

# Living with wildfire in Sierra Nevada forests

*How to get to a resilient forest*

Susie Kocher, Registered Professional Forester #2874  
 University of California Cooperative Extension  
 Amador County Master Gardener Training  
 May 2024

Photo by Sierra Nevada Conservancy

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## Talk outline - California forests

- California forests/ Forest ecology
- Expanding forest disturbances
  - Wildfire and insects
- What can we do?
  - Thinning/ harvesting
  - Prescribed fire / fire use
  - Reforestation
- Home hardening
- UC ANR forestry resources

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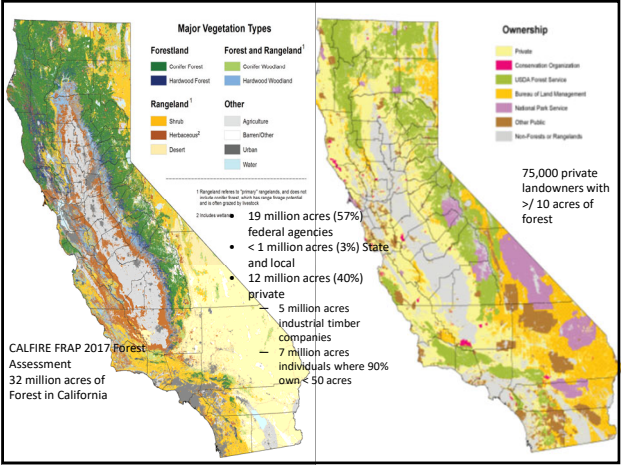
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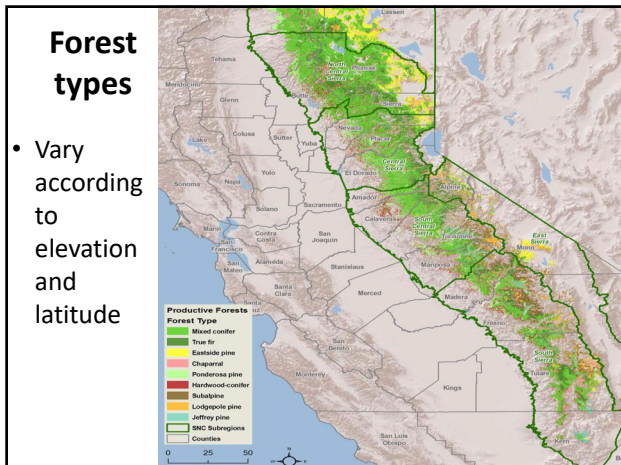
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**Forest types**

- Vary according to elevation and latitude

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**Sierra Nevada Mixed Conifer**

- Ponderosa pine, Douglas-fir, sugar pine, white fir, incense cedar and black oak.
- Pines (pinus spp.)
  - Needles in bundles, seeds carried on cones that fall to ground whole, ponderosa is yellow pine (3 needles) and sugar is a white pine (5 needles)
- Firs (abies spp.)
  - Needles individually attached to stems, Cones do not fall whole to the ground, Douglas-fir is not a true fir but a pseudo hemlock
- Cedar (calocedrus genus) has leaves in needles
- Black oak is deciduous and resprouts after top killed

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### Tree characteristics determine location where they thrive

- Trees are found where they are because they outcompete others in their particular location
- Related to species' characteristics
  - Shade tolerance
  - Drought tolerance
  - Fire tolerance
  - Snow tolerance



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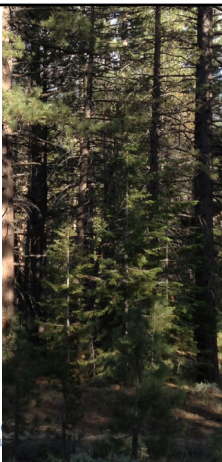
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### Shade Tolerance

