

Fuels Management in the Sierra Nevada: There is Hope



2021 Dixie Fire
960,000 acres

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and Forest Policy
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Historical Fire Effects

Mixed-conifer and ponderosa pine forests in Sierra Nevada

Show and Kotok (1924):

“California pine forests represent broken, patchy, understocked stands, worn down by the attrition of repeated light fires.”



Bear Creek Guard
Station - 1915
Plumas National Forest

“Extensive crown fires...are almost unknown to the California pine region.”

Remove fire for over a century and cut the largest trees, what can be done?

Forest Restoration Treatments

Restoration thinning and prescribed fire,
20-years of continuous research in Sierra
Nevada mixed conifer forests

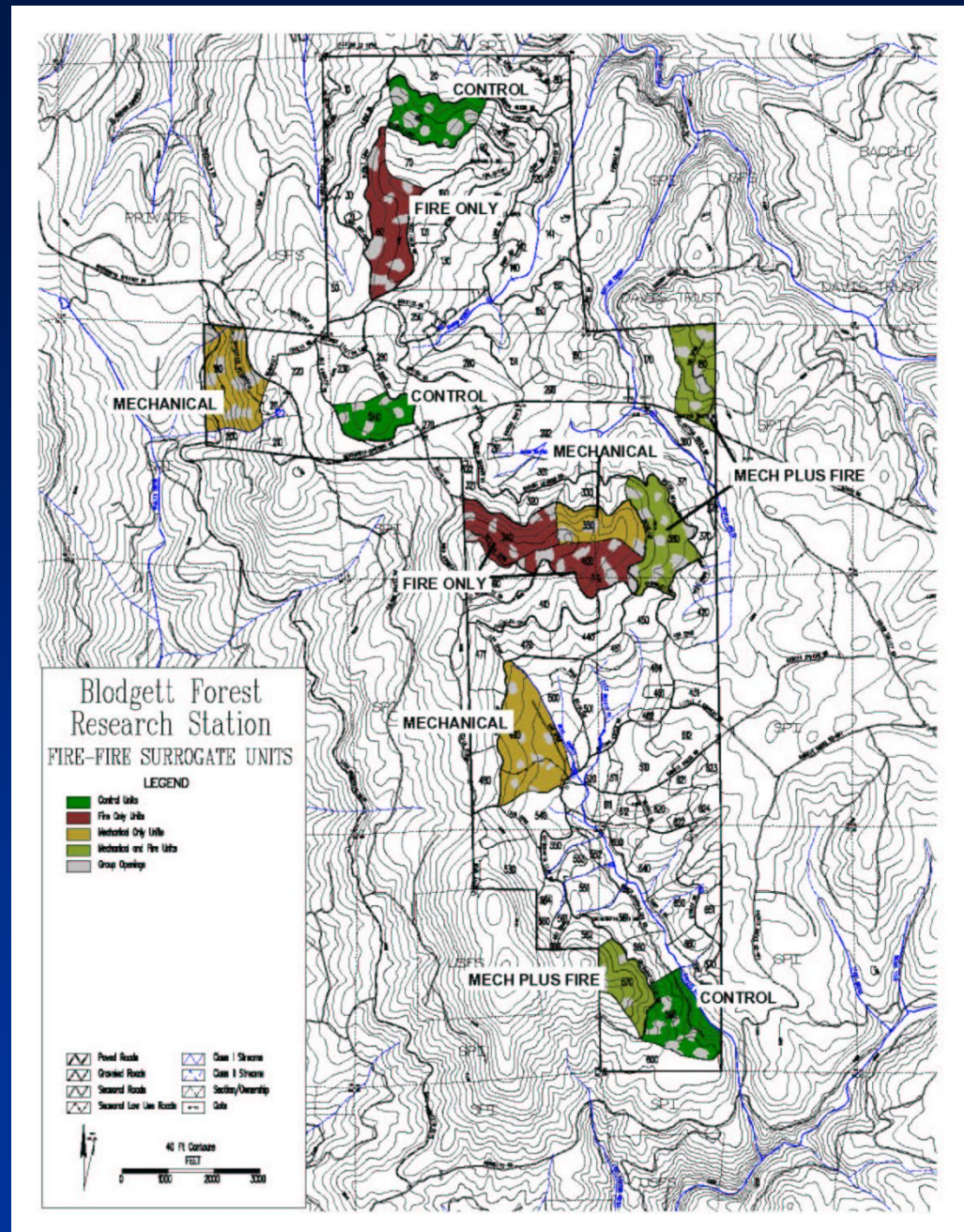
Restoration thinning

Focus on what you want to leave versus
what you want to take
species, tree sizes, spatial patterns

Combination of thinning followed by
prescribed fire an important treatment too

UCB Blodgett Fire and Fire Surrogate Study

- 3 control
 - 3 mechanical only
 - 3 mechanical plus fire
 - 3 fire only
-
- Units 40-60 acres in size with 25 acre core area used for all measurements



