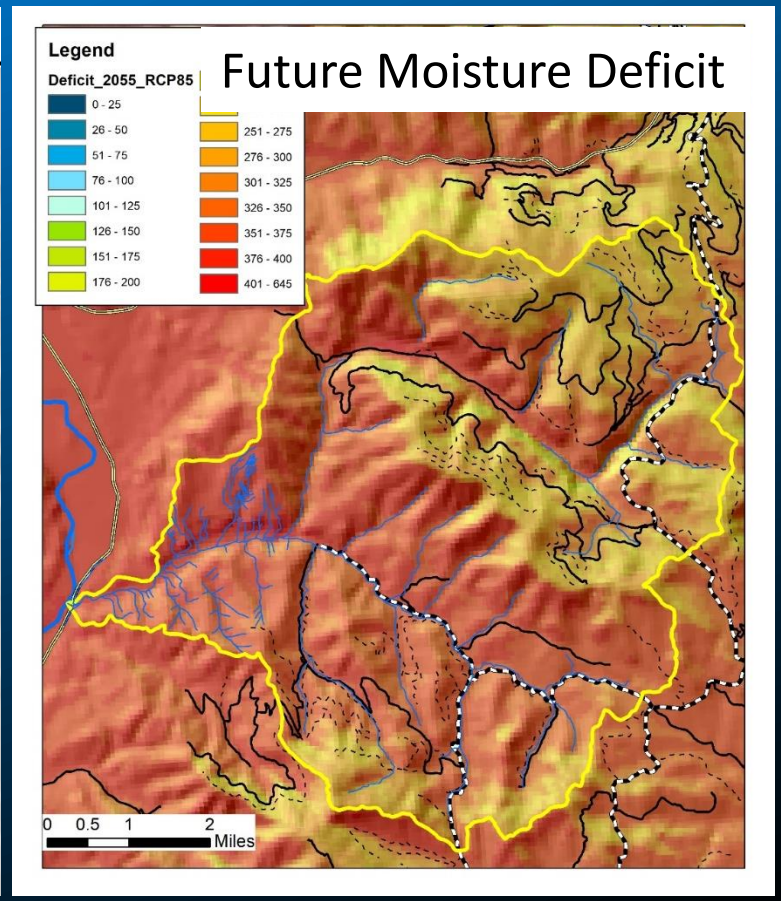
➔ Economic objectives: capture value of wood.

Post-fire landscape Rx

Landscape Restoration Principles	Landscape Rx Need	Locations
1. Reset forest - non-forest	Increase fire resistant forest to break up large patch of herbland.	North facing slopes ➔ lower moisture deficit ➔ future forest capable
3. Shift species composition	Shift to drought tolerant species	







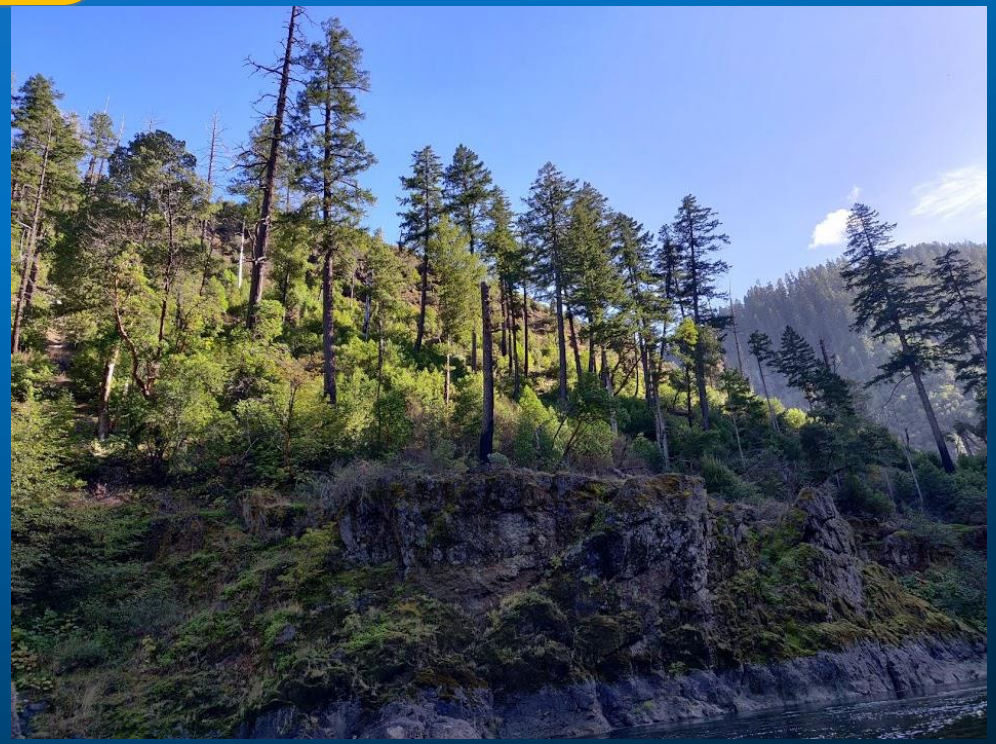
Post-fire landscape Rx

Landscape Need:
- Fire/drought resistant forest with restored fuels

Fire Severity & Trajectory
- Burned at high severity
- Large fire resistant trees survived
- Regen: ok to high, right species
- Future fuel ok or too high

