Sudden Oak Death

Pepperwood Preserve November 15, 2014

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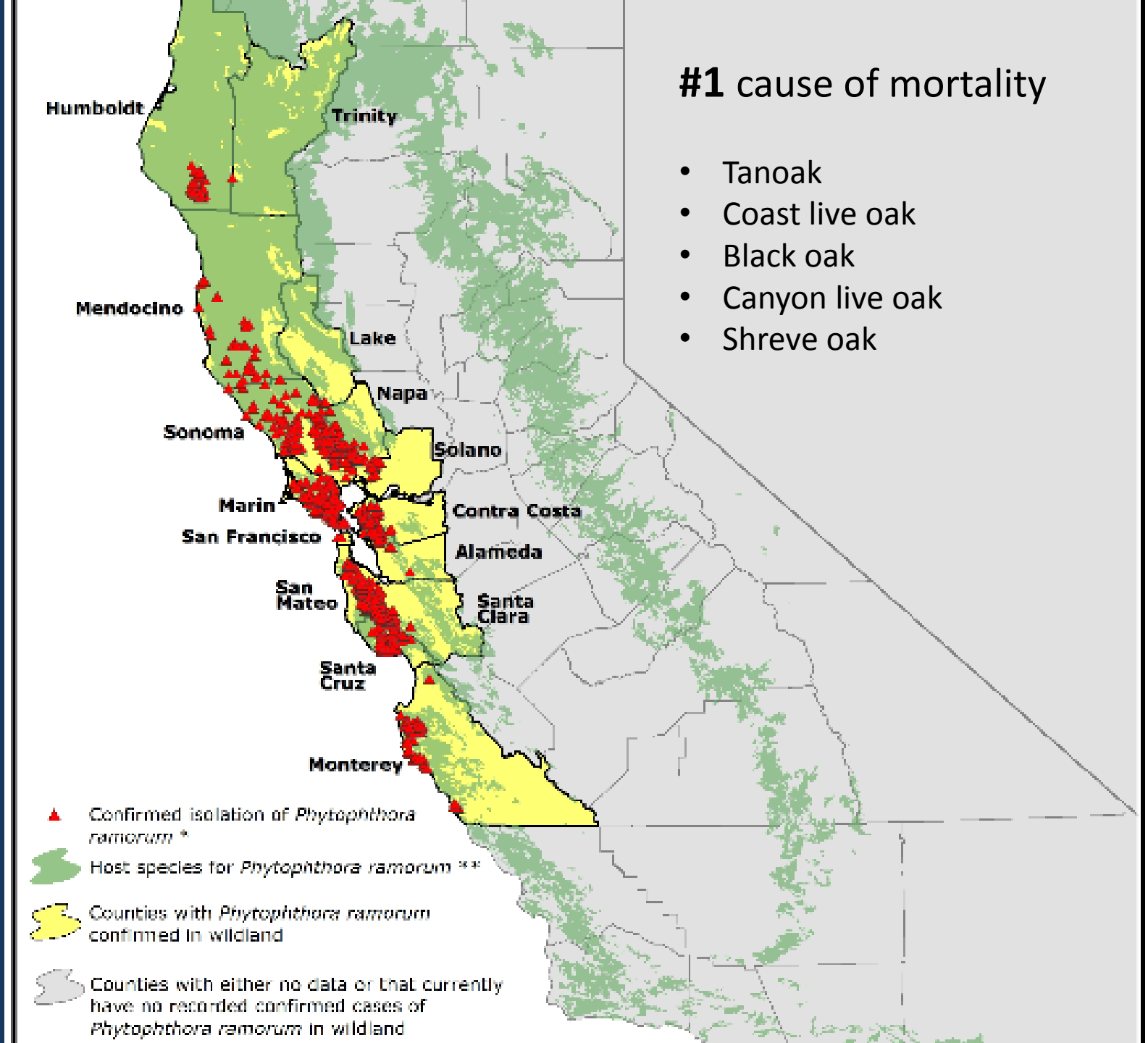
UC Cooperative Extension

Sonoma County

Topics

- SOD history
- Where it is
- Species it infects
- How it spreads
- Necessary environmental factors
- Management

