

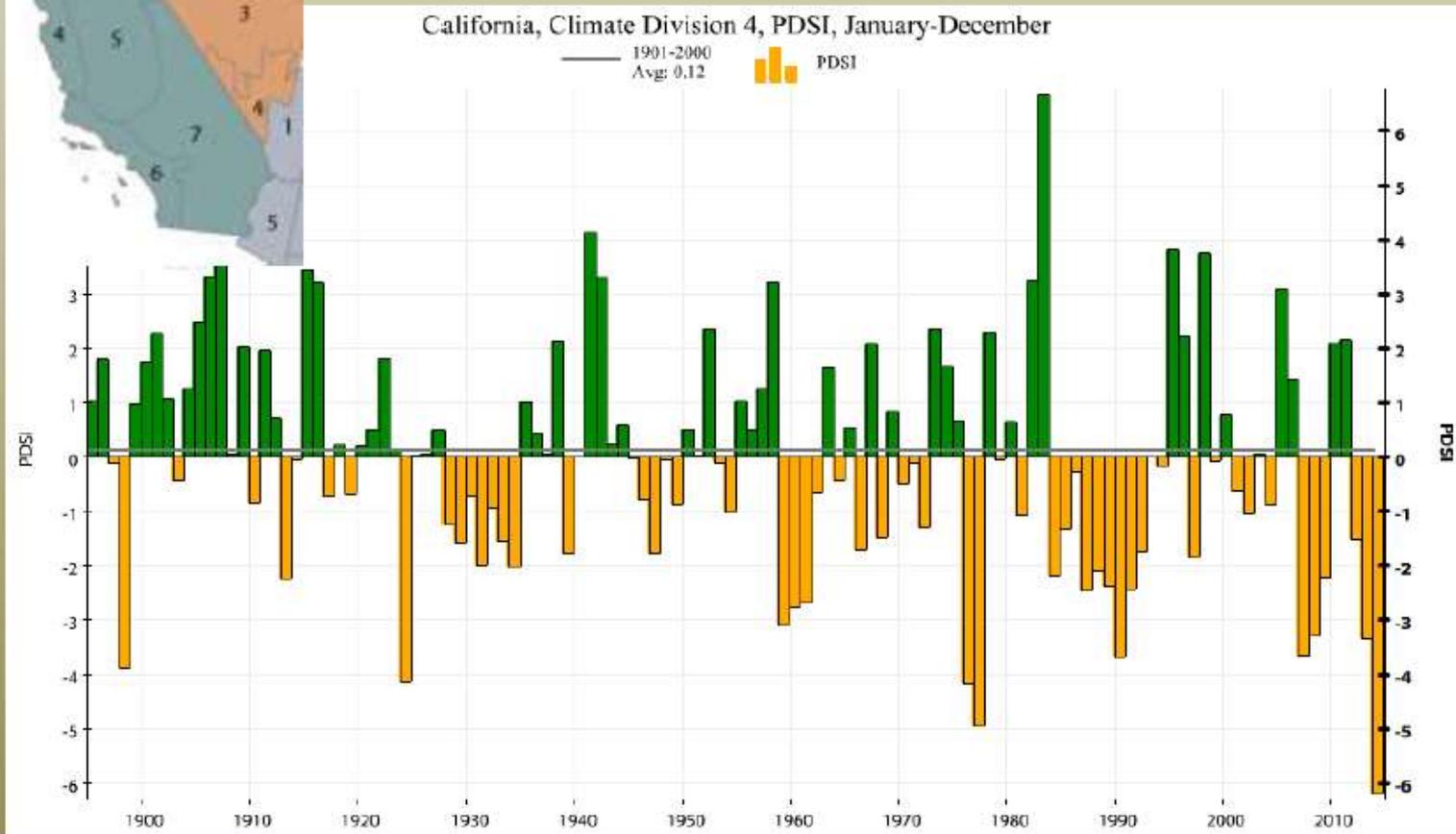


Pines, Drought, & Bark beetle complex in Mariposa and Madera Counties

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South Sierra Shared Service Area

How bad is the drought?

PDSI: Palmer Drought Severity Index is a measurement of *dryness* based on recent precipitation and temperature.



