SOD BLITZes 2017: Results & New SOD Management Recommendations

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SOD Blitzes: a unique citizen science program

- Yearly volunteer-based survey to track expansion and contraction of the pathogen's range
- Volunteers collect over a weekend
- **UC Berkeley tests all samples**
- **Early Fall, results of yearly blitz are available and made public**
- Mid Fall, Blitz results added to SODmap
- SODmap mobile accesses data from SODmap :
  - App allows to identify sampled trees in the field
  - App calculates risk for oak infection at any locatio

Funding and acknowledgements

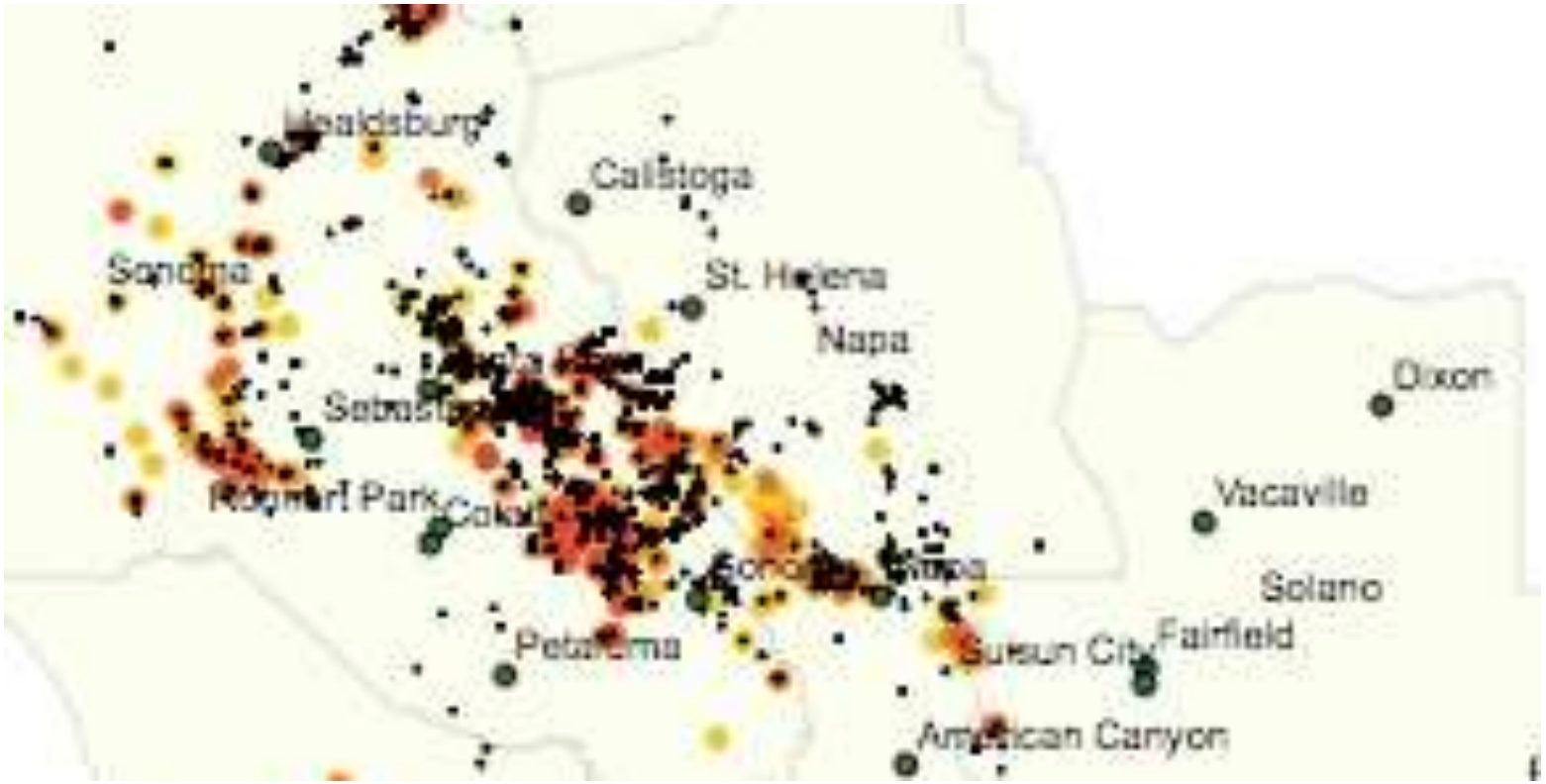
- United States Forest Service
  - **Region 5: Susan Frankel**
  - **State and Private Forestry: Phil Cannon**
- PG & E Foundation, San Francisco
- Mid Pen Open Space

- Local Organizers and CNPS who make the Blitzes possible

- Local and State organizations: Save Mount Diablo, National Parks, SFPUC, Mid Pen Open Space, Santa Lucia Preserve, State Parks, the UCSC Bot Garden, East Bay Regional Parks, Calfire, Sonoma State University

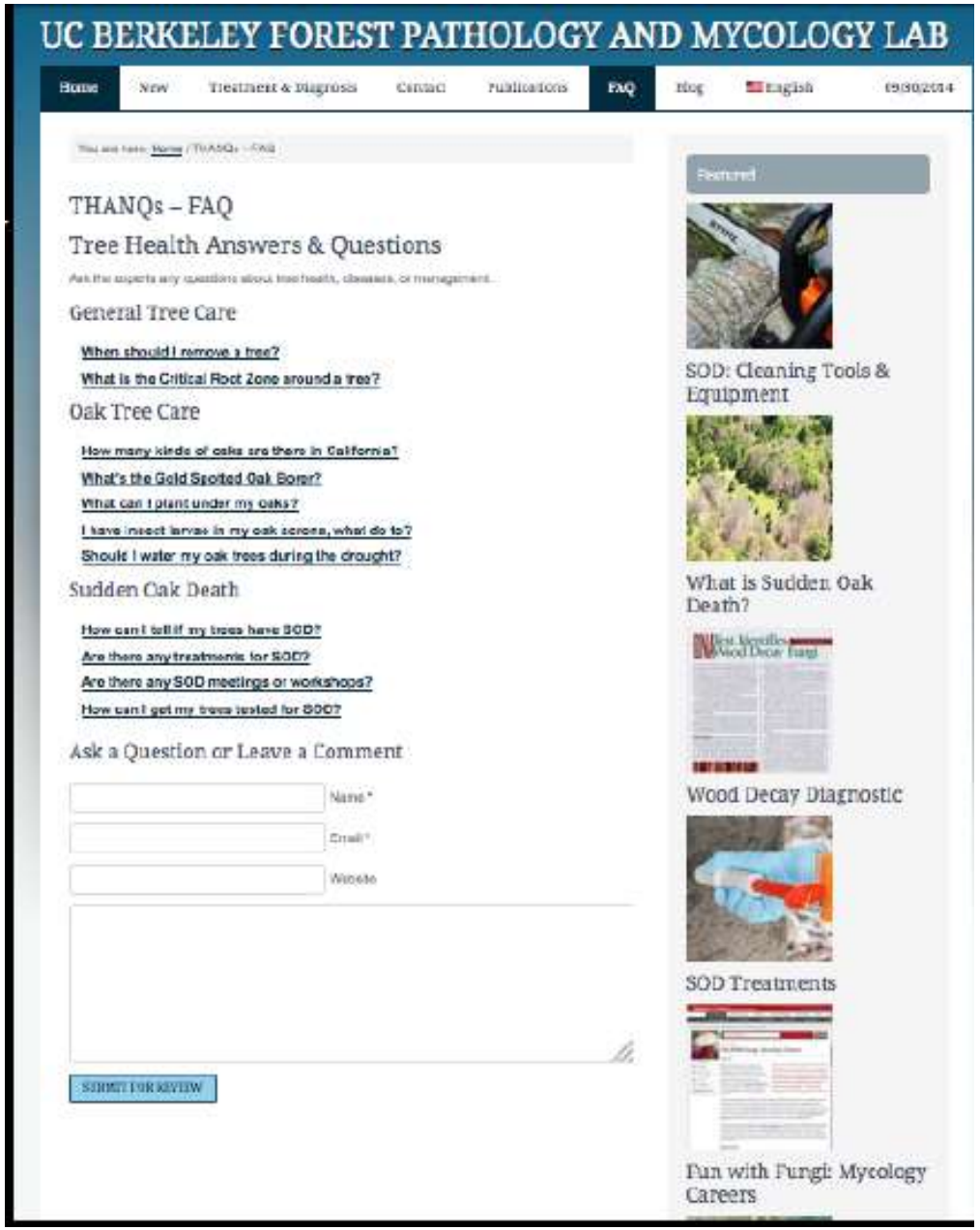
- Doug Schmidt, U.C. Berkeley

Devastating fires where SOD is high (red and orange areas)



- www.TreeFAQs.org

- Tree Health Answers & Questions
- Good or new questions are published



By submitting a question to **TreeFAQs.org**

- You will get an answer within approximately a week by the best experts in the field
- Your question will be published on the website by the same name and thus you will help to build a database of FAQs for California

You can also use TreeFAQs.org

- To let us know of wrong location of your samples on the SOD blitz map

- Please double check accuracy of sampled trees and provide us with feedback to improve quality

Sodblitz.org

- Summary table of 2017 SOD Blitzes
- Google Earth map of 2017 SOD Blitzes
- Conversion excel file that allows *blitzers* to identify trees they sampled

Sodmap.org

- Google earth map of all SOD distribution data (updated when new blitz results come in)
- SOD heat maps

Sodmapmobile.org

- Companion file that explains in depth how to best use the free APP (Apple and Google Play)

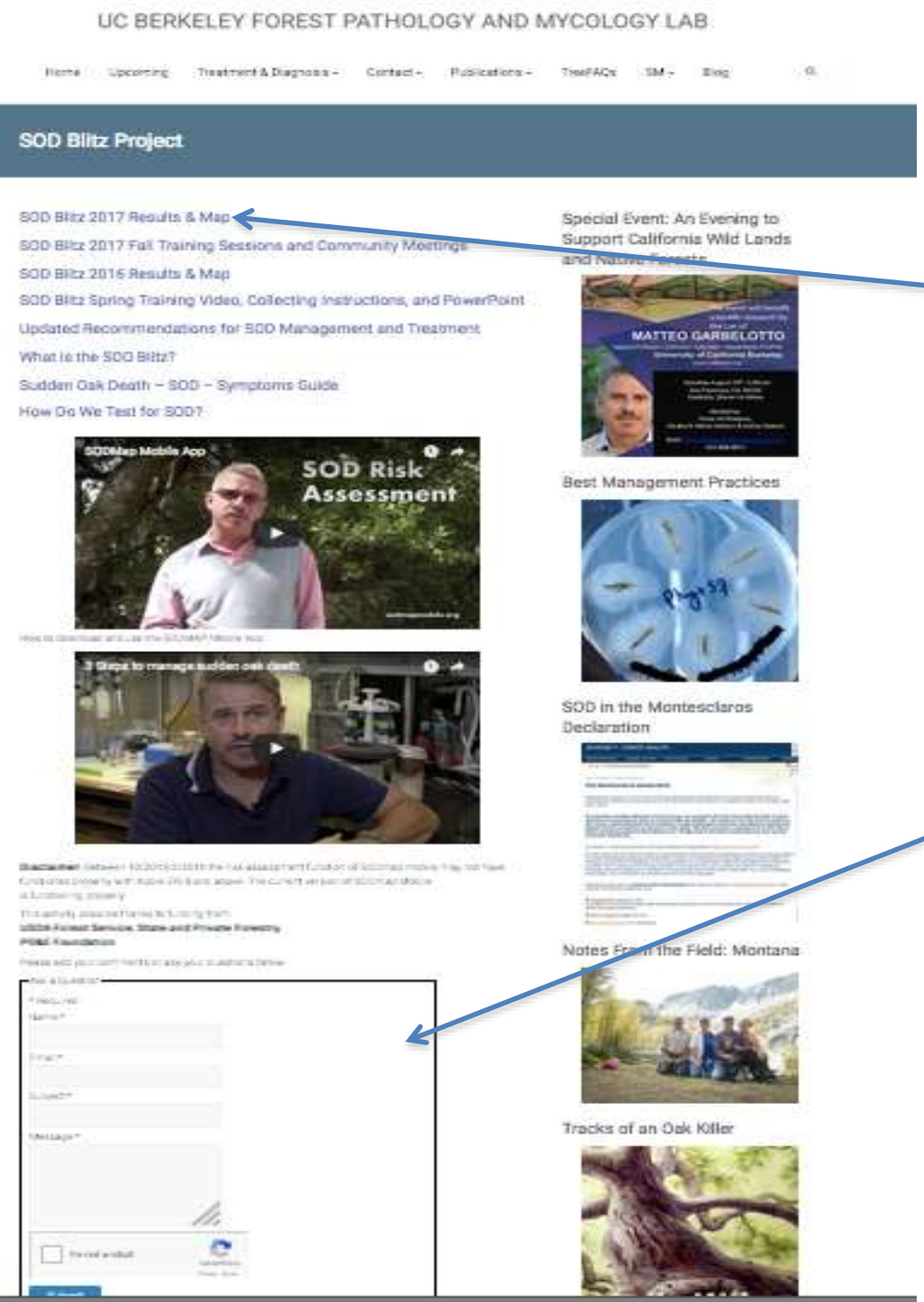
SODmap mobile

- Video that shows how to use the APP

SODmap mobile

Matteolab.org

- All other websites contained in it
- New recommendations to manage SOD



SODblitz.org

Results: map, table, conversion file

Correct wrong tree locations

- 2017 Results page

MAP

SUMMARY TABLE

CONVERSION FILE

SOD Blitzes 2017: some statistics

- A total of 23 Blitzes, including three on tribal lands, Kurok and Kashia. Largest area ever surveyed
- Siskiyou (OR border) the Northernmost
- San Luis Obispo (Santa Barbara border), Southernmost
- 315 collectors, 600 participants
- Trees surveyed: 15000!
- Trees sampled: 2000
- Rate of Positive trees 31%
- True Infection rate: 13%: **largest ever recorded in 10 years of Blitzes** (9 years of data)

Citizen science helps predict spread of sudden oak death

By Sarah Yang, Media Relations | May 1, 2015

BERKELEY — Efforts to predict the emergence and spread of sudden oak death, an infectious tree-killing disease, have gotten a big boost from the work of grassroots volunteers.

