Science and the Angora Fire: Results from Vegetation Monitoring and Intro to Afternoon Session

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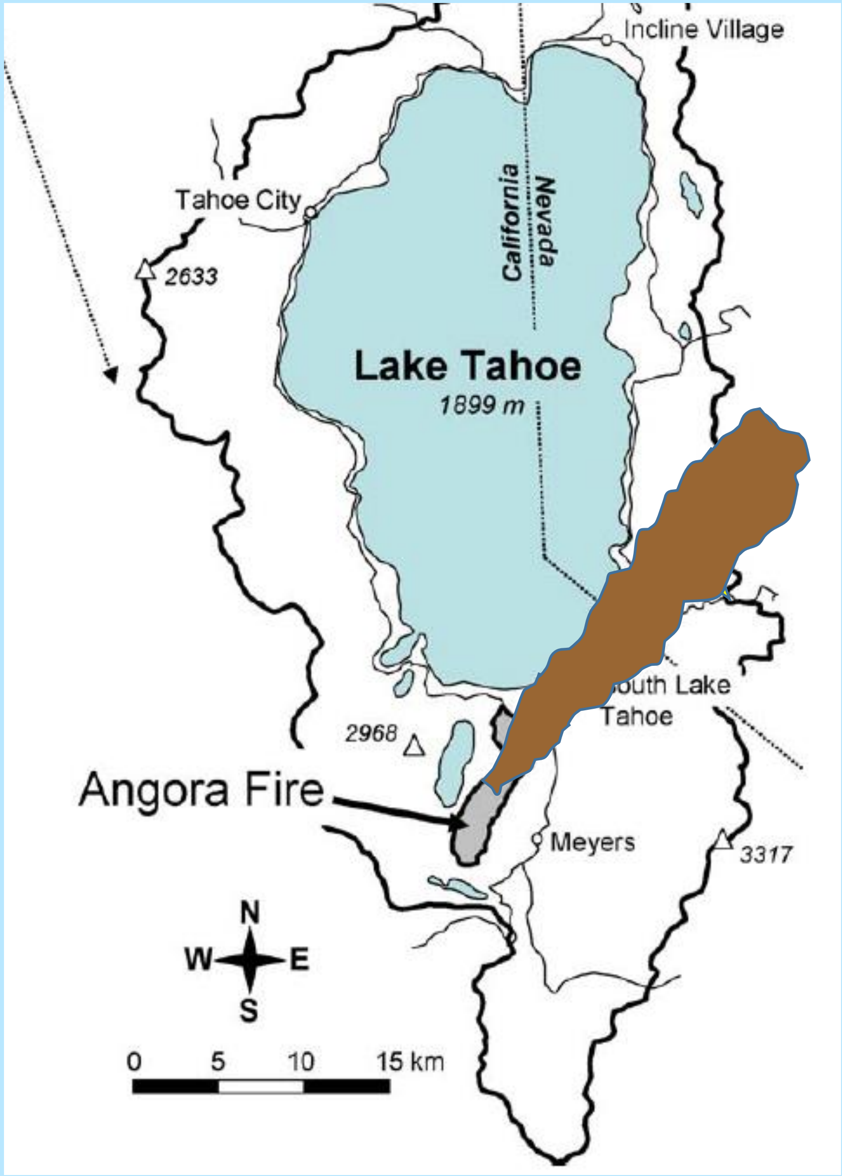
Angora Fire: small but impactful

Sierra Nevada Fire	Year	Size (ac)	Scientific Citations	Direct costs (fire supression + structural loss)	Direct costs/ac	Citations/ ac
Angora	2007	3100	361	$160,000,000	$51,613	0.116
Chips	2012	75400	128	$60,000,000	$796	0.002
King	2014	98000	429	$125,000,000	$1,276	0.004
McNally	2001	150700	103	$60,000,000	$398	0.001
Moonlight	2007	65000	103	$35,000,000	$538	0.002
Rim	2013	257300	2140	$145,000,000	$564	0.008
Storrie	2000	52000	67	$30,000,000	$577	0.001

My first view of the Angora Fire:
~1500, June 24, 2007



Incline Village
Tahoe City
California
Nevada
2633
Lake Tahoe
1899 m
outh Lake
Tahoe
2968
Angora Fire
Meyers
3317
N
W
E
S
0
5
10
15 km

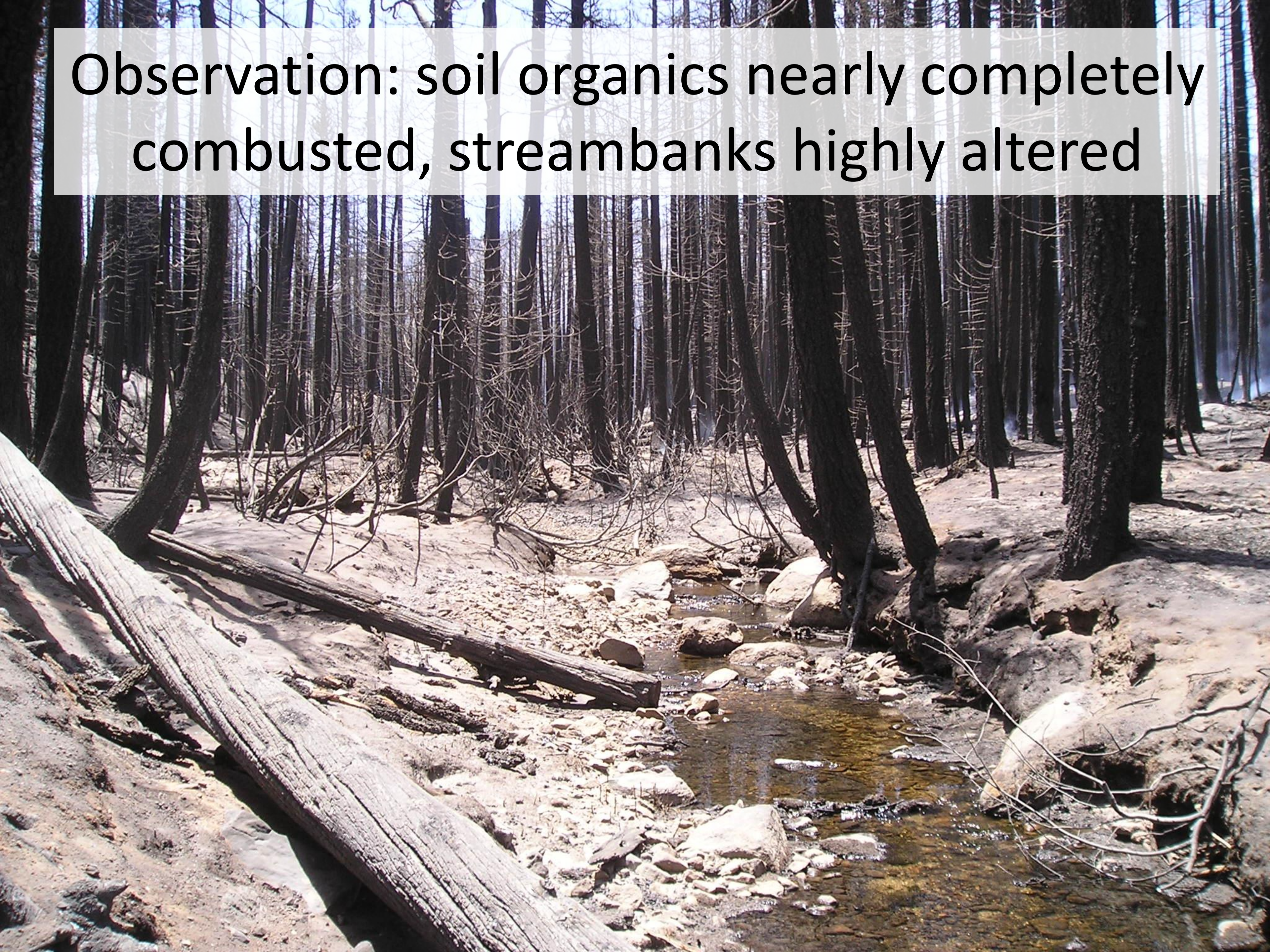

The smoke lifts: ~1530


View from Castle Rock: ~1630


Inspection of fire effects, Tahoe Paradise,
June 29


Observation: much of untreated forest
experienced complete mortality

Observation: soil organics nearly completely combusted, streambanks highly altered




Observation: most trees in treated forest
survived the fire

Observation: many trees in treatments supported unburned sand rings and little to no direct burning

Postfire inspections made clear that the Angora Fire could help to answer some important and interesting scientific questions

In addition:

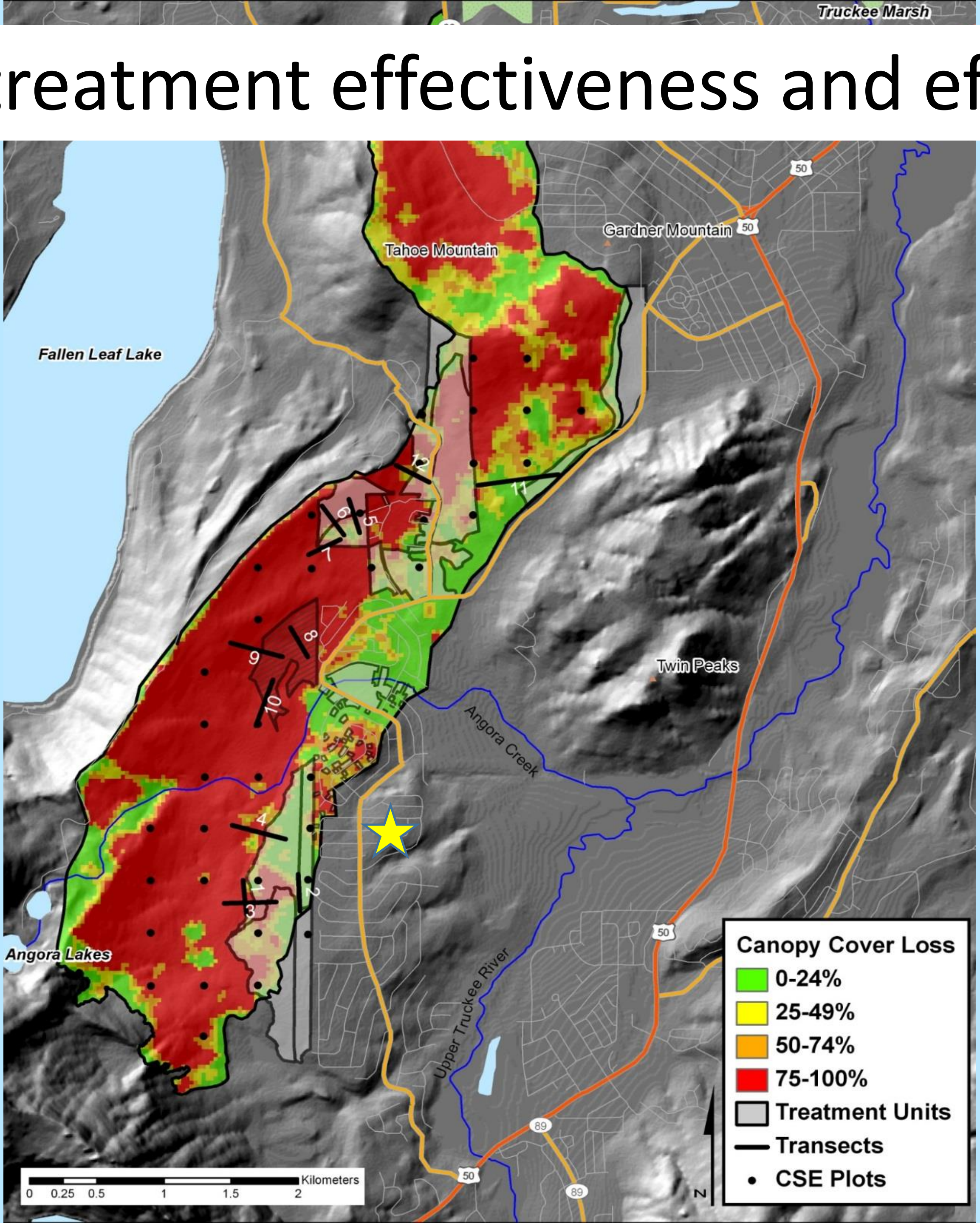
- Fire one of first in US to burn into system of WUI forest fuel treatments
- Lake and stream impacts of fire always a concern in LTB
- Fire was easily accessed
- Near research and mgt facilities of USFS, UCD, UNR, etc.
- LTBMU had money in those days…

Angora Fire Vegetation Monitoring Plan

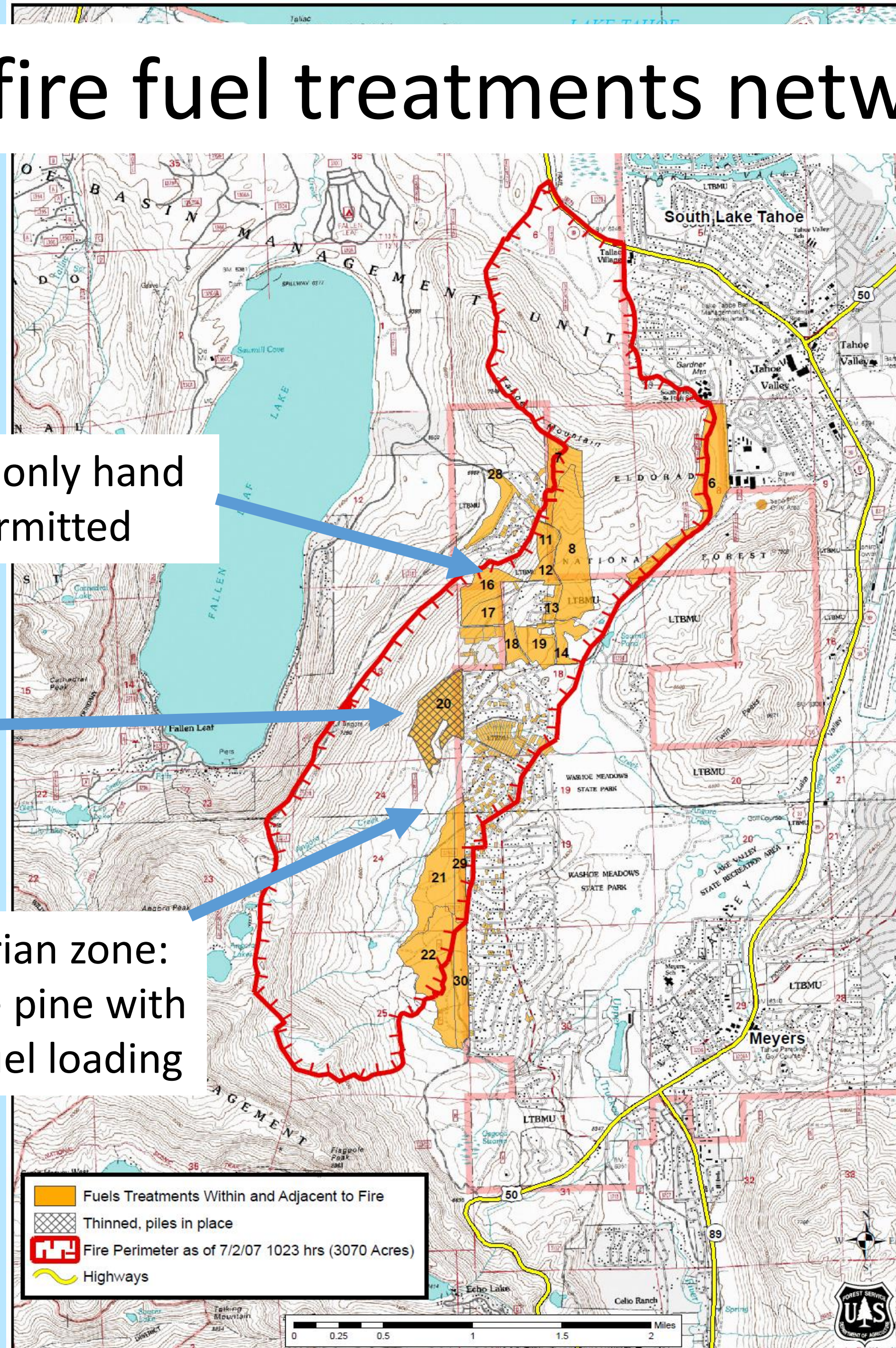
Nine overarching focus areas

- Fuel treatment effectiveness and effects
- Vegetation succession/forest recovery
- Biodiversity
- Fuels accumulation
- Conifer regeneration
- Snag fall and retention
- Conifer mortality rates
- BAER treatment monitoring
- Support to other monitoring and research

Fuel treatment effectiveness and effects



Prefire fuel treatments network



>30% slopes = only hand thinning permitted

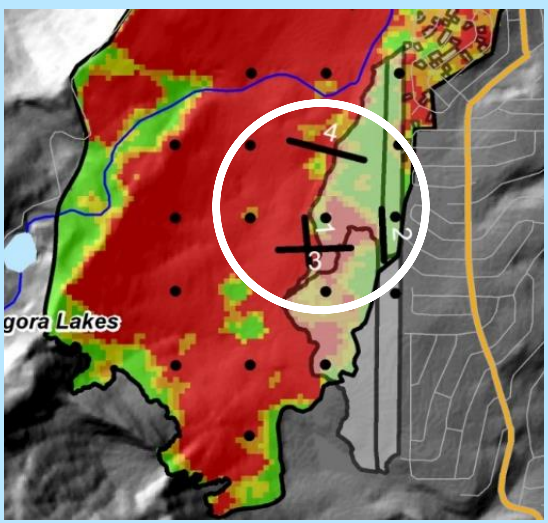
Fuel piles still on ground

Untreated riparian zone: dense lodgepole pine with heavy surface fuel loading

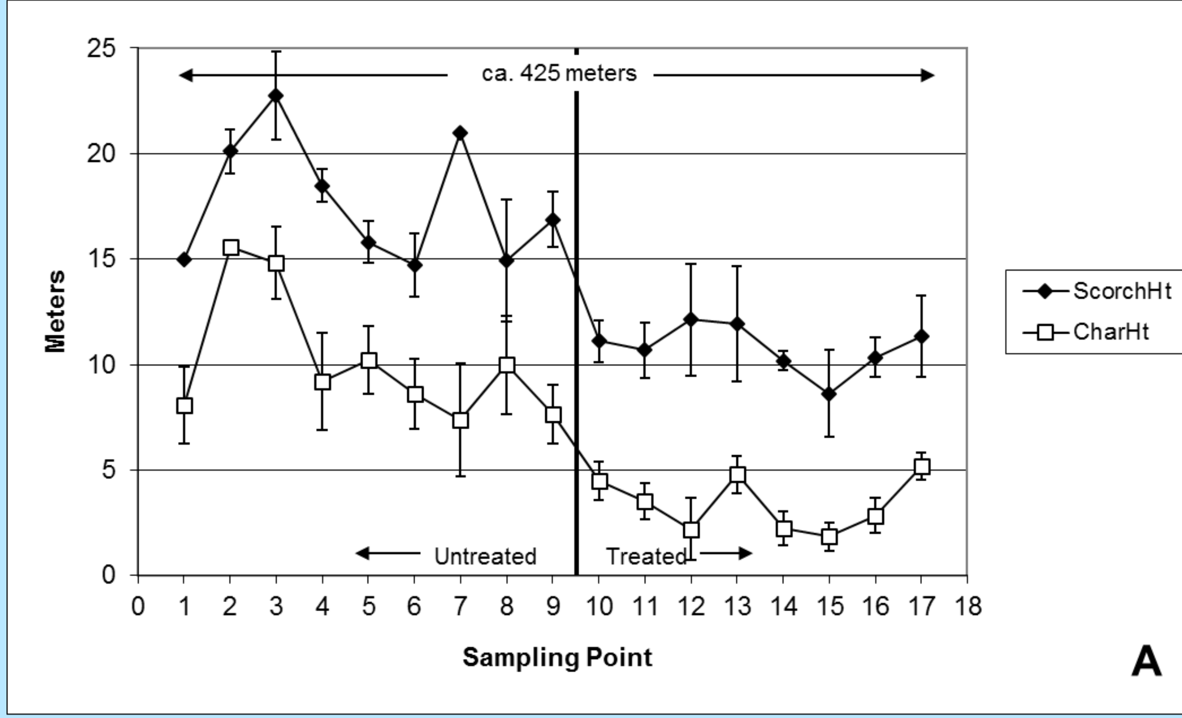
480 acres of treatments
Mostly three entries over 2-4 years

