



2022 Red Fire  
Yosemite – will  
see again

**Forest Fires in California's New Climate Reality: There is Hope**  
Scott Stephens, Department of Environmental Science, Policy, and  
Management, University of California, Berkeley

# Tree Mortality in the Southern Sierra Nevada

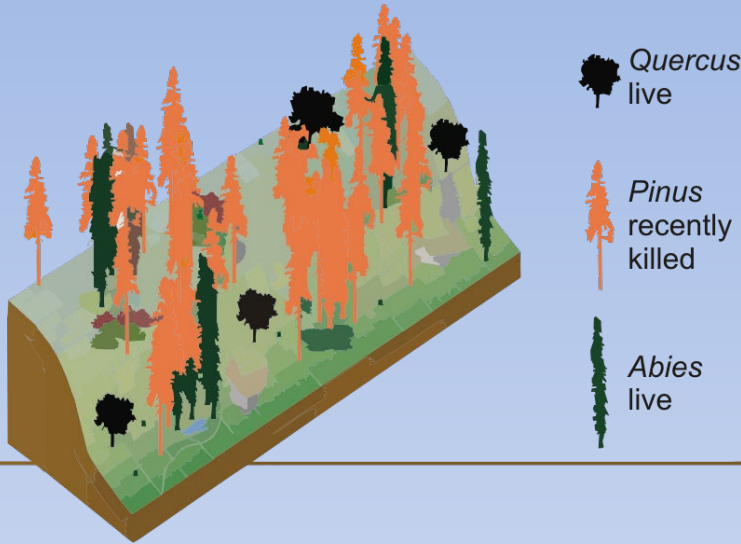
