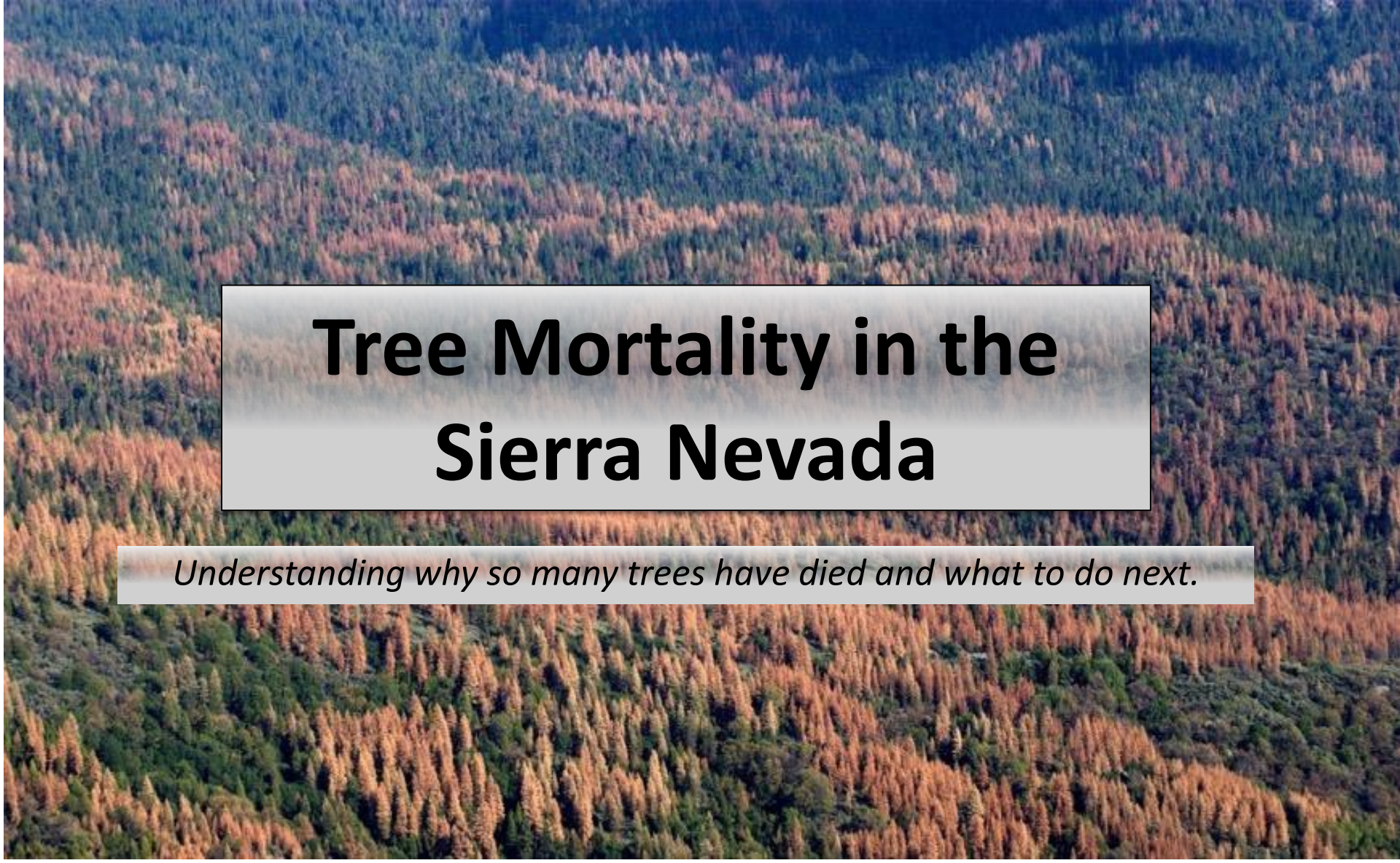

Tree Mortality in the Sierra Nevada

Understanding why so many trees have died and what to do next.

Photo by Sierra Nevada Conservancy

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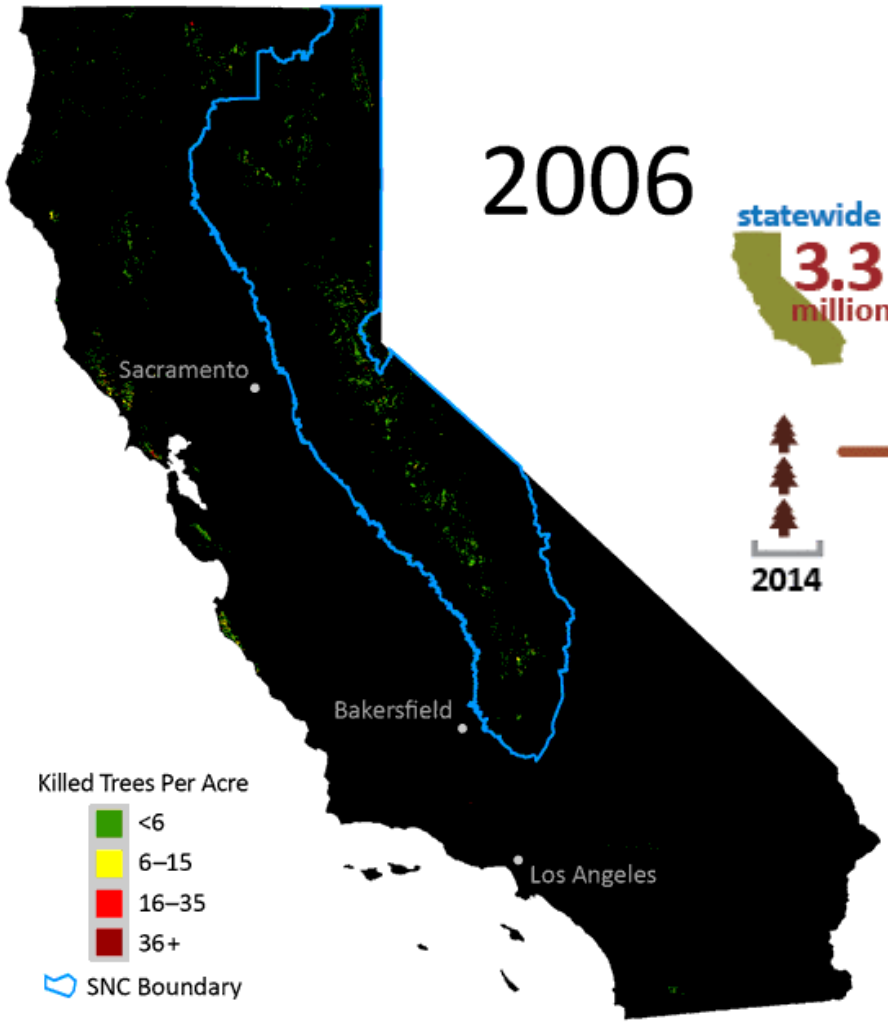
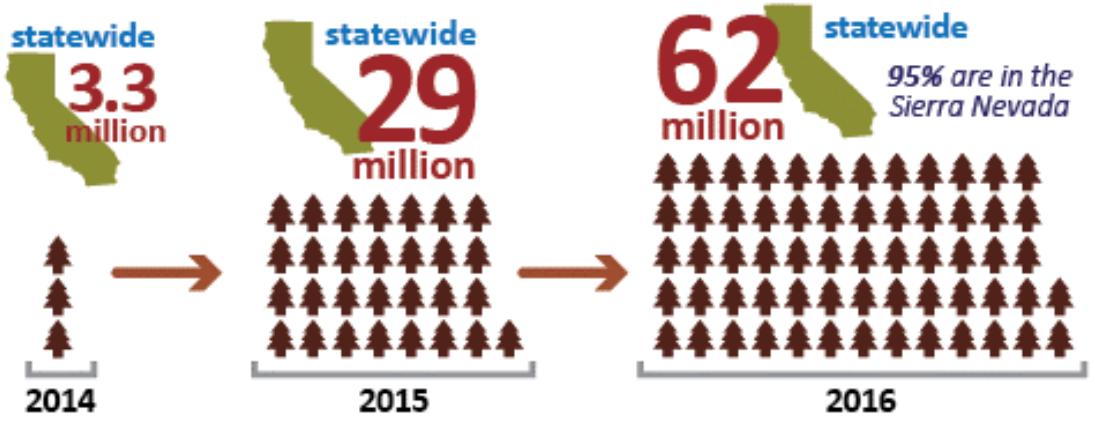
Talk outline