Bug kill in the southern Sierra

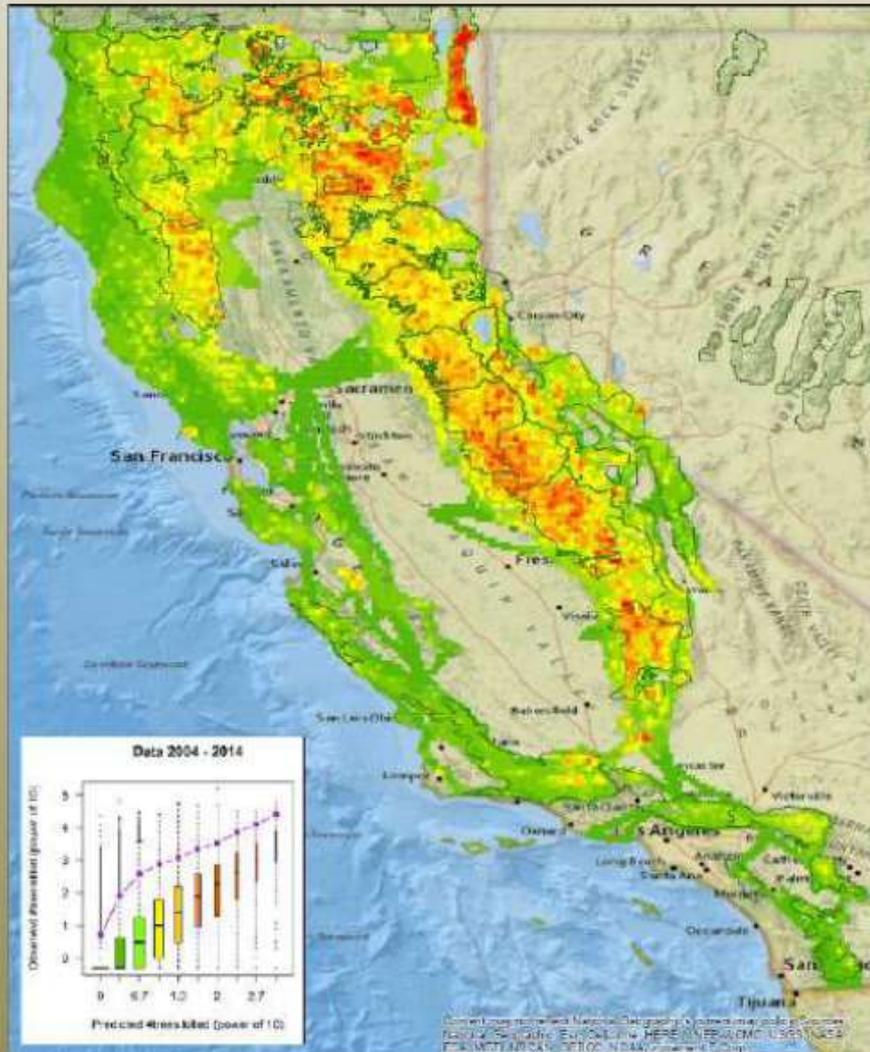


- Tree mortality has been steadily increasing across the Sierra and Sequoia NFs over the last several years
- Large stands of dead trees are becoming more prominent