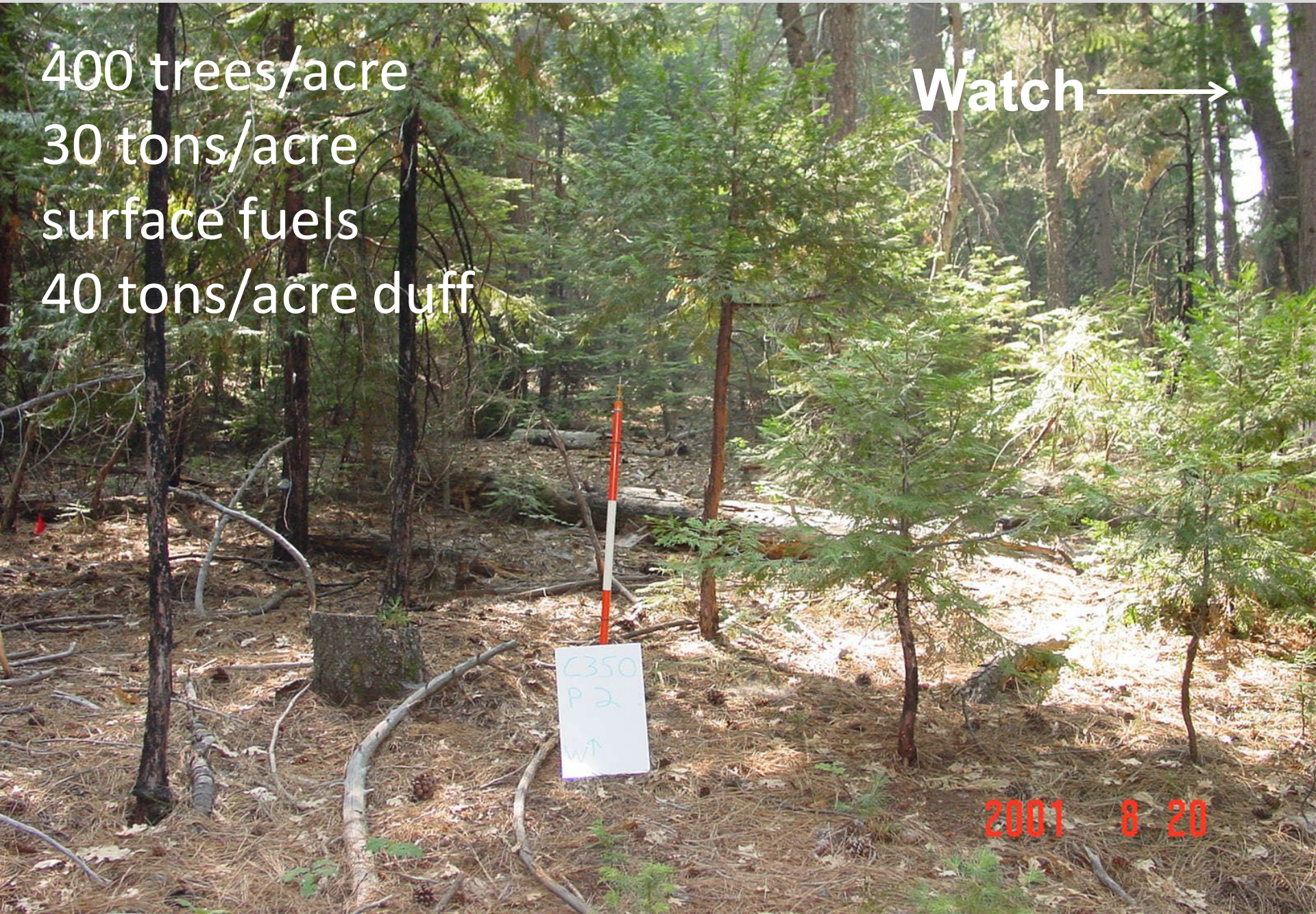
Mechanical Only – Pre-Treatment (2001)

400 trees/acre
30 tons/acre
surface fuels
40 tons/acre duff

Watch →

E350
P2
W↑

2001 8 20



Rotary Masticator at Blodgett Forest



Crown thin, commercial thin from below, mastication

Mechanical Only – Post-1st Treatment (2003)



Watch →

C 350
P 2 W
8-19-03
MECH
AFTER TREAT

Mechanical Only – Post-1st Treatment 8 yrs. (2010)



Watch →

75% of masticated
fuel bed
decomposed

Mechanical Only – Post-1st Treatment 13 yrs. (2015)



Watch

08/09/2015

Mechanical Only – Post-2nd Treatment (2020)



Watch →

Very effective at reducing
potential fire behavior
and sequestering carbon
Made money

FFS Study: Fire Only – Pre-Treatment (2002)

Prescribed Fire Only
Treatment

Watch →

C400
P 103 S
SEP -24-02
F
PRE-BURN

Prescribed Fire

Blodgett Forest

Burning windows
impacted by
climate change

Must be nimble

Workforce needed

12:26 AM



Fire Only – Post-1st Prescribed Fire (2003)



Same Tree →

C 400
P103 S
8-19-03
FIRE ONLY
AFTER TREAT

Fire Only – Post-1st Prescribed Fire 7 yrs. (2009)



Same Tree



Fire Only – During 2nd Ignition (2009)

Same Tree →



Fire Only – Post- 2nd Prescribed Fire (2010)



Same
Tree

Fire Only – Post-2nd Fire 8 years (2017)



Same
Tree

11/01/2017

Fire Only – During 3rd Ignition (2017)



Same
Tree

11/01/2017

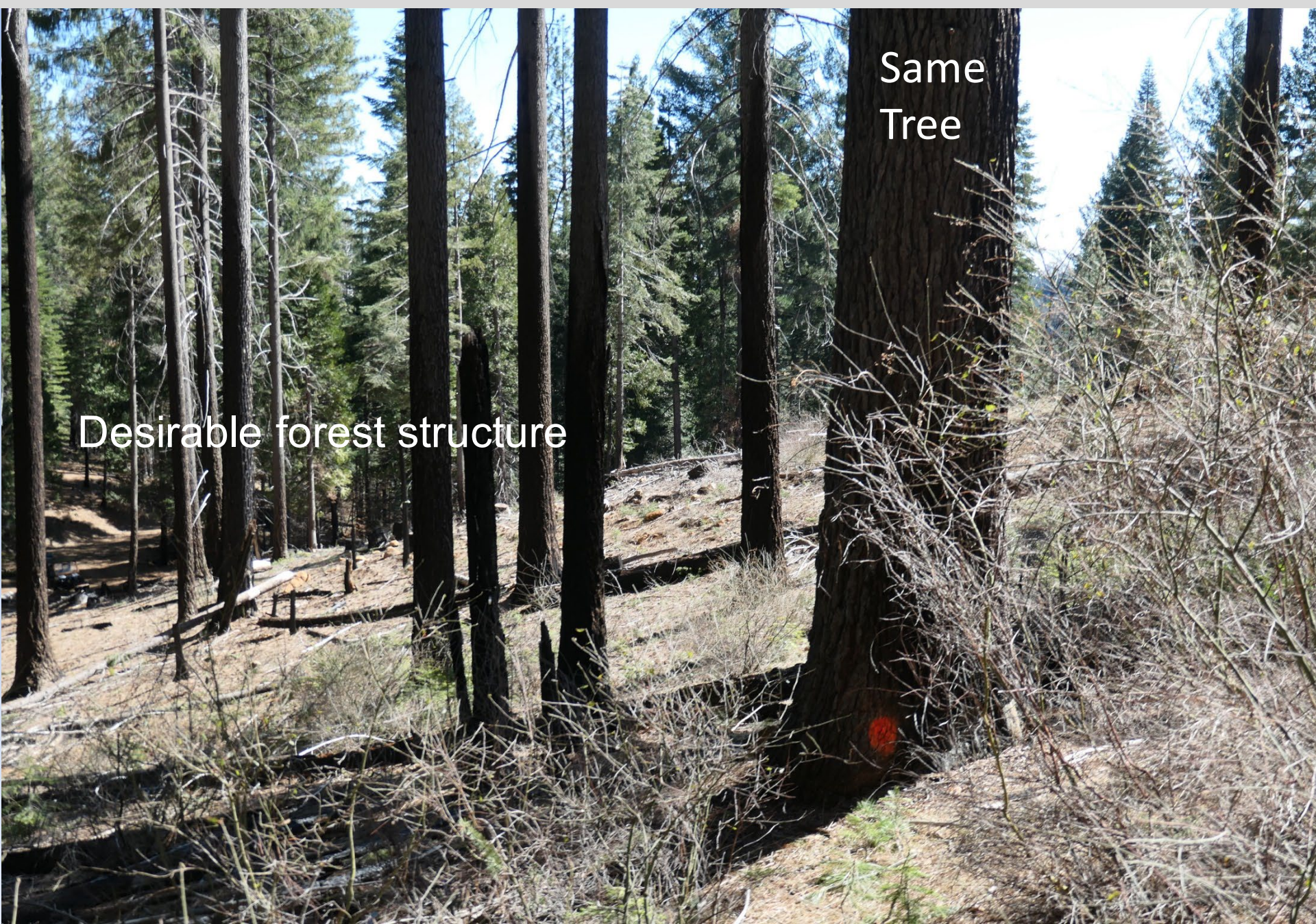
Fire Only – 1 yr After 3rd Prescribed Fire (2018)