2012-2015

Drought



# Vegetation and Fuel Dynamics Following Severe Pine Mortality (theoretical)

1-2 yr

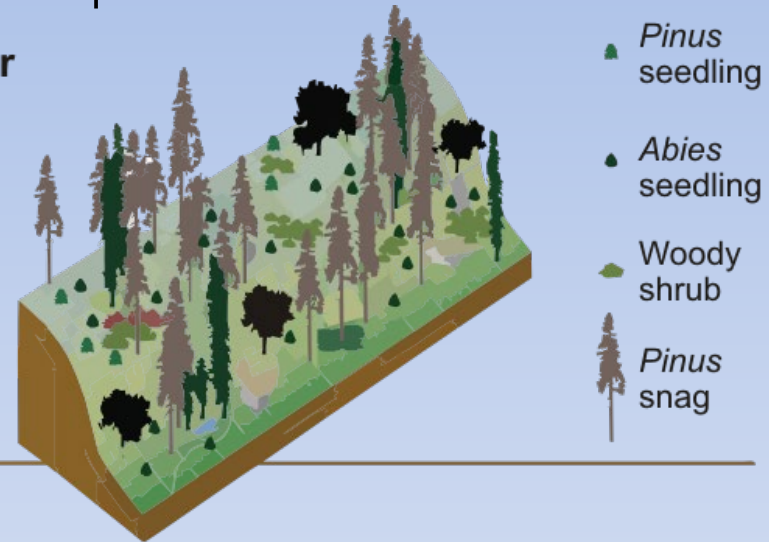


↓ **Canopy fuel moisture**

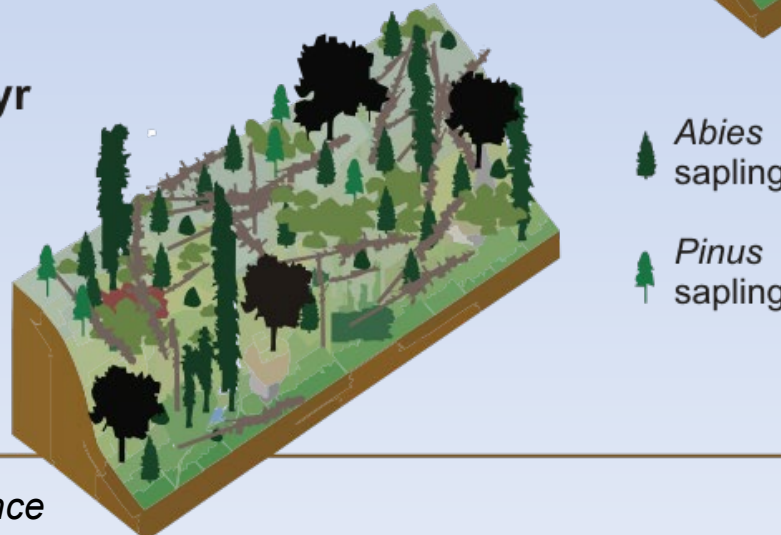
↓ **Canopy fuel load**

↑ **Fine surface fuel load**

3-10 yr



11-20 yr