Slides courtesy of Tom Rolinski, USFS Meteorologist, Riverside

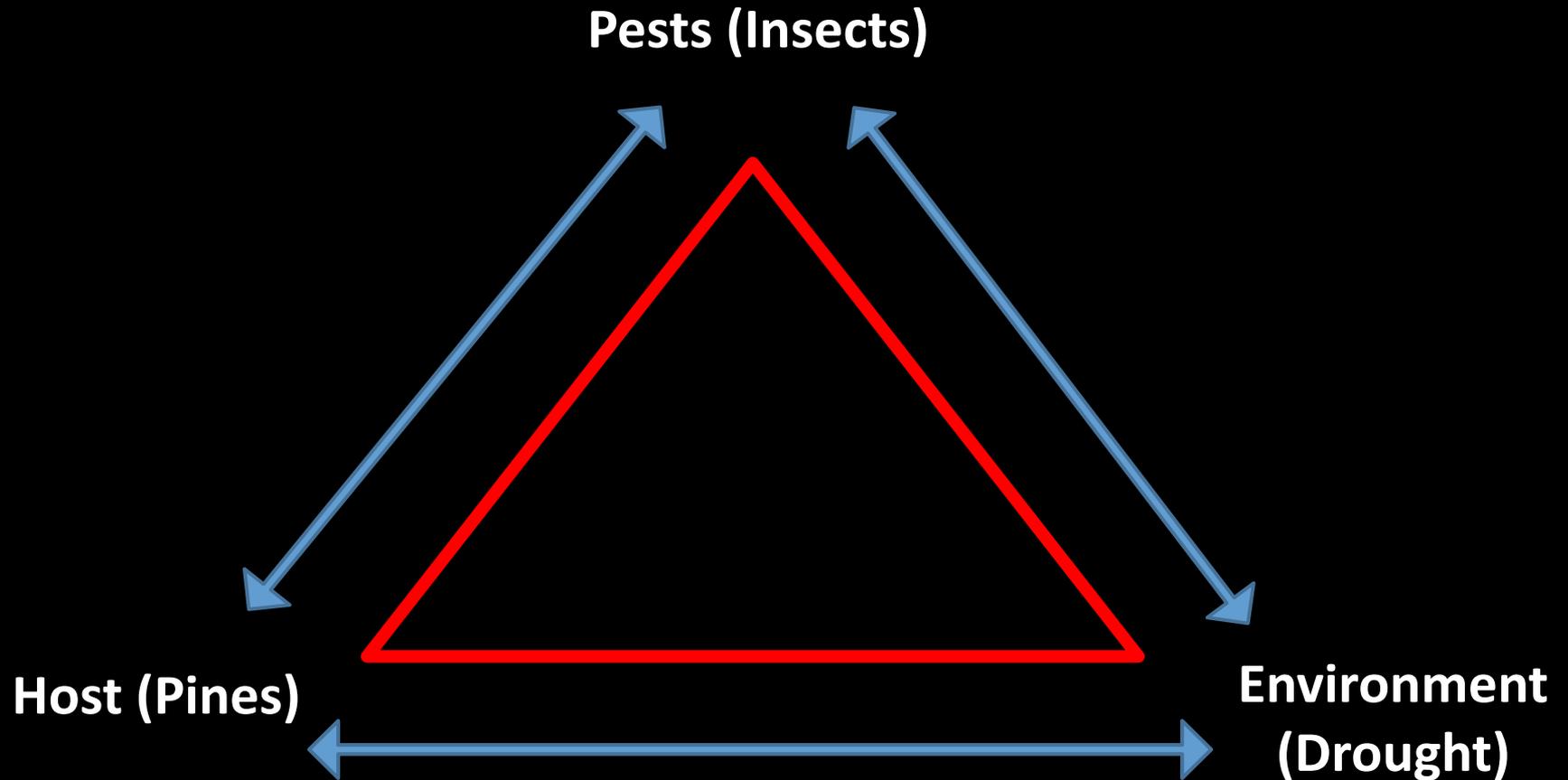
Predicted Tree Mortality for 2015



- Over 2 million trees died from bark beetles across 820,000 acres in 2014, which is double the acres with mortality from 2013.
- A dramatic increase in tree mortality is anticipated this year.