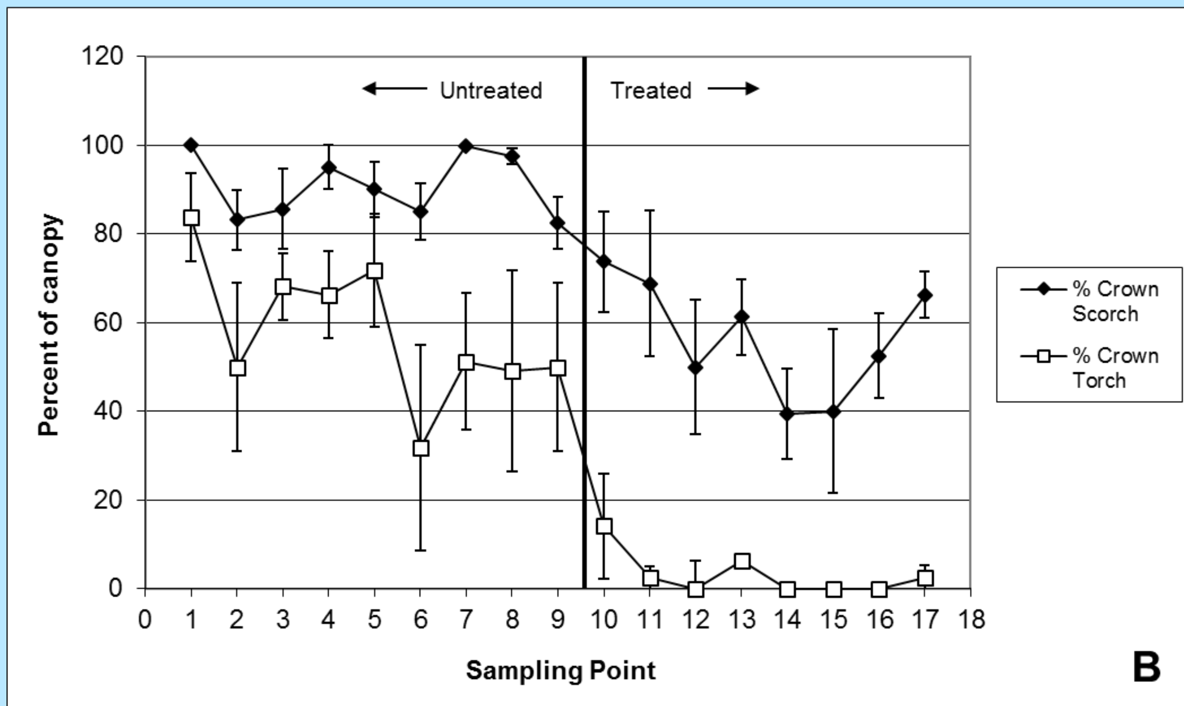
- Commercial thin
- Hand thin and pile
- Burn