Operational
- No access or not commercially viable

Restore Resilience
Reburn 10-20 years to reduce fuels & thin regen



Post-fire landscape Rx

Landscape Need:
- Fire/drought resistant forest with restored fuels

Fire Severity & Trajectory
- Burned at very high severity
- Few seed trees
- Regen: very low or wrong species
- Future fuel too high

Operational
- Road access
- Commercially viable

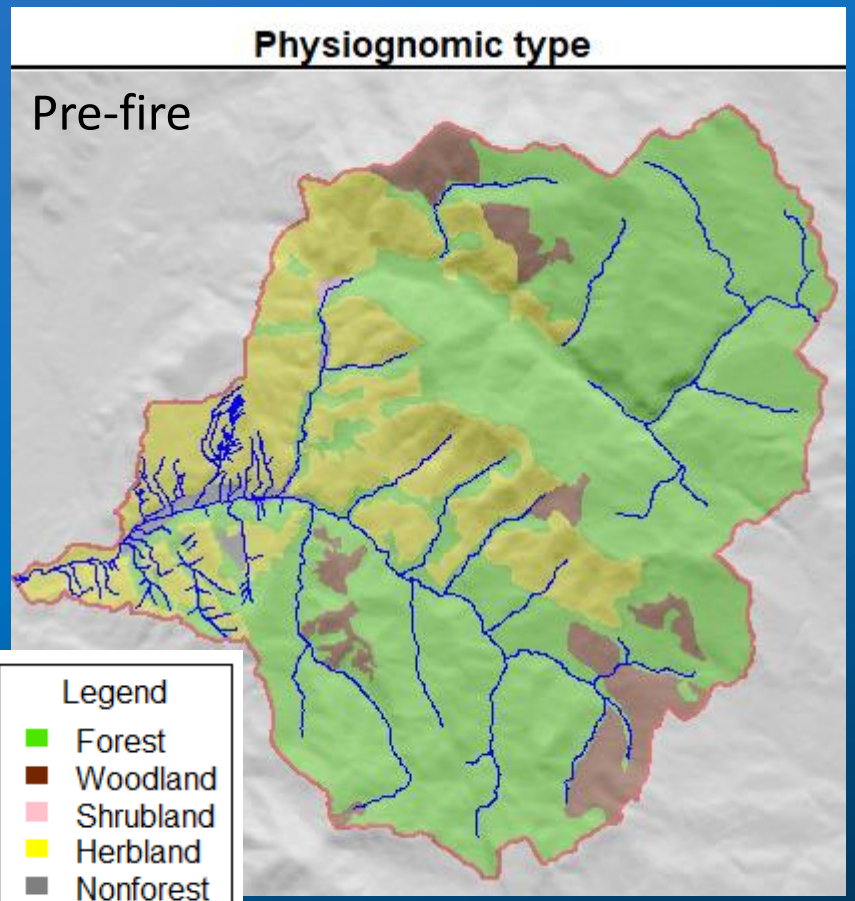
Adapt/Transition
Salvage + Rx fire
Plant

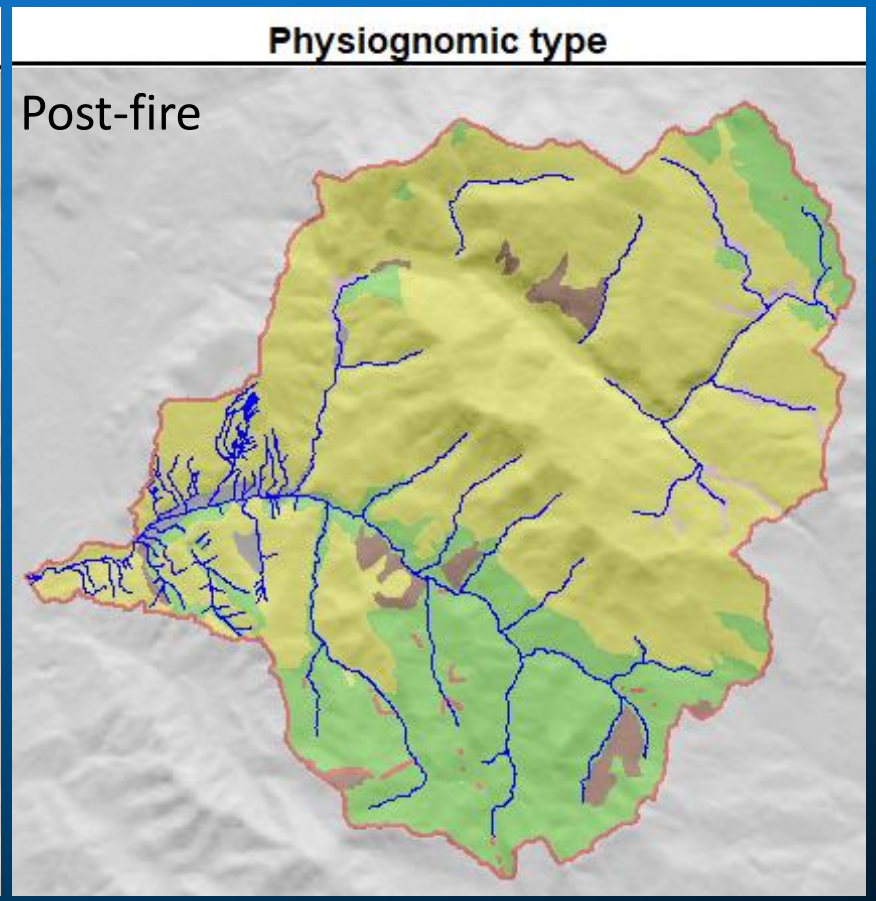
Operational
- No access, high impacts, or not commercially viable

