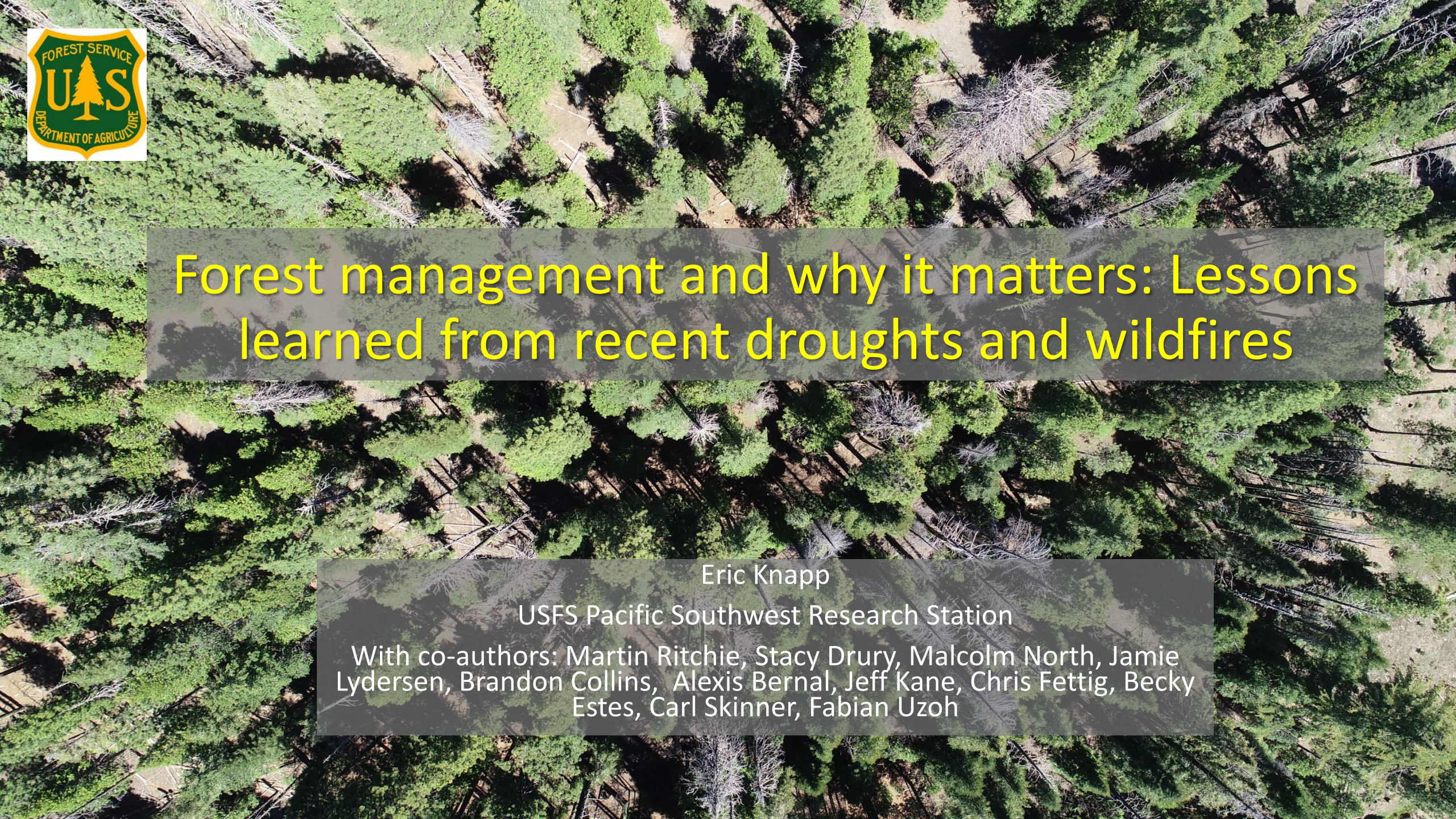

Forest management and why it matters: Lessons learned from recent droughts and wildfires

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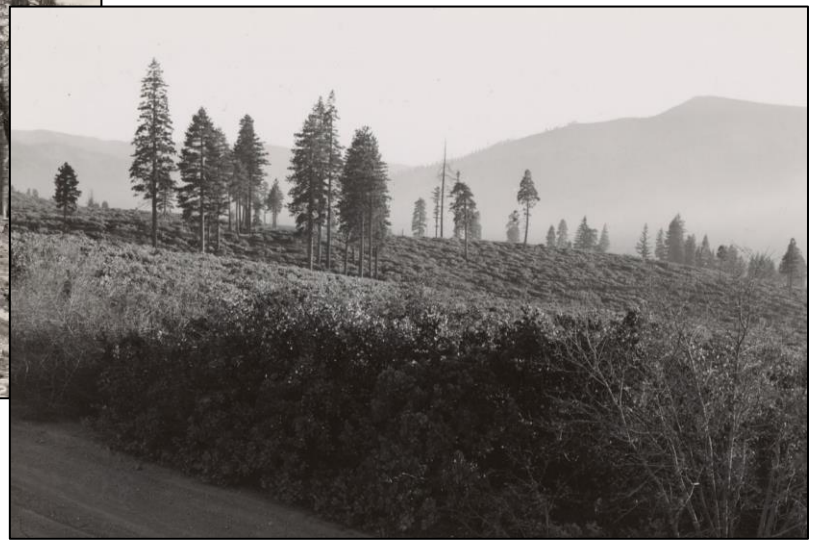
With co-authors: Martin Ritchie, Stacy Drury, Malcolm North, Jamie Lydersen, Brandon Collins, Alexis Bernal, Jeff Kane, Chris Fettig, Becky Estes, Carl Skinner, Fabian Uzoh

