BARK BEETLES

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Forest Entomologist

Forest Health Protection

Pacific Southwest Region

Northeastern California Shared Service Area

Not a Bark Beetle

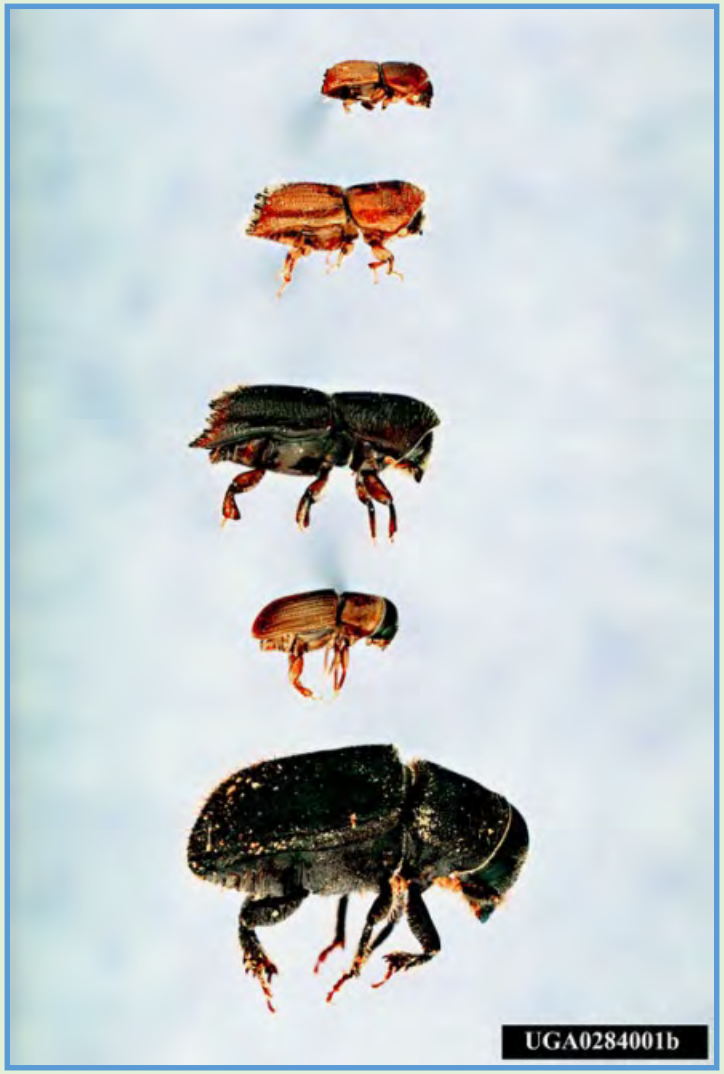
Not a Bark Beetle

Also Not a Bark Beetle

This is a Bark Beetle

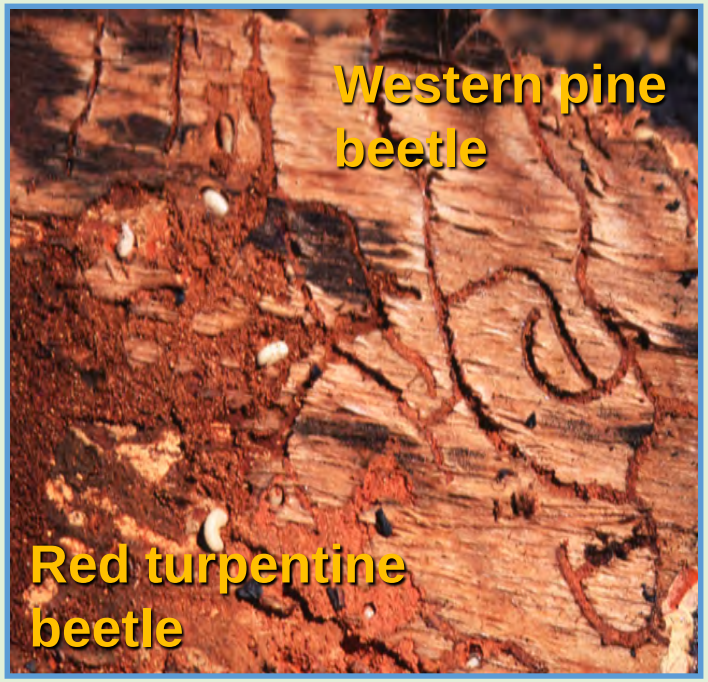
Bark beetles

- 600 species in North America
- About 200 species in California



Bark beetles – Common attributes

- Bark beetles live beneath the bark of host trees in ***galleries*** that are unique for each species



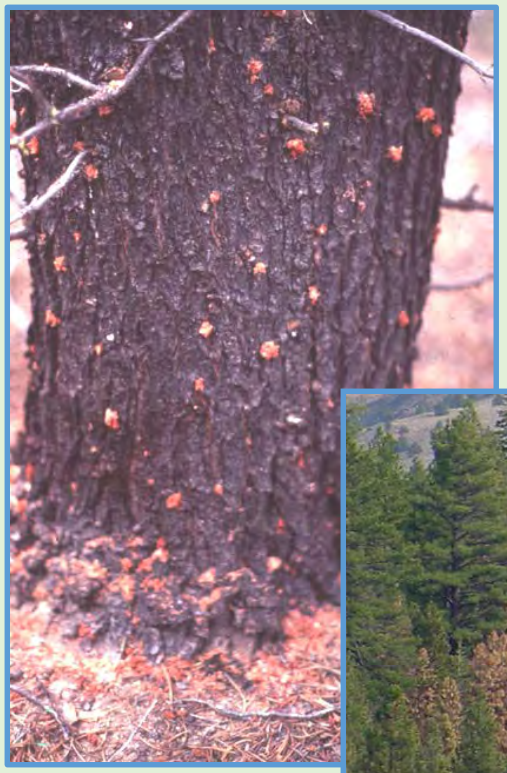
Bark beetles – Common attributes

- Bark beetles are ***opportunistic***, infesting trees weakened by other agents or factors

  - Disease infection
  - Infestation by other insects
  - Mechanical damage, including fire
  - Soil compaction (high use sites or construction)
  - Air pollution
  - **Drought**
  - **High stand density**

Bark beetles – Common attributes

- Bark beetles produce ***aggregating attractants*** that insure mass attack of suitable host material