- Ability of a tree to grow and survive in low light conditions
- White fir can grow in understory shade of other trees
- Life strategy is to survive in the understory until there is a whole in the canopy then shoot up and take over the site
- Can live up to 80 years in the understory waiting for its chance



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Pocket of shade tolerant white fir being torched in prescribed burn

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### Shade Tolerance

- Pines are shade intolerant - Ponderosa pine that is overtopped by other trees and cast into shade will die
- Life strategy is to grow quickly into overstory or die

Shade tolerance in Order

Red fir

White fir



Sugar pine

Incense cedar

Lodgepole pine

Ponderosa pine

Black oak

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### Drought Tolerance

- Ability of tree to survive under conditions of moisture stress
- Adaptations: Waxy or hairy leaves, stomata that close



Drought Tolerance

Oregon white oak

California black oak

Jeffrey pine

Ponderosa pine

Lodgepole pine

Incense cedar

Douglas fir

White fir

Red fir

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### Fire Tolerance

- Ability of a tree to survive a fire
- Adaptations: Thick bark, deep roots, self pruning lower limbs

Fire Tolerance

Ponderosa pine


Douglas fir

Sugar pine

Incense cedar

Lodgepole pine

White fir



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### Snow and Cold Tolerance

- Ability of a tree to survive cold temperatures and snow loads
- Adaptations: Conifers with short flexible branches that shed snow, deciduous trees that shed leaves


**Snow load tolerance**

- Red fir
- White fir
- Jeffrey pine
- Douglas fir
- Sugar pine
- Ponderosa pine





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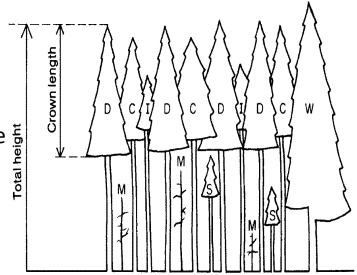
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### Competition

- Trees on site are product of genetics & site conditions
- Trees are constantly competing and their form reflects their "progress"
- Tree species are found where they outcompete others
- Forests separate into forest types depending on how elevation and location advantage which trees grow there





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Diameter growth slows with increasing competition. 23 yrs





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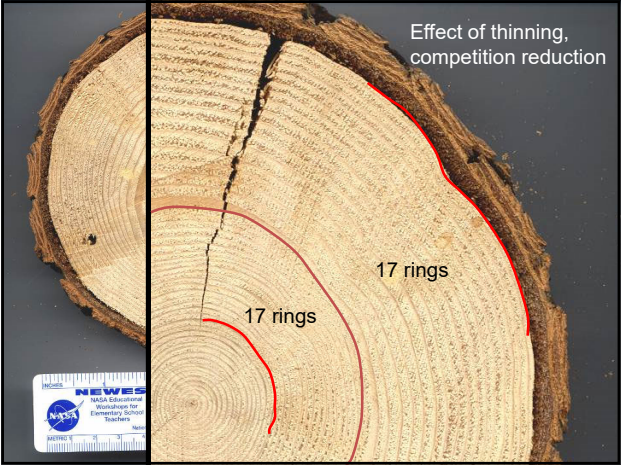
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**Sierra Nevada forests are frequent fire forests**

- Both natural (lightning) and anthropogenic starts
- California Indians managed the landscape with fire for at least 10,000 years before colonization
- Practices and population mostly maintained under Spain & Mexico
- 1849 California Gold Rush led to widespread genocide and fire exclusion

*The past is never dead. It isn't even past.*  
William Faulkner

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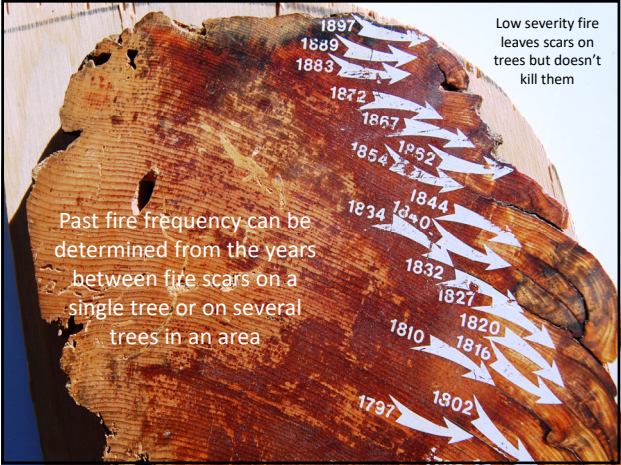
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### Fire Return Interval