- Water stress and mortality
- Bark beetles as a mortality agent
- Forest succession
- Reforestation
- Replanting at the neighborhood scale

Photo by: USFS Region 5

Tree mortality throughout the state has been severe





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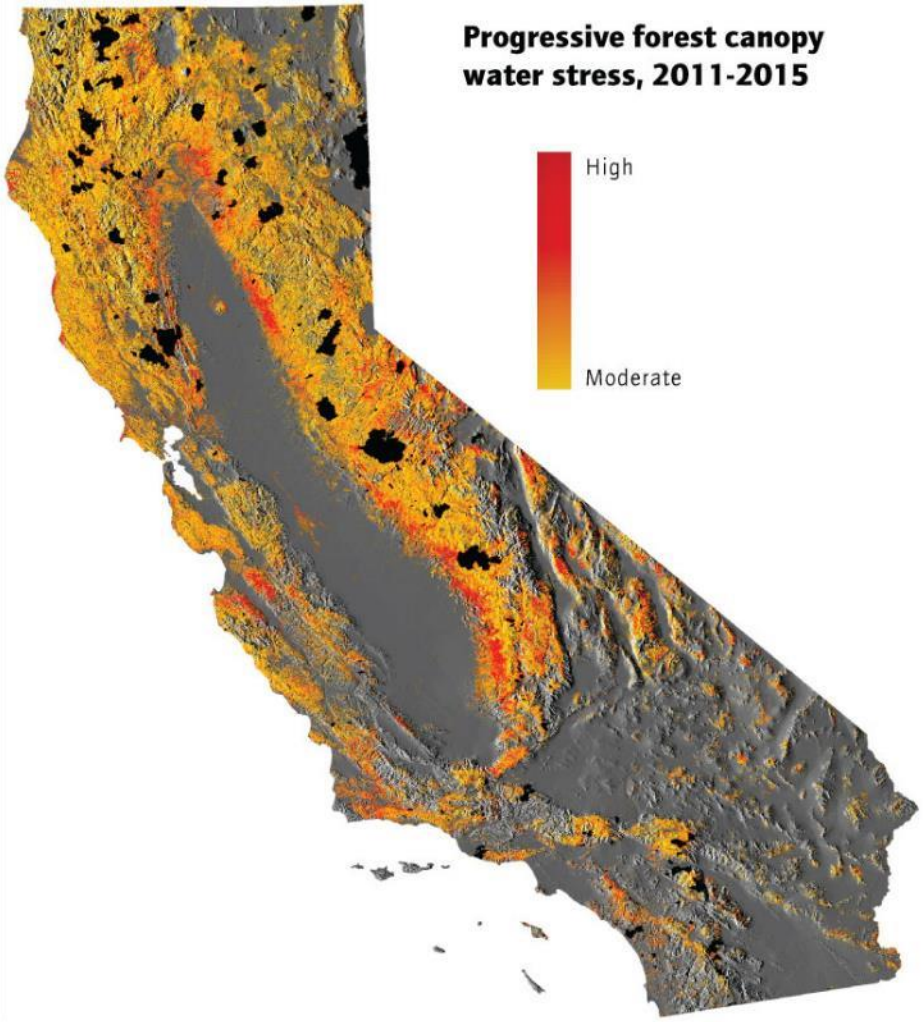
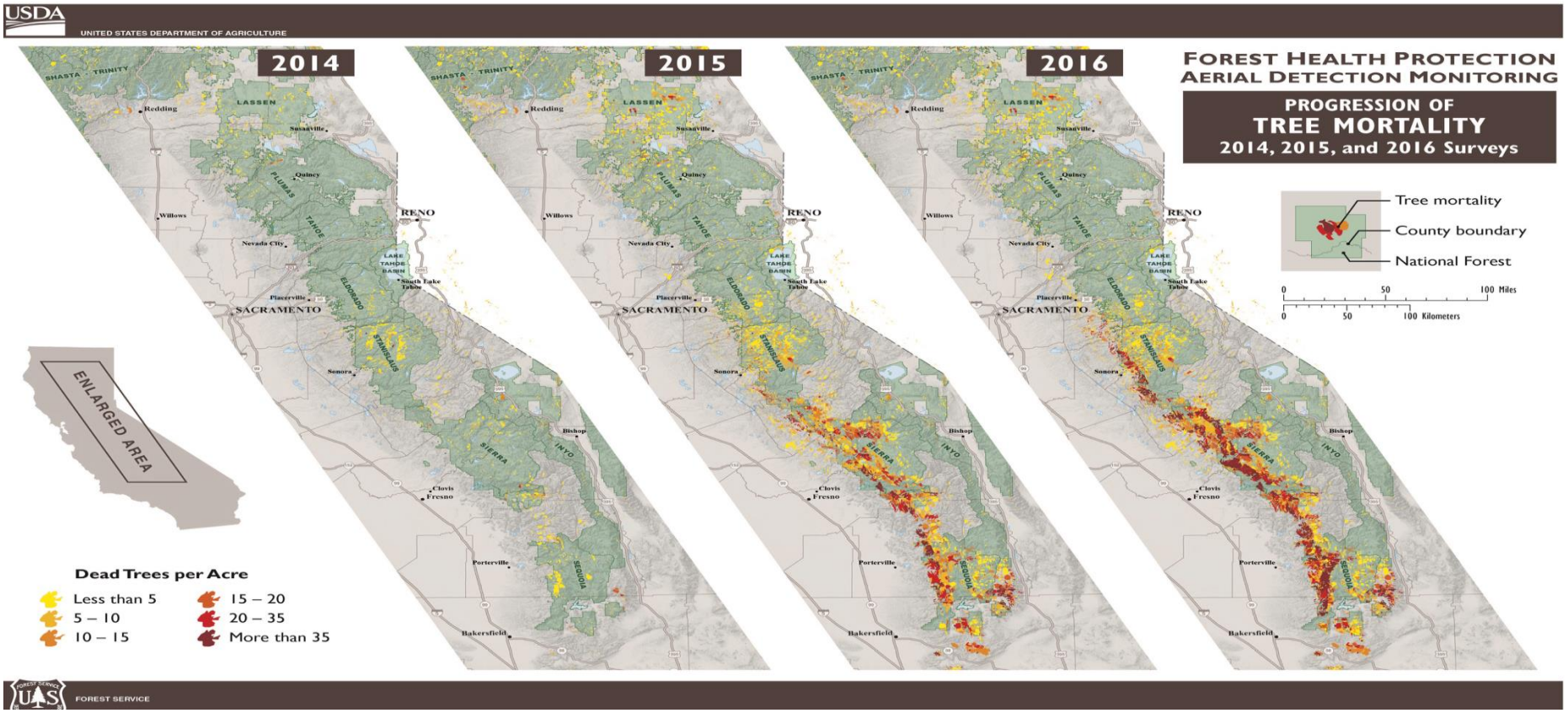
Water stress has played a significant role

- 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
- 100 years of fire suppression has led to overcrowded forests
  - Individual trees get less soil moisture when they are crowded
- Water stress weakens the ability of trees to fight off attack by native bark beetles