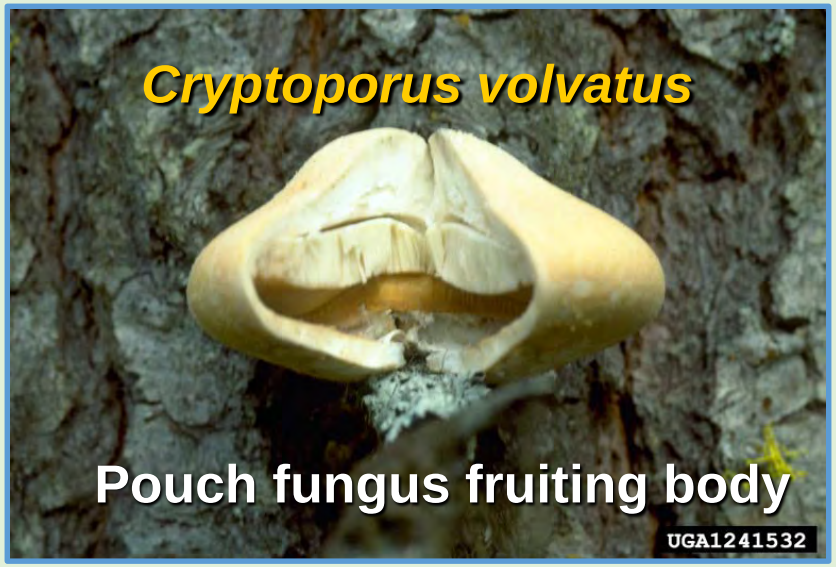
These attractants ***(pheromones)*** also lead to group-killing of trees

Bark beetles – Common attributes

- Bark beetles carry ***staining fungi*** that help reduce tree defenses and make the host material more palatable and nutritious for developing larvae

Bark beetles – Common attributes

- Many bark beetles also carry ***decay fungi*** that begin the recycling process of dead wood



Bark beetles – Common attributes

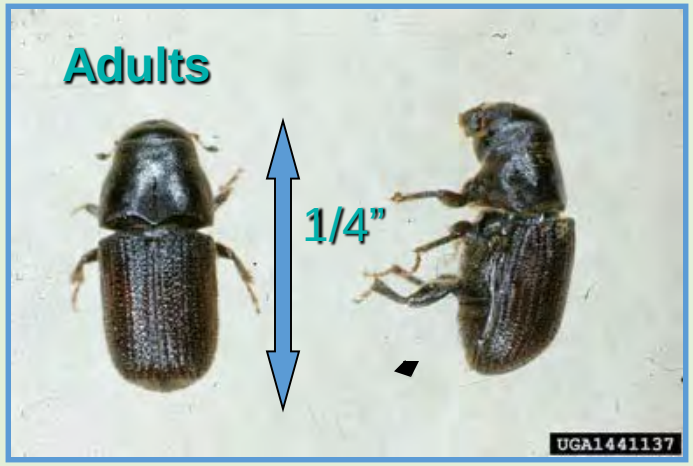
- A ***high reproductive potential*** allows bark beetles to multiply rapidly when conditions are favorable

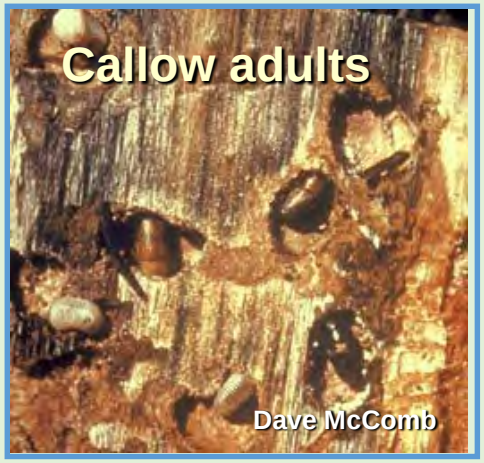
Bark beetles – Common attributes

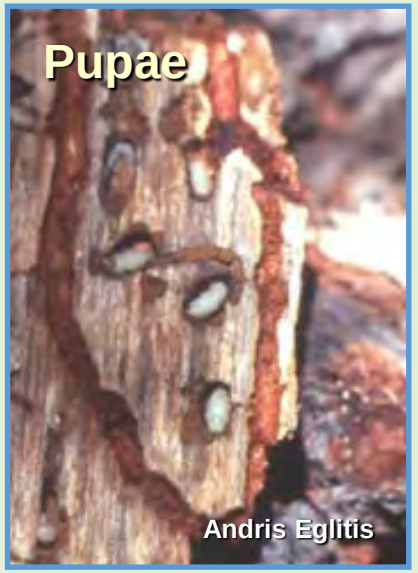
- Beetle populations are ultimately controlled by ***available food source*** (habitat)

Life stages

Mountain pine beetle, *Dendroctonus ponderosae*



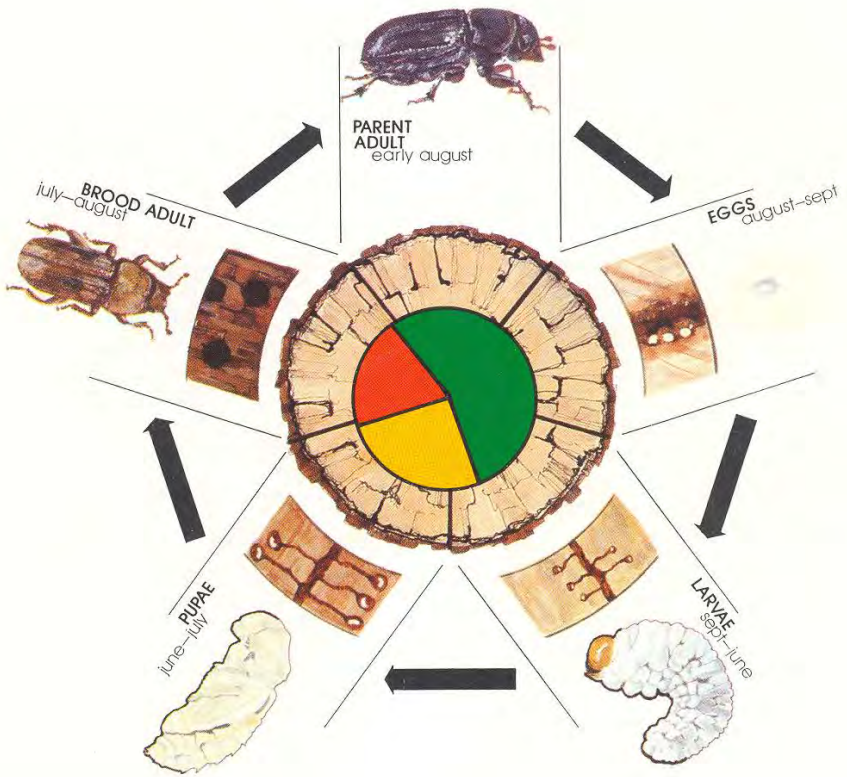




Typical life cycle

A ***one-year*** life cycle is most typical, although beetles may require ***two years*** to complete a generation at high elevations and in the northern portion of their range.