A joint study reveals the power of citizen science in SOD Blitz, a survey project in which volunteers are trained to identify symptoms of sudden oak death. Led by Matteo Garbelotto at UC Berkeley and Ross Meentemeyer at North Carolina State University, the study was published today (Friday, May 1) in the journal *Frontiers in Ecology and the Environment*.

Two volunteers collect samples in the East Bay during the 2014 SOD Blitz. (Photo by Douglas Schmidt, UC Berkeley)

Sudden oak death is a fungus-like disease that has felled hundreds of thousands of trees in California. Crowdsourcing the survey and sampling work allowed researchers to gather information that would otherwise be too impractical and cost-prohibitive to obtain. Researchers then used the data to create a model that predicts the presence of the sudden oak death pathogen, *Phytophthora ramorum,* based upon such variables as rainfall and density of host trees.

Study authors compared the model based upon crowdsourced data gathered from the 2008-2013 blitzes with models using "pre-Blitz" research observations collected from 2000 to 2007. They found the SOD Blitz model to be more powerful, correctly predicting the presence of the pathogen 74 percent of the time, compared with models based on other sources of data.

3 rather substantial papers published using crowdsourced data

forests

MDPI

Article

Environmental Factors Driving the Recovery of Bay Laurels from *Phytophthora ramorum* Infections: An Application of Numerical Ecology to Citizen Science

Guglielmo Lione [1,2], Paolo Gonthier [1] and Matteo Garbelotto [2,*]

precipitation

slope

temperature

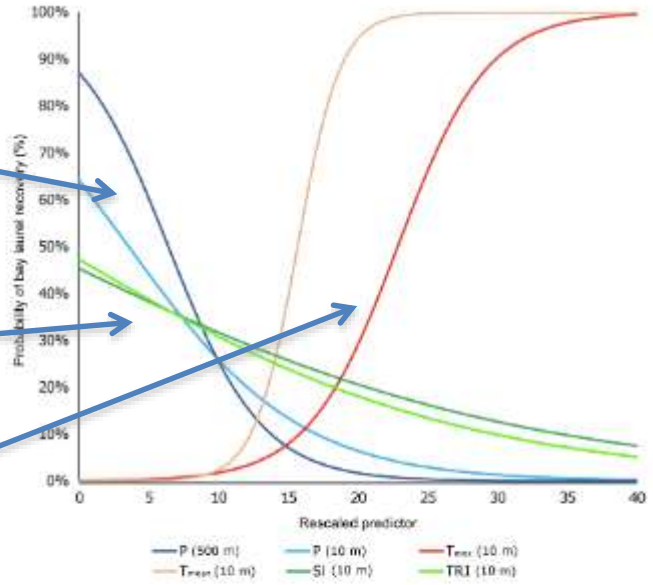
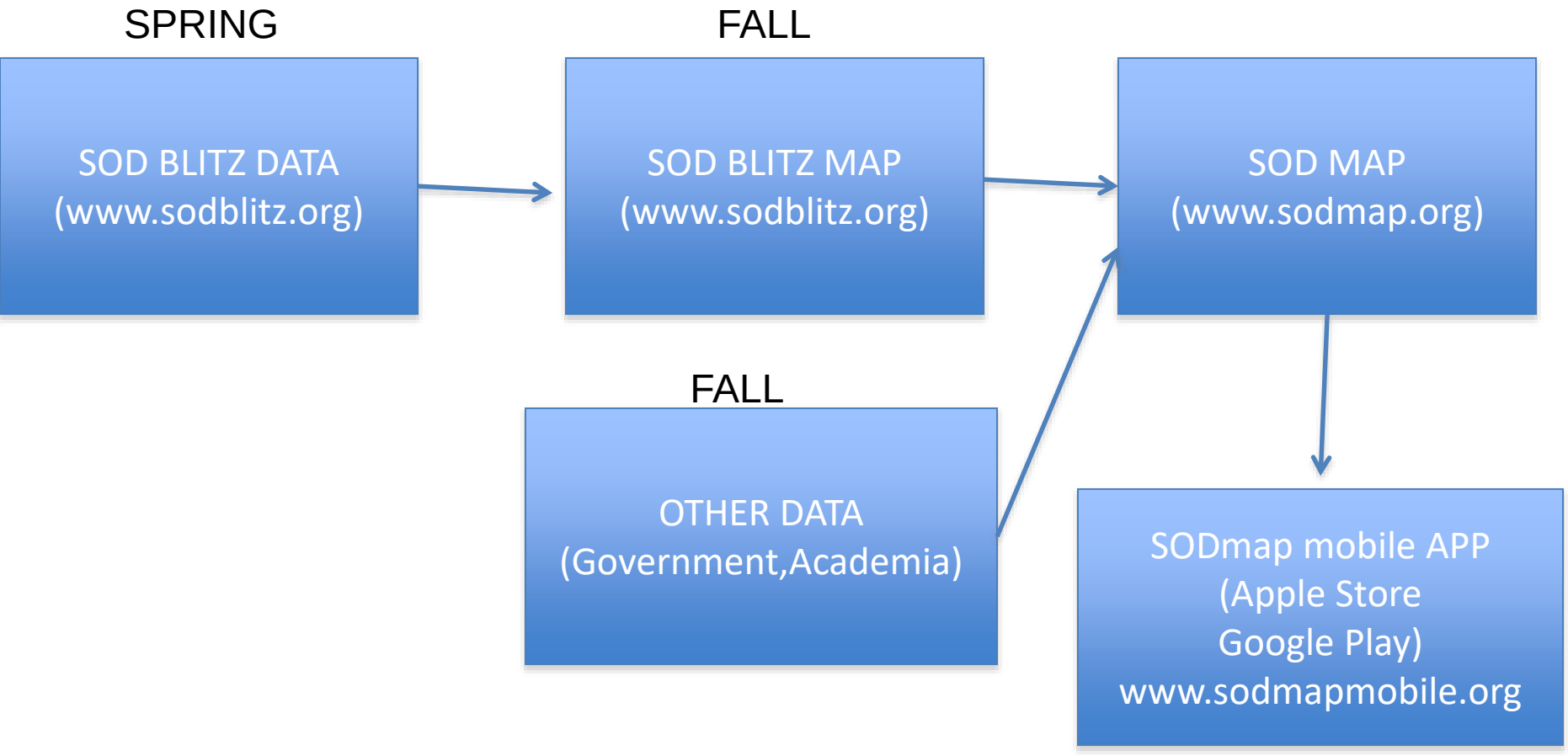


Figure 6. Graphs of the logistic equations modelling the probability of bay laurel recovery based on the single significant predictors detected in scenario-500 m (500 m) and scenario-10 m (10 m). The abscissa (rescaled predictor) represents each factor eventually rescaled so that one unit equals: 100 mm for precipitations (P), 1 °C for temperatures (T), 1% for slope (Sl) and 10 points of terrain ruggedness index (TRI). For more details about factors acronyms, see the main text.

Data flow chart



Area	Trees Sampled 2015	Estimated Infection rate 2015	Tree Sampled 2017	Estimated Infection rate 2017	2015-107 Fold Difference in Infection rate
Big Sur	41	19.2	4	55.3	2 + fold
Carmel	287	6.7	214	18.9	2.5 fold
East Bay-East	**115**	**1.5**	**43**	**15.3**	**10 fold**
East Bay-South	9	0.0	6	0	0
East Bay-West	376	3.3	97	7.3	2+ fold
Lake County	11	0.0	1	100	Cannot be calculated
Marin	263	7.9	129	19.5	2+ fold
Mendocino	61	0.3	45	0.6	2 fold
Napa	90	5.9	129	0.5	Areas sampled were different
Peninsula-East	**59**	**2.5**	**54**	**37.3**	**15 fold**
Peninsula-North	68	10.5	14	6.5	negative
Peninsula-South	182	13.5	126	38.1	3 fold
Peninsula-West	**148**	**2.9**	**225**	**14.3**	**4+ fold**
San Francisco	**146**	**0.2**	**165**	**1.3**	**5 fold**
San Luis Obispo	119	0.0	289	0	0
Santa Cruz	**9**	**2.8**	**91**	**19.4**	**10 fold**
Sonoma-East	**64**	**3.8**	**122**	**37.0**	**10 fold**
Sonoma-North	17	1.5	65	3.4	2 fold
Sonoma-West	84	12.6	96	21.1	1.5 fold
Total=	2168	3.7	1981	13	3 fold
Trinity Humboldt Siskiyou Countyies	19	0.0	71	0	Areas sampled were different

Note that:

- Probably only statewide % infection is easily comparable between years, due to "haphazard" sampling approach of SOD Blitzes

- There are two main sampling/survey approaches:
  - Focusing on symptomatic trees whether extensively (one sample every 100 yards) or intensively (one sample every 10 yards)
  - Set up of sentinel trees to catch infection when it first arrives: Trinity, Mount Diablo, San Luis Obispo

Know that:

- Infection on bay laurel indicates arrival of the pathogen but oak infection may require several more years and one or two years with higher than average rainfall, however if bays have tested positive for SOD, that is the indication it may be necessary to preventatively protect your trees from the pathogen

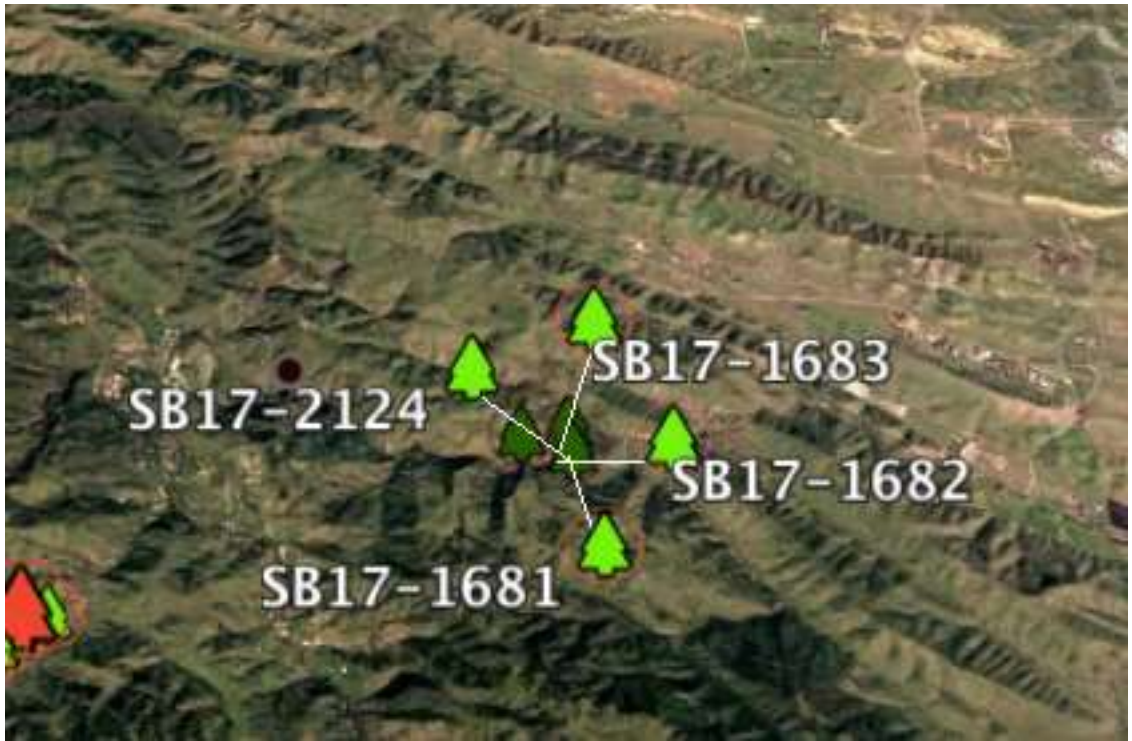
- Google Earth Platform
- All colored icons were tested
- Red= has SOD
- Green= had symptoms but not SOD
- Circle means oaks dying but for any reason (e.g drought)

Use these commands to:

move around map

enlarge it

Even when magnified, icons will stack. Click on one to see all icons in a so called spiderfy