Tree mortality reflects drought stress



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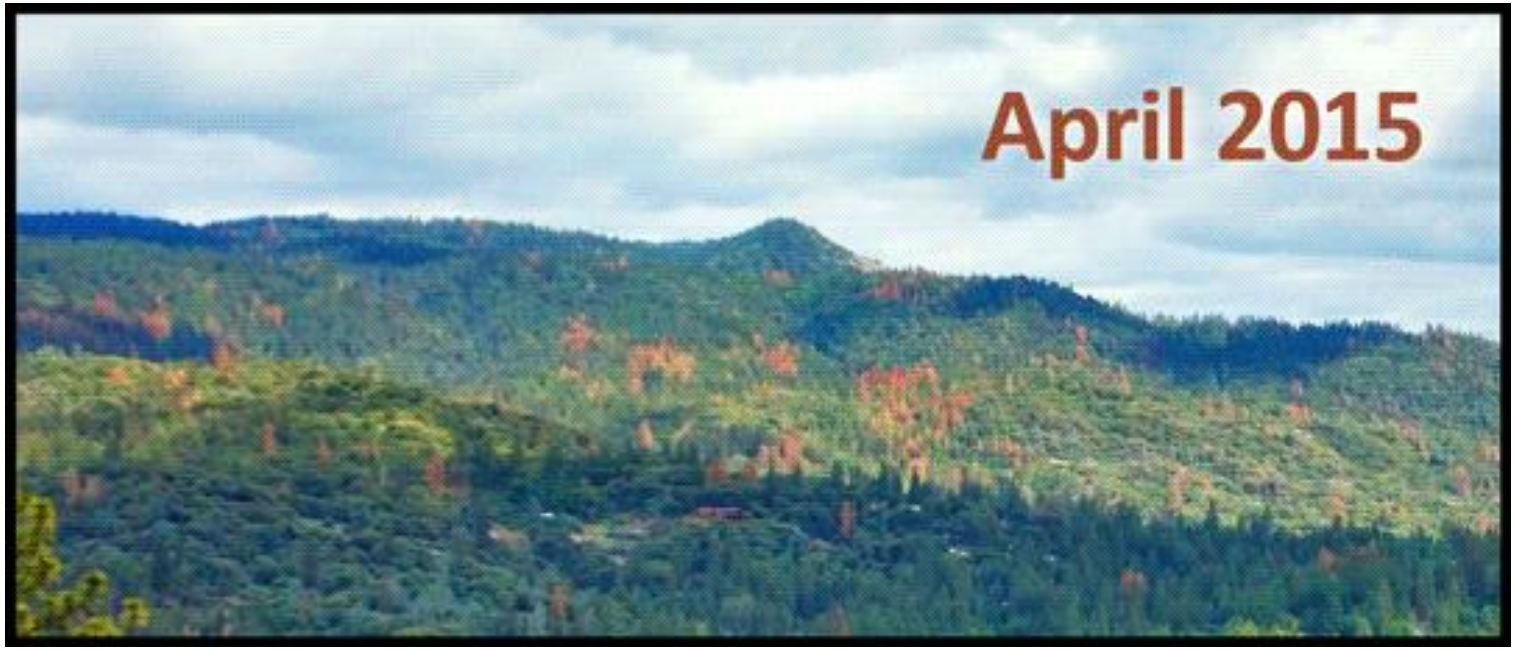
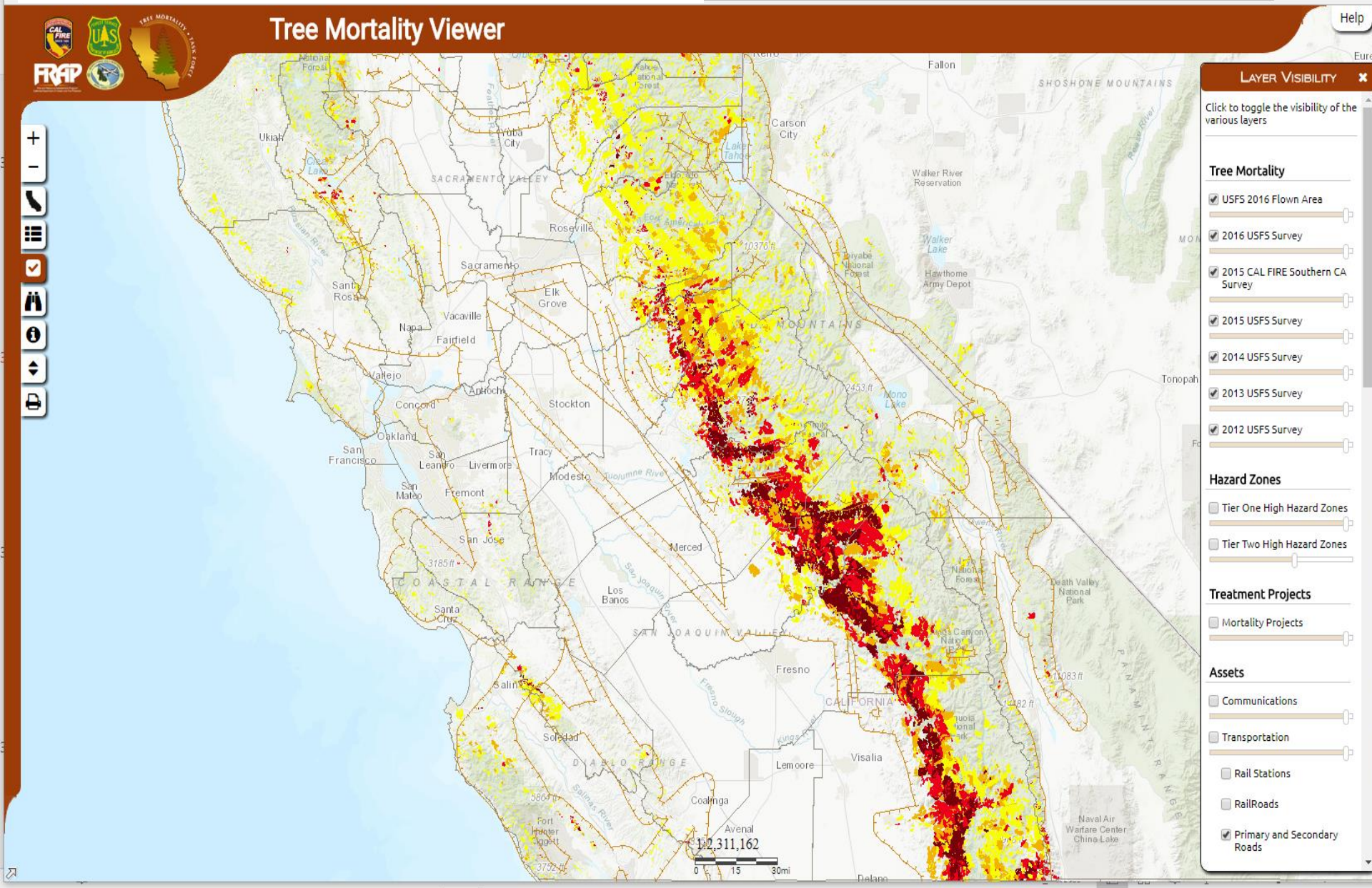


Location in Madera County before and after tree mortality began spreading.
Photos: Margarita Gordus, CA Department of Fish and Wildlife

