SOD BLITZes 2019: Results & New SOD Management Recommendations

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Natural Resources
UNIVERSITY OF CALIFORNIA, BERKELEY

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 location

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

RESEARCH, SCIENCE & ENVIRONMENT

First known cases of sudden oak death detected in Del Norte County

By Kara Manke | SEPTEMBER 24, 2019

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Two tanoak trees in Del Norte county tested positive for the pathogen known to cause sudden oak death, reports a team of collaborators from Cal Fire, UC Cooperative Extension and SOD Blitz. (UC Berkeley photo courtesy Matteo Garbelotto)

A team of collaborators including the citizen science project SOD Blitz have detected the first cases of the infectious tree-killing pathogen *Phytophthora ramorum* in California's Del Norte county.

OP-EDS

FRIDAY, OCTOBER 4, 2019

Citizen science making a difference for California

VIVIAN DU/STAFF

BY MATTEO GARBELOTTO | SPECIAL TO THE DAILY CAL

LAST UPDATED OCTOBER 4, 2019

The term "citizen science" has become increasingly popular among the public and the research community. Citizen science is any program in which nonscientists, mostly volunteers, are recruited and trained to participate in a scientific study. Despite its increasing popularity, scientists and funding agencies are still split on the true merits of citizen science. One side claims that citizen science is mostly just a way to engage and inform the public on a variety of issues. The other side further believes that citizen science is a

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RELATED POSTS

Matteo Garbelotto

Leading the citizen science contagion

By Mackenzie Smith, photos by Jim Block | Spring 2019

Each winter, Matteo Garbelotto (PhD '96 Plant Pathology) creates an assembly line in his Mulford Hall lab. To compile hundreds of training kits for volunteers, Garbelotto's team of researchers and students gathers boxes of supplies: pencils, pads, and laminated cards featuring photos of trees infected with sudden oak death (SOD).

"We give volunteers everything they need to be successful citizen scientists," says Garbelotto, a Cooperative Extension specialist and adjunct professor in the Department of Environmental Science, Policy, and Management. "Using paper and pencil to record data in the field is more time-consuming for my lab to translate into data, but it's also more inclusive—kids, families, and elderly community members alike can participate in SOD Blitz."

The SOD Blitz kits are used to train nearly 1,000 Californians annually to identify the fungus-like tree disease that causes cankers on trunks, foliage dieback, and eventually the death of the infected plants. SOD has killed millions of trees in 14 coastal counties in Central and Northern California, destroying healthy forest ecosystems throughout the state. There is no cure, but if SOD is identified early, its spread can be managed through chemical treatments and the removal of diseased trees.

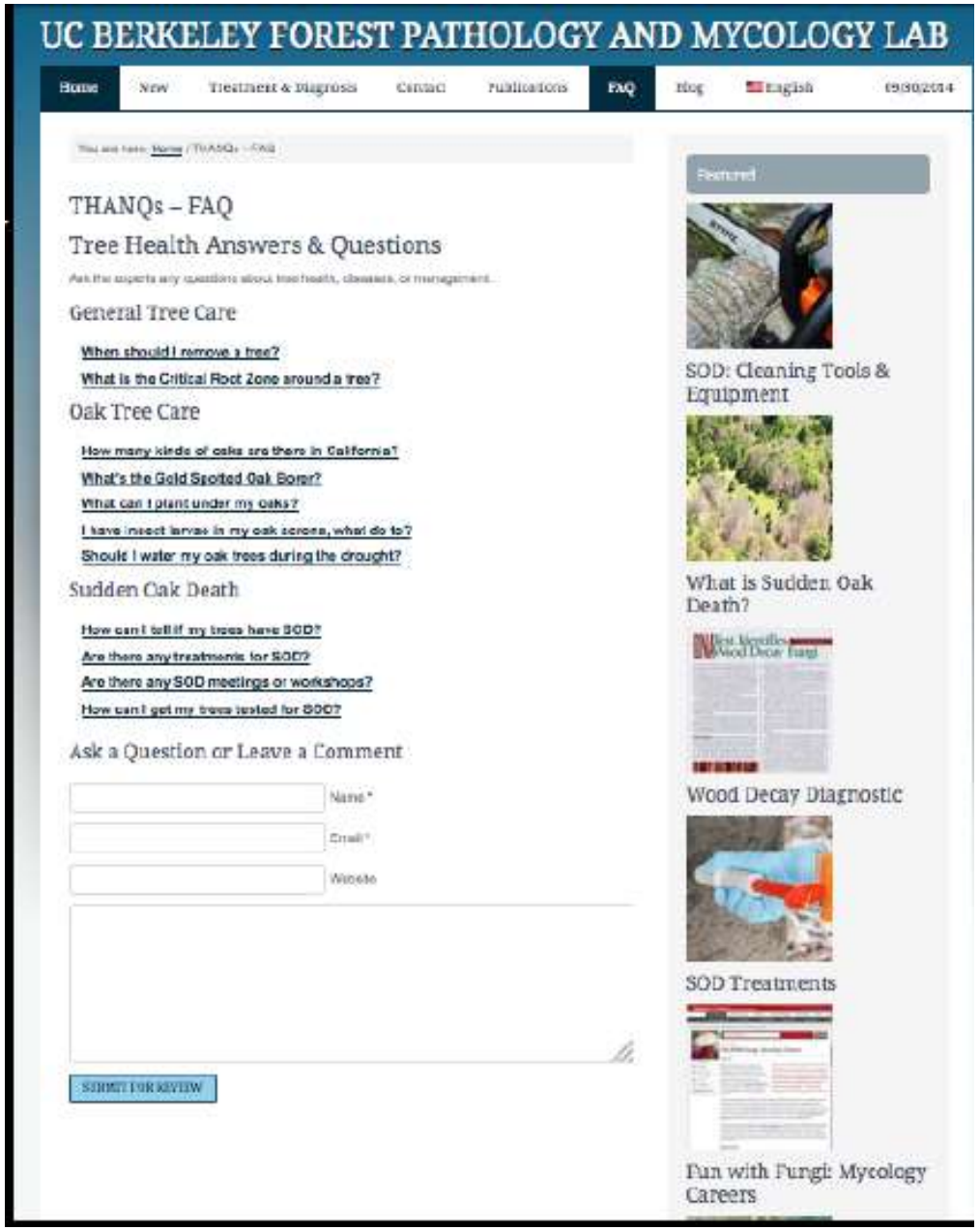
Scientists first discovered the pathogen that causes SOD, *Phytophthora ramorum*, in California in the 1990s. As reports of the disease became more frequent, Garbelotto began developing treatment strategies and tried to create an accurate map of infected trees throughout the state, a task that proved nearly impossible. "Even if I had an infinite amount of funding and hired a top-notch research team to survey diseased trees, it just wouldn't work," he says. To prevent SOD from ravaging California's forests, Garbelotto needed the data that only local experts—and concerned community members—could provide.

Citizen scientists want answers and treatment options; Garbelotto needs data and accurate outbreak maps. The SOD Blitz citizen science project helps achieve both. PHOTO: Jim Block

Hunting for Healthy Forests

- 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 2019 SOD Blitzes (you can turn on previous years' data on sidebar)

- Google Earth map of 2019 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

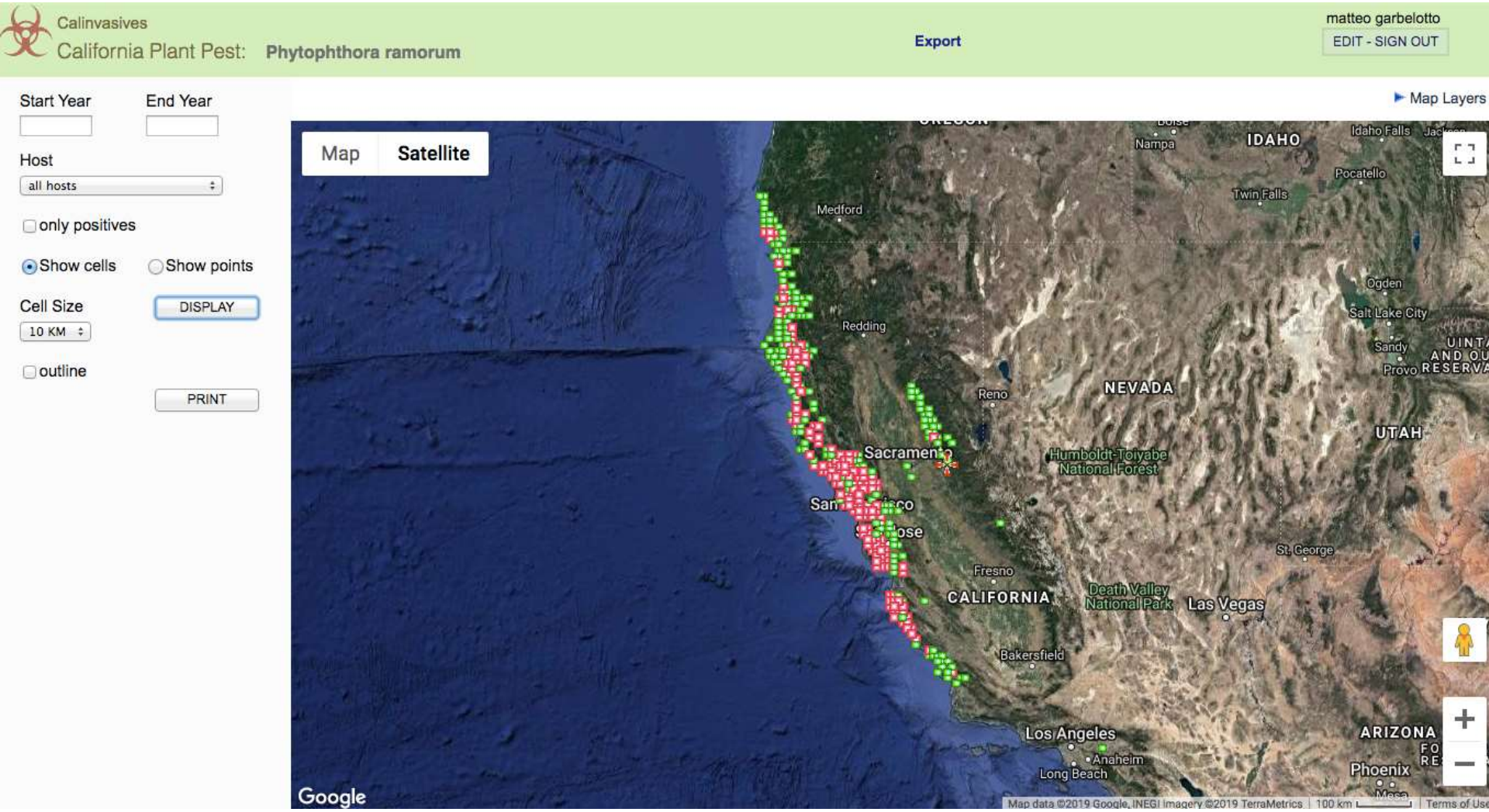
- Video that shows how to use the APP

SODmap mobile

Matteolab.org

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

Calinvasives



www.sodblitz.org
(TOP)

Google Map of Results

Results in Table format

www.sodblitz.org
(MIDDLE)

SOD Blitz Community Meetings and Workshops Schedule

SOD Blitz Results Fall 2010

Commentary on Results

Videos on what to do

Link to 2017 SOD Blitz Results

Link to 2016 SOD Blitz Results

Link to 2015 SOD Blitz Results

Link to 2014 SOD Blitz Results

Link to 2013 SOD Blitz Results

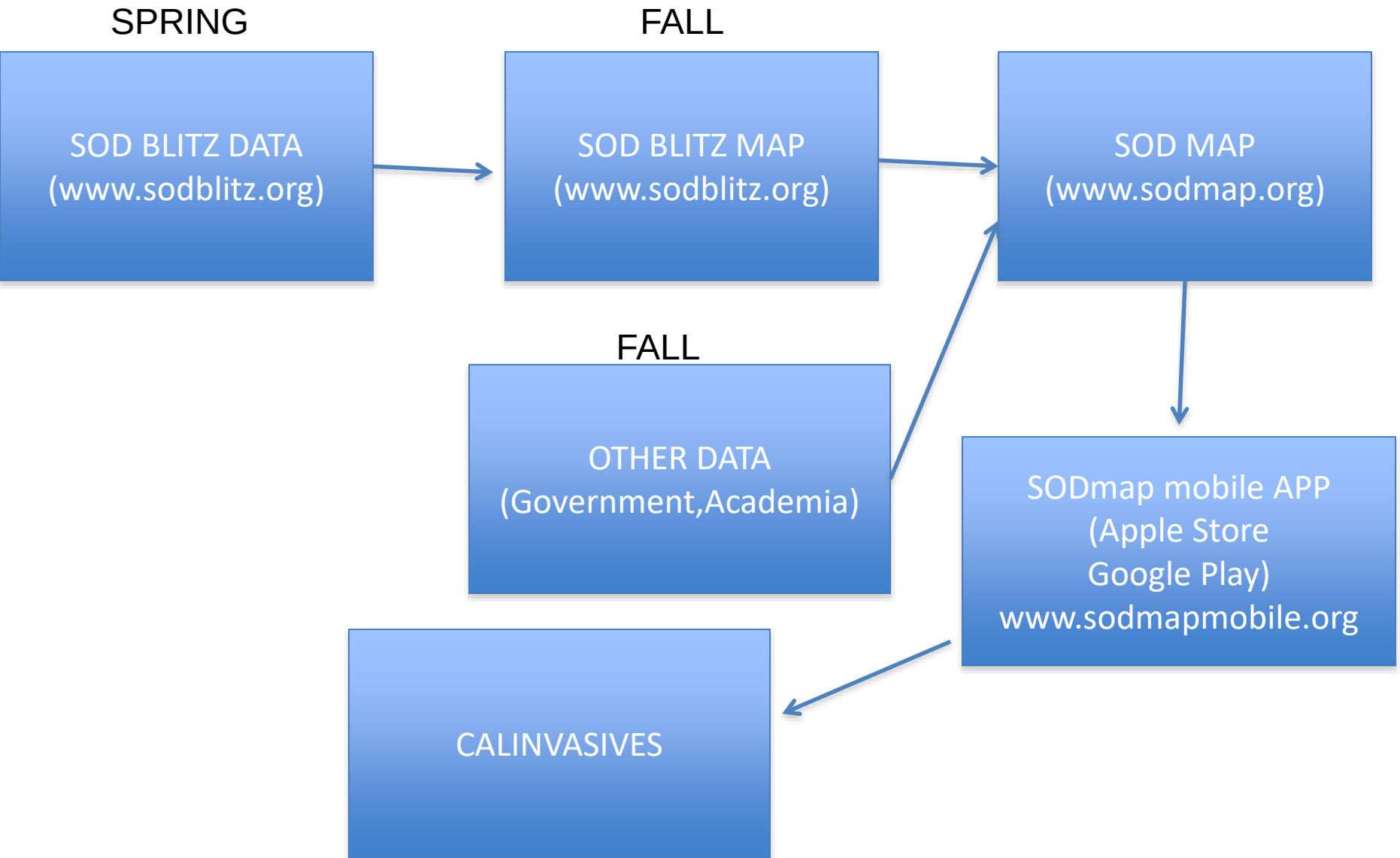
Link to 2012-2008 SOD Blitz Results

Previous years results

www.sodblitz.org
(BOTTOM)

Conversion file
To identify numerical code
For each tree

Data flow chart

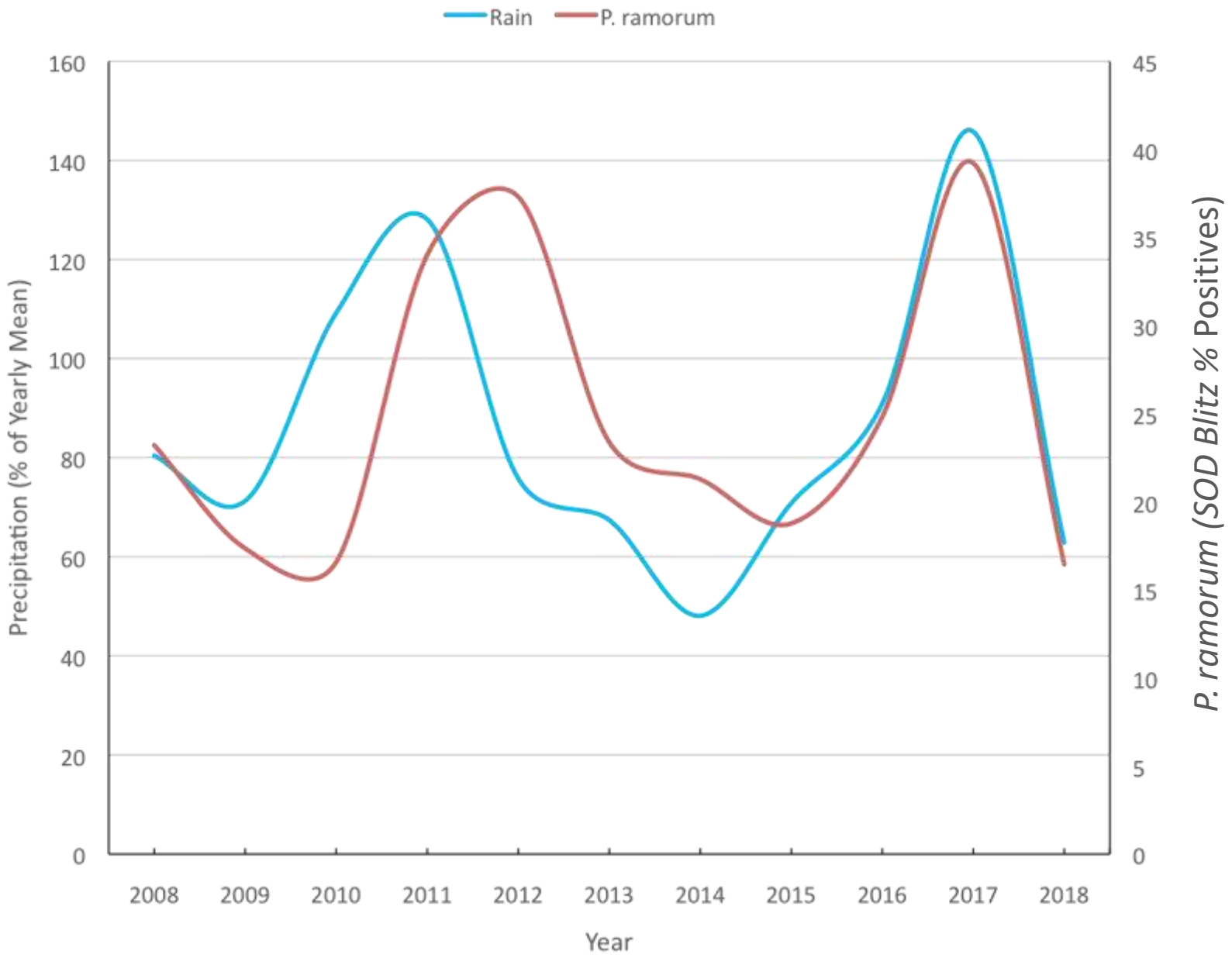


SOD Blitzes 2019: some statistics

- A total of 21 Blitzes, including three on tribal lands, Karuk , Pomo, Kashia. Largest area ever surveyed
- Del Norte (Oregon border) the Northernmost
- San Luis Obispo (Santa Barbara border), Southernmost
- 422 collectors, 600+ participants
- Trees surveyed: 16,227
- Trees sampled: 1732
- Statewide Rate of Positive trees 19.2% (was 9.8% in 2018)
- Statewide True Infection rate: 5.9% (was 3.5% in 2018)