Fire and historical forest structure

Burney area, 1941

Burney area, 1925

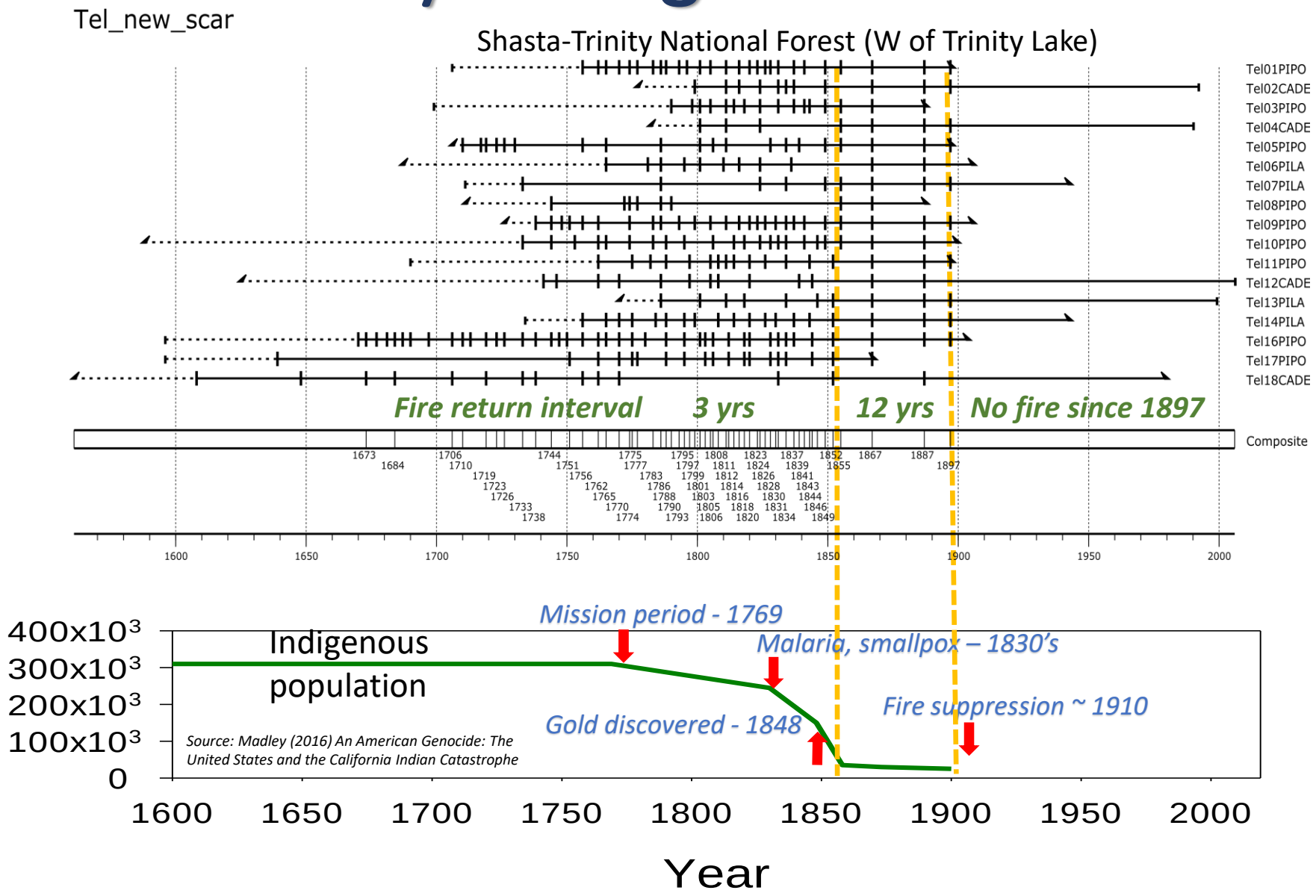
Near Mt. Shasta, 1941



"Suppression of young growth has always been one of the most serious results of fires in this region. The land does not carry more than 35 percent of the quantity of timber it is capable of supporting." – **John B. Leiberg (1902)**