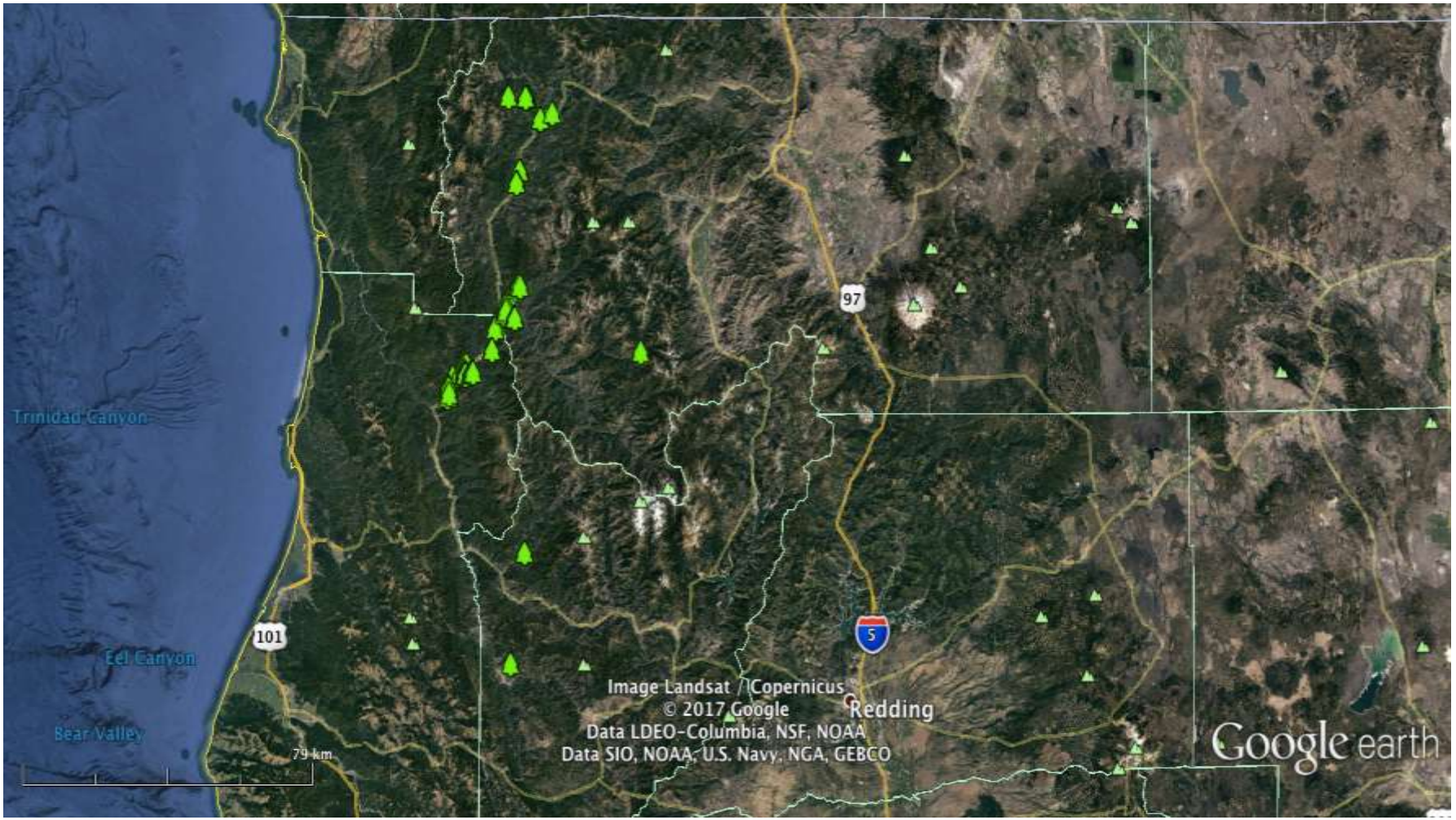


Most Interesting Findings of 2017 Blitzes- I

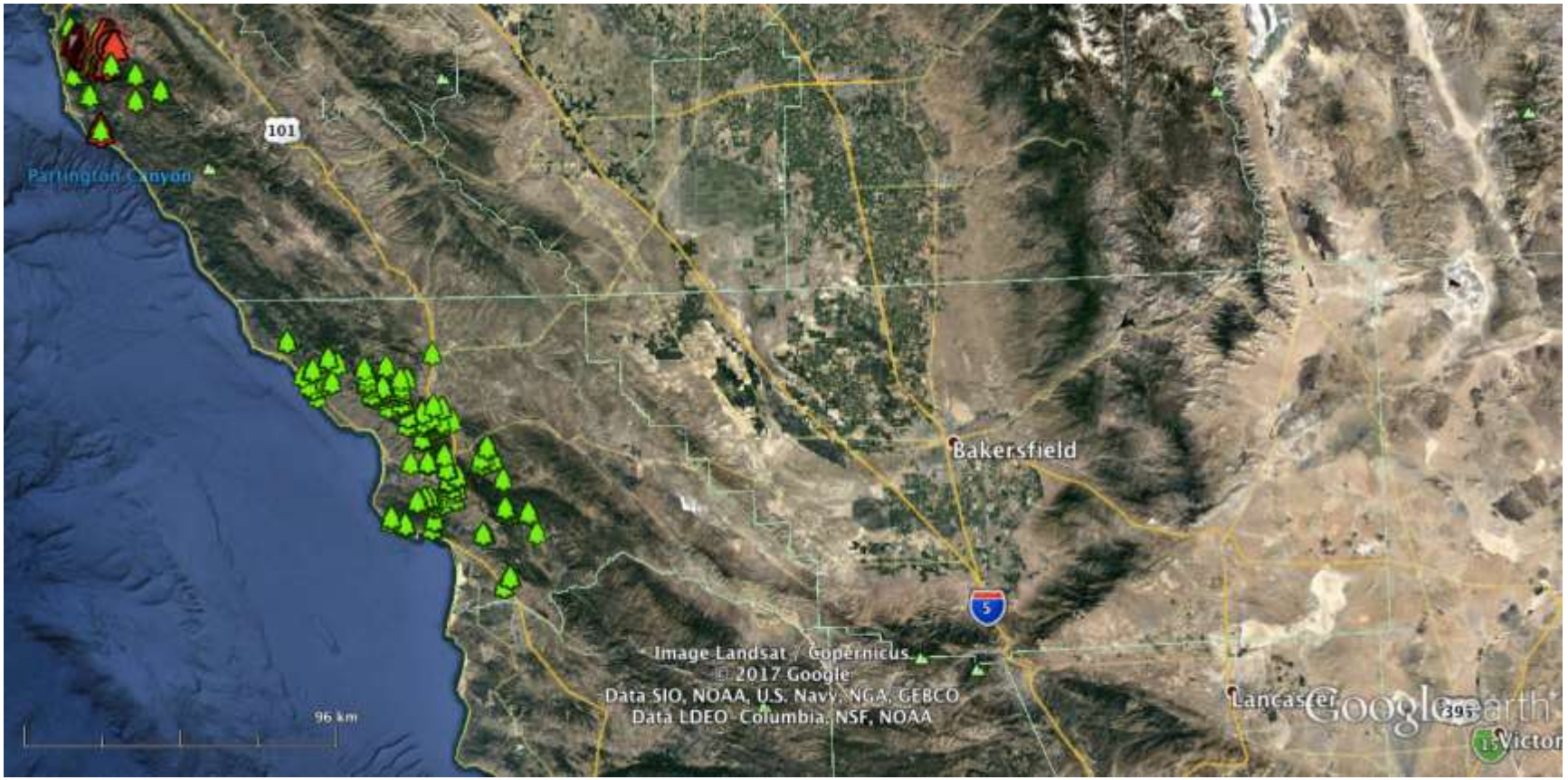
- San Luis Obispo County has been intensively resurveyed and all results indicate it is negative for SOD (2016 results were so called false positives)

- Siskiyou county samples were all negative, same for NorthEastern Humboldt and Trinity (note that Humboldt and Trinity have confirmed SOD in other locations

Sentinel networks: Siskiyou negative in 2017



Sentinel networks: San Luis Obispo negative in 2017

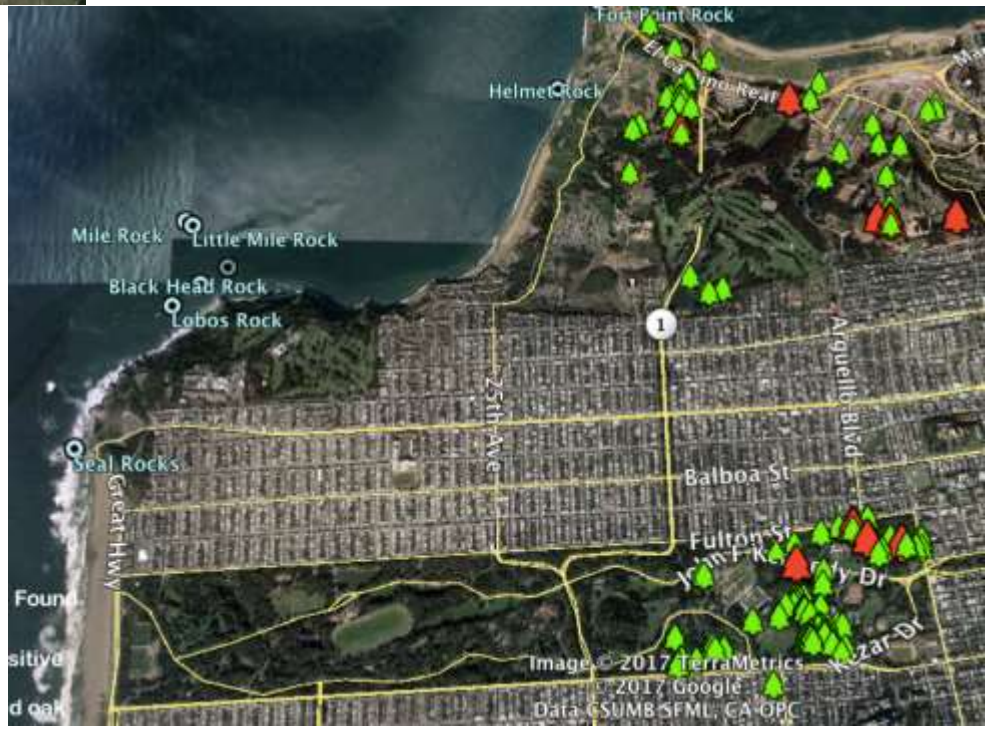


Most Interesting Findings of 2017 Blitzes-II

- Highly visited areas have significant outbreaks

- Point Reyes National Seashore Visitor Center
- Presidio National Park
- Main U.C. Berkeley campus and UC Berkeley Botanical garden
- UC Santa Cruz Arboretum
- Golden Gate Park : AIDS memorial grove

Point Reyes



San Francisco

UC Santa Cruz Arboretum

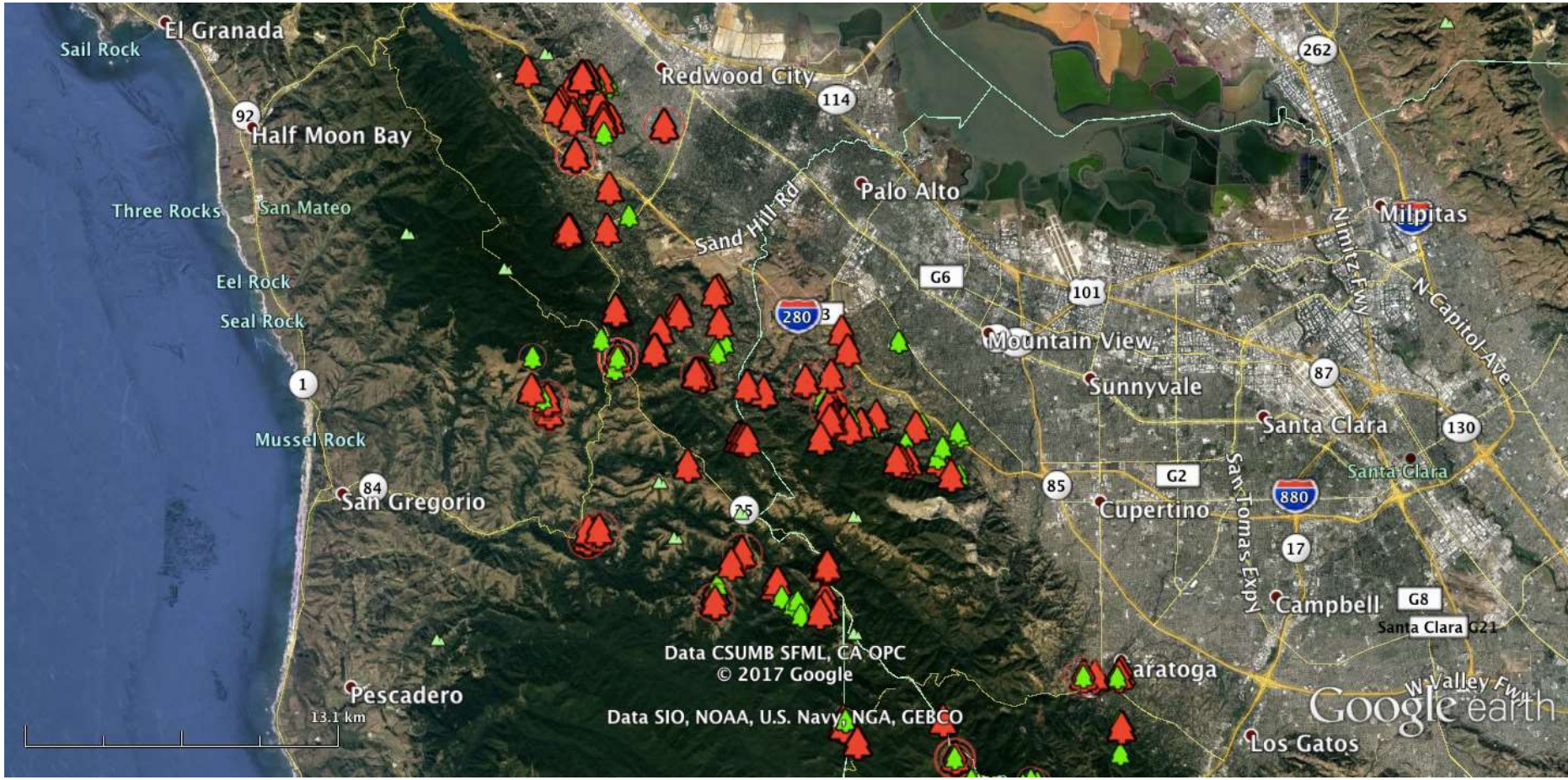
UC Berkeley

Most Interesting Findings of 2017 Blitzes-III

- Outbreaks in urban/rural areas and not only in forested areas

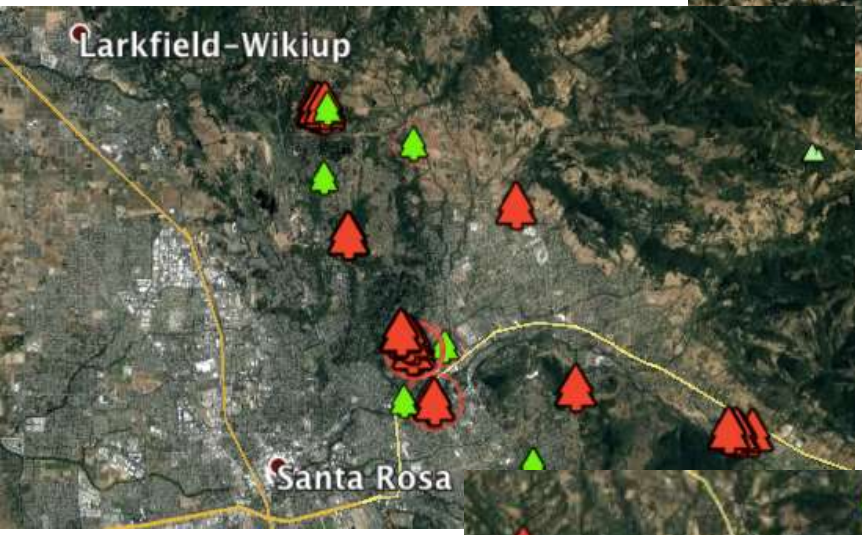
- SF Peninsula
- Sonoma County
- Carmel Valley
- East Bay