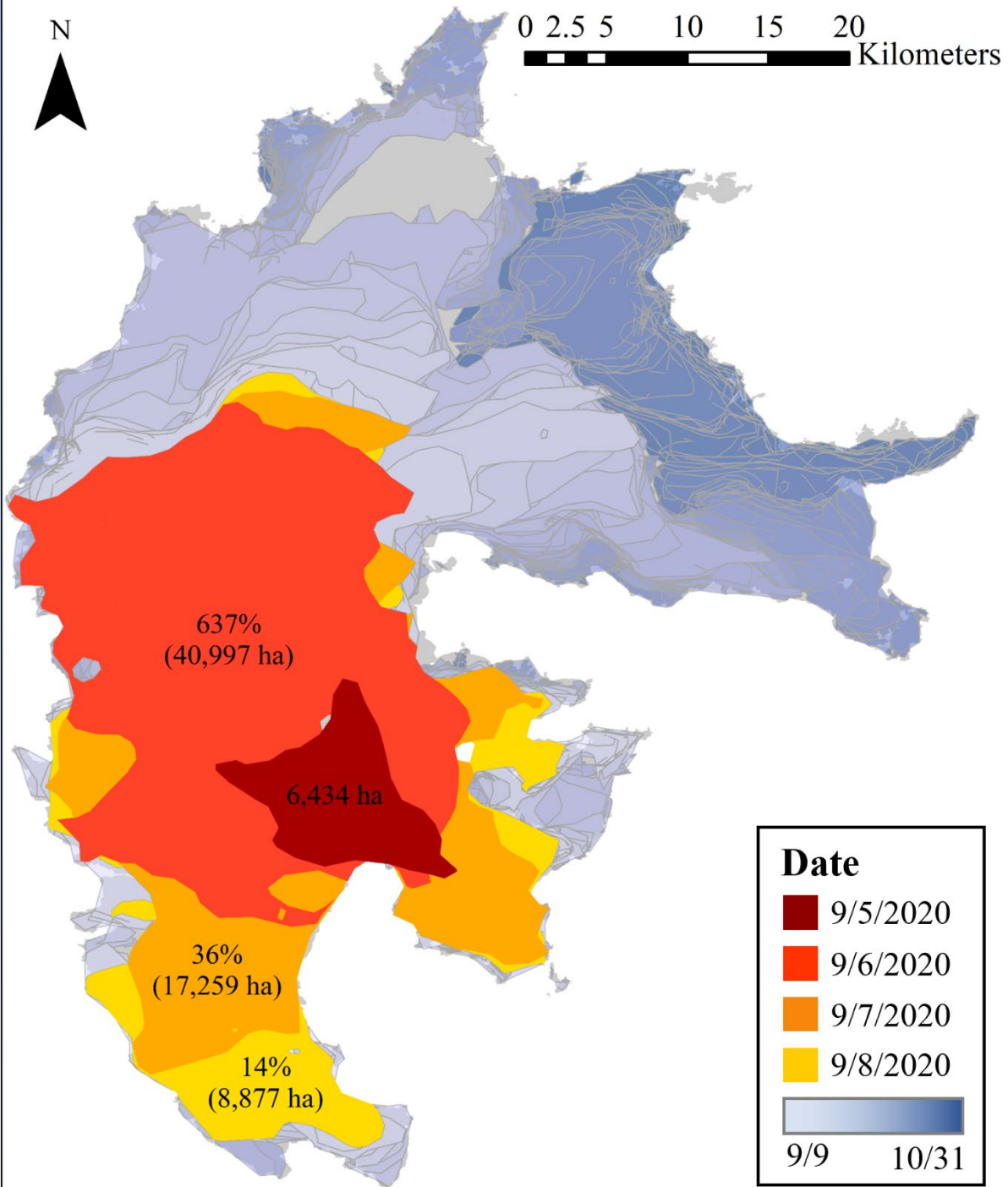
↓ **Canopy fuel load**

↑ **Coarse & live surface fuel load**

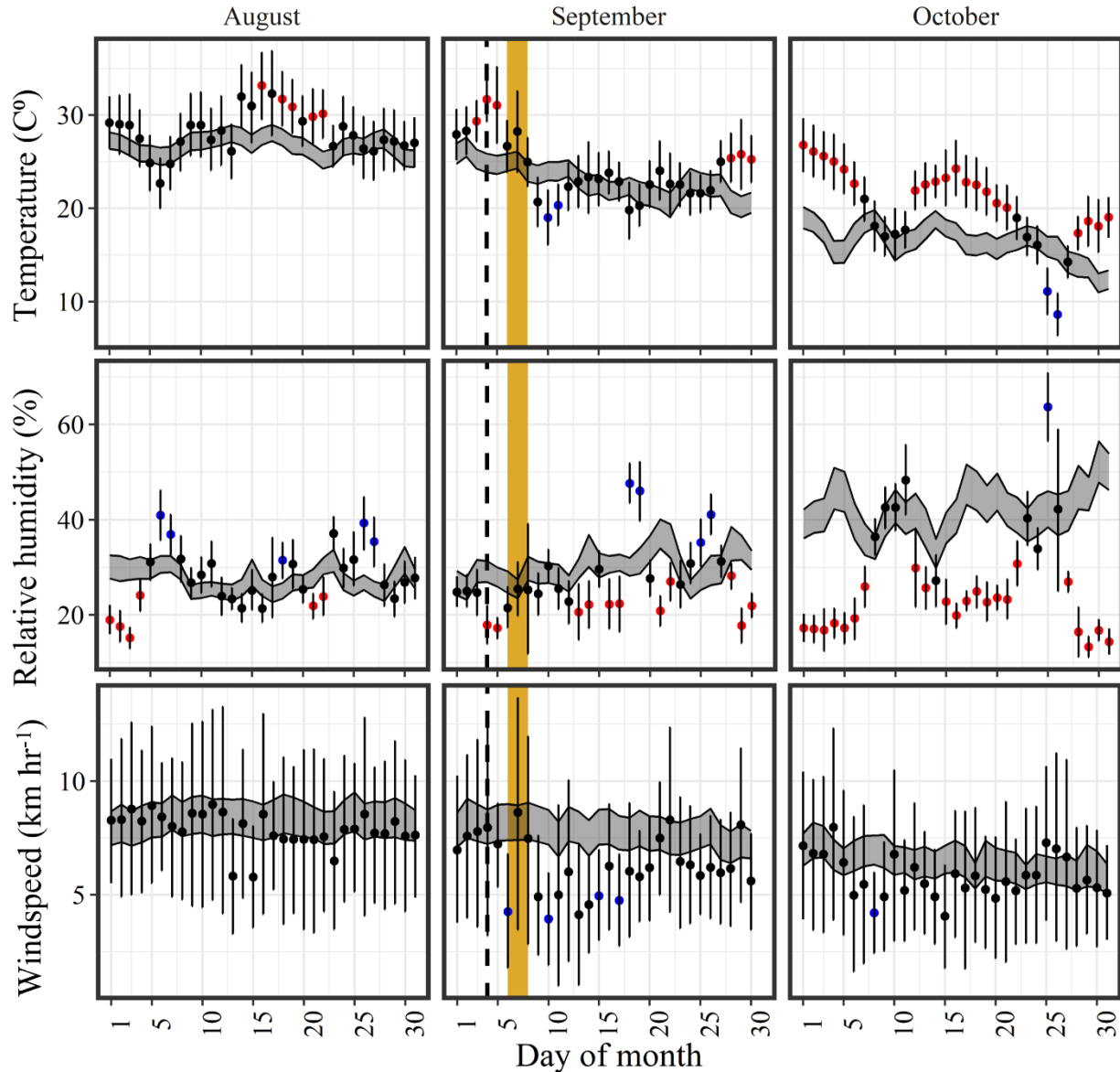
# Creek Fire (2020) – Early Fire Progression



Stephens et al. 2022, *Forest Ecol. Manage.*



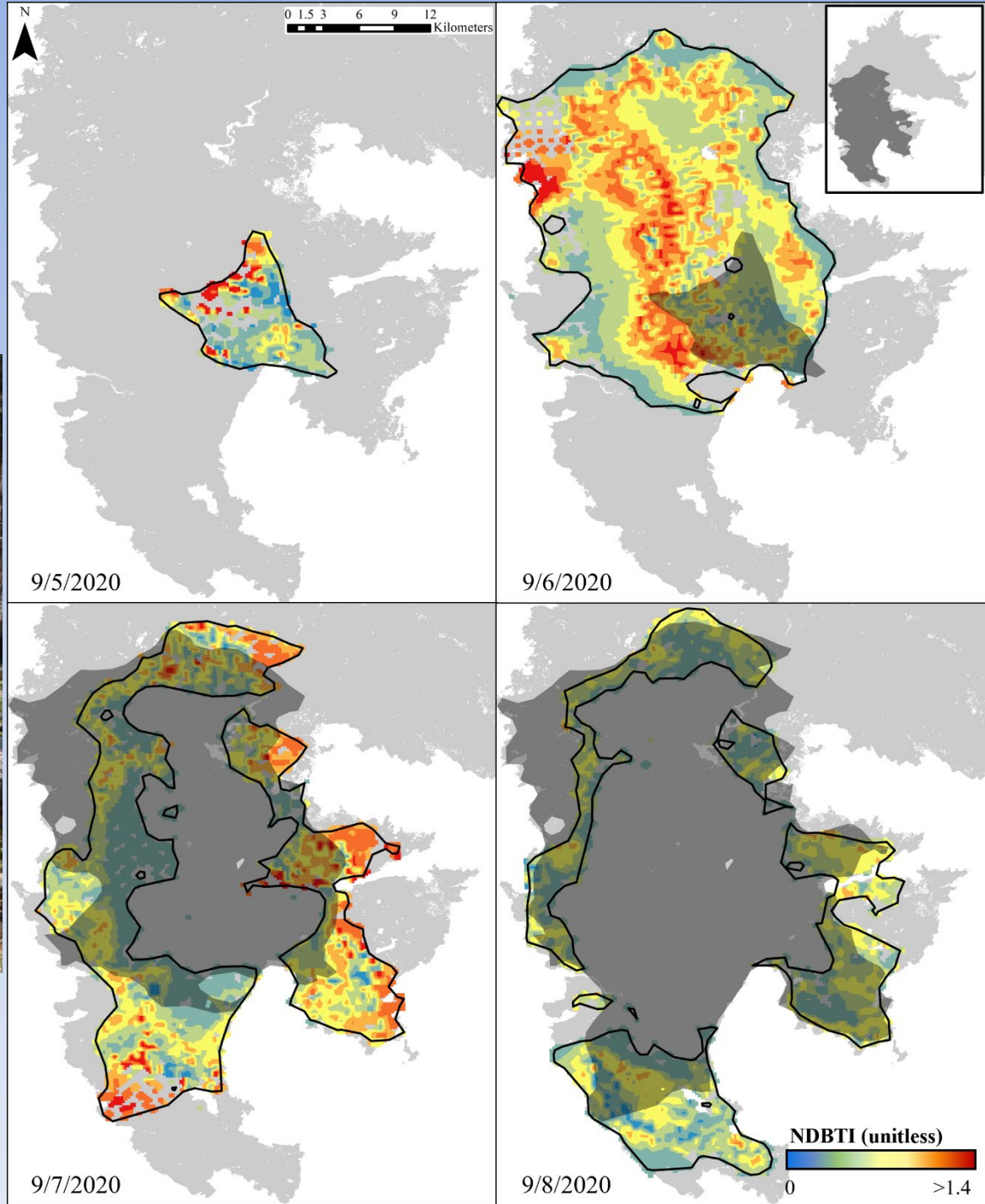
# Creek Fire weather: Relative to previous 20 years