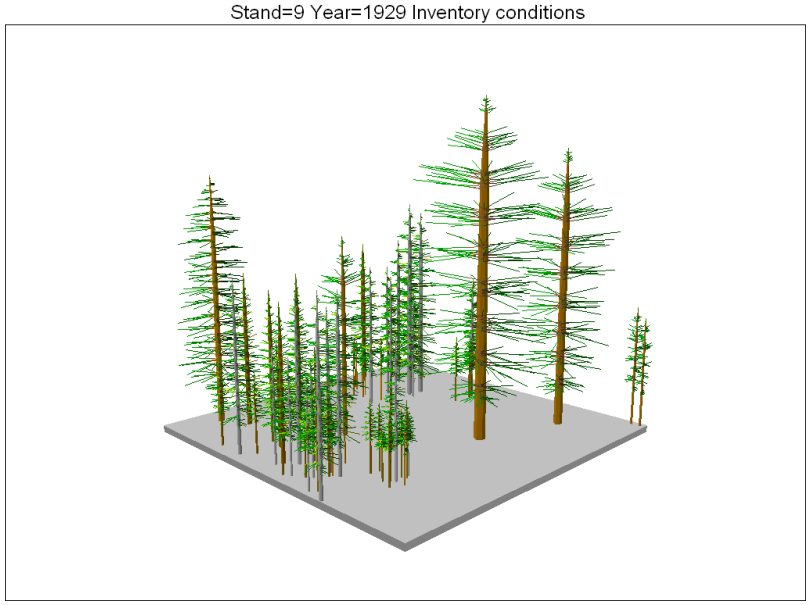
Photos: A.E. Wieslander

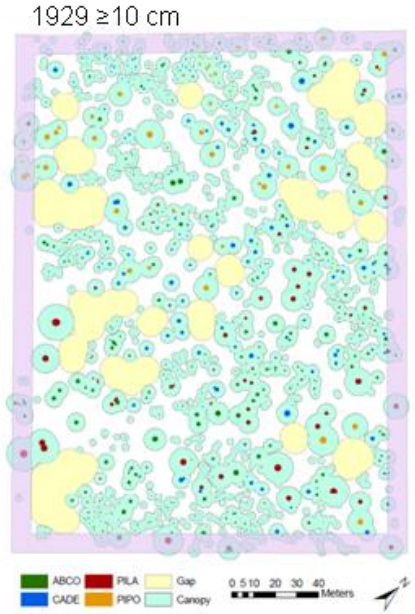
Fire activity through time



Change over time (trees > 4”) – Stanislaus NF; median fire return interval – 6 yrs; last fire: 1889