- Time between two successive fire events at a given site or area
- Ponderosa 5 – 12 years
- Mixed conifer 8 - 20 years
- Red fir 15 - 50 years
- Sub-alpine 25 - 60 years
- 4.4 -11.9 million acres/ year or 5% - 12% of California's lands burned annually pre-settlement

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### Full time fire suppression

- Began 1905 with formation of the US Forest Service
- 1910 Big Blow Up burned 5 million acres (Montana & Idaho), killed 79 firefighters - USFS decides to stress fire prevention and control fires as quickly as possible.
  - Light burning continues in CA, Red River Lumber company near Lake Almanor used fire on 800k acre property
- 1924 USFS researchers concluded light burning was ineffective, impractical, economically indefensible, CA State Board of Forestry agreed, outlawed til mid 1950's

Ponderosa pine, sugar pine, black oak type, with manzanita and grass as associated dominants – “poorly stocked”. Mariposa County  
 UC Library, Digital Collections

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### Consequences of fire suppression

- Long Ravine railroad trestle near Colfax, Placer County. Source: Gruel 2001

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### Consequences of fire suppression

Spaulding Lake in Nevada County, 1919 and 1993. Source: Gruel 2001

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### Consequences of Fire Suppression

View from Union Point west down Yosemite Valley, 1866. Source: Gruel 2001. Same location 1961. Inset 1994. Source: Gruel 2001.

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### Fire suppression and exclusion has led to overcrowded & unhealthy forests

- Increased competition and mortality
- Increased susceptibility to native bark beetle outbreaks
- Fires now more likely to be high severity meaning most or all trees are killed
- Conifer encroachment in oak woodlands, meadows, aspen, shrub habitat

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### Add in Climate Change on Top



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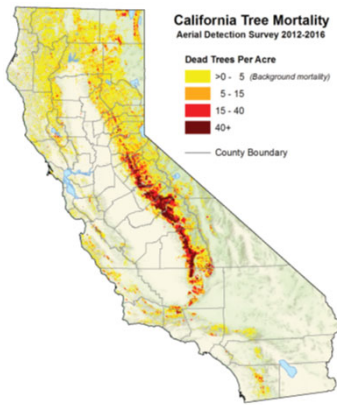
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### Drought caused water stress in trees

- Warm drought of 2012 to 2016 caused moisture stress throughout the state, especially at lower elevations in southern Sierra Nevada
  - Plants need more moisture when its hotter
- In overcrowded forests individual trees get less soil moisture and produce less pitch
- Weakened trees less able to fight off attack by native bark beetles



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### Western Pine Beetle

- Native beetle attacks ponderosa pine and coulter pine
- Start flying in early spring (~ 60°F) and continue until stopped by cold weather (less than 50°F)
- Parent females produce 1 to 3 broods a year = overlapping generations



Adult beetle: length 0.12 - 0.20 in, dark brown  
Larval galleries



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**April 2015**

Location in Madera County before and after tree mortality began spreading.  
Photos: Margarita Gordus, CA Department of Fish and Wildlife



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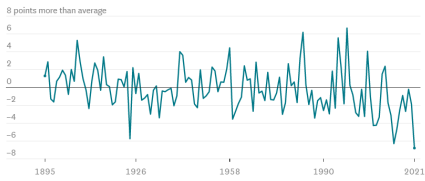
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### Add in climate change

- 2021 hottest summer on record (until 2023)
- Average temperature in CA reached 77.4° F from June to August. Broke record of 76.5° F from 2017.
- 2021 driest year on record

The Palmer Drought Severity Index estimates dryness based on temperature and precipitation data. Higher numbers indicate less dryness.



