

# Pyrosilviculture. And other topics.

1. Alternatives to herbicide
2. Pyrosilviculture: definition, examples, and opportunities
3. Winter burning
4. Giant sequoia x wildfires

# Alternatives to herbicide in forestry



# Three alternatives that I have thought about

- Manual control (motor or human powered)
  - High cost makes it considered as unfeasible
- 1. Managing edge effect and competition
- 2. Fire
- 3. Planting and patience

# 1. Managing edge effect and competition

Can canopy gap size be used to “naturally” control shrubs?

0.2 acre gaps harvested in 2012

Herbicide applied



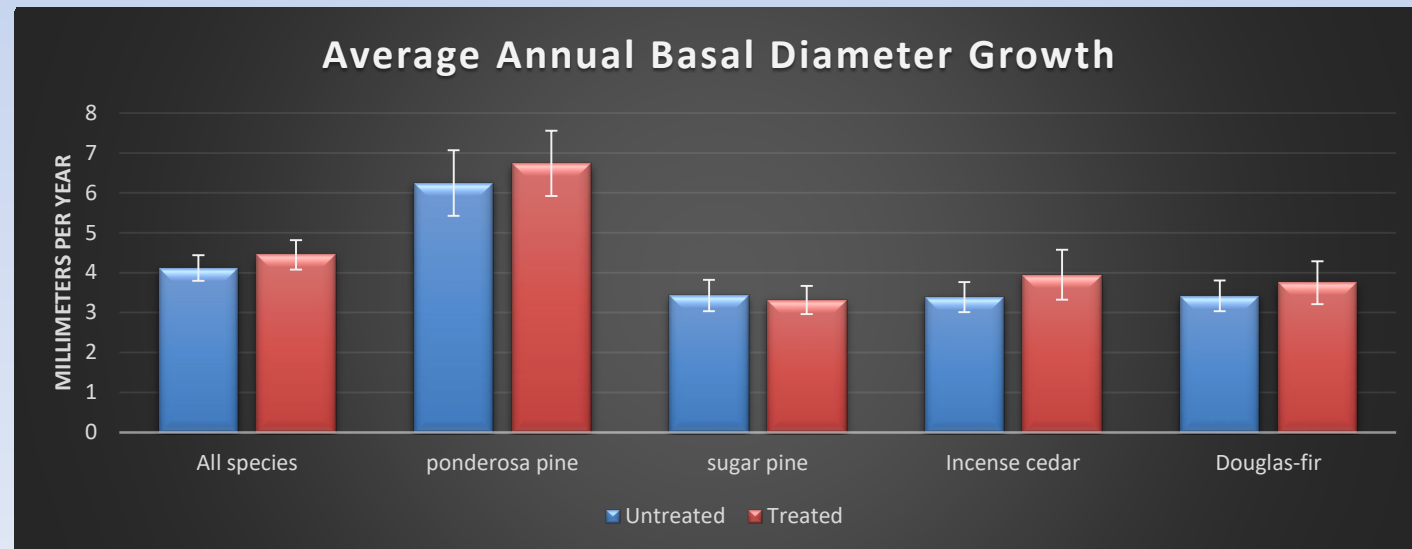
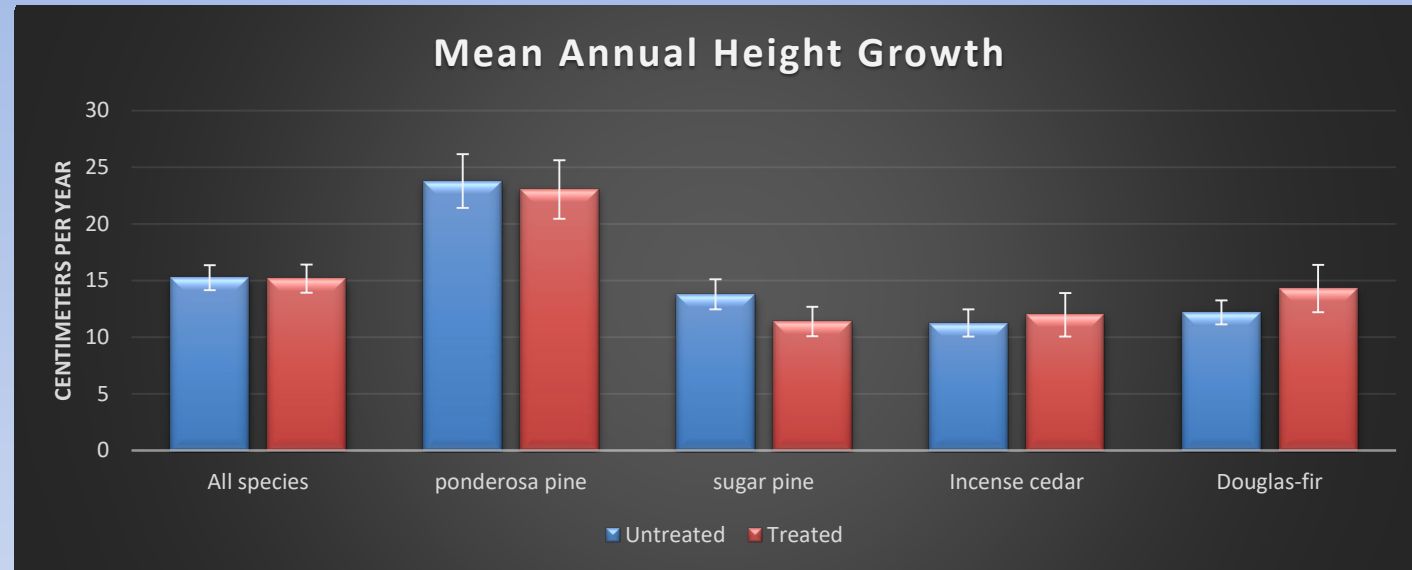
Herbicide NOT applied



# After 6 years, herbicide has had NO effect

In 0.2 acre gaps:

- Shrub cover was 30% when no herbicide applied
- Shrub cover was 2% when it was applied
- A nearby clearcut with herbicide had 50% taller seedlings (*all* seedlings considered)



# What does this mean?

Gap-based silviculture can be a way to reduce the use of herbicides because:

- Competition is dominated by surrounding trees (edge effect), not shrubs
- All species can regenerate, albeit slower than in a clearcut (on average)



## 2. Fire... it works, if you can do it.

Plantation burning research

3 30-yr old stands burned in Feb, 2019

Winter burning reduced shrub cover by 93%, on average

Tree mortality <3%, crown scorch 25%



Masticate only



Masticate + burn



# 3. Plant quick and then be patient

McDonald and Fiddler 2010

Most widely-cited literature that supports herbicide use in forestry

Important to understand the context and details of the study:

- Study sites were >20 acre plantations
- Mostly P. pine, some Douglas-fir
- Most results are through 10 years
- 250 trees per acre were *chosen* at the beginning of the study as trees to follow

## Twenty-Five Years of Managing Vegetation in Conifer Plantations in Northern and Central California: Results, Application, Principles, and Challenges

Philip M. McDonald and Gary O. Fiddler



Today's context:

- Multiaged silviculture (e.g. gap based silviculture) is more common
- More mixed-species stands, including in 20 acre plantations
- Long-term dynamics is more relevant (e.g. longer rotation ages)
- Large, well spaced trees is often the objective (e.g. < 250 trees per acre)



# When we spray, are we just helping the losers?

When considering the “crop trees” / “fire resistant trees”