1929

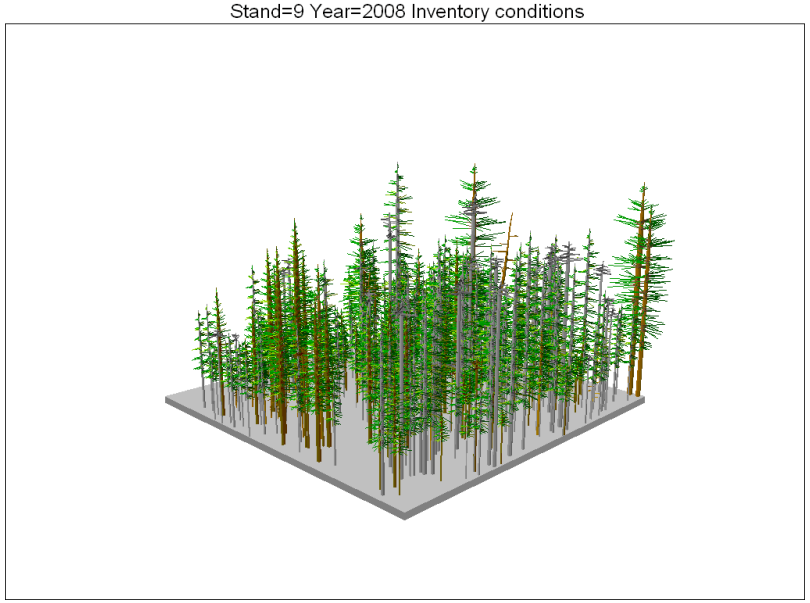


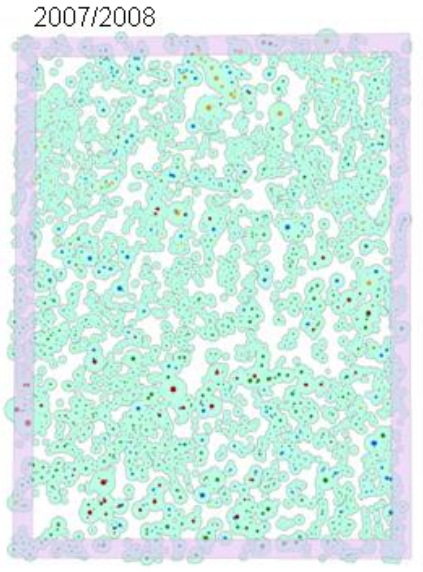


Trees ac^{-1}: 127

Gap area: 20.1%

2008





Trees ac^{-1}: 300

Gap area: 0.4%

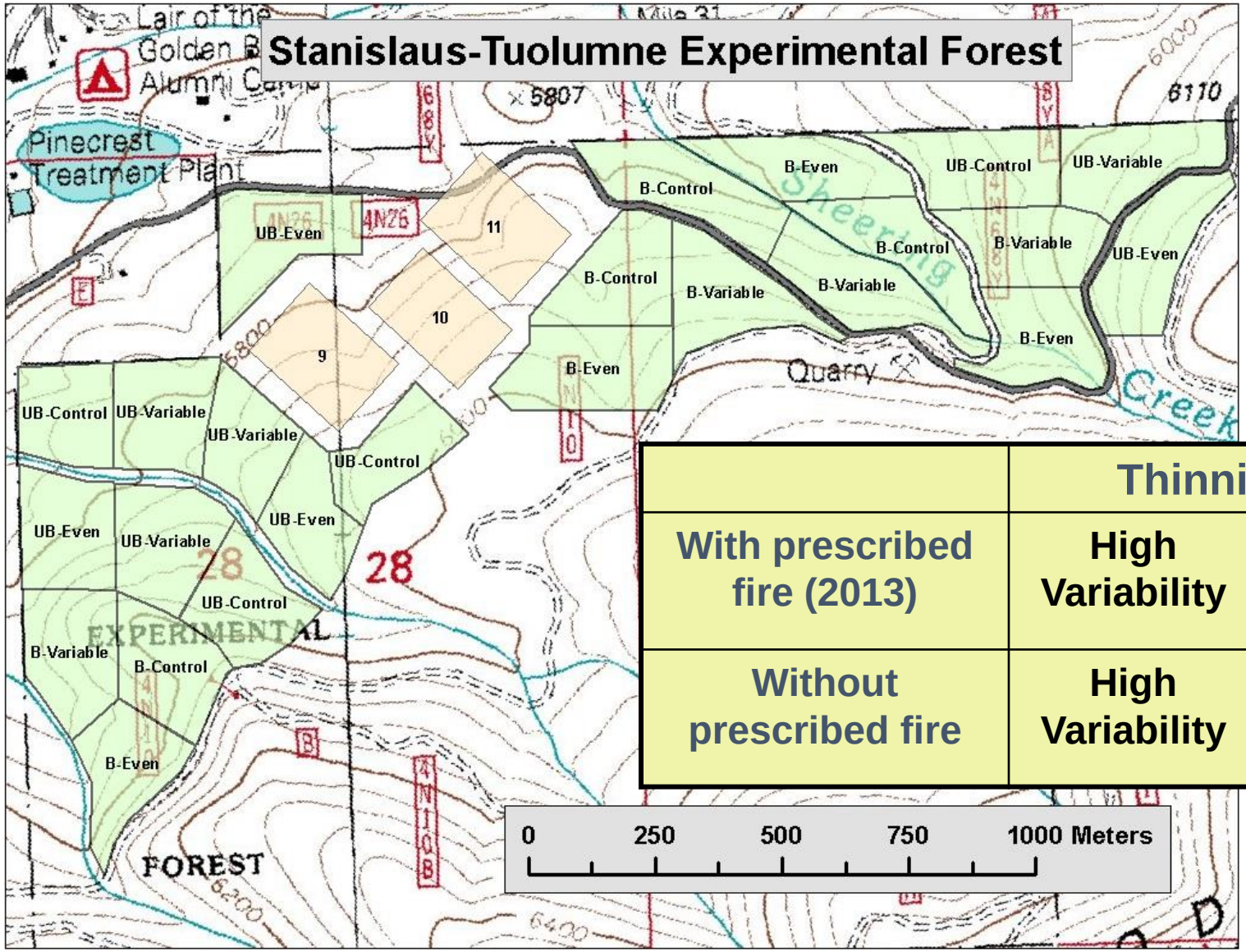
From: Lydersen JM, North MP, Knapp EE, Collins BM. 2013. Forest Ecology and Management 304: 370-382

Fire suppression: early foreshadowing of fuels consequence

"Twenty-one years of protection has in many placed filled up the holes in the forest and many of you old-timers know of comparatively large areas of almost impenetrable pole stands that were open forests then. This is of course as it should be and we must be prepared to cope with the increased hazard."

-MA Benedict (Forest Supervisor, Sierra NF) 1930

STEF Variable Density Thinning & Prescribed Fire study



	Thinning treatment (2011)		
With prescribed fire (2013)	High Variability	Low variability	Unthinned control
Without prescribed fire	High Variability	Low variability	Unthinned control

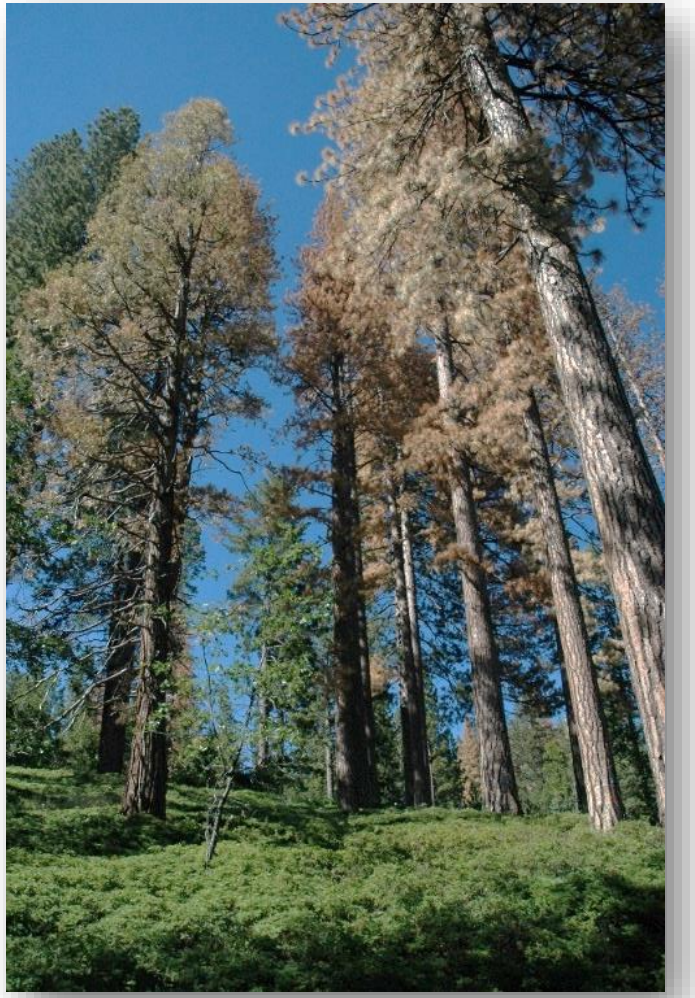
Treatment	*Density Trees ac^{-1}*	*Basal area (ft^2 ac^{-1})*	*Quadratic mean diameter (in)*	*Pine basal area (%)*
Control	300	289	13.3	19.2
High Variability thin	63	166	21.9	32.6
Low Variability thin	60	164	22.5	34.2