Mountain pine beetle, *Dendroctonus ponderosae*



Gene Amman
Ogden, UT

Ecological roles of bark beetles

- Recycling of older trees or stands
- Influence plant succession
- Accelerating decomposition rates of dead wood by introducing decay fungi
- Natural stand thinning
- Gap formation in dense stands (agents of diversity in the forest)
- Creation of specialized habitats (snags)
- Food source for other organisms

Important bark beetle species in California

Dendroctonus jeffreyi, Jeffrey pine beetle (JP)

Dendroctonus brevicomis, Western pine beetle (CP, PP)

Dendroctonus ponderosae, Mountain pine beetle (LPP, PP, WWP, SP, KP, WBP)

Dendroctonus pseudotsugae, Douglas-fir beetle (DF)

Dendroctonus valens, Red turpentine beetle (all pines)

Ips pini, Pine engraver (all pines)

Ips paraconfusus, California five-spined ips (all pines)

Ips confusus, Pinyon ips (pinyon pine)

Scolytus ventralis, Fir engraver (true firs)

Additional Bark Beetle Species

- *Dendroctonus rufipennis*, Spruce beetle (SS, ES)
- *Scolytus unispinosus*, Douglas-fir engraver (DF)

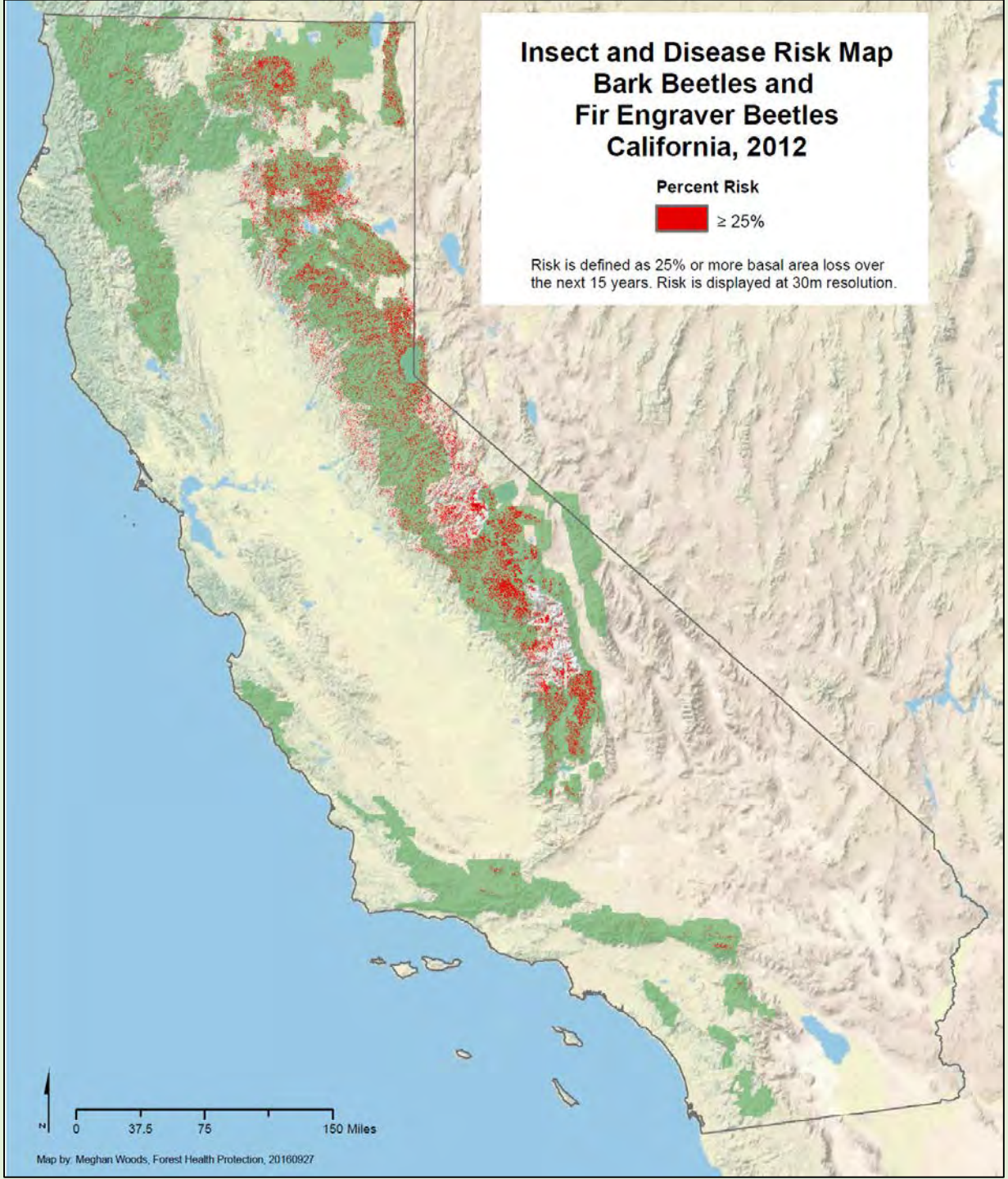
- Root feeders
- Twig girdlers
- Several bark beetle species that feed on host such as Cedar, Juniper, Oak, Mahogany, and Aspen as well as other tree and shrub species.

Bark beetle misconceptions during the current Sierra Nevada outbreak

- We just need a cold winter like we used to have to kill the beetles
  - Historic temperature records for California suggests cold temperatures have likely never played a significant role in controlling bark beetle populations
- Warmer winters due to climate change are allowing bark beetles to reproduce year round
  - No evidence of an increase in the number of generations per year for western pine beetle (2 to 3 or 4 historically based on latitude, elevation and seasonal differences); mountain pine beetle life cycle still one generation/year max. Not aware of any observations of winter attacks on trees by WPB.