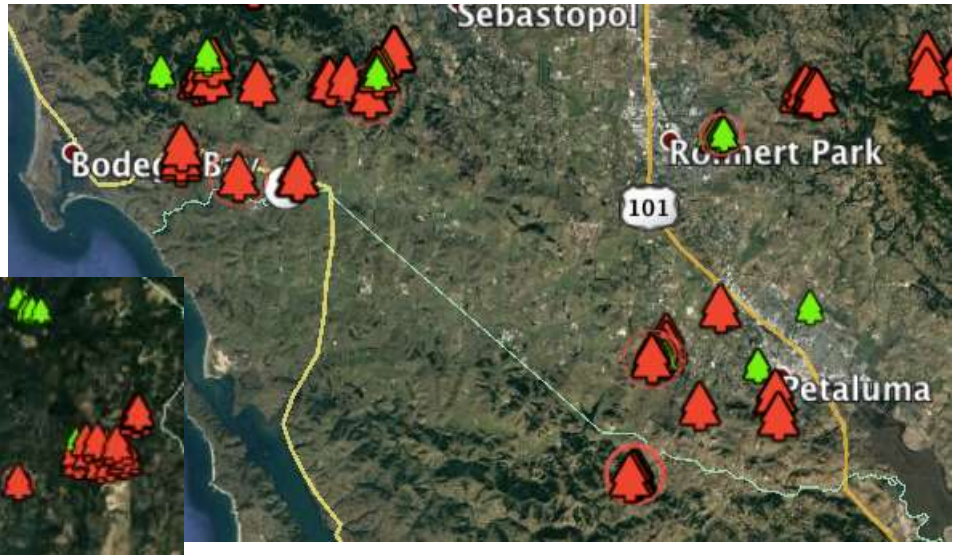
SF Peninsula: Redwood City to Saratoga



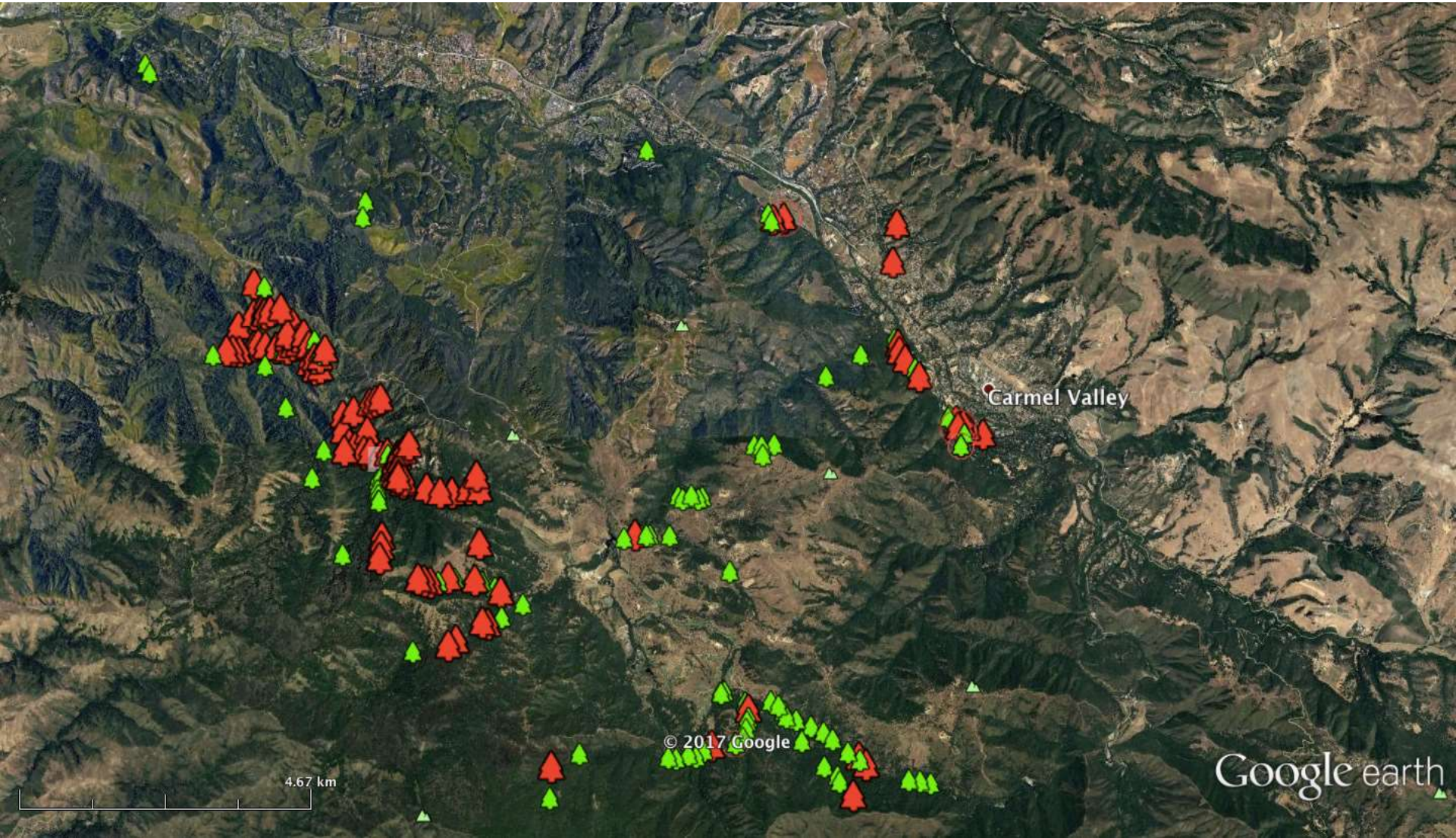
Also increasing in Western San Mateo County

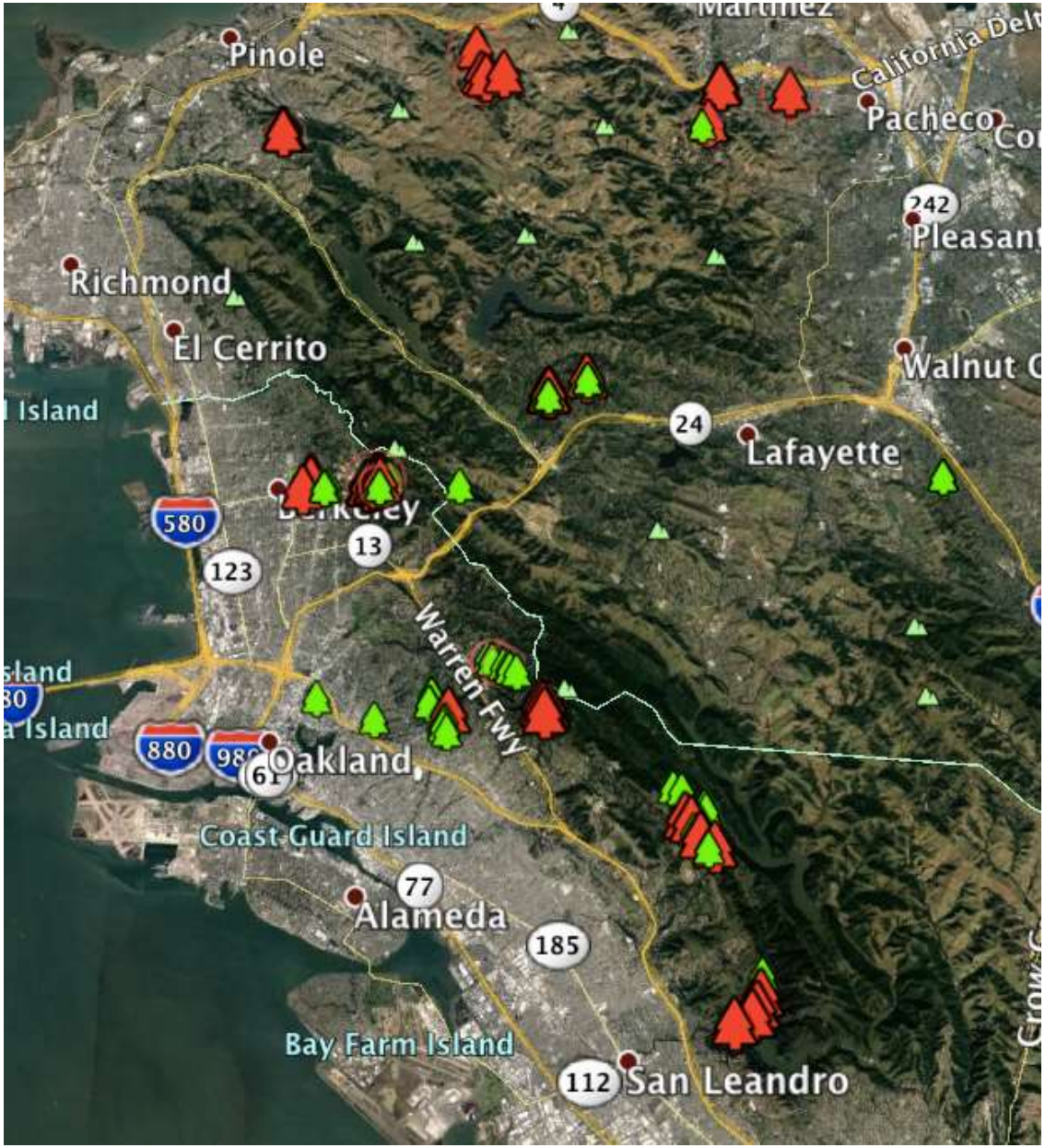
Sonoma and Southern Mendocino counties





Carmel Valley & SLP




Pinole
Pacheco
242
Richmond
El Cerrito
Walnut
Island
24
Lafayette
580
13
123
Warren Fwy
880
Oakland
Coast Guard Island
77
Alameda
185
Bay Farm Island
112
San Leandro

East Bay

Most Interesting Findings of 2017 Blitzes-IV

- Manzanita: native genus *Arctostaphylos*. California regarded as the world's region of maximum biodiversity for these plants and until 2017 regarded as a marginal host for SOD. AT LEAST 7 SPECIES MAJORLY AFFECTED: THIS WAS UNPREDICTED and has people scrambling to protect these rare species

Severe dieback of silverleaf manzanita

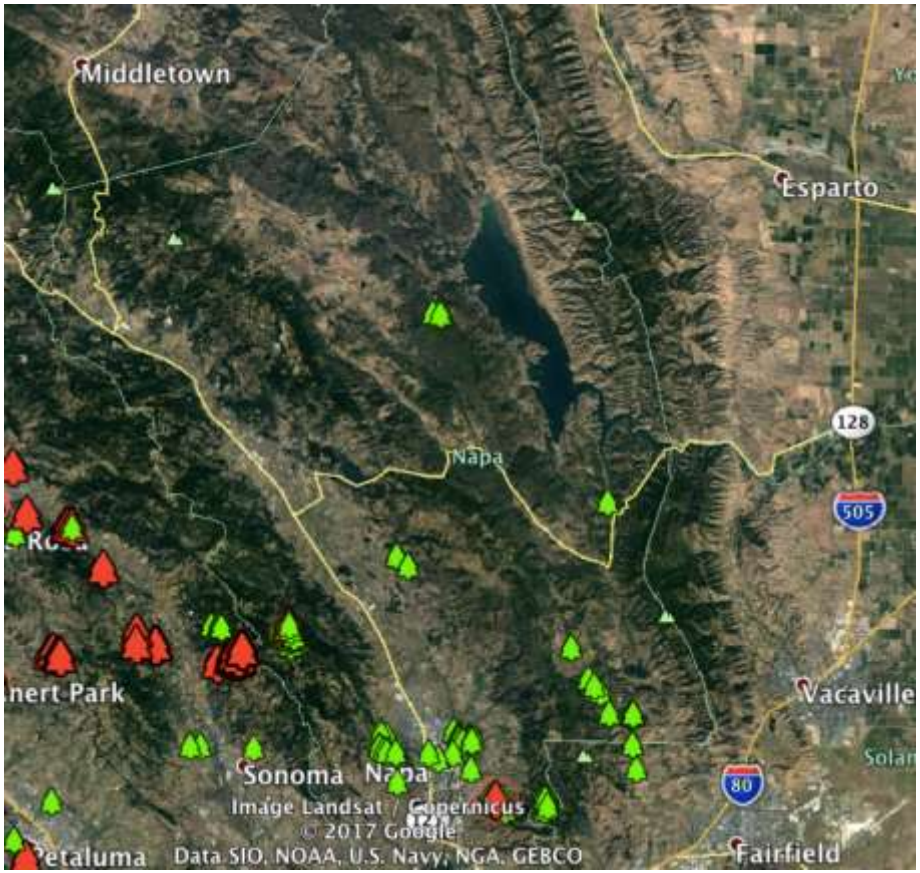
Severely affected:

A. A. montaraensis
B. A. silvicola
C. A. montereyensis
D. A. pumila
E. A. pilosula
F. A. morroensis
G. A. hooveri

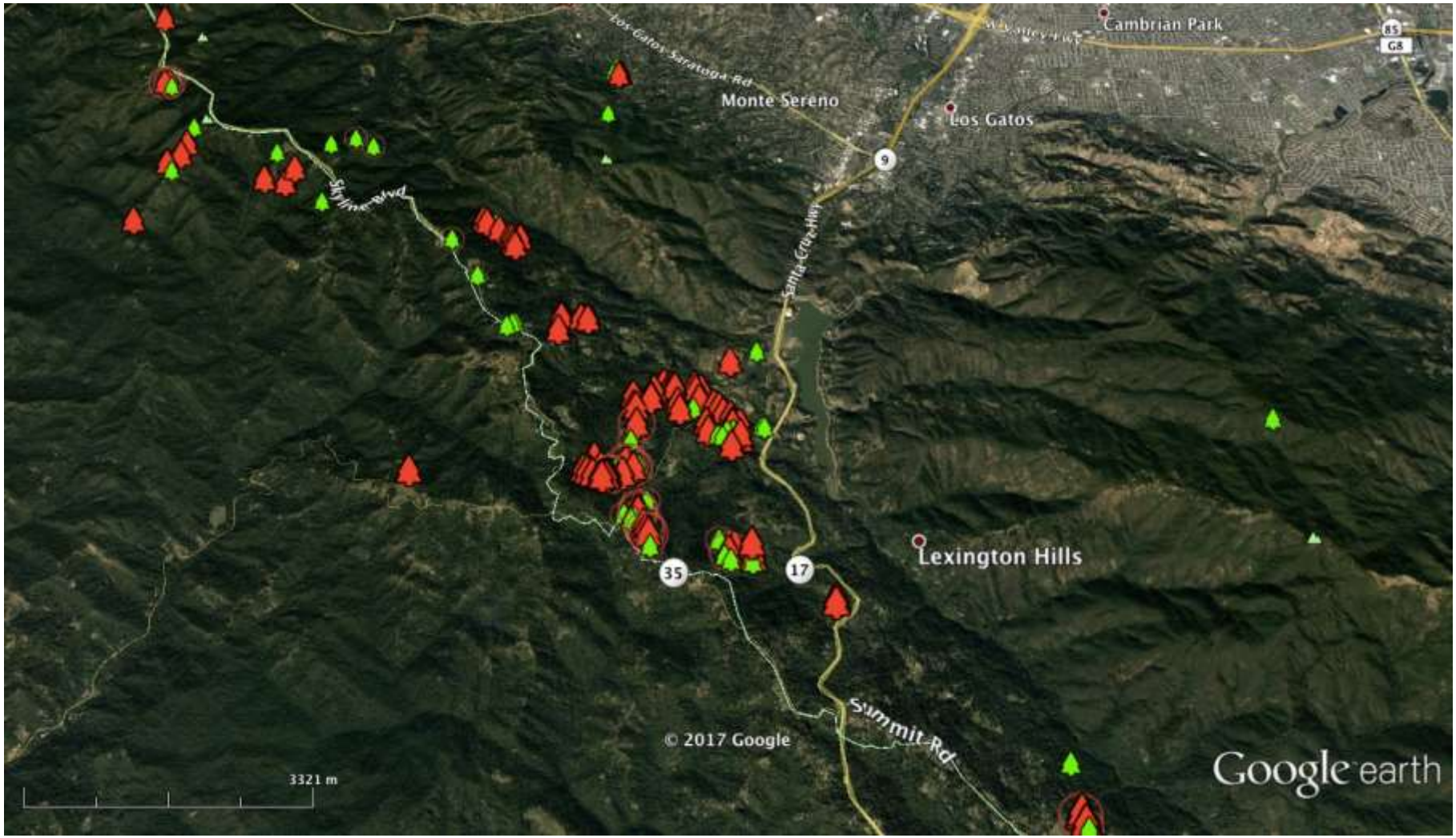
All are endangered and rare!!

Most Interesting Findings of 2017 Blitzes-V

- Napa County: warmer weather does not seem very conducive to SOD



Santa Clara-Santa Cruz County border wins the prize for worst infested



Sudden Oak Death

New disease caused by an exotic pathogen introduced in CA in thelate 80s probably from Asia through infested ornamental plants. Oaks are completely susceptible (up to 100% mortality)

Spreads by itself aerially by wind & rain during mild wet season (but only a few hundred yards)

Risk for oak infection **only** when pathogen is within 200 yards

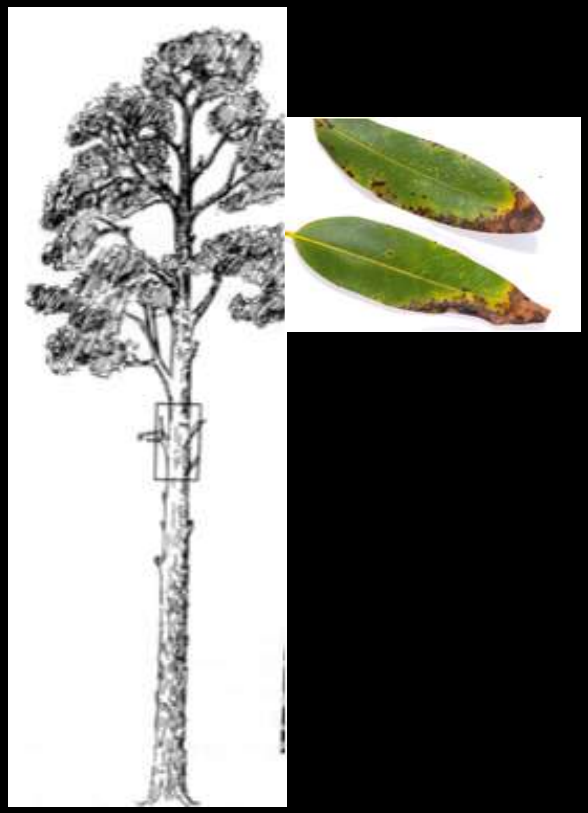
Need to have a fine-scale map of pathogen distribution





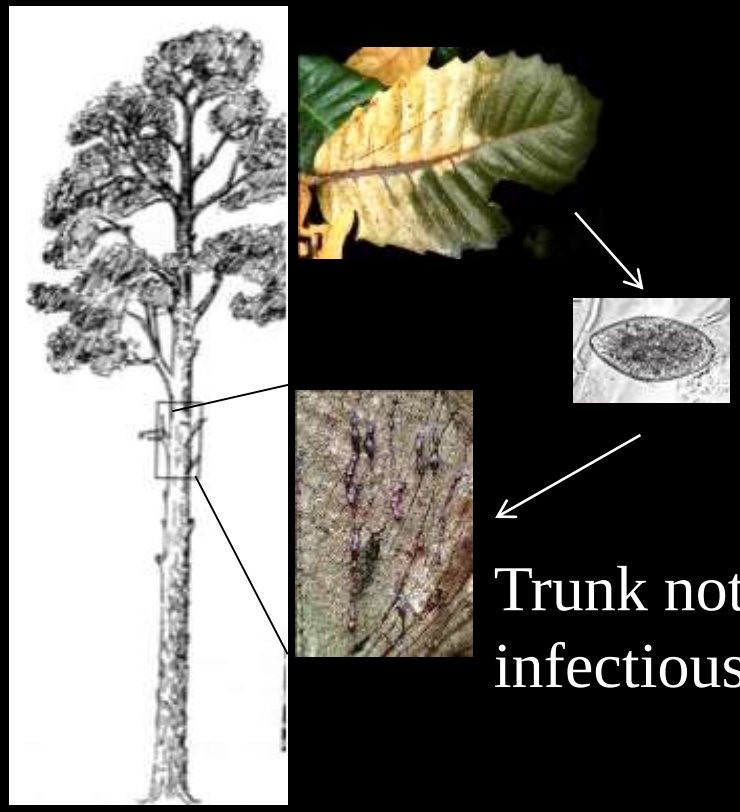
Infectious hosts in CA forests

- CA Bay Laurel



Only leaves,
highly infectious

- Tanoaks



Leaves, petioles, twigs=infectious
(Branches, trunks=not infectious)

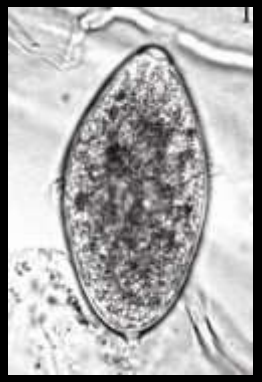
Bay/Oak association (not tanoak-oak)

Yearly, in spring

Coast Live Oak (no sporulation)

Canker margin in phloem

Wave years



Bleeding canker

Soil/Water

More on bay-oak transmission

- Oaks and bay have to be within 60 feet
- Rainfall needs to be exceptionally high 6 weeks prior to infection (this has happened only in 2000/2001; 2005/2006; 2010/2011; 2017)
- Temperatures need to rise to 70 F for infection to occur. Early rain is too cold.

Disease Management: 1st step

- Do I live in an area at risk for SOD?
- Are there California Bay Laurels and/or tanoaks where I live?
- Are my oak species:
  - California Coast Live Oak
  - California Black oak
  - Shreve's oak (Santa Cruz to Santa Barbara)
  - Canyon Live Oak
  - Tanoak

SODmap Mobile:

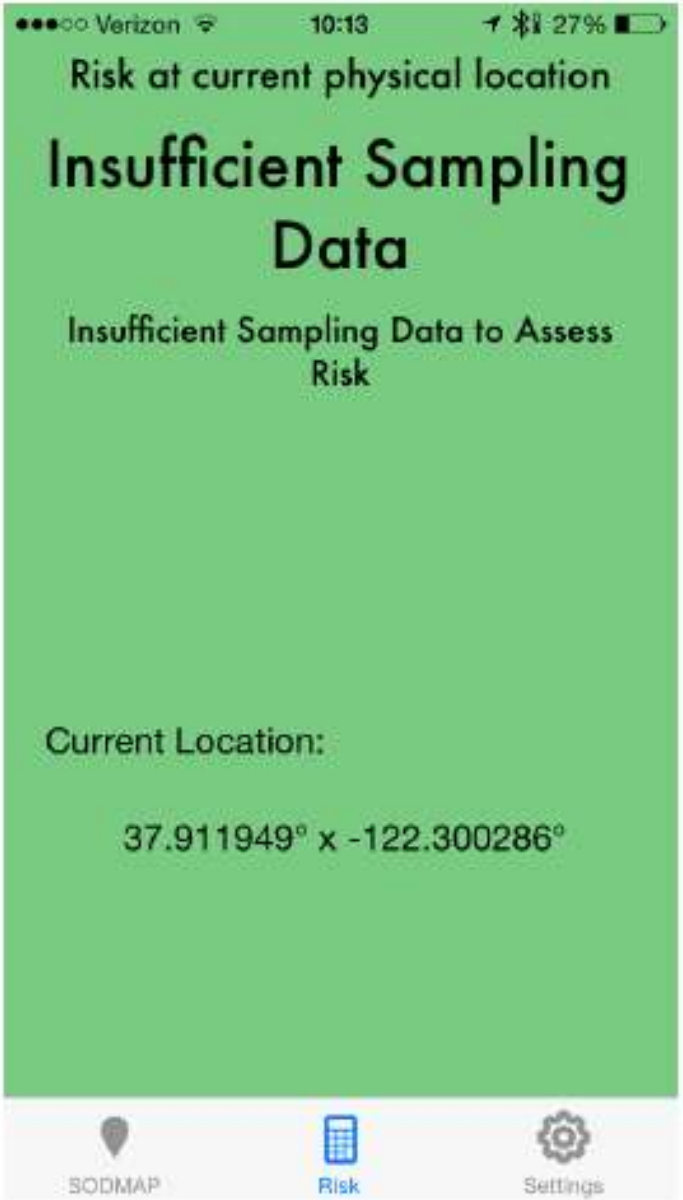
SODMAP Mobile

U.C. Berkeley
Forest Pathology
and Mycology
Laboratory

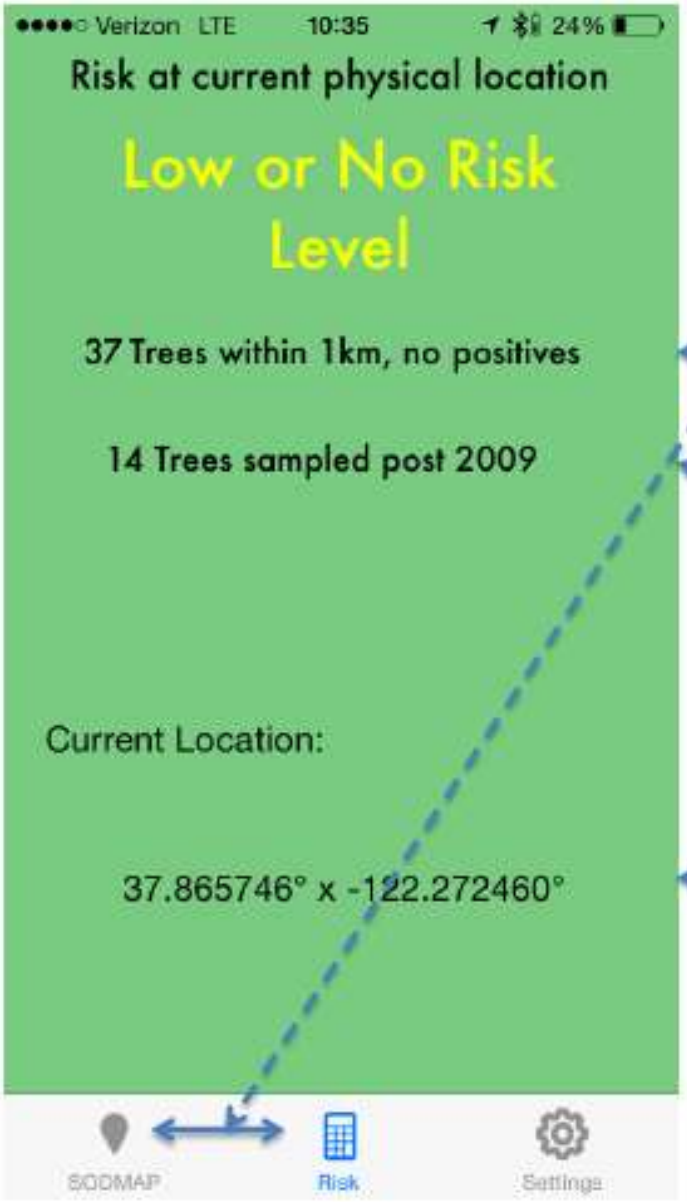
Enlarge screen view using your Index and thumb fingers