Photo: Marin County Fire Department



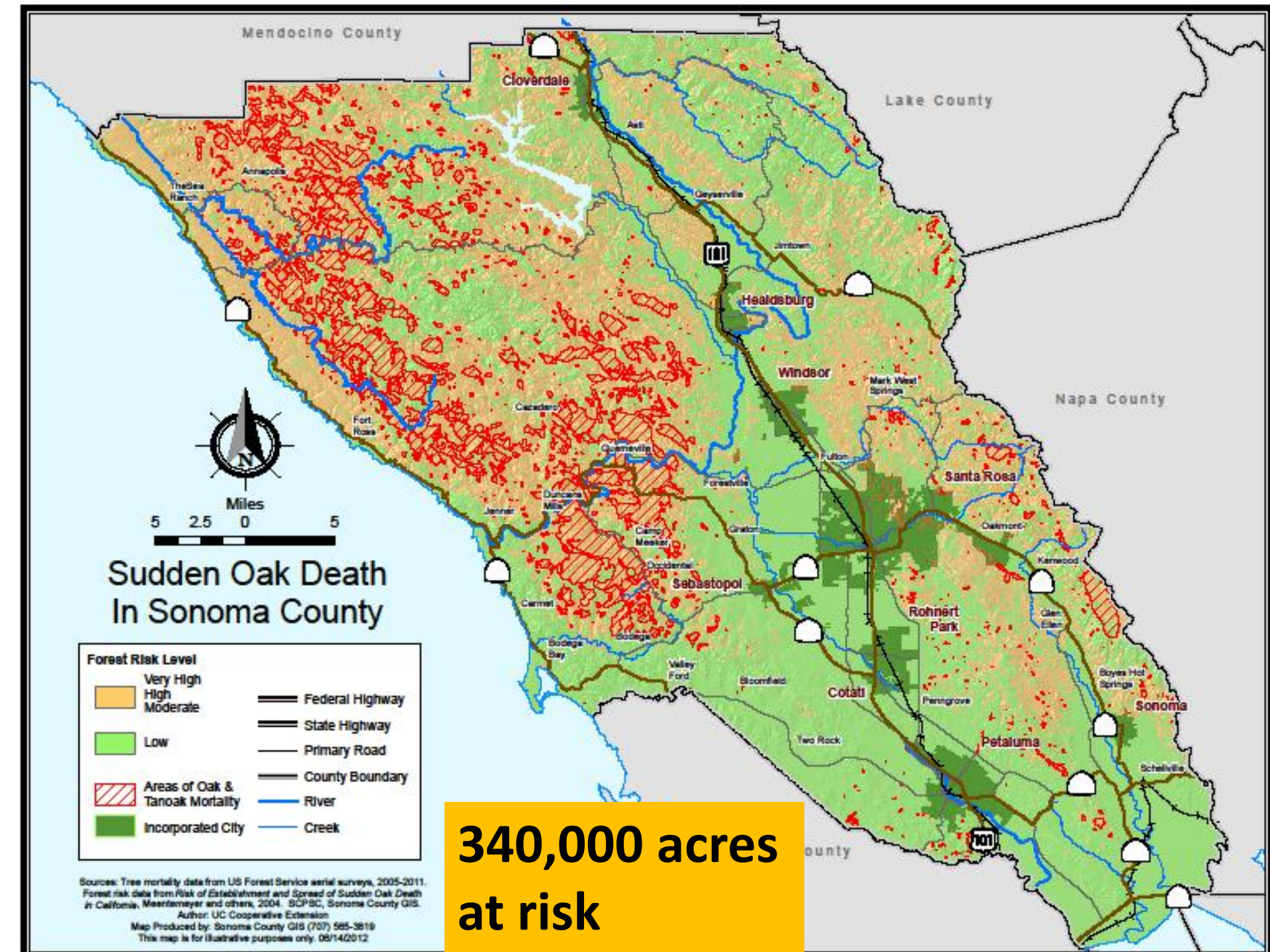
#1 cause of mortality

- Tanoak
- Coast live oak
- Black oak
- Canyon live oak
- Shreve oak

Statewide total acres affected, 2007-2011

	Acres detected with tree mortality attributed to SOD by year.					
County	2007	2008	2009	2010	2011	Total affected acres
Lake	26	6	6	6	0	44
Alameda	163	0	153	1	14	331
Solano	209	226	91	0	5	531
Contra Costa	663	0	526	2	26	1,217
Napa	451	798	470	54	25	1,798
Santa Cruz	665	881	269	31	23	1,869
Santa Clara	3,379	1,717	786	33	54	5,969
San Mateo	4,674	3,101	1,109	152	108	9,144
Mendocino	5,886	2,671	575	314	597	10,043
Humboldt	6,895	2,450	345	466	2,755	12,911
Monterey	9,588	2,633	450	491	193	13,355
Marin	9,780	5,955	2,481	398	219	18,833
Sonoma	48,374	14,049	2,573	941	3,871	69,808
Statewide total*	90,753	36,495	11,843	4,899	7,890	205,880

Now (2014) 100,000 acres


Mendocino County
Lake County
Napa County
Cloverdale
Healdsburg
Windsor
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Petaluma
Sonoma
Annapolis
Geyserville
Jimtown
Cazadero
Fort Ross
Guerneville
Forestville
Duncans Mills
Jenner
Camp Meeker
Occidental
Graton
Fulton
Mark West Springs
Oakmont
Kenwood
Glen Ellen
Boyes Hot Springs
Penngrove
Two Rock
Bloomfield
Valley Ford
Bodega
Bodega Bay
Carmet
Schellville
N
Miles
5 2.5 0 5
Sudden Oak Death
In Sonoma County
Forest Risk Level
Very High
High
Moderate
Low
Areas of Oak & Tanoak Mortality
Incorporated City
Federal Highway
State Highway
Primary Road
County Boundary
River
Creek
Sources: Tree mortality data from US Forest Service aerial surveys, 2005-2011.
Forest risk data from Risk of Establishment and Spread of Sudden Oak Death in California, Meentemeyer and others, 2004. SCPSC, Sonoma County GIS.
Author: UC Cooperative Extension
Map Produced by: Sonoma County GIS (707) 565-3619
This map is for illustrative purposes only. 06/14/2012
340,000 acres at risk

tanoak, coast live oak, black oak, canyon live oak, Shreve oak

Ambrosia Beetle damage

Puts the sudden in Sudden Oak Death

Annulohypoxylon (Fungus)

Trees prone to failure even when green.

Tree failure at infection site

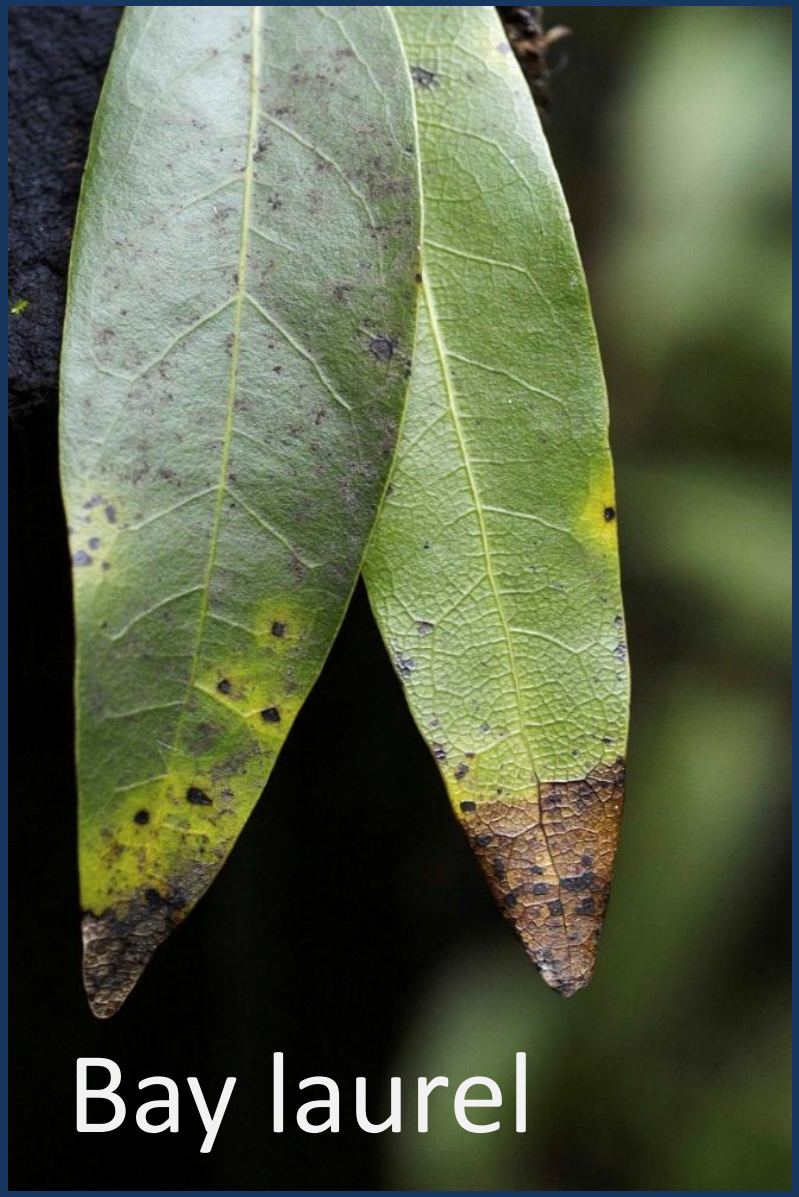
Scientific name	Common name
Abies concolor[a]	White fir
Abies grandis[a]	Grand fir
Abies magnifica[a]	Red fir
Acer circinatum[a]	Vine maple
Acer macrophyllum	Bigleaf maple
Adiantum aleuticum	Western maidenhair fern
Adiantum jordanii	California maidenhair fern
Aesculus californica	California buckeye
Arbutus menziesii	Pacific madrone
Arctostaphylos columbiana[a]	Hairy manzanita
Arctostaphylos manzanita	Whiteleaf manzanita
Berberis diversifolia (= *Mahonia aquifolium*)	Oregon-grape
Calycanthus occidentalis[a]	Spicebush
Ceanothus thyrsiflorus[a]	Blueblossom
Clintonia andrewsiana[a]	Andrew's clintonia bead lily
Corylus cornuta[a]	California hazelnut
Dryopteris arguta[a]	California wood fern
Frangula californica (= *Rhamnus californica*)	California coffeeberry
Frangula purshiana (= *Rhamnus purshiana*)	Cascara
Fraxinus latifolia[a]	Oregon ash
Garrya elliptica[a]	Silk tassel tree, coast silktassel
Gaultheria shallon[a]	Salal, Oregonwintergreen
Heteromeles arbutifolia	Toyon
Lonicera hispidula	California honeysuckle
Mahonia nervosa[a]	Creeping Oregon grape
Maianthemum racemosum (= *Smilacina racemosa*)	False Solomon's seal
Osmorhiza berteroi[a]	Sweet cicely
Phoradendron serotinum subsp. *macrophyllum*[b]	Colorado Desert mistletoe
Pseudotsuga menziesii var. *menziesii*	Douglas-fir
Rhododendron spp.	Rhododendron
Rosa gymnocarpa	Wood rose
Rubus spectabilis[a]	Salmonberry
Sequoia sempervirens	Coast redwood
Taxus brevifolia[a]	Pacific yew
Torreya californica[a]	California nutmeg
Toxicodendron diversilobum[a]	Poison oak
Trientalis latifolia	Western starflower
Umbellularia californica	California bay, California laurel, pepperwood, Oregon myrtle
Vaccinium ovatum	California huckleberry
Vancouveria planipetala[a]	Redwood ivy, redwood insideout flower