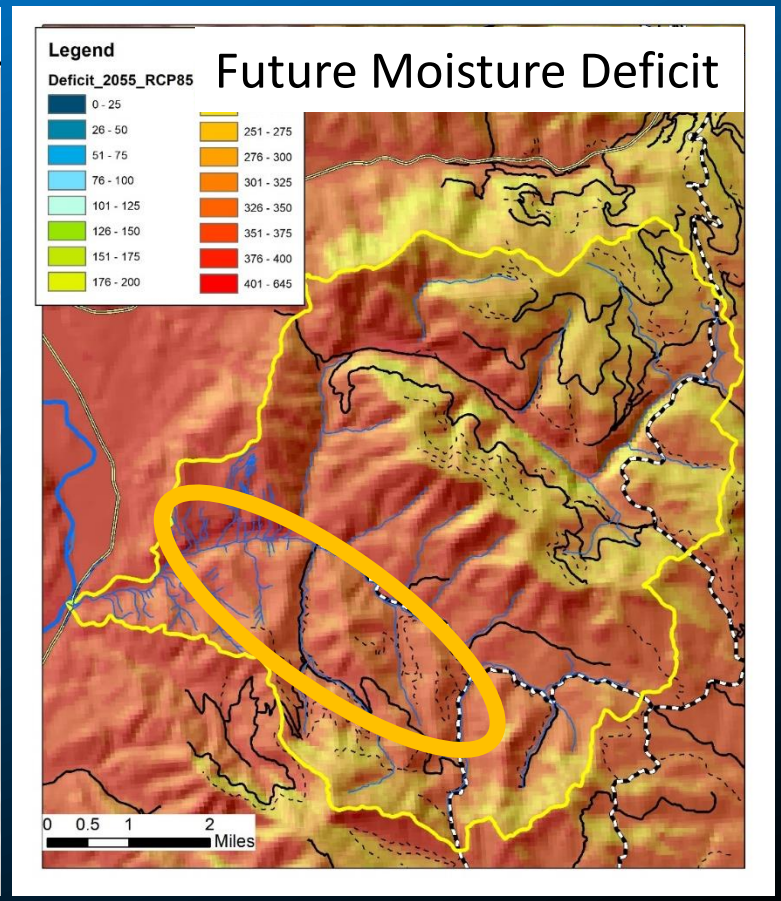
Adapt/Transition
Plant
Reburn

Post-fire landscape Rx

Landscape Restoration Principles	Landscape Rx Need	Locations
1. Reset forest - non-forest	Patches of shrubland – herbland with restore fuel beds	High future moisture deficit, where forest is unlikely to grow







Post-fire landscape Rx

Landscape Need:
- Herb/shrubland with restored fuels

Fire Severity & Trajectory
- Burned at high severity
- Regen: very low or wrong species
- Future fuel high
- Forest not likely

Operational
- No access, high impacts, or not commercially viable

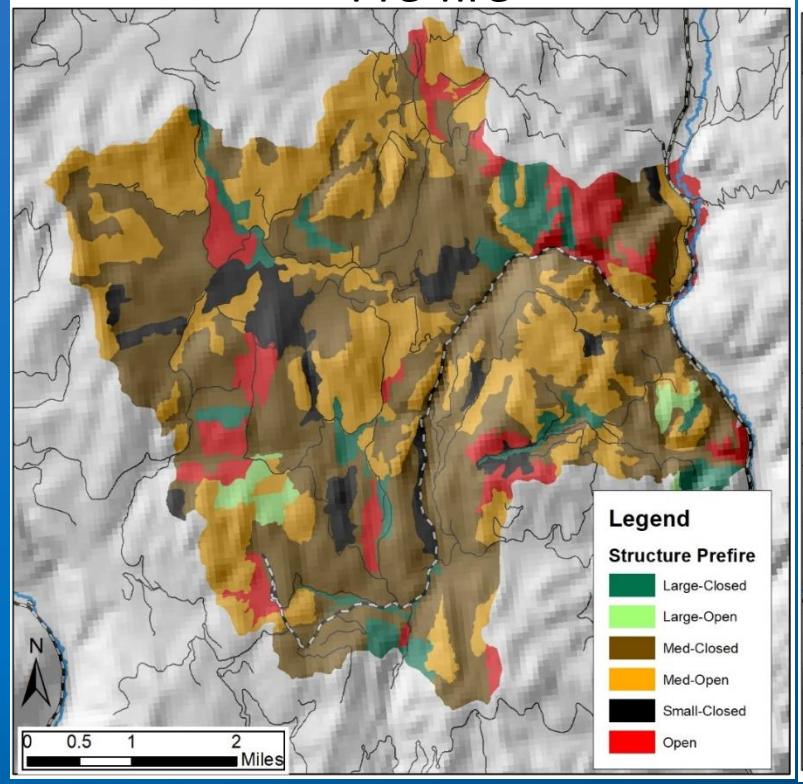
Adapt/Transition
No treatment, but allow reburns to consume fuels