Forest Health Issues

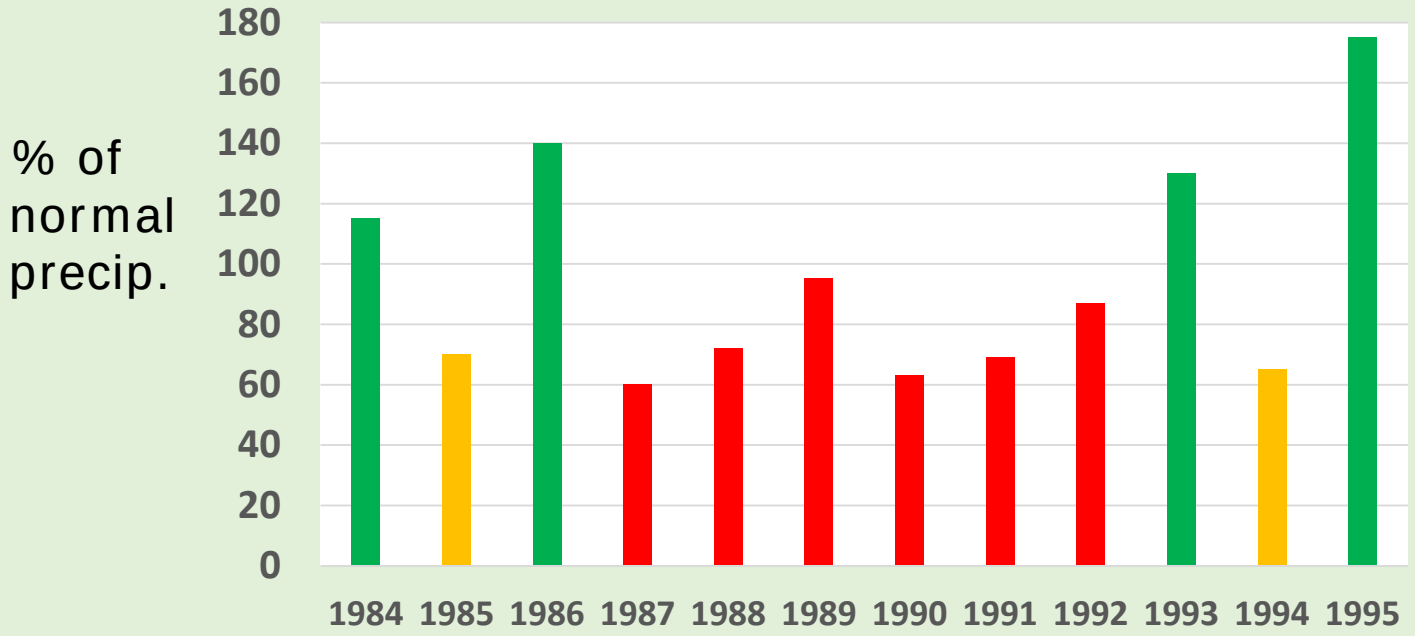
- Too many trees!
- Altered species composition and forest structure
- Excessive fuel loads
- Highly susceptible to stand replacing wildfire
- Highly susceptible to bark beetle outbreaks


Insect and Disease Risk Map
Bark Beetles and
Fir Engraver Beetles
California, 2012
Percent Risk
≥ 25%
Risk is defined as 25% or more basal area loss over the next 15 years. Risk is displayed at 30m resolution.
N
0
37.5
75
150 Miles
Map by: Meghan Woods, Forest Health Protection, 20160927