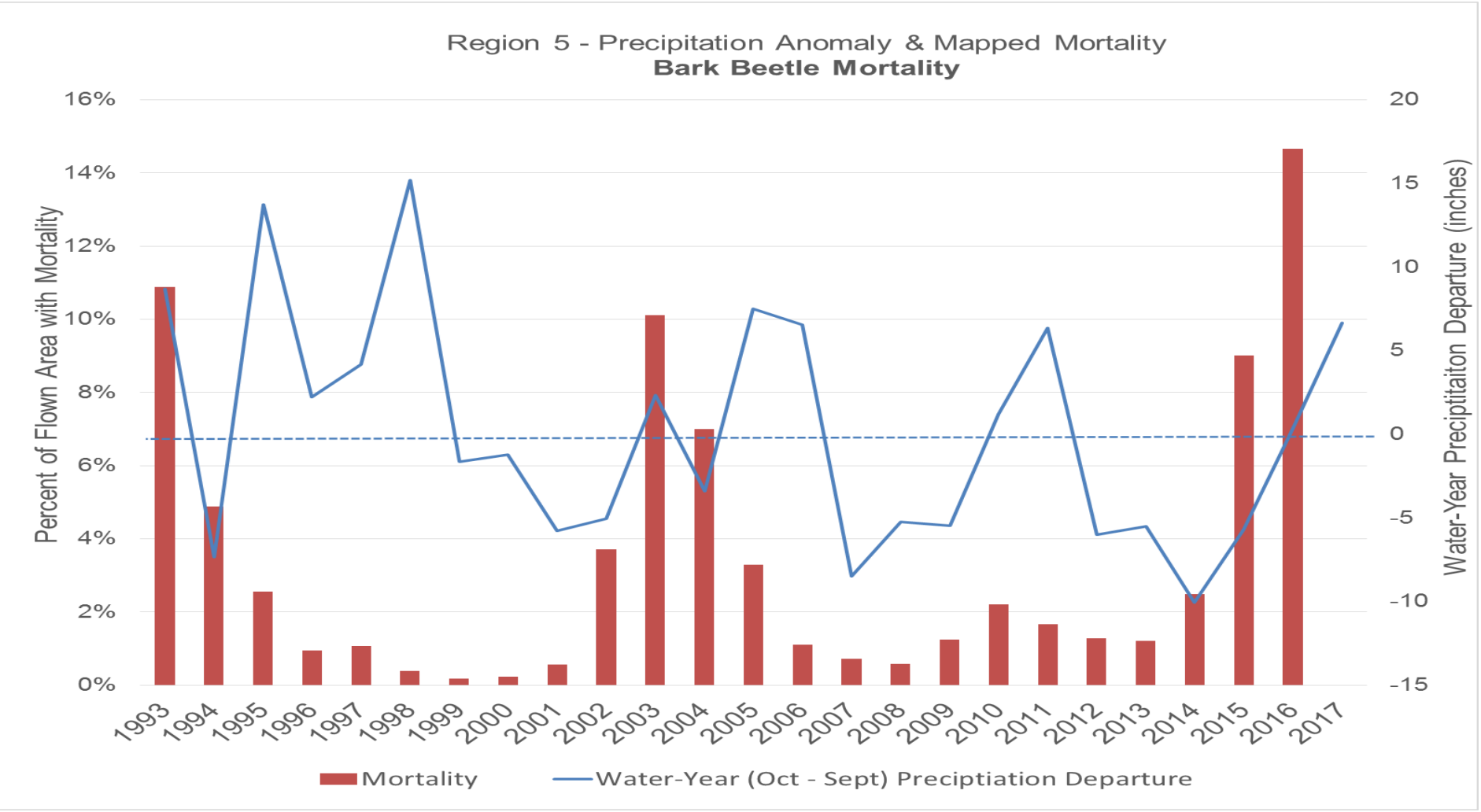
http://egis.fire.ca.gov/TreeMortalityViewer/



Mortality is being caused by native beetles

- Bark beetles are opportunistic, attacking trees weakened by other agents or factors including
  - Drought
  - Disease/infection
  - Injury (including fire)
  - Other insects
- Bark beetles affecting different trees are mostly of different species
  - Pines – western pine beetle, pine engraver, Jeffrey pine beetle
  - Firs – fir engravers
  - Cedars – most mortality is probably directly due to drought
- Bark beetles attack only mostly living trees (different beetles attack dead trees – wood borers)

Bark beetle outbreaks follow precipitation patterns



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Bark beetles are tiny insects - the size of a grain of rice

Western pine beetle has been the primary insect killing ponderosa pines

Bark Beetles attack specific locations

- Bark beetles specialize by location on the tree – top, middle, and base.
- Beetles attacking the top and bottom of pines rarely kill the tree by themselves

Pine Engravers
Woodborers

Western Pine Beetle;
Mountain Pine Beetle;
Jeffrey Pine Beetle

< 6 inches/horizontal:
- Pine engravers

Woodborers

Red Turpentine
Woodborers

Indicators of attack

- **Boring dust**
  - Mix of bark/wood shavings and frass (excrement)
- **Pitch tubes**
  - Resin accumulation at point of attack

Western Pine Beetle

(*Dendroctonus brevicomis*)

- Attacks and kills ponderosa & coulter pine
- Attacks mid trunk, then spreads up and down; may attack in conjunction with other pests
- 2-4 generations / year
- Adults fly late spring-late Oct

To feed on a western pine beetle brood, woodpeckers have stripped off the outer bark of the tree, exposing the bright-orange inner bark

Mountain Pine Beetle

(Dendroctonus ponderosae)

- Attacks lodgepole, ponderosa, sugar, and western white pines
- Generally attacks mid to lower trunk
- 1-2 generations / year
- Adults fly May-Oct

Tree trying to “pitch out” attack

Jeffrey pine beetle

(Dendroctonus jeffreyi)

- Attacks only Jeffrey pine
- Much larger beetle than the mountain or western pine beetle
- Attacks large trees mid trunk
- Emerge as early as April
- Up to 2 generations / year
- Long J-shaped galleries
- 2nd generation larvae may overwinter, emerge in Spring

Red Turpentine Beetle

(Dendroctonus valens)

- Attacks a variety of conifers, but most problematic to sugar and ponderosa pines
- Attacks low on trunk
- Creates large pitch tubes
- Not primary killer
- One generation / year is typical but the life cycle may be longer or shorter depending upon location
- In warmer parts of the state, attacks may be initiated at nearly any time of the year, although most attacks occur in the spring and summer

Pine engraver

(*Ips paraconfusus*)

- Attacks pine trees & green slash
- 1 to 5 generations / year
- Adults fly spring-fall
- Attacks pines near top of trunk; makes wishbone-shaped galleries
- **Can breed in slash and firewood left untreated**