Fire Severity Measures Example: Transects 3 & 4

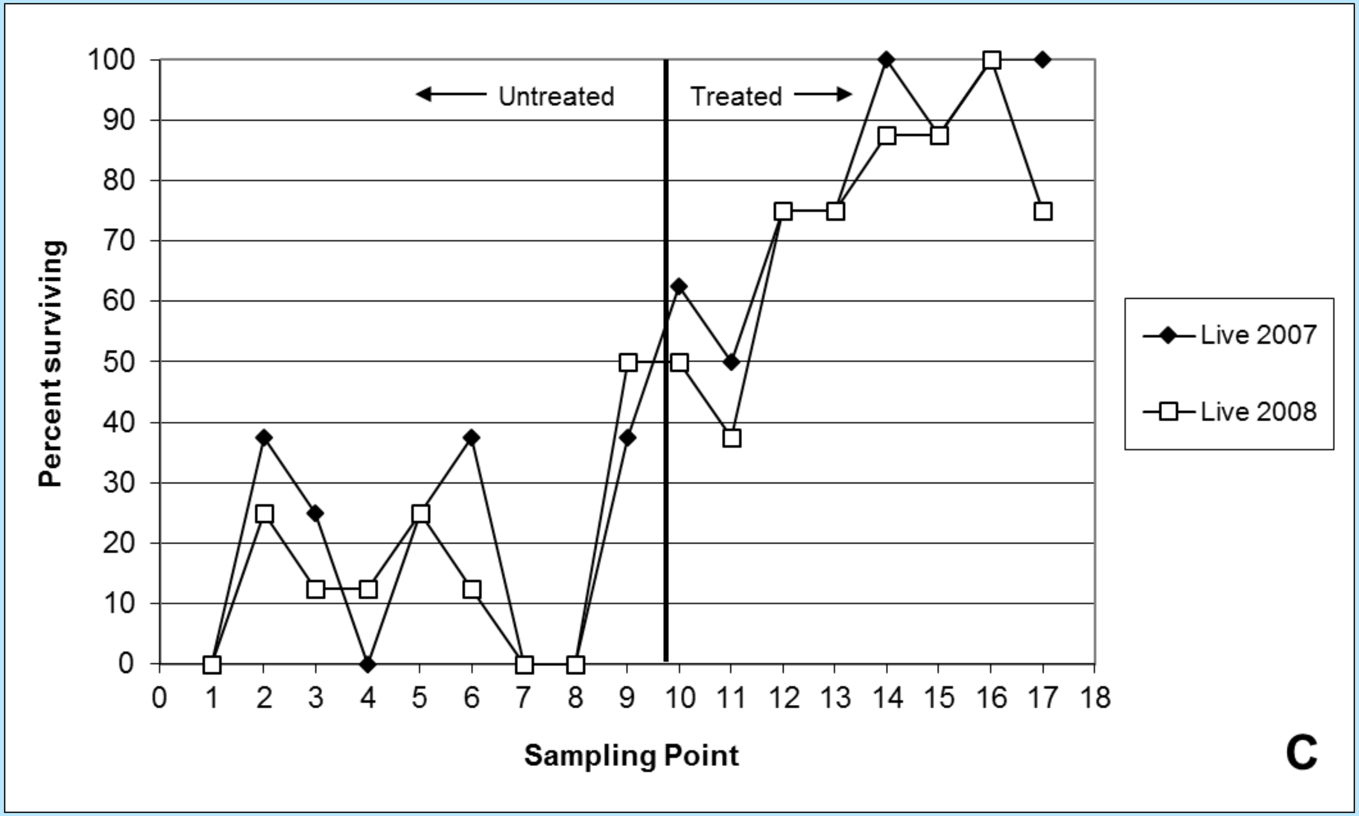


Safford et al. 2009. *Forest Ecol & Mgt*





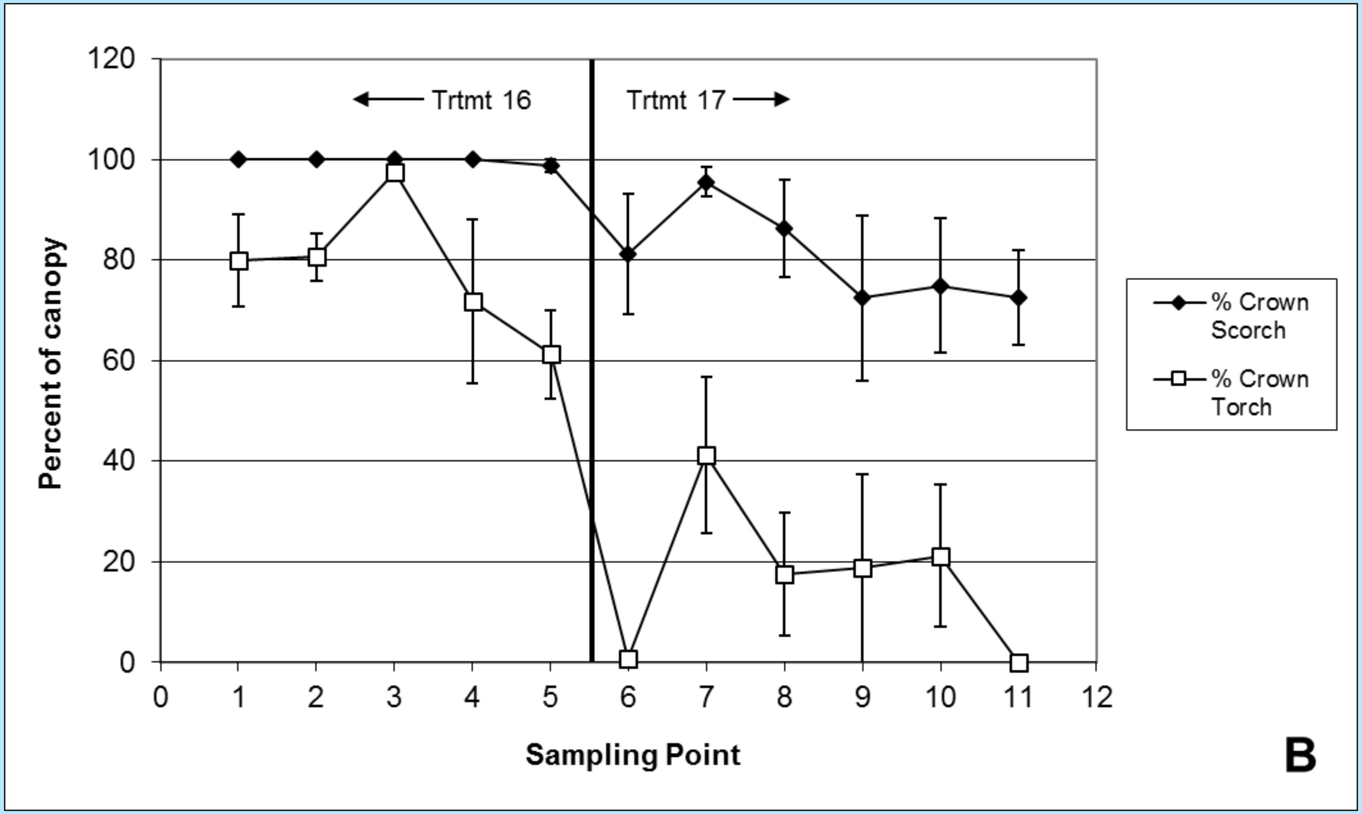
Tree Mortality along Transects 3 & 4



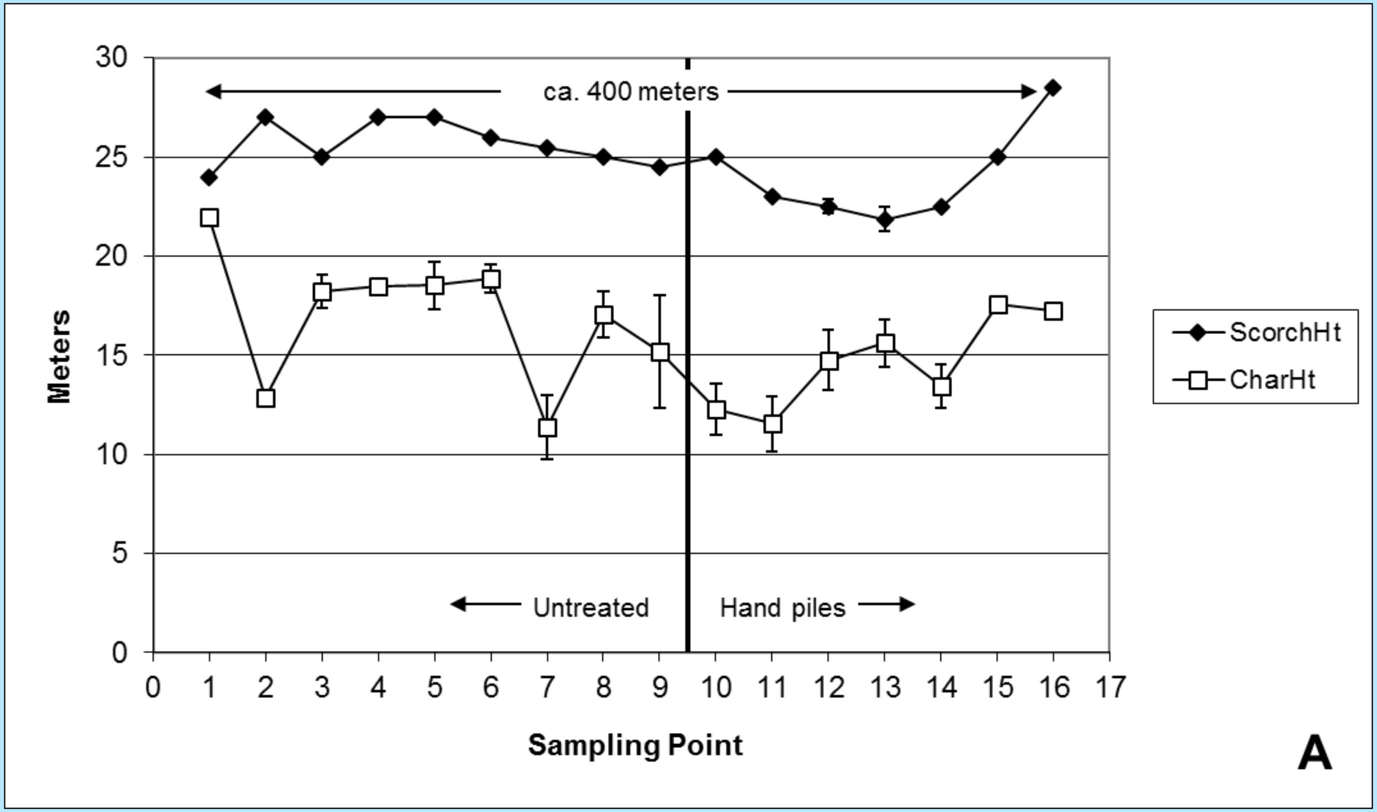
Safford et al. 2009. *Forest Ecol & Mgt*

Not all treatments worked well

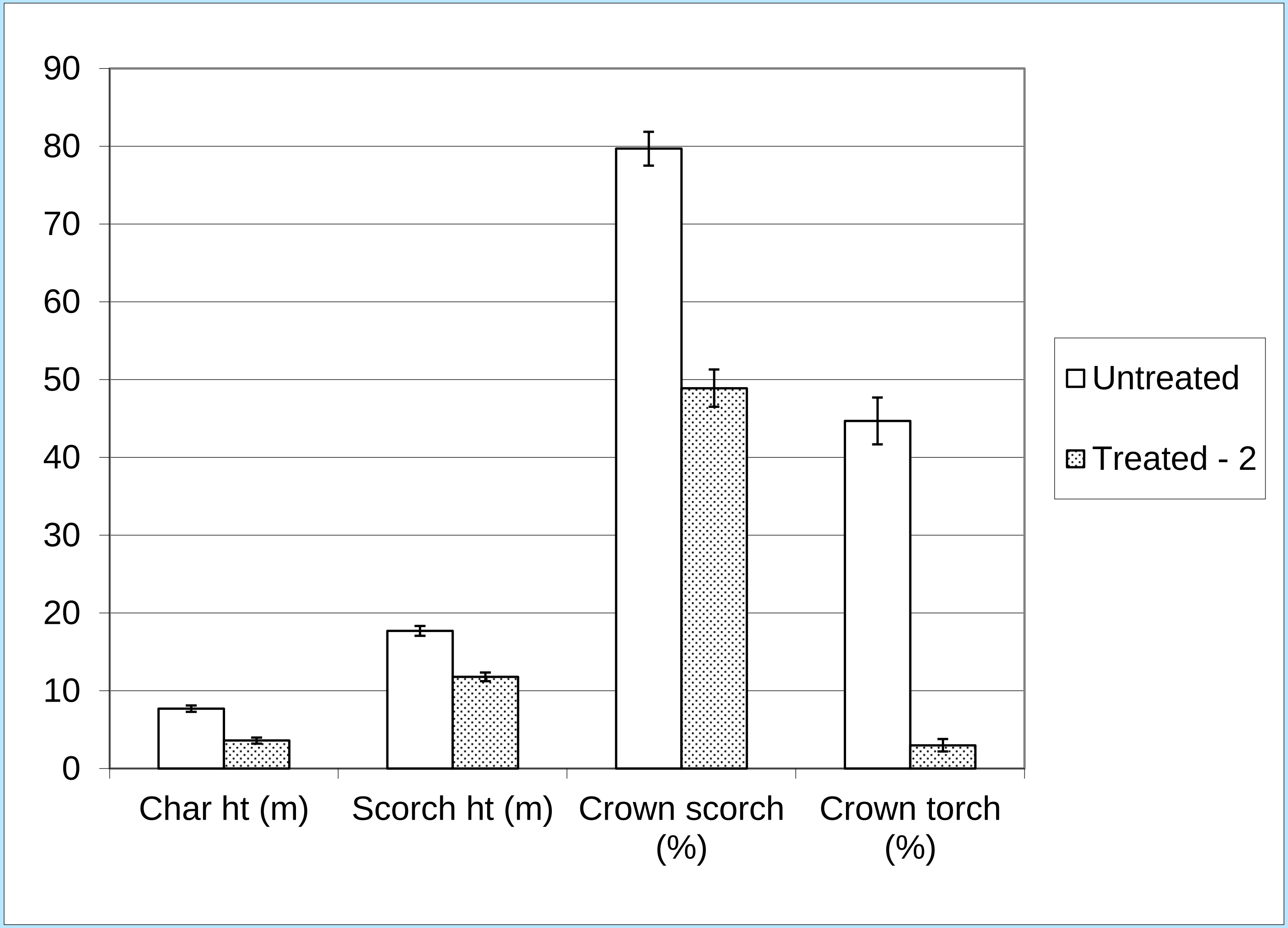
Trtmt 16: >30% slope, wind aligned, SE facing, hand thinned