Temporal Criterion for Bay Laurel Removal

Precipitation and *P. ramorum*



Comparison between 2018-2019

Location	Survey Trees	Survey Trees	Syptomatic Oaks Nearby	Syptomatic Oaks Nearby	Estimated True inf rate	Estimated True inf rate
BS	87	**165**	38.1	**26.1**	3.8	**42.4**
Carmel	985	**966**	3.7	**1.4**	1.1	**5.4**
Del Norte		**160**		**5.0**		**0.6**
EBE	56	**408**	12.5	**0.0**	12.7	**0.5**
EBS	54	**7**	0.0	**0.0**	0.0	**0.0**
EBW	584	**133**	6.2	**8.5**	1.1	**12.0**
Humboldt		**3771**		**25.6**		**3.9**
Marin	1073	**1241**	22.9	**8.6**	2.5	**7.1**
Mendo	592	**669**	12.3	**16.2**	1.4	**0.5**
Napa	53	**265**	0.0	**12.0**	1.5	**7.6**
PenE	816	**715**	17.9	**8.0**	6.0	**1.7**
PenN	177	**63**	7.4	**25.0**	1.0	**6.3**
PenS	300	**501**	17.0	**11.5**	19.1	**21.6**
PenW	3558	**3116**	20.7	**23.6**	6.1	**18.1**
SC	324	**1036**	3.0	**0.0**	3.6	**0.4**
SF	2982	**1314**	0.0	**12.0**	0.0	**0.0**
SLO	699	**682**	3.6	**2.6**	0.0	**0.0**
SonE	390	**594**	17.9	**11.5**	9.7	**20.4**
SonN	124	**87**	18.9	**0.0**	1.8	**1.0**
SonW	532	**217**	10.8	**7.5**	2.9	**9.0**
TS	118	**117**	0.0	**9.1**	0.0	**0.0**
Total	13504	**16227**	12.2	**12.4**	3.5	**5.9**

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

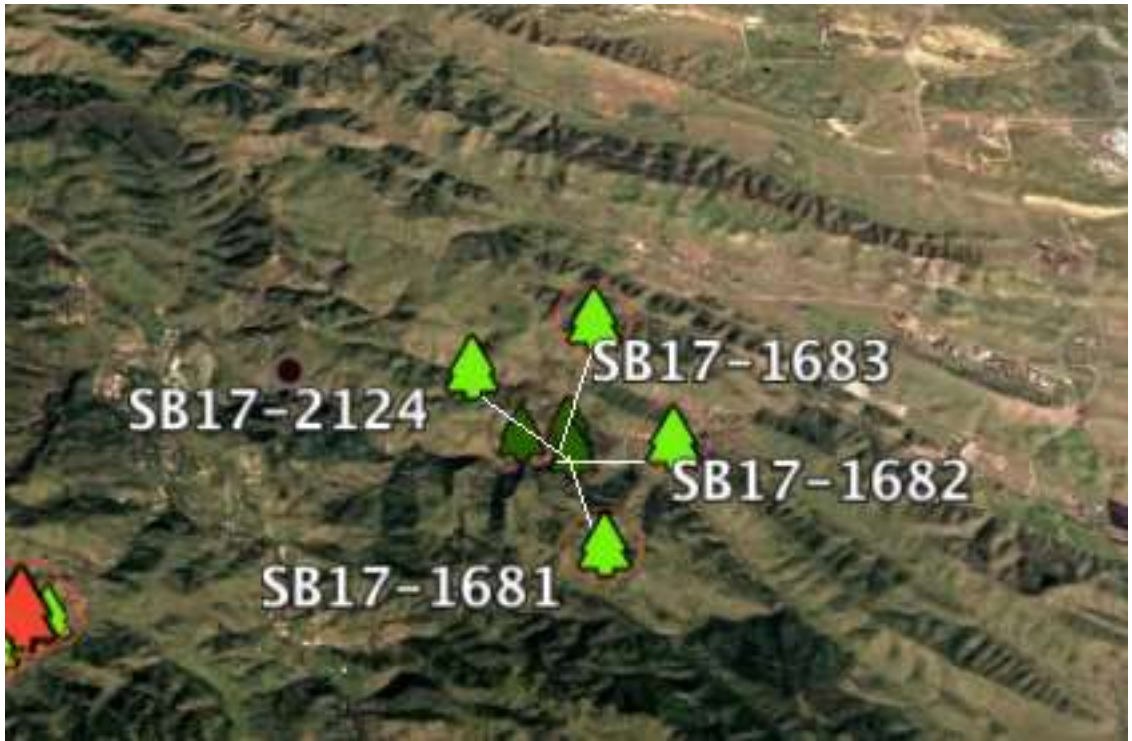
- Google Earth Platform
- All colored icons were tested
- Red= has SOD
- Green= had symptoms but not SOD
- Circle means oaks dying but for any reason (e.g drought)

Use these commands to:

move around map

enlarge it

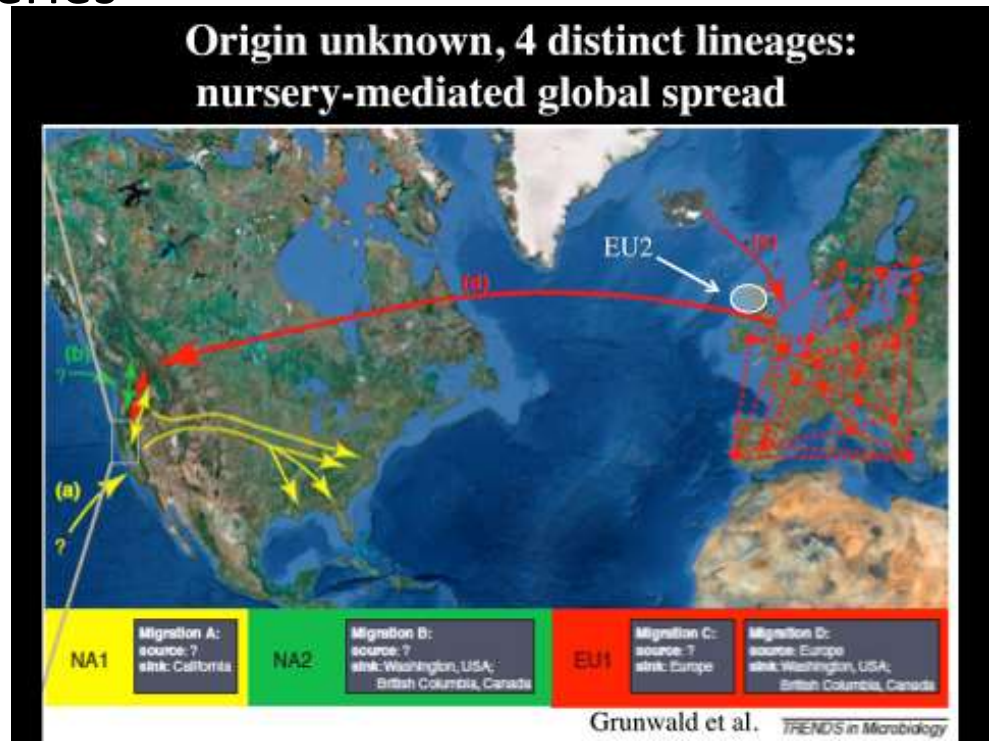
Even when magnified, icons will stack. Click on one to see all icons in a so called spiderfy



Phytophthora ramorum lineages

- F different subspecies (lineages)
- Each is different (mating type. virulence)
- Only NA1 in California Forests
- EU1 present in California nurseries
- And in Oregon forest

- BLITZ TESTS FOR LINEAGE!!!



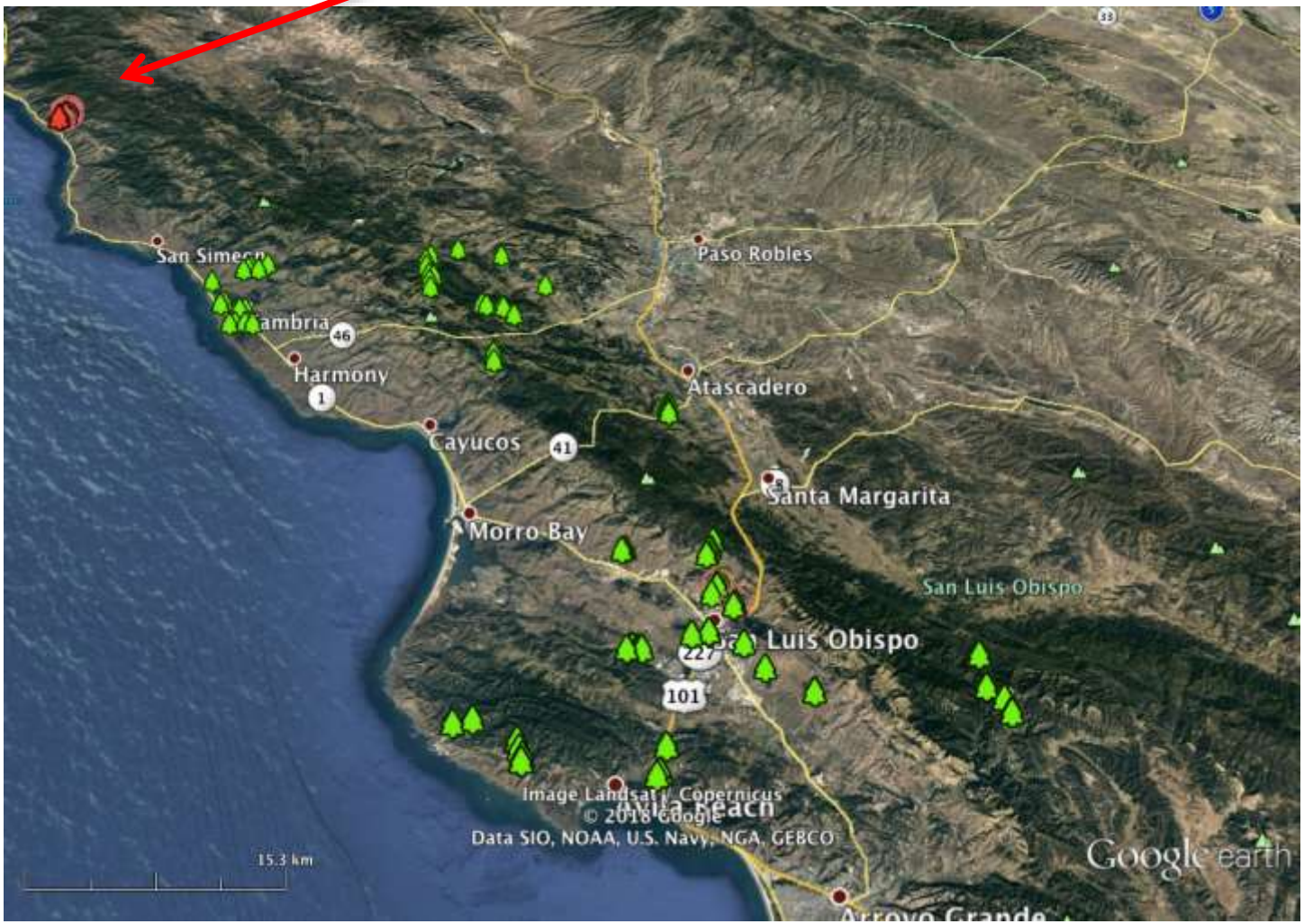
2019 Lineage Results

- All samples were NA1

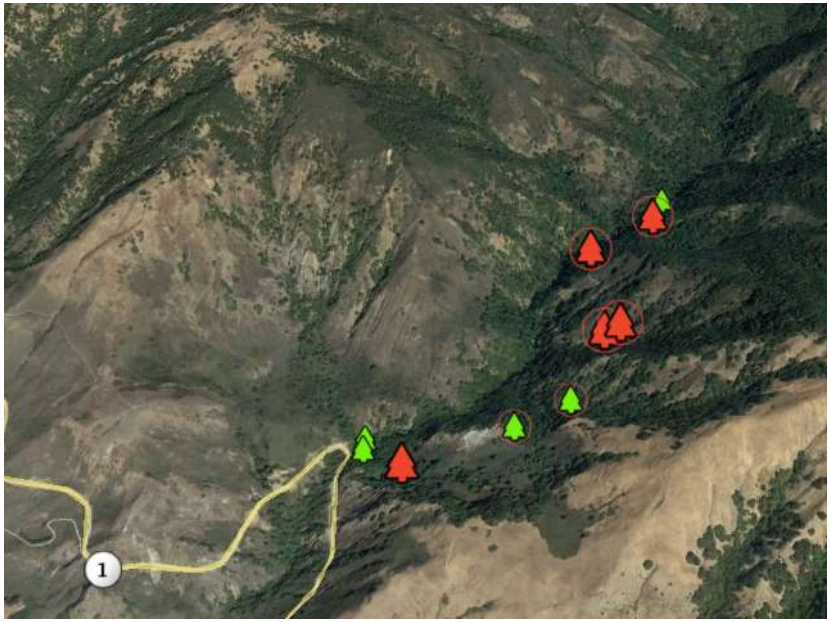
Most Interesting Findings of 2019 Blitzes- I

- San Luis Obispo County has been intensively resurveyed and all results indicate it is negative for SOD
- Note that 2019 Blitz confirms multiple positive trees in Salmon Creek, South Monterey. SOD pathogen was only detected in water prior to 2018 Blitz
- North Eastern Humboldt and Trinity were negative (note that Humboldt and Trinity have confirmed SOD in other locations)
- We did detect the first positives ever (2 tanoaks) in Del Norte County

Sentinel networks: San Luis Obispo negative in 2019, but several positives in Salmon Creek Canyon



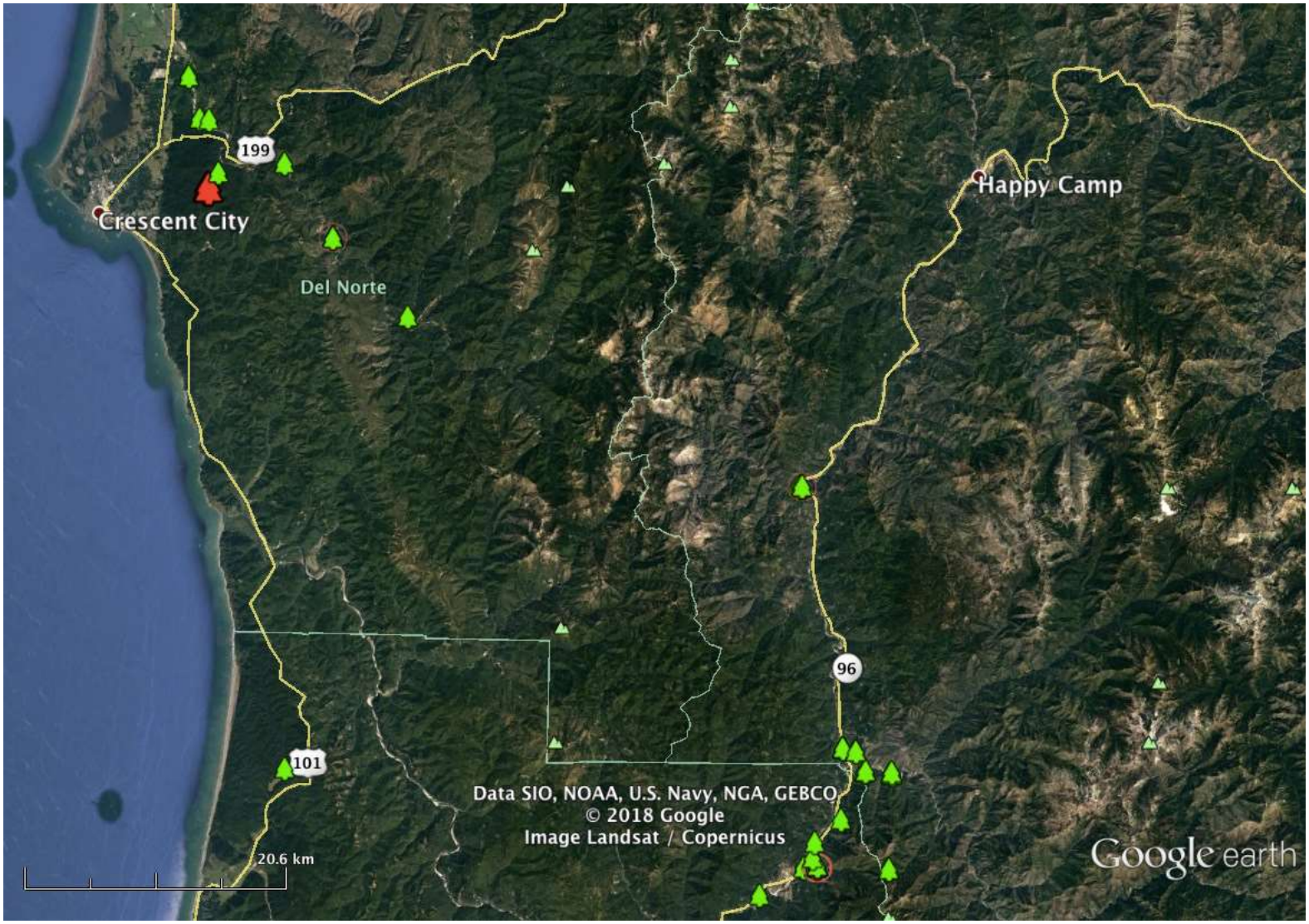
Salmon Creek 2018 vs. 2019



What does Salmon Creek Mean for San Luis Obispo?