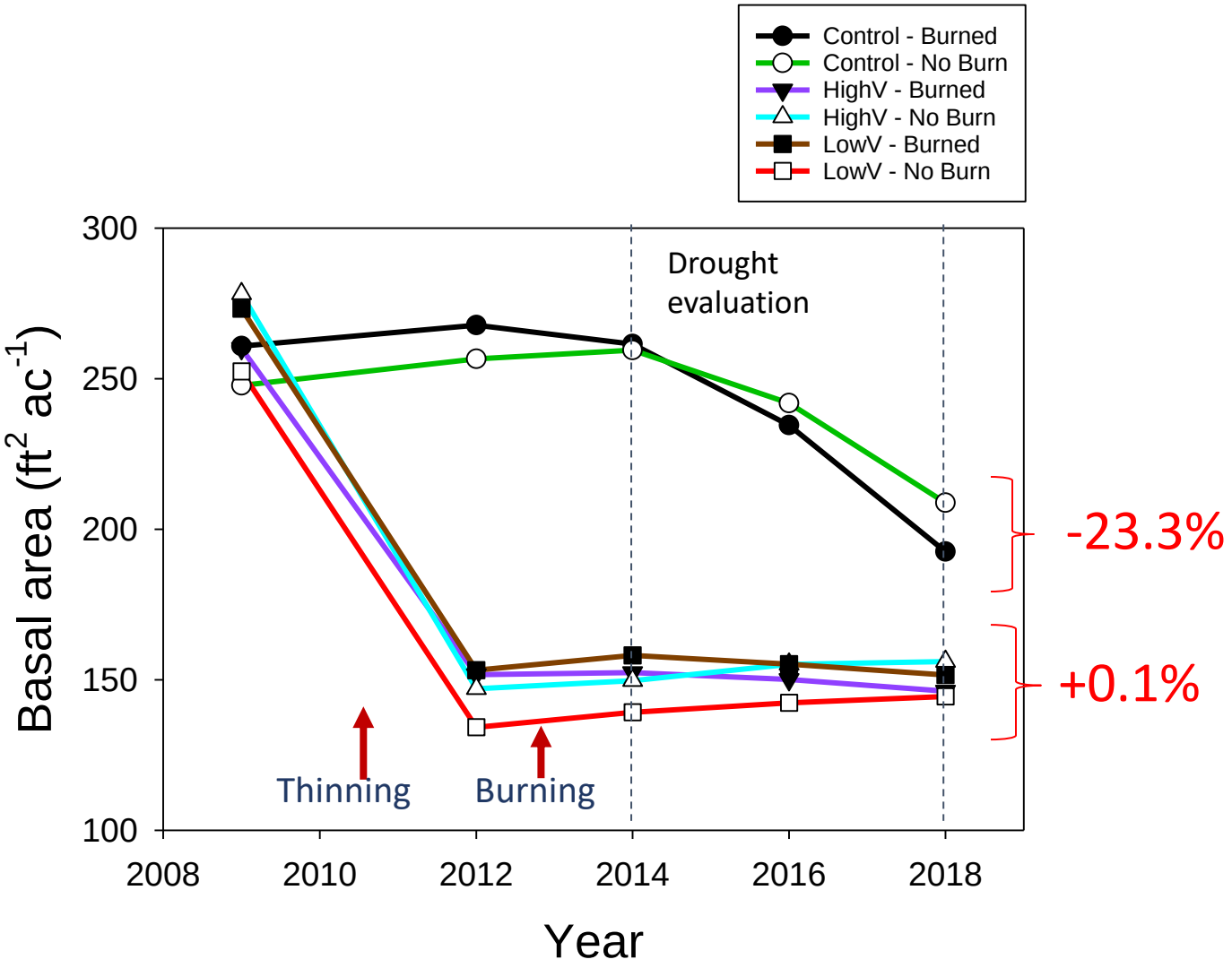
Before and after photos
‘High Variability’ thinning + prescribed fire

2011 – before logging

2020 (logged 2011, burned 2013)

Were treatments more resilient to 2012 - 2016 CA drought?



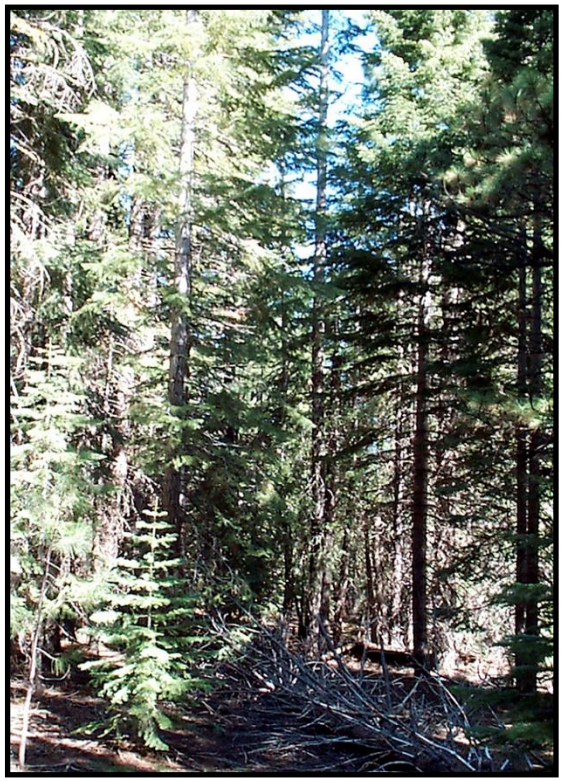


From: Knapp EE, Bernal AA, Kane JM, Fettig CJ, North MP. 2021. Variable thinning and prescribed fire influence tree mortality and growth during and after a severe drought. Forest Ecology and Management 479:118595.