Treatment 19: thinning completed but hand piles still on site

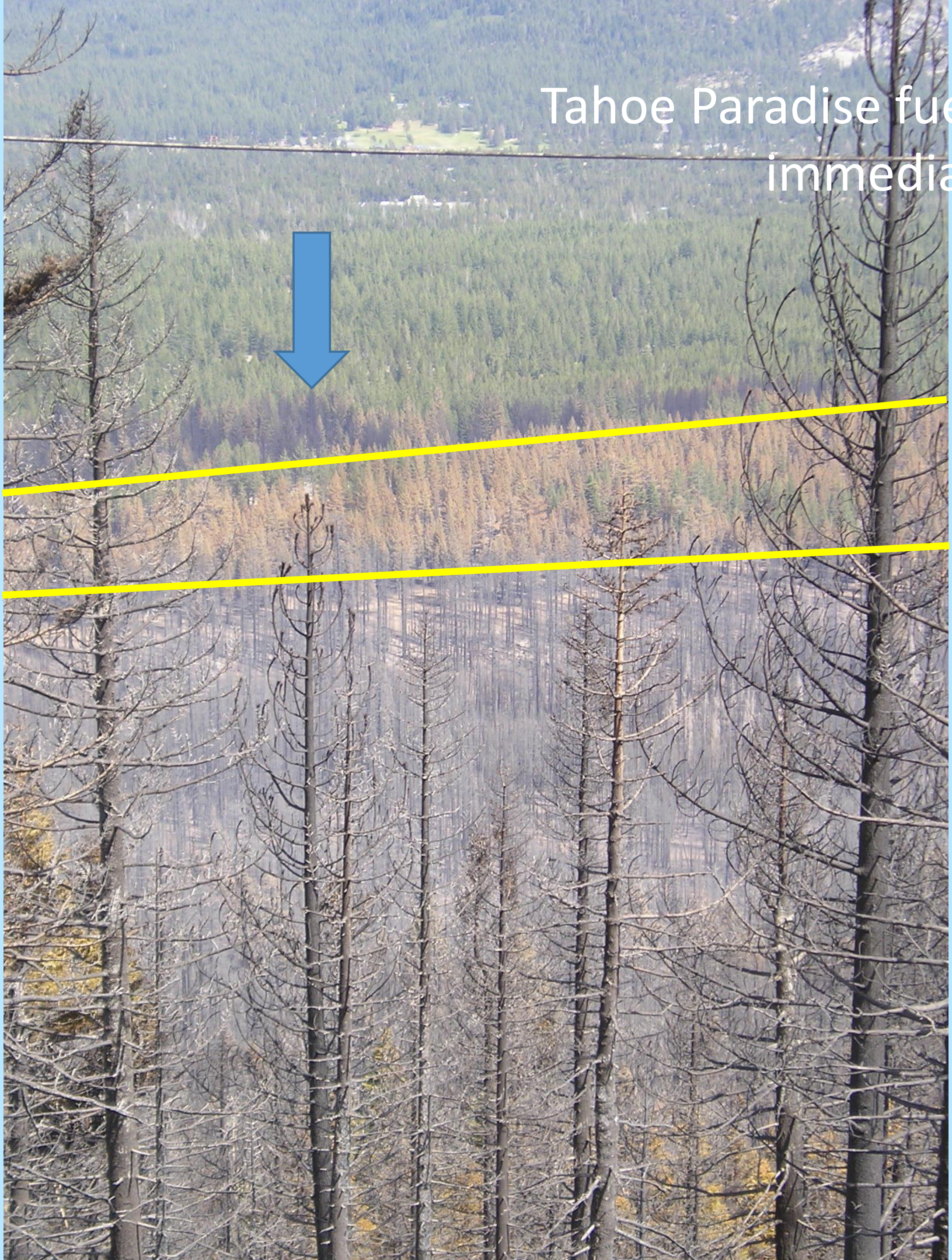


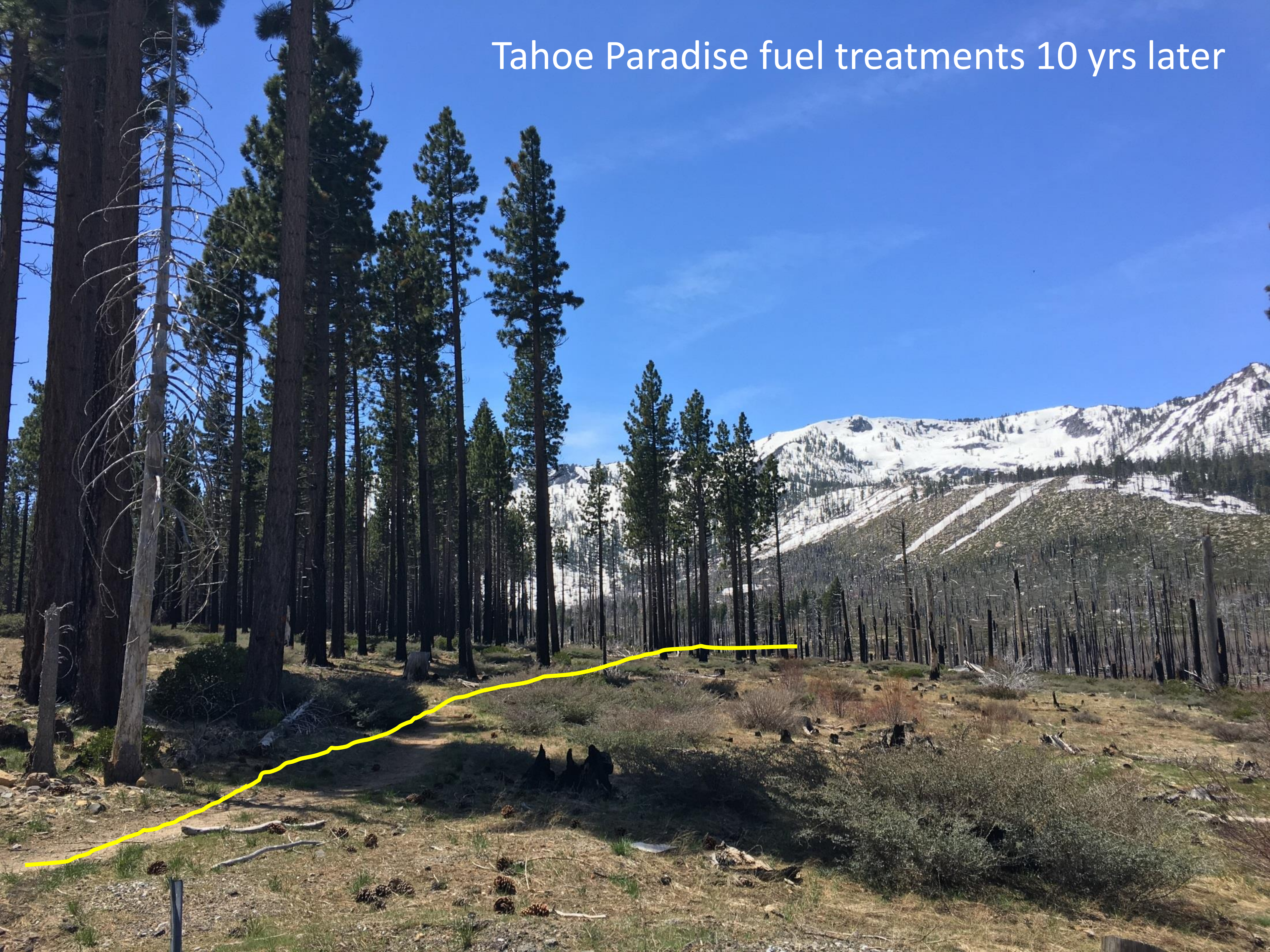
Overall Fire Severity Measures: Treatments greatly reduced severity



Safford et al. 2009. *Forest Ecol & Mgt*

Tahoe Paradise fuel treatments immediately after fire




Tahoe Paradise fuel treatments 10 yrs later

Fuel treatment effectiveness

- Fuel treatments in the Angora Fire substantially moderated fire behavior and reduced tree mortality
  - Exceptions were on steep slopes, where mechanical treatments were restricted and surface fuels and canopy cover were higher; and where surface fuels had not been removed (unburned fuel piles, lodgepole pine riparian zone)
  - Steep slopes, especially facing S and E, require *more* fuel removal than flat ground to realize same benefit
- Crown fire reduced to surface fire within 50 m in most fuel treatments. Based on various considerations, fuel break *minimum* width in WUI is 400-500 m (1300-1600')
- Many homes burned in spite of fuel treatment success due to wind-blown embers
  - "government efforts to reduce fuels around urban areas and private lands do not absolve the public of the responsibility to reduce the flammability of their own property,"