Operational
- Road access
- Economic objectives
- Commercially viable

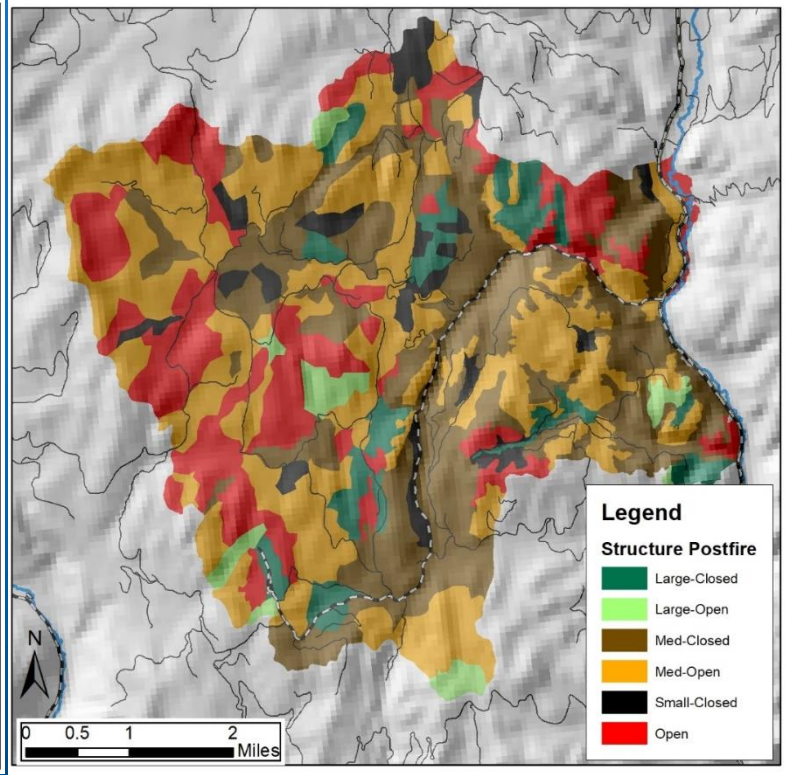
Adapt/Transition
Salvage + fire

Landscape Restoration Principles	Landscape Rx Need	Locations
2. Align structure & fuels with future climate	Larger patches (1000 ac+) of large tree, fire/drought resistant forest	Dry forest, high-medium moisture deficit. Large-medium fire resistant trees present
3. Shift species composition		