8 points more than average

Chart: Yoohyun Jung / The Chronicle - Source: NOAA National Centers for Climate Information

*"The future is already here – it's just not evenly distributed." William Gibson, maybe*

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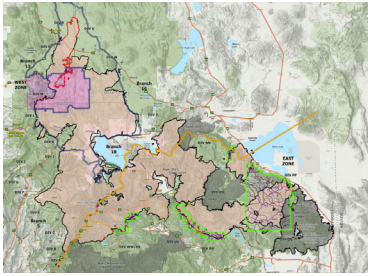
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### Wildfires becoming impossible to contain

- Fires showing extreme behavior
  - Fires 8 largest wildfires in CA have all burned since 2017.
  - 1 of every 8 acres in CA has burned in the last 10 years – 12 mil of 100 mil acres
- 2020 fire season
  - 4.4 mil acres, 4% of state
- 2021 fire season
  - 2.5 mil acres, Dixie fire 1 mil acres, destruction of Greenville,
  - Caldor fire 220,000 acres, destruction of Grizzly Flats



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### Forest management constraints

- Size of ownerships makes some of these activities uneconomical
  - Cost-share funding available, but planning and permitting knowledge curve steep
  - Shortage of registered professional foresters
  - Shortage of contractors
  - Shortage of woods products facilities
- Lack of prescribed fire capacity
  - ‘professionalization’ of prescribed fire
    - Laws outlawing/discouraging private burning – this is changing
    - Lack of clarity in permitting – still an issue
    - Lack of opportunities for experience – probably the biggest issue





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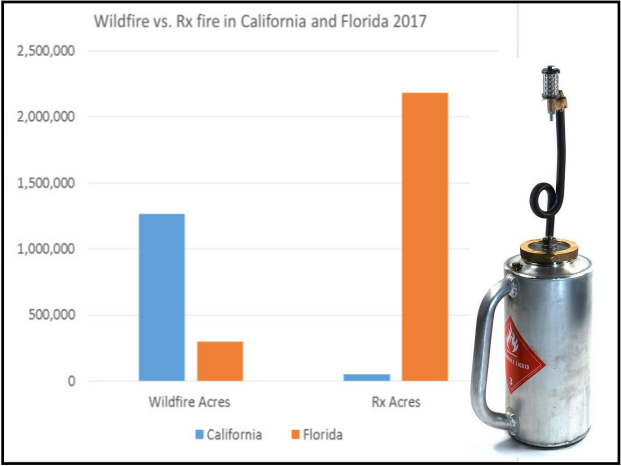
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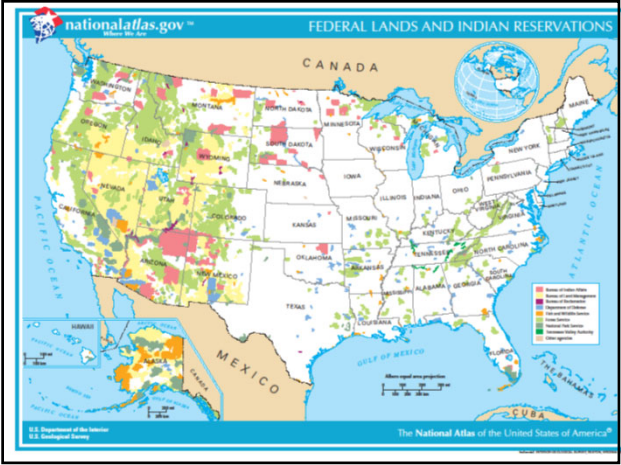
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### Options for private lands burning