Same
Tree

10/30/2018

Fire Only – Post 3rd Prescribed Fire 4 years (2021)



Same
Tree

Desirable forest structure

4th Prescribed Fire Ignited 11-2025

Fires never end!!

Combine with
cultural burning?

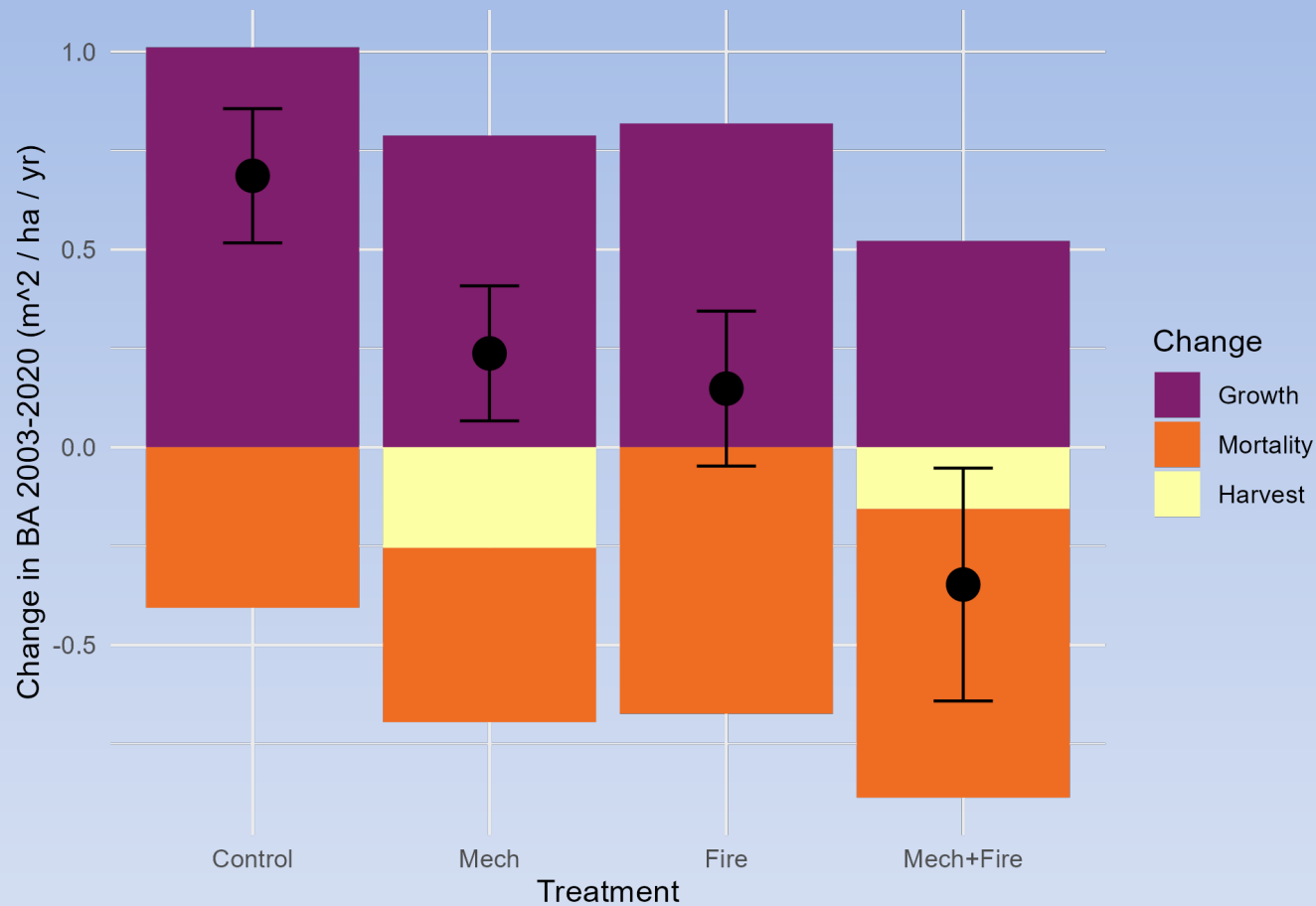


Study Results

- Ecosystem components exhibit very subtle effects or no measurable effects at all (soils, small mammals and songbirds, vegetation, non-native plants, bark beetles, with carbon sequestration and economics a bit more complicated)
 - ***No evidence of ecological harm***, all positive effects (*Stephens et al. 2012 BioSci*)
 - All 3 active treatments (Fire, Mech, Mech + Fire) produced conditions much more resistant to wildfire
 - Multiple pathways for achieving success (*Stephens et al. 2023 Eco Apps*)

What about forest resilience to drought, bark beetles, and climate change?