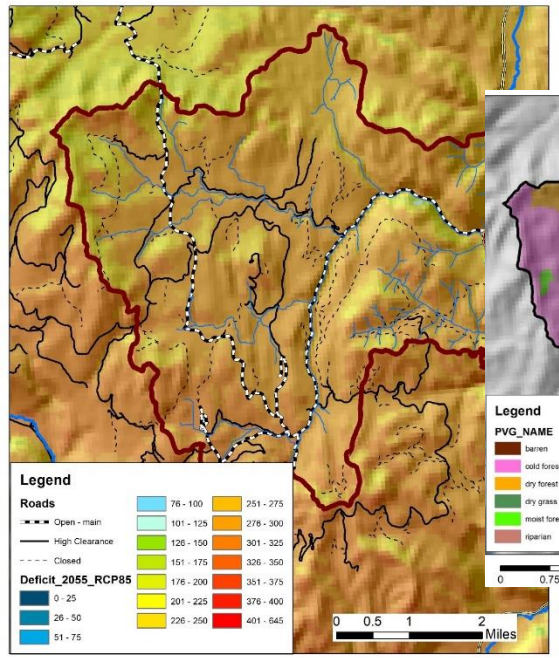
Pre-fire

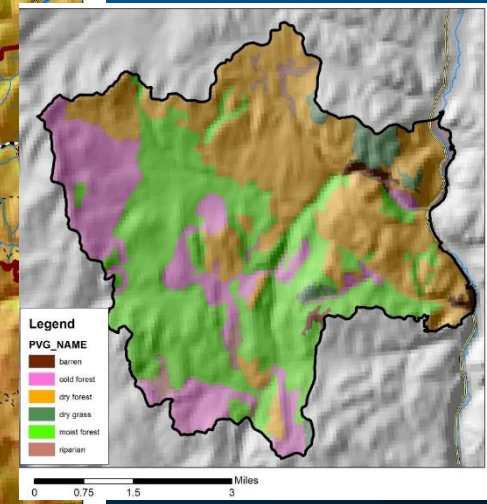


Post-fire



Future Moisture Deficit





Landscape Restoration Principles	Landscape Rx Need	Locations
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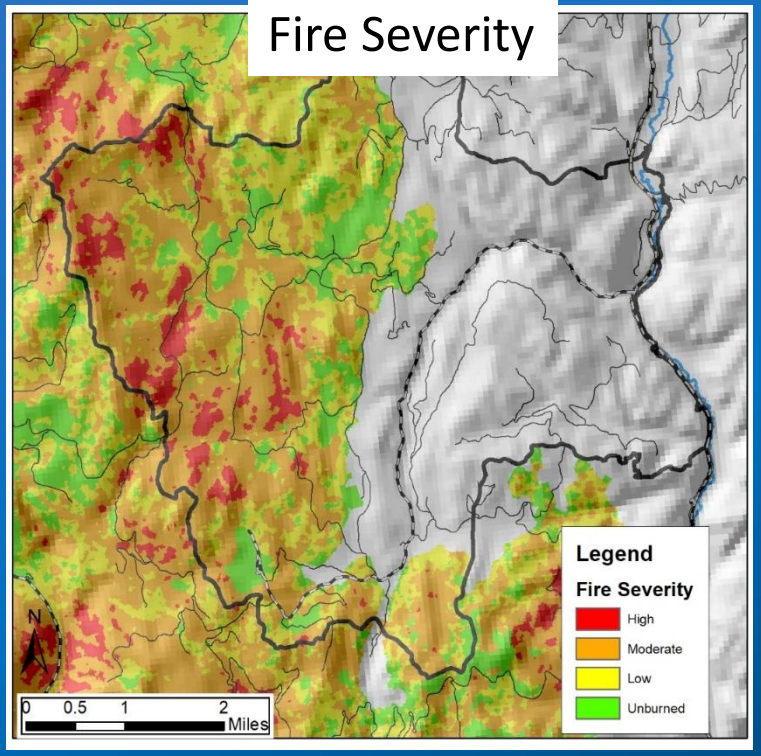
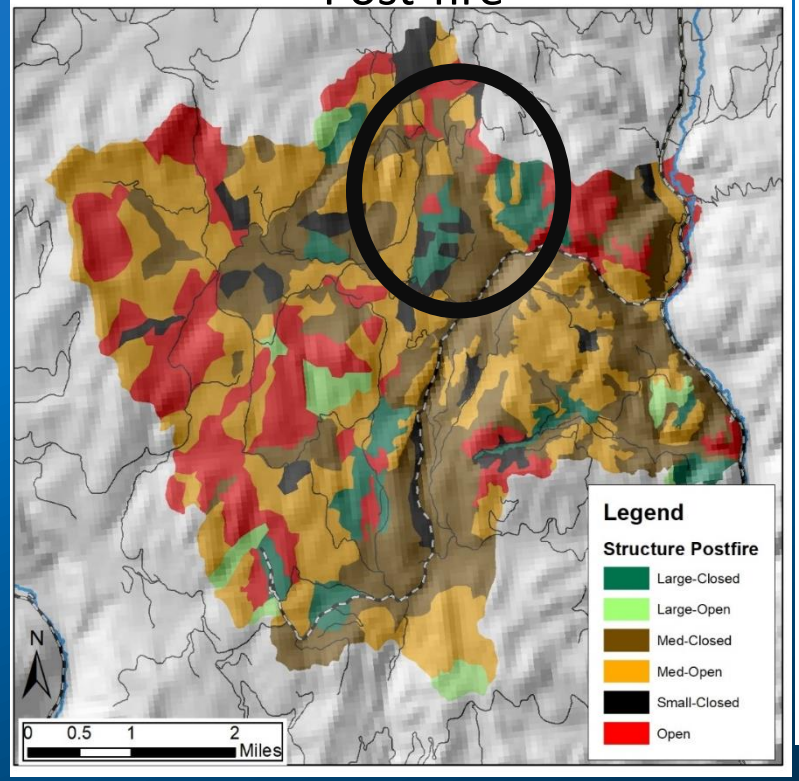
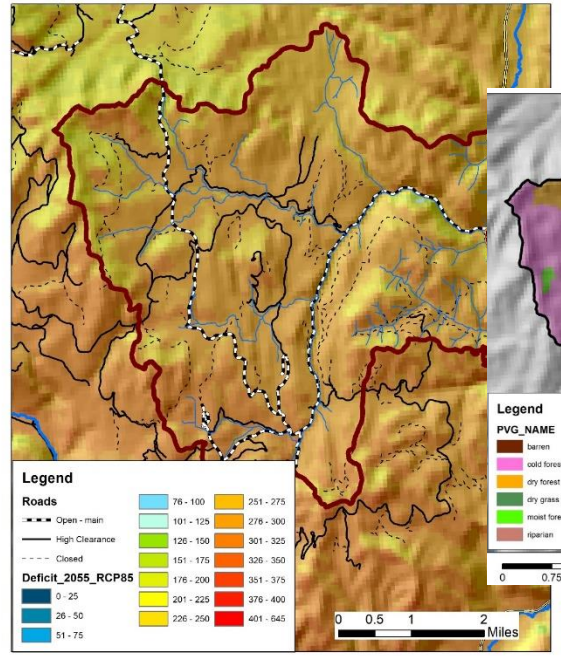
Fire Severity

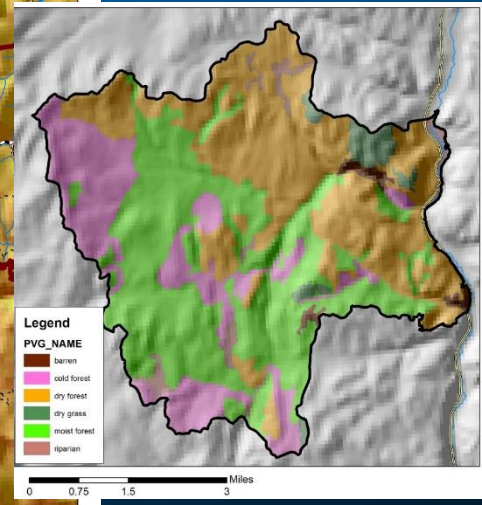


Post-fire



Future Moisture Deficit





Post-fire landscape Rx

Landscape Need:
- Open, large tree, fire/drought resistant forest with restored fuels

Fire Severity & Trajectory
- Low-mod severity or unburned
- Backbone of large-med. fire resistant trees
- Density still to high ➔ drought & fire risk
- & or future fuel loads too high

Operational
- No access, high impacts, or not commercially viable
- Rx fire possible