- Increase in number of SOD positive trees in Southernmost Monterey Canyon, right at the county line threatens to be a source for infestation of San Luis Obispo !

Sentinel networks: Trinity Humboldt Karuk Lands negative. Del Norte first positive



Del Norte Findings

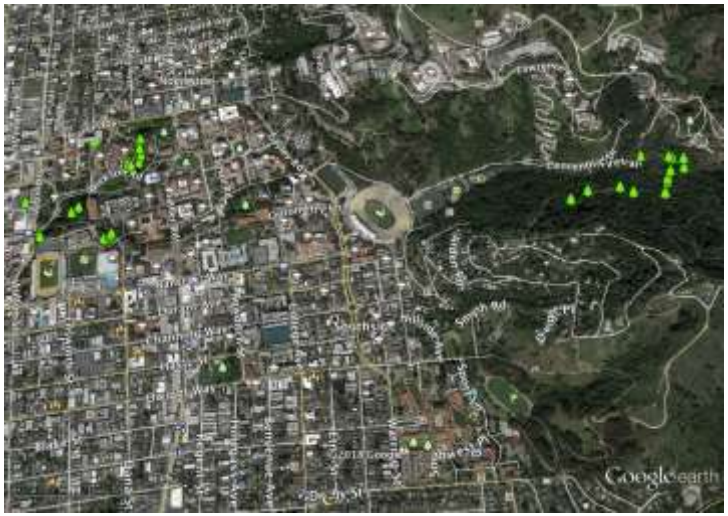
- Two tanoaks were positive, two were dead. Other trees tested but negative (although tests were done in Fall)
- In a State Park with camp sites. Are campers moving infected plant materials
- The smallest outbreak ever detected in California. Eradication/mitigation possible
- It is equidistant from the OR and the northernmost Humboldt outbreak. Where did it come from?

Del Norte

Most Interesting Findings of 2019 Blitzes-II

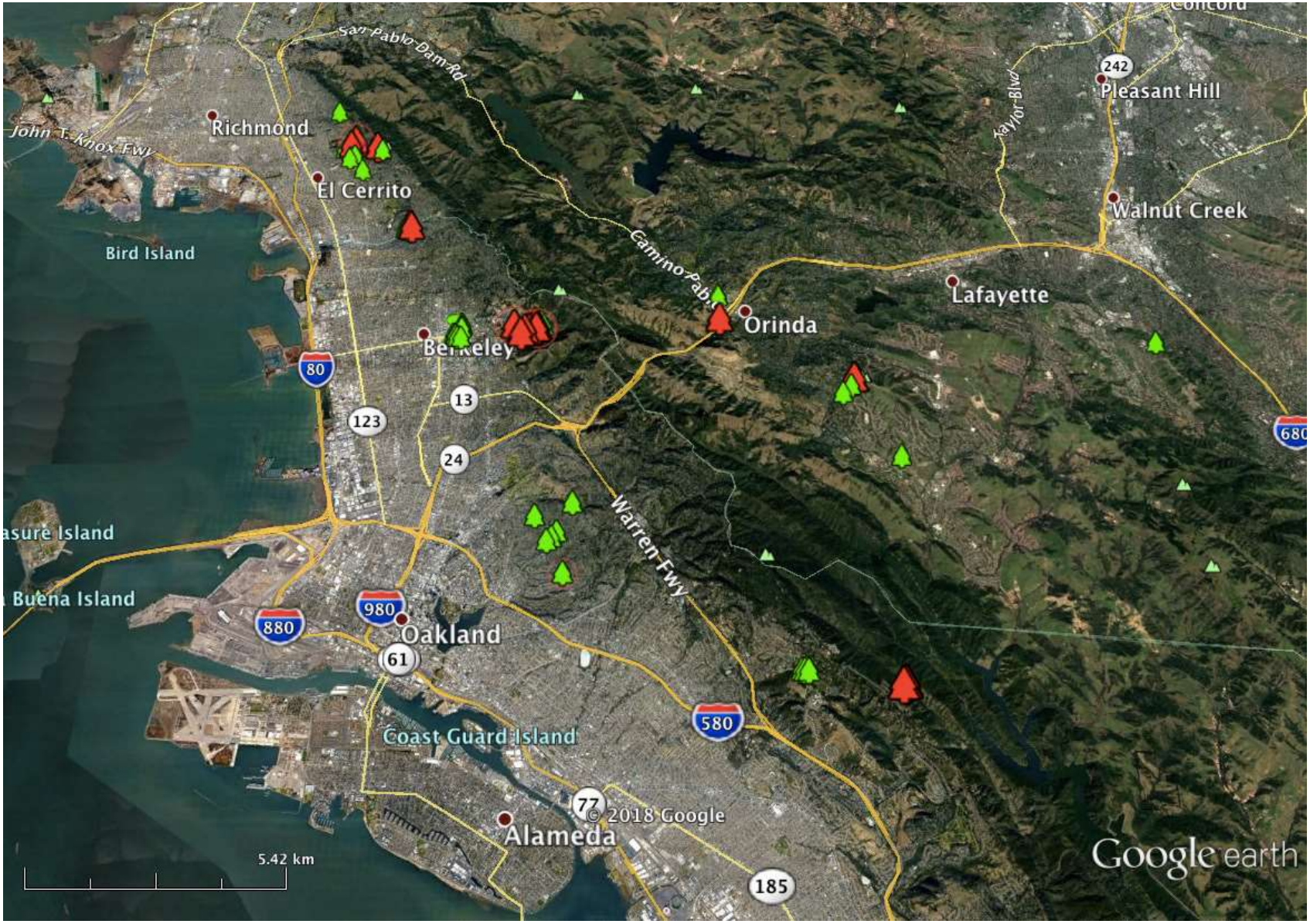
- San Francisco negative for second year in a row!
- Maybe management is working

U.C Berkeley 2018 vs.2019

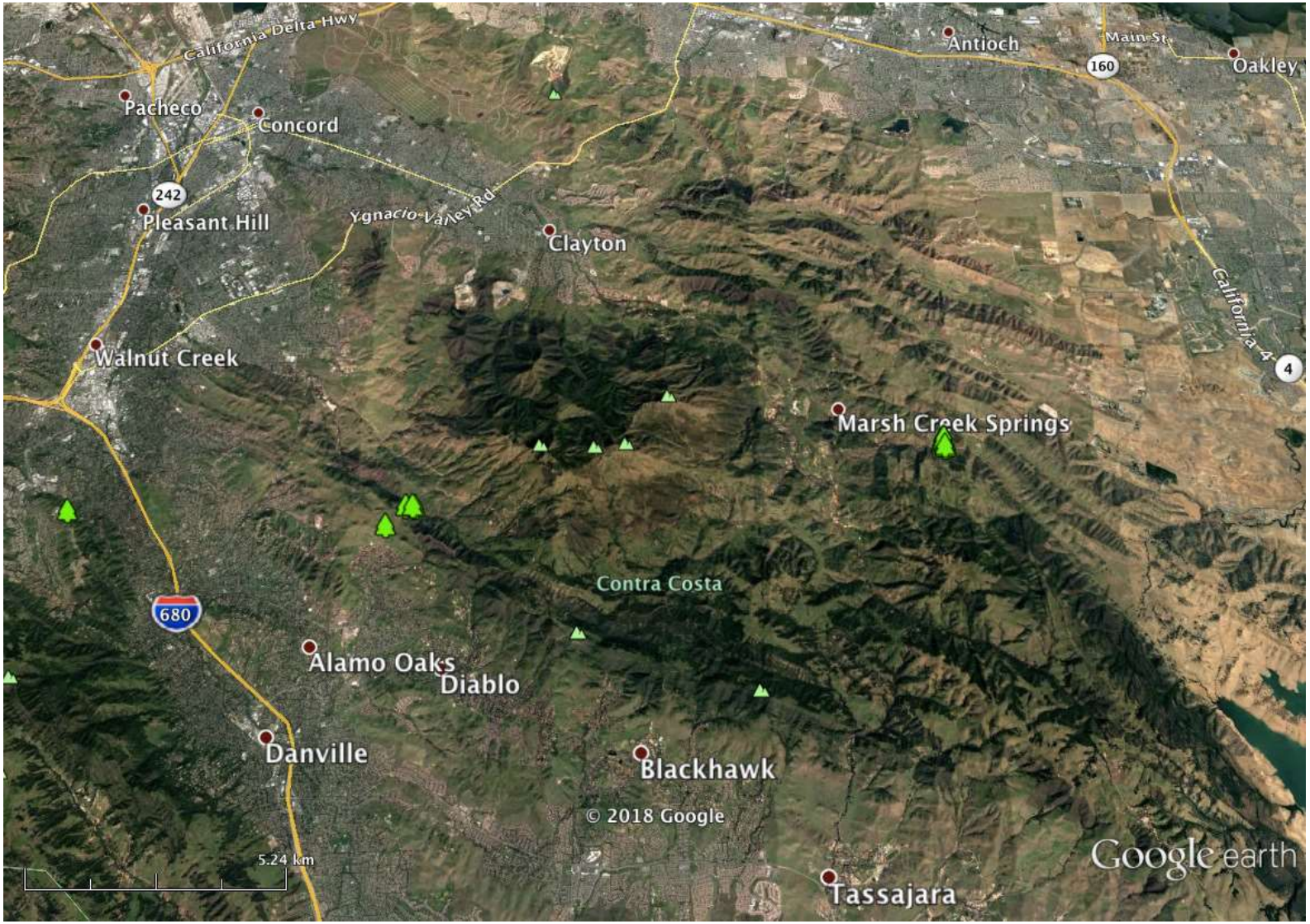


- With no management SOD re-emerges even in urban or quasi urban areas

Most Interesting Findings of 2019 Blitzes
East Bay



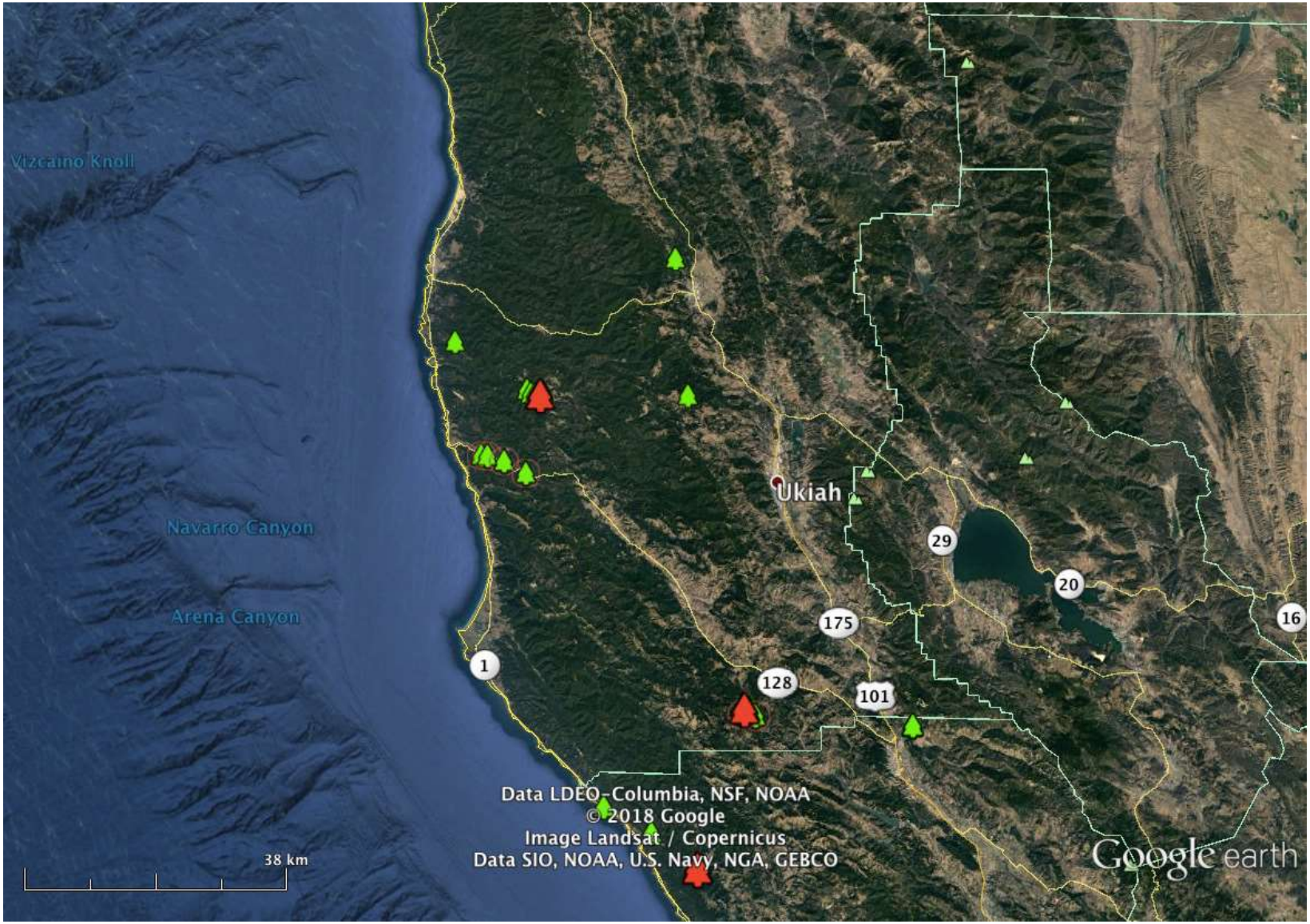
Mount Diablo



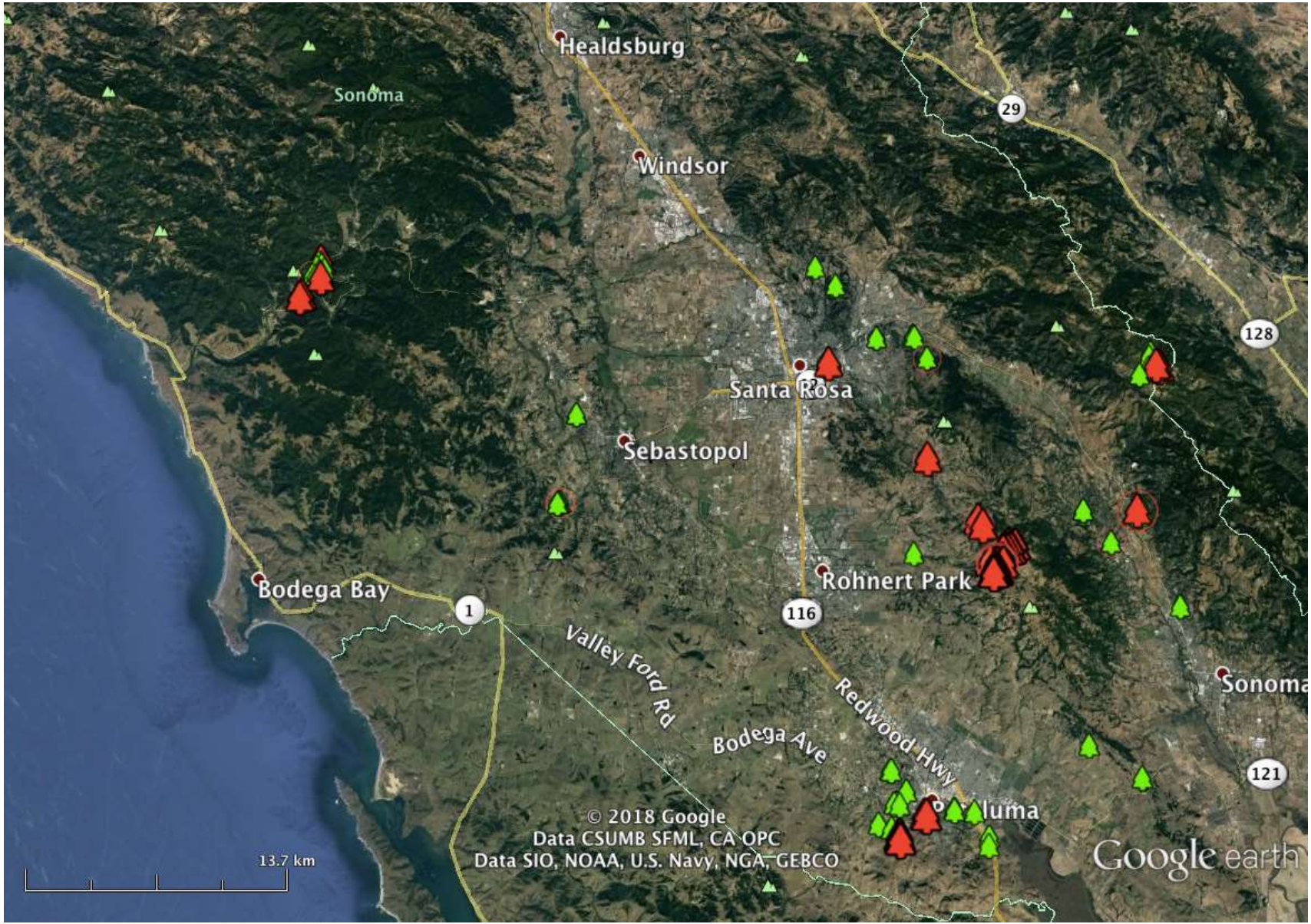
East Bay

- Combining results from previous years…
- Mount Diablo: SOD has arrived but it is not establishing itself rapidly, probably because of hot temperatures
- In Sunol area no SOD, again it is hot there
- In Western part of East Bay, SOD is established and intensifies when weather is wetter
- Infestation from Richmond-Martinez to Lake Chabot and then isolated outbreak in Castro Valley
- SOD in Orinda Moraga corridor