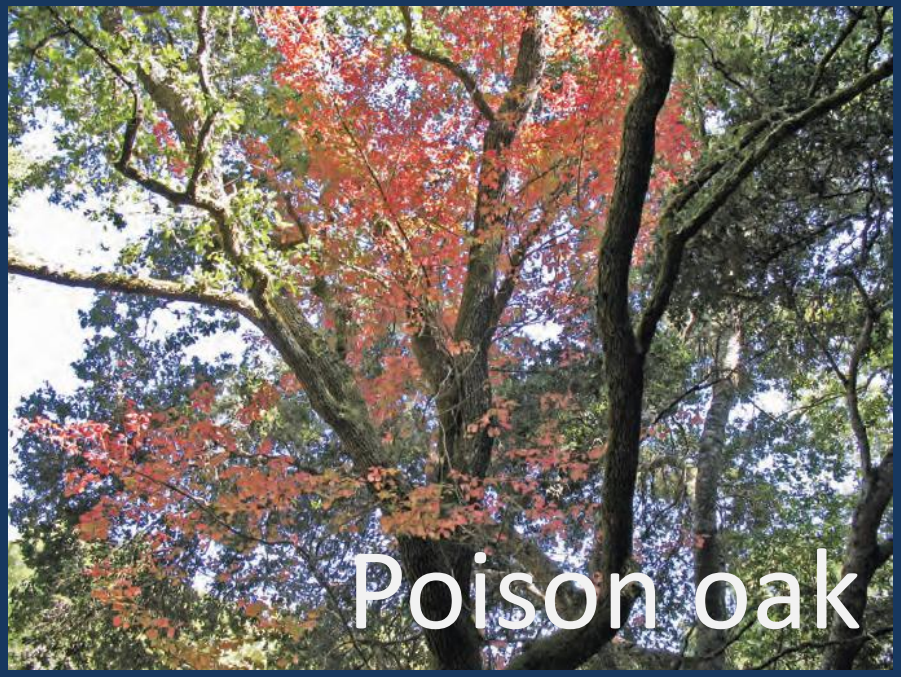
Local Flora
are hosts for
Phytophthora ramorum

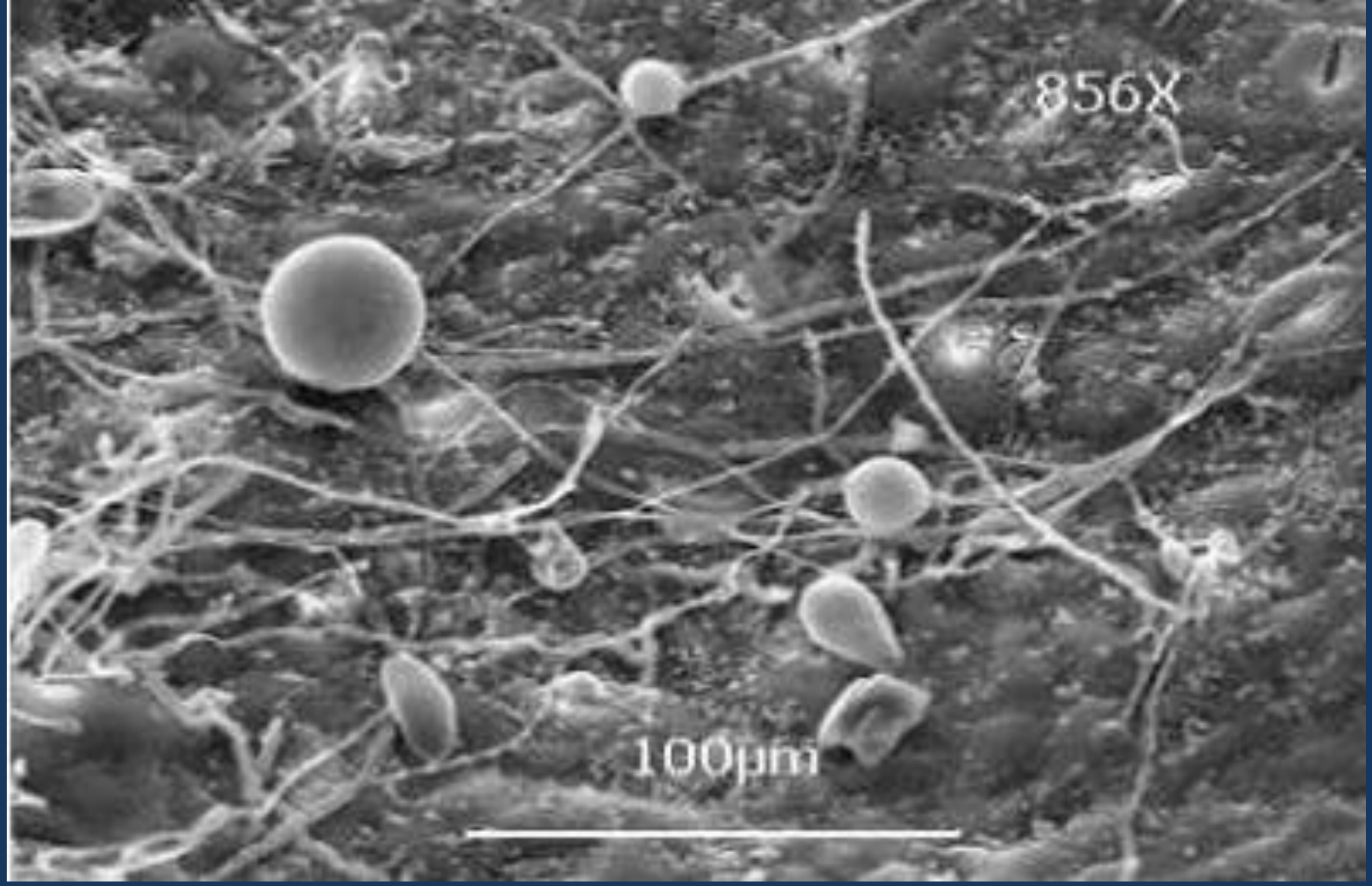
Madrone
Ceanothus
Honeysuckle
Doug fir
Rhododendron
Redwood
Rose
Huckleberry
Poison Oak