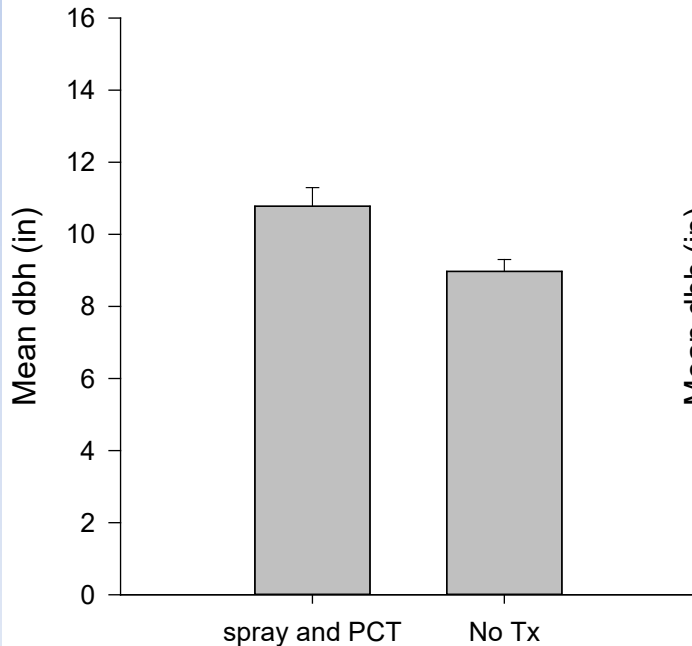
After 24 years at Blodgett Forest:

- No difference in dbh or height

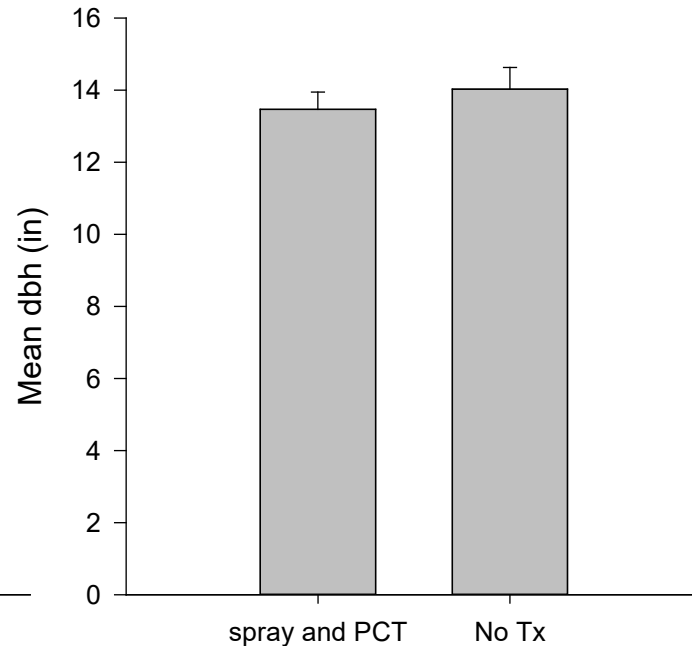
Key processes:

- Initial floristics
- Growth differentiation

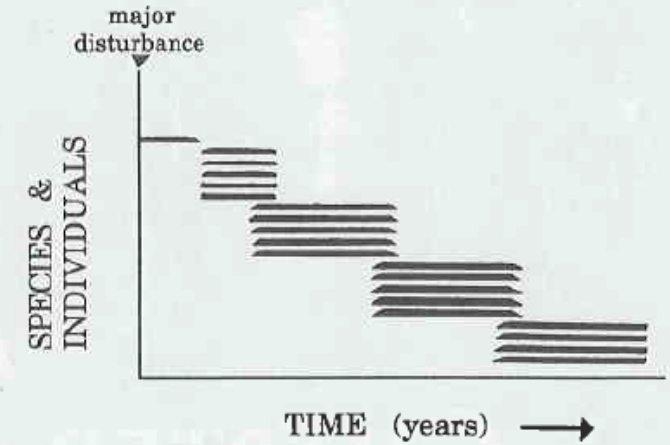
Trees > 4.5" dbh



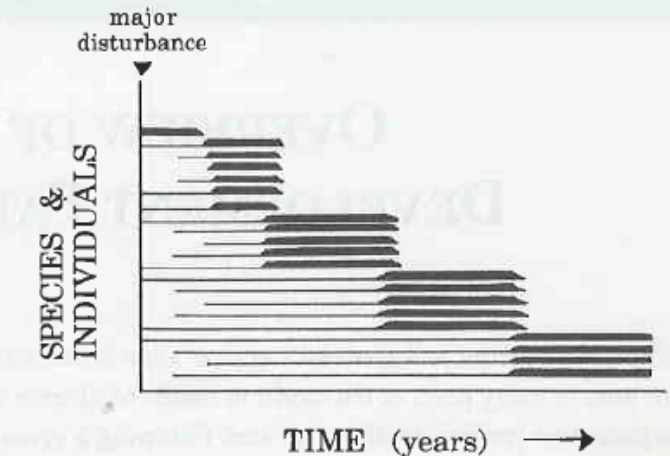
Largest 100 trees / acre



A. "RELAY FLORISTICS"



B. "INITIAL FLORISTICS"



# Integrative Pest Management

~

## Integrative Vegetation Management

- IPM- does not ban pesticide use completely
- Seeks to reduce the use of pesticides by:
  - Understanding ecological roles of “pests”
  - Understanding the long-term effects of applications
  - Managing forests so that, over the long-term, less pesticide will be needed

# PYROSILVICULTURE

Talk objectives!

1. Definition of pyrosilviculture
2. Historical example of pyrosilviculture
3. Challenges v. opportunities

# Pyrosilviculture Definition

1. Using fire directly to meet management objectives
2. Alter nonfire silvicultural treatments explicitly so that they can optimize the incorporation of prescribed fire in the future

York et al. 2021

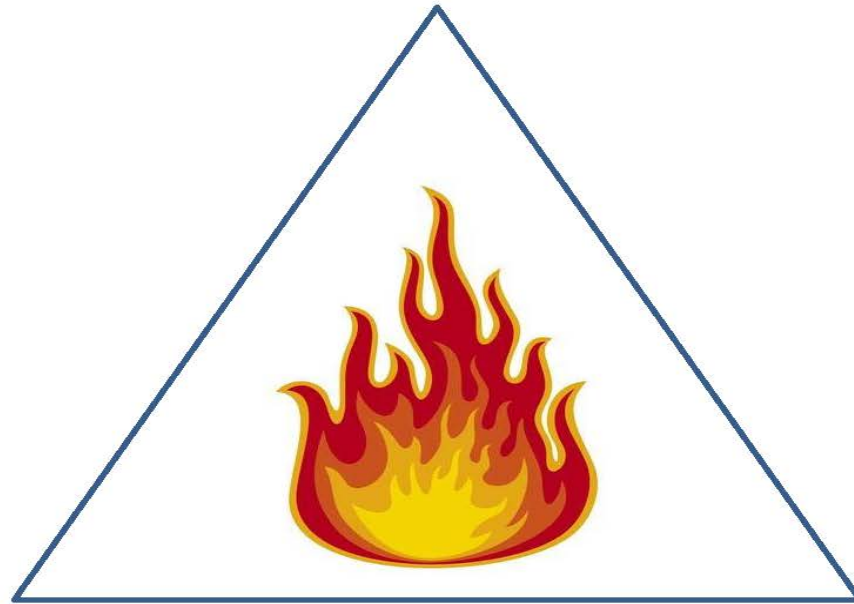


# The Fire Triangle

Suppression

Silviculturalist

Land Owner



Fire Fighter

# The Fire Triangle

Management

~~Silviculturalist~~

*Pyro-Silviculturalist*



~~Land Owner~~

*Pyro-Land Owner*

~~Fire Fighter~~

Fire Manager

# An early example of pyro-silviculture in California

*Red River Lumber Company* in southern Cascades,  
near Lake Almanor, owned by Walker family

– Owned 750,000 acres used light burning to 1920's



*Forest History Society pictures*  
1920

# Clinton Walker wrote in letter in 1938

- ‘The general condition of the forests when the white man first came into CA was very excellent’
- ‘Then came the foresters from Yale University and put the tourniquet on the forests’
- ‘I would prefer to remove the tourniquet in our timber matters [which] is the lack of fire’





# Will there be a modern-day equivalent of the Red River Lumber Company?

Not until we have a return of the  
Pyrosilviculturalist:

Foresters and landowners burning

Foresters and landowners preparing forests to  
be burned





Show/Hide Menu

### View Ignitions By:

- Agency
- Burn Status

### Select Date Range

10/15/2018 Start  
10/15/2018 End

View

### Legend

- National Parks
- US Forest Service
- BLM
- US Fish & Wildlife
- CalFire
- CA State Parks
- Tahoe Conservancy
- Local Fire Agency
- Local Non-Fire Agency
- Private Industry