Slides courtesy of Tom Rolinski, USFS Meteorologist, Riverside

Pest Complex



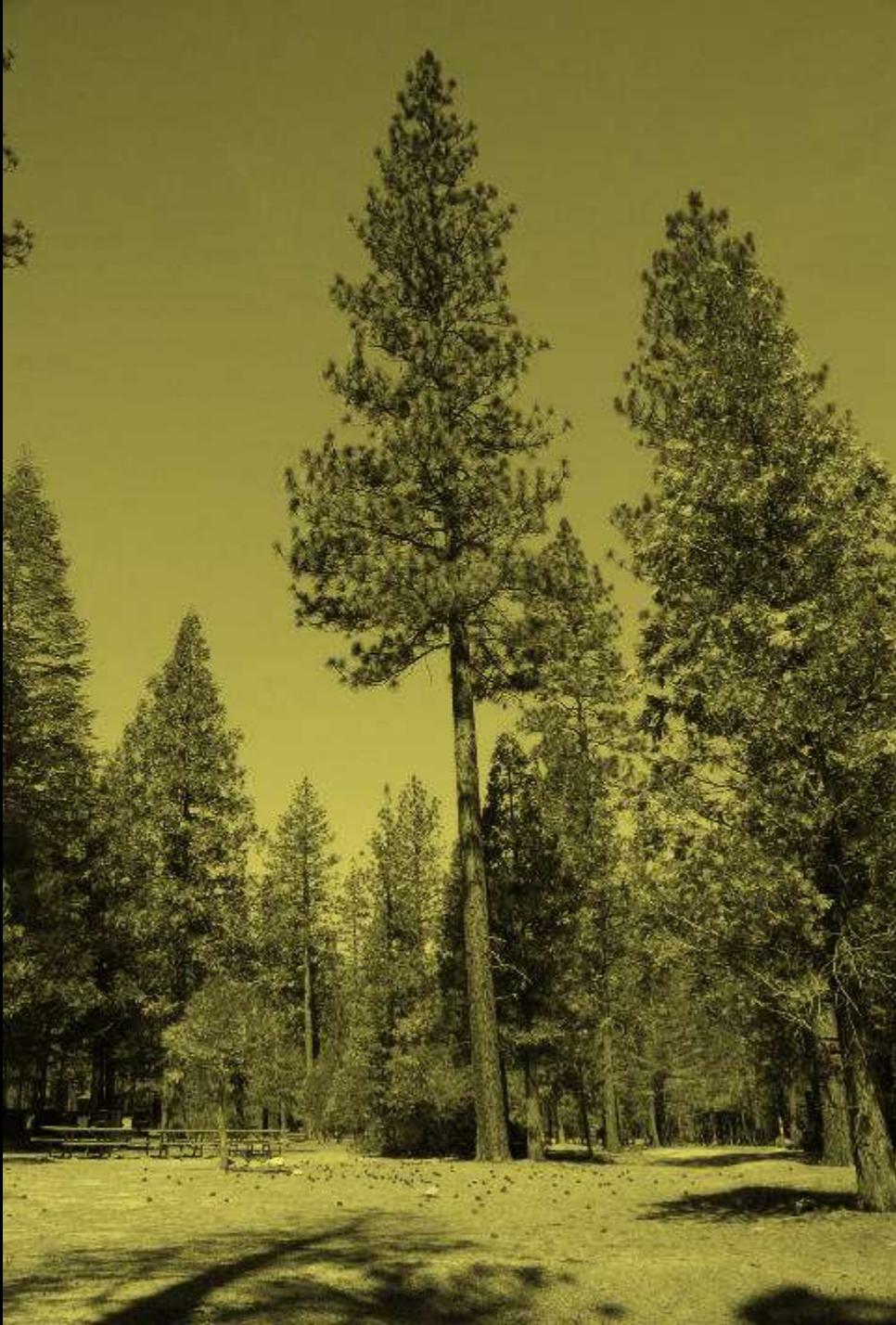


Pine Engravers
Woodborers

Western Pine Beetle
Woodborers

< 6 inches/horizontal:
• Pine engravers

Red Turpentine
Woodborers



Dead tree:

- Woodborers
- Ambrosia Beetles
- Pouch Fungus
- Ants
- Termites
- Conks

Bark Beetles: General Biology

Hosts: pines, firs

- HOST SPECIFIC
- Typically prefer trees bigger trees to protect brood
- Select diseased/injured/weak trees
- *Attacks associated with site conditions (EX: tree density, microclimate)*
- Grouped/single mortality pattern



Natives

Bark beetles are *opportunistic*, attacking trees weakened by other agents or factors:

- **Disease infection**
- **Injury (including fire)**
- **Other insects**
- **Drought**

Western Pine Beetle



Photos courtesy: William Ciesla, USDA Forest Service

How Bark Beetles Cause Tree Mortality

- ⌘ **Invade the bark of living trees**
 - ⌘ Colonize, mate, and reproduce in phloem
 - ⌘ Feeding girdles a tree
- ⌘ **Introduce fungi**
 - ⌘ Possibly helps overcome tree defenses
- ⌘ **Able to kill trees**
 - ⌘ Often stressed trees in endemic levels
 - ⌘ Healthy trees at epidemic levels



Host Colonization

- Facilitated through volatile chemical communications (pheromones)
- Aggregation pheromones**
 - Recruit other male and female beetles to “**mass-attack**”
- Anti-aggregation pheromones**
 - Tell other beetles habitat is full
- Switching mechanism
 - Adjacent trees attacked
 - Can lead to grouped mortality