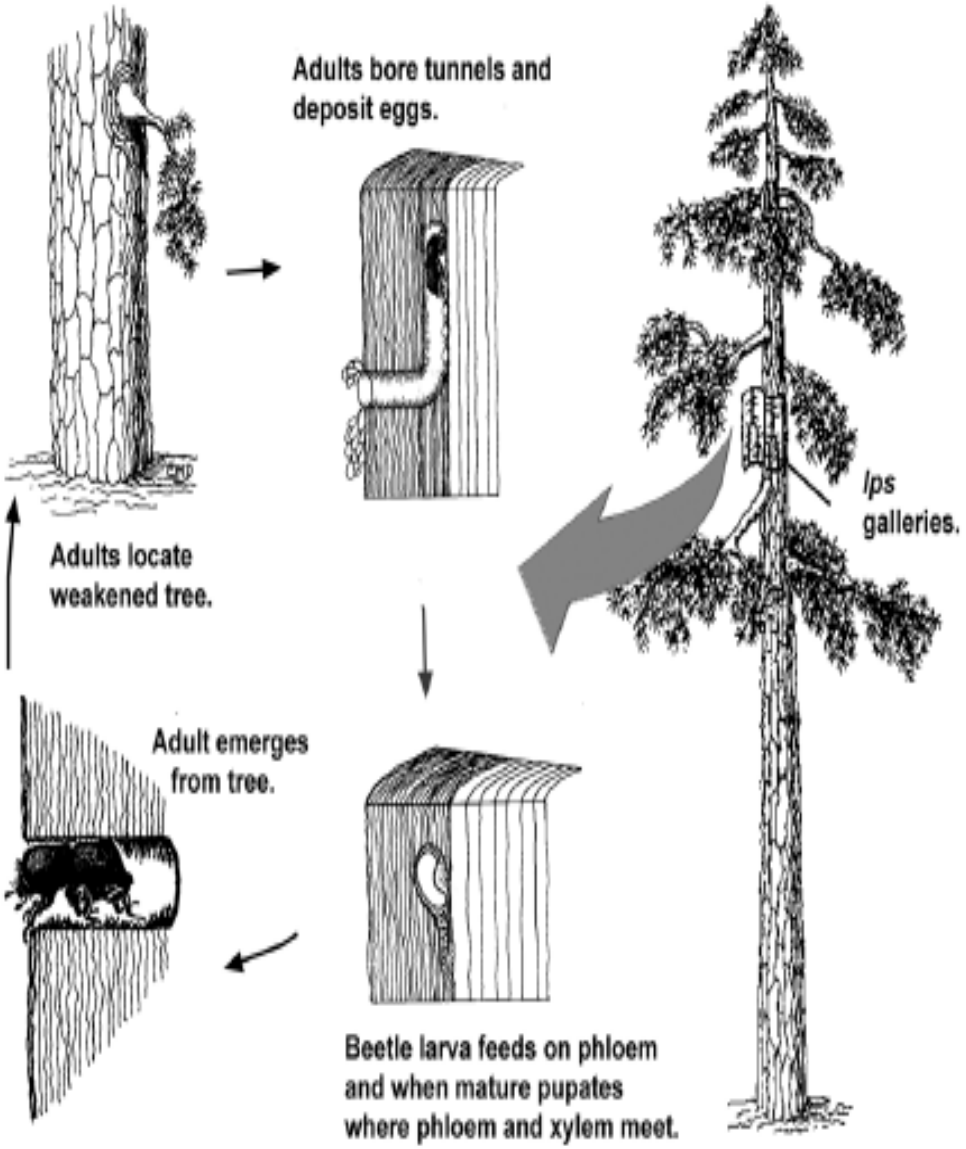
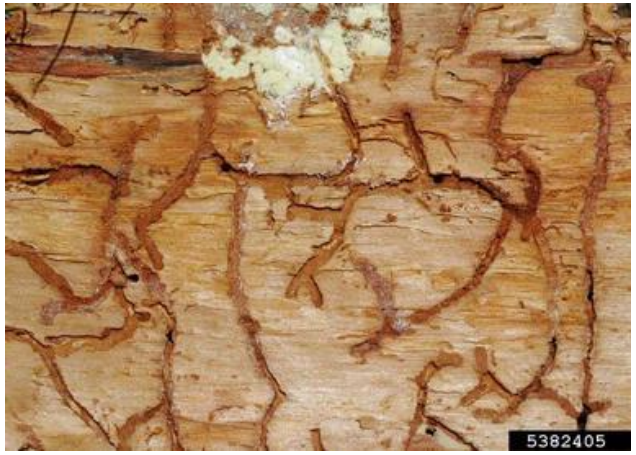


Figure 3. Life cycle of the California fivespined ips, an engraver beetle.

Fir engraver (*Scolytus ventralis*)

- Attacks white and red fir
- No pitch tubes
- 1 to 2 generations / year
- Overwinter as larvae; adults excavate deep and long, two-armed galleries across the grain of the sapwood

Each bark beetle species has a characteristic gallery pattern



Western Pine Beetle

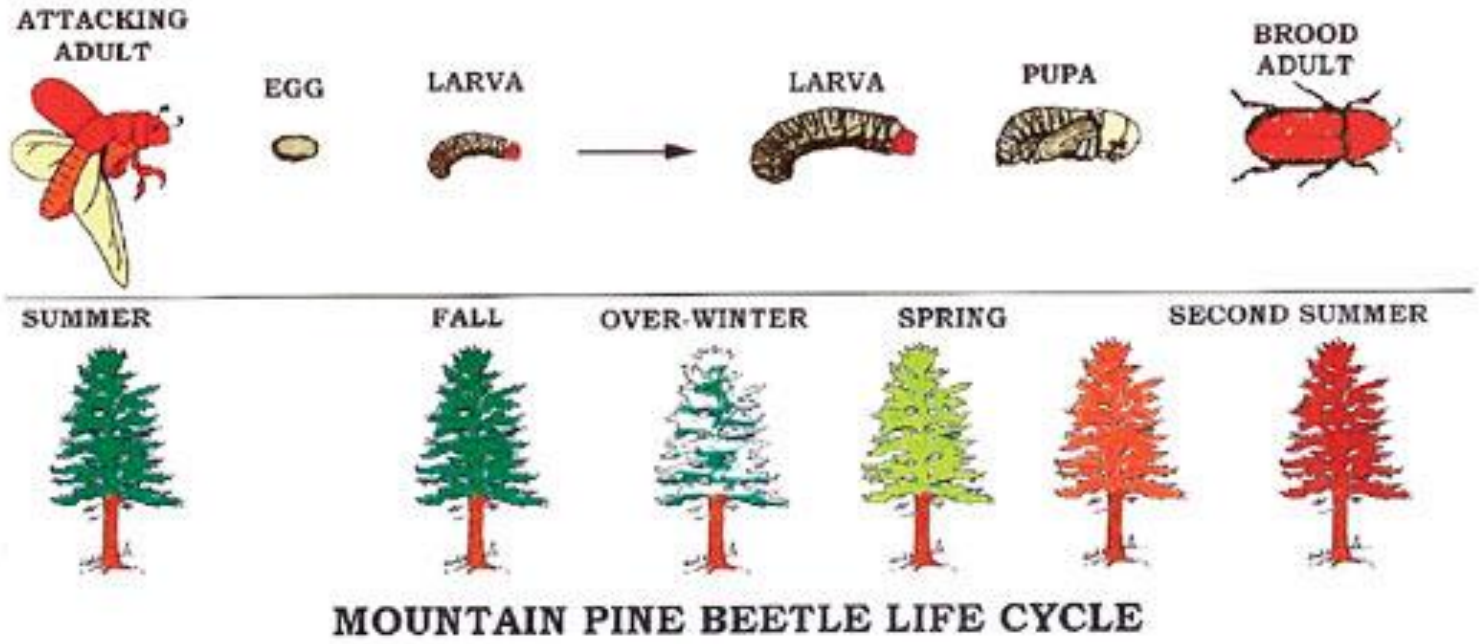
Mountain Pine Beetle

Fir Engraver

Pine Engravers

Beetle life cycle

- Beetles burrow into the bark and dig galleries to lay eggs in. This girdles the tree and kills it.



MOUNTAIN PINE BEETLE LIFE CYCLE

Western Pine Beetle produces several generations per year

- Broods hatch and fly between June through September
- Not a good time to cut, as freshly cut wood attracts beetles
- Warming temperatures can increase number of broods annually
- Thin pine stands during normal precipitation years

Forest Succession - What will the future forest be?

- Depends on living trees still on site:
- Ponderosa pine seedlings grow well only in sunny conditions and do not tolerate shade, but seedlings may be found in gaps created by canopy trees dying, sprout on bare mineral soil
- In shade, incense cedar and white fir, often growing in understory. Sugar pine and Douglas-fir may be found in intermediate conditions
- Oaks may be doing well where nearby conifers have died and be taking over where other trees have been removed
- Fir and cedar already in the understory likely to take over

Pines may need to be planted to recover in some locations

Just because pines have been killed by beetles doesn't mean they are not well suited for replanting

- Pines are well adapted to the Sierra Nevada
- Beetles typically don't attack trees under five inches in diameter
- Historical data and reconstruction studies in the Sierra indicate mixed-conifer forests were highly clustered with **gaps** where sun loving pines grew