### Map Overlays

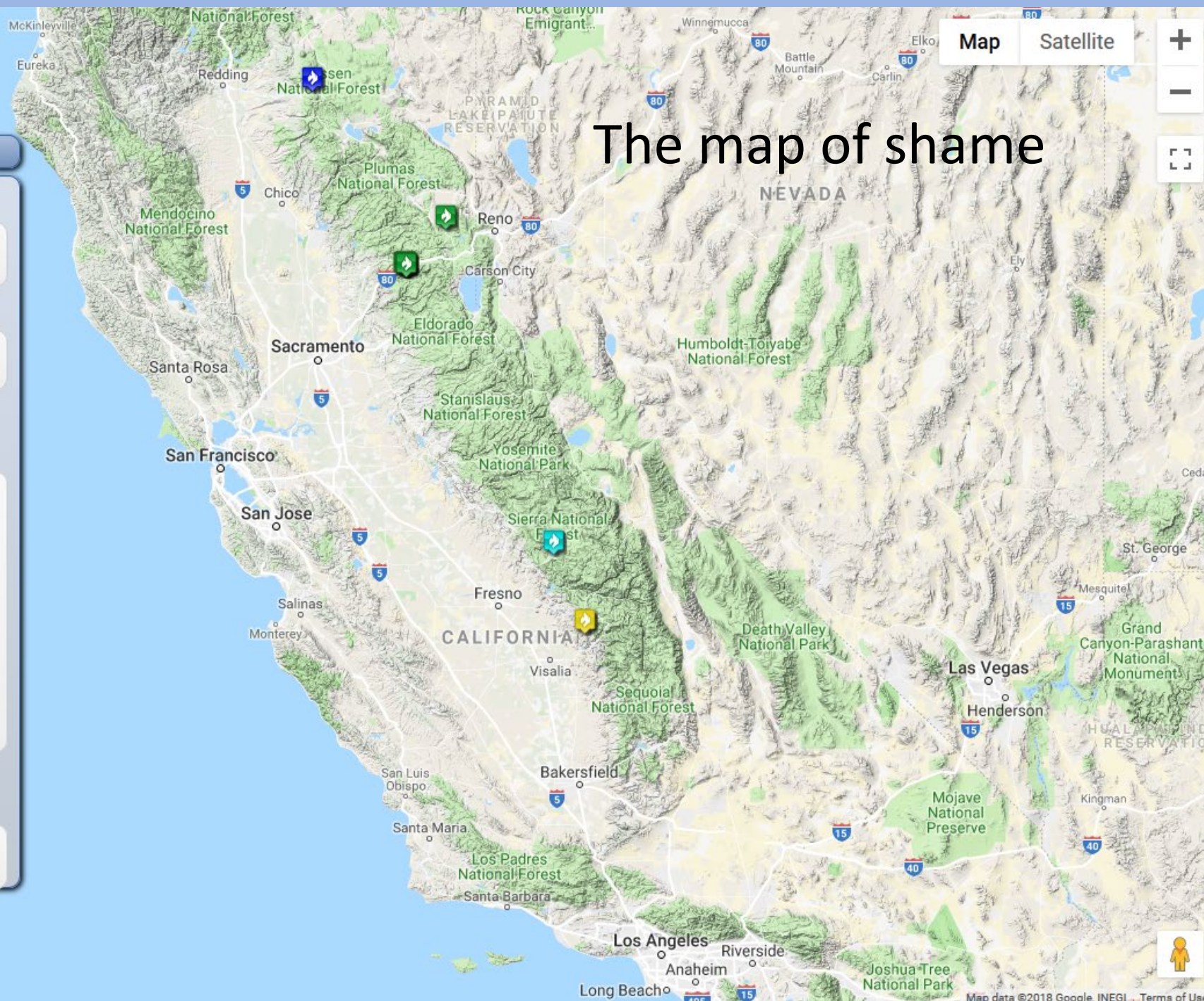
- County Boundaries
- Air Districts

Map

Satellite



# The map of shame



# Can silviculturalists become pyrosilviculturalists?

- Yes!
- 4 opportunities
- 3 challenges



# 1. A reason why: Nimbleness

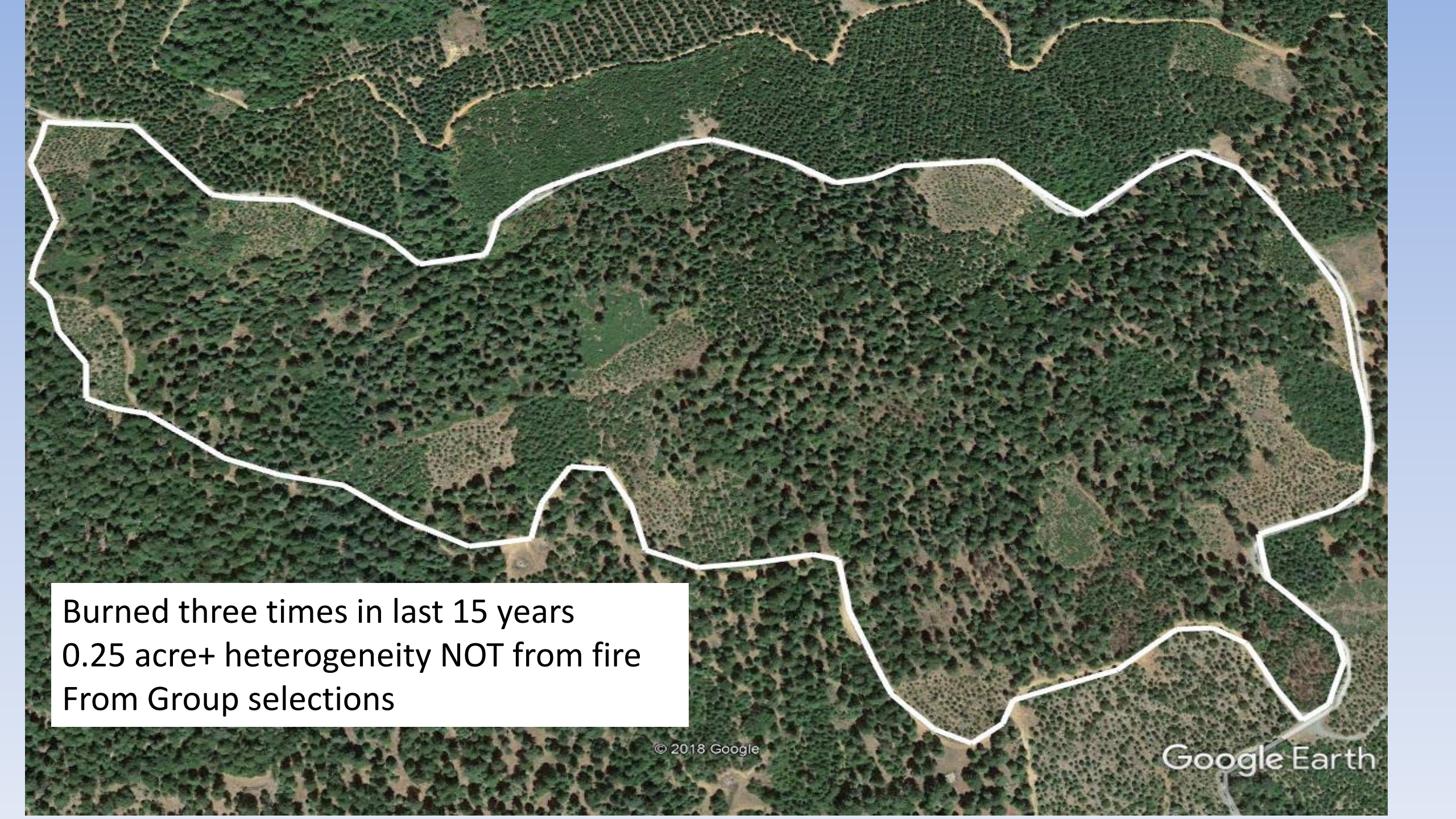
- Foresters are good at *seasonal planning*
  - *E.g. planting, herbicide in narrow climate windows*