Leaf spots, small branch damage

Sporulating Hosts







Phytophthora ramorum **infection on bay leaf**
hyphae, sporangia, chlamydospore

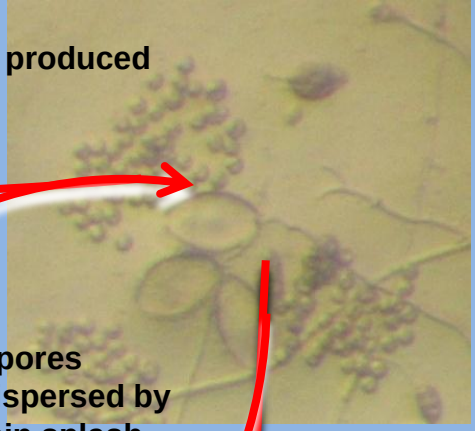
Tanoak

DRY SEASON

Phytophthora ramorum **survives in infected twigs on overstory and understory tanoaks**

WET SEASON

Sporangia and zoospores produced on infected tanoak twigs



Spores dispersed by rain splash infect more tanoak leaves and twigs

Spores splashed from twigs onto trunk initiate cankers

Phytophthora ramorum **does not spread from trunk cankers on tanoaks**

Phytosphere Research

Susceptibility in Tanoak

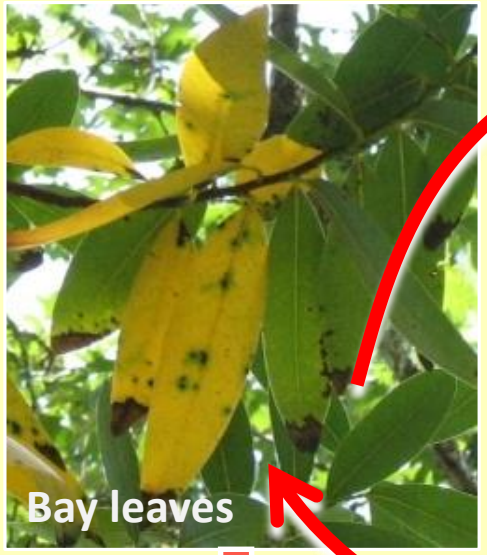
- No resistance known
- Usually die within 3 years
- Sometimes - no bleeding trunk
- Infection on leaf, twig, trunk
- Sporulating host

Oak/bay forest

DRY SEASON

WET SEASON

P. ramorum survives in infected bay leaves on trees



Many infected bay leaves senesce and drop over dry season

P. ramorum can survive in fallen leaves and soil

sporangia and zoospores on bay dispersed by rain

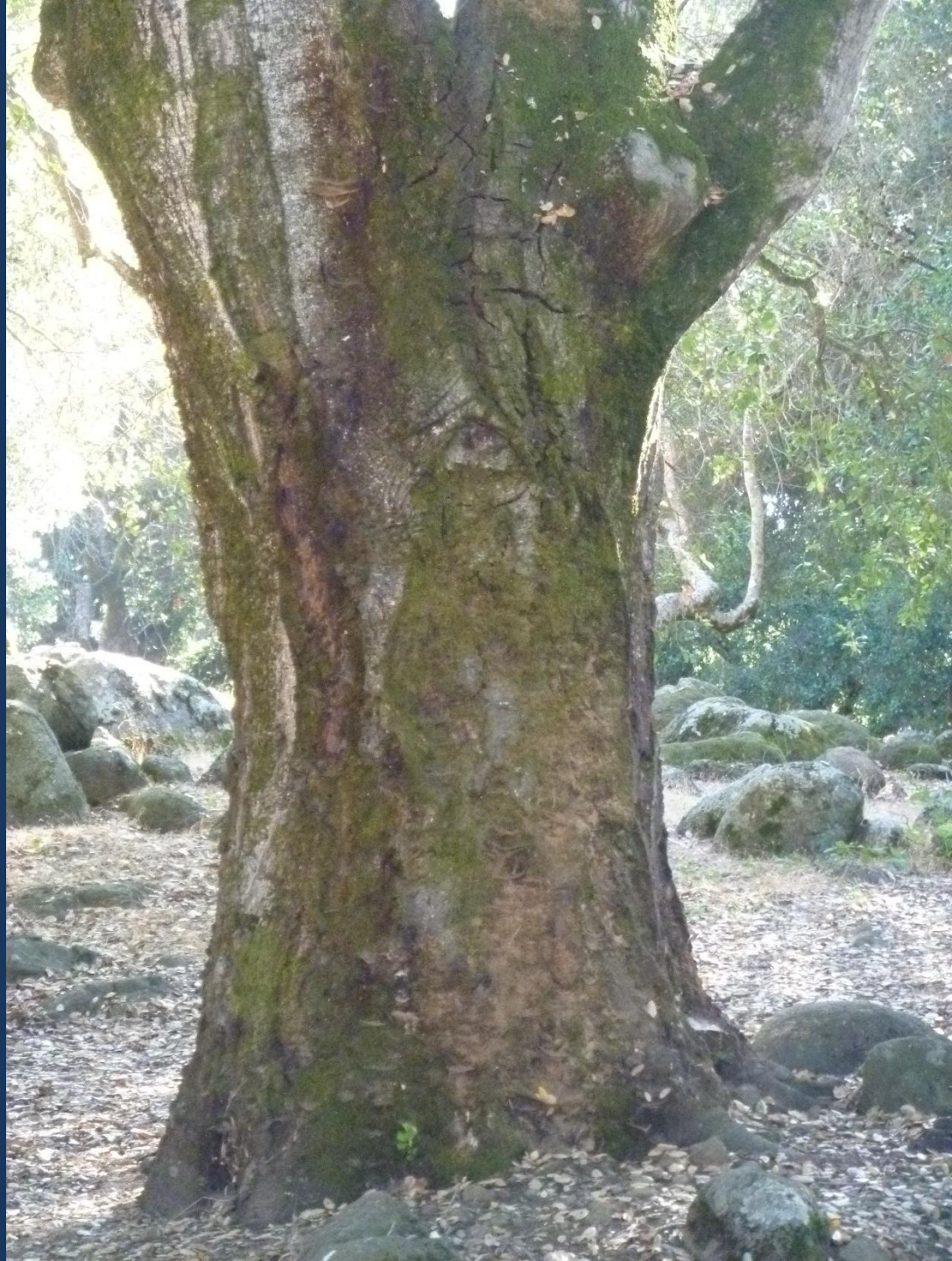
Spores infect oak trunks

P. ramorum does not spread from cankers on oaks

Phytosphere Research

Individual oak tree susceptibility

- **Large cankers**
  - Rapidly expanding cankers
  - Beetles, fungus appear within 2 yrs
- **Small cankers**
  - < 10 cm, stay small
  - Inactive 1-2 years after bleeding
  - No secondary agents
- **Intermediate reaction**
  - > 10 cm
  - Stop growing, become inactive
  - Callus tissue may develop
  - Bark dries and cracks
  - Secondary agents may be present




Beetle activity
Dead wood, hypoxlyon


Full
canopy

Small canker

- < 10 cm, stay small
- Inactive after 1-2 years
- No secondary agents

Intermediate reaction

- >10 cm
- Stop growing, become inactive
- Callus tissue may develop
- Bark dries and cracks
- Secondary agents may be present