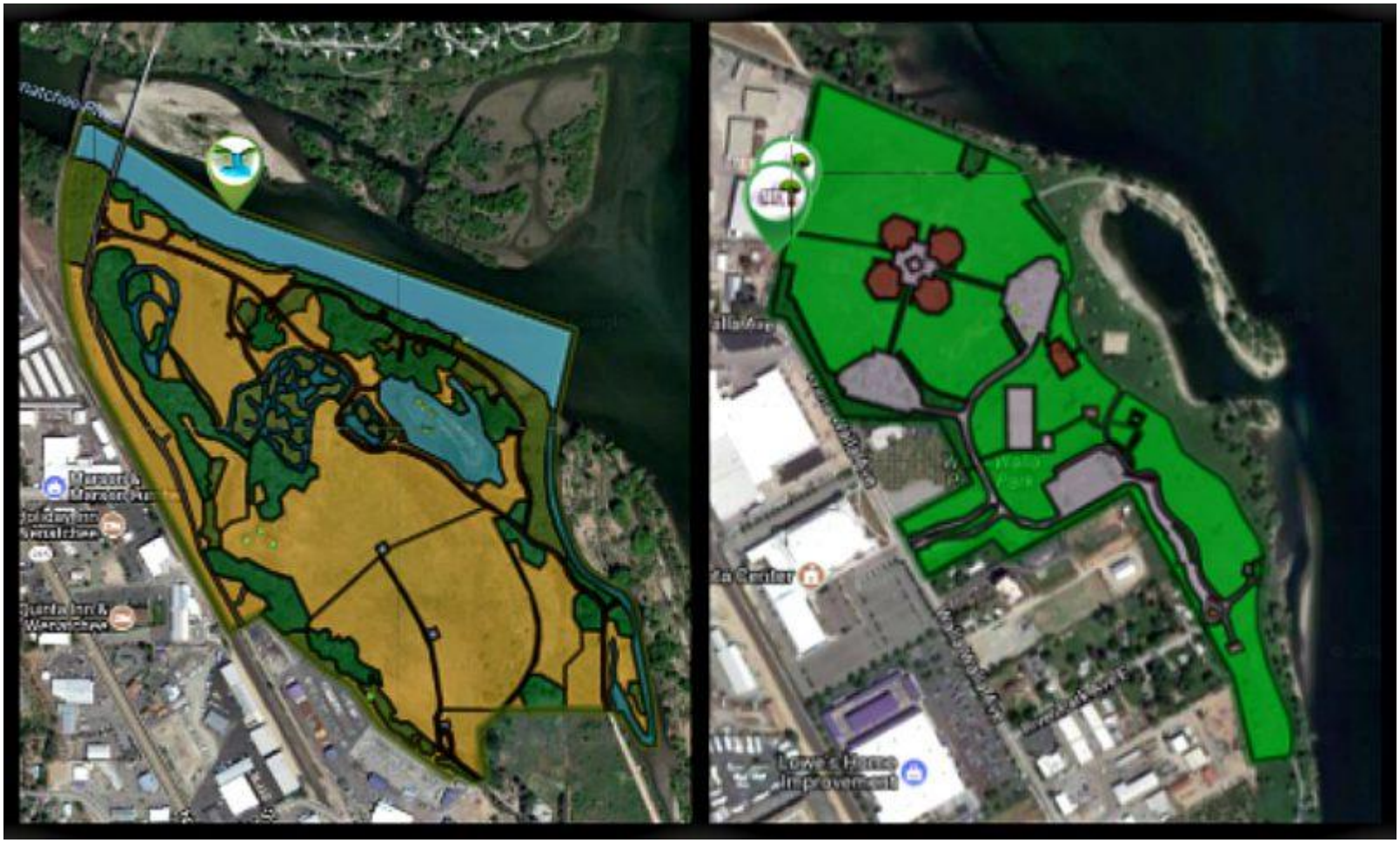
Ackerson Meadow, Tuolumne County
(1941) Old growth stand of ponderosa pine
UC Library, Digital Collections

Replanting at the Neighborhood Scale - Process

- Assess your landscape
  - See what is left after tree removal. Survey your property, marking where you find living trees and identify by species and size.
- Nurture existing trees
- Replant
- Maintain

Mapping your habitat

http://content.yardmap.org/



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Do I need to replant?

- Want the landscape to mimic a fire having moved through it every 10-35 years
- You can easily ride a horse in between trees
- Canopies don't touch
- Promote diversity of species and age classes
- Promote drought tolerant species

Nurture existing trees

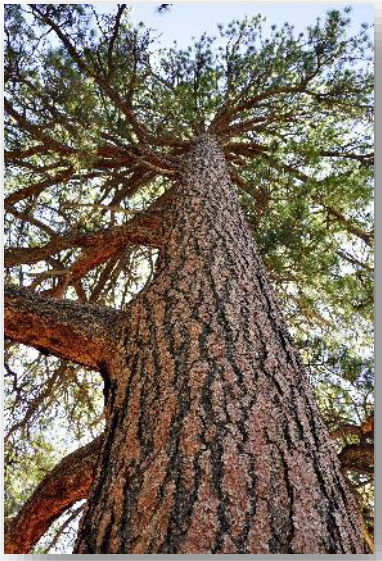
- If you have a significant number of trees left, you may not need to replant.
- Thin trees so that available sun and soil moisture is focused on the healthiest trees.
- Water where trees are receiving more sun to reduce stress.
- Clear out competing shrubs, grass and other vegetation.
- Digging up natural seedlings and moving them is not often successful.

Replanting

- Spacing – at least 10-14 feet apart.
- Defensible space – Trees and flammable vegetation should be kept at least 5 feet from the home and thin within 30 feet.
  - 30-100 feet zone, trees should be widely spaced so their crowns don't touch when mature. Trees can fill in to a more natural looking forest 100 feet from the home.
- Power line clearance - Trees should be planted at least 10 feet from power lines and other utility lines.
- Road right of way - Trees should not be planted within the road right away.
- Sun availability – Plant pines where there is now a lot of sun. Future solar energy generation should also be assessed before planting.
- Views – Consider future views and don't plant tree that will block them.

Replanting tree choices

Native trees - Native conifers are adapted to our climates. Due to climate change, choosing trees that were grown from seed stock collected from a slightly lower elevation may hedge against warmer temperatures in the future.



Seed Zones of California

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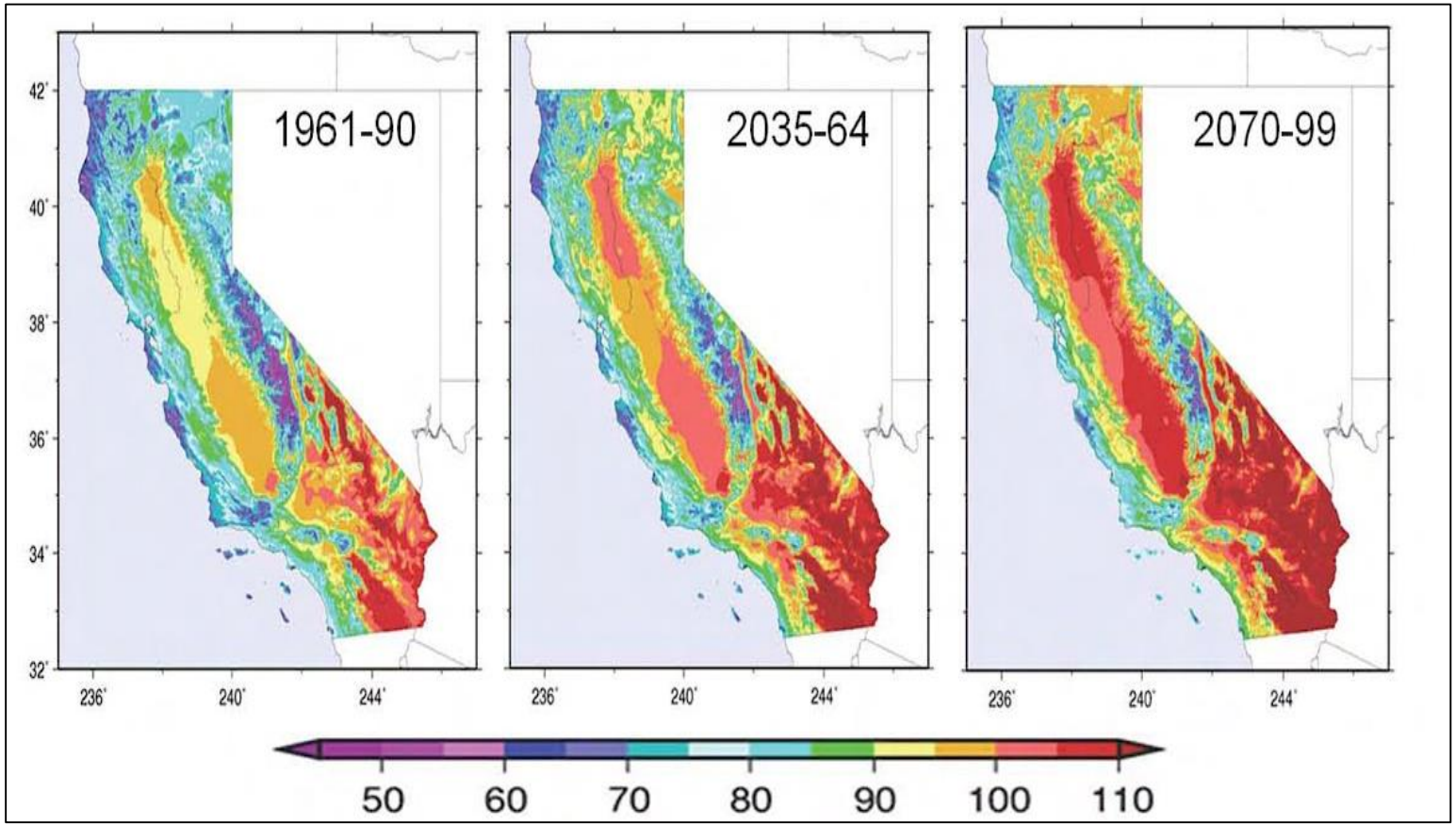
Replanting tree choices