## 2. Can create coarse structural diversity

- “Light burning” can *reinforce* homogeneity
- e.g. Rx fire + group selection





Burned three times in last 15 years  
0.25 acre+ heterogeneity NOT from fire  
From Group selections

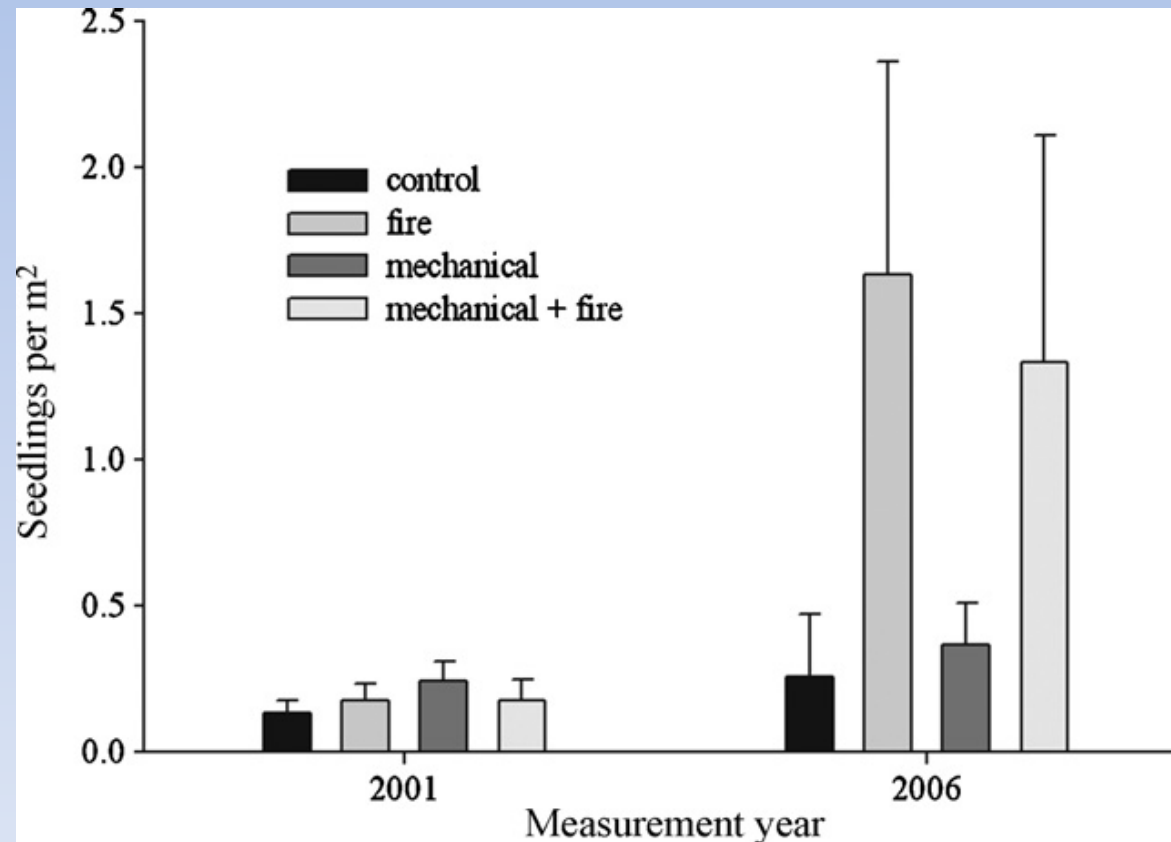
© 2018 Google

Google Earth

# Foresters can *regenerate* with precision

## Fires cannot

Fire and fire surrogate treatments: Seedling responses



White fir

# 3. Can extend the burn window

- Fall burning is ideal, but is it far too restrictive
- At Blodgett in 2020 and 2021
  - ZERO days when we could burn in the fall with a LE-7 permit before significant rain
- Is winter the new fall for burning?





# What winter burning is not:

A song of ice and fire

White walker not the best burn boss



# What burning is (or can be if people did it)



# Winter burning

e.g.

- Low canopy density (~50%)
- Receptive litter (pine needles)
- **Flammable forb layer**
  - **Dormant fern**
  - **Bear Clover**

Silviculture made it possible:

Structure created with chainsaws and winter burning:

**Torching probability = 0.1**

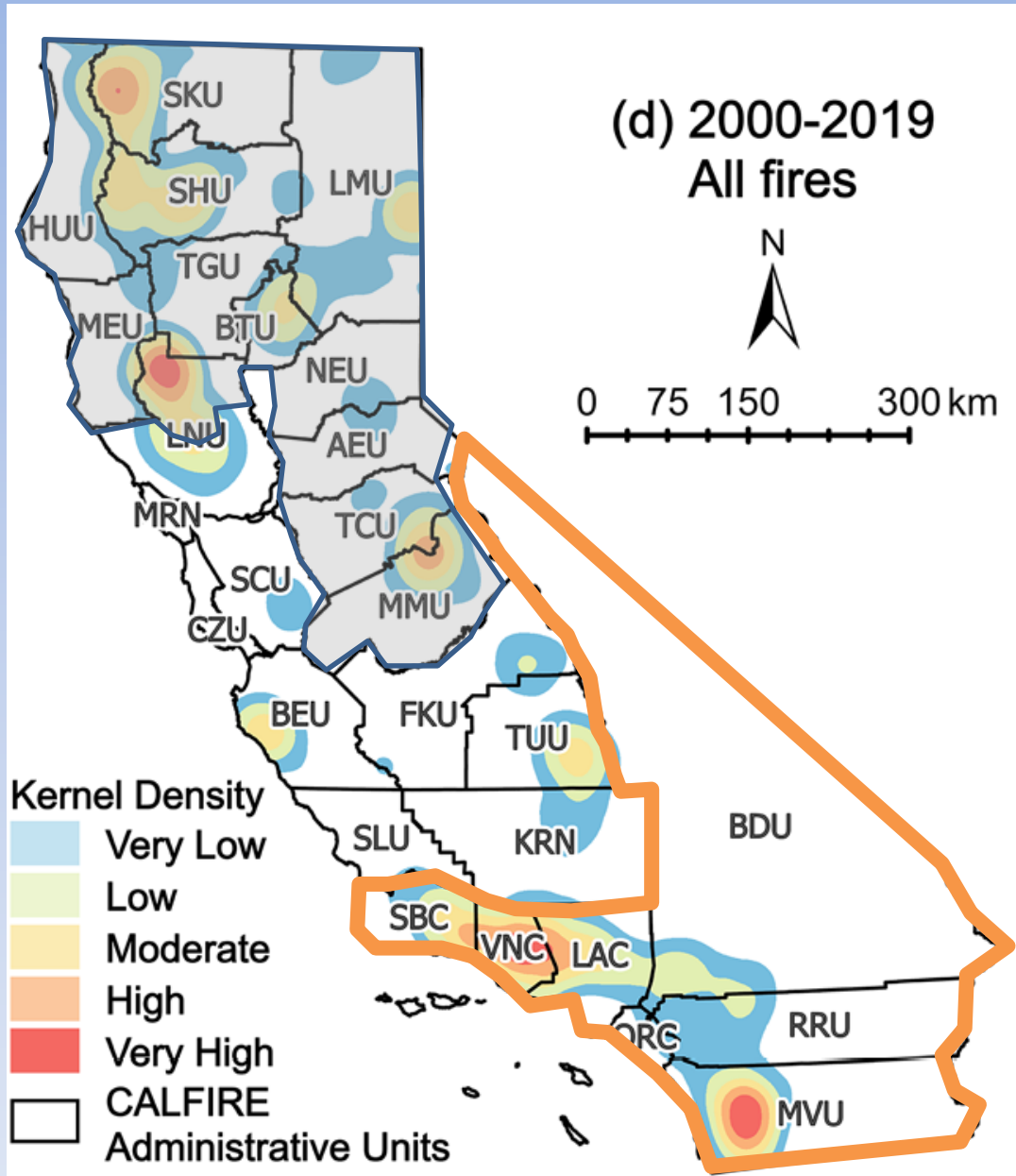
**Torching index = 80 mph**

**Timber = 1 MBF/yr**

(no dbh maximum)

Feb, 2018 burn





Adapted from Li and Banerjee 2021; Nature Sci. Rep.