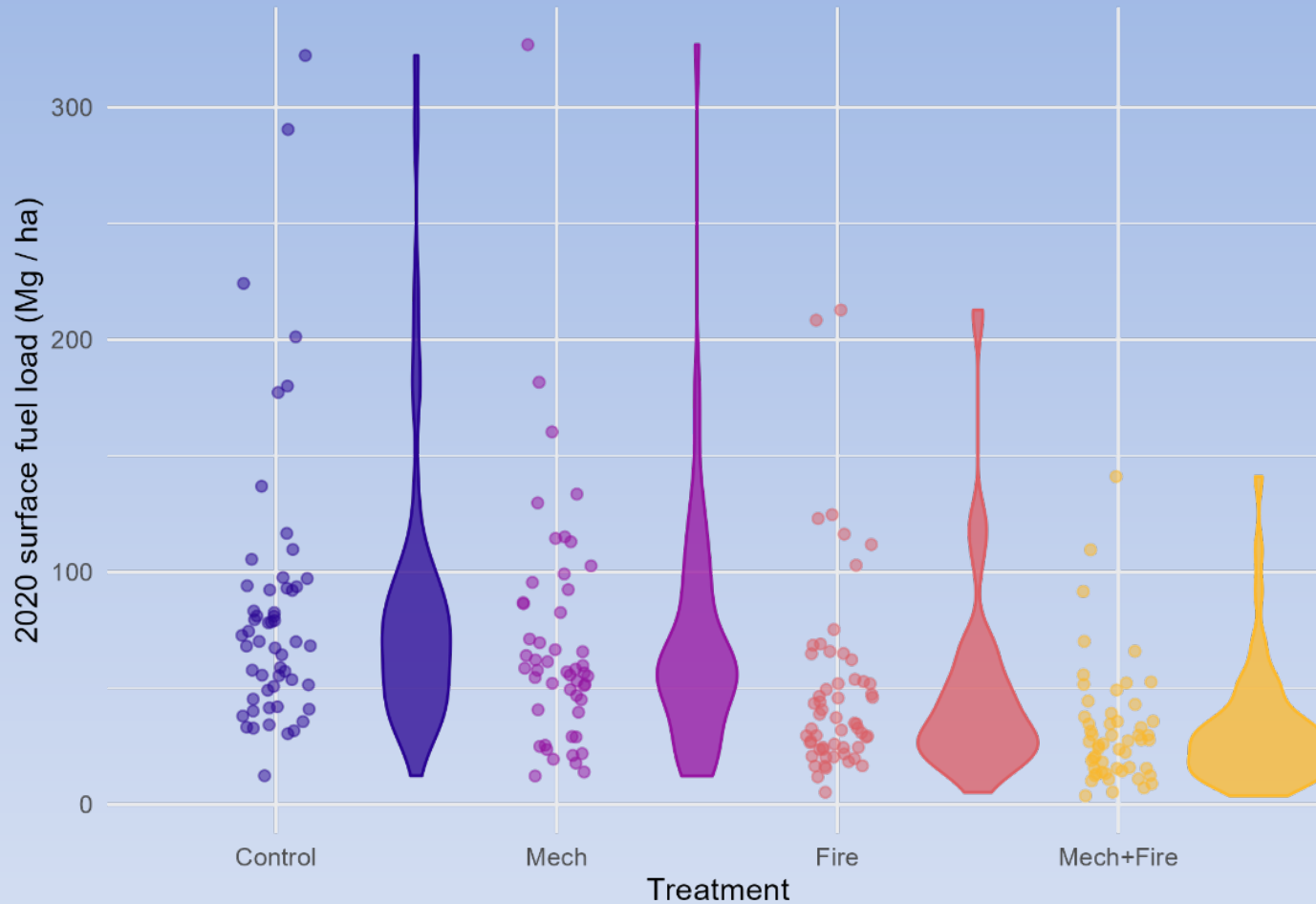
Change in Basal Area Over the Last 20 Years



Net change lower on Mech and Fire plots, but these were not significantly different from Control. Net change in Mech + Fire plots was significantly lower than Controls

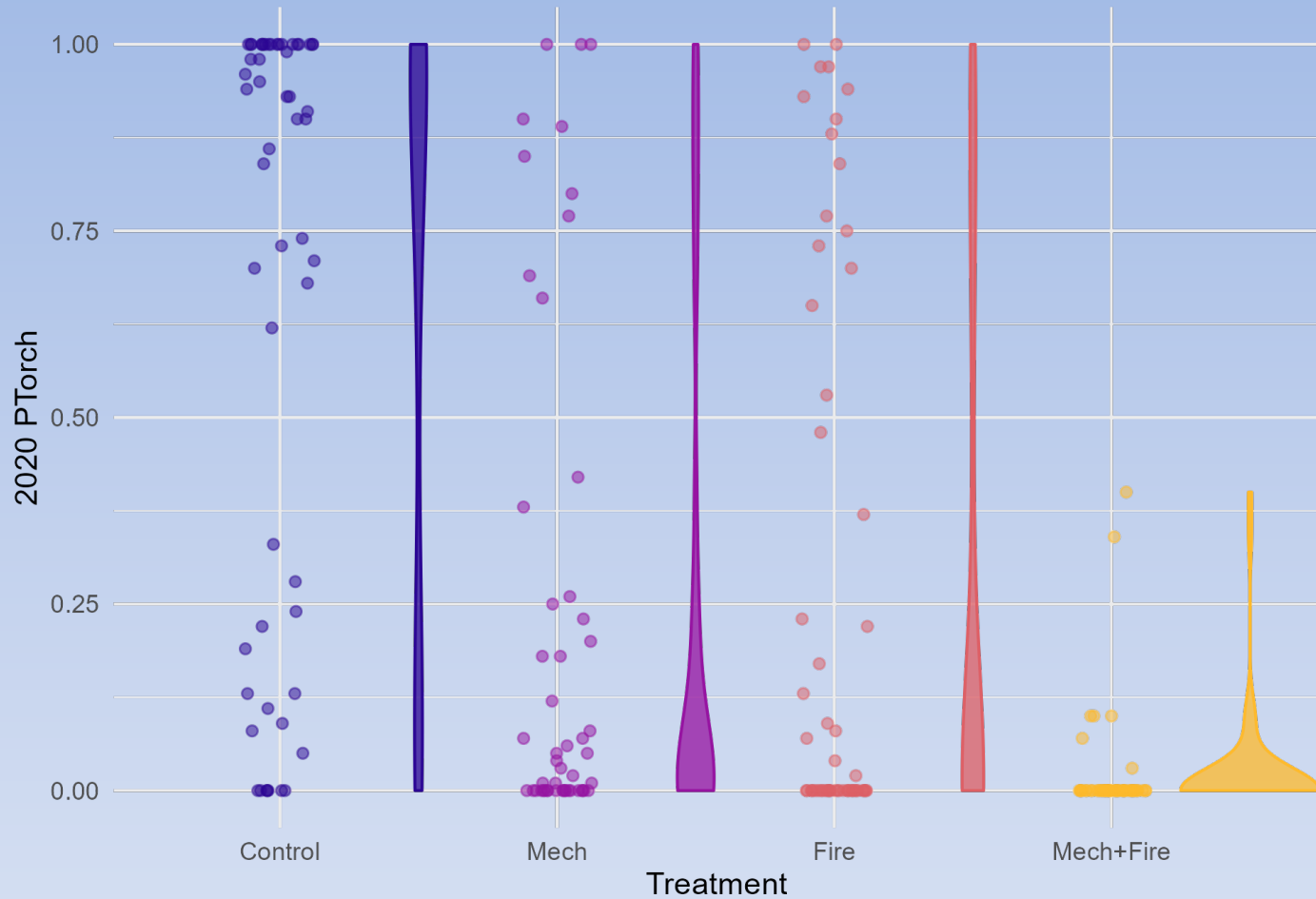
Stephens et al. Eco Apps Special Feature (in press)

