After the Angora Fire: Forest recovery from high severity fire

Angora 10 year science symposium

June 23rd, 2017

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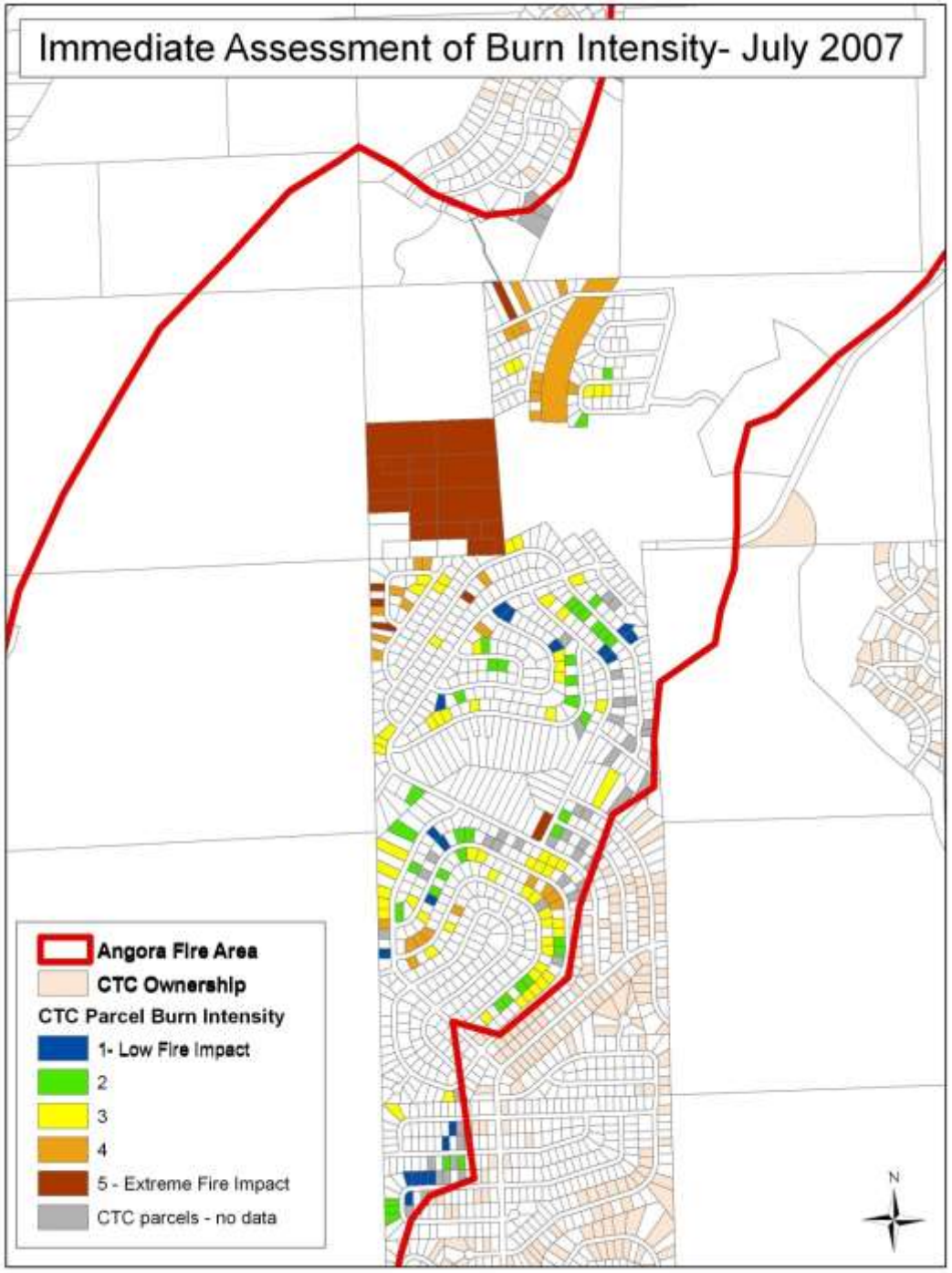
Presentation goals

- Discuss management approach used for reforestation by the California Tahoe Conservancy post Angora fire
- Present findings from post fire monitoring of Conservancy parcels

California Tahoe Conservancy

- an independent state agency
  - manages about 7,000 acres in the basin.
  - had about 100 acres within the burn area,
  - all WUI which encouraged an active management approach



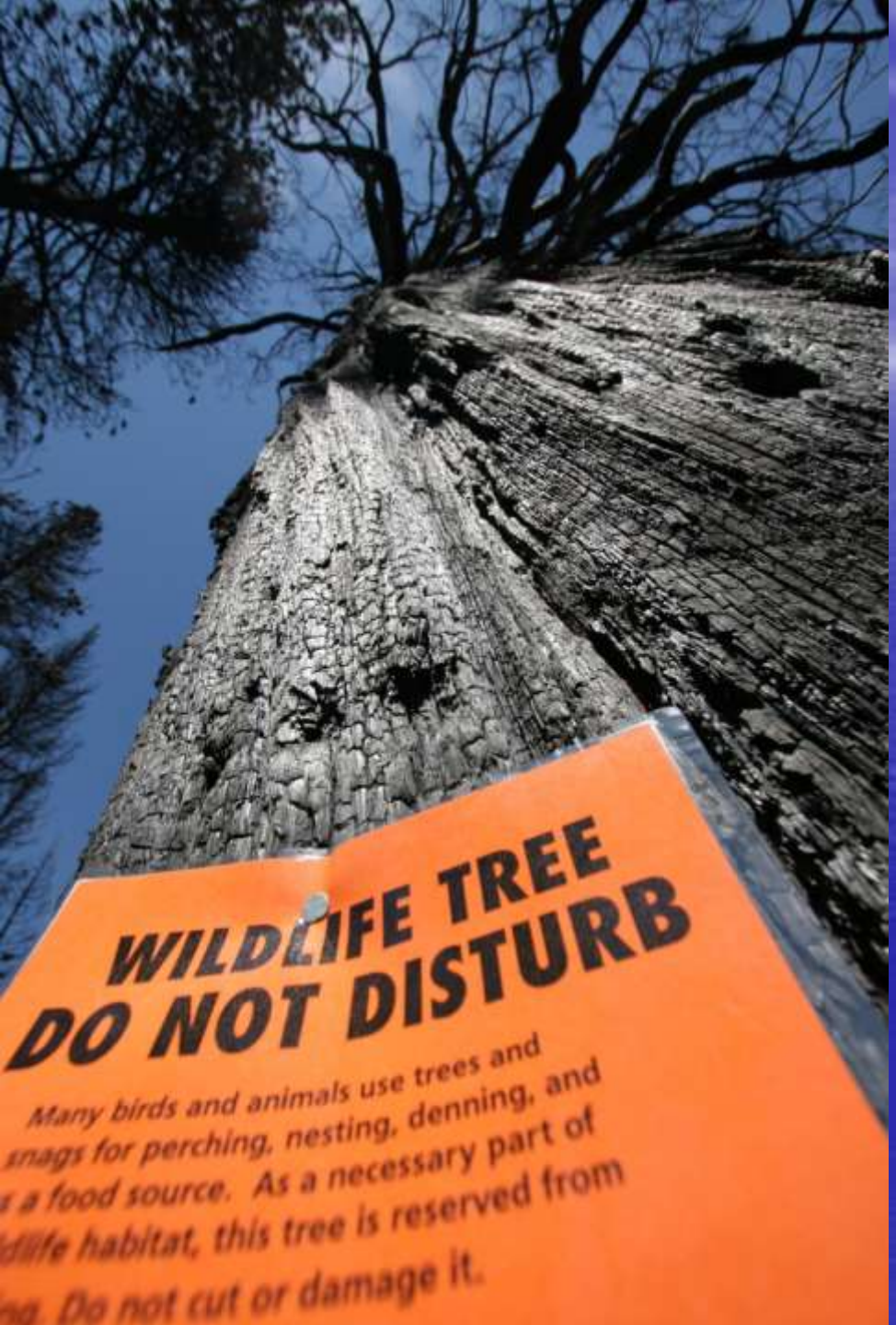
Treatment Goals

- Reduce hazard posed by dead trees falling and creating fuels in the future
- Reduce risk of soil erosion and sedimentation to Lake Tahoe
  - Monitor and mitigate any soil impacts from treatment
- Re-establish forest structure as quickly as possible
  - Favor native conifer species
  - Minimize brush domination

Treatments - Tree Removal

Dead and dying trees were removed to minimize public safety hazards and to reduce future fuel loads.

- Marketable lumber was sent to Sierra Pacific Industries mill in Camino.
- Slash material was masticated and left to provide at least 75% cover of exposed soil to reduce erosion.
- Value from tree removal was used to offset costs of mastication and erosion control treatments.
- Tree removal completed by Oct 2007



- 4-6 dead trees per acre left standing for wildlife habitat
- snags left in riparian area

Treatments - Erosion Control

Various erosion control features were used on exposed slopes to minimize the risk of sedimentation into Angora Creek.

- Mulching with masticated material and straw
- Tree tops laid on slope contour
- Native seed mix applied

Treatments - Riparian

Various techniques were used to avoid channel incision, rills, and gullies that could lead to sediment delivery to streams

- Coir logs, contour logs, rock check dams and pine placed within/around the channel.
- A native hydric seed mix spread. aspen cuttings from a nearby site were planted.

Treatments – Tree Planting

Volunteers, Conservancy, CCC planted both container stock and bare root seedlings (2007, 2008, 2009, 2010)

- Planted Jeffrey pine, incense cedar, quaking aspen and rust-resistant sugar pine
- Target 150-200 tpa

Treatments – Brush control

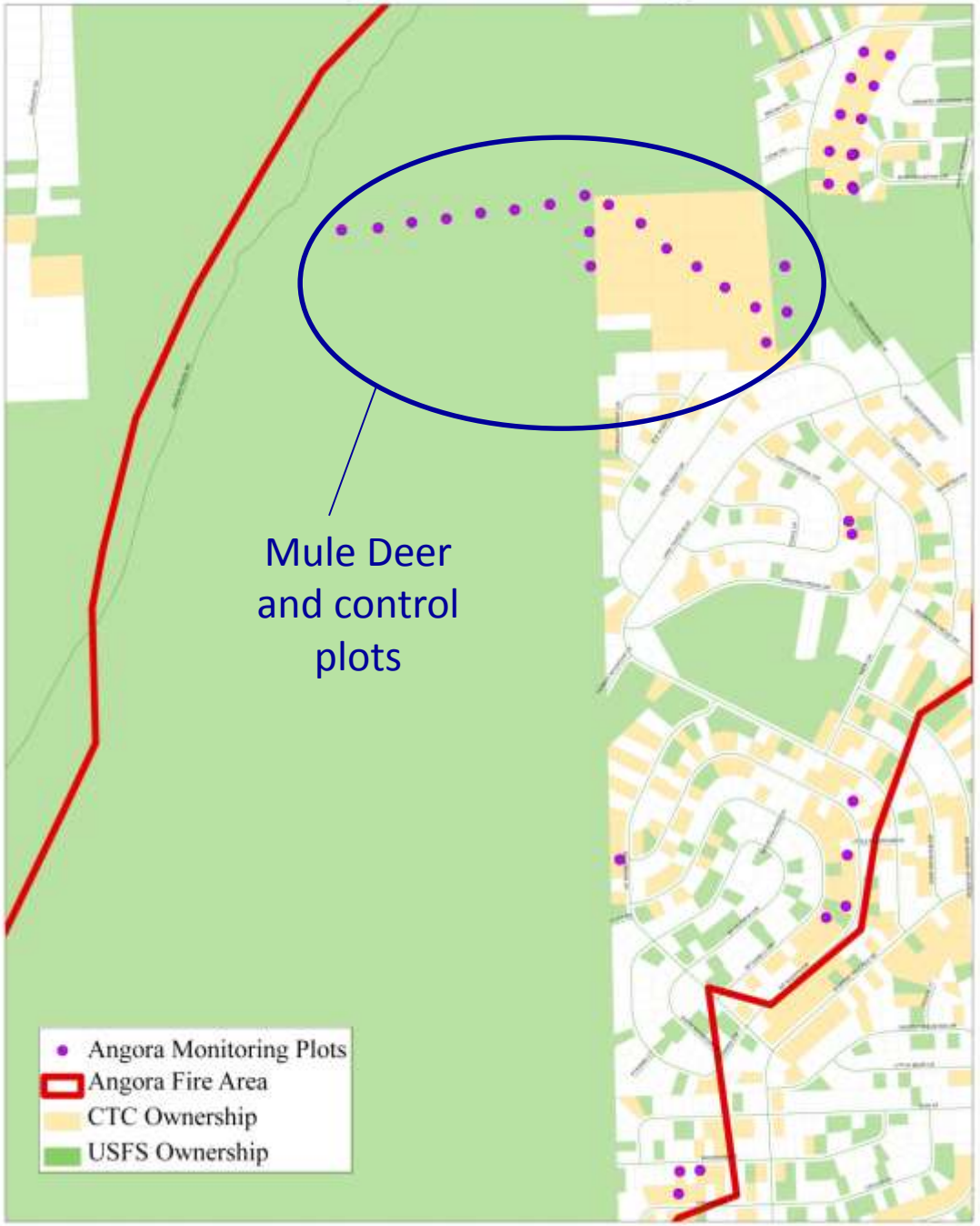
- Mostly whitethorn (ceanothus cordulata)
  - CCCs pulled up new shoots in 2009
  - Crews cut and pilled in 2014/2015
  - Burned piles in 2016

Monitoring Questions: Did treatments….

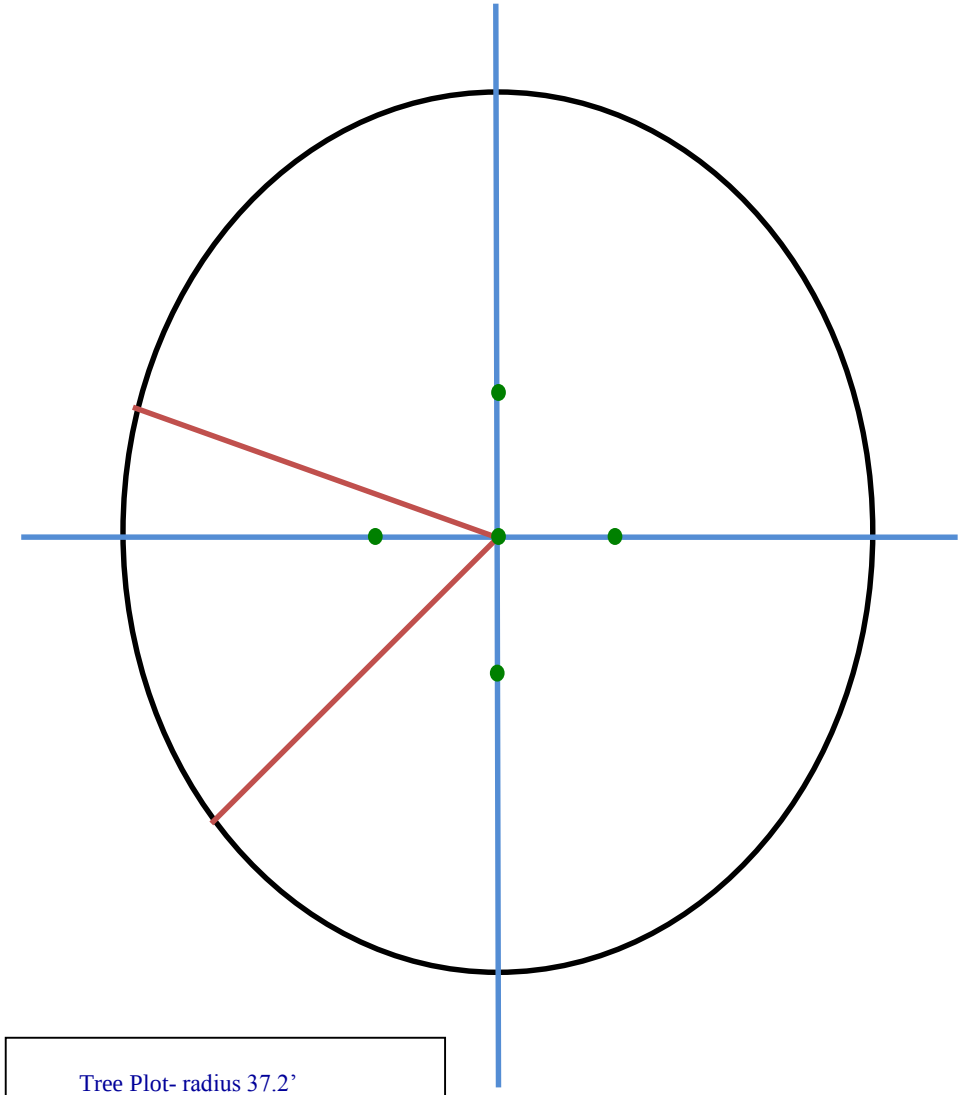
- accelerate forest stand development? YES
- promote increased ground cover of desired species? YES
- reduce ground fuels accumulation and associated fire risk? MAYBE – LONG TERM ISSUE

- impact soil quality? NO
- minimize soil erosion? PROBABLY, SOIL EROSION WAS MINIMAL EVERYWHERE

CTC Angora Fire Monitoring Plots



Forest Inventory Plots



- Where majority of data taken
- Include tree (height, DBH, etc.) ground vegetation, fuels and soil strength data.
- Forest service plots were no longer ‘control’ plots after 2009 when treatments occurred in plots (including planting, salvage logging, and fuels reduction)

2007 Pre-treatment

2009 Post-treatment

Untreated

Masticated (light cover)

Masticated (heavy cover)

Reforestation outcomes

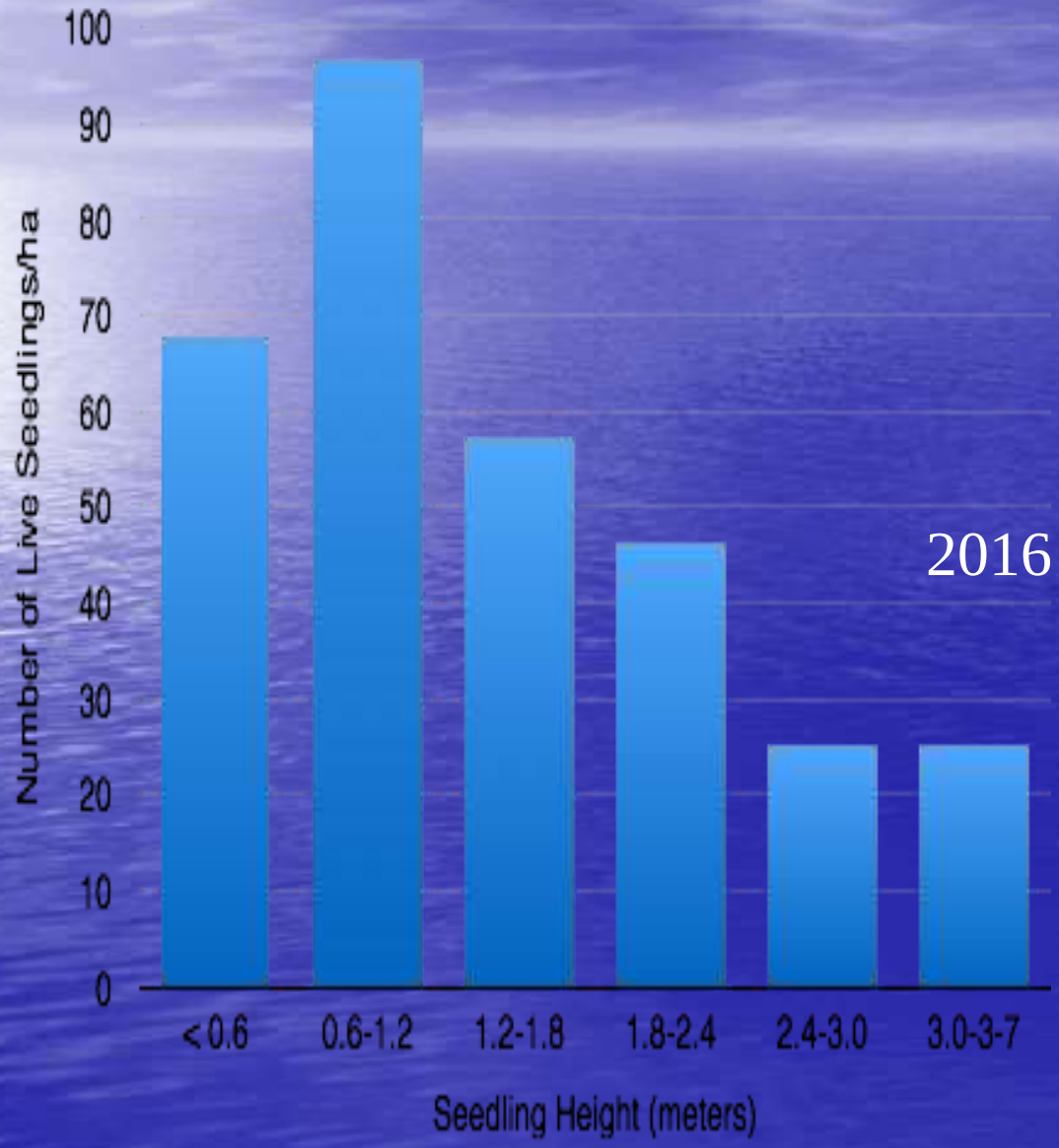
- Few naturally growing tree seedlings were found on plots in the first 3 years of monitoring, more later
- 129 trees per acre (90% Jeffrey pine)
  - Average 4.2’ tall in 2016
  - >50% >4’ tall
  - >30% >6’ tall

Seedling planted in 2007

Tree height

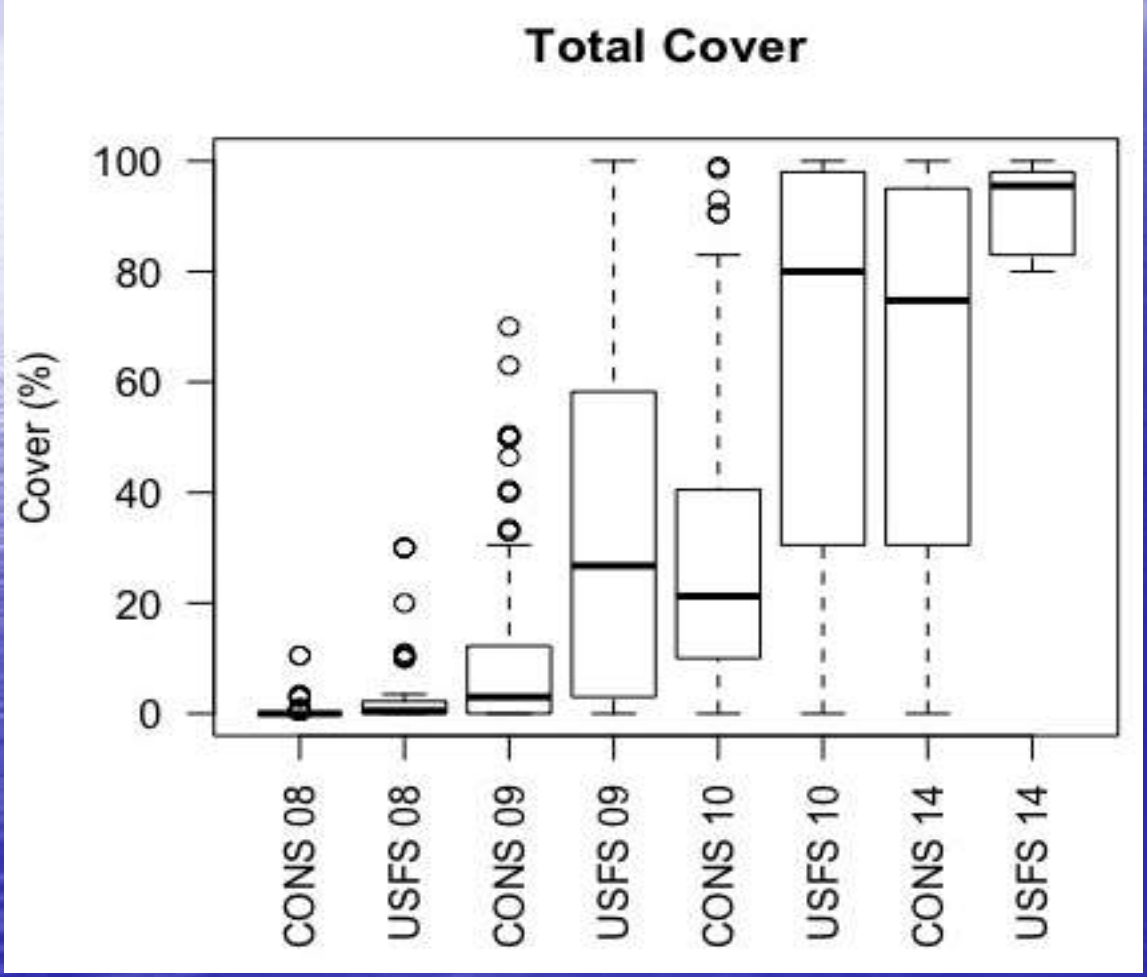
2009

2016



Vegetative Cover:

Cover returned steadily, more quickly on untreated Forest Service control plots



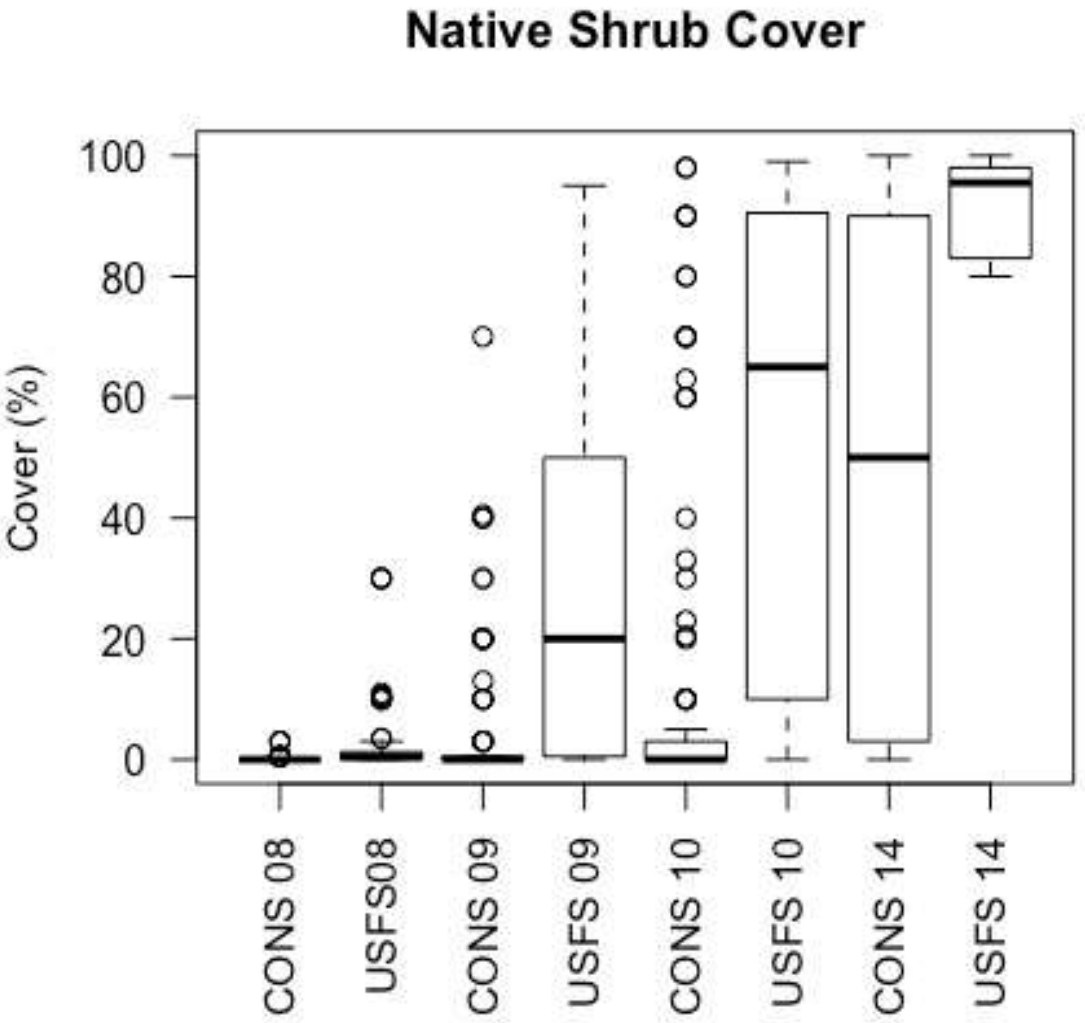
Horizontal line across each box represents the median. 50% of all values are within box.

Circles represent values that are outliers farther than 1.5 times the interquartile range.

Whiskers show data farther than 1.5 times the interquartile range.

Native shrub cover

Cover was dominated by shrubs, and more so on untreated Forest Service plots where they were also taller



Avg (mode)	2010	2014	2016
Conservancy	1.0 (1.0)	2.9 (2.0)	--
Forest Service	1.4 (1.5)	3.3 (2.5)	-- (2.8)

Height of shrubs in feet

Problem for growing trees when that is the goal

Species richness

There were more native plant species on the Conservancy lot where shrubs dominated less

Vigorous shrub growth on untreated plot

Surface Fuel Loads

- After the fire there was very little surface fuel.
- Salvage logging slash and mastication added fine and coarse fuels
- 7 years after treatment still more than twice as much fuel on the ground as before
- Coarse fuels will continue build in untreated areas

Surface fuel load	1-100 hour	1000 hour	Total tons/ acre
2007 (before treatment)	0.3	20.4	20.7
2014 (after treatment)	9.1	38.6	47.7

Conclusions

- Immediate salvage logging & mastication, (along with later brush removal) aided seedlings by suppressing shrubs as has been found elsewhere
- Shrubs overtopped trees on Forest Service comparison plots where trees were planted later and shrub control was not done
- Species richness is higher where shrub competition is suppressed

Biggest impact is increased fuel loading

- Increase of 229% in total fuel on the Conservancy parcel.
- Similar to another recent study of post-fire logging which found an increase of 219% in stands logged heavily after fire (McIver and Ottmar, 2007)

Long term fuel dynamics?

- Fuels on unlogged sites increase as snags fall while fuels on logged sites decrease with decay.
- 1-100hr fuel loads on logged sites dipped below amount on unlogged sites
  - 10 to 28 years (Peterson et al. 2014)
  - 18 to 22 years (Dunn and Bailey 2015)
- 1000-hr fuel loads on logged sites dipped below levels found on unlogged sites
  - 6 to 39 years (Peterson et al 2014)
  - 7 years (Dunn and Bailey 2015).

Thank you!

- **University of California Cooperative Extension**
  - Gary Nakamura and Dr. Richard Harris for study ideas and enthusiasm
- **US Army Corps of Engineering** for fire restoration and monitoring
- **California Tahoe Conservancy**
  - Staff time, support and access for 10 years since the Angora fire.
  - Brian Hirt and Milan Yeates for treatment information and coordination
- **CalFire**
  - Forester Christy Daugherty planning and implementing the treatment.
- **US Forest Service Lake Tahoe Basin Management unit**
  - Dave Fournier for collaborated on Forest Service sites
  - Rita Mustatia supplied Forest Service treatment and seedling survival data
- **UC Davis**
  - Jonah Weeks of the Safford Lab, for 2016 vegetation data for USFS sites.
  - Dr. Christina Restaino, for statistical advice