## Permitting in California

- Confusing and difficult to obtain a permit
- But in the “State of Jefferson,” burn permits are often not required in the winter
- Opportunity for landowners to conduct lower-stress and productive burning



# 2 strategies for extension work

## 1. Burn and learn together

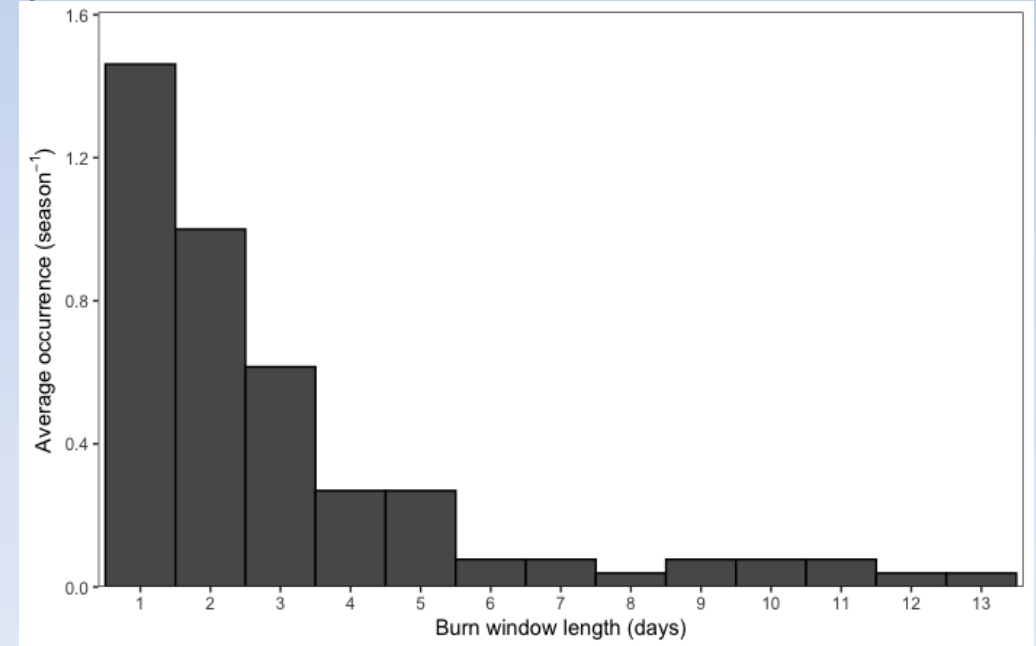
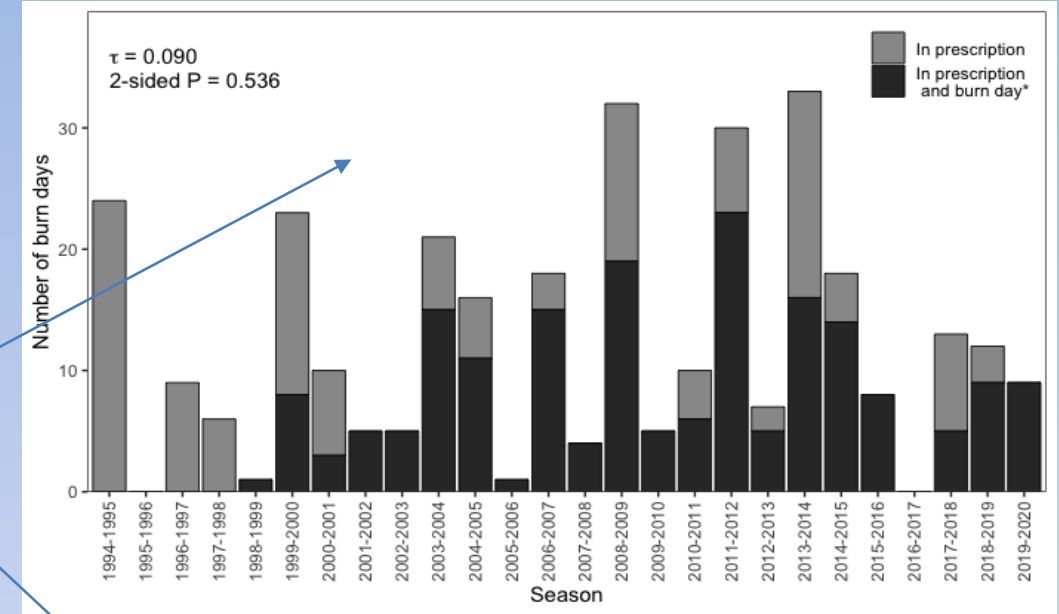
- Explain when permits are required
- Winter burning specific prescriptions
- Prove the concept of winter burning feasibility

## 2. Experimental burns in a wet forest to assess effectiveness

- Shrub cover reduction: 94%
- Fine fuels reduction: 59%
- 1000-hr reduction: 26%
- Duff reduction: 15%



Opportunity  
Challenge



# Increasing the burn window

What we can control, silviculturally:

Understory composition

Overstory composition

Canopy density

Fuel density

2018 Burn crew:



# 3 Reasons why pyrosilviculture is a pipe dream

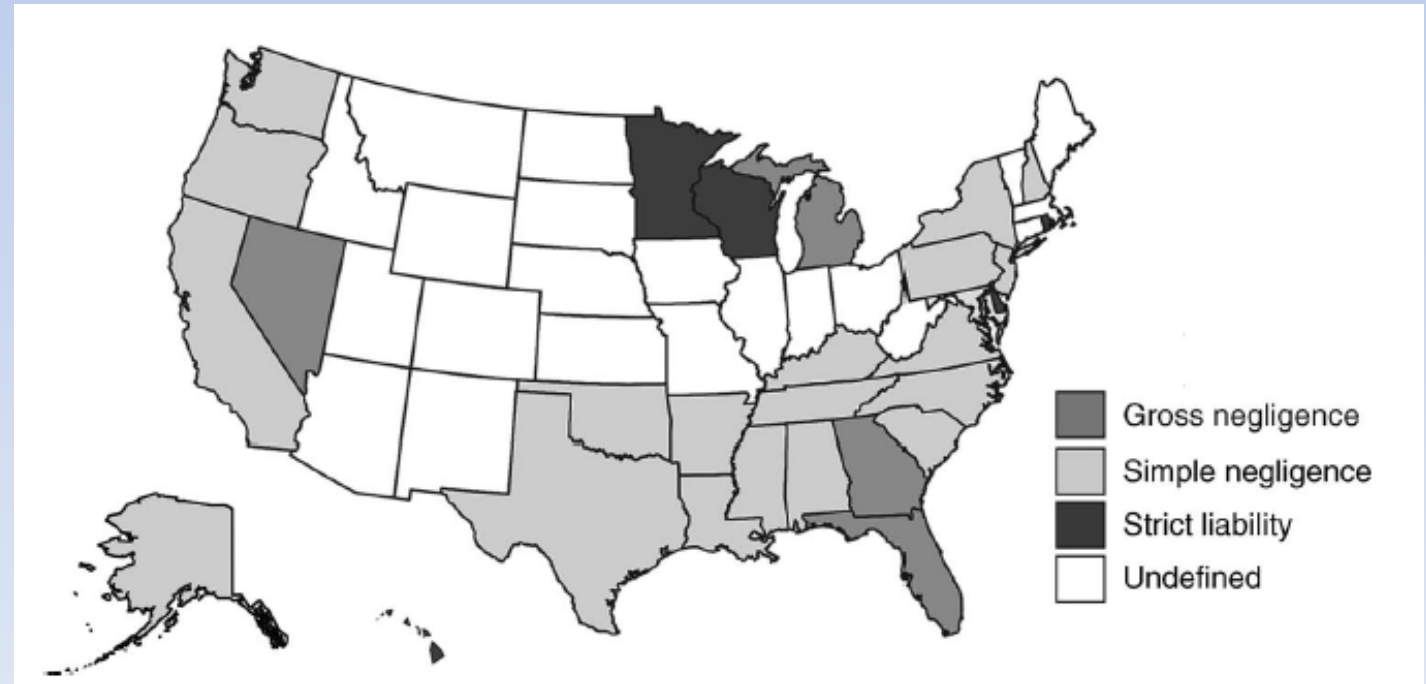


# 1. Landowner liability (or perception of)

- Will the switch from simple to gross negligence be enough?
- Maybe: Wonkka et al. 2015:

In southeast, counties with gross negligence standards burn more than counties with simple negligence

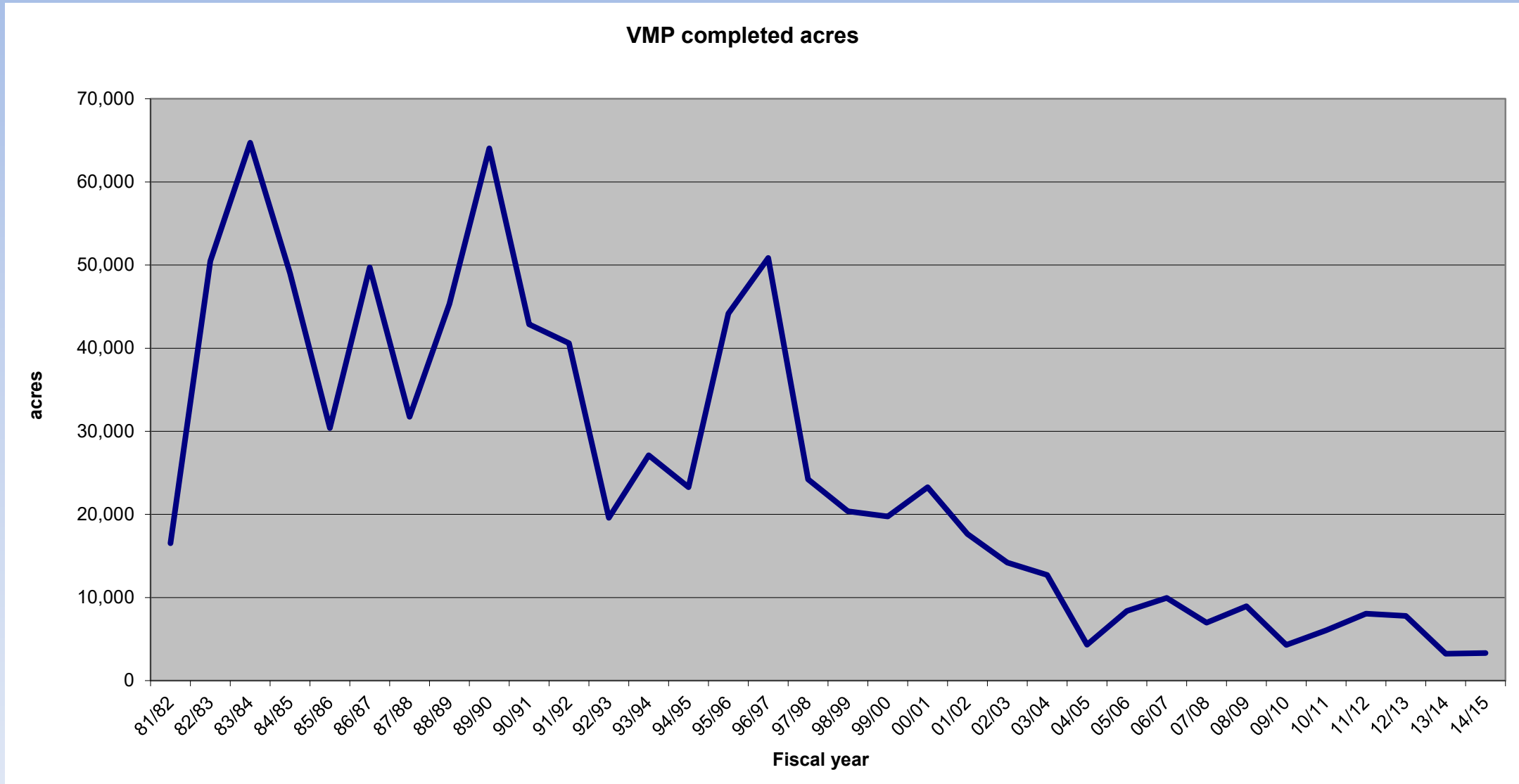
- Or was liability a scapegoat?
- Or will it be irrelevant because of permitting constraints?





## 2. Big agencies still “own” fire

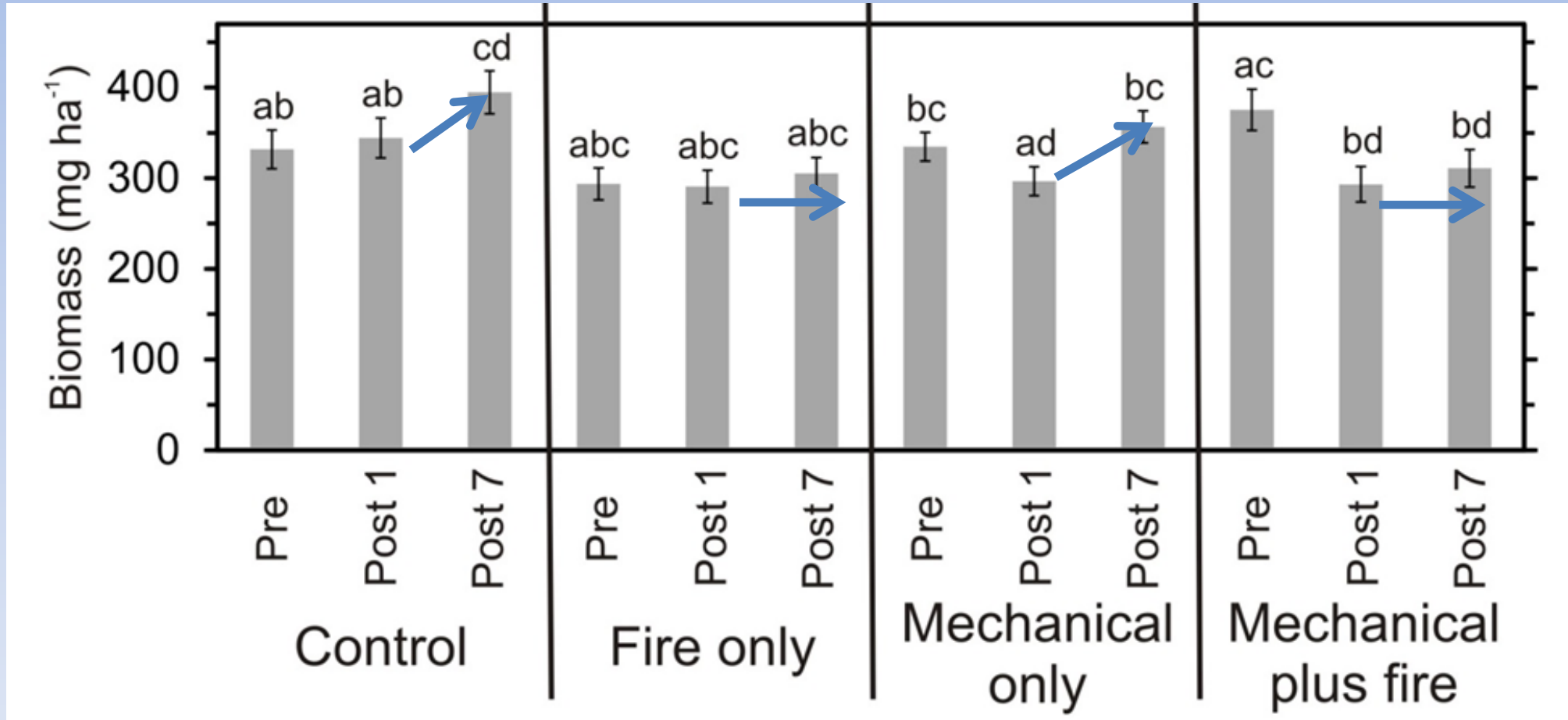
Fundamental conflict of interest: facilitating and stopping fire