Surface Fuel Loads



Control loads were highest, Mech was lower but not significantly different than controls. Surface fuel loads on Fire and Mech + Fire treatments were significantly lower than Controls

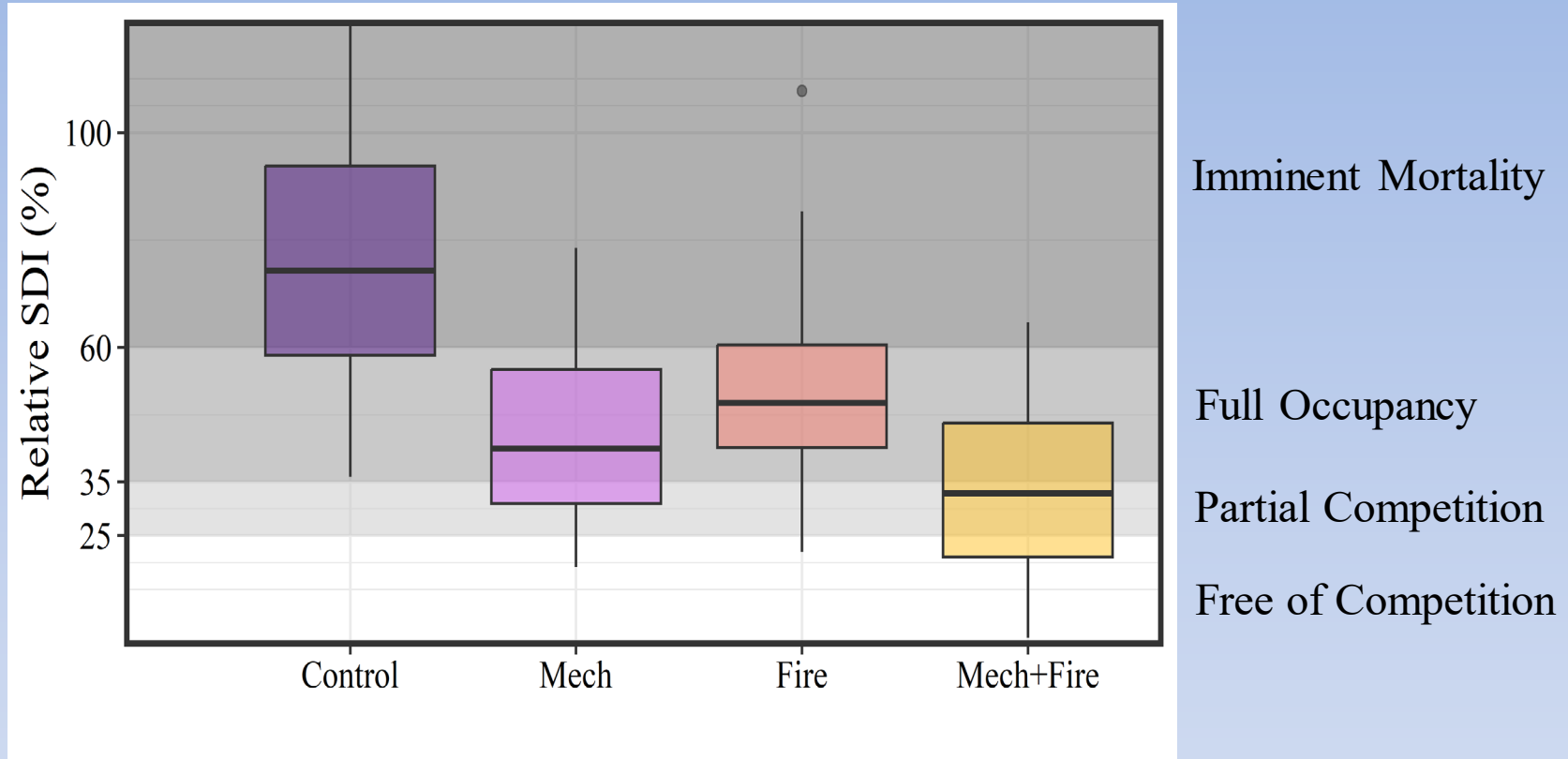
P-Torch



Plots from all three active treatments had a significantly higher P-torch than Controls (this is a good result)

Forest Resilience after 20-Years: How Are We Doing?

Almost all Treatments Left Too Many Trees



Fire hazard reduction: Focus on surface and ladder fuels in mature forests (Agee and Skinner 2005)

Forest resilience: Harder to define and achieve but just as important for long-term forest conservation *Stephens et al. 2023 Eco Apps*