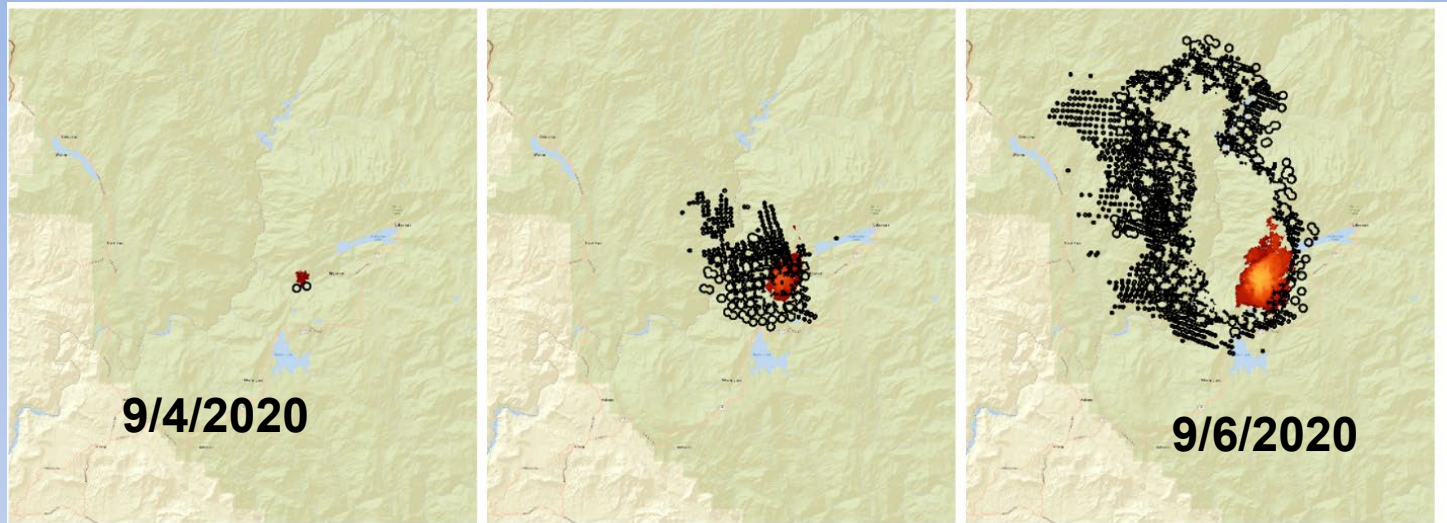
Weather departure

● High ● Low ● Normal ■ 95% CI<sub>2000-2019</sub> ■ Largest fire growth (9/6-9/8)