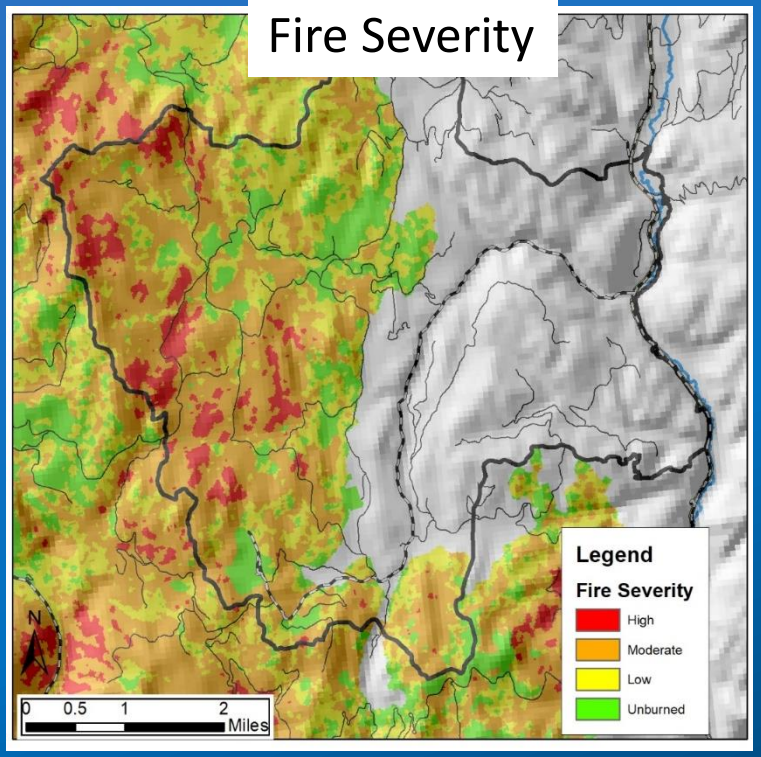
Restore Resilience
Reburns at mod severity to reduce density & fuels

Operational
- Road access
- Commercially viable

Restore Resilience
Dead & green tree commercial thin + Rx fire/fuels treat

Landscape Restoration Principles	Landscape Rx Need	Locations
4. Sustain patches with large/old trees	More & larger patches of large tree, closed forest	Moist or cold forest. Low-medium deficit. Existing medium or large tree forest

Fire Severity



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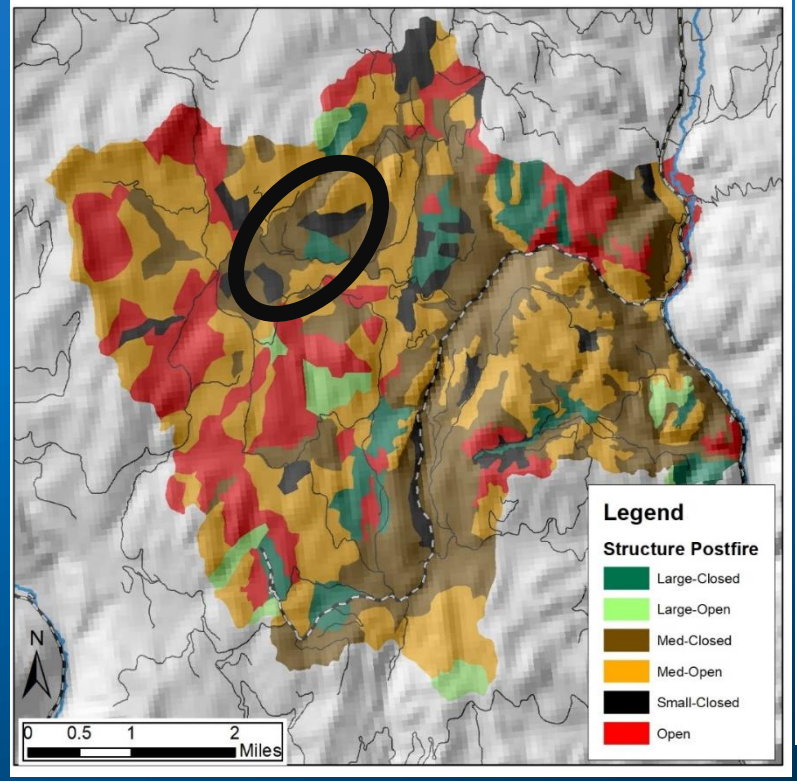

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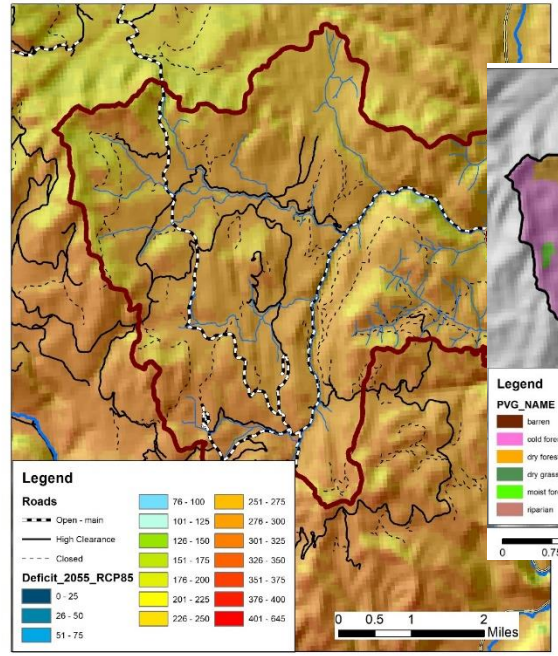
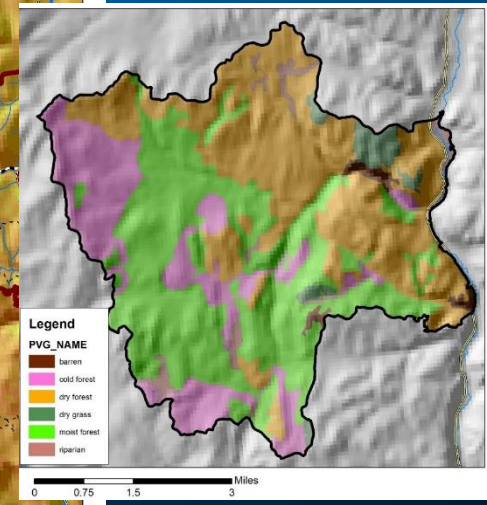