What about treating with prescribed fire only?

- ~ 10.5% of trees killed by R_x fire alone
  - most small (4 to 10 in diameter)
- Too few overstory trees killed to substantially influence structure or species composition
- Burned treatments = 72% less surface fuel

Does thinning heighten fire hazard by reducing fuel moisture and increasing wind speeds?



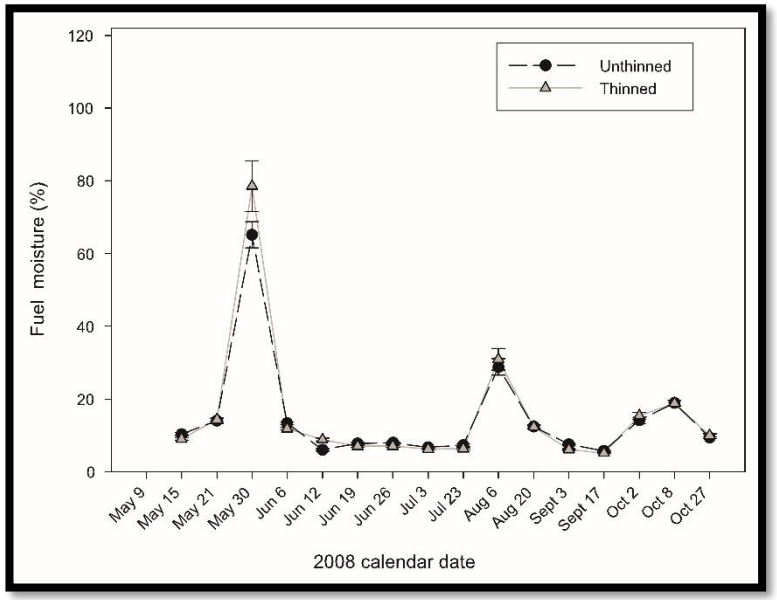
Unthinned

Thinned with prescribed fire

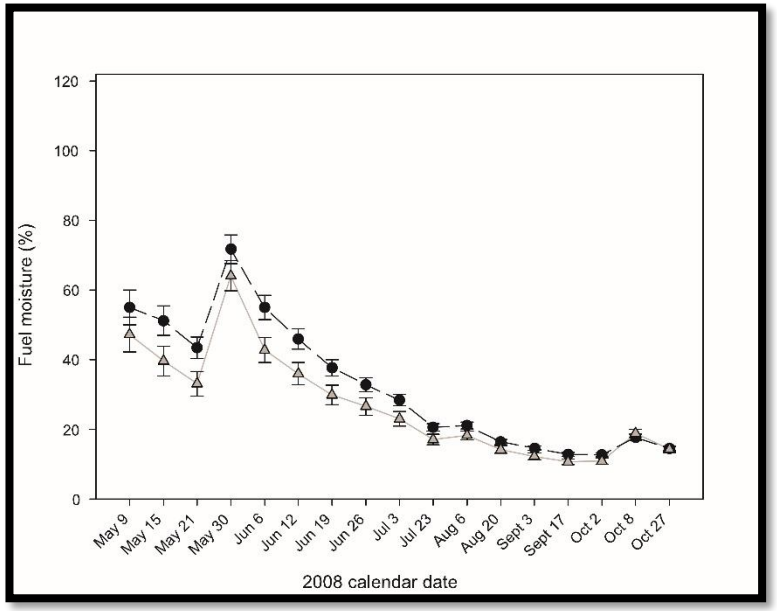
Goosenest Adaptive Management Area – Klamath NF

Mean Seasonal Fuel Moisture

10 hour – ¼-1” diam.



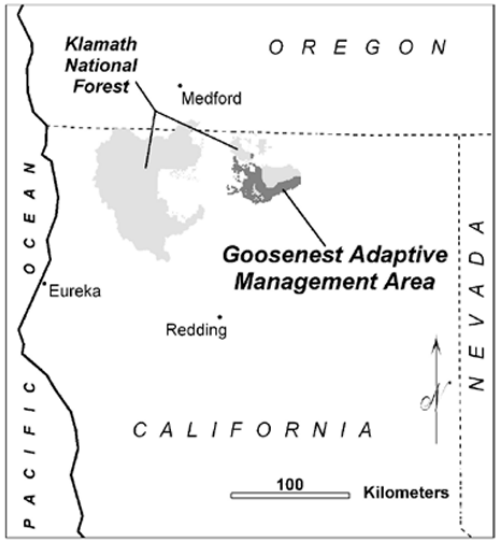
10,000 hour – >8” diam.