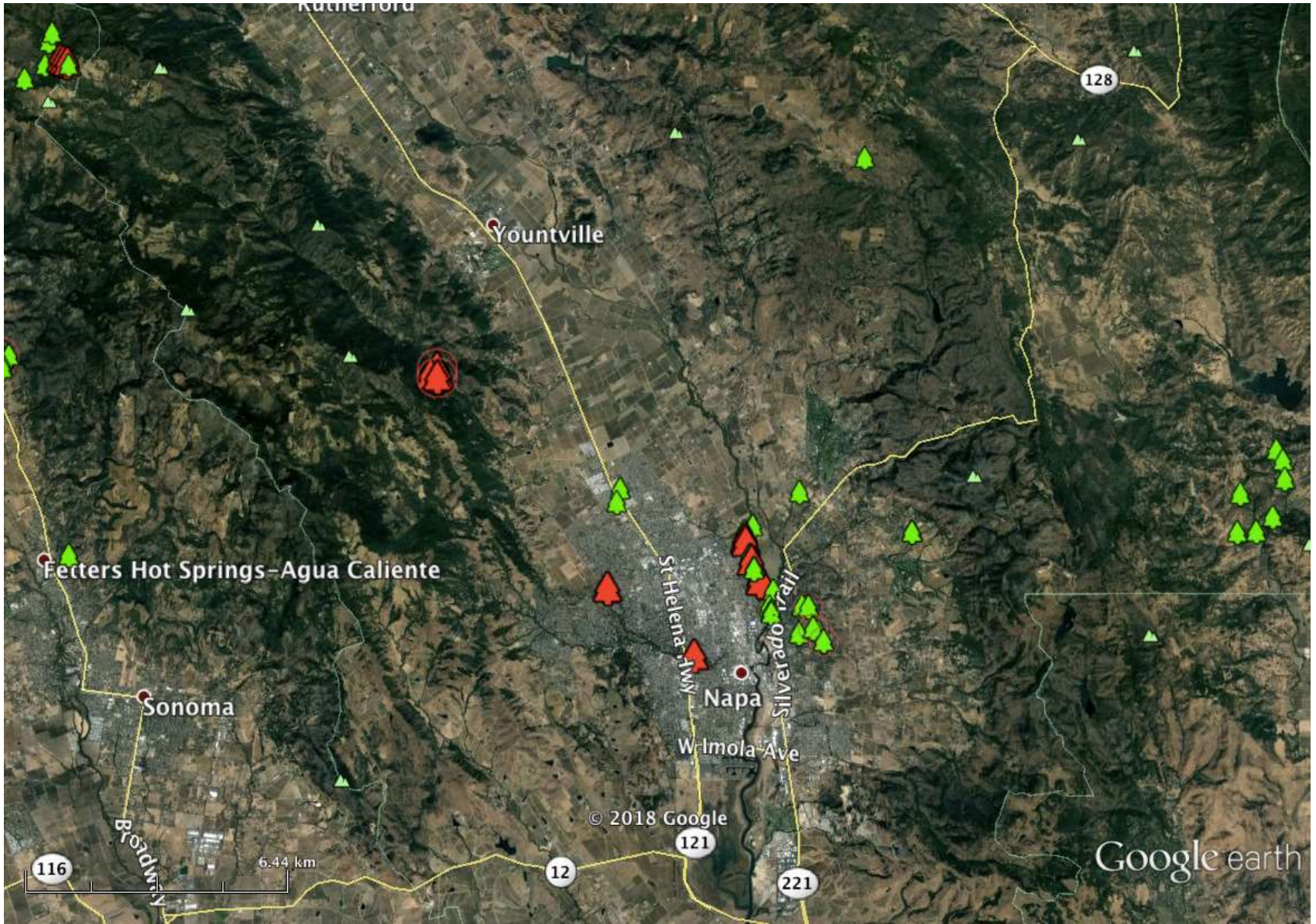
Northern Sonoma and Mendocino Counties



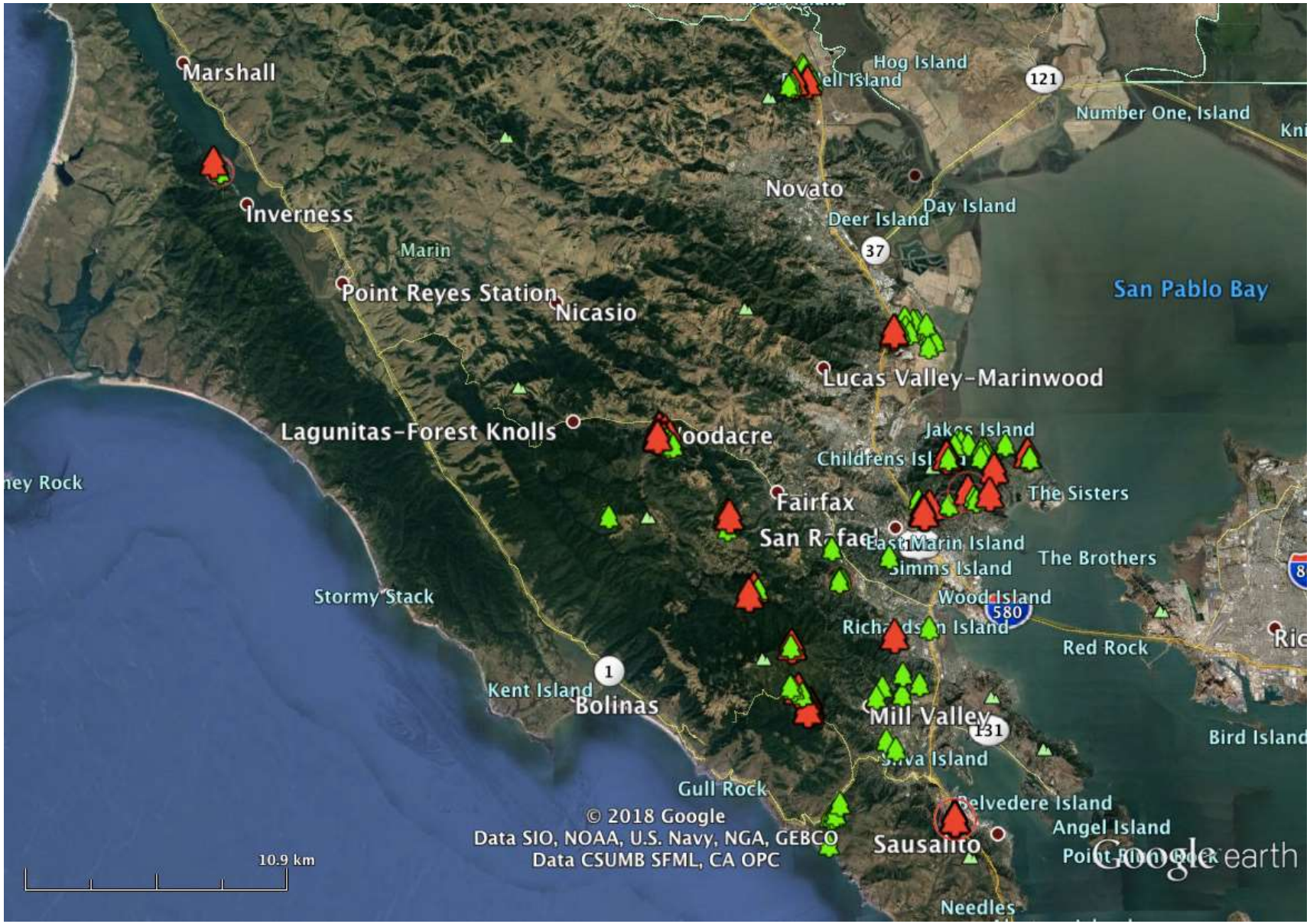
Central and Southern Sonoma



Napa- SOD reemergence, last positives in 2011



Marin


Marshall
Inverness
Marin
Point Reyes Station
Nicasio
Lagunitas-Forest Knolls
Stormy Stack
Kent Island
Bolinas
Gull Rock
Hog Island
Number One, Island
Novato
Day Island
Deer Island
37
121
San Pablo Bay
Lucas Valley-Marinwood
Childrens Island
The Sisters
Fairfax
East Marin Island
Simms Island
The Brothers
Wood Island
580
Red Rock
Mill Valley
131
Bird Island
Belvedere Island
Angel Island
Sausalito
Needles
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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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10.9 km
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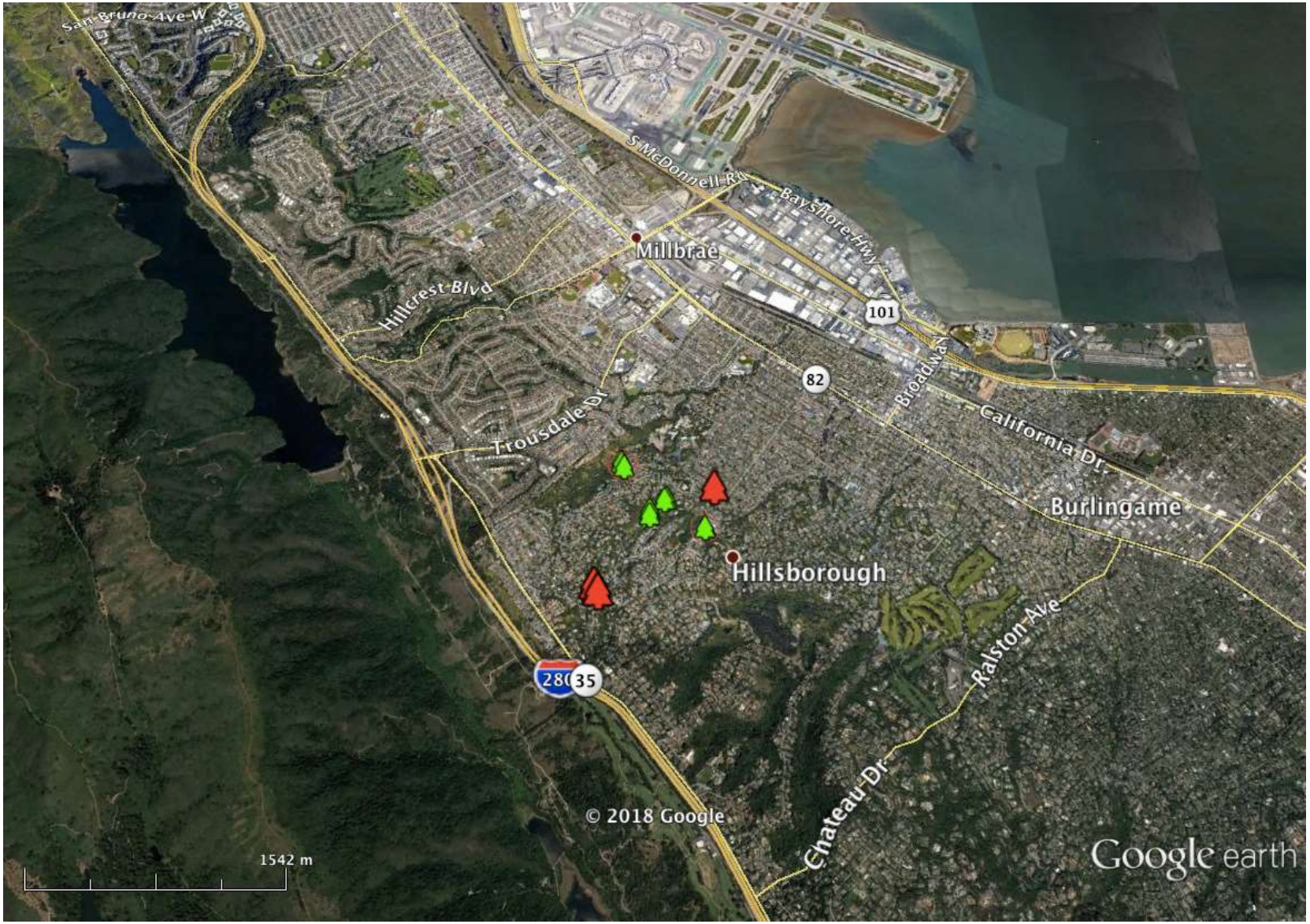
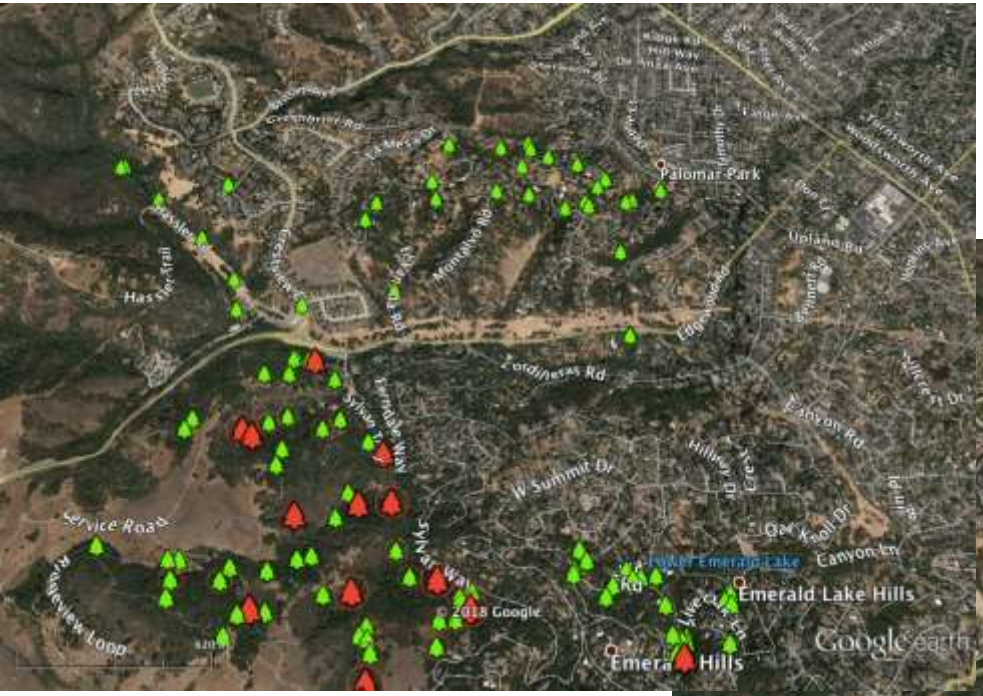
SF Peninsula North