Indicators of Attack - Galleries

Pine engraver



Western pine
beetle



Indicators of Attack

↳ Boring dust

- ⌘ Mix of bark shavings and frass
- ↳ Reddish/brown

↳ Pitch tubes

- ⌘ Resin accumulation at point of attack

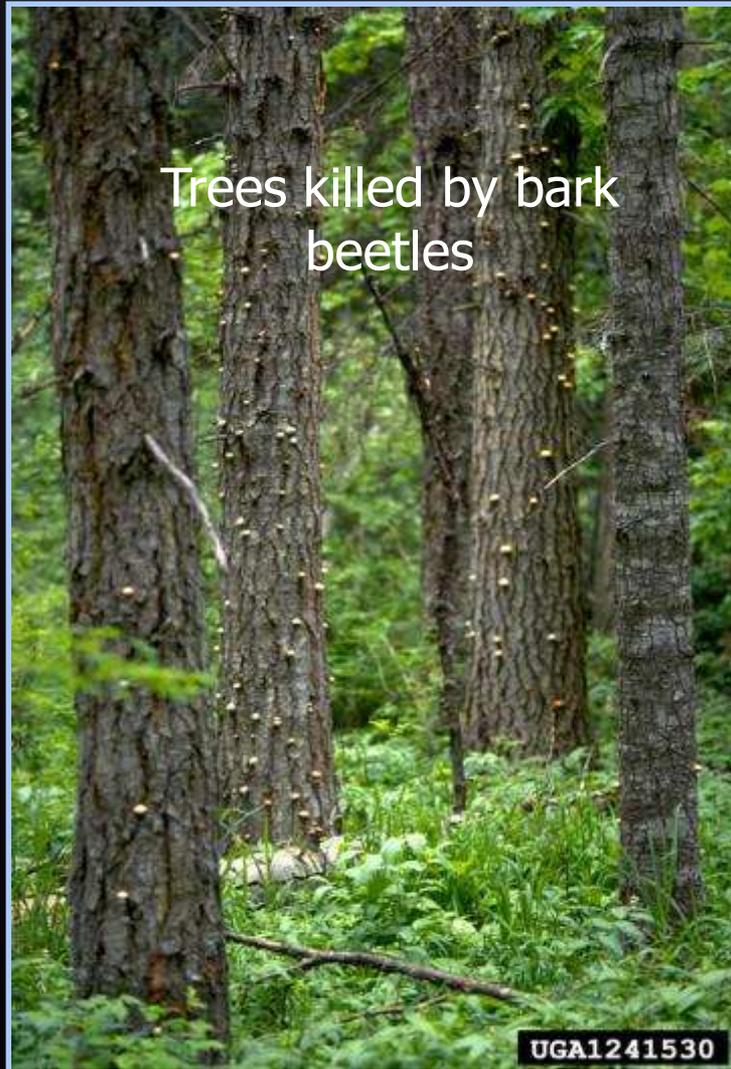


Indicators of Attack from a Distance

- & Fading foliage
- & Grouped mortality
- & Woodpecker foraging



Pouch fungus, *Cryptoporus volvatus*



Management Options for Pines

- *Silviculture/cultural*
- *Chemicals (only studied effective)*
- *Semiochemicals*
- *No action*

General Bark Beetle Management

Stand & Landscape Level: Prevention

☞ *Promote diversity*

☞ Species Diversity

- ☞ Selective tree removal
- ☞ Species/spatial location to plant

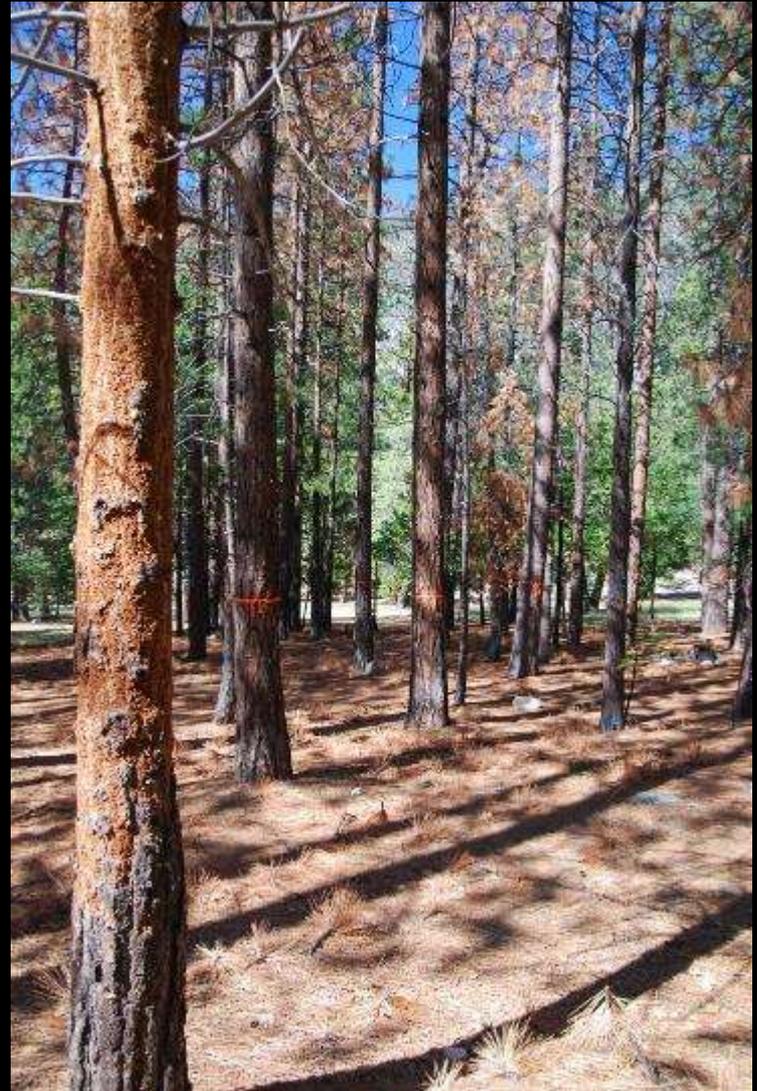
☞ Vertical diversity in age/diameter classes