Post-fire landscape Rx

Landscape Need:
- Closed, large tree forest
- Snags & downed wood desirable

→

Fire Severity & Trajectory
- Low-mod severity or unburned
- Backbone of healthy medium to large, fire resistant trees
- Some fire intolerant species ok

→

Operational
- Keep fire out of if possible

→

Protect/ Maintain
No Treatment

Post-fire landscape Rx

➔ Integrate landscape level needs to target stand level treatments

➔ Provide scientific basis for post-fire management

➔ Increase understanding and agreement among stakeholders & managers for post-fire management in specific landscapes.

Post-fire Landscape Evaluation

Data needs & sources:

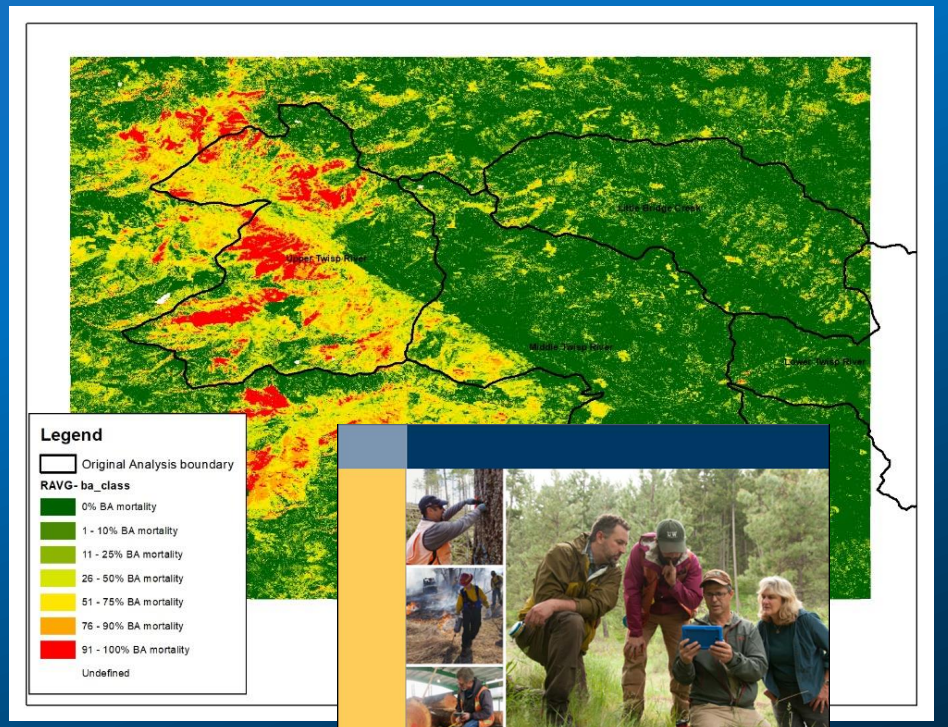
1. Obtain & analyze fire severity data:
   - RAVG or MTBS, GEE fire severity
   - Proportion of severity & patch sizes.

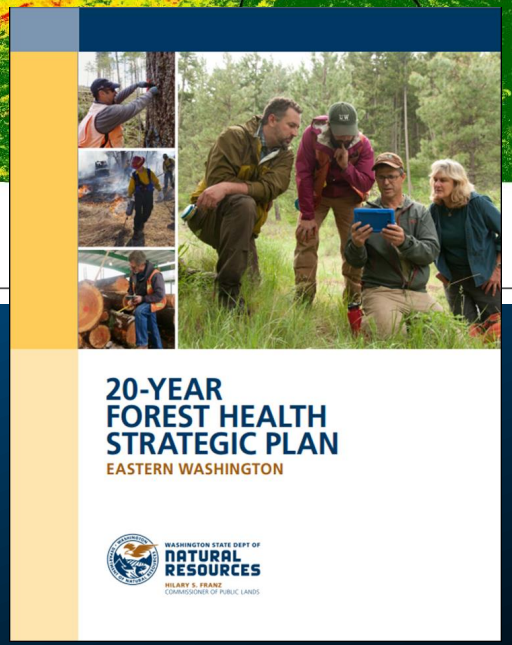
2. Obtain pre and post-fire veg data for landscape:
   - Aerial photos, LiDAR, inventory data.
   - DAP from DNR – 20 Year Plan
   - Infer post-fire data from burn severity maps

3. Assess landscape level work of fire:
   - Amount & direction of change in % land & pattern of structure, composition & habitat
   - Evaluate against climate adapted reference/target ranges