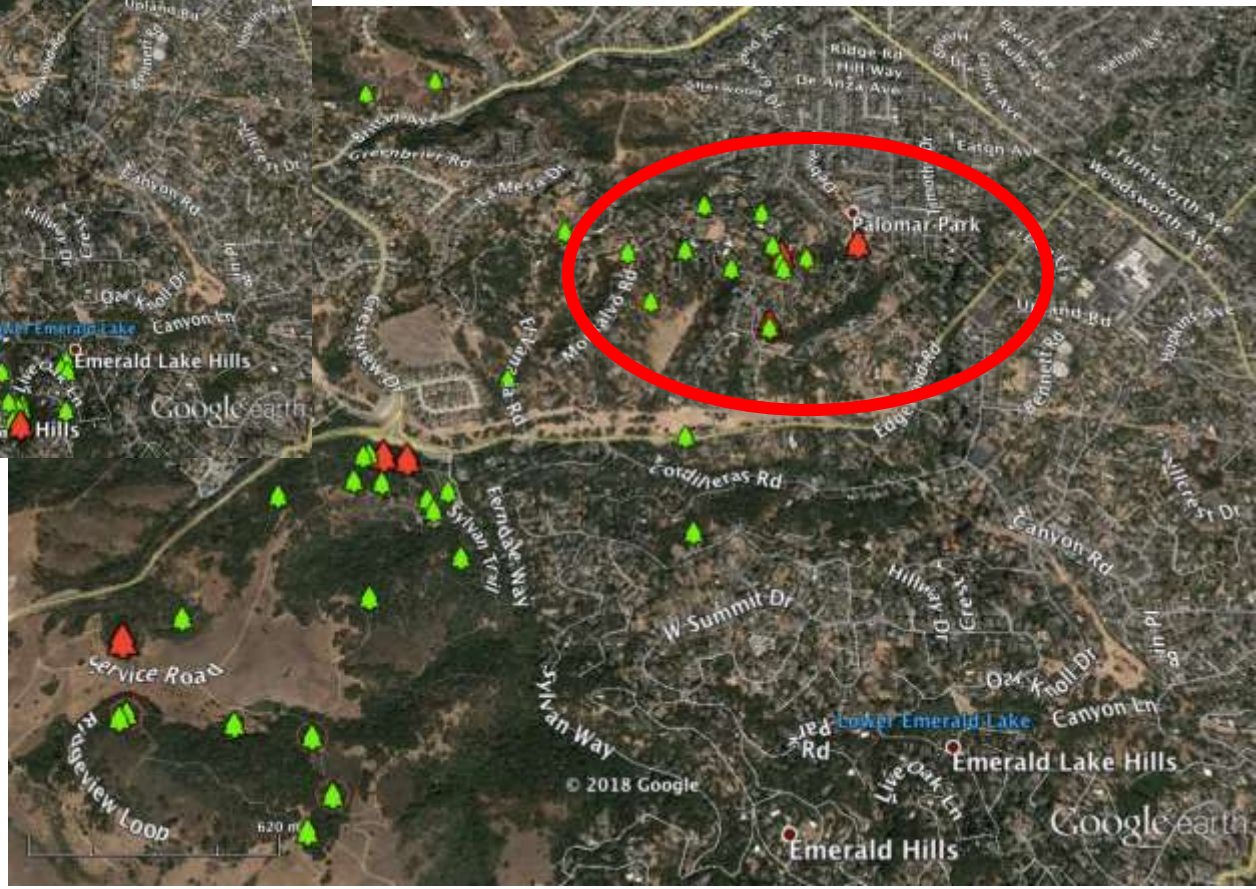


Emerald Hills- Palomar Park
SOD moved North

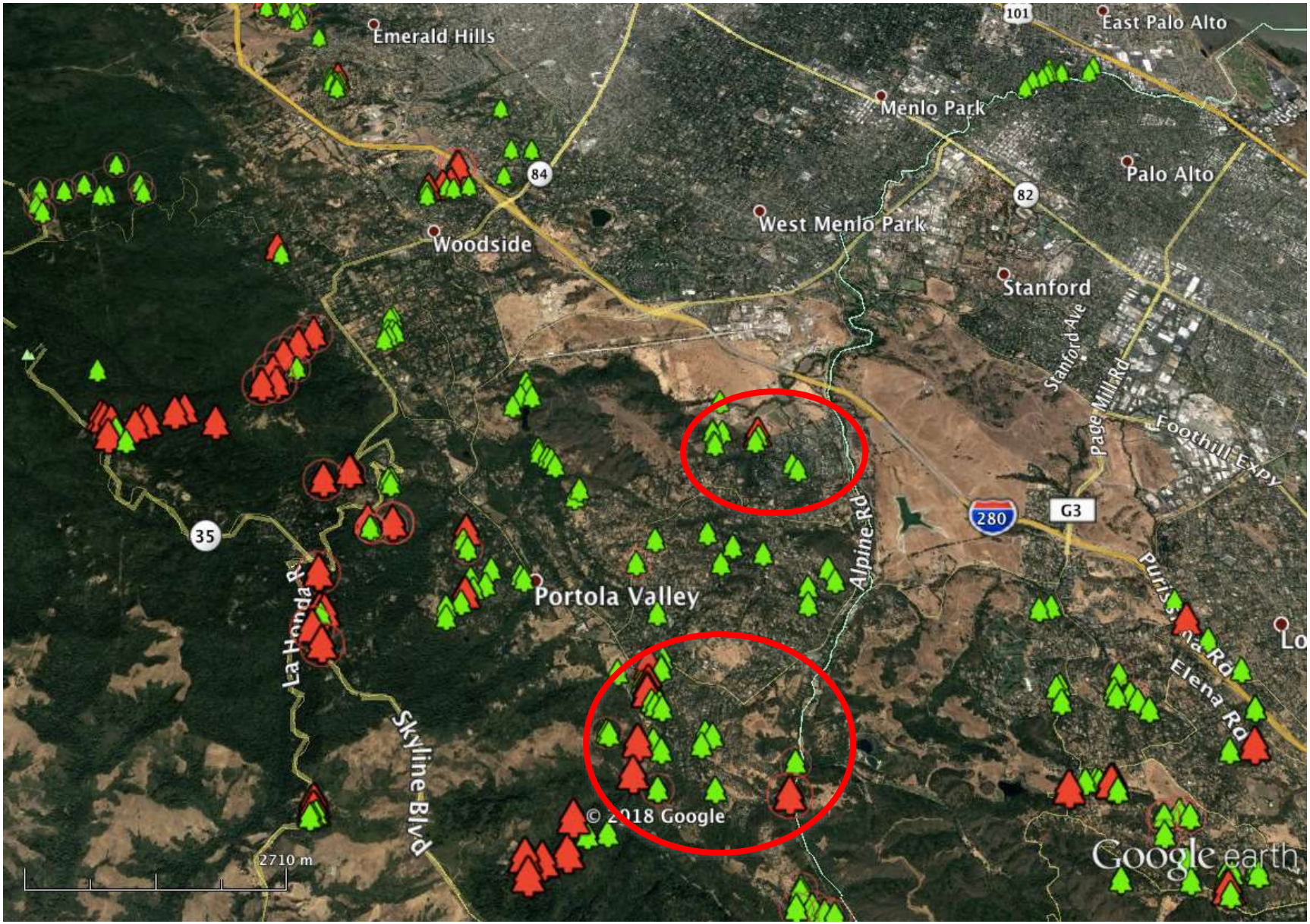


2018

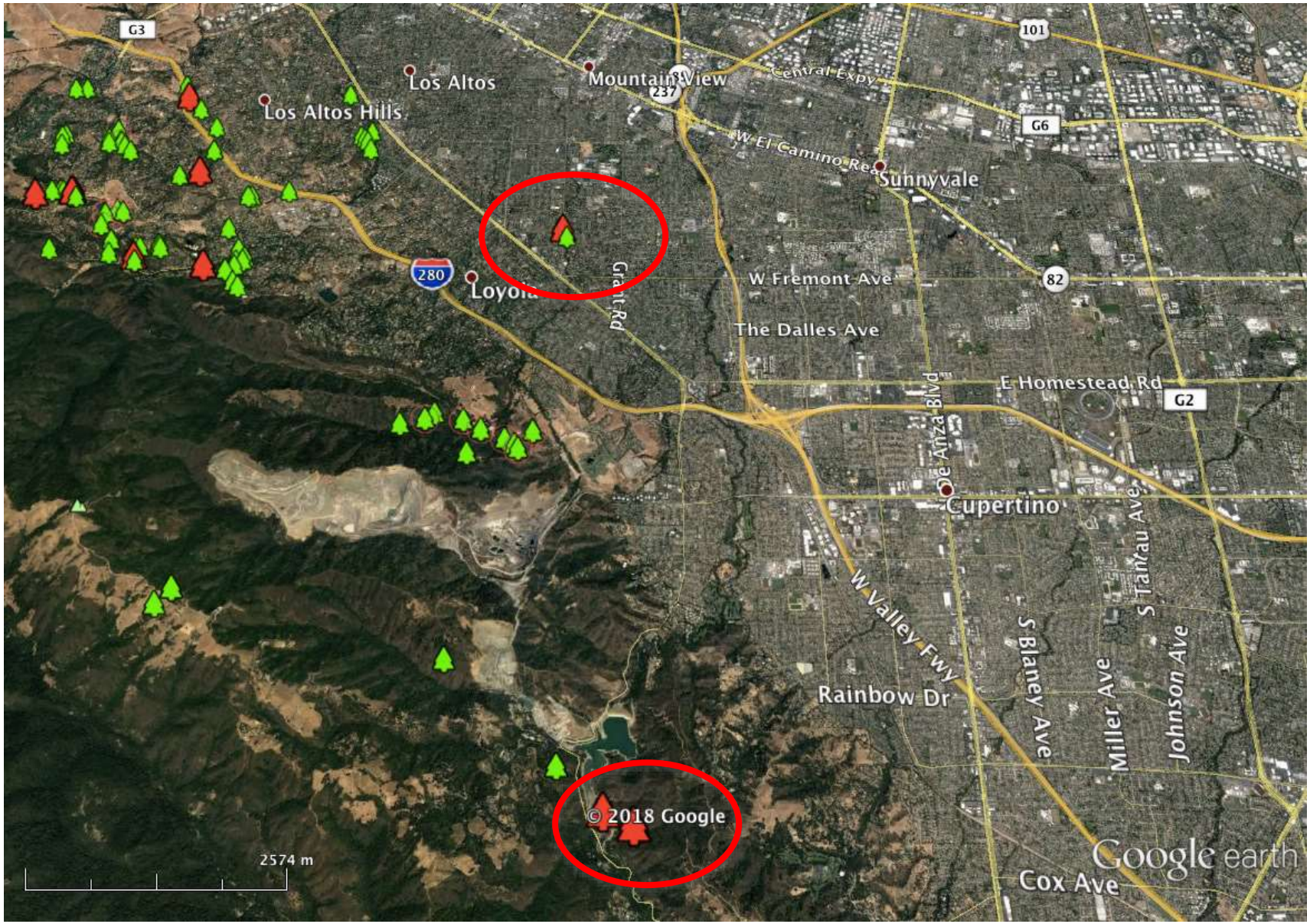
2019



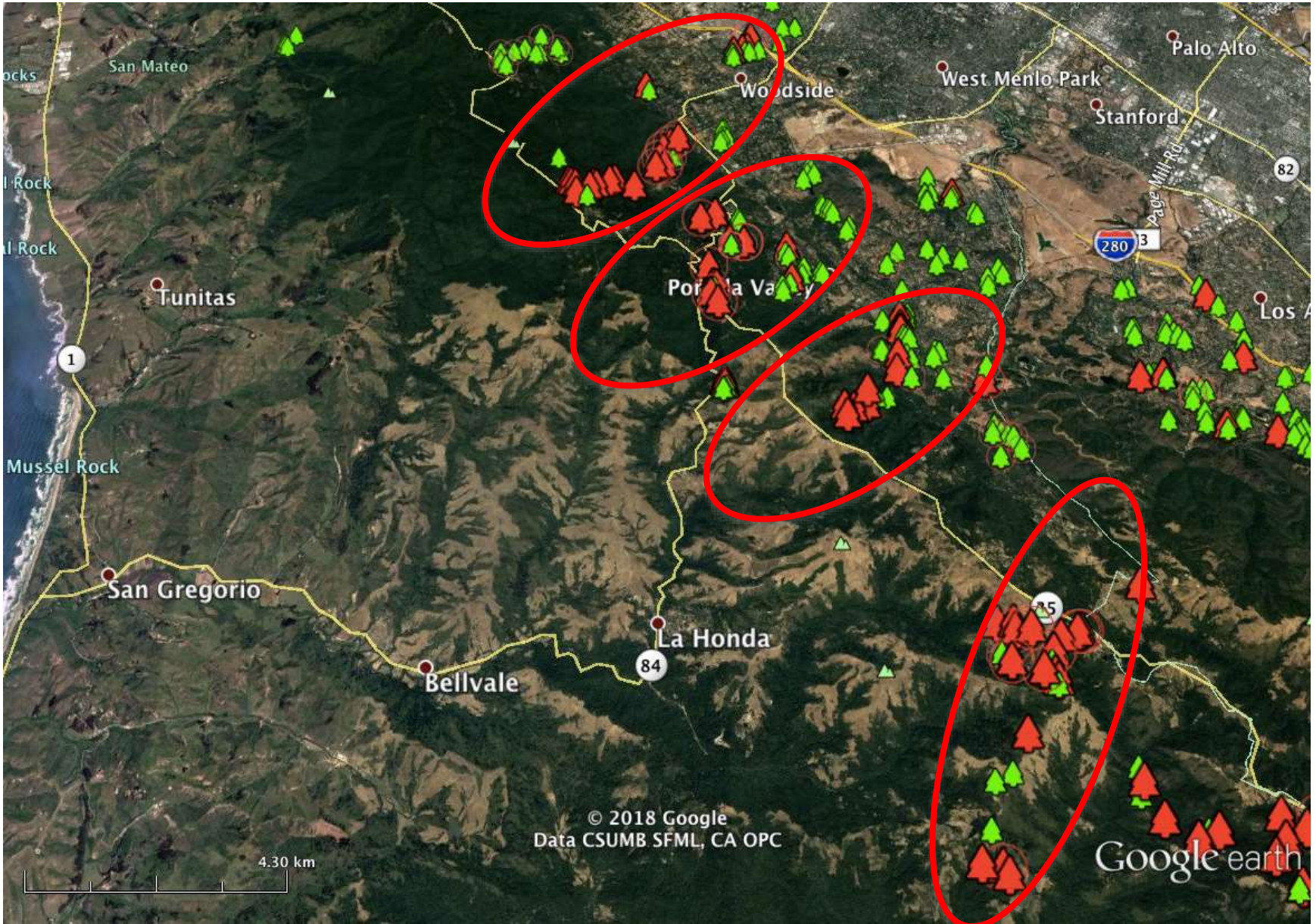
SF Peninsula: Woodside- PV



SF Peninsula: Los Altos Hills



Skyline & CO.


San Mateo
Palo Alto
West Menlo Park
Stanford
Page Mill Rd
82
280
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1
San Gregorio
La Honda
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Bellvale
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Data CSUMB SFML, CA OPC
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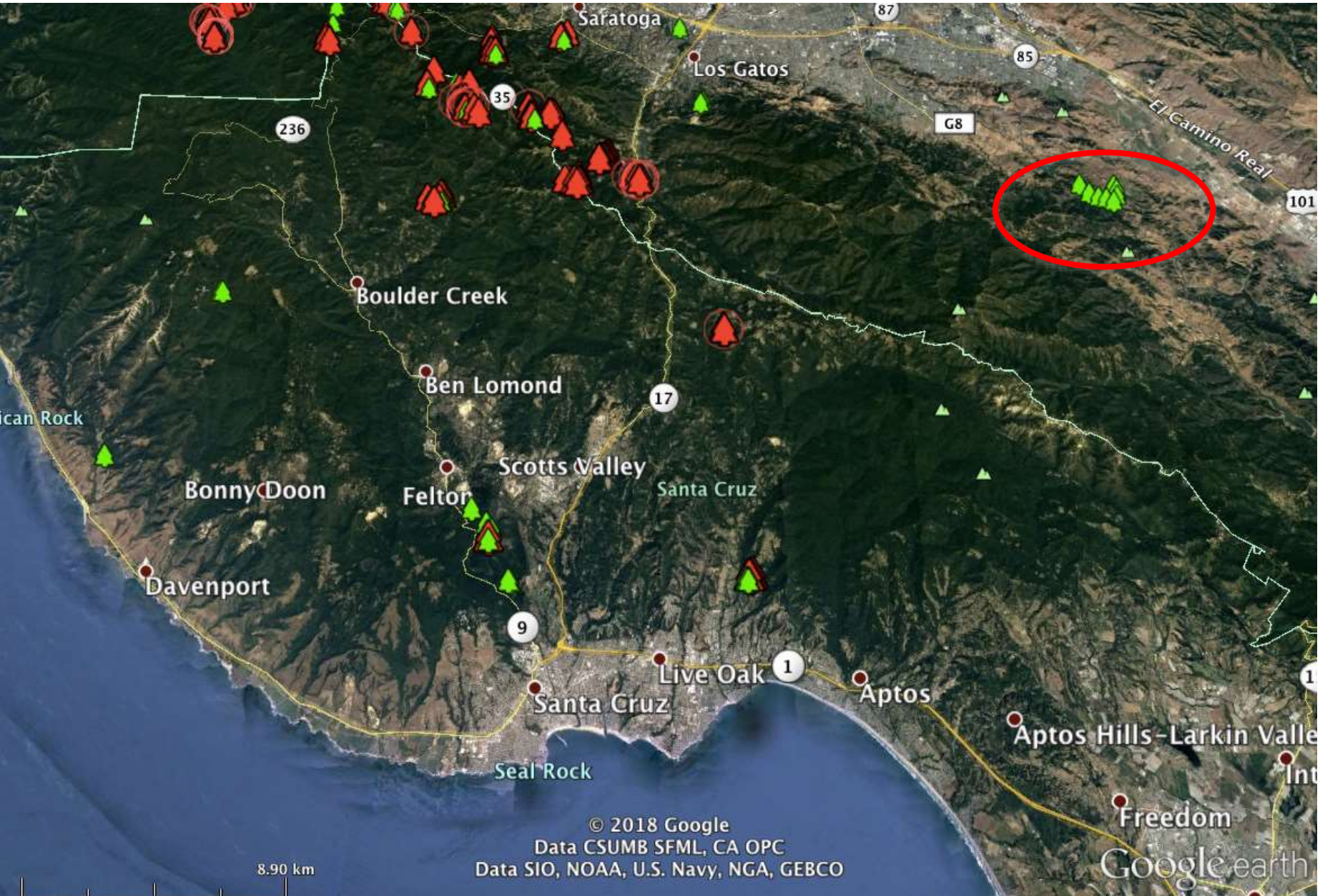
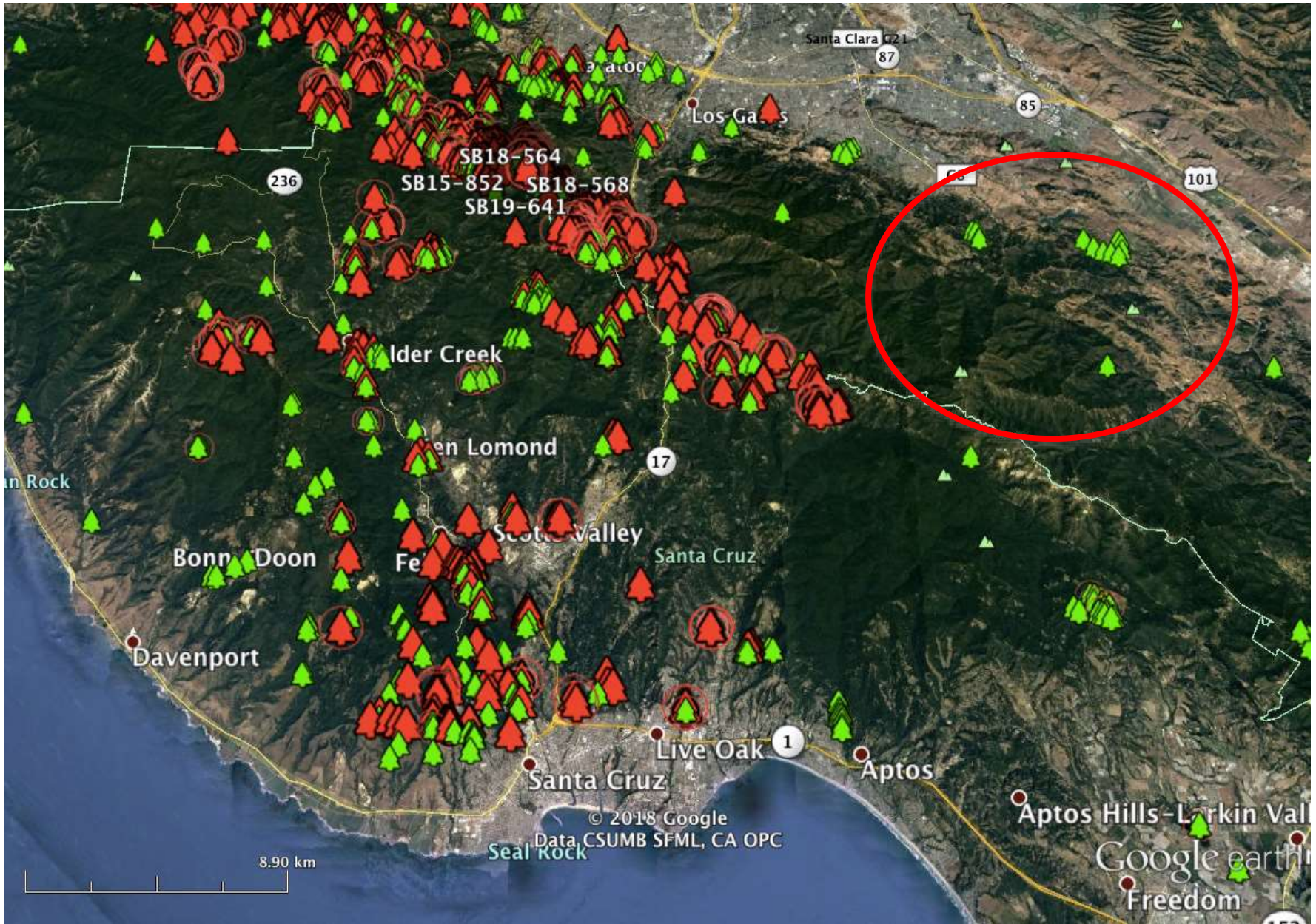
Google earth