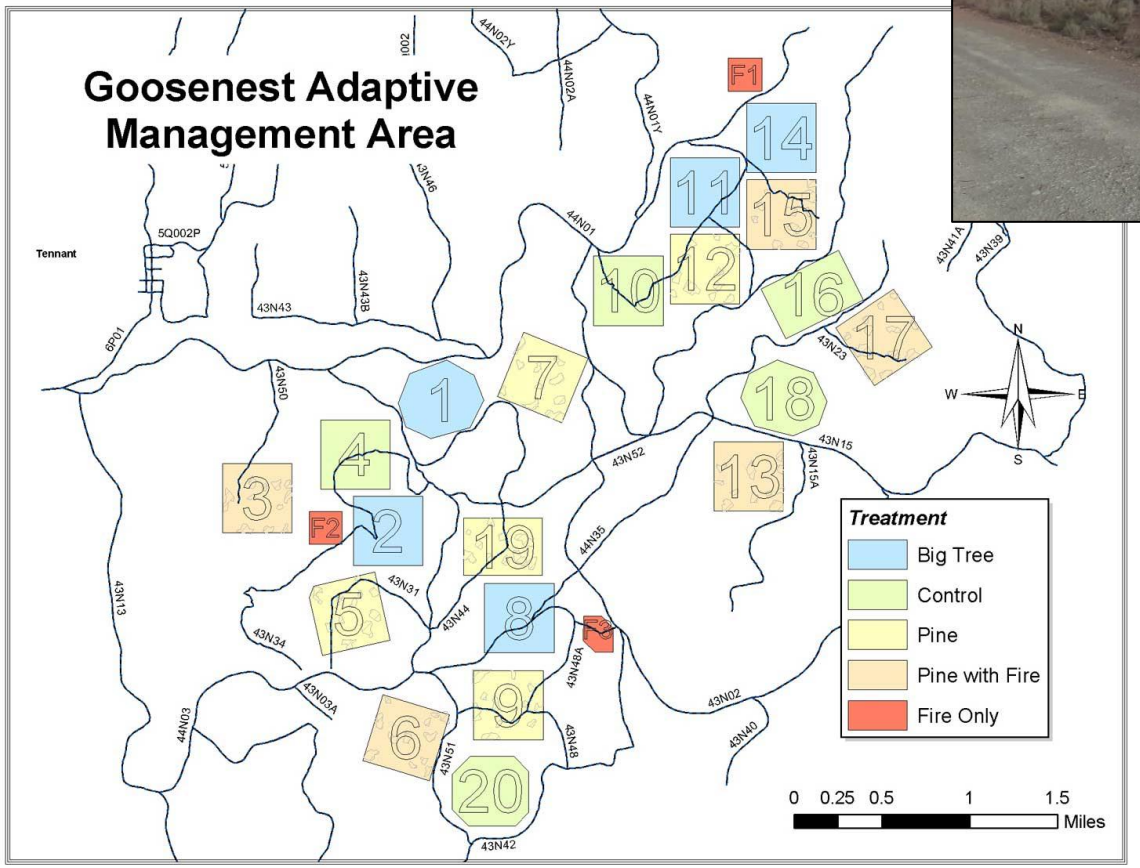


- Very little difference in fuel moisture between thinned and unthinned stands
- Higher windspeeds in thinned stands? – Yes
- But, lower crown bulk density reduces crown fire behavior
- **Net effect of thinning: generally, a reduction in fire intensity**

From: Estes BL, Knapp EE, Skinner CN, Uzoh FCC. 2012. Seasonal variation in surface fuel moisture among forest structure treatments in a mixed conifer forest, northern California, USA. International Journal of Wildland Fire 21:428-435.

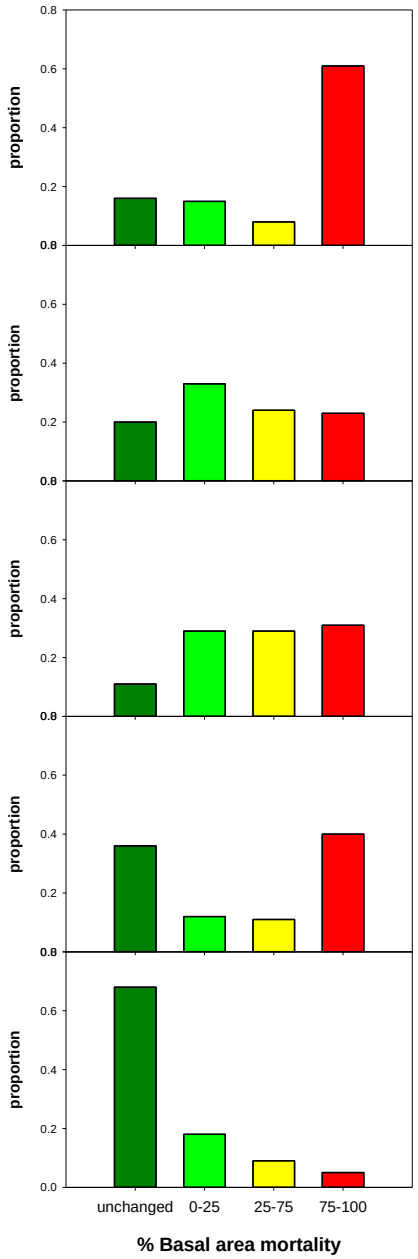
Goosenest Adaptive Management Area Ecological Study & 2021 Antelope Fire





- Thinning: 1999-2001
- Burning: 2001-2002 and again 2010-2011
- 20+ years of data

Fire severity – satellite remote sensing (preliminary)