Landscape trees – Trees other than conifers can also be planted. This could include native and nonnative species.

- These can provide color, aesthetic or other values.
- Important to choose the most appropriate site for the tree.
- Choose a tree that is best adapted to the local growing conditions and will thrive in the area with the fewest pest problems.
- Important to choose plants that are not invasive or weeds.

Choosing the right landscape trees

- Species suited to your location will change with a warming climate



https://selectree.calpoly.edu/

Urban Forest Ecosystems Institute

Skip to content

Search by Name

Search Trees by Characteristics

Search Help

About SelecTree

Right Tree Right Place

Utility Precautions

Browse securely

SelecTree: A Tree Selection Guide

Search for trees Enter a tree name Search

- Tree Characteristics Glossary
- Search Help

> Do not be very upright in your dealings for you would see by going to the forest that the straight trees are cut down and the crooked ones are left standing.
>
> — Chanakya

Pittosporum undulatum

Fairly drought resistant...

Photo by M. Ritter, W. Mark, J. Reimer and C. Stubler

~ you can search for a tree by desired characteristics!

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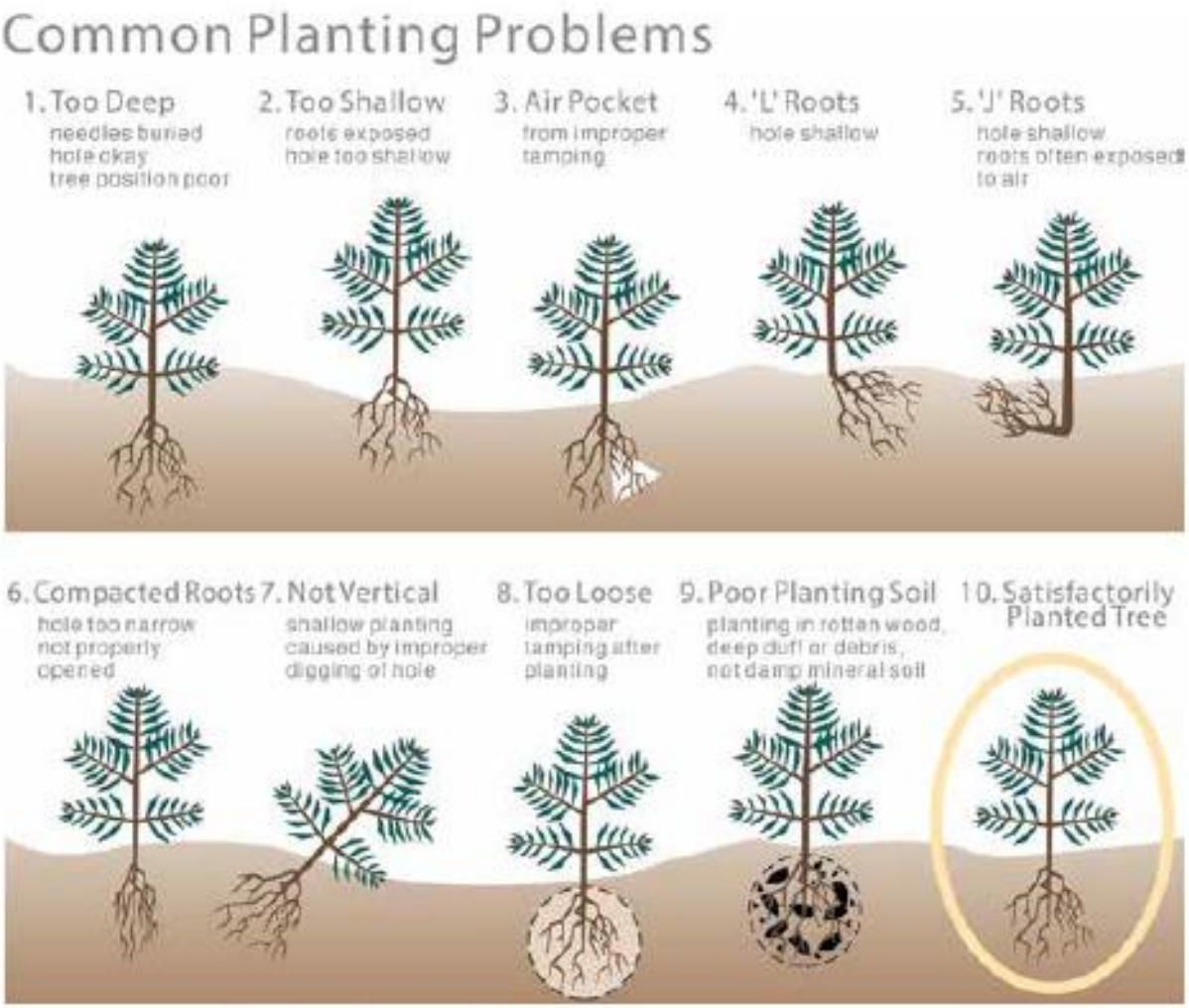
Replant – size options

Saplings: Most expensive. Requires soil amendments and weekly waterings during the dry season for the first few years. Best for select locations near the home for visual screening or wind breaks.

Container grown seedlings: Much less expensive. May require some care including watering during the dry season. May be held in pots until ready to plant.

Oaks: Container sized plants can be expensive. Least expensive option is starting by seed. Gather acorns locally in the fall and plant immediately. Germination success can be high if done right.



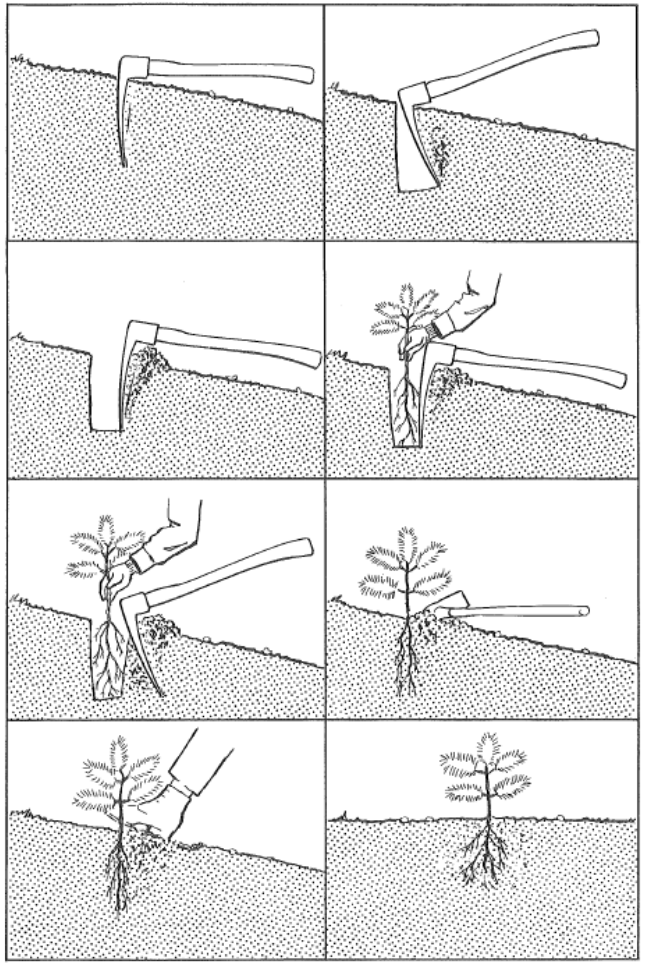


Figure 18. Steps in tree planting, using the western planting tool.