# Creek Fire (2020) – Remotely sensed fire intensity (NDBTI)



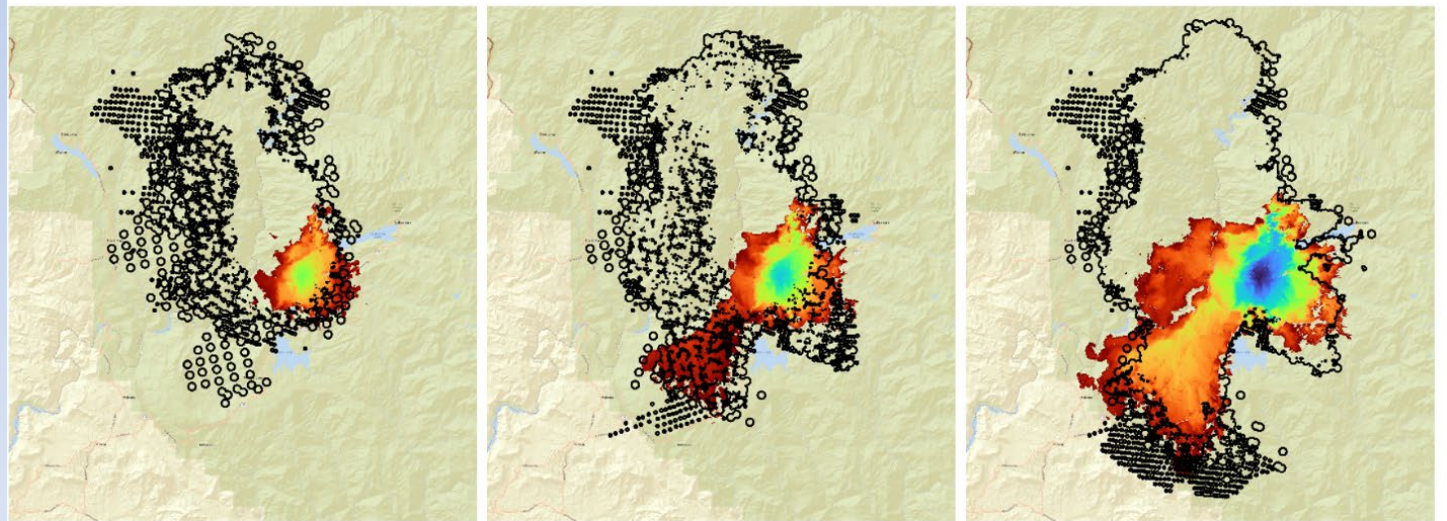
# Creek Fire actual vs. modeled fire spread



(a)

(b)

(c)



(d)

(e)

(f)

# Forest Management Implications

- **Historical frequent fire forests generally low density, yet highly variable**
  - **Fire was the key process in these forests**
  - **Changed dramatically**
- **Forest change = greater vulnerability to fire AND drought-related mortality**
  - **Vegetation/fuel development following these can lead to long-term forest loss from repeat high severity fires**
  - **Operational fire models don't work on worst fires (mass fires)**
- **Large-scale forest restoration needed**
  - **Research fully supports restoration treatments in these forests**
    - **Stephens et al. 2020 *Front Ecol Envir***







Valentin (Val) Lopez,  
Chairman of the  
Amah Mutsun Tribal  
Band

“Fire is a gift from  
creator for the  
stewardship of the  
land”

What a way to look  
at fire

# Cultural Restoration Santa Cruz Mountains

Three treatments replicated 3 times, experimental unit size 4 ha (CZU Lightning Complex Fires burned all areas) in mixed evergreen forests

- 1) Underburn with dead understory trees removed
- 2) Shaded fuel break with approximately 60% canopy cover, remove understory
- 3) Full restoration with almost all conifers removed leaving dominant oaks and some smaller oaks (25% canopy cover)
- 4) Goal is to move forest towards Indigenous values and reduce fire hazards

# Experimental Units Before Treatment



Cultural burning ends  
200 years ago

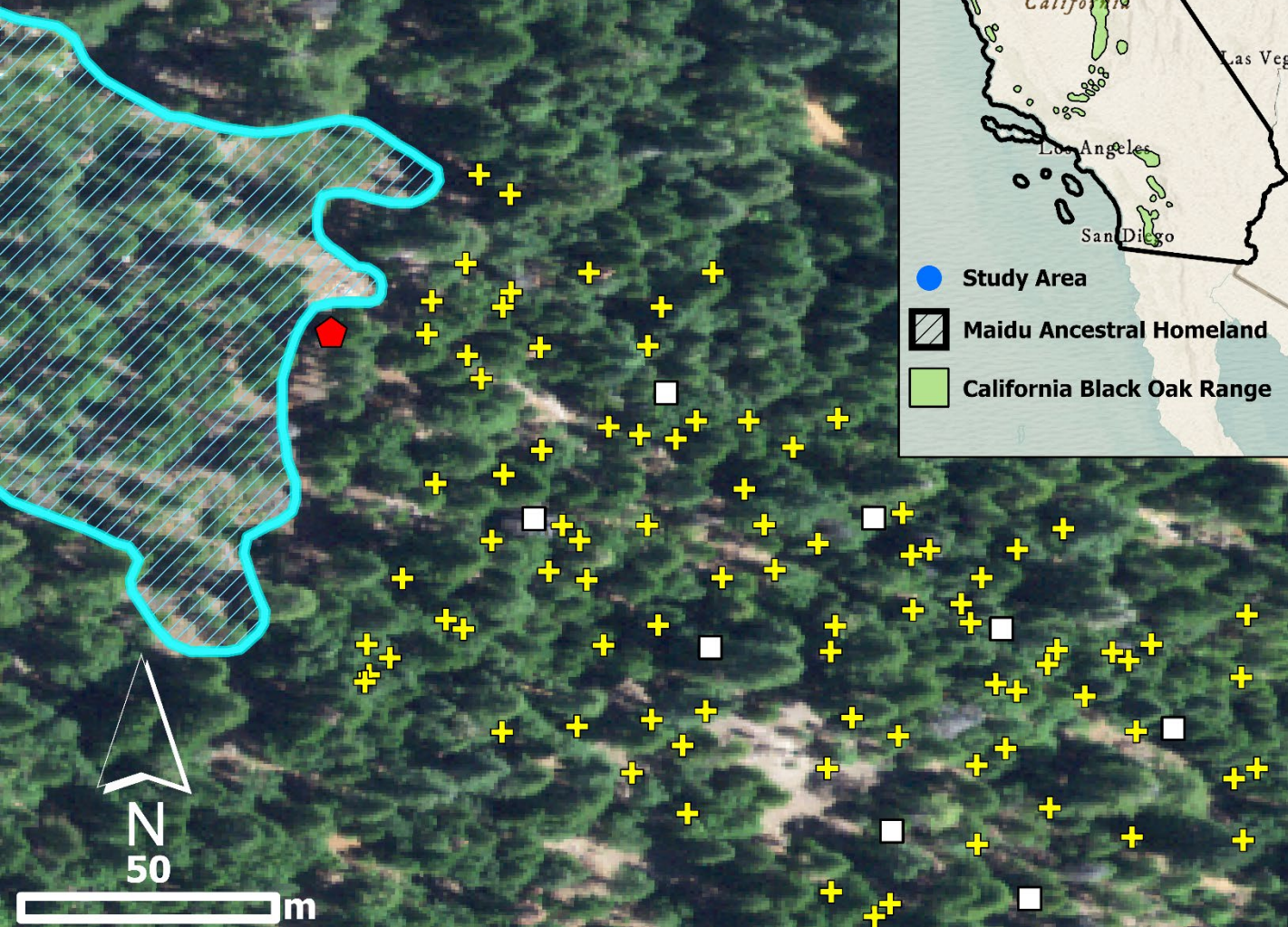
# Full Restoration (25% Canopy Cover)