Managed Wildfire

50 years of fire use
45,000 ac watershed
Fire removed 1875

**Yosemite program: 1974
to present**



2001 Hoover Fire Yosemite National Park



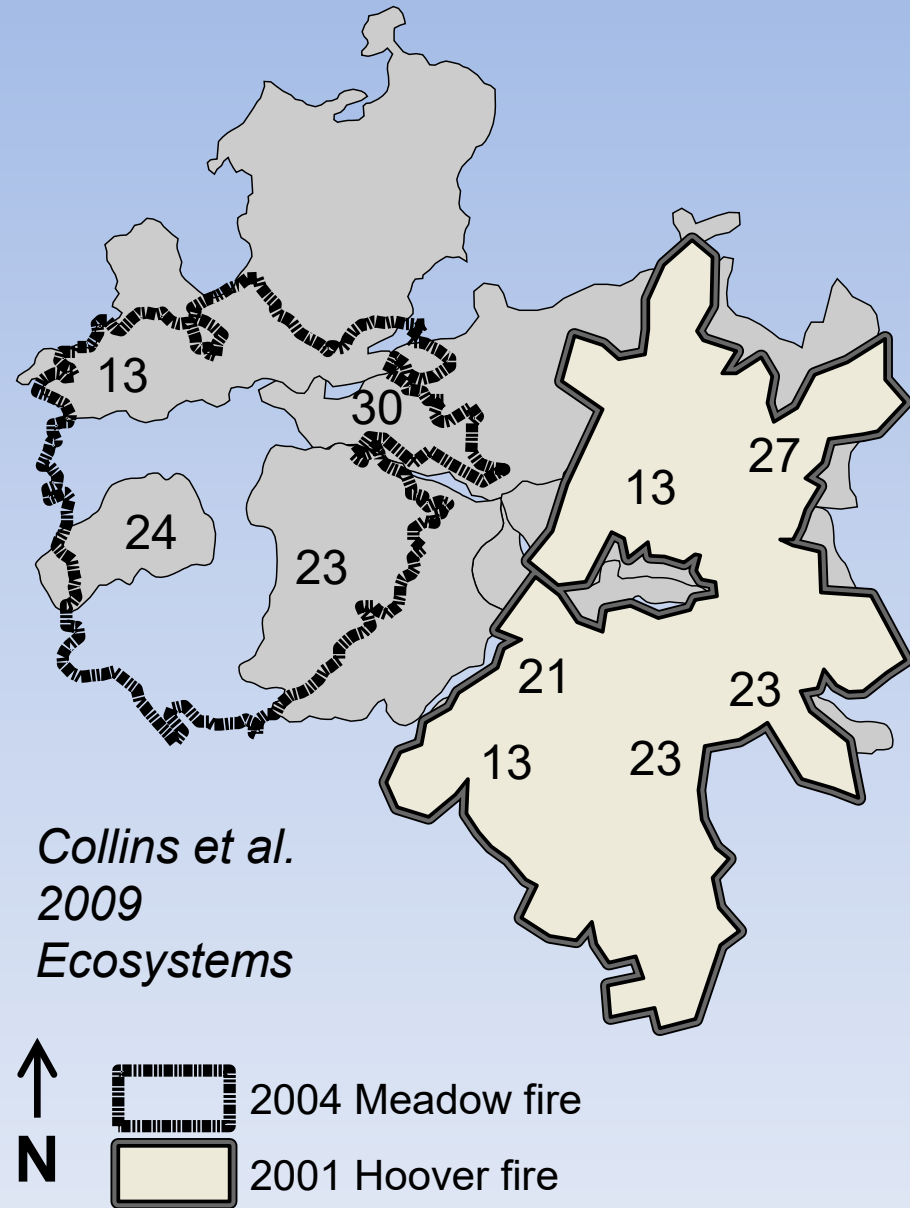
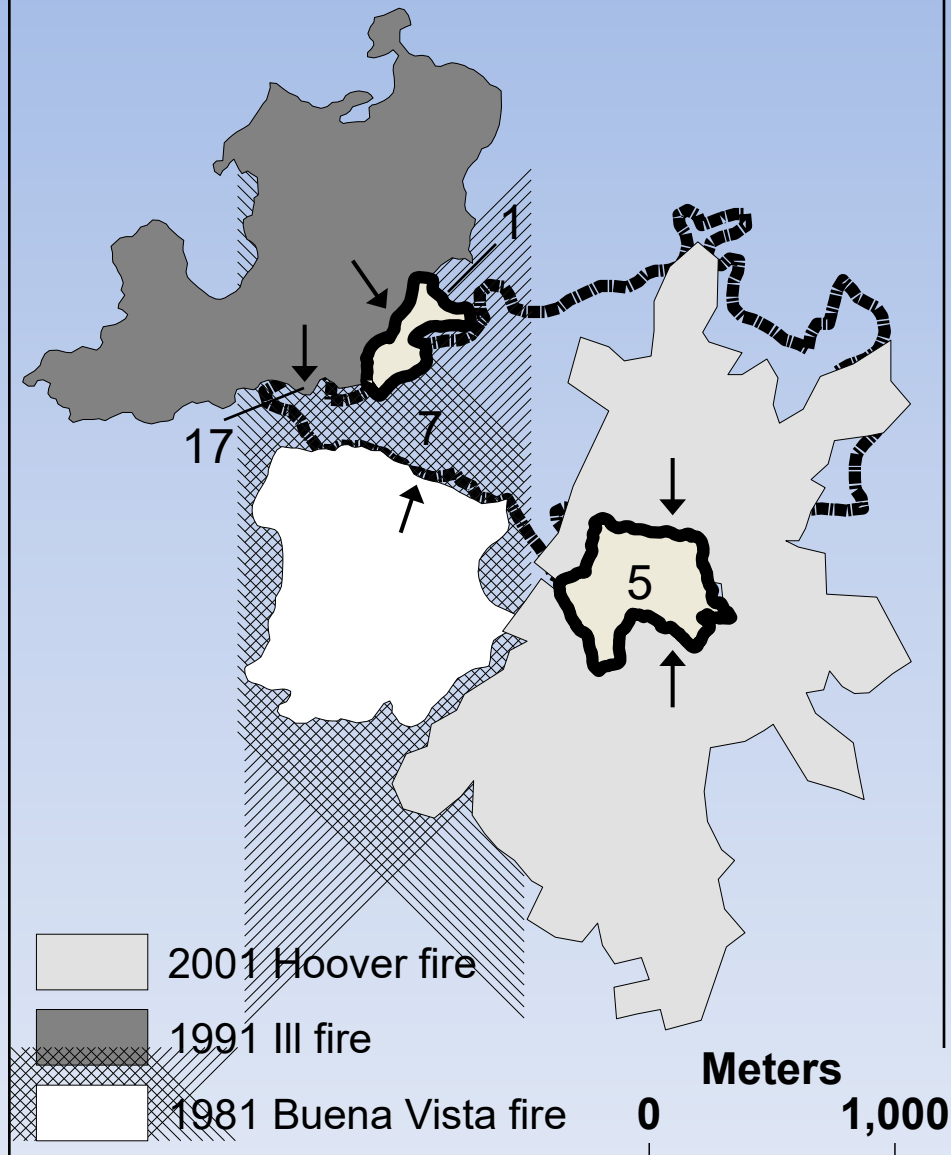
High Severity Patch with Forest Recovery