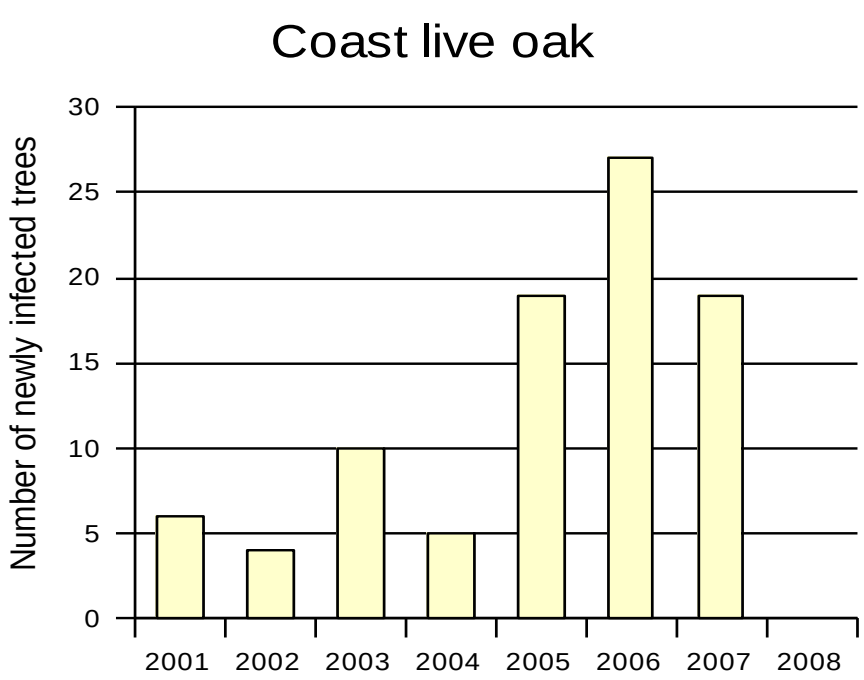
Infection

Water and Temperature

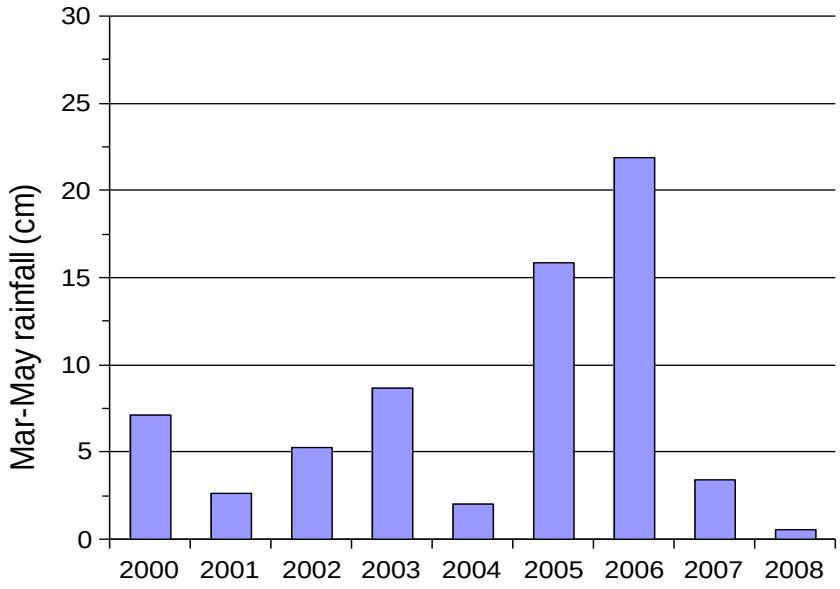
6 to 12 hours continuous wetness

50-86° F (range) - optimum 60-70 ° F

Spore production and survival



Oak infections

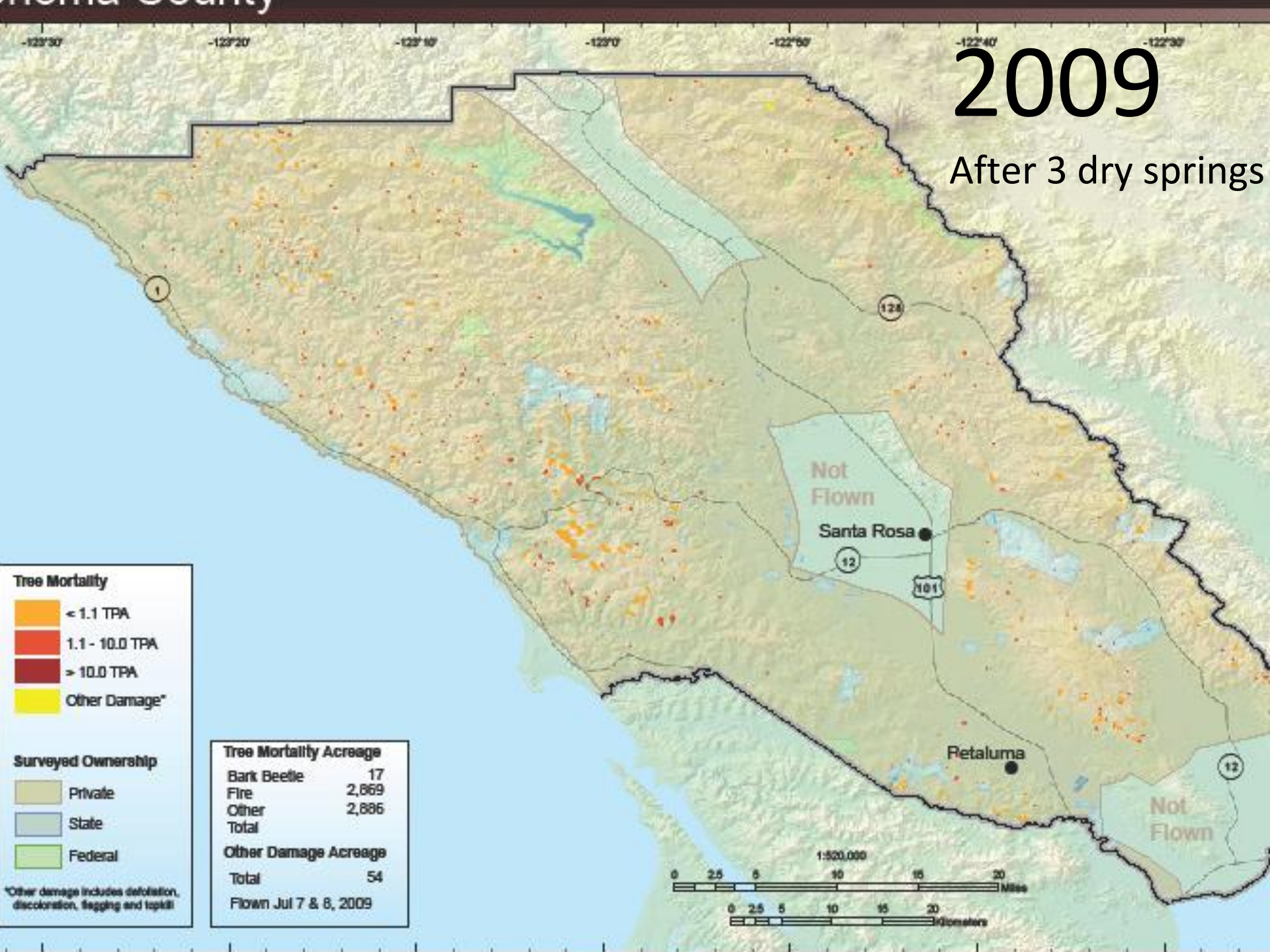


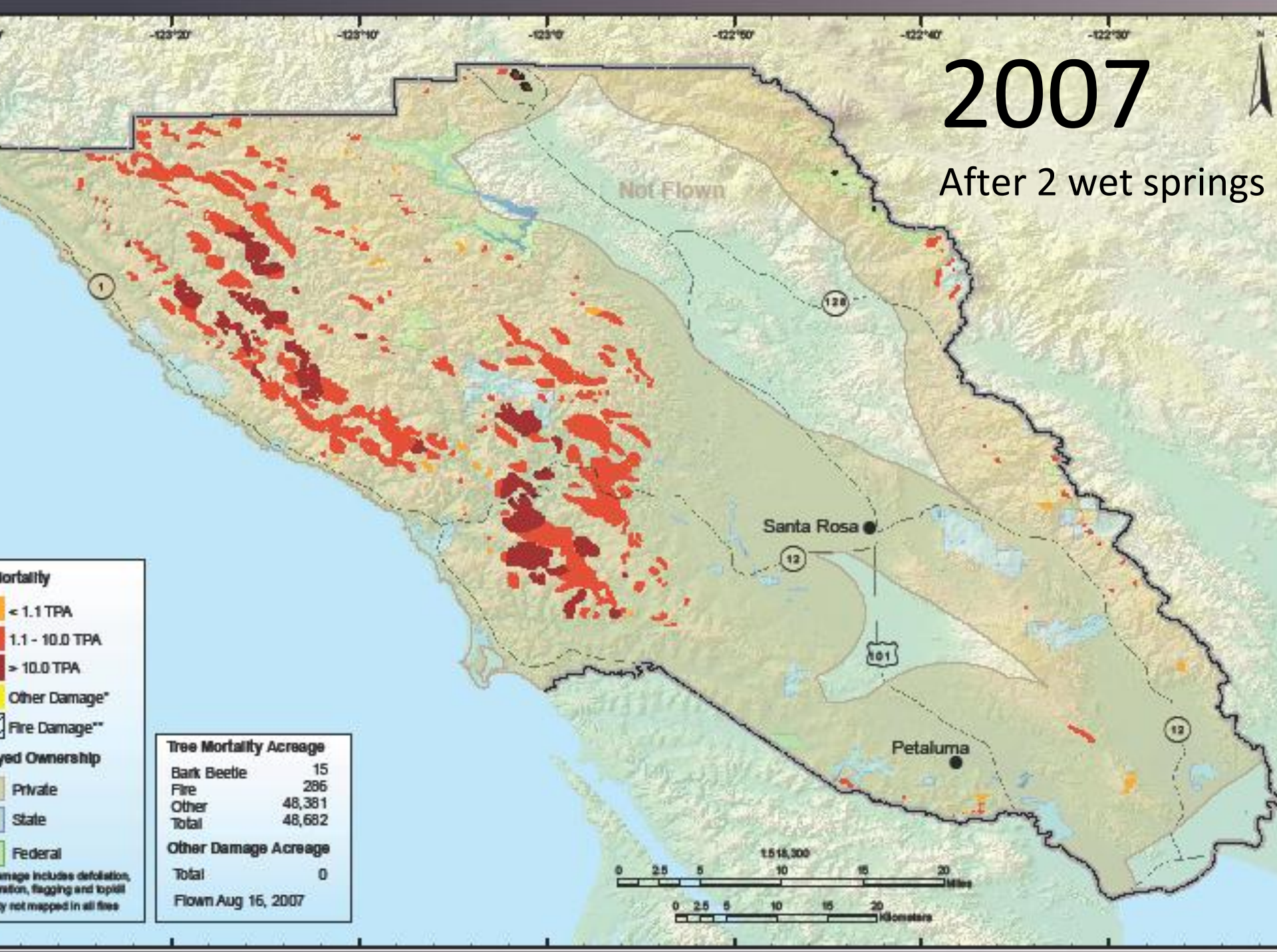
Rainfall

Phytosphere Research

Annual Aerial Survey maps Hardwood Mortality

Differences between
wet springs and dry springs


2009
After 3 dry springs
Not Flown
Santa Rosa
Petaluma
Not Flown
Tree Mortality
< 1.1 TPA
1.1 - 10.0 TPA
> 10.0 TPA
Other Damage*
Surveyed Ownership
Private
State
Federal
*Other damage includes defoliation, discoloration, flagging and topkill
Tree Mortality Acreage
Bark Beetle 17
Fire 2,869
Other 2,886
Total
Other Damage Acreage
Total 54
Flown Jul 7 & 8, 2009
1:520,000
Miles
Kilometers


2007
After 2 wet springs
Not Flown
Santa Rosa
Petaluma
101
12
128
1
Mortality
< 1.1 TPA
1.1 - 10.0 TPA
> 10.0 TPA
Other Damage*
Fire Damage**
yed Ownership
Private
State
Federal
mage includes defoliation,
ation, flagging and topkill
y not mapped in all fires
Tree Mortality Acreage
Bark Beetle 15
Fire 286
Other 48,381
Total 48,682
Other Damage Acreage
Total 0
Flown Aug 16, 2007
1:518,300
0 2.5 5 10 15 20 Miles
0 2.5 5 10 15 20 Kilometers

Hardwood Mortality

USDA Forest Service aerial survey

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Acres affected	22,788	28,914	48,360	14,055	2,574	482	3,880	22,709	19,619
Dead trees	76,512	184,409	491,881	30,642	3,314	734	13,520	136,918	113,899