# Treatment Challenges

- No commercial use of material including Douglas-fir logs
  - How do you fund projects?
    - Funded by a large Cal Fire grant and local funds
    - Is this transportable?
- Very little prescribed fire experience even with a Cal Fire crew on the property
  - Cultural fire? Some has occurred
- Dedicated forest manager (Nadia Hamey) and dedicated partnership makes it possible
  - Pile burn next step to reduce activity fuels

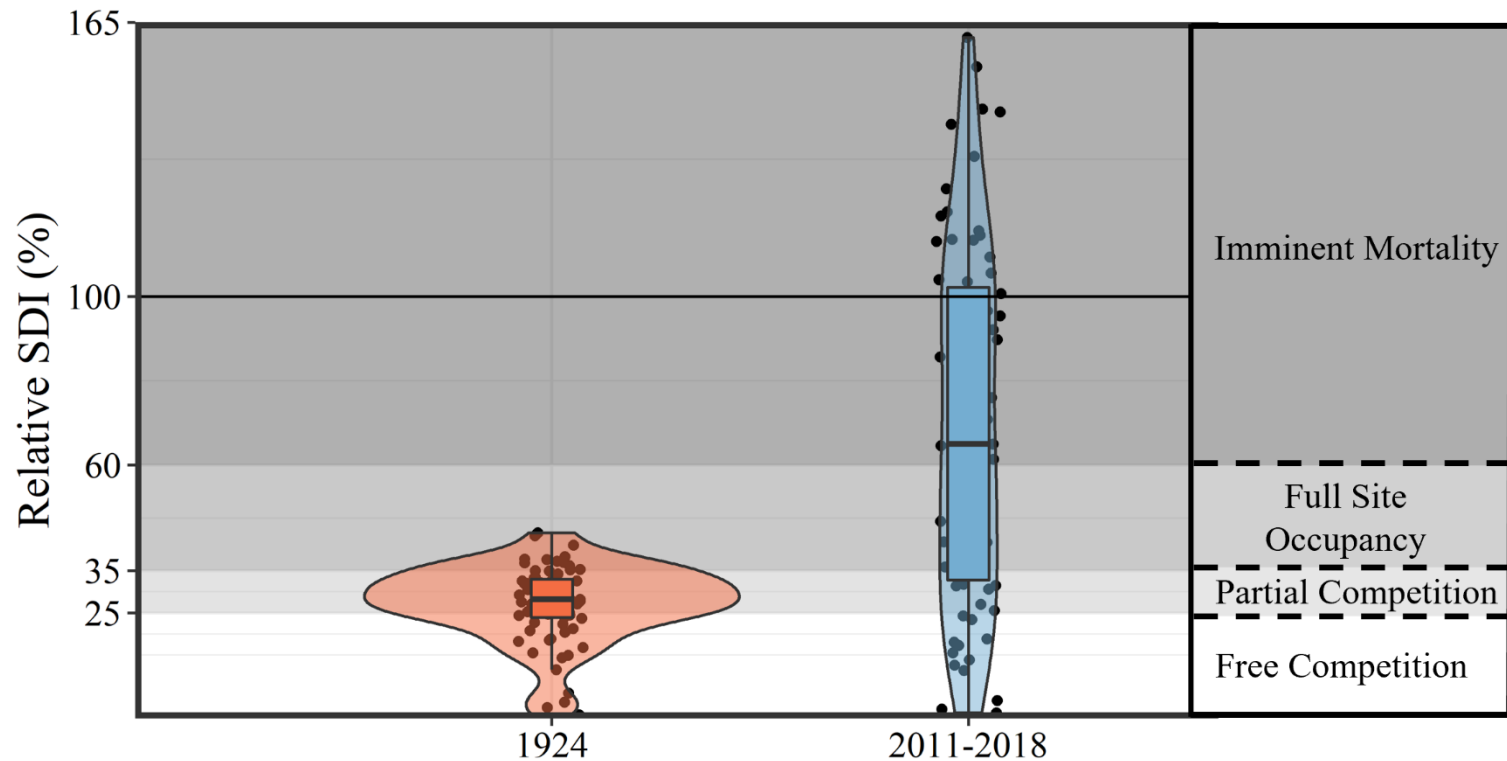
- California Black Oak
- Fire History Sample
- Forest Inventory Plots
- 2009 Silver Fire