Red pins = SOD positive, tap to find out date and number

Tap on risk icon



Risk where you are physically standing



When assessing risk at a second location, remember to tap SODMAP button and then Risk button, in order to reset, otherwise you may get same warning as in the previous location

A two-digit number in this line gives you more confidence

Number > 4 in this line gives you more confidence

Precise location and coordinates of user: You can record if needed

Stay alert but no need to do anything

May want to do something

Urgent to do something if you have Oaks and bays growing together

What to do and when to act

- Insufficient data or low risk
  - Keep monitoring your bay trees for infection, by participating in one of the many SOD blitzes in the Spring of each year. For info and details go to www.sodblitz.org
- Moderate or high risk
  - Do most of the significant yard work (e.g. pruning, grading, cutting dead trees) in the late summer or fall
  - Selectively remove "key" bay laurel trees in Summer and Fall
  - Apply a preventive phosphonate treatment to oaks at risk in the late Fall (after Halloween and before Xmas)

2nd What to do

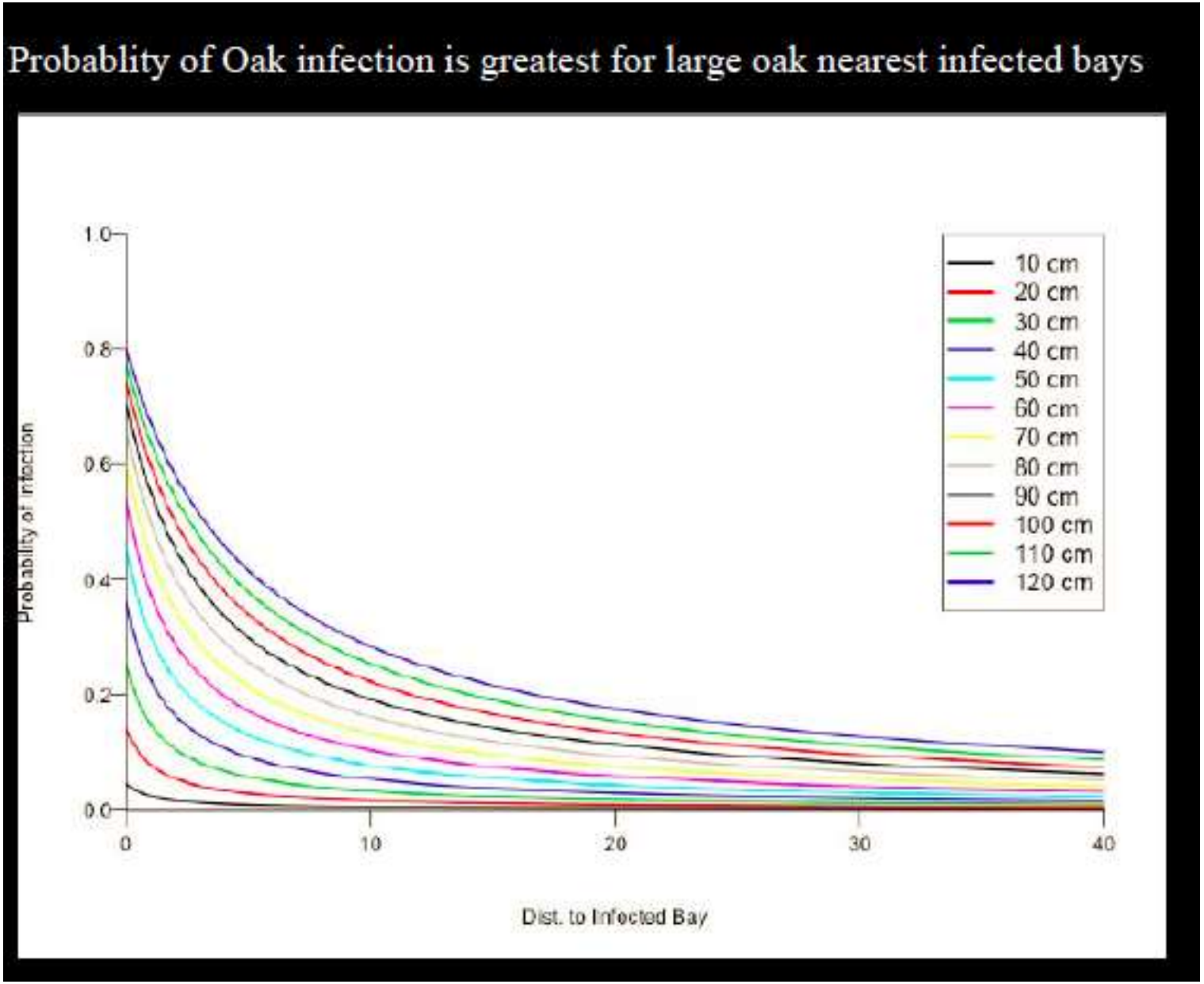
- Oaks are infected by spores produced on leaves of California Bay laurels
  - Selectively remove bay laurels around high value oaks
  - Reduce overall bay density in property

Symptomatic CA bay laurel

+ rainfall (over 400 mm)= oak infection

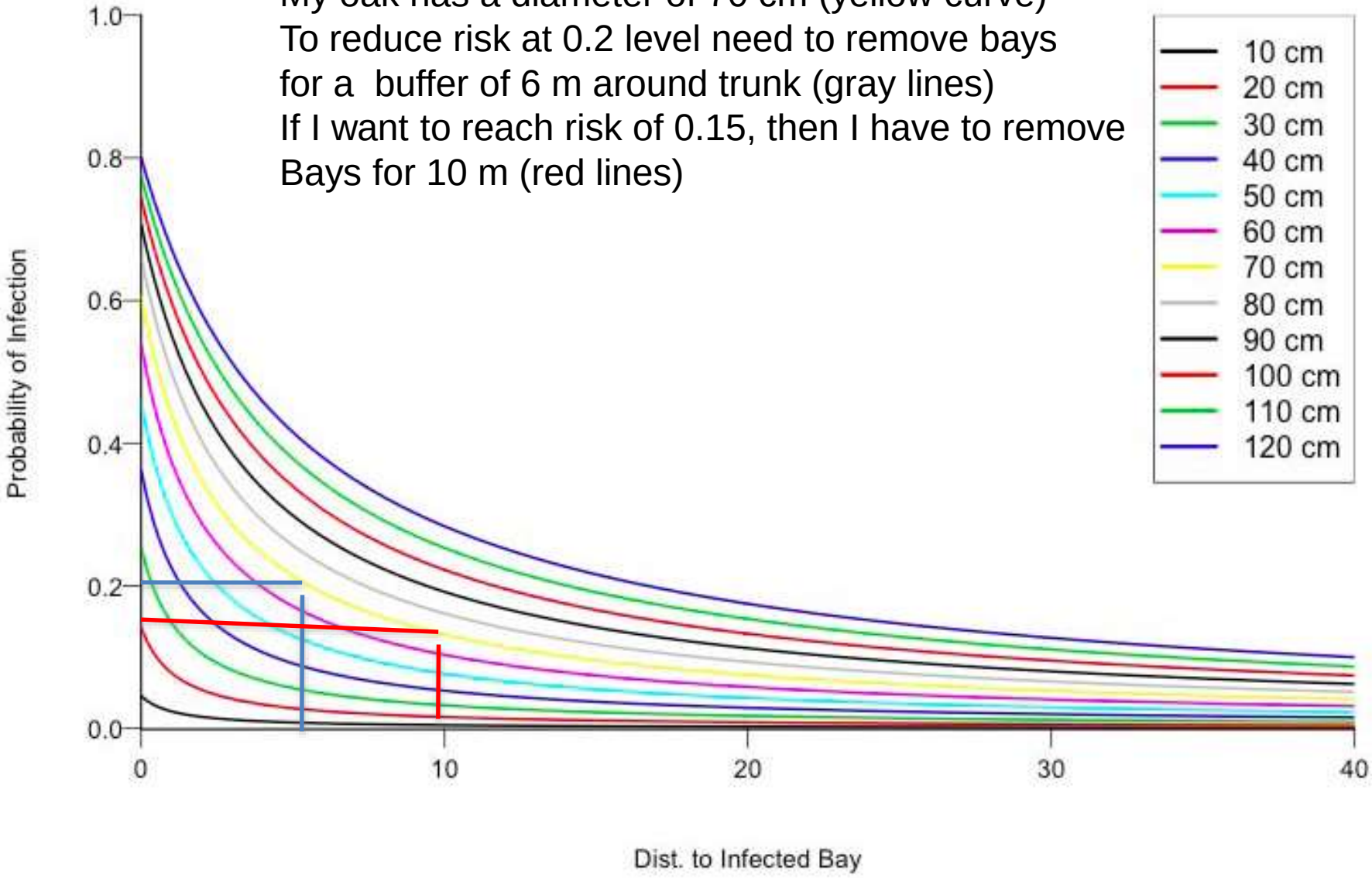
Probablity of Oak infection is greatest for large oak nearest infected bays

NEW!!!



Choose line depending on size of your oak. Risk should be no more than 0.2. Draw horizontal line from 0.2 until it intersects the line you picked based on size of oak. Draw vertical line at intersection point. On x axis is the minimum buffer zone where you should remove bay laurels

My oak has a diameter of 70 cm (yellow curve)
To reduce risk at 0.2 level need to remove bays
for a buffer of 6 m around trunk (gray lines)
If I want to reach risk of 0.15, then I have to remove
Bays for 10 m (red lines)

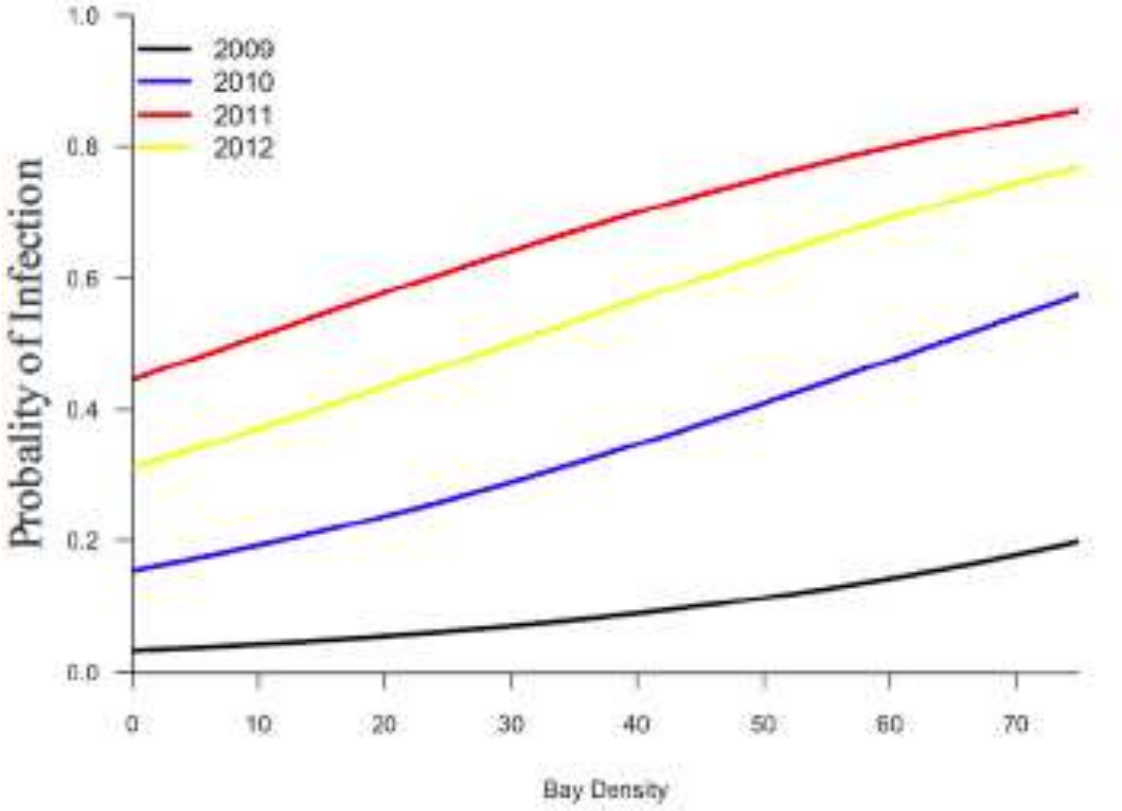


Drip-line to trunk distance (DTD)

If on a slope, or bay is upwind, increase distance 10 or 20 %

Reducing overall bay density beneficial (red line infection rate when it rains a lot; black line infection levels when dry)

NEW!!!



Which bays should I remove?

- Only up to 20 " diameter, only if slope not too steep, and only if tree further than 10 yards from a stream
- Remove bays whose canopy drip line is within 10 yards of oak trunk if oak diameter is 35" or less, for larger oaks try to remove bays in a buffer area up to 15-20 yards from oak trunk
- Remove bays that are SOD infected after long drought (i.e. SOD positive in 2014 blitz) if frequency of positives 20% or lower

Preventive treatments with phosphites aka phosphonates (I)

- Water soluble, neutral pH, systemically absorbed by plant they increase natural defenses of trees. If dosage is right, no significant side effects

- Treatments need to be applied on healthy trees in areas with confirmed SOD between Halloween and Christmas

Preventive treatments with phosphites aka phosphonates (II)

- Injections
- Multiple per tree but can use same injector
- Only diluted phophonate
- Once every two years in Fall
- Trees of all sizes

- Bark application
- Need to combine with Pentrabrak
- Once every year (unless soil was amended with gypsum)
- Trees with DBH under 45 cm (20 inches)

NEW!!!

Table 1. New recommended phosphonate injection dosages.

- Label Dose = 1 part chemical + 2 parts water = 1:3 delivered in 10ml dose (discontinued).
- Dilution #1 = 1 part chemical +29 parts water = 1:30 delivered in 20ml dose (Chemjet injector).
- Dilution #2 = 1 part chemical + 59 parts water = 1:60 delivered in 40ml dose with higher pressure (Arborjet injector).