- ☞ Patch cuts/group selection can promote regeneration, age diversity
- ☞ Bark beetle-caused mortality often contributes to diversity



General Bark Beetle Management = Basic Forestry Practices

- ⌘ Promote *healthy* trees resilient to bark beetle attack
 - ⌘ Plant *proper tree species* for site
 - ⌘ *Minimize damage* to trees
 - ⌘ Mechanical damage, herbicide damage, root compaction, etc.
 - ⌘ Ensure good *growing space*
 - ⌘ Reduce competition
 - ⌘ Watering/irrigation can help
 - ⌘ *Prune* DM infections



General Bark Beetle Management: Stand level

⌘ Beetle suppression

⌘ Felling and removal of infested trees before beetle emergence and flight

⌘ **Not so direct with WPB**

⌘ Consult local forester/RFP



Photo courtesy: David Moorhead, Univ of Georgia

General Bark Beetle Management

Tree Level: Prevention

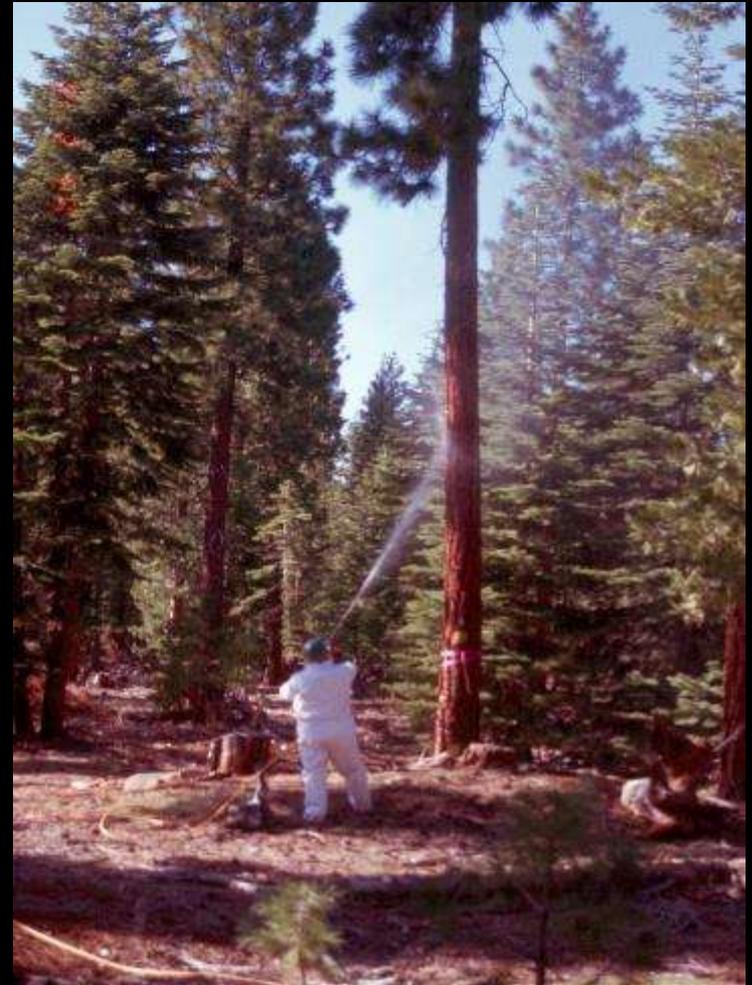
⌘ Preventative pesticide

⌘ **Expensive** – used for high-value trees likely to be exposed to high bark beetle populations