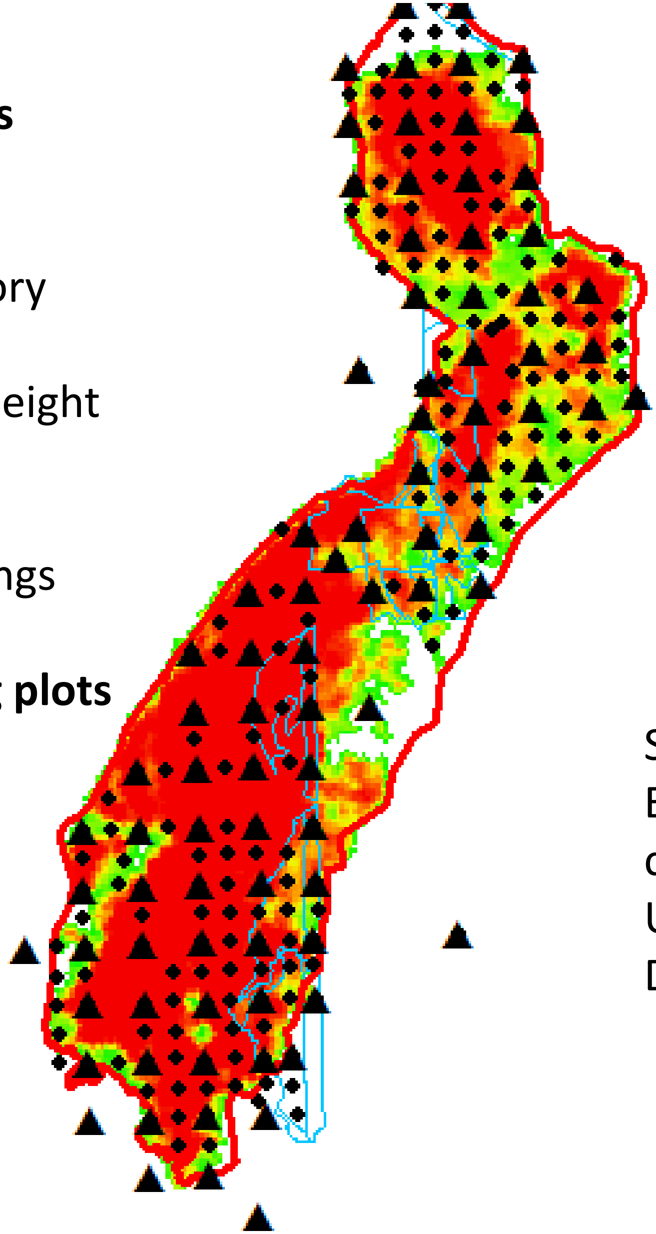
Angora Vegetation monitoring

~95 common stand exam plots

- 400 m grid
- ~800 sq m (1/5 ac)
- Full vegetation inventory
    - Ground cover
    - Species cover & height
    - Fuels & CWD
    - Trees
    - Seedlings & Saplings

~230 regeneration monitoring plots

- 200 m grid
- ~60 sq m (1/70 ac)
- Inventory of all regen
    - Species
    - Ages
    - Heights
    - Growth



Sampled by USFS Regional Ecology Program and collaborators, including Univ. of Montana and UC-Davis

Angora Fire Vegetation Monitoring Plan

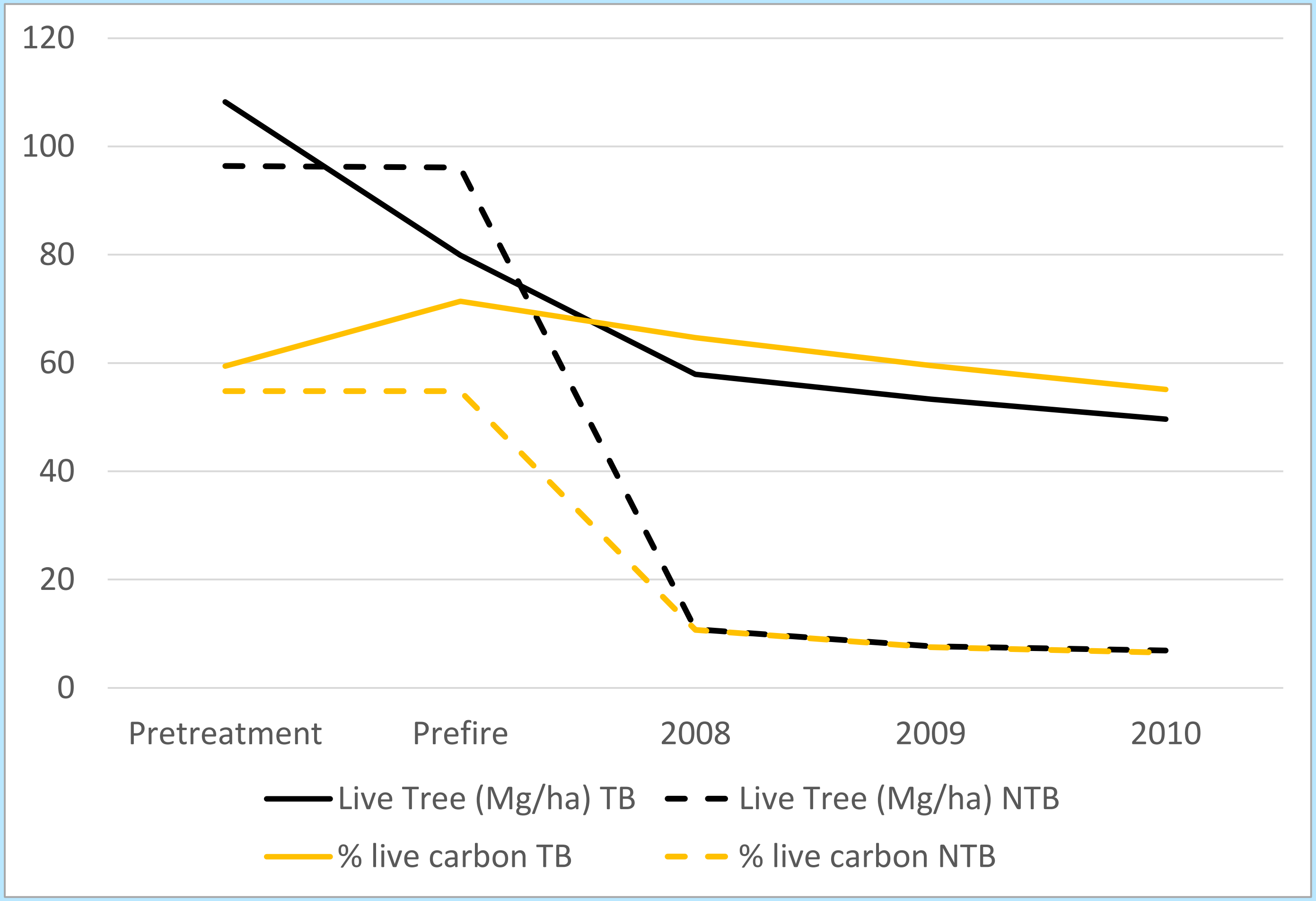
Nine overarching focus areas

- Fuel treatment effectiveness and effects ***DONE***
- Vegetation succession/forest recovery *10 yrs monitoring*
- Biodiversity *10 yrs data, in analysis now (Jonah Weeks)*
- Fuels accumulation *10 yrs data, analysis this fall*
- Conifer regeneration *Fed Sierra Nevada study, Jonah Weeks*
- Snag fall and retention *10 yrs data, analysis this fall*
- Conifer mortality rates *10 yrs data, analysis this fall*
- BAER treatment monitoring *Hydromulch: never completed*
- Support to other monitoring and research