Treatment once every two years

Injections using 40 mL and 35 PSI (Moderate Pressure)

20 mL and 20 PSI (low pressure)

Injected Phosphonate Efficacy

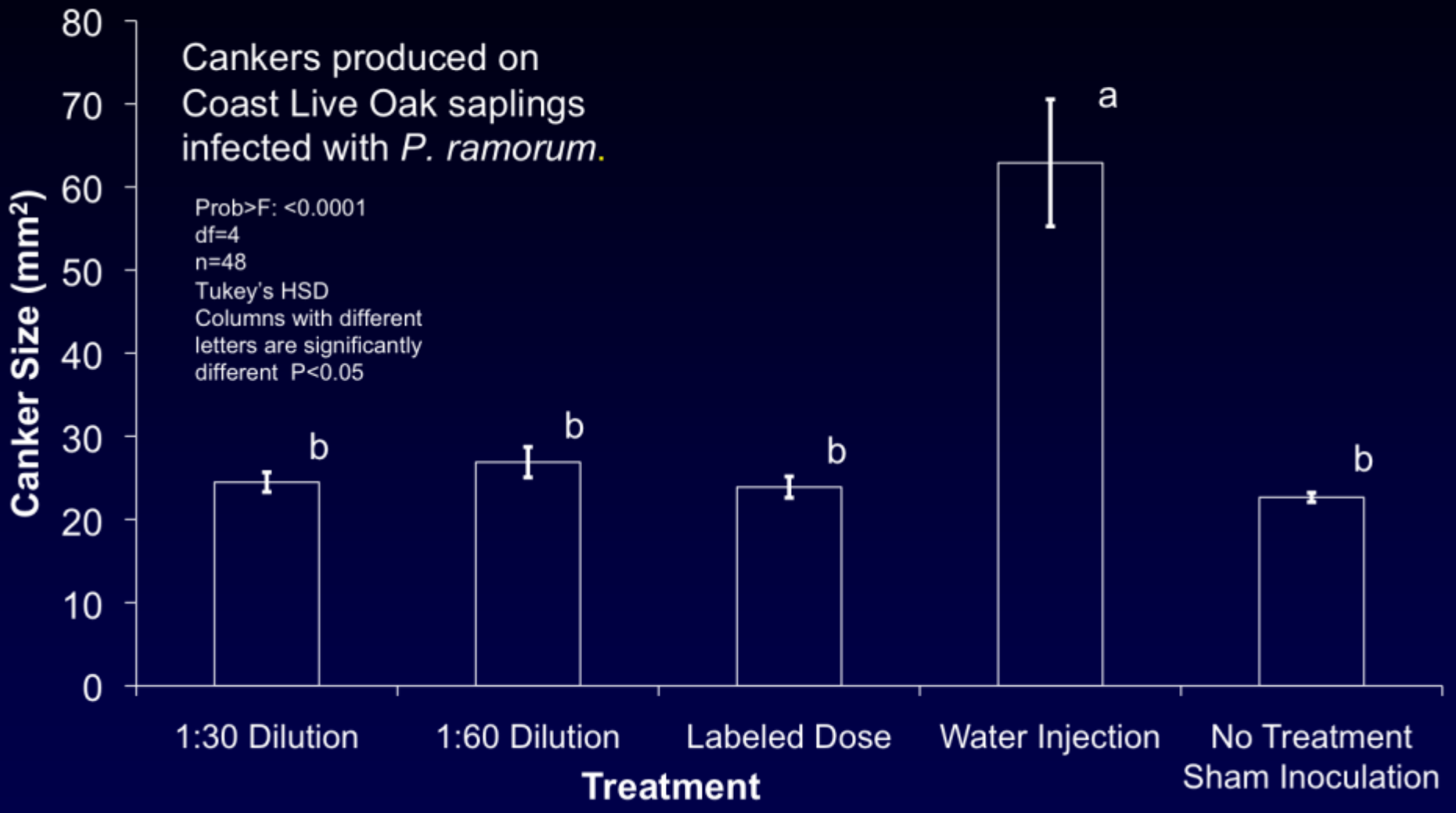


Figure 1. Efficacy of labeled dose vs updated dilution ratios. Smaller lesions = higher efficac

Phosphonate Damage to Wood

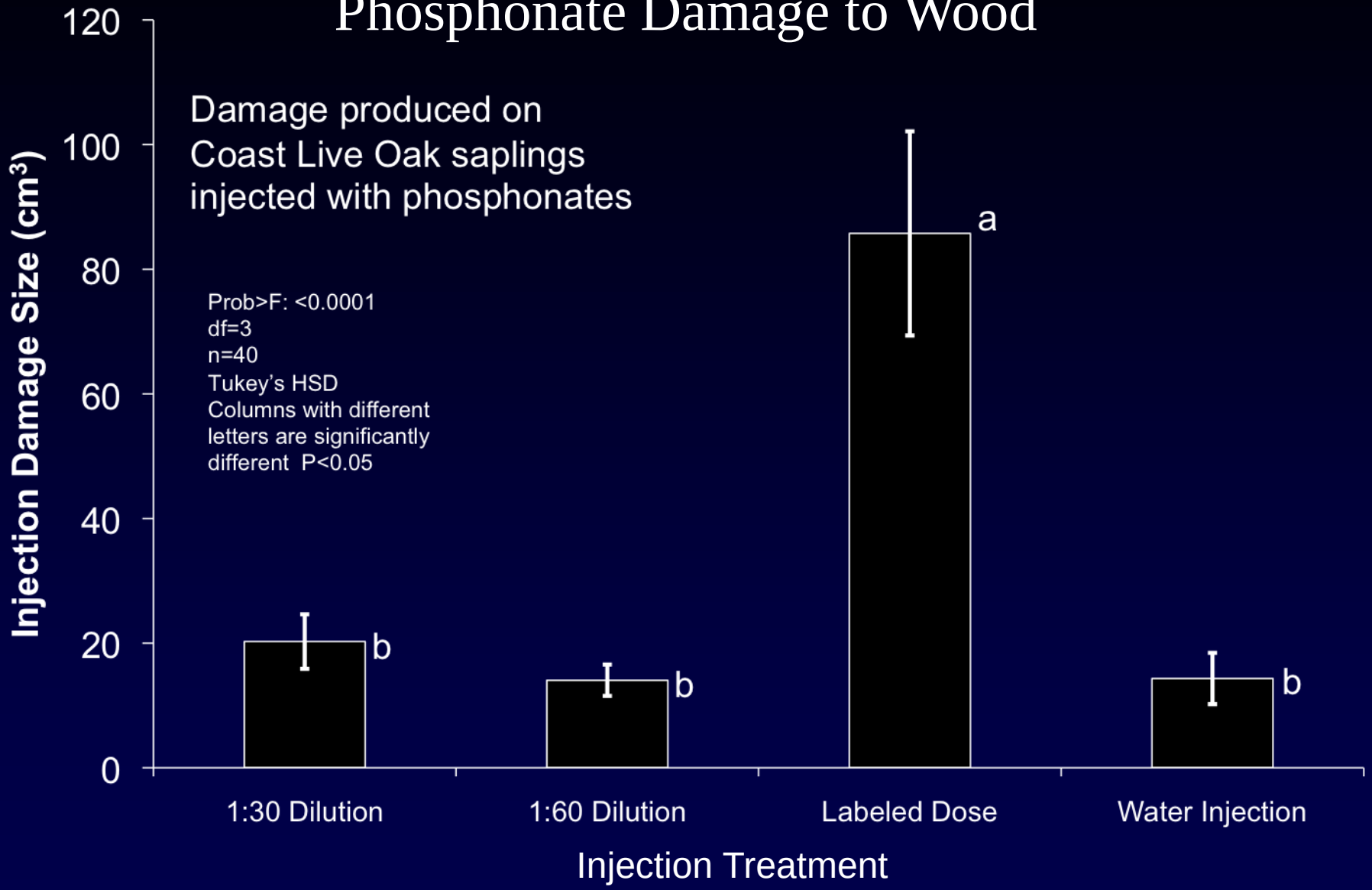


Figure 2. Injection damage caused by labeled dose vs updated dilution ratios. Note that updated dosage damage is indistinguishable from damage caused by only injecting water.


AGRI-FOS®
SYSTEMIC FUNGICIDE


PENTRA-BARK
BARK PENETRATING SURFACTANT
PENTRA-BARK
CAUTION
Quest

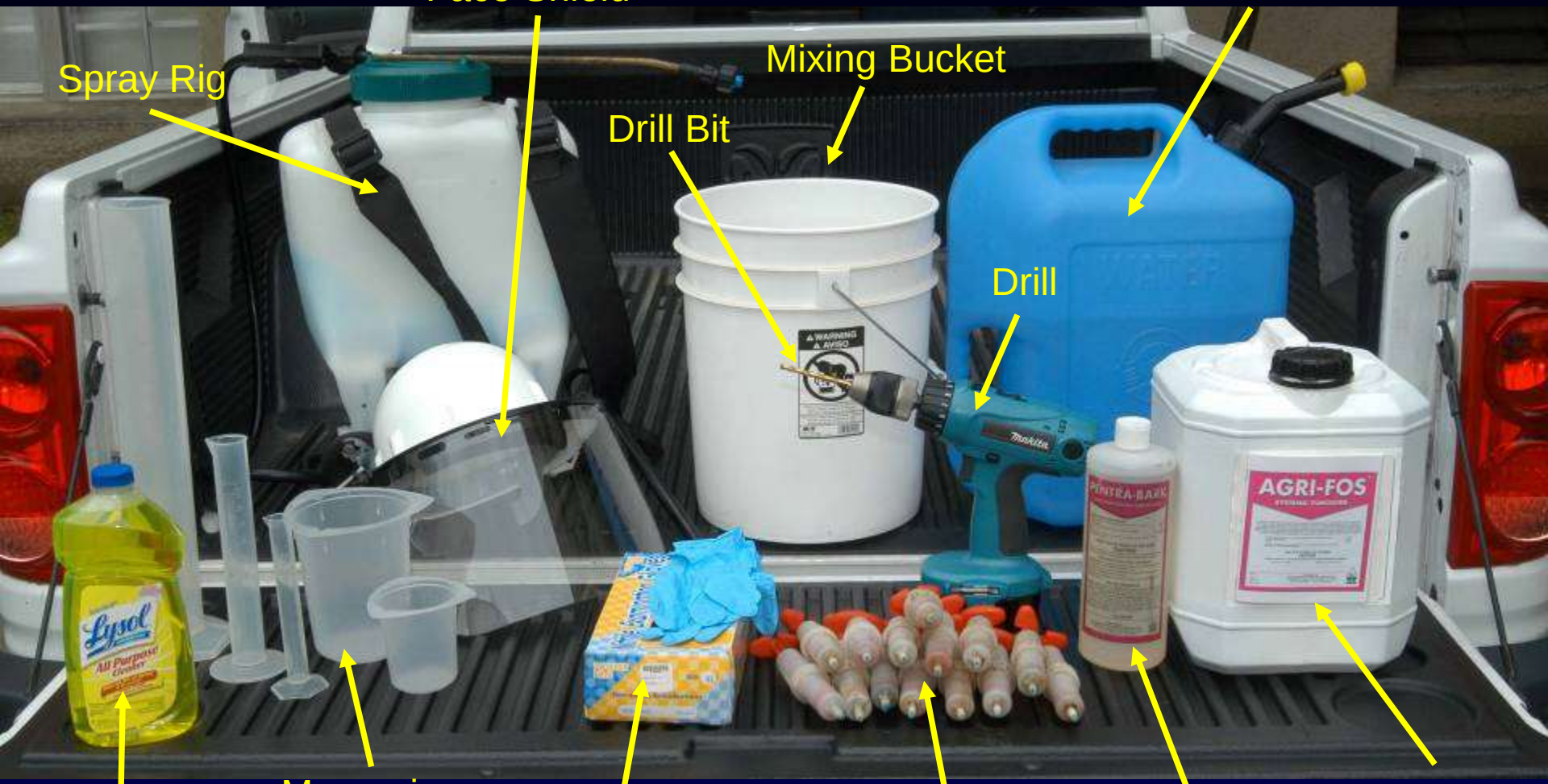

Topical Treatment

Application Protocol Pt. 2

Injection treatments require additional equipment in the form of spring-loaded, hydraulic, or air pressure injectors that maintain a positive pressure required for introducing the diluted product into the tree. The injections are made through holes drilled into the trunk and use relatively small amount of chemical usually about 50-200ml (1.5 – 7oz), to treat a tree.

The topical application, on the other hand, uses commonly available liquid spray equipment and does not leave holes in the tree. The topical method however requires considerably more product (2-15L, 0.5-4gal) and overspray may damage surrounding vegetation, including moss and lichens.

Phosphonate Application Materials and Supplies



NEW

- Injection dosages changed, one injection every two years between Halloween and Christmas
- Topical treatment unchanged, one treatment in the Fall each year, but with Gypsum amendment one topical treatment every two years may be reasonable
- Soil amendment with Gypsum highly recommended but only if treating with phosphites and in soil that are not too rich in calcium

Gypsum amendments (Anhydrous Calcium Sulfate)

About 3 feet around trunk

- 3-5 lbs of granular Gypsum per tree, depending on tree size
- Mix with top layer, ain an area with radius of about 3 feet around trunk
- Apply possibly one two two weeks before phosphonate treatment, or at the latest at the same time as treatment
- Increases efficiency of both injections and bark treatments
- Bark treatments plus gypsum can be applied once every two years rather than yearly

Gypsum amendment OK if color is not yellow to redGtpsum

Calcium Carbonate ?