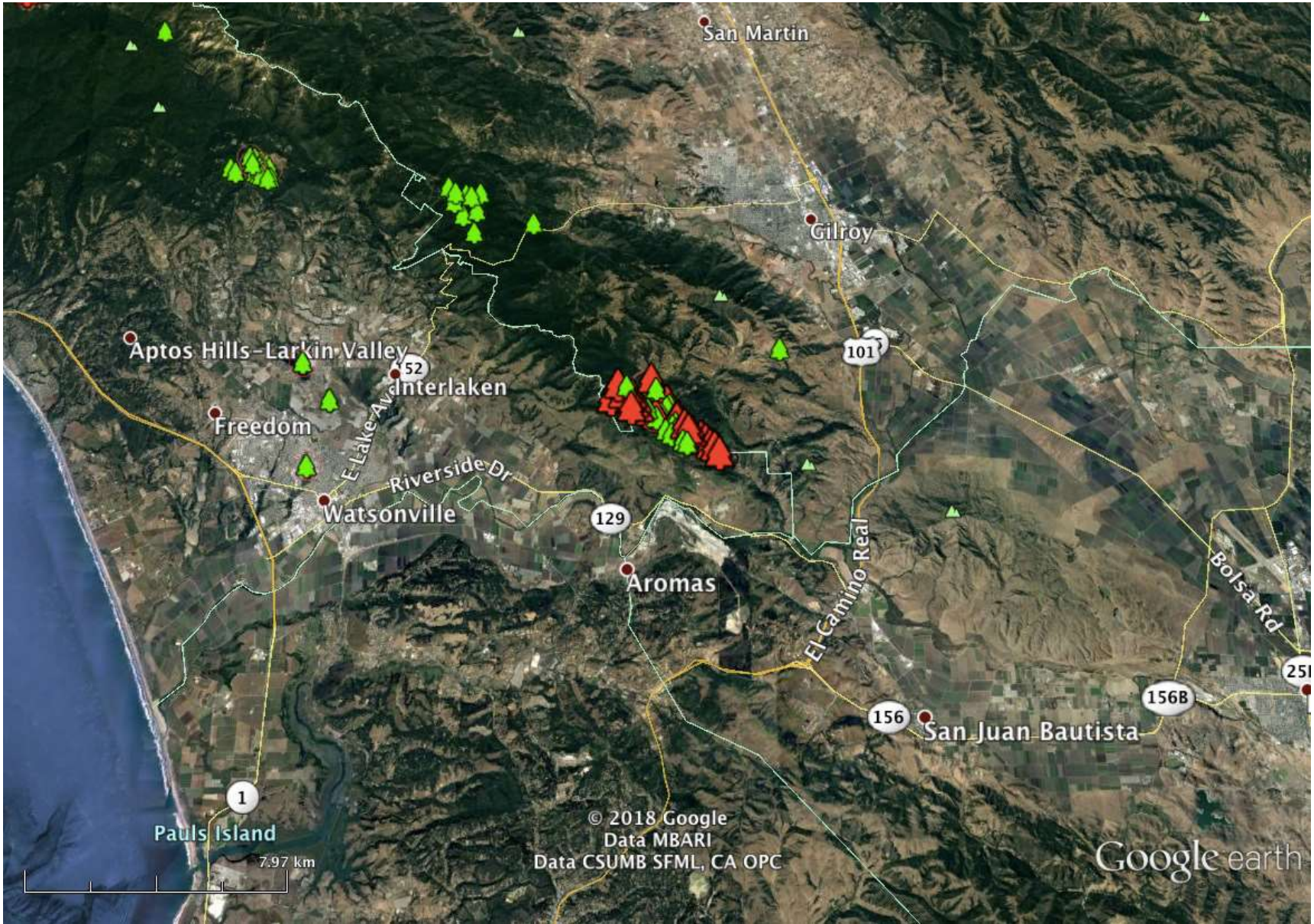
Santa Cruz- Santa Clara



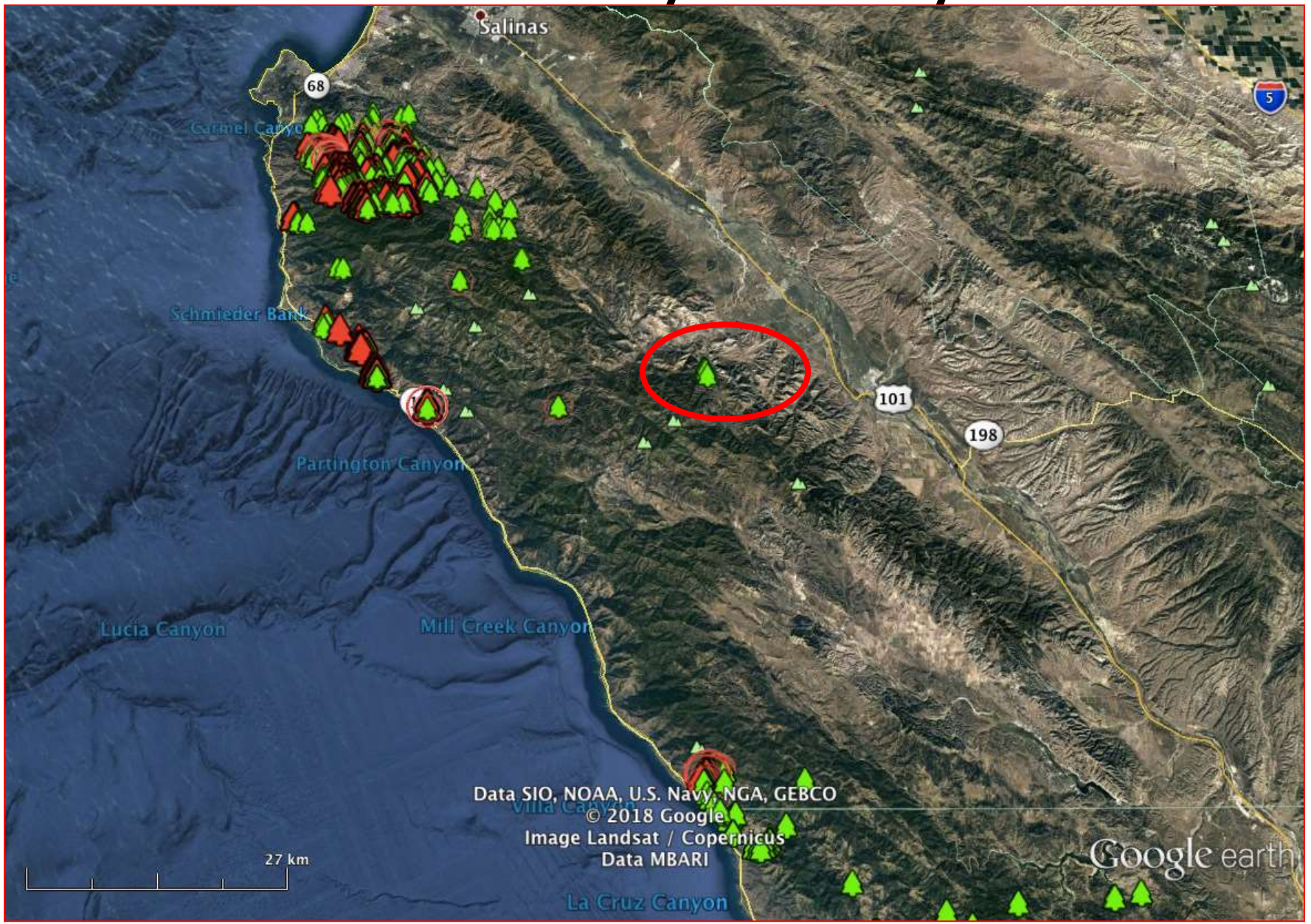
Santa Cruz- Santa Clara all data



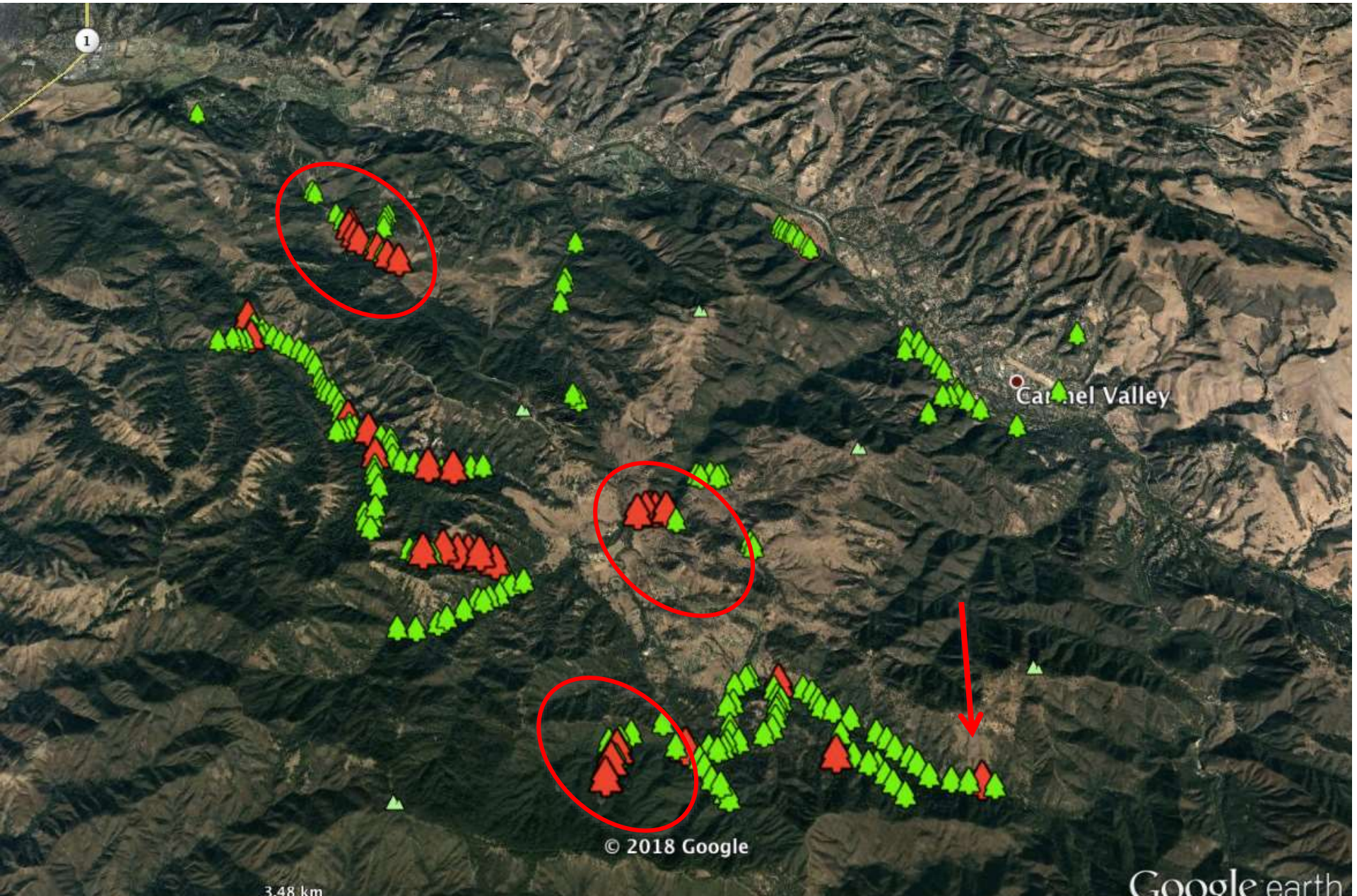
Santa Cruz-Santa Clara 2016/17



Monterey County



Carmel Valley & SLP: higher incidence in a few areas



Concluding remarks

- Infection rate goes up with increasing rainfall
- In 2019, we have detected outbreaks in many areas where SOD had been reported before, but had not been detected for a while. It suggests that the microbe is now established and survives through dry years. This is the first year in which we have so many historical outbreaks expressed at the same time
- We did have novel outbreaks both at the edges of current range, e.g. Southern Monterey County and Del Norte, and within the current range (e.g. North of Emerald Hills)
- Hotter areas a problem for the establishment of SOD
- Cooler areas like North Peninsula are ideal for SOD
- In Berkeley and elsewhere significant oak mortality due to oak infections that occurred in Spring of 2017
- SF maybe indication management can work

Oakstep.org

- Oakstep program was started because

- Confirmation of SOD on one oak is important:

  - SOD infected oaks burn very hot
  - SOD infected oaks are likely to fail
  - Confirmation of SOD on one oak is the most pressing signal the landowner needs to protect other neighboring oaks

UC BERKELEY FOREST PATHOLOGY AND MYCOLOGY LAB

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OakSTeP Project

What is OakSTeP? **Oak S**OD **Te**sting **P**rogram is a new program aimed at making a step in the right direction towards the detection and control of Sudden Oak Death (SOD). The other major program aimed at empowering communities in the fight against SOD is called "SOD Blitzes" and allows lay people to identify and confirm the presence of SOD on California Bay Laurel and Tanoak leaves, the two major vectors for the disease in California forests. OakSTeP is a new program launched by the U.C. Berkeley Forest Pathology Laboratory aimed at filling the gap of knowledge on SOD in oaks. Currently, oak testing for SOD is prohibitively expensive and too complex to perform, even for tree care specialists. OakSTeP facilitates the cooperation between professional tree care specialists, oak owners who are their clients, and U.C. scientists to provide a rapid and inexpensive diagnostic service on SOD infection on oaks. Although "SOD blitzes" remain key in protecting oaks from SOD, by identifying the disease in its major vectors (Bay Laurels and Tanoaks) before oaks are infected, early detection of SOD on an oak in any given property, may allow a tree care specialist to save that oak, or more realistically, it may allow her or him to save uninfected oaks that grow nearby.

How Does OakSTeP Work?

OakSTeP stands for "**Oak S**OD **Te**sting **P**rogram". It is a program directed at licensed tree care workers to provide them with all that is needed to sample symptomatic oaks at a fraction of the cost. By enrolling in the program, a licensed tree care worker will have access to the following:

1. Sets of Petri dishes and associated data forms directly delivered to them and to be used when sampling oaks.
2. Instructional Video and written instructions describing step by step all tools needed to sample oaks: when, where and how to sample oaks; where and how to send samples.
3. Analysis by the U.C. Berkeley state-of-the-art Diagnostic Lab.
4. Easy to read diagnostic reports that may be shared with clients.

Matteo's Instructional Video

OakSTeP

Special Event: An Evening to Support California Wild Lands and Native Forests

Secure Donation Page

CLICK HERE TO DONATE

Oakstep.org

-Program description

-Instructional video on how to sample oaks

-How to get all necessary materials

-Written instructions

-All forms needed to enroll and request materials

However: (II)

- Diagnosing SOD is the first step, but what about **treatments** to prevent disease spread? Only treatments will make a difference

- SOD treatment has a cost but is easy, all treatment to de done in the Fall: 1)- Identify high risk areas using SODmap mobile; 2)- Remove bay laurels 15 -30 feet around oaks you want to protect; 3)- Treat oaks that have very high value with phosphites

-Fill in the extended Treatment form record included in your collection packet. THIS WILL CREATE A DATABASE OF HOW MUCH CALIFORNIANS ARE WILLING TO INVEST TO STOP SODAND TO GET POLICY MAKERS TO INVEST MORE ON SOD

Fill in form inside packet or go to www.sodquest.org

Sudden Oak Death (SOD) TREATMENT SURVEY

Date: **Full Name:**

Zip code: **Email:**

Your position, circle one:

Owner Manager Renter Arborist or similar

Year when SOD was first officially diagnosed in property:

How was it diagnosed, circle all that applies:

SOD Blitz results

Ag commissioner/CDFA

Professional Arborist/private lab

Circle all tree species present in property:

Coast live oak	Shreve's oak	Black oak
Canyon live oak	Tanoak	California bay laurel

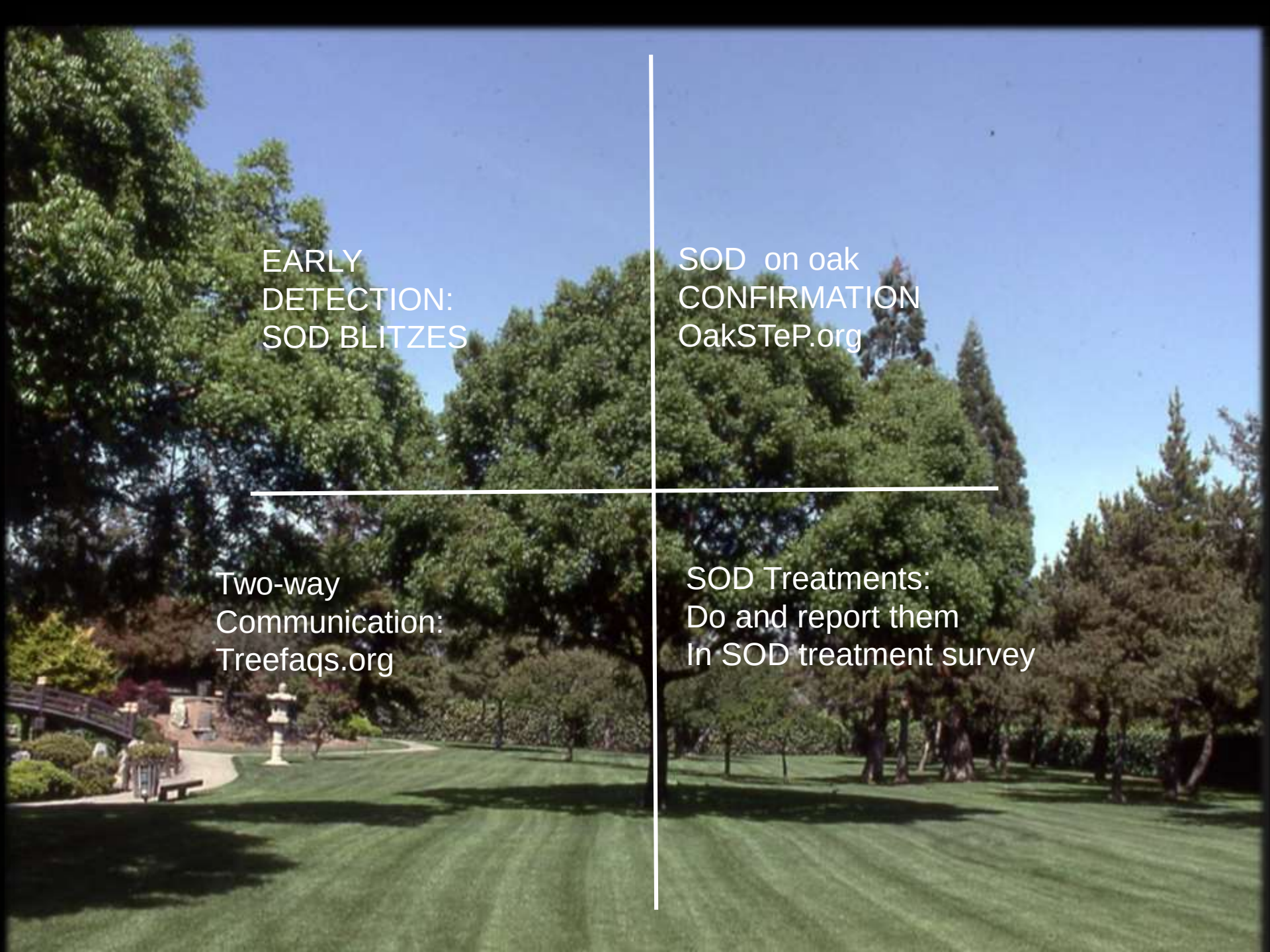
What actions have you taken to control SOD, circle all the apply:

Removed bay laurels around oaks

your contribution will remain anonymous

SODQUEST 2019 results

- 69 responses, 27 hired an arborist
- 2410 trees were protected
- Average success rate 91% (27-100)
- Average cost per tree $ 158


EARLY
DETECTION:
SOD BLITZES
SOD on oak
CONFIRMATION
OakSTeP.org
Two-way
Communication:
Treefaqs.org
SOD Treatments:
Do and report them
In SOD treatment survey

EARLY DETECTION:SOD BLITZES

www.sodblitz.org
www.sodmap.org
www.sodmapmobile.org

SOD CONFIRMATION ON OAKS

www.sodblitz.org
www.oakstep.org

Reporting and questions

www.sodblitz.org
www.sodquest.org
www.treefaqs.org

Learn SOD Treatments

www.sodblitz.org
www.matteolab.org
www.suddenoakdeath.org

This is the “whole enchilada” to protect our oaks

- Thanks to NSF, Gordon and Betty Moore Foundation, PG&E Foundation, MidPen Open Space and USFS State and Private Forestry

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)

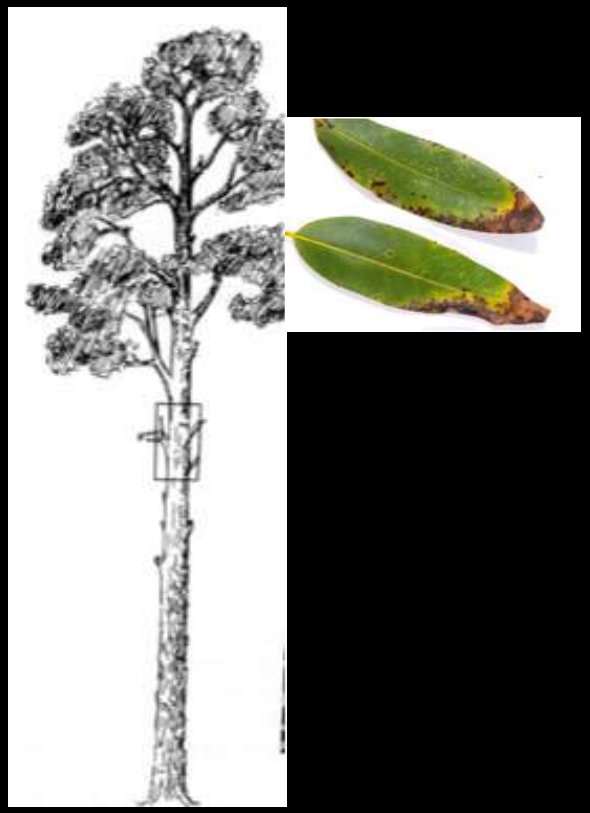
Spreads by itself aerially by wind & rain during mild wet season (but only a few hundred yards)

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

Need to have a fine-scale map of pathogen distribution

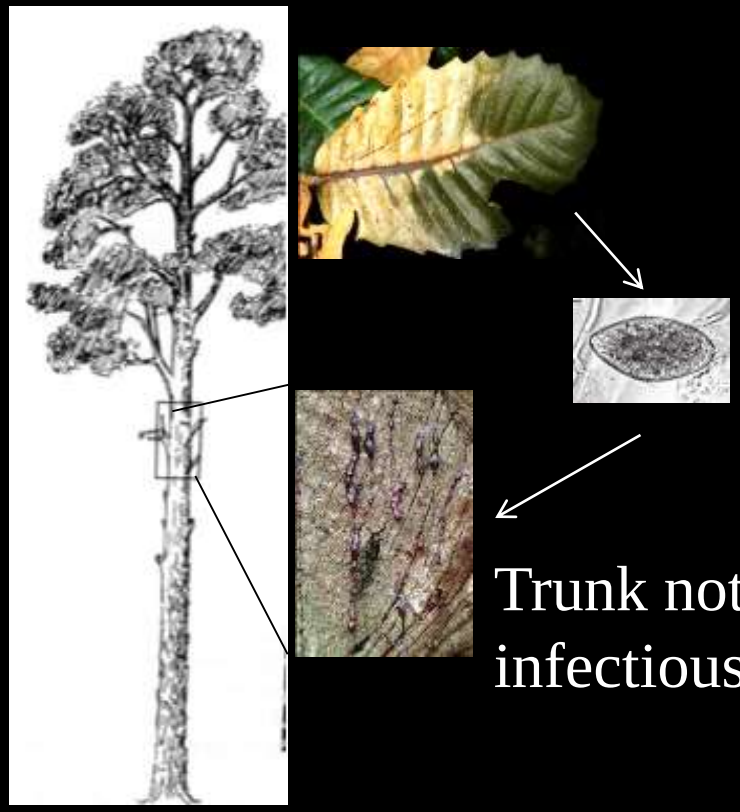
Infectious hosts in CA forests

- CA Bay Laurel



Only leaves,
highly infectious

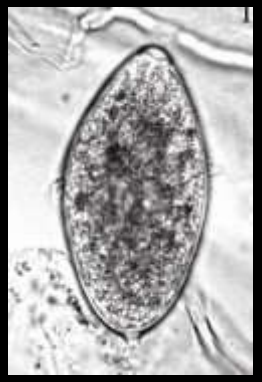
- Tanoaks



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

Bay/Oak association (not tanoak-oak)

Yearly, in spring, bay laurels



Wave years

Coast Live Oak (no sporulation)

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:

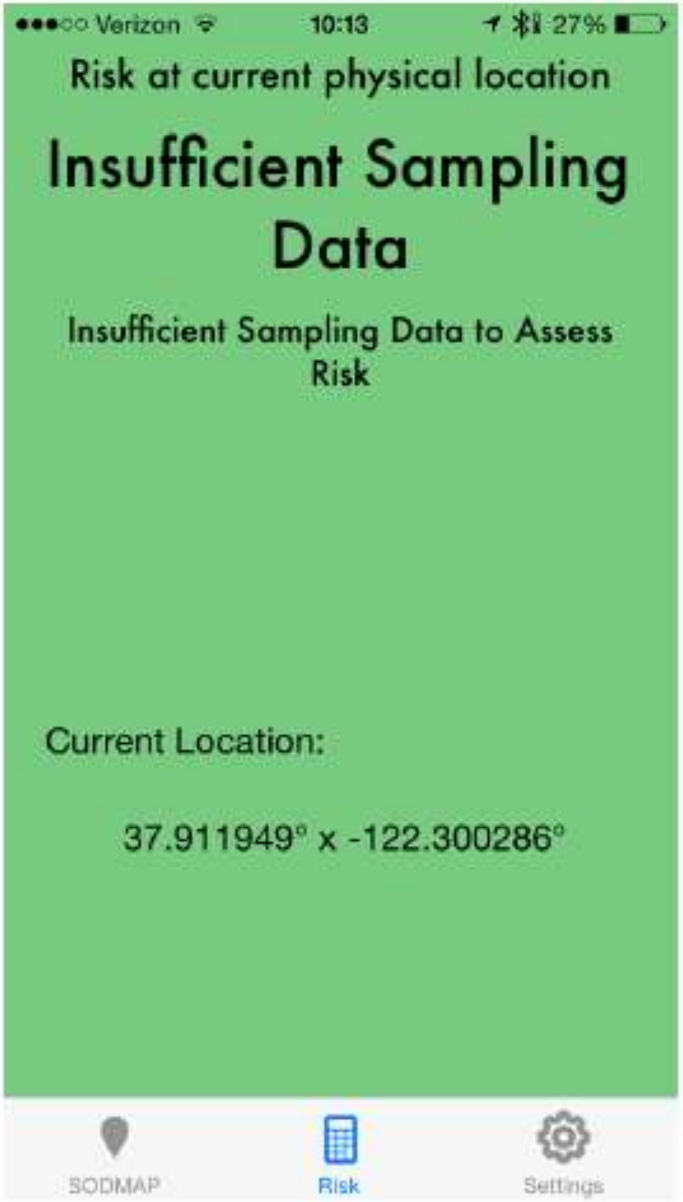
SODMAP Mobile

U.C. Berkeley
Forest Pathology
and Mycology
Laboratory

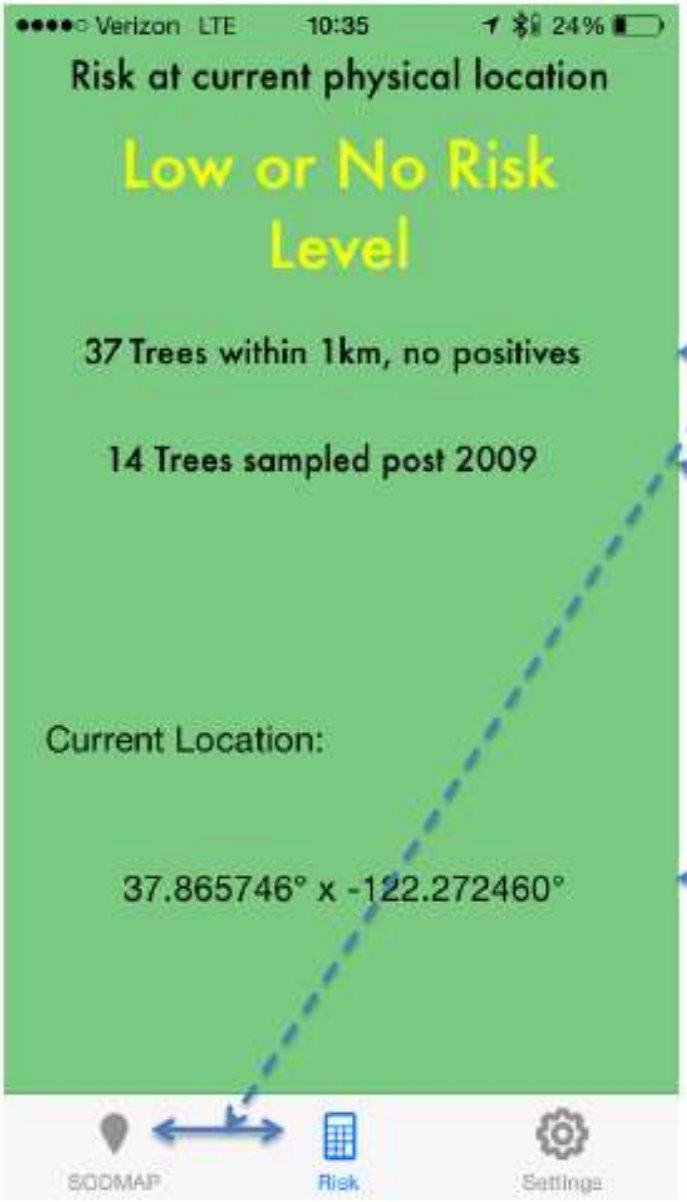
Enlarge screen view using your Index and thumb fingers

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

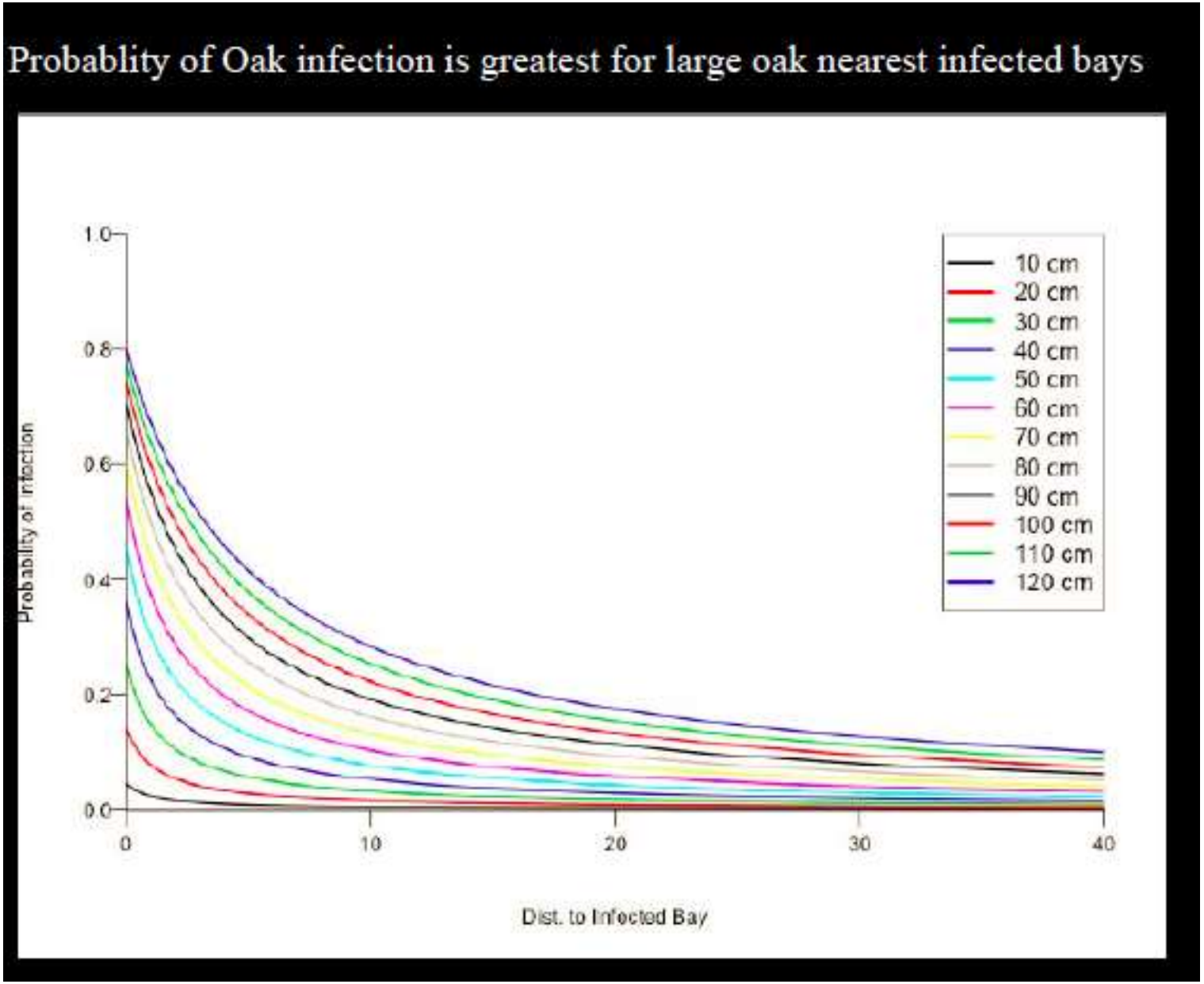
- Oaks are infected by spores produced on leaves of California Bay laurels
  - Selectively remove bay laurels around high value oaks
  - Reduce overall bay density in property

Symptomatic CA bay laurel

+ rainfall (over 400 mm)= oak infection

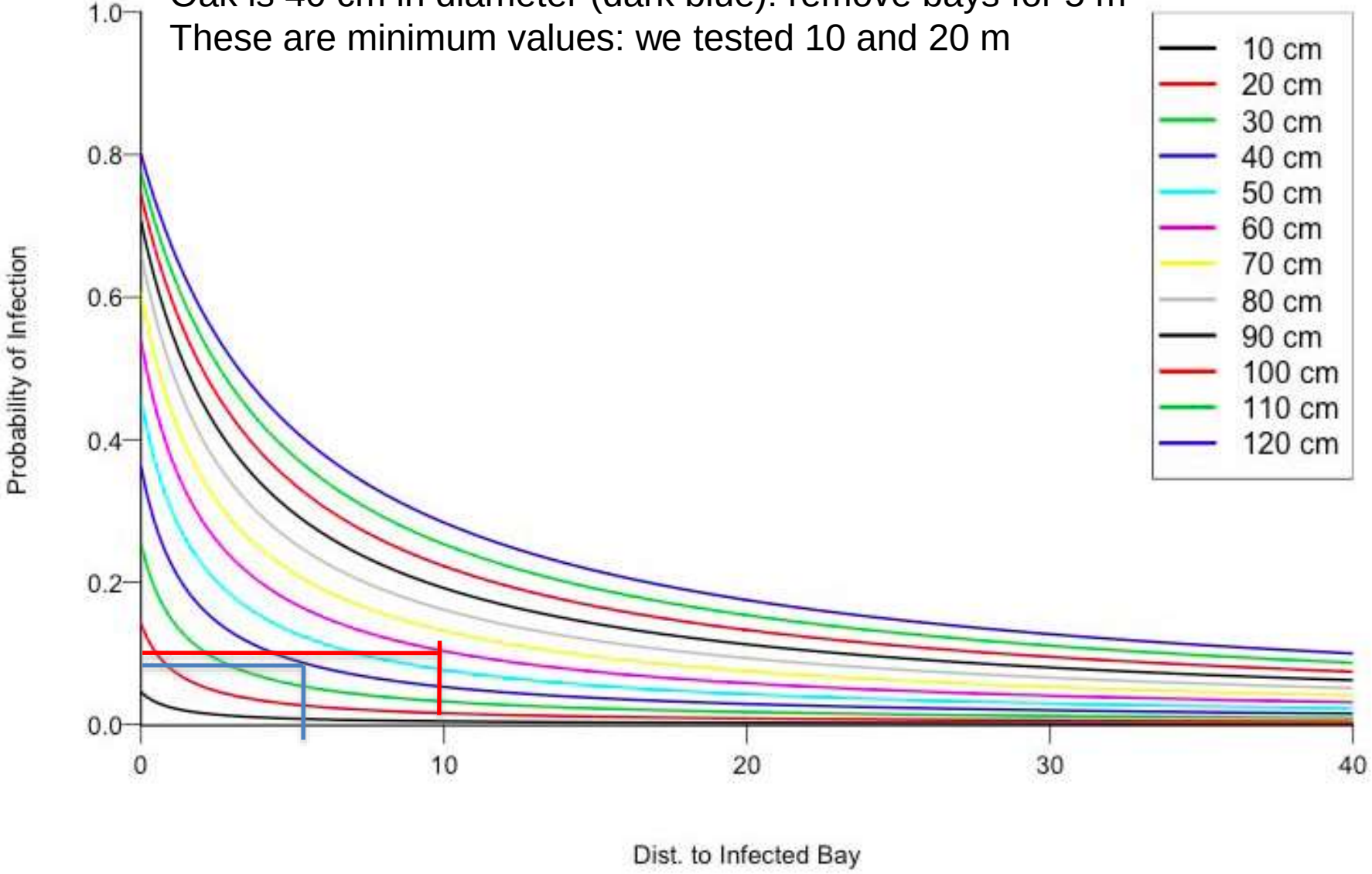
Probablity of Oak infection is greatest for large oak nearest infected bays