  Data used in Carbon studies, Wildlife studies, Hydrology studies,

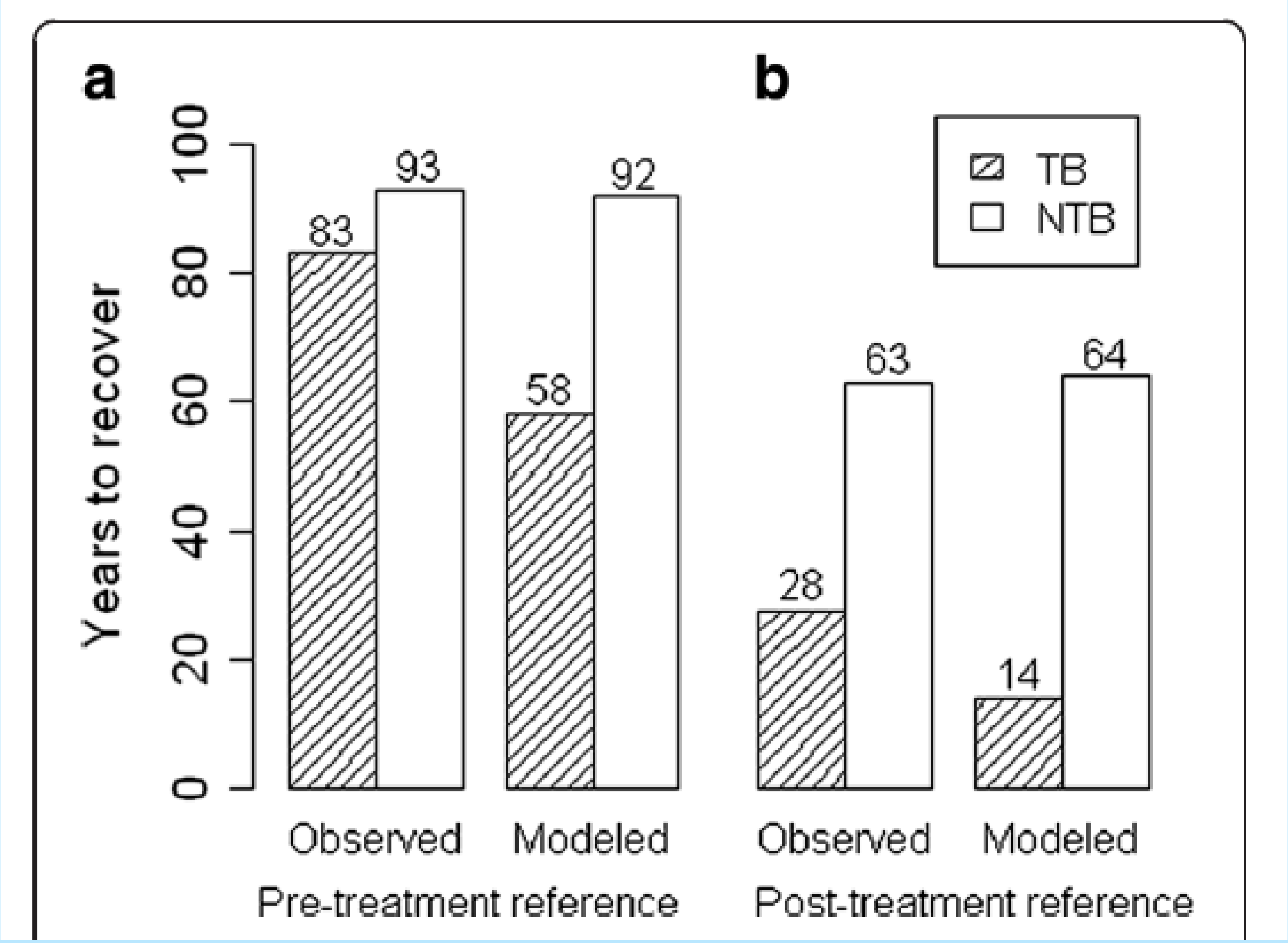
Carbon Impacts of Angora Fire

Treated vs Untreated Plots: Live Tree and % Live Carbon



Carlson, Dobrowski, & Safford. 2012. *Carbon Balance & Mgt*

Carbon recovery times: treated vs untreated



Carlson et al. 2012. *Carbon Balance & Mgt*

Carbon

- Fuel treatments removed up to 30-40% of aboveground biomass, greatly reduced fire severity
- Treated and untreated forest supported similar amounts of carbon after fire
  - But only 7% live carbon on average in untreated, vs. 51% in treated
  - Preponderance of dead carbon in untreated = decades of carbon emissions
- Treated stands on track to recover baseline carbon storage 10-35 years more rapidly than untreated
- Carbon recovery strongly dependent on fire severity/tree mortality; important role of tree regeneration only in high severity stands

Intermission:
Angora Photo Time Series


PLOT 4 2008


PLOT 4 2009


06 10 2010 13:07
PLOT 4 2010


PLOT 4 2011


PLOT 4 2016


PLOT 29 2008

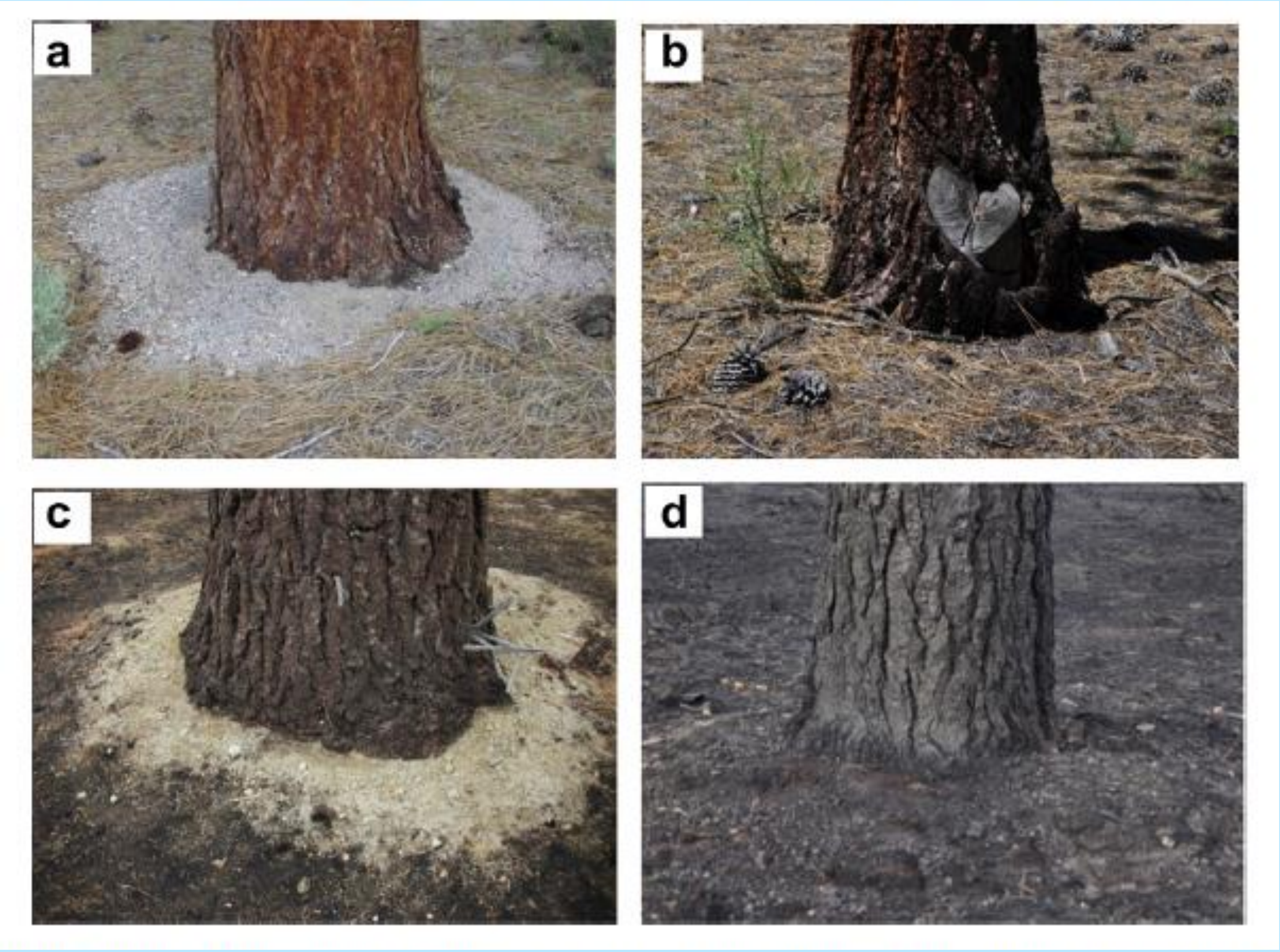

PLOT 29 2009


06 21 2010 16:32
PLOT 29 2010


PLOT 29 2011

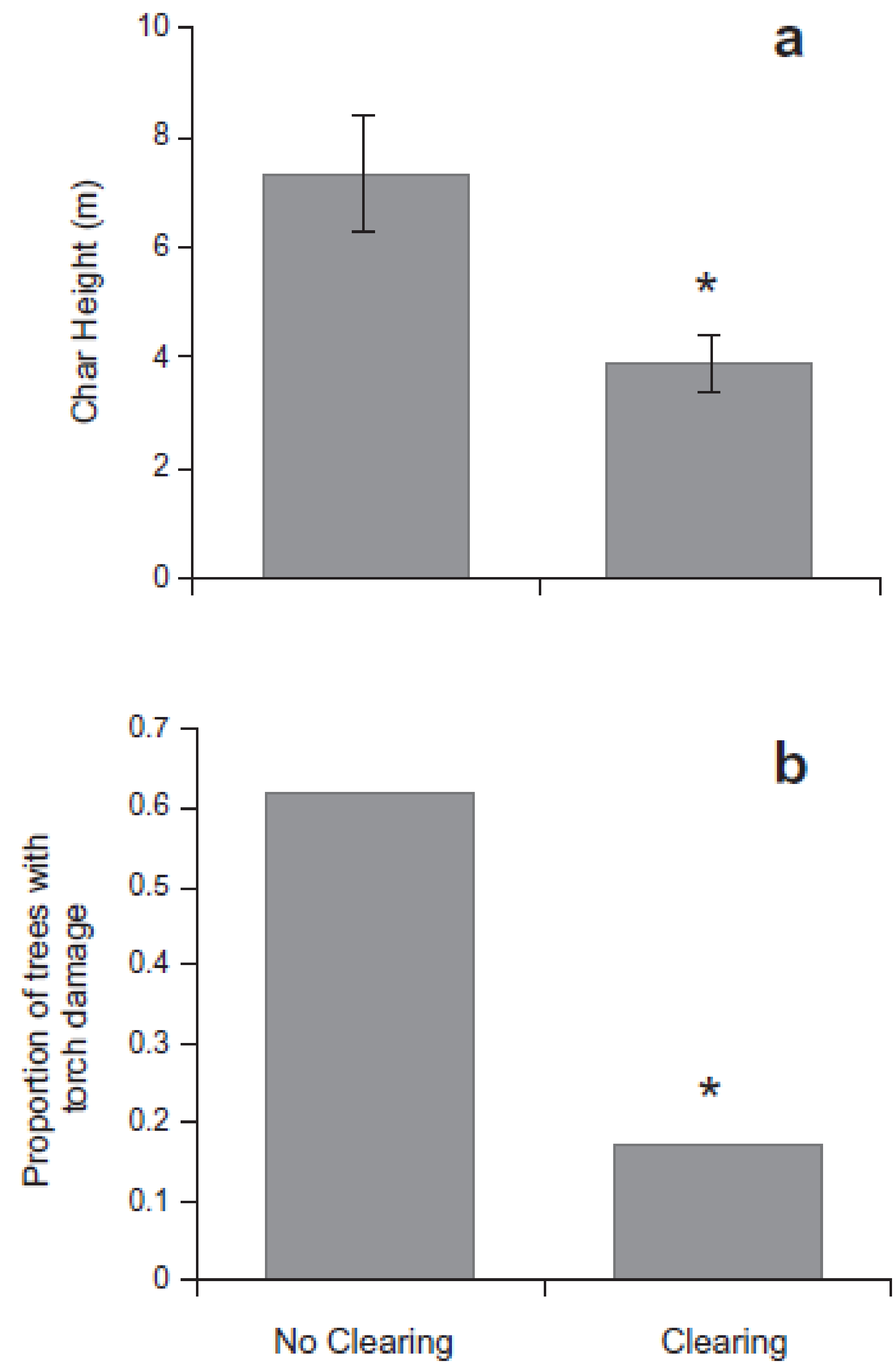

PLOT 29 2016

Strange basal clearings in Jeffrey pine forest: what are they, what is their function?