⌘ **Highly effective**: 1-2 year efficacy post-treatment

⌘ Listed for forest-use only

⌘ **Toxic to non-target organisms**

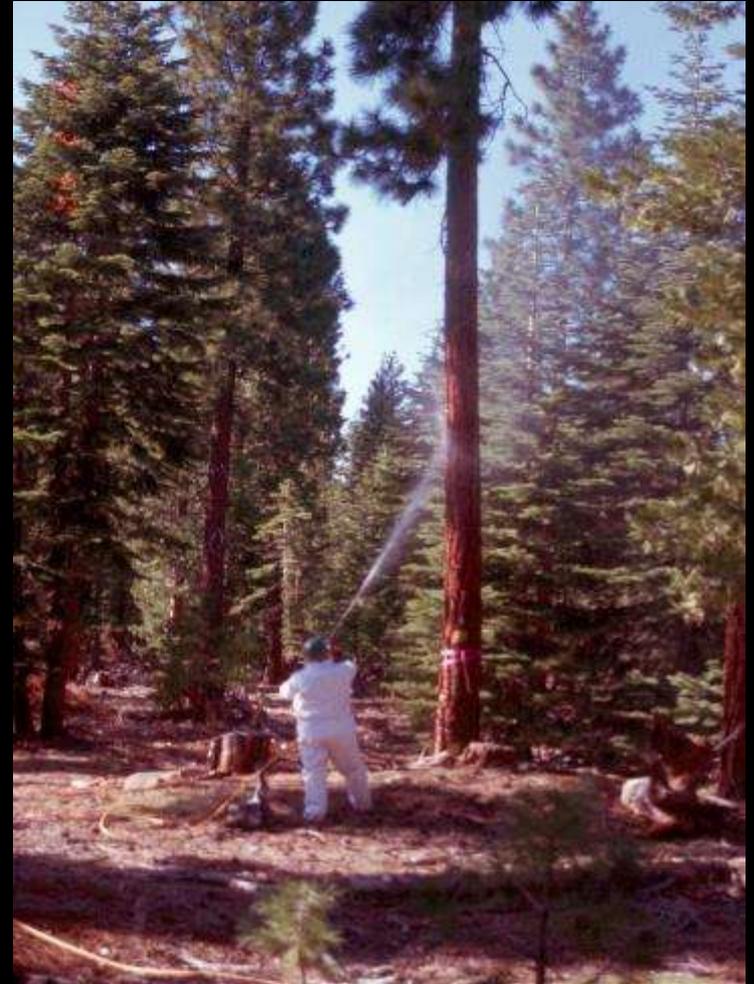


General Bark Beetle Management

Tree Level: Prevention

↳ **Carbaryl-based**

- ⌘ Topical application
- ⌘ **2 seasons of** protection
- ⌘ Proper timing and application are **very important!!**
- ⌘ Require QAC applicator

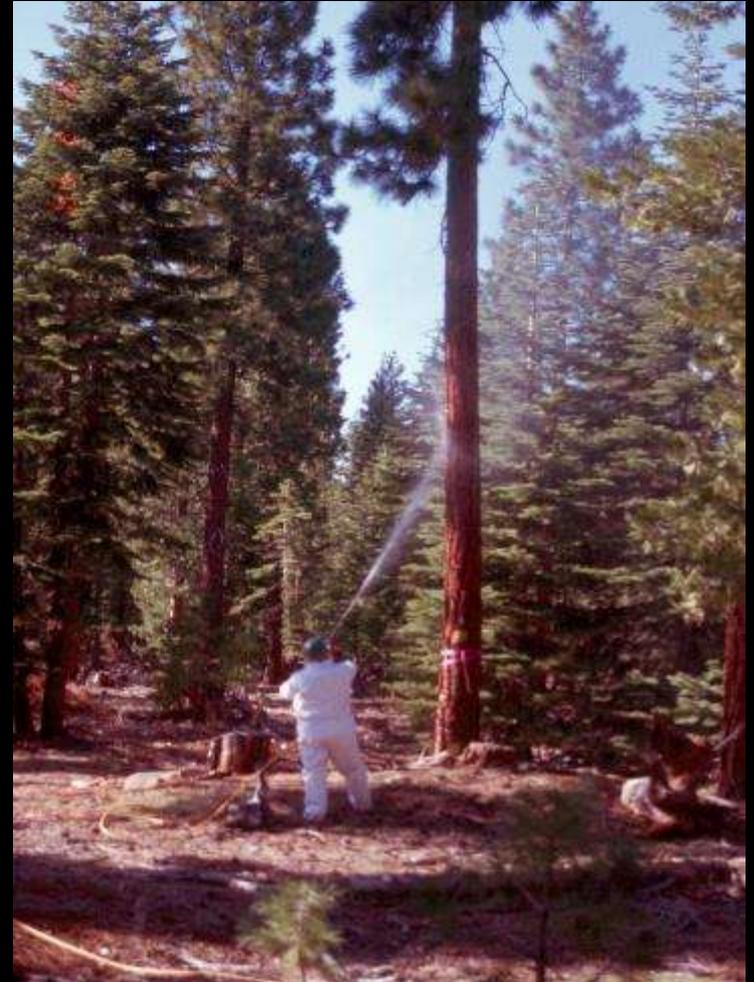


General Bark Beetle Management

Tree Level: Ponderosa Pine only

& Pyrethroid-based

- ∅ Topical application
- ∅ *1 season* of protection
- ∅ Proper timing and application are *very important!!*
- ∅ Require QAC applicator



General Bark Beetle Management

Tree Level: Ponderosa Pine only

⌘ **Still in RESEARCH**

⌘ **Tree injection** pesticide

⌘ Consider time for uptake

⌘ Requires QAC applicator

⌘ Emamectin benzoate (a.i.)