### 3. Fire conflicts too much with timber and carbon

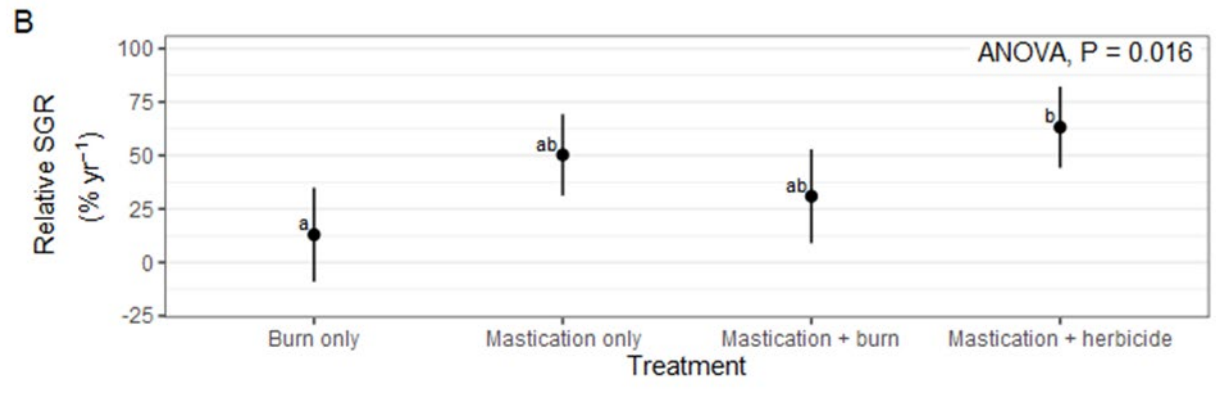
Mechanical only and controls have won so far

BUT, first fire was a HOT fire... not jibing with Pyrosilviculture

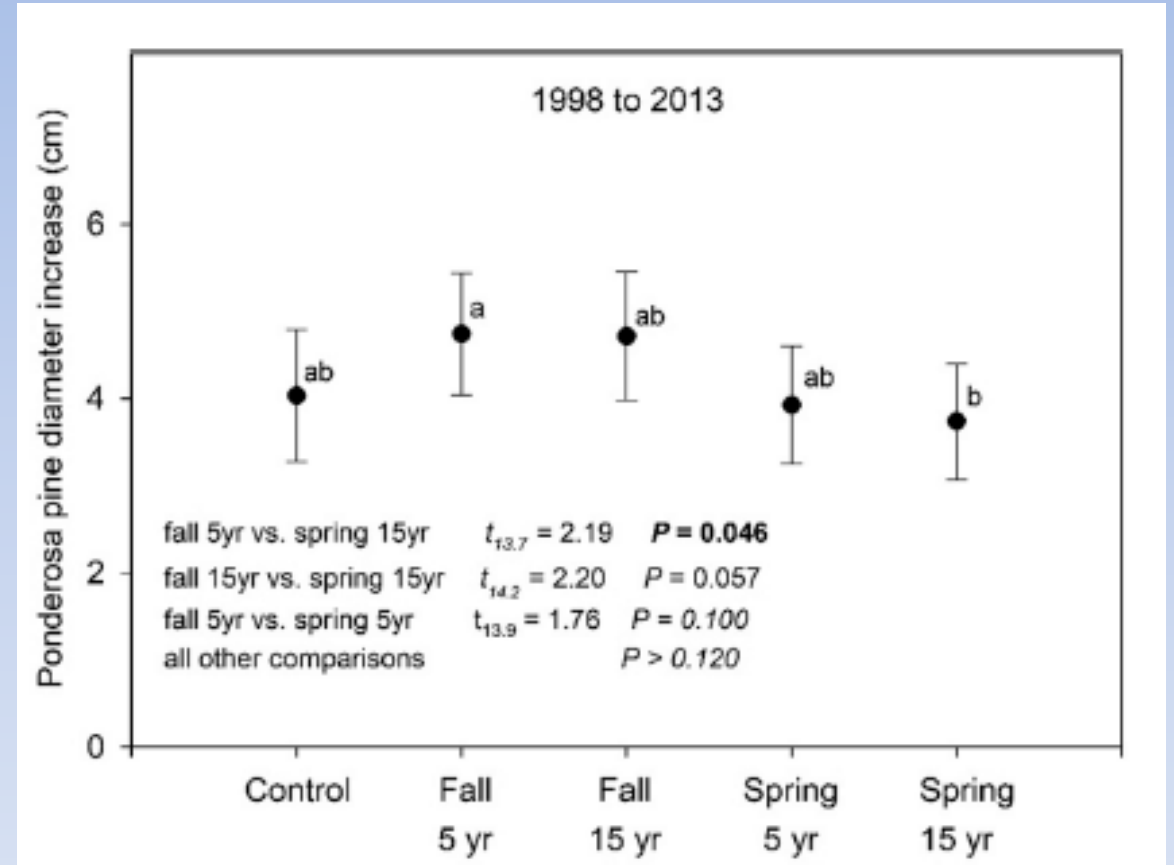


# Can fire and stand growth get along?

Or is using fire the only way in which stand growth can occur?



Russell and York In Revision



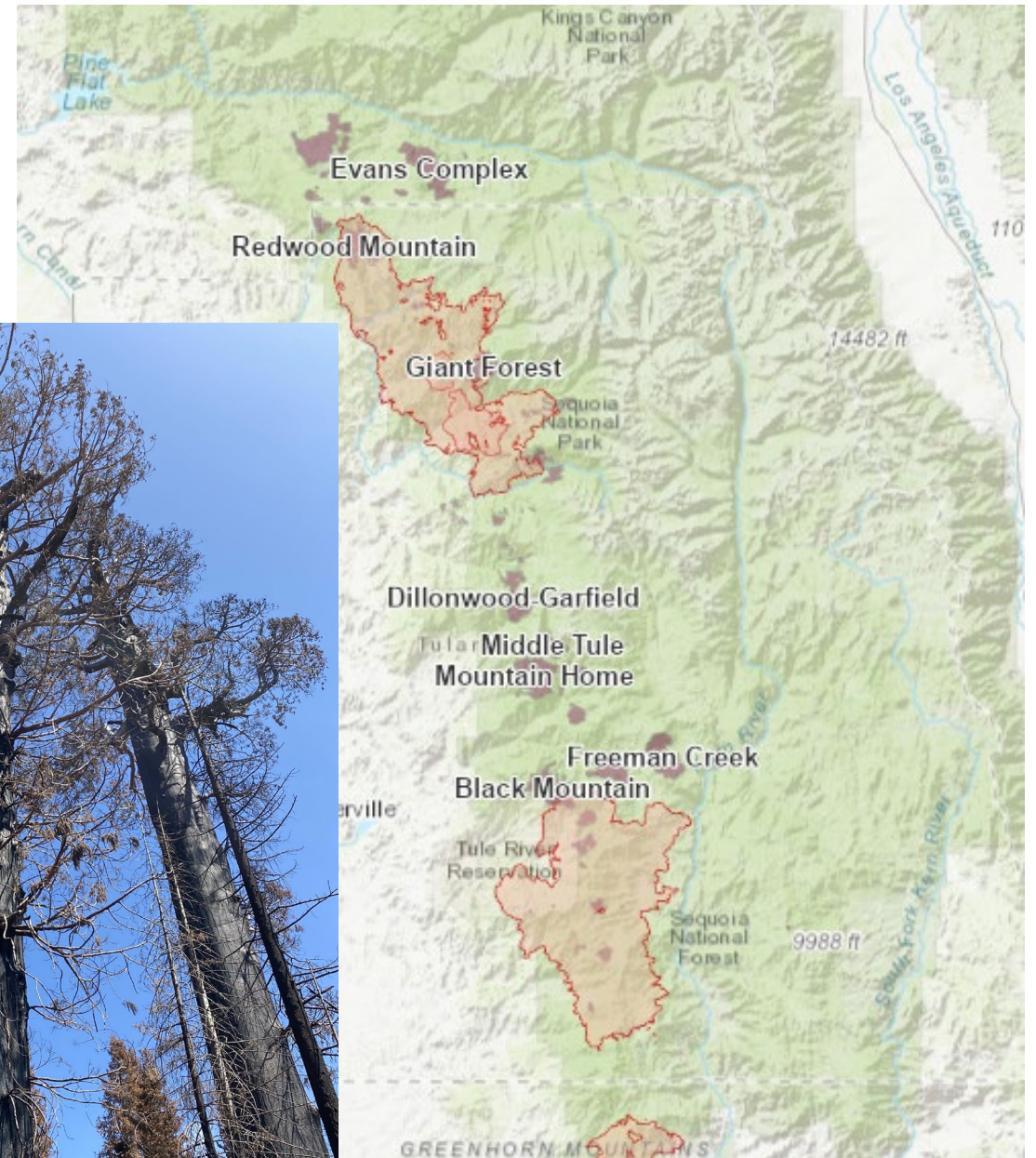
Westlin and Kerns 2021

# CA wildfires x Giant sequoia

HUGE impact on native giant sequoia  
~~ 90% of native groves have burned in  
wildfires since 2015