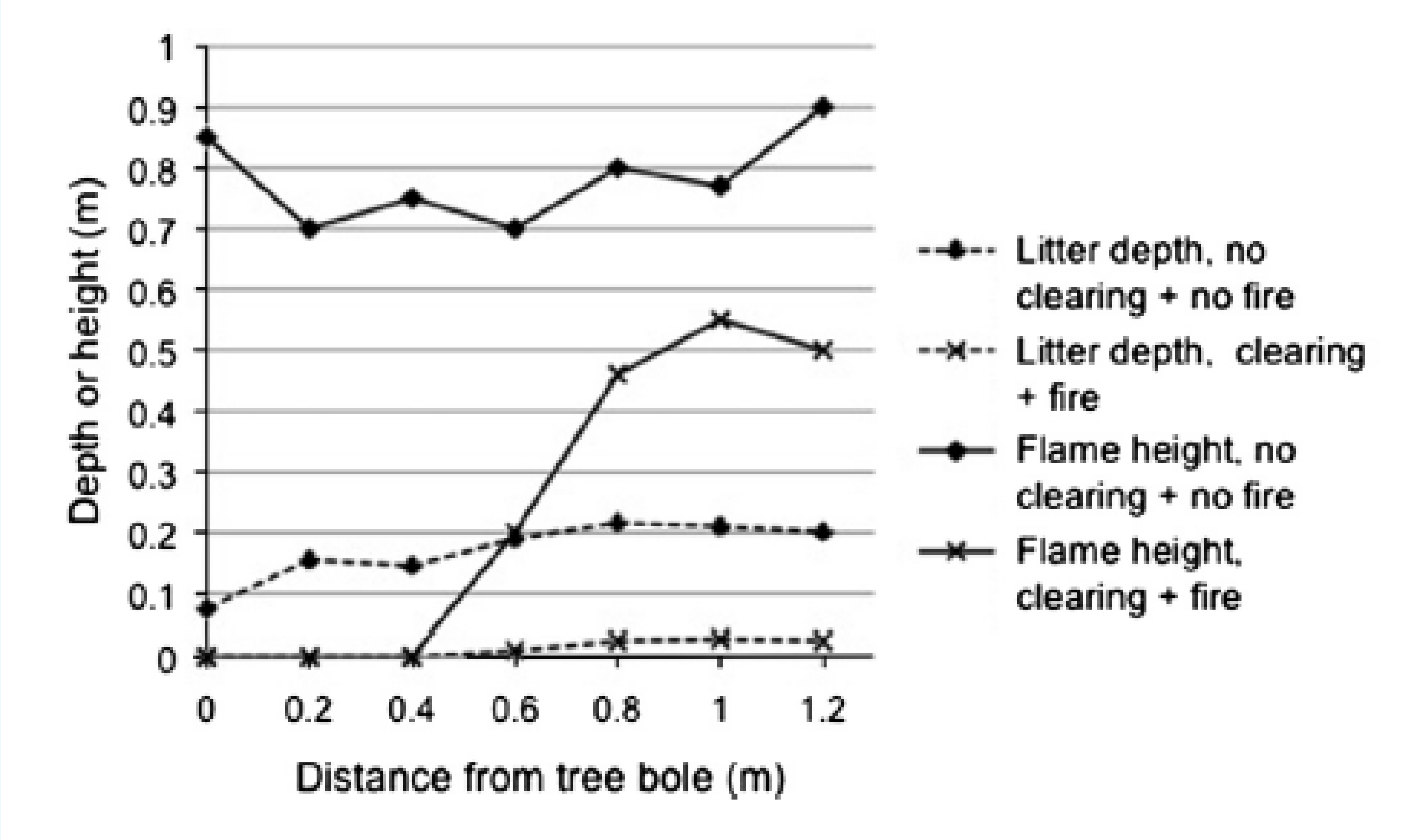
Basal clearings greatly reduce fire damage to trees

Data from Angora Fire, Tahoe Paradise treatments



Dalrymple & Safford. 2013. *Forest Ecol. & Mgt*

Lack of fuel around tree base = reduced prob. of direct fire contact and lower flame lengths



Dalrymple & Safford. 2013. *Forest Ecol. & Mgt*

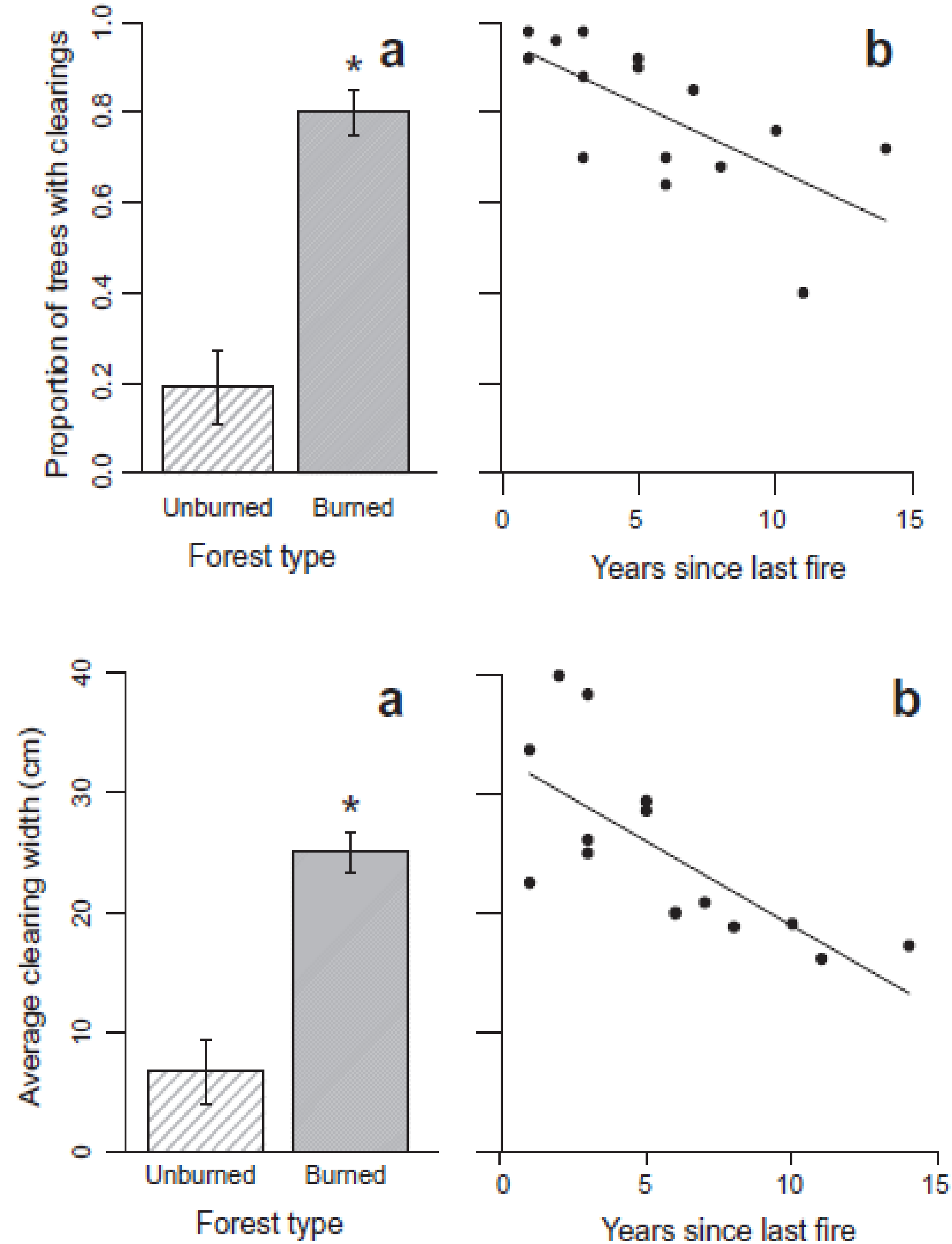
Potential culprits from our observations and experimentation: stem flow, overland flow in winter (over frozen ground in tree wells), wind, fire and…

Formica sibylla frequently nests in the clearings

The ants remove needles and small sticks that are placed on their nest

MOVIE

Data from Mammoth RD, Inyo NF: clearings also dependent on recurrent fire



Dalrymple & Safford. 2013. *Forest Ecol. & Mgt*

Ants forage in the tree canopy

Upshot: maintenance of clearings promotes tree survival during fires and maintains principal source of food for ants!

Basal clearings and ants

- We have done further experimentation, about to submit paper 2
- *F. sibylla* populations are very low in places with deep, extensive litter layer
- The story seems to be:
  - *F. sibylla* depends on bare ground (brood temperatures and/or food procurement/ease of travel)
  - Bare ground very common after (low to moderate) severity fire, ant nests are everywhere
  - Over time, in the absence of fire, various factors maintain clearings near trees (stem flow, overland flow, wind circulation, ants themselves), but clearings away from trees are gradually covered by litter
  - After 15-20 years without fire (which is the major driver of litter-free conditions), input of needles too high and clearings around trees also disappear
  - Clearings protect trees from surface fire and therefore preserve the ants' chief source of sustenance

Other examples of science from the Angora Fire

- For example:
  - Empirical demonstration of fire ember size-distribution
    - Important for fire modeling and engineering of fire-safe structures and materials
  - Stream chemistry, stream health, and stream biota after fire
    - Heayvart presentation 15:10
  - Microscopic black carbon input into Lake Tahoe from fire
    - Large inputs were quickly biodegraded, surprising researchers
  - Atmospheric inputs of N and P to lake and implications for lake plankton
    - Lake plankton community changed markedly in response to high N
  - Fire severity impacts on plant and animal communities
    - White presentation 14:20; Weeks presentation 15:40


Thank you