# Indigenous Stewardship in the northern Sierra Nevada

2009 Silver Fire burned in the area and then the 2021 Dixie Fire burned the whole region

# Historical Relative Density and FIA Plots Around Indigenous Study Area



**Average Relative SDI for contemporary forests is 159% higher (~70% of maximum SDI) than what existed historically (~27% of maximum SDI)**

**Massive change in forests in the last 100 years also found in the southern Cascades, central Sierra Nevada, southern Sierra Nevada (Collins et al. 2017, Stephens et al. 2015, 2018)**

# Ponderosa Pine Stump Found in 2020





# Mountain Maidu Fire Record on Ponderosa Pine Stump

- 33 Different fires recorded from 1518-1794
  - Before colonization
  - 11 Intervals of 5 years or less, 1 interval of 2 years
  - No way only lightning ignited
- Scars 42% Dormant, 21% Latewood, 6% Late Earlywood, Others Undetermined
  - Latewood and late earlywood scars likely September with fewer fires in August (mixed ignitions)
  - Dormant season fires October through April with some in winter during dry periods (Indigenous)

# Summary

- Fire exclusion and suppression led to a slow, albeit catastrophic, shift for California black oaks
  - Cultural burning ended with Mission period or later in CA
- Mixed conifer forests in the 1920s had low tree densities dominated by large ponderosa and sugar pine
  - Would have allowed California black oak to thrive
- The number of very short fire intervals recorded on stump cant be explained by lightning alone
  - Management of this area for Indigenous purposes
- Wildfire provides opportunity to allow California black oaks to regain dominance
  - It would take Active Stewardship and could be done by the Mountain Maidu and federal managers (*Stephens et al. 2023 Fire Ecology*)