Buying Trees

- For small scale replanting
  - Local nurseries
- For larger plantings
  - El Dorado County Resource Conservation District has partnered with the USFS nursery in Camino, CA
    - 200 seedling minimum
    - Orders must be received by Oct 1 each year for Sugar pine, and Dec 1 for all other species
    - http://www.eldoradorcd.org/nodes/info/reforestation.htm
    - (530)295-5630

Maintain trees

- Amount of maintenance will vary with tree type, size, location and local conditions.
- Keep newly planted trees well watered during the growing season. Many trees will need to be watered for the first couple of years or until established.
- Mulch
- Staking – depending on the size and type
- Clear competing vegetation
- Prune – only critical branches

BE WATER-WISE. IT'S EASY. HERE'S HOW.

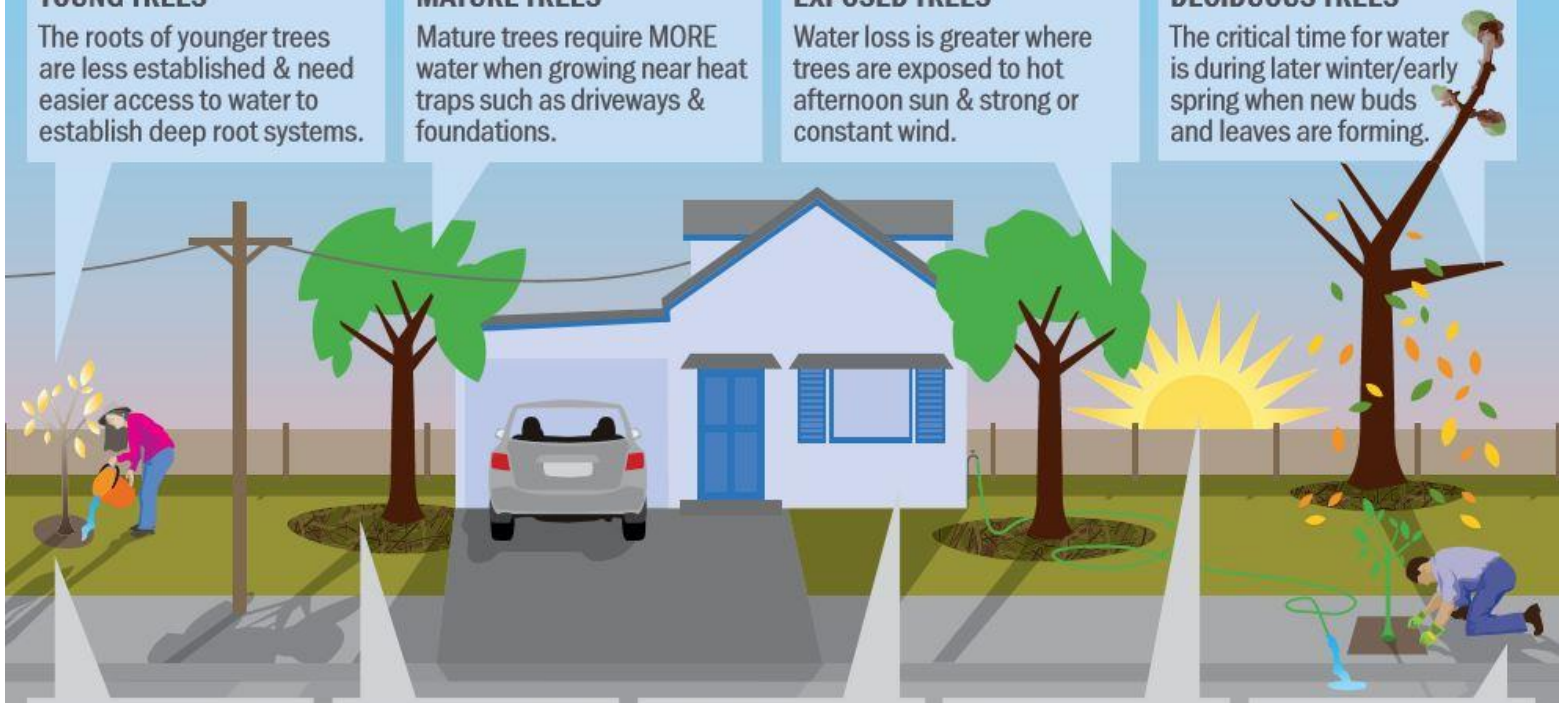
Trees and water are both precious resources. Trees make our houses feel like home–they also improve property values, clean our water & air, and even make our streets safer & quieter. When we water wisely and maintain our trees carefully, we enjoy a wide range of benefits at a low cost and with little effort.

YOUNG TREES
The roots of younger trees are less established & need easier access to water to establish deep root systems.

MATURE TREES
Mature trees require MORE water when growing near heat traps such as driveways & foundations.

EXPOSED TREES
Water loss is greater where trees are exposed to hot afternoon sun & strong or constant wind.

DECIDUOUS TREES
The critical time for water is during later winter/early spring when new buds and leaves are forming.



THE RIGHT AMOUNT
Water young trees twice per week (about 5 gallons) & mature trees once per week in several places (the equivalent of 1 to 1.5 inches of rain).

IN THE RIGHT PLACE
Water the "drip zone," area directly beneath the foliage & shaded by the tree. Also, add mulch to lower soil temperatures & reduce water evaporation.

CONSERVE & RECYCLE WATER
Inside: Place buckets in the shower to collect warm up water. Recycle water from the dehumidifier, collect air conditioning condensation, & "save a flush" to conserve. Outside: Convert irrigation systems to drip, low-flow or micro spray & fix leaks.

THE RIGHT TIME
Water early in the morning or after the sun has set, as this is when trees replace the water they've lost during the day. Also less water is lost to evaporation at these times. Mulching your tree will also keep soils warmer in winter & cooler in summer.

DON'T WASTE WATER
Water should soak into the ground rather than running off into the drain.

THE RIGHT WAY
During drought, water directly with a hose or 5-gallon bucket.

THE RIGHT DEPTH
Deep watering helps deep root growth & healthier trees.

THE RIGHT CHOICE
Plant native or drought resistant tree species that require less water. Choose trees over lawn, as trees are a long-term investment.

Deep Watering Mature Trees

Water at the drip line and a foot beyond

Think of your soil as a dry sponge

Water SLOWLY, soaker hose works well

Water for a long time and very infrequently, 2-3 times from spring to summer

Landowner assistance programs

- USDA Natural Resources Conservation Service - Environmental Quality Incentive Program (EQIP)
- Farm Services Agency
- Your county Tree Mortality Task Fore
- CalFire - California Forest Improvement Program (CFIP)

Local Task Forces

- El Dorado County Fire Safe Council for free chipping: http://www.edcfiresafe.org/programs-grants-2/chipper-program/
- Community Development Services, Housing Community and Economic Development Program: El Dorado County 530-621-5159 Assistance for low income seniors

Acknowledgements

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Presentation

The presentation was developed by:

- Susie Kocher and Scott Oneto, UCCE
- Sarah Robinson, Master Gardener, El Dorado County