⌘ TREE-age®



General Bark Beetle Management

Tree Level: *Prevention only*

↳ Pheromone manipulation

↳ *BeetleBlock*™ --
NOT REGISTERED in California

↳ *Still in research*



↳ ***Dependent upon management objective***

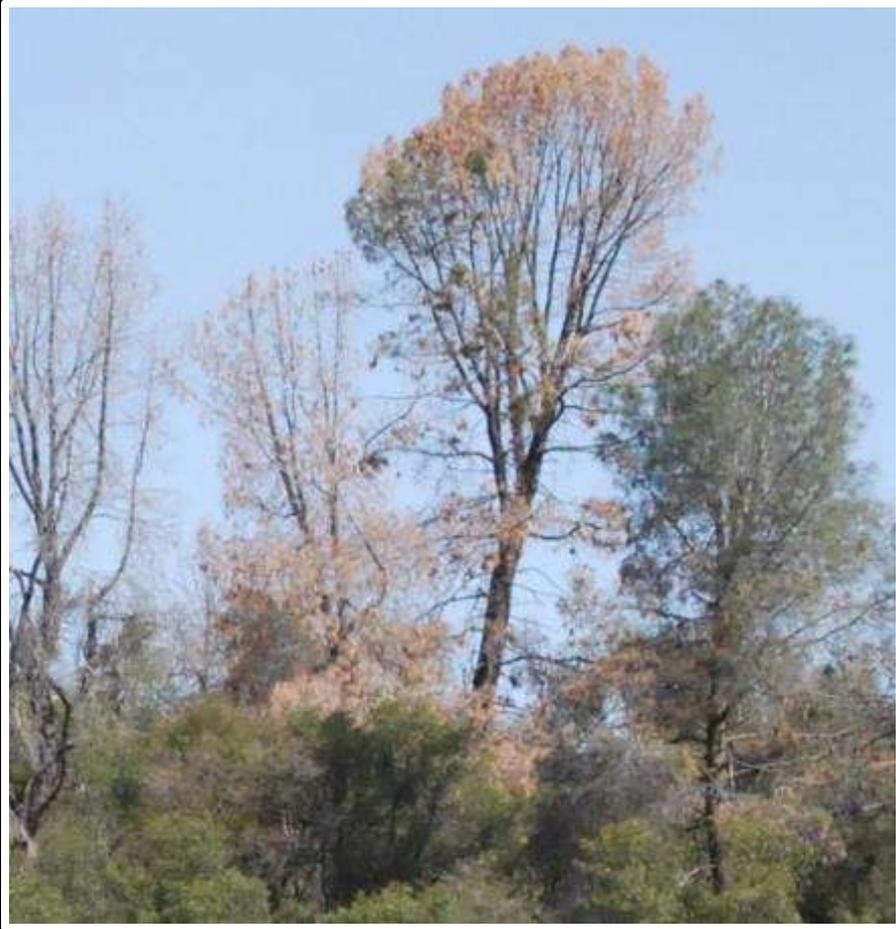
- ⌘ Public Safety and protection
- ⌘ Wildlife habitat
- ⌘ Fuel loading
- ⌘ Change in Composition

No Action is an option.

Green slash: *proper disposal*

- Prevention of engraver beetles
- *Keep green slash away from residual/host trees*
- Hasten drying if possible
- *Wrap tightly in CLEAR plastic*





Woodborers

Pine Engravers

{ Red Turpentine Beetle
Dwarf Mistletoe
Root Disease
(*Heterobasidion* spp.)

Twig beetles

Foothill pine (*aka* Grey)

General Bark Beetle Management = Basic Forestry Practices, Grey Pines

- ↳ Promote *healthy* trees resilient to bark beetle attack
 - ⌘ Ensure good *growing space*
 - ↳ Reduce competition
 - ⌘ Watering/irrigation can help
 - ⌘ *Prune* DM infections
 - ⌘ *Promote regeneration*



Pest Complex

Incense Cedar



Incense Cedar management

Same as for any other species

- Reduce tree density, competing veg
- Prevent/avoid soil compaction
- Avoid roots/trunk injury

Thank you