2016 Credit: Leif Mortenson

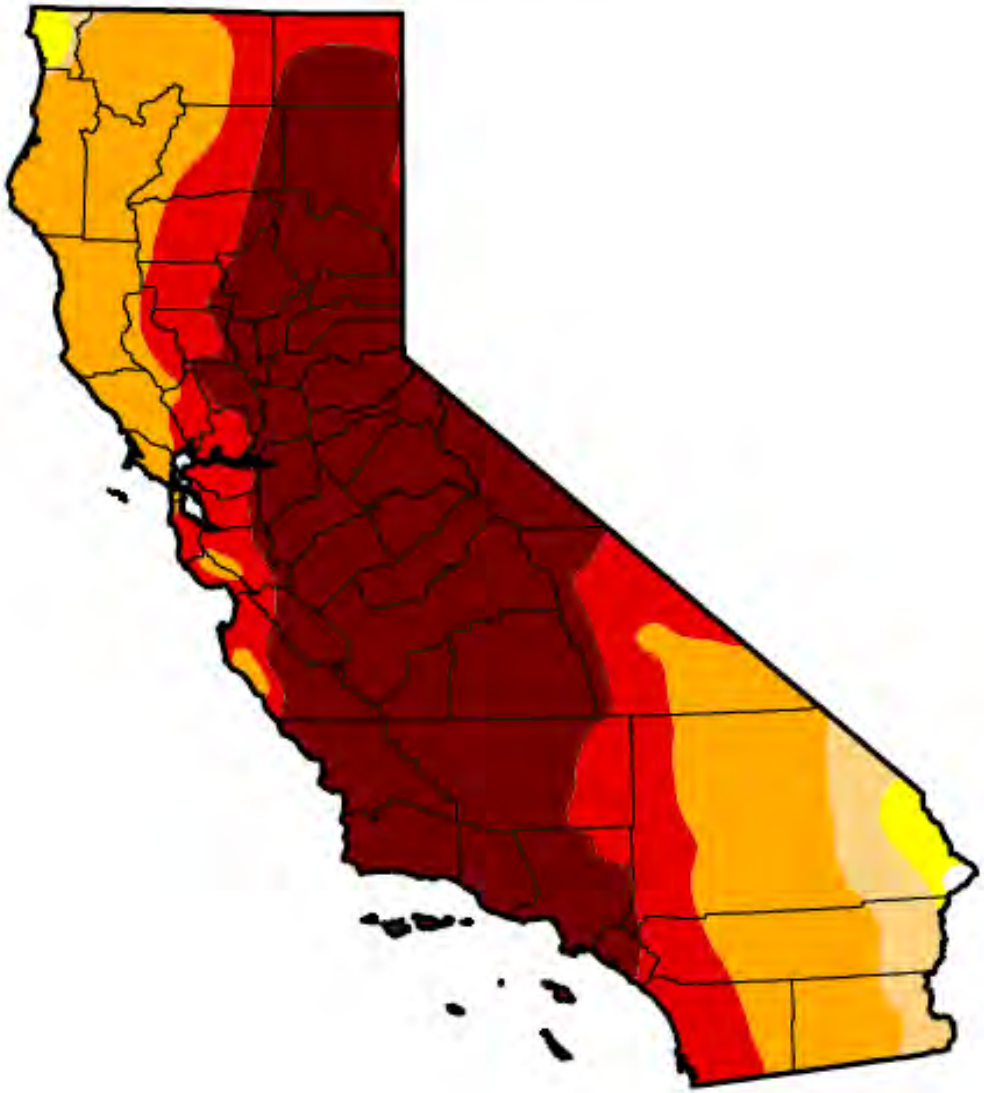

1978 or 1979 Credit:
Don Owen

Protracted drought period 1987 - 1992: Sierra Nevada, southern Cascades, Modoc



high levels of mortality: white fir (east side), ponderosa pine, Jeffrey pine

U.S. Drought Monitor
California



May 19, 2015
(Released Thursday, May. 21, 2015)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.14	99.86	98.28	93.91	66.60	46.77
Last Week 5/12/2015	0.14	99.86	98.28	93.91	66.60	46.77
3 Months Ago 2/17/2015	0.16	99.84	98.10	93.44	67.46	41.20
Start of Calendar Year 12/30/2014	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year 9/30/2014	0.00	100.00	100.00	95.04	81.92	58.41
One Year Ago 5/20/2014	0.00	100.00	100.00	100.00	76.68	24.77

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

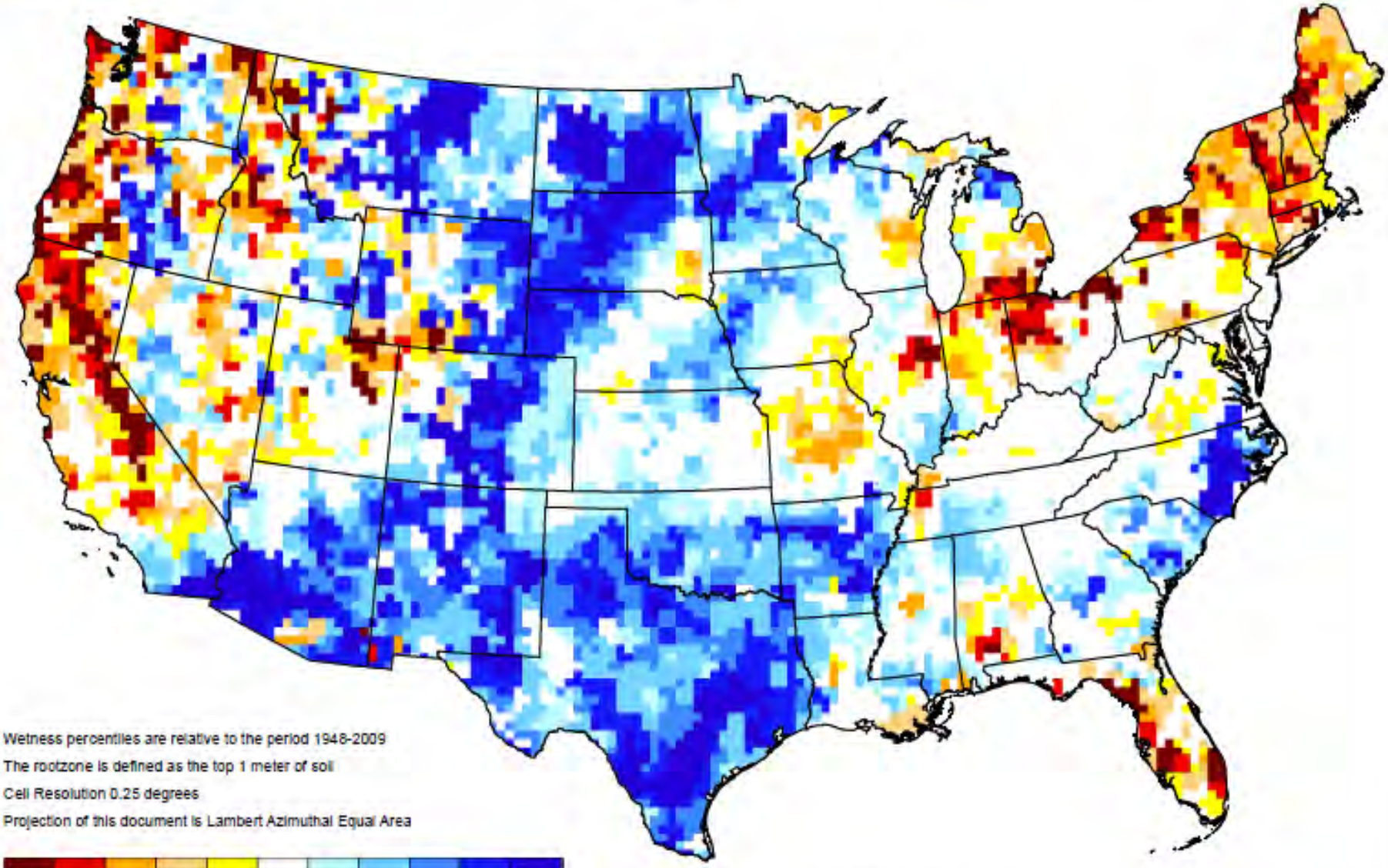
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brad Rippey
U.S. Department of Agriculture