$CaCO_3$ (kg/m²)

	0 - 5
	5 - 25
	25 - 75
	75 - 150
	150 - 225
	225 - 300
	> 300

https://casoilresource.lawr.ucdavis.edu/ca-soil-properties/

SCRIBING

- Can we excise cankers from oaks stems, if we catch them early on
  - Run experiment during dry 2012-2014 period in 3 sites
  - Results show that during drought 75% of oaks are not easily infected
  - Using the remaining 25% we can say with strong statistical support that:

- *P. ramorum* was detected in an equal number of scribed vs. non scribed trees
- Positive, yes *P. ram* DNA
- Negative, no *P. ram* DNA
- Summary

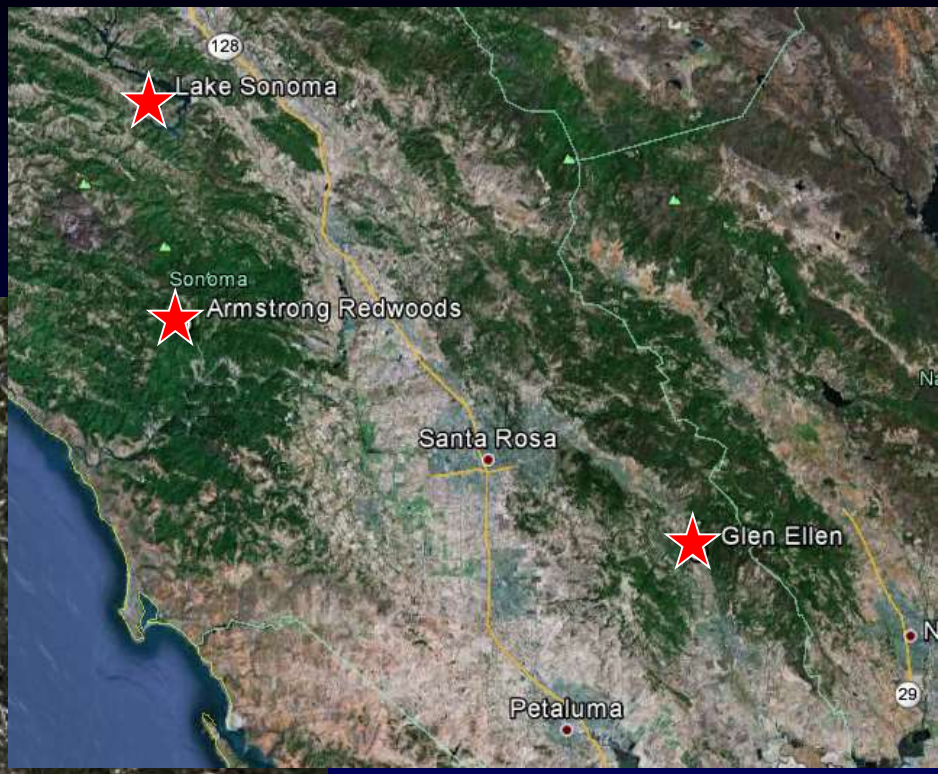
  n=68

  Scribing positives= 14; negatives 54

  Untreated positives= 12; negatives 56

  P=0.66

SOD Canker Scribing Experiments

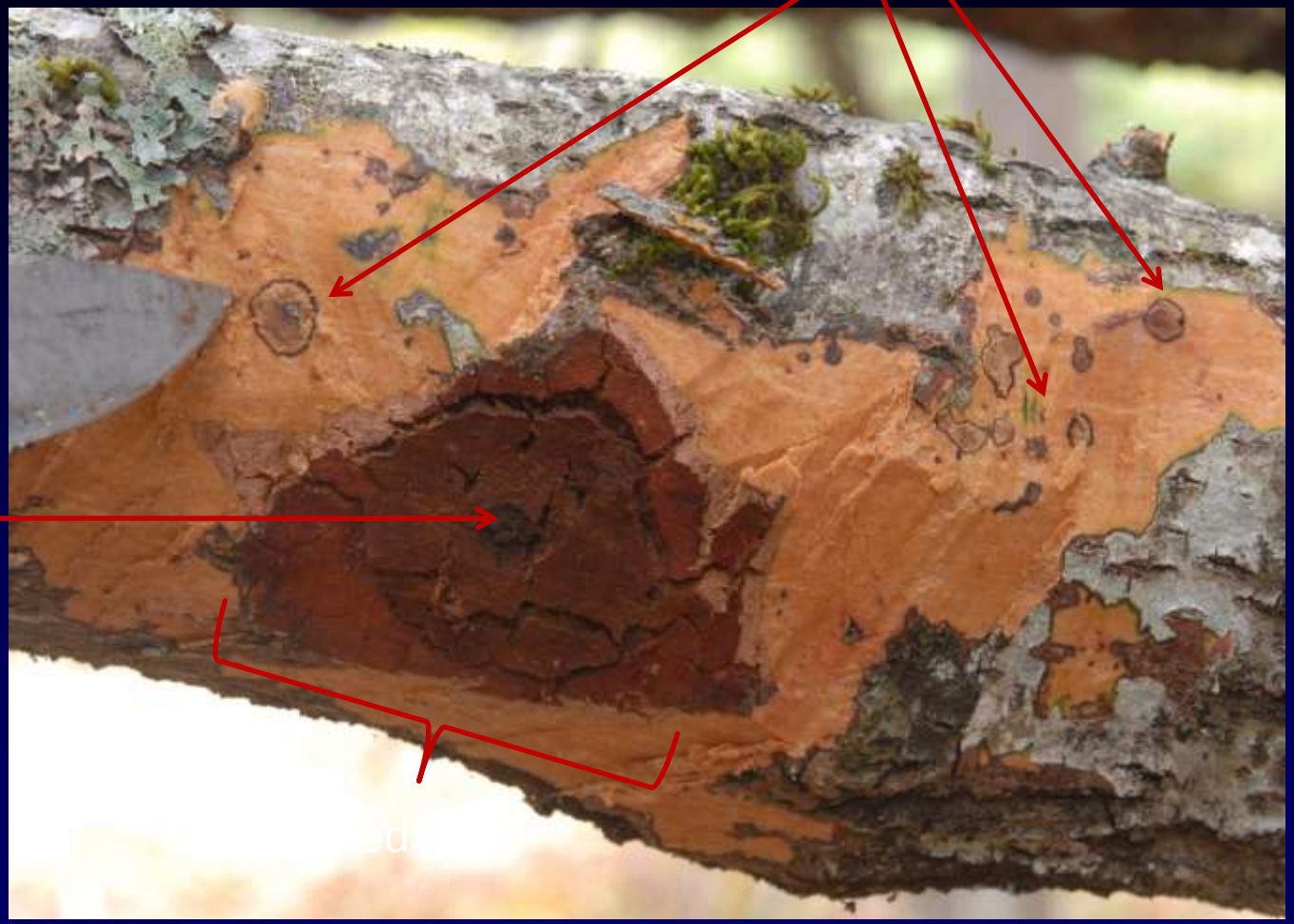


Positive control (infected but not scribed) lesion

Infected/scribed lesion

New lesions outside scribed area ? Maybe

≈ 1cm



Initial infection site

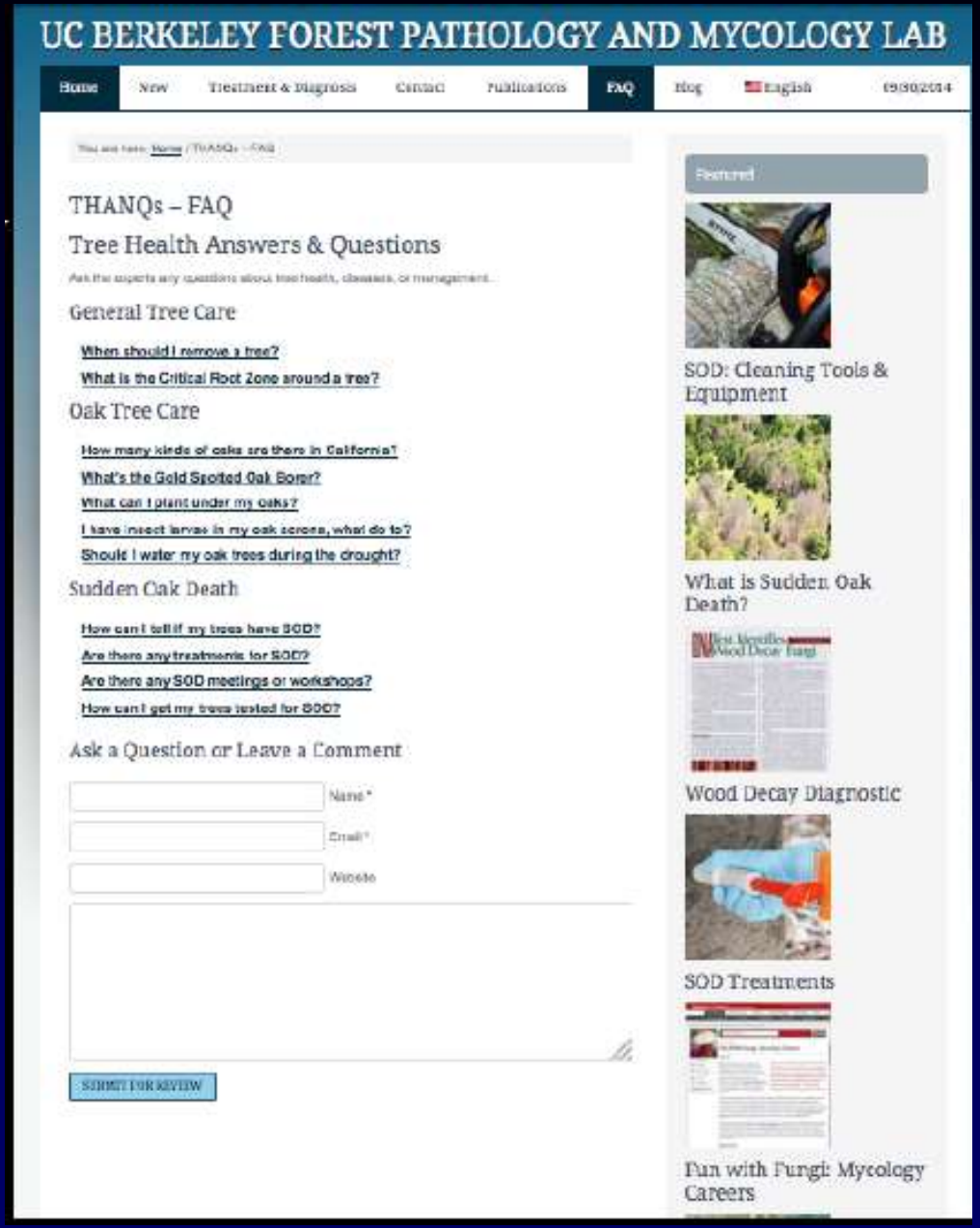
Scribing

- Based on our results we cannot recommend scribing

Final additional recommendations

- Green waste and live infected plants the most dangerous ways to spread SOD
- Tools not very effective in spreading SOD: however if tool looks clean then SOD will not be spread
- Mulch could harbor SOD, fine grain commercial compost does not harbor it
- Dead trees or plants: grind and disperse locally: do not pile or cover. Infected material needs to dry fast

- www.TreeFAQs.org
- Tree Health Answers & Questions
- Good or new questions are published and help create a database of important issues in CA



Important URLs

- Matteolab.org
- Suddenoakdeath.org
- Sodblitz.org
- Sodmap.org
- Treefaqs.org

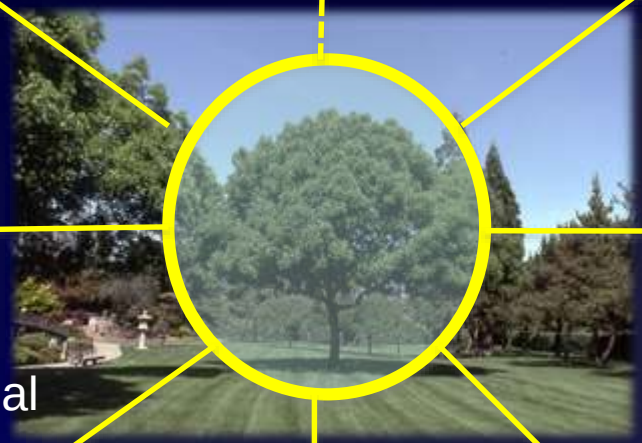
Drought and oaks

- Water deficiency due to prolonged diminished precipitation and increasing temperatures
- Physiological changes:
  - Direct effects such as thinner canopy, leaf abscission, stunted growth
  - Indirect effects: secondary pathogens and pests
- Some effects reversible: direct physiological changes, branch and foliage issues, stem decay
- Some effects irreversible: stem issues, some root rots

Stunted growth

Fungal twig dieback
Cryptocline

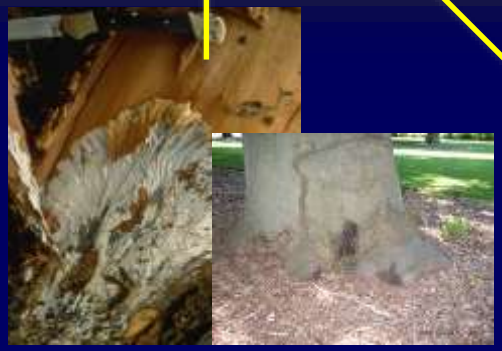
Fungal branch dieback
Diplodia



Stem cankers & terminal
secondary decay fungi

Twig girdlers *Agrilicus*
Foliar insects, oak pit scale

Trunk insects &
associated fungi



Root rots, *Armillaria*
Soilborne Phytophthoras

Canker rots, *Hymenochaetal*

Managing drought (I, short term))

- Ameliorate conditions to avoid onsite of irreversible symptoms, normally done during drought:
  - Place ground cover around (not on) tree base to lower evaporation and increase absorption
  - In case of prolonged drought and onsite of symptoms, water deeply (12 inches) once a month, November to June, only
  - Within a tree species, there is variable resistance to drought among individuals this is both genetic and site dependent. Learn to speak “tree”, to understand which ones need help
  - When irreversible symptoms are obvious; there is nothing you can do except for making sure windthrows will not cause damages or fatalities

Managing drought (ii, Long Term)

- South aspect, shallow sandy or rocky soils, midslope are most impacted by drought
- Maintain a density appropriate for the site: thin, thin, thin: but do so before or after drought
- Make sure canopy is pruned back, important when trees are isolated or in low density stands
- When landscaping, avoid planting under trees. Also when making compositions use species with comparable drought resistance
- Individual trees growing in drier sites are more drought tolerant: saplings growing in these sites may be more drought tolerant.