4. Future climate & veg data: moisture deficit

RAVG Fire Severity Data





Concluding Thoughts

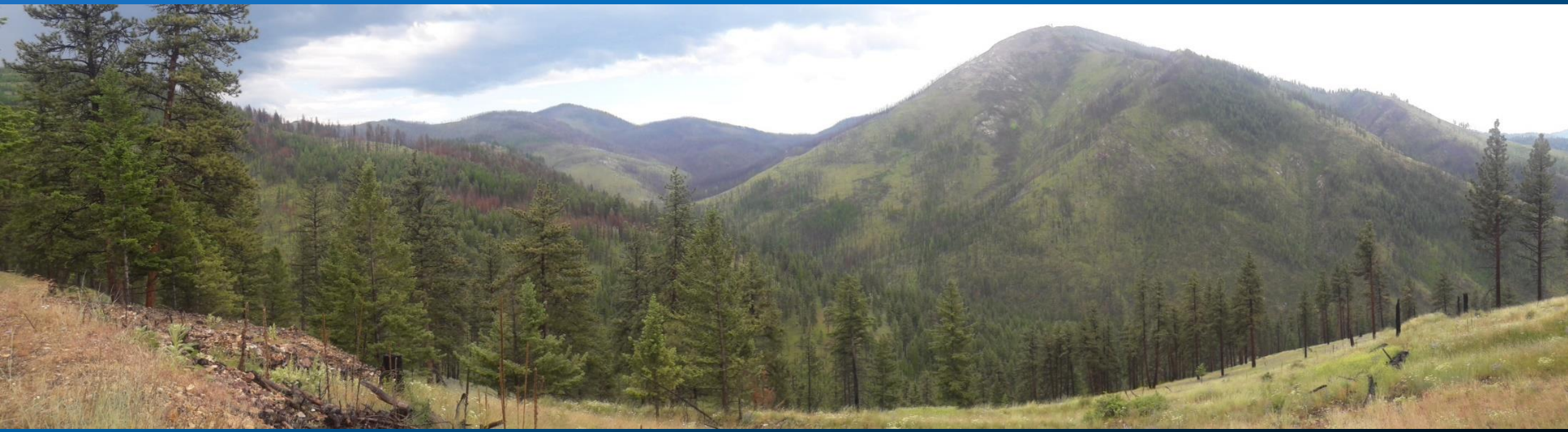
- Need for rapid analysis to make commercial harvests possible

- Consumption of fuels buys us a ~10-20 year window of lower fire probability & intensity.
  - ➔ Control lines to safely manage wildfire & large Rx burns.

- Future fuel will accumulate & regen will grow:
  - ➔ Wildfires are often "first entry"
  - ➔ Longer term need for reburns (5-20 years)

Looking Forward

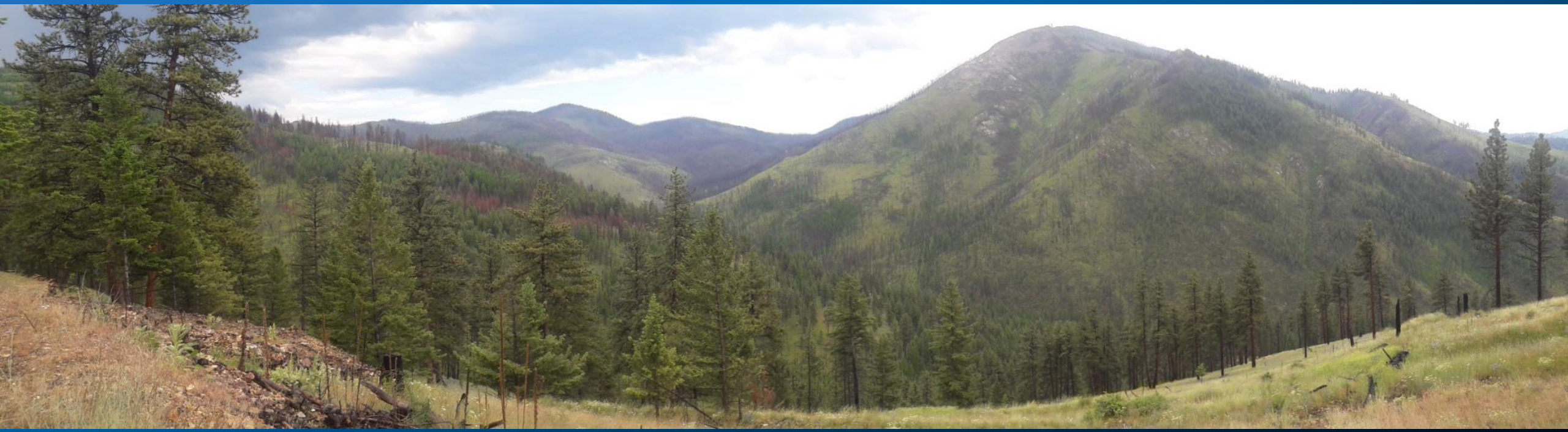
- **Fire is our biggest land management tool**—treating the most acres



Introduction to NEWFIRE project | Principles & ecological foundation | Fire severity & forest structure | Tree regeneration | Landscape evaluations - Fx | Landscape Evaluations –Rx | Panel discussion

Looking Forward

- **Fire is our biggest land management tool**—treating the most acres
- **Anticipate future fire in long-term & NEPA/project planning**—faster reaction time



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Looking Forward

- **How to maximize beneficial work during and after wildfire?**
  - **During: “We expected and planned for this fire. We hope it does X here and Y over there.”**
  - **After: “What work did fire accomplish for us, and what new opportunities did it create?”**