http://droughtmonitor.unl.edu/

GRACE-Based Root Zone Soil Moisture Drought Indicator

May 18, 2015



Wetness percentiles are relative to the period 1948-2009

The rootzone is defined as the top 1 meter of soil

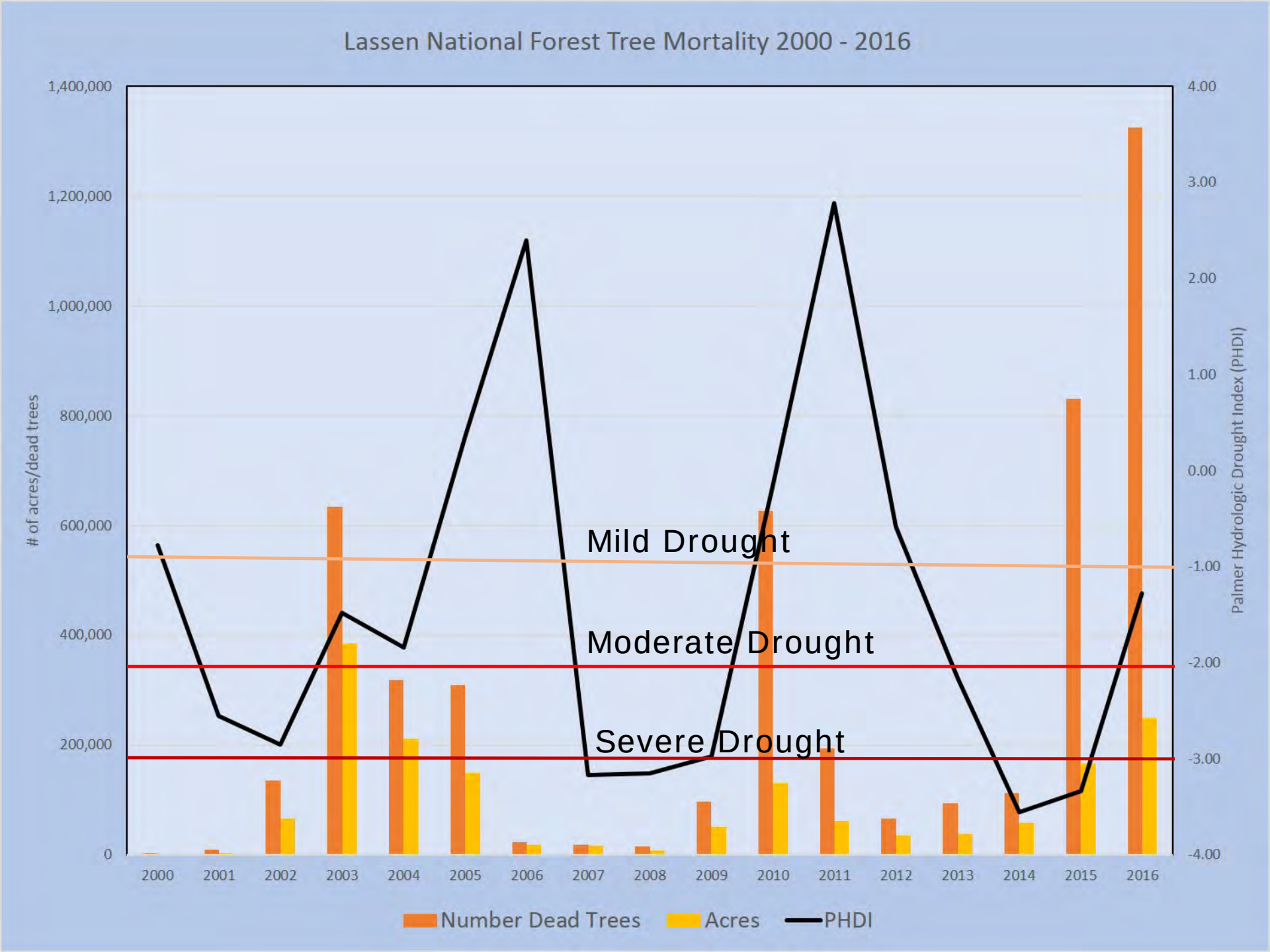
Cell Resolution 0.25 degrees

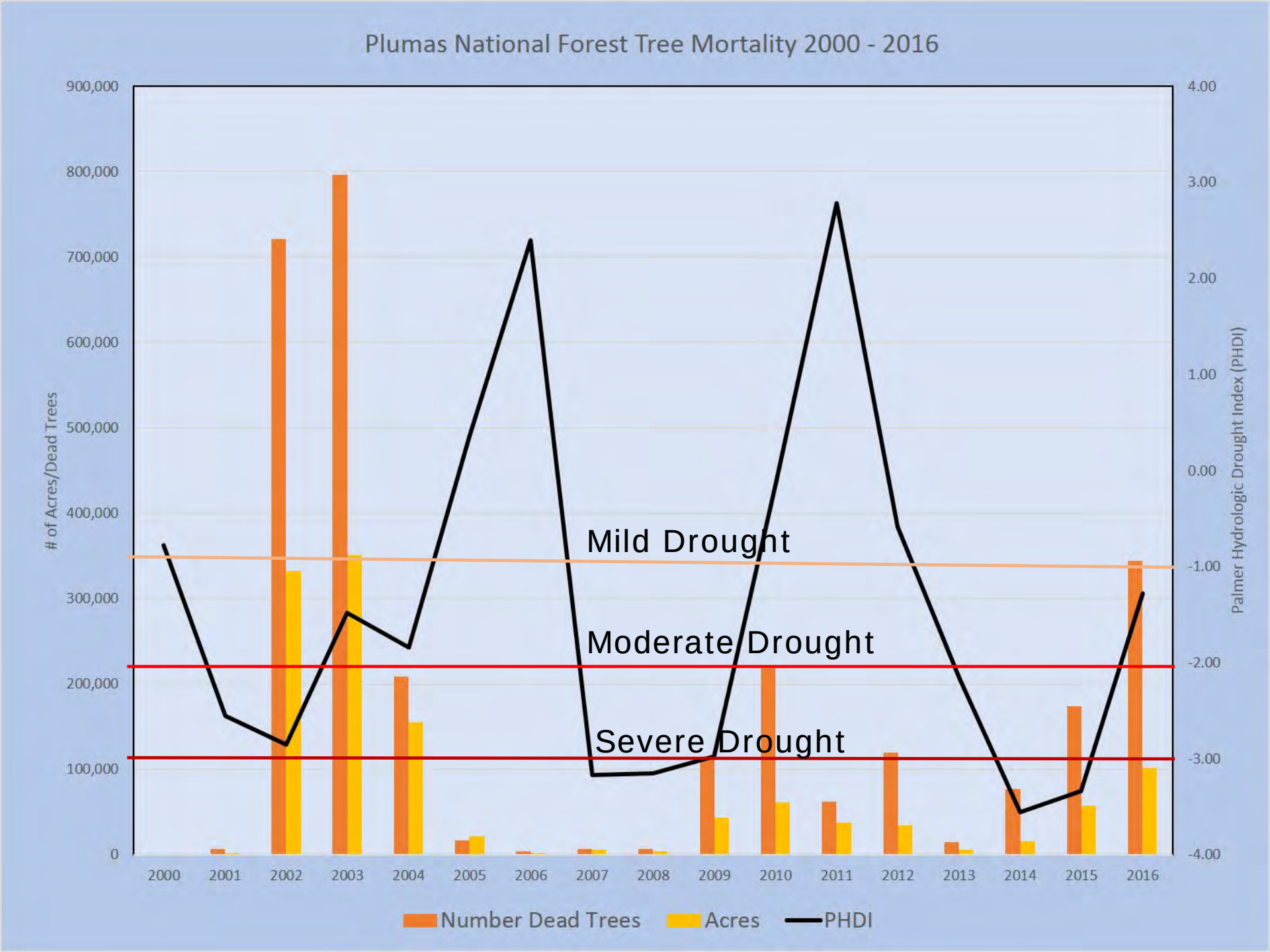
Projection of this document is Lambert Azimuthal Equal Area