**Cal Fire Vegetation Management Program (VMP)**

**Contractor**

**Do-it-yourself**

**Prescribed Burn Association**

**Pros**

- Liability covered
- Low cost

**Cons**

- Limited agency capacity
- Environmental compliance
- Not guaranteed
- Overall timeline

**Pros**

- Contractor provides some insurance
- Experienced crews/resources
- Landowner can set expectations and timeframes

**Cons**

- For profit firm: Cost
- Limited capacity

**Pros**

- Low cost
- You're in charge—do it when and how you want

**Cons**

- Liability
- Manpower/resources

**PRIVATE PROPERTY**

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### Prescribed Burn Association (PBA)

**Pros**

- You're in charge—do it when and how you want
- Low cost—volunteer based
- Environmental compliance
- Equipment/labor pooled through PBA
- PBA can apply for grants/funding
- Every burn is a training opportunity

**Cons**

- Liability (though you can hire a burn boss with insurance)
- Permits/air quality
- Someone has to coordinate

Find one near you: <http://calpba.org>, Butte PBA

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### Formation of the Motherlode PBA

- 7/2021 - Held a zoom meeting – 40
  - Id'd a steering committee
- 8/2021 - Held a field trip to Columbia College - 30
- 11/2021 – Pile burn (non-burn day) - 15
- 12/2021 – 1<sup>st</sup> broadcast burn! - 20

PBA field trip to Columbia College 8/11/2021

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### Fostering Fire Adapted Communities

– Neighborhoods located in wildfire-prone areas that can survive wildfire with little or no assistance from firefighters.

- A = access
- B = built environment
- C = community fuel breaks
- D = defensible space
- E = evacuation

*Graphic from University of Nevada Cooperative Extension [www.livingwithfire.info](http://www.livingwithfire.info)*



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### Where is the risk in your home and near landscape?

- Focus on removing highest risk elements first
- Wooden roofs very risky
- Large fire tolerant native trees probably not an issue unless VERY close to house
- Small, suppressed, less tolerant, crowded trees are an issue
  - Can crowd under eaves
  - Create fire ladder



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### Trees can be the major risk



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**Trees /shrubs/roof combined form risk**



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**Trees/roof create risk**



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**Roof creates risk**



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**Is there risk?**




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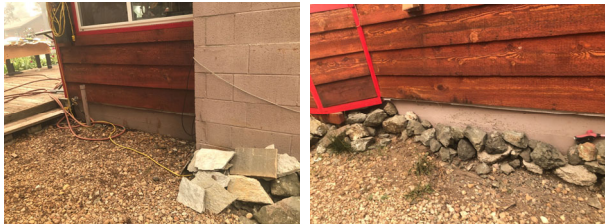
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**Structure prep for the Caldor fire**

East side of house - just removed needles




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South side of house – vent covers, removed items from next to house, removed vegetation next to wood shed




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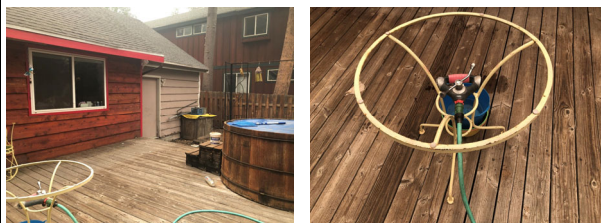
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North side of house – removed items next to house and deck, hot tub full, sprinkler for deck



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West side of house - tempered glass window, waiting on Hardie Plank, raked out good neighbor fence, staged water



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Yard – moved combustibles to lawn, staging water



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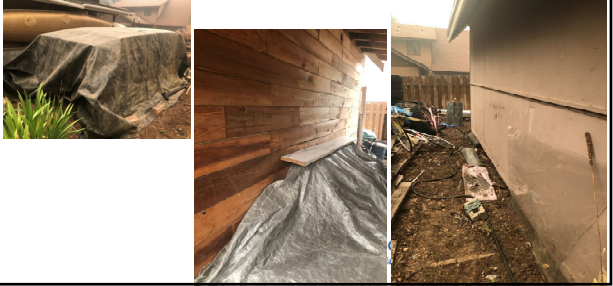
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Shed – remove or covering combustibles



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Valuables (boats, cars etc.) – cover and move to vacant lot




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Prep and be ready to evacuate early!