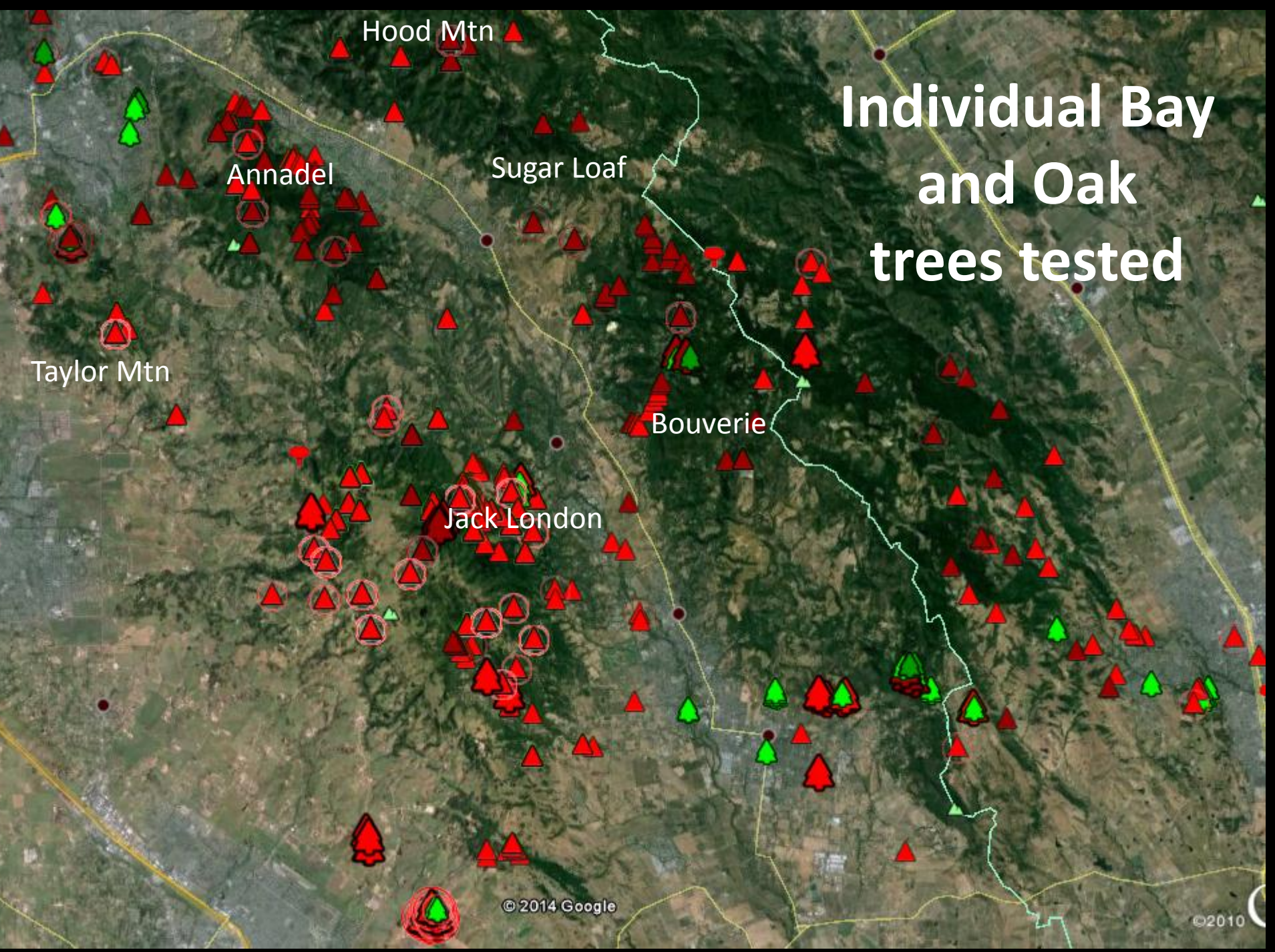
Testing individual trees

SOD BLITZ Monitoring

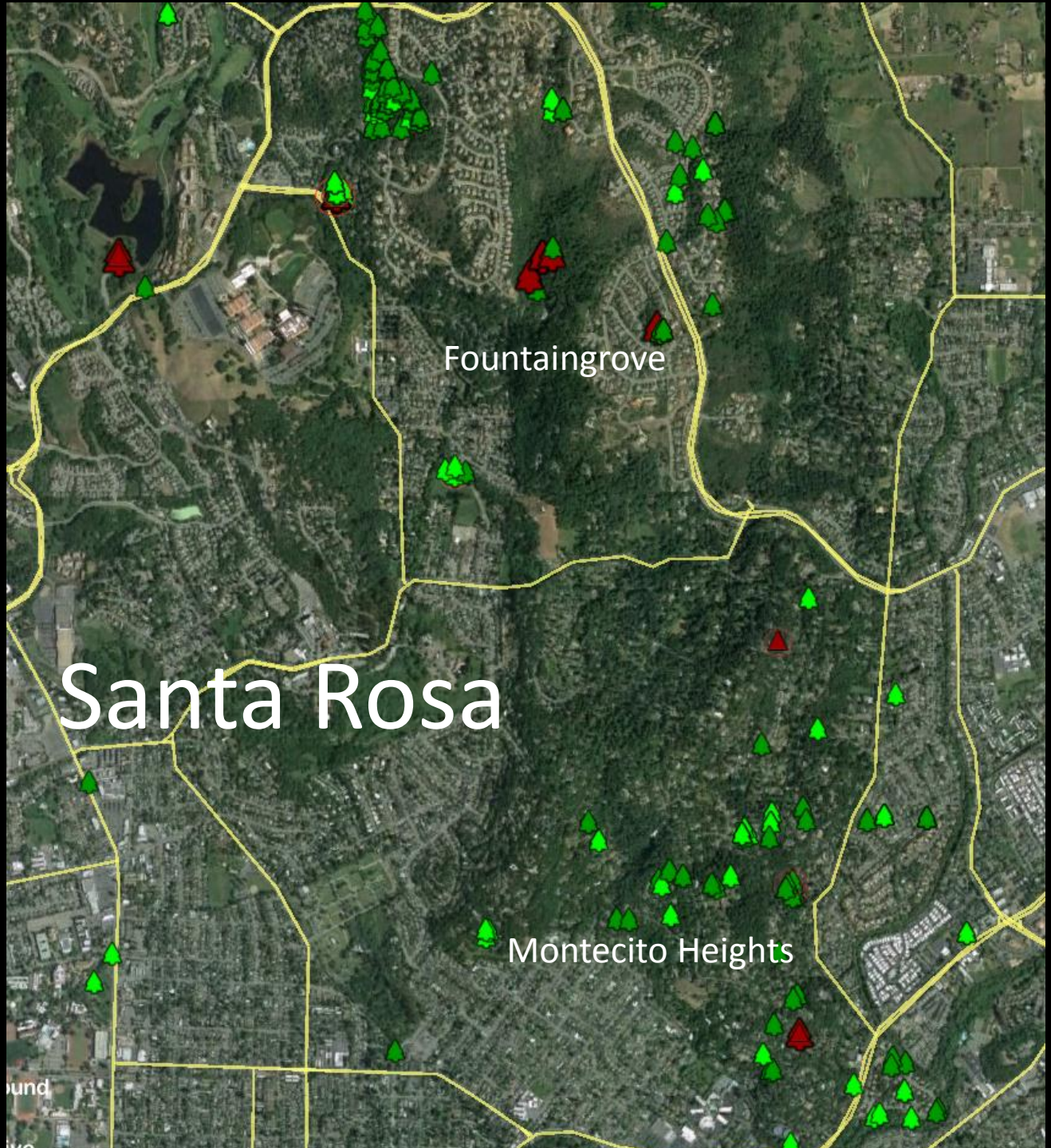
- ID symptoms
- Collect bay leaves

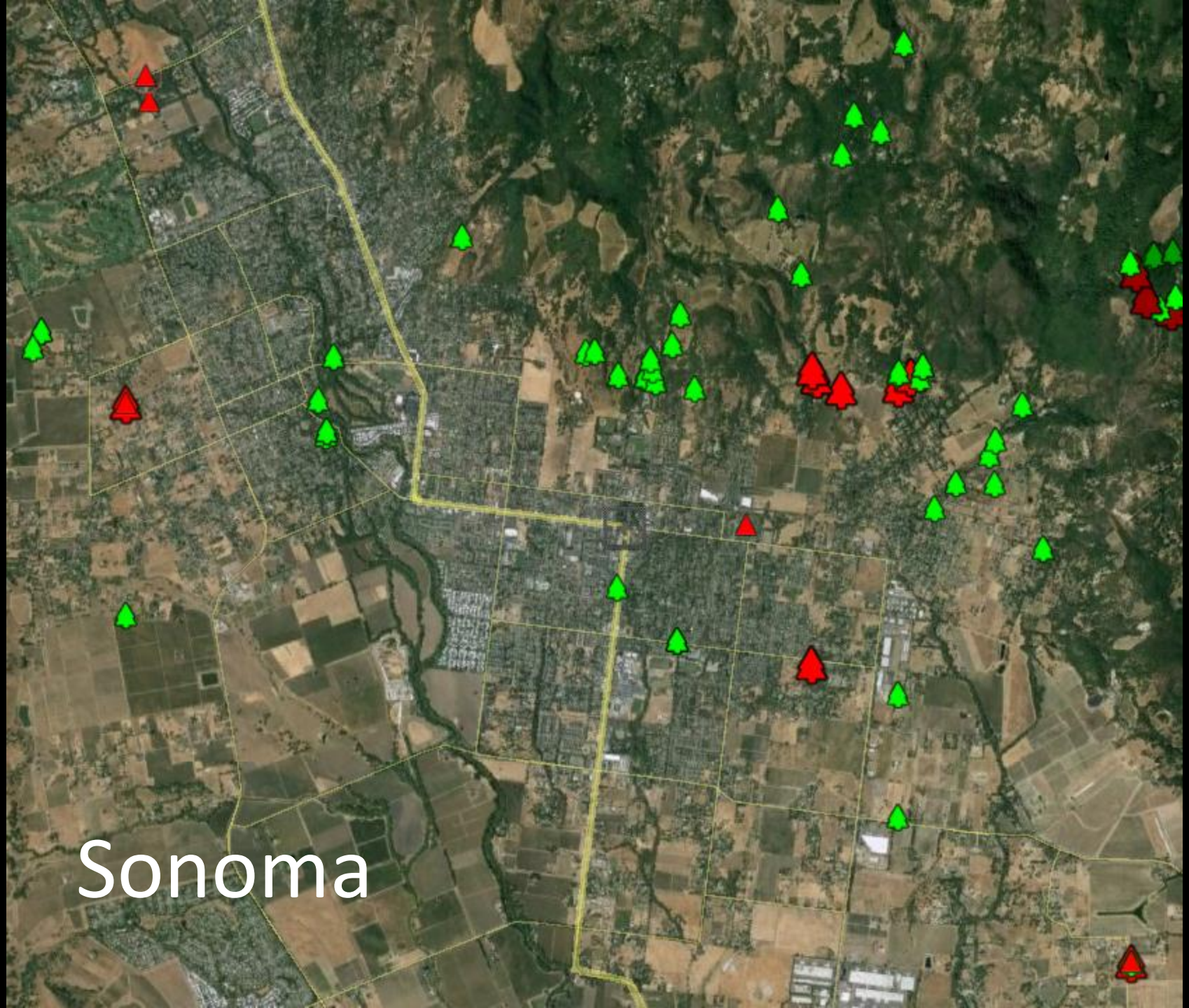
- Sent to UC Berkeley lab
- Results posted on Google Earth map
- Follow-up trainings/results workshop

Healdsburg



Individual Bay and Oak trees tested


Fountaingrove
Santa Rosa
Montecito Heights


Sonoma

Spread by people

- Initially spread from nursery plants
- Mud on shoes and bike tires
- Plant material on tools and machinery

Knock mud off tires, shoes, machinery

Watch nursery plants

United States Department of Agriculture
Forest Service

Pacific Southwest
Research Station

General Technical
Report
PSW-GTR-242

December 2013

A Reference Manual for Managing Sudden Oak Death in California