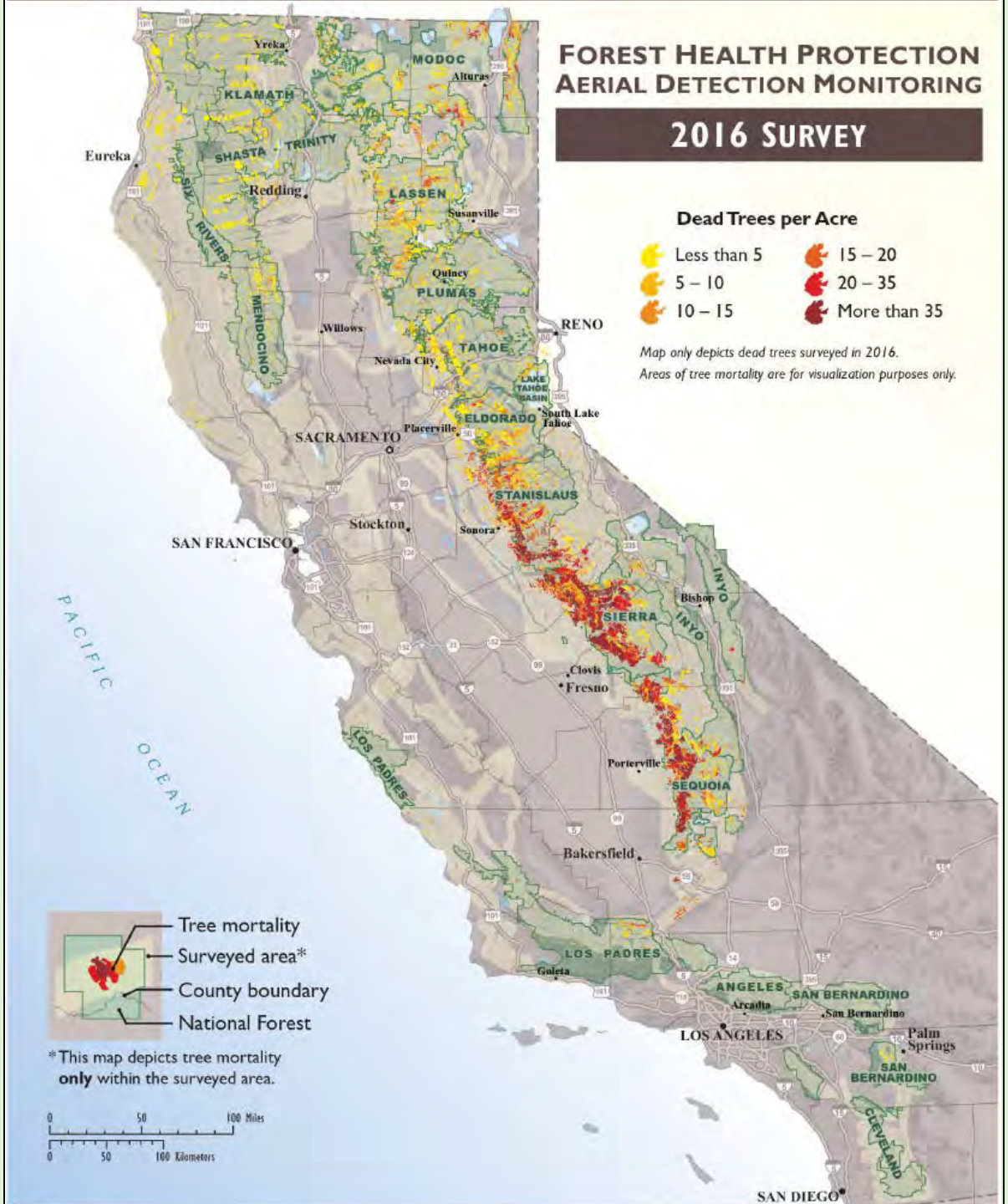
2 5 10 20 30 70 80 90 95 98

Wetness Percentile

http://drought.unl.edu/MonitoringTools/NASAGRACEDataAssimilation.aspx


Lassen National Forest Tree Mortality 2000 - 2016
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
# of acres/dead trees
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
Palmer Hydrologic Drought Index (PHDI)
Mild Drought
Moderate Drought
Severe Drought
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Number Dead Trees
Acres
PHDI


Plumas National Forest Tree Mortality 2000 - 2016
# of Acres/Dead Trees
Palmer Hydrologic Drought Index (PHDI)
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
Mild Drought
Moderate Drought
Severe Drought
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Number Dead Trees
Acres
PHDI


FOREST HEALTH PROTECTION
AERIAL DETECTION MONITORING
2016 SURVEY
Dead Trees per Acre
Less than 5
5 – 10
10 – 15
15 – 20
20 – 35
More than 35
Map only depicts dead trees surveyed in 2016.
Areas of tree mortality are for visualization purposes only.
Tree mortality
Surveyed area*
County boundary
National Forest
*This map depicts tree mortality only within the surveyed area.
0 50 100 Miles
0 50 100 Kilometers
Yreka
MODOC
Alturas
KLAMATH
Eureka
SHASTA
TRINITY
Redding
LASSEN
Susanville
SIX RIVERS
MENDOCINO
Quincy
PLUMAS
Willows
RENO
TAHOE
Nevada City
LAKE TAHOE BASIN
South Lake Tahoe
EL DORADO
Placerville
SACRAMENTO
STANISLAUS
Stockton
Sonora
SAN FRANCISCO
INYO
Bishop
SIERRA
Clovis
Fresno
PACIFIC
OCEAN
LOS PADRES
Porterville
SEQUOIA
Bakersfield
LOS PADRES
Goleta
ANGELES
SAN BERNARDINO
Arcadia
San Bernardino
LOS ANGELES
Palm Springs
SAN BERNARDINO
CLEVELAND
SAN DIEGO