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

Risk acceptable, varies subjectively, but lets say 10%
Oak is 60 cm in diameter (purple line): remove bays for 10 m
Oak is 40 cm in diameter (dark blue): remove bays for 5 m
These are minimum values: we tested 10 and 20 m

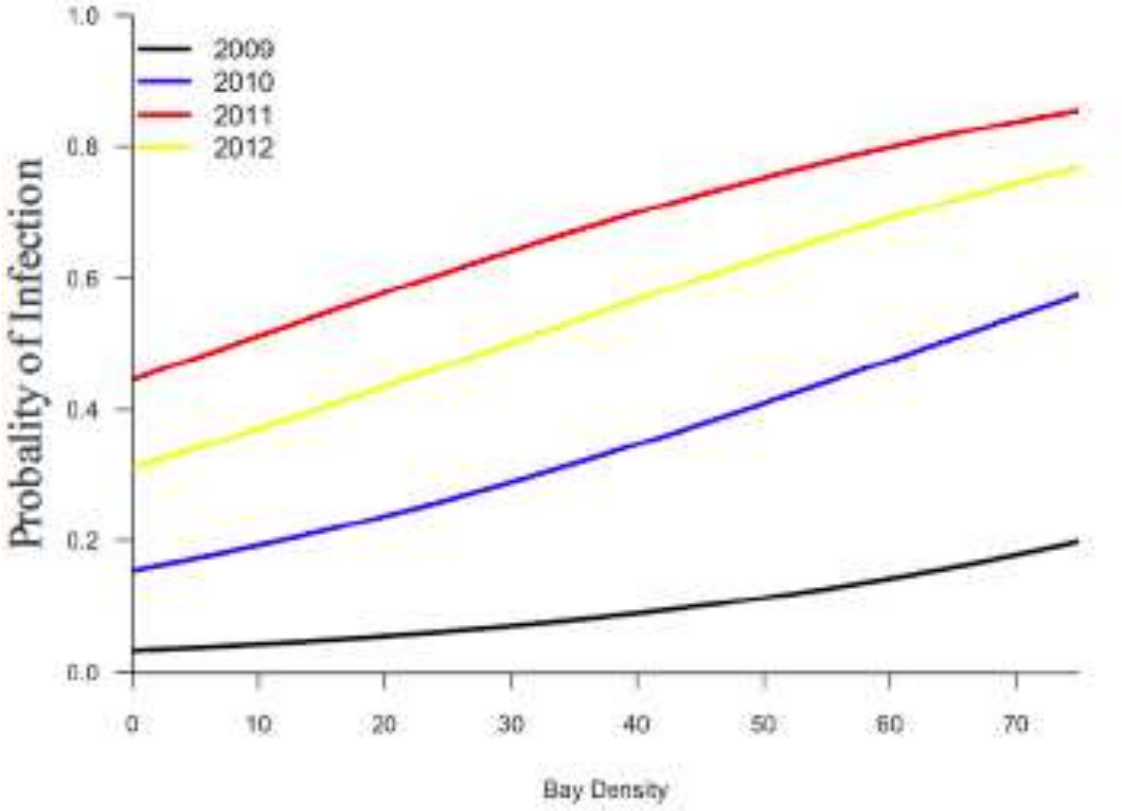


Drip-line to trunk distance (DTD)

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)

Injections using 40 mL and 35 PSI (Moderate Pressure)

20 mL and 20 PSI (low pressure)

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

Injected Phosphonate Efficacy

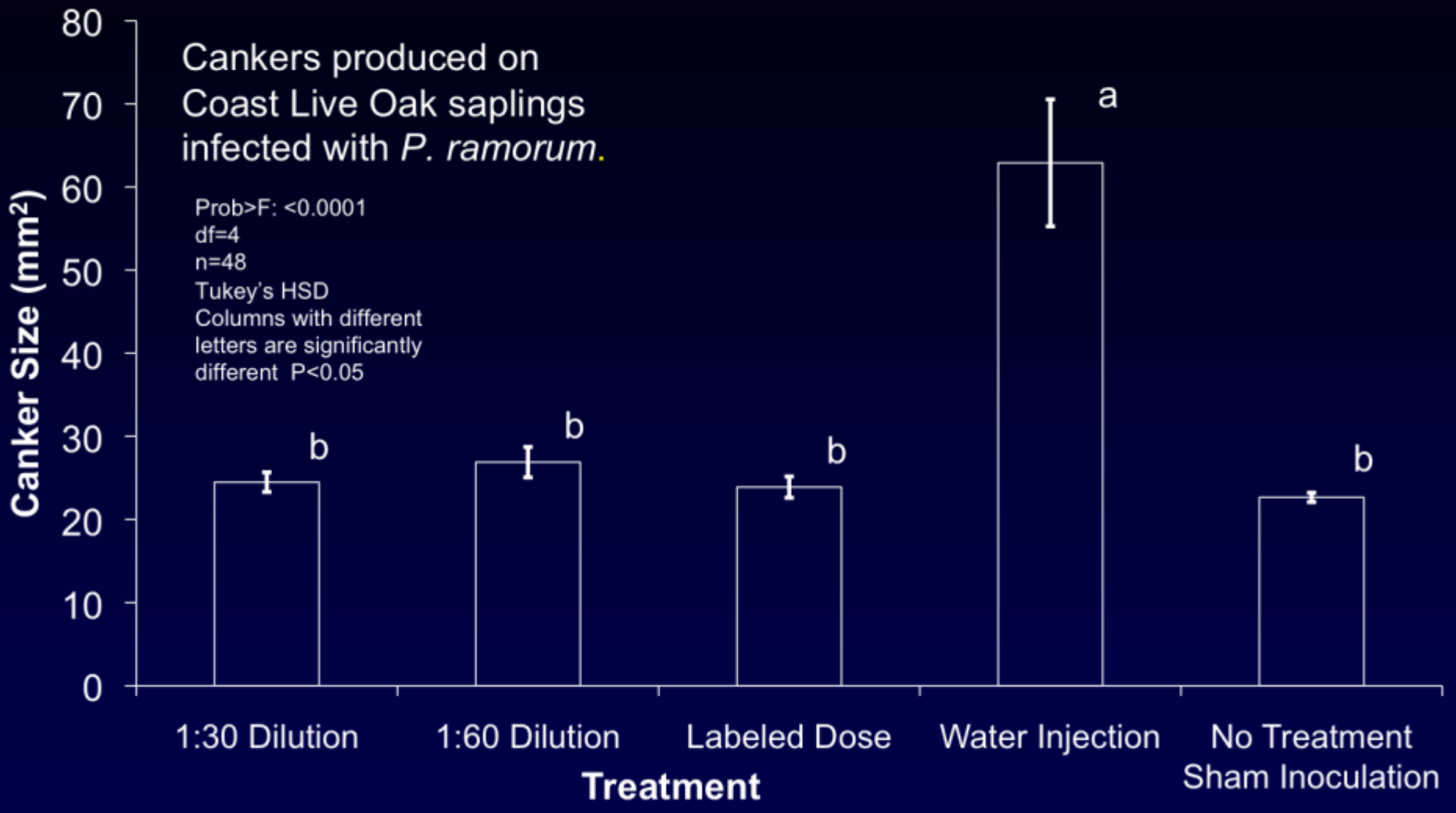


Figure 1. Efficacy of labeled dose vs updated dilution ratios. Smaller lesions = higher efficac

Phosphonate Damage to Wood

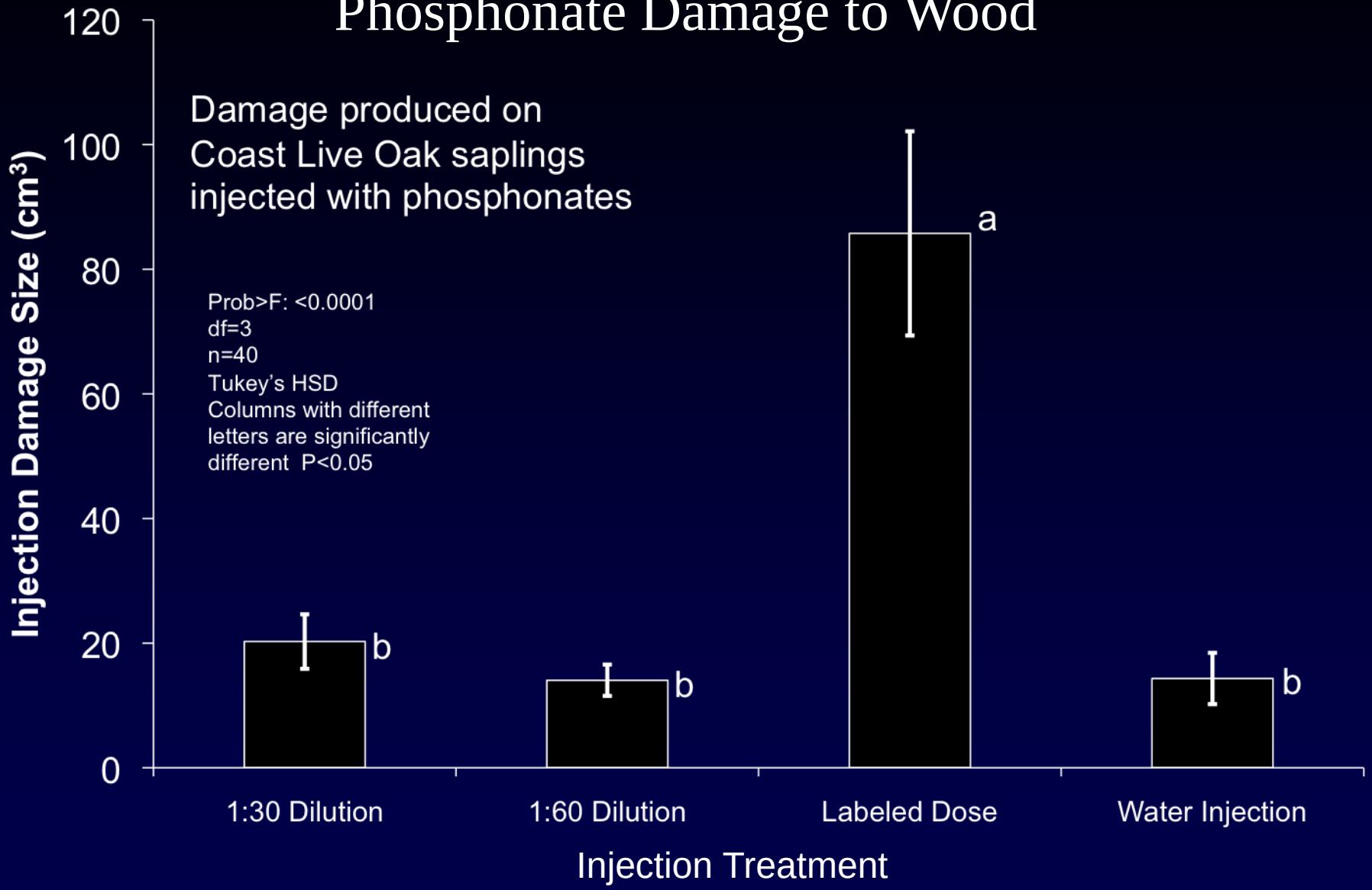


Figure 2. Injection damage caused by labeled dose vs updated dilution ratios. Note that updated dosage damage is indistinguishable from damage caused by only injecting water.

AGRI-FOS®

SYSTEMIC FUNGICIDE

PENTRA-BARK

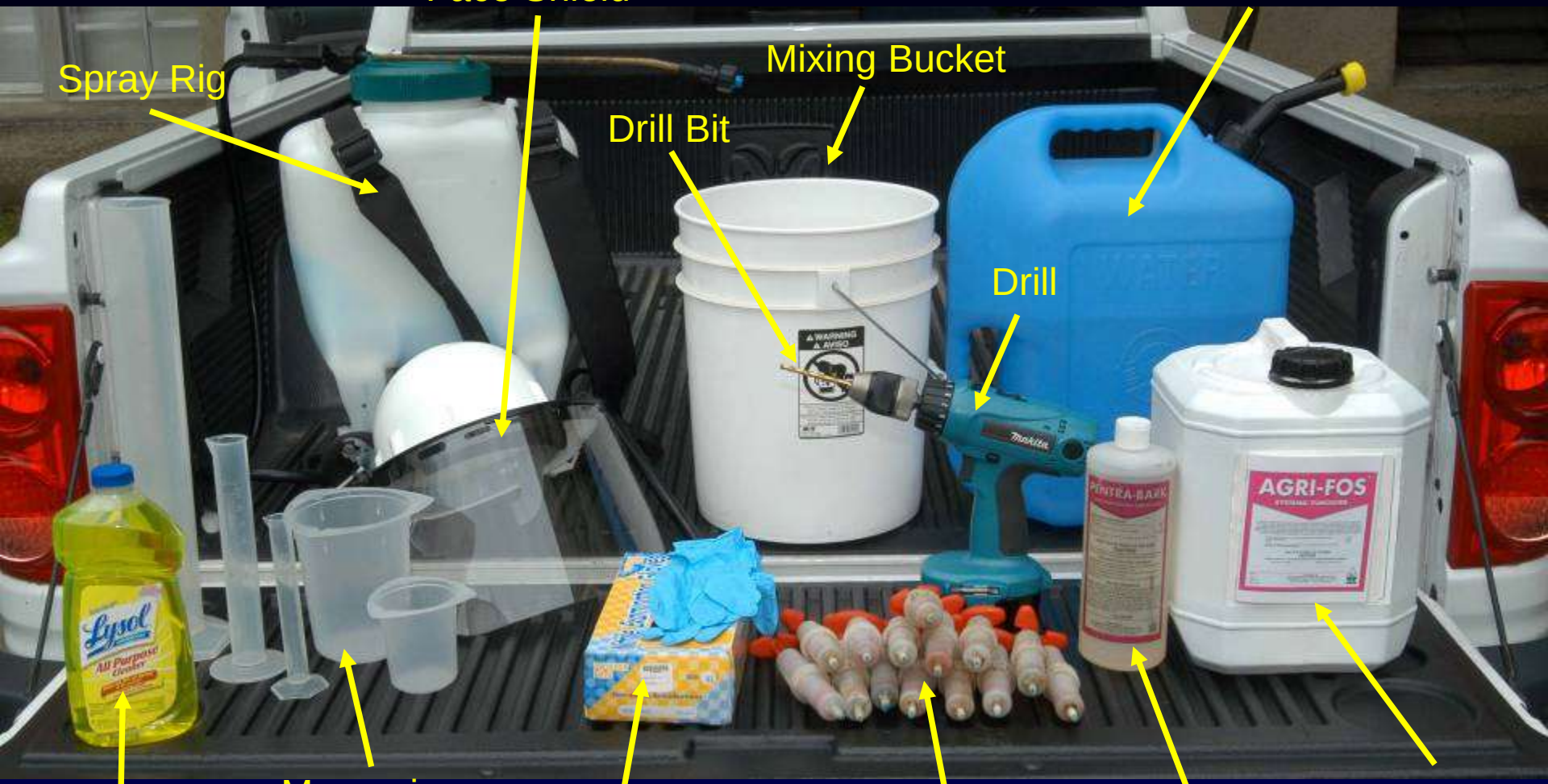
BARK PENETRATING SURFACTANT

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

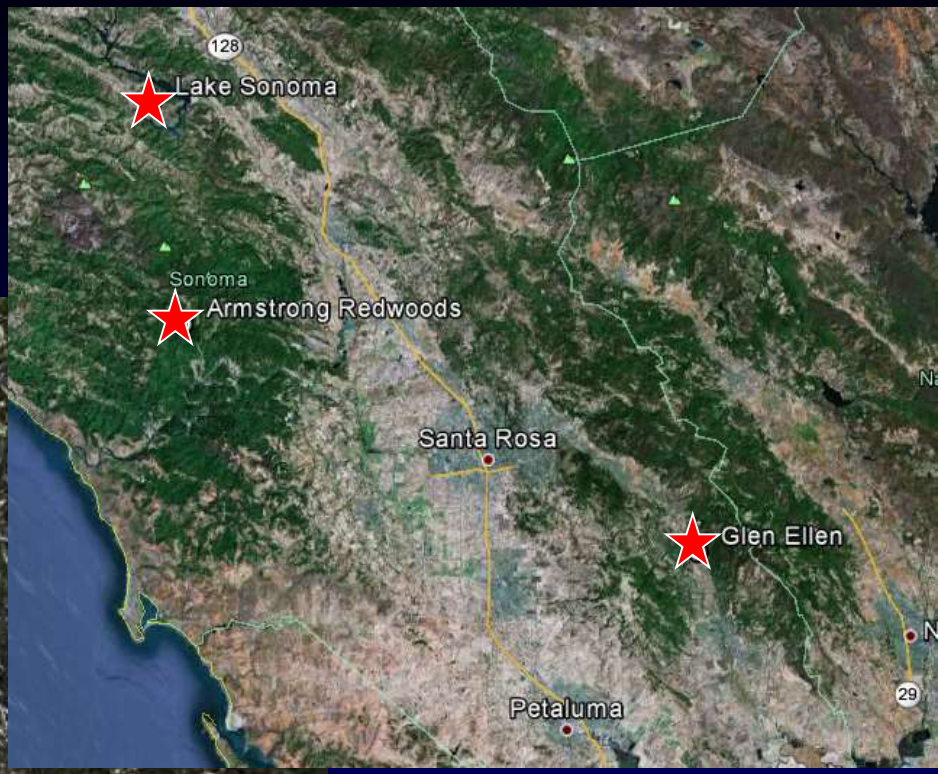
  n=68

  Scribing positives= 14; negatives 54

  Untreated positives= 12; negatives 56

  P=0.66

SOD Canker Scribing Experiments