Tedmund J. Swiecki and Elizabeth A. Bernhardt

Management Actions Need Management Plans

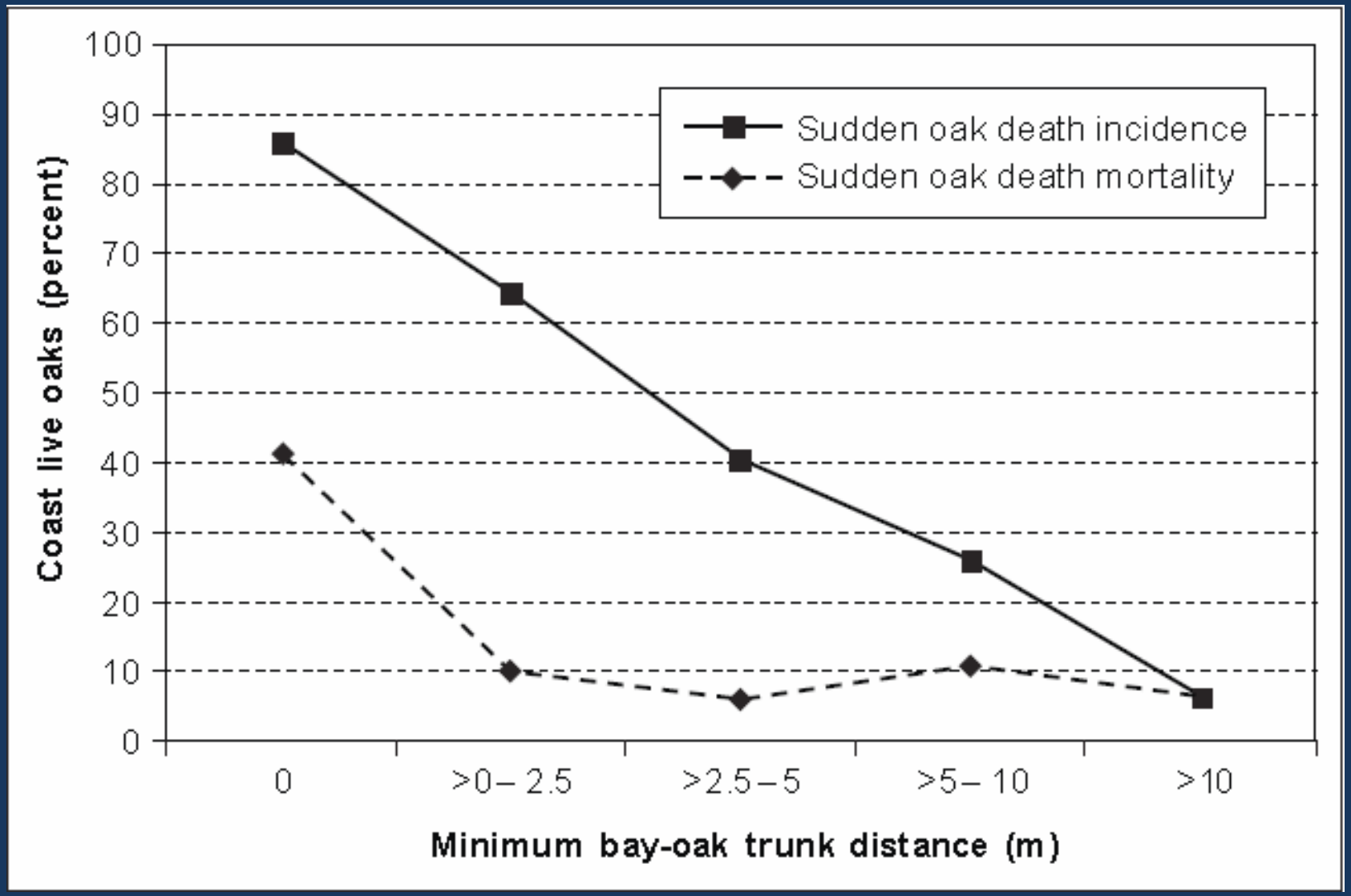
Prevent introduction (sanitation)

Reduce spore load: host removal (bay)

Avoid pruning oaks during wet season
Don’t get rid of oaks (just because they are infected)
Watch for fire or falling hazards, and act
Keep it on property: burn, chip, lop & scatter
Phosphonate application

Plant or replant with non-susceptible hosts

Bays nears oaks kill oaks



Phytosphere Research

For oak tree huggers

- Management manual by Swiecki
  - Pest and diseases
  - Urban oaks

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Thanks to the USDA Forest Service for funding the Sonoma County Sudden Oak Death Education Program.

UC Cooperative Extension
University of California
Division of Agriculture and Natural Resources