Messy Forest

Limited fires

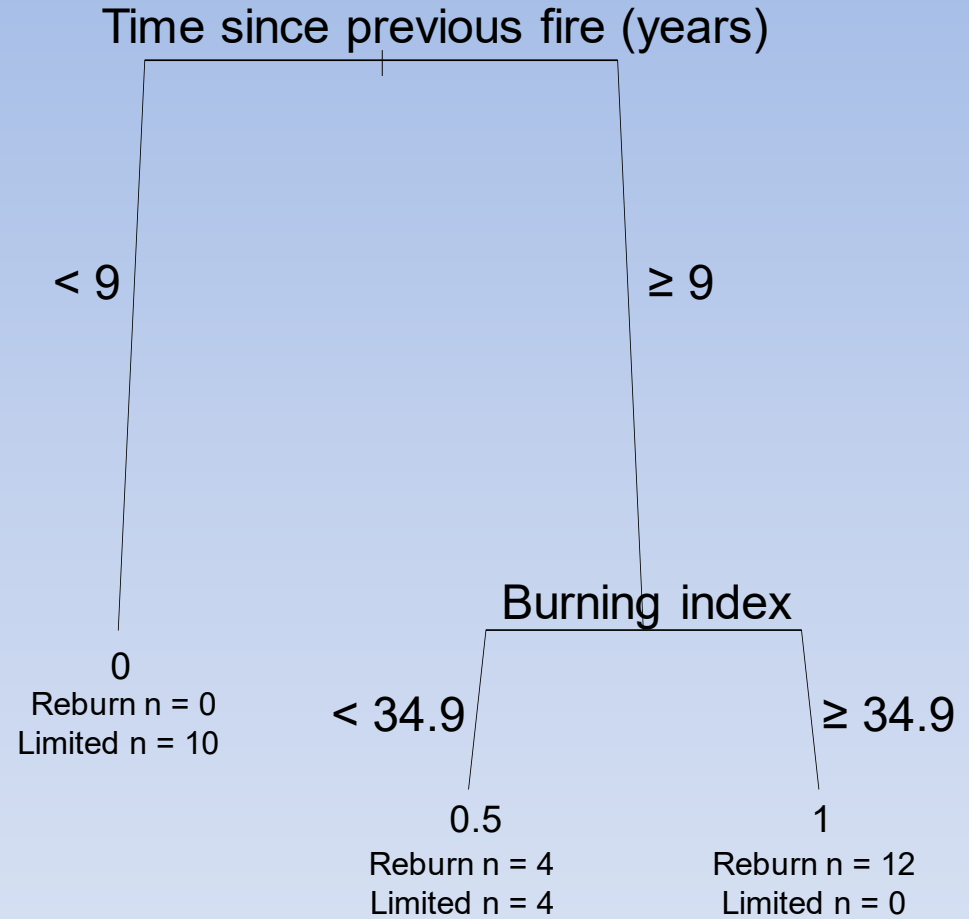
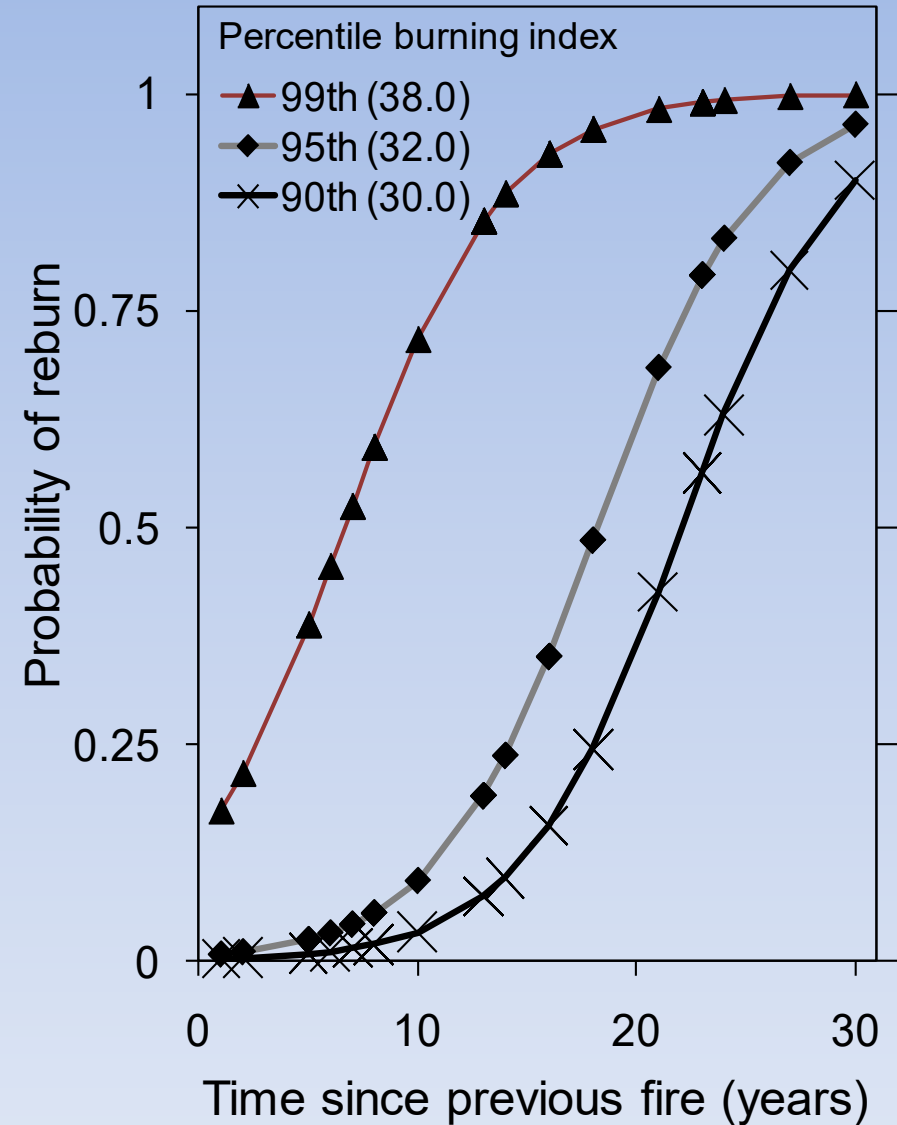
Reburn fires