Three possible outcomes:

1. Doom's day: Heavy ancient tree mortality and no regeneration because of droughts
2. Delayed doom's day: Heavy ancient tree mortality, heavy regeneration, then high severity reburn of regeneration
3. Silver lining: Moderate ancient tree mortality but significant regeneration that is resistant to fire



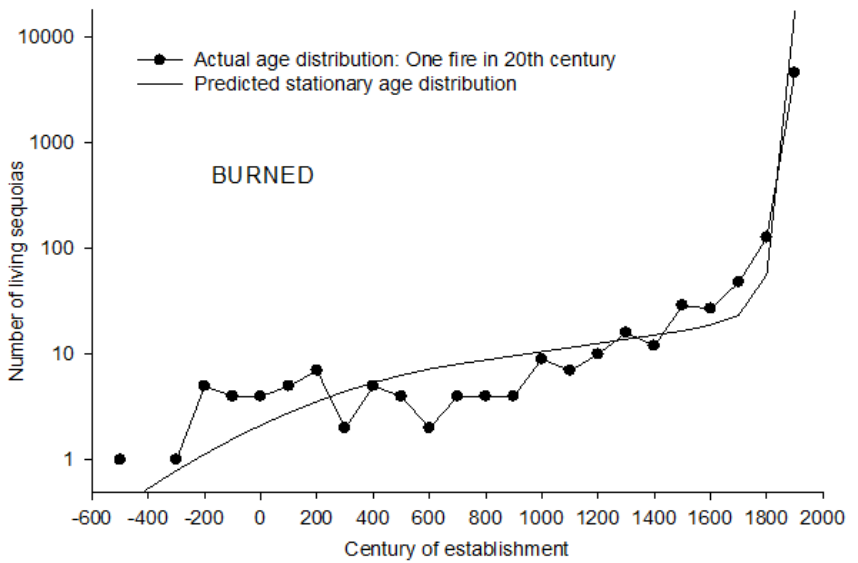
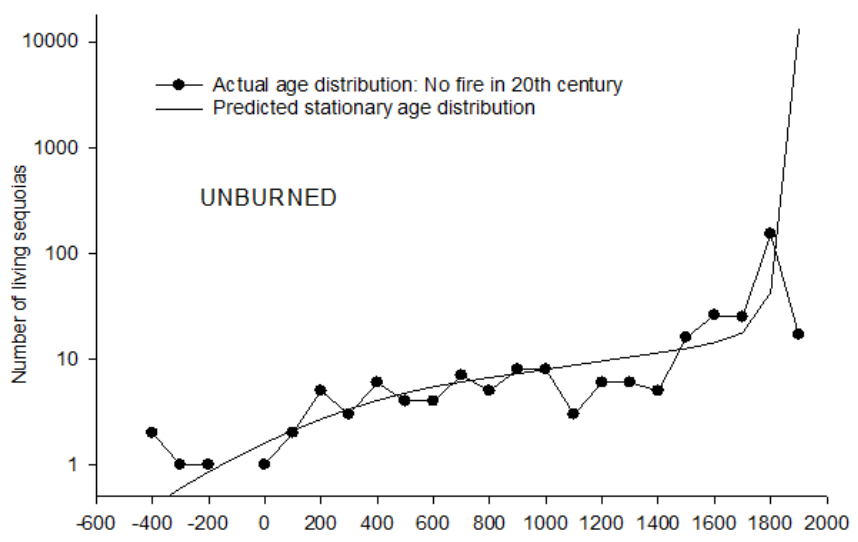
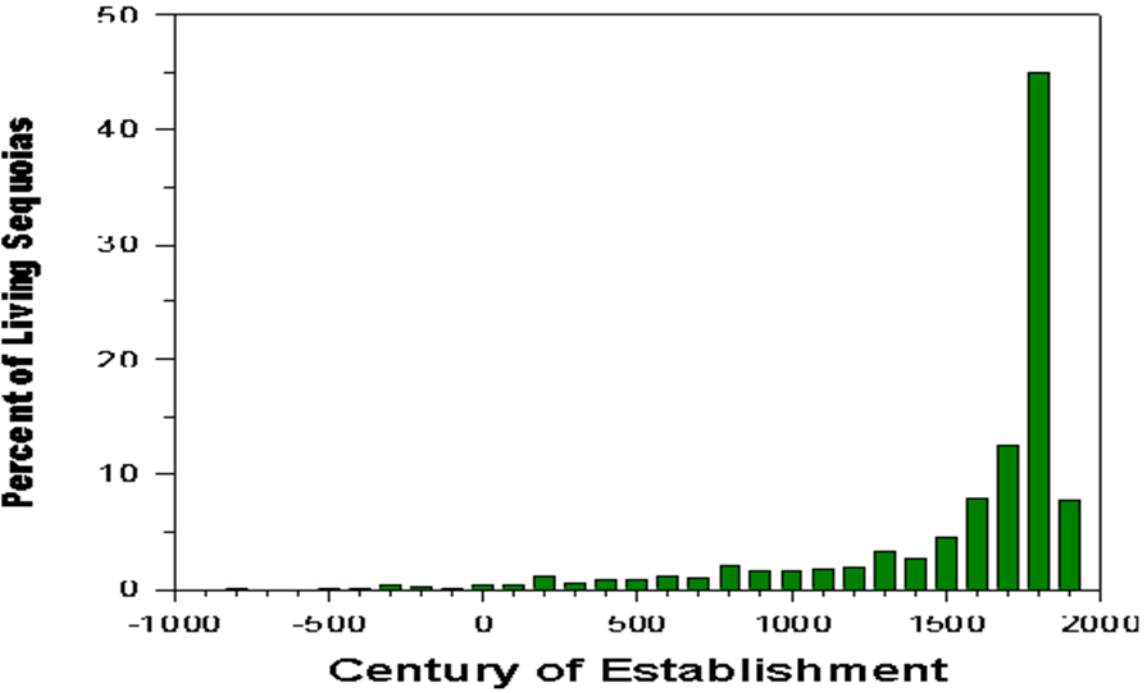
# The poor condition of giant sequoia has been known for a long time....

Metric	Integrity Measure	Current Condition	Summary Comments and Potential Impact
<b>Fire Return Interval Departure</b>	Higher degrees of departure = poorer integrity. Values are between 1.0 (extreme departure) and 4.0 (no departure)	POOR	In some high-profile groves repeated burns are maintaining low departures, but on the whole departures remain high. Most groves are currently surpassing several maximum return intervals. The potential impact is high because of the risk of extensive high-severity fire following extended fire-free periods and because of inadequate regeneration correlated with disturbance-free periods.
<b>Ozone</b>	Ozone concentration within groves (ppb). Damage not expected unless 8-hr highs > 200 ppb	GOOD	Current levels are lower than those observed to be necessary for damaging individuals. Levels have not increased, although some seedlings may be affected at current levels. The potential impact is low at current levels.

Regardless of whether it is fire suppression or climate change (it's both), the thing we need is the same: Good fire or a surrogate for it



# New research opportunities: Understanding tradeoffs



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