Site 2 - 3800' elevation, central Sierra Nevada

Source: Chris Fettig, USFS, PSW Research Station

March 2014

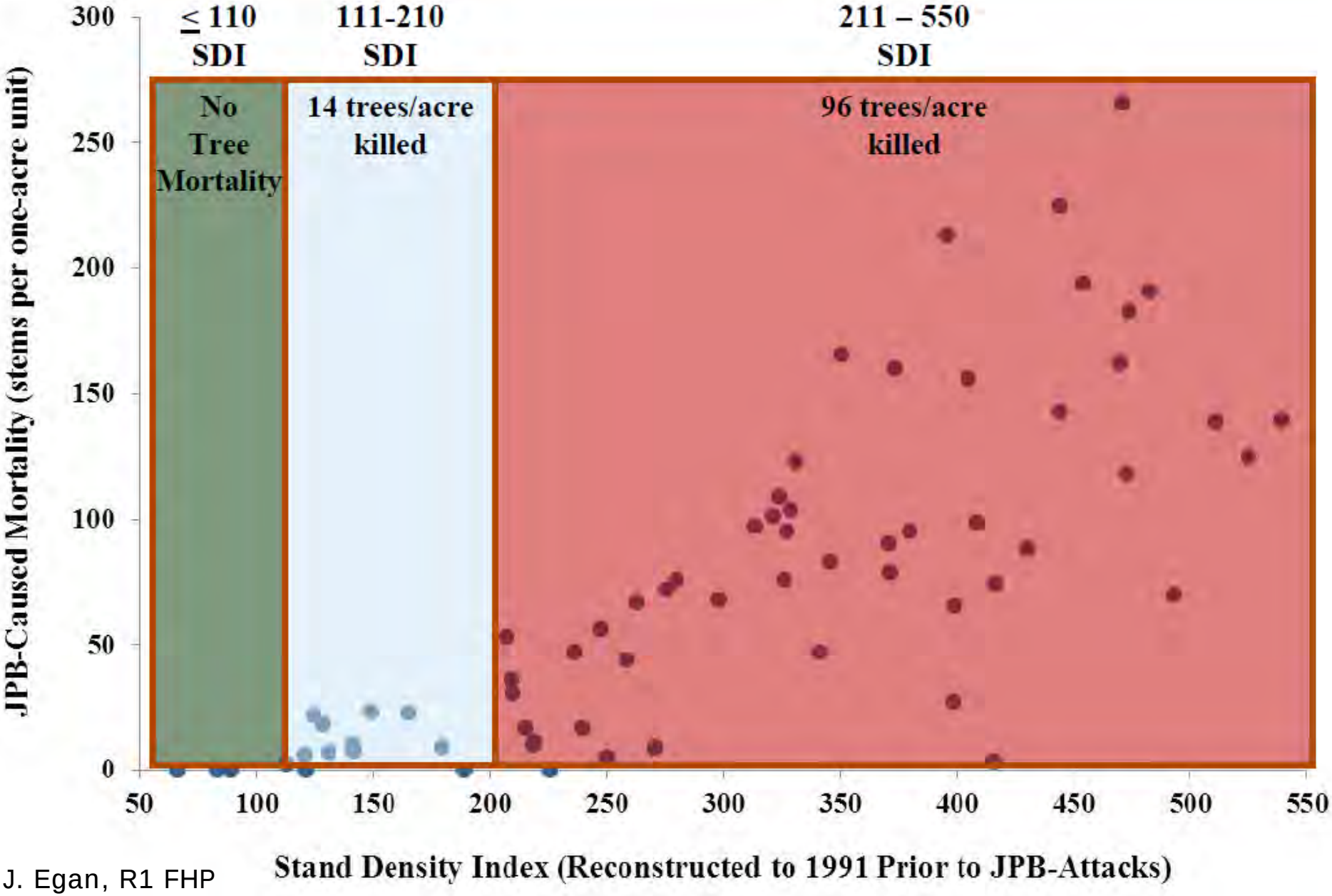
360 TPA
500.1 ft^2 BAA
50% PIPO
39% CADE
11% QUCH

March 2016

230 TPA
73.1 ft^2 BAA
74% CADE
17% QUCH
9% PIPO*

In a period of <u>two</u> years, 36% of trees and 85% of basal area were killed. A forest once dominated by large-diameter (23.6 in. mean dbh) PIPO is now dominated by small-diameter (6.0 in. mean dbh) CADE. All PIPO were colonized by western pine beetle in 2015, but two trees have yet to exhibit crown fade.*

Jeffrey pine outbreak 1991 to 1995, Spooner Junction, CA



J. Egan, R1 FHP

Bark Beetle Management

- Provide vigorous growing conditions for the host trees.
- Keep stand densities below the “Upper Management Zone” (Cochran 1992). (UMZ is the point where density-dependent mortality begins to occur).
- Thinning should include the removal of weakened individuals.
- Insecticides are available to protect high value individual trees from attack (sprayed on bole before beetles attack).
- Other treatment alternatives for high value individual trees are under development (anti-aggregation pheromones, non-host angiosperm volatiles and systemic insecticide injections).

How can I save my trees? Short-term

- If they are already infested it is too late
- Remove infested trees
- Deep watering
- Preventative spraying of uninfested trees
- Anti-aggregation pheromones
- Avoid leaving green slash or firewood near standing live trees
- Fertilizers will not save your trees

Removing infested trees

- To be effective removal must be accomplished before beetle emergence
- Be careful not to damage surrounding trees
- All material larger than 3” in diameter should be removed from the site, chipped, buried, or burned
- Firewood cut from infested trees should be stacked in a sunny location away from live trees
- Covering woodpiles with heavy, clear, plastic in sunny location can effectively kill beetles

Watering trees

- Watering should occur early in the growing season after a drier than normal winter
- Soil should be saturated down to 2 feet in a donut shape at the drip line or outer edge of tree branches
- Over watering during the growing season may cause root damage

Preventative spraying

- Spraying **uninfested** but susceptible trees can prevent bark beetle attack
- Should be performed by a commercial applicator
- Due to high cost and environmental concerns only "high-value" trees should be treated
- Treatments should be limited to susceptible host species

- **Treatments should occur in early spring before beetle flight (March/April)**
- **Insecticide injections** show promise but are unproven at this point.

Pheromones

How can I save my trees? Long Term

- **Reduce tree competition**
  - Thinning is the best long-term solution to increasing tree health and vigor and reducing the chances of bark beetle related mortality
  - Thinning should be accomplished in late summer or fall after insect flights have decreased
  - Treat logs and slash properly to avoid creating more habitat for beetle development
- **Avoid injuring trees during construction or landscaping projects**
- **Avoid creating stressful growing conditions**
- **Plant trees native to the area**

In Conclusion:

- Bark beetles are a diverse group of insects with common attributes
- Bark beetles make a living off of finding and colonizing stressed trees
- Any factor that increases tree stress will increase the available habitat for bark beetles
- High numbers of suitable host trees (species, size) provide the opportunity for bark beetle populations to reach epidemic levels
- Drought and high stand density are the primary causes of tree stress in the Sierra Nevada
- We cannot control the frequency or severity of drought, we can control the tree density in many of our forested areas

STAND DENSITY MATTERS!!!