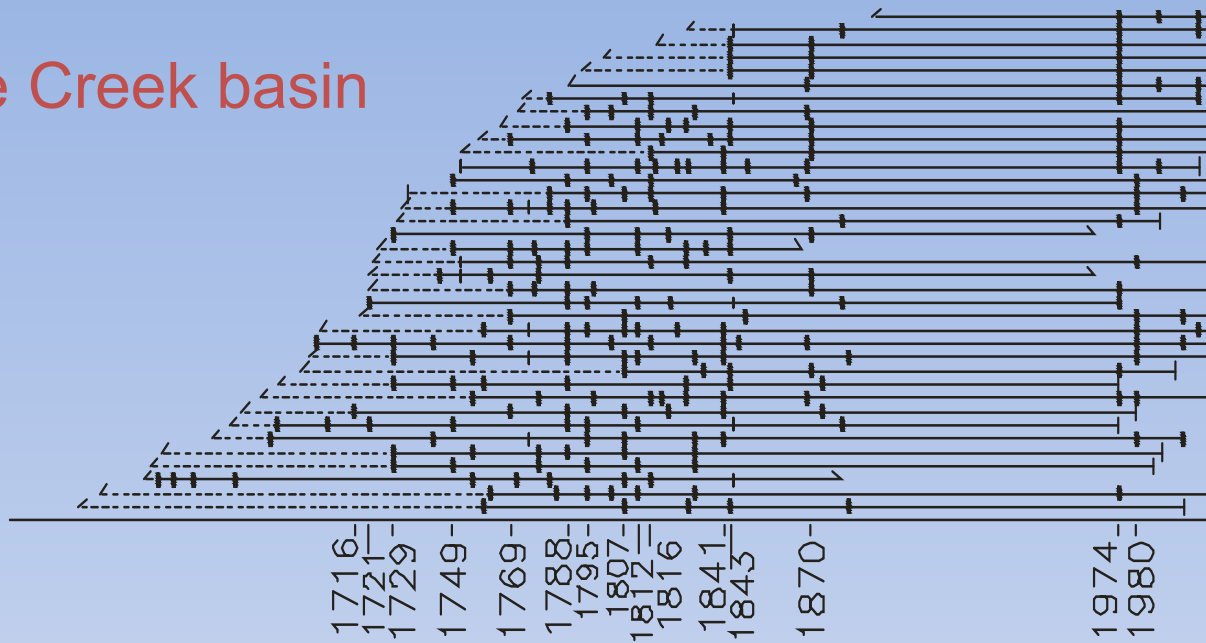
# Back to Yosemite

50 years of fire use  
15,000 ha watershed

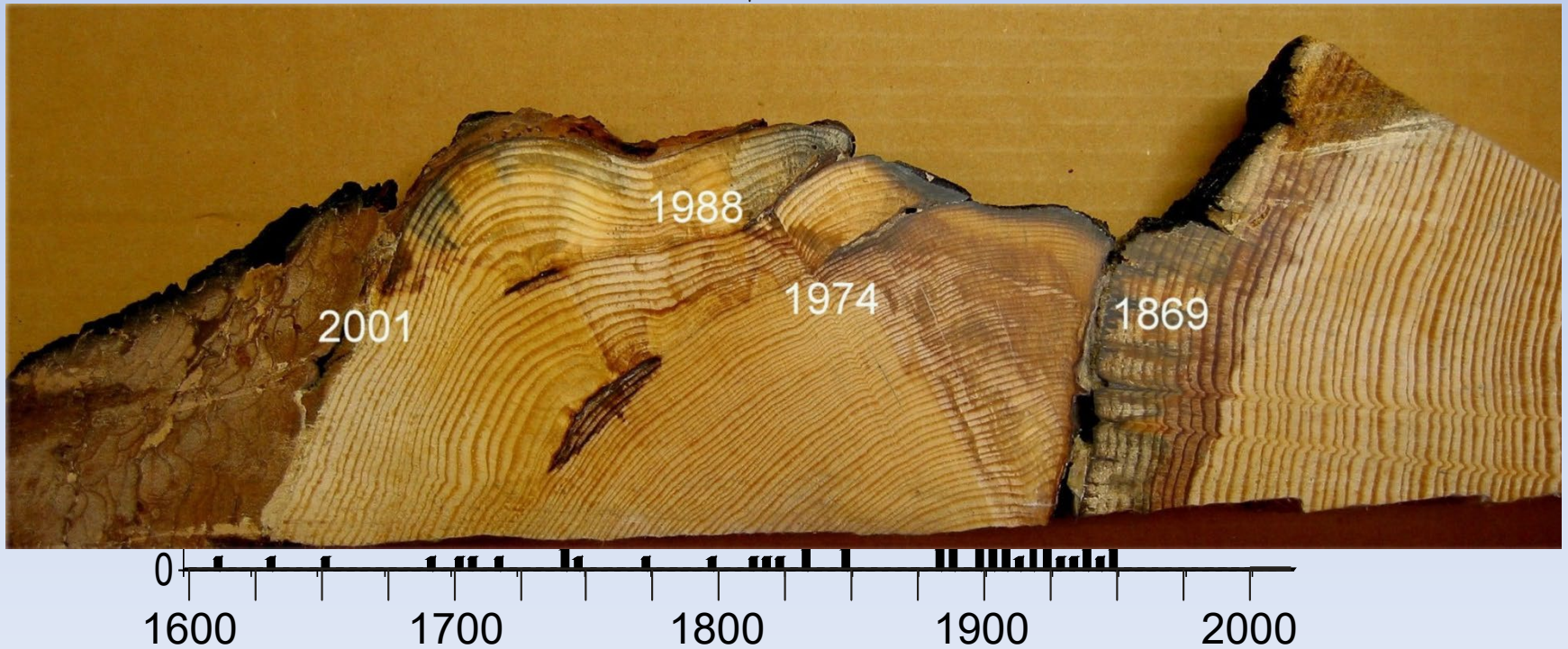
**Yosemite program: 1974  
to present**



# Illilouette Creek basin



Collins &  
Stephens  
2007. *Front.  
Ecol. Environ.*



# Mortars and Pestle in Illilouette Basin (same place)



Basin over 7000 feet in elevation

Most thought that this area was dominated by lightning fire

Two grinding rock found recently and obsidian tools and flakes

Wilderness designation in this National Park and elsewhere

Wilderness Act of 1964: “an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.”

**21<sup>st</sup> century?**

# The Stewardship Project: A Partnership of Indigenous and Western Science

50-50 policy partnership between Indigenous people and western science across the western US (Stephens, Don Hankins, Sara Clark leaders)

- Tribal Right to Steward
- Realignment of Regulatory Framework
- Workforce Development
- Wildfire opportunity zones

**Biden Wildfire Commission** results last week

Partnership with Indigenous people a solution

Western science strong but needs partnership

# Acknowledgements

Brandon Collins, Less Hall, Lex Bernal, Jason Moghaddas, Jan van Wagtendonk

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Summaries of research papers available at:

[www.cnr.berkeley.edu/stephens-lab/](http://www.cnr.berkeley.edu/stephens-lab/)