Interactions between adjacent fires

Logistic regression

Categorical tree

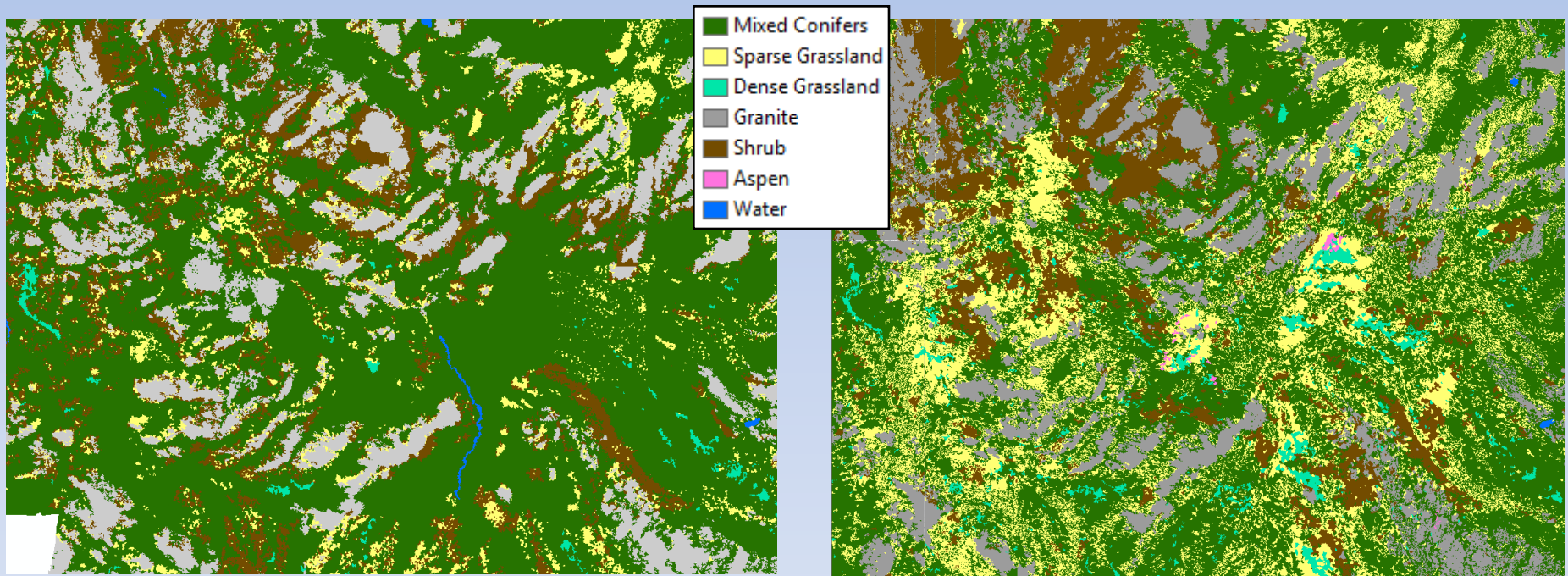


YOSE Vegetation Change From Photos

Fires Reduced Forest Area by 22%

1970 (~100 yr fire removed)

2012

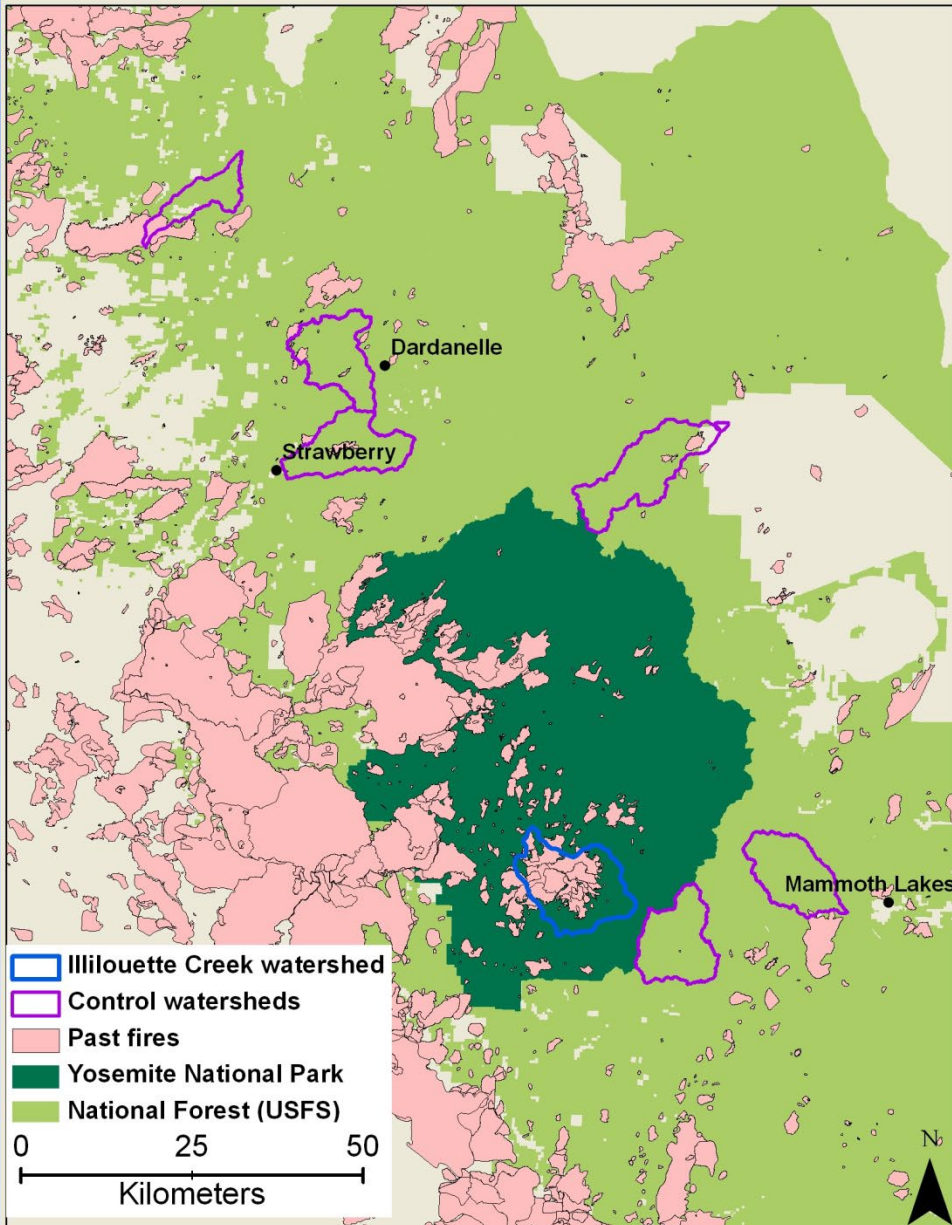


Wet meadows increased by 200%
Dry meadows increased by 200%
Shrublands increased by 30%

Massive change in this landscape

Boisramé et al. 2017 For. Ecol. Man.

Fire and Water



In Yosemite amount of stream water leaving watershed has increased since 1974. Three other control watersheds significantly decreased
Biosrame et al. (2016, 2019)

Soil water storage up, less tree mortality in 2012-2015 drought

Fire severity stable over decades, flood risk fine

Research also found similar benefits in next 50 years with climate change but more volatile
Rakhmatulina et al. (2021)
Policy work?

Summary

- California frequent fire forests have big problems
 - Climate change is certainly a factor but fuels and forest structure most critical
 - We have effective options
 - Prescribed fire, Indigenous burning, restoration thinning, wildfire
 - Treatments can reduce wildfire severity, forests more resilient to climate change, stabilize or increase water resource's
- California has focused on this issue more since 2016
 - Cal Fire grants for fuels management > \$2.6 billion since 2019
 - MOU signed by California Governor and US Forest Service Chief – 1,000,00 acres/yr treated by 2025
- Federal government > \$2 billion but need policy reform
 - The lack of progress is a big issue in the western US
 - Stewardship Project making some progress policy reform
- Optimistic but we are running out of time!