Untreated control

Big Tree emphasis thin

Pine emphasis thin

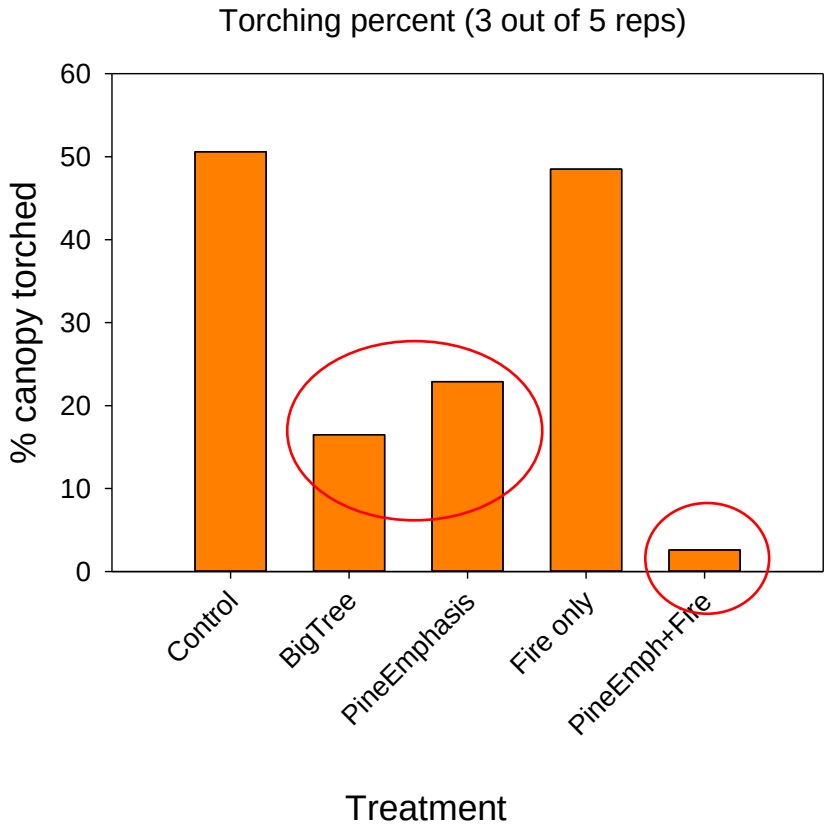
Fire only

Pine emphasis thin + fire

Unthinned

Pine emphasis thin with Rx fire

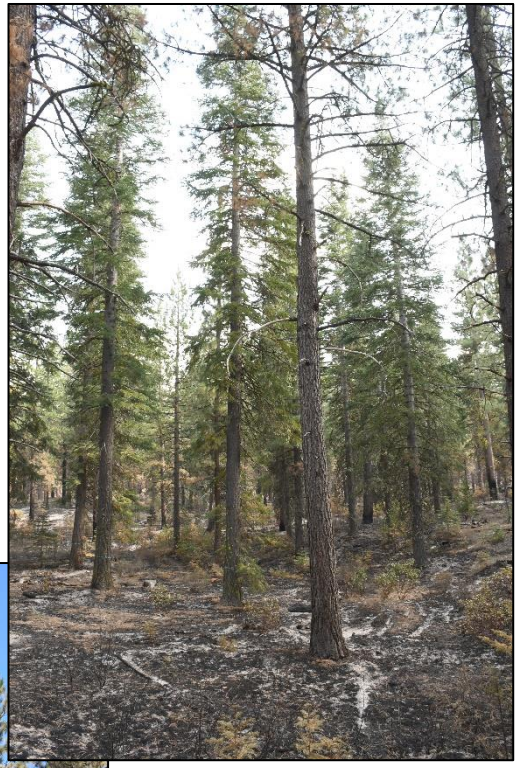
Crown fire behavior – torch %

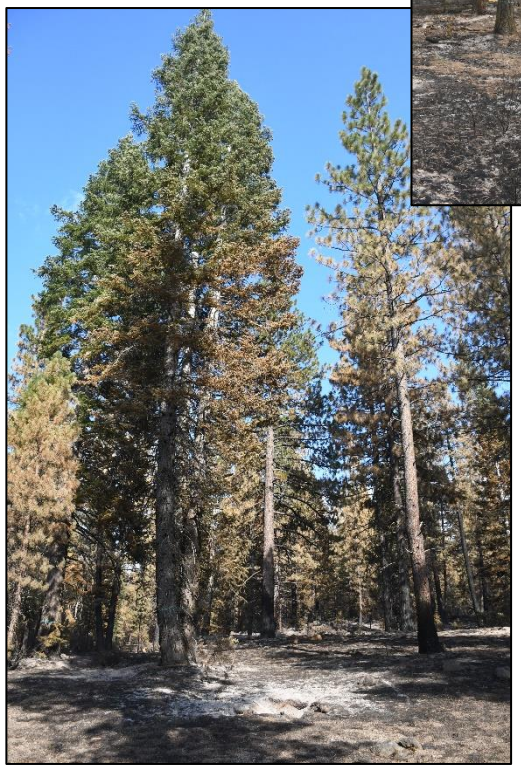


- Thinning reduced crown fire behavior
- Thinning in combination with prescribed fire – almost no torching
- All very preliminary – two out of five replicates remain to be measured

Thin only

- Many overstory trees heavily damaged by crown scorch
- Regeneration often torched
  - Fire necessary to keep white fir from establishing
- Thinning alone often not enough: treating both surface fuel and crown fuel = best tree survival under most extreme fire weather conditions





Prescribed fire only

- Either worked well or not
- Prescribed burns may have not reduced fuel enough or thinned stands enough, or the killed trees created fuel

Thinning with two prescribed fires (2001 and 2010)

- Even this not enough under very worst weather conditions
- Reburning necessary: 11 years since last burn may be too long

Summary

- Excess tree density and decades to over a century of accumulated surface fuels have made our forests extra vulnerable
- Can we mitigate the impact of a warming climate?
  - Reduce tree density and reduce surface fuel loading
  - Examples from adjacent treated and untreated areas show that it works!

Acknowledgements

- Stanislaus and Klamath National Forests
- PSW and other field crews 2007-2021
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