House wasn't challenged by  
 fire or embers  
 - No structures burned in  
 South Lake Tahoe



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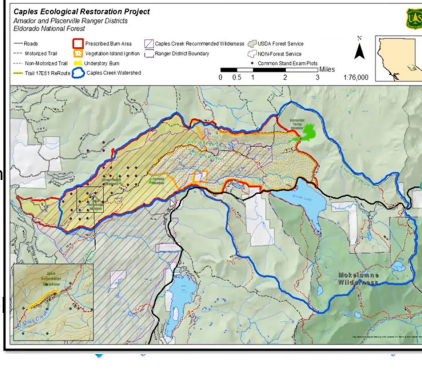
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### Many treatments on the El Dorado Natl Forest

- Caples burn  
Proposed 9,000 acres of burning
  - 4,500 acres low elevation (western 1/2)
  - 4,500 acres high elevation vegetation islands (eastern 1/2)
- 55 foot wide fuel break along northern ridge



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### Caples Project: Volunteers removed needles from base of large trees



Images from California Fire Science Consortium  
<https://www.cafiresci.org/events-webinars-source/category/caples2019?q=caples>

- Objectives:
- Improve watershed and forest health
  - Reduce hazardous fuel accumulation
  - Meadow restoration
  - Improve conditions for aspen and oak
  - Improve public safety

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### Large scale Rx fire: Caples Project

- Ignited Sept 30 2019, burned 3400 acres
  - 1070 acres Rx fire
- Oct 10<sup>th</sup> declared wildfire
  - Burned 2330 acres
  - Declaring it a wildfire meant more resources
- Review identified some mistakes in measuring fuel moisture, lack of continuity in staffing, hit with wind events, lack of resources (grant funds) for prescribed fire.



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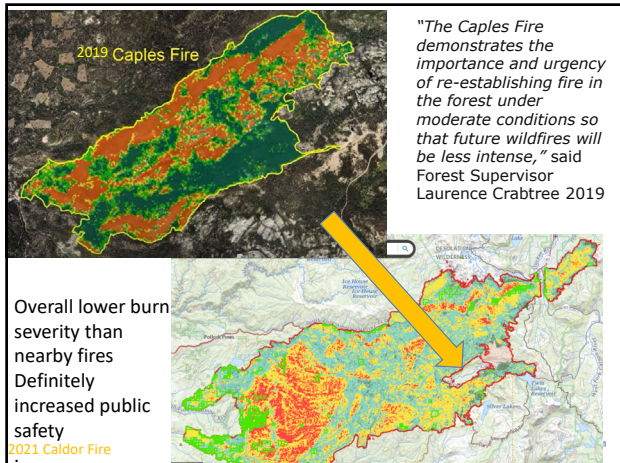
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**Suppression succeeded because:**

- 1) Huge deployment of fire fighting resources – highest priority fire in country
  - 4,451 fire fighters
  - 523 fire engines
  - 84 water tenders
  - 27 helicopters
- 2) Massive deployment of fuels reduction resources. After 2007 Angora fire burned 250 homes, agencies treated 65K acres of the 200k acres Lake Tahoe basin
  - Forest thinning — by hand and machine — and prescribed burning.
  - Cost between 2010 and 2020, \$133 million




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- 3) Homeowners did defensible space around their homes that allowed fire fighters access to fight the fire

*"Flames were stretching 150 feet high as the fire marched toward homes in Meyers....But once the fire reached parts of the forest that had seen recent thinning or controlled burns, the flames lowered to just 15 feet tall, which gave fire engines and hand crews a window to take action, stop the fire from advancing into the neighborhood and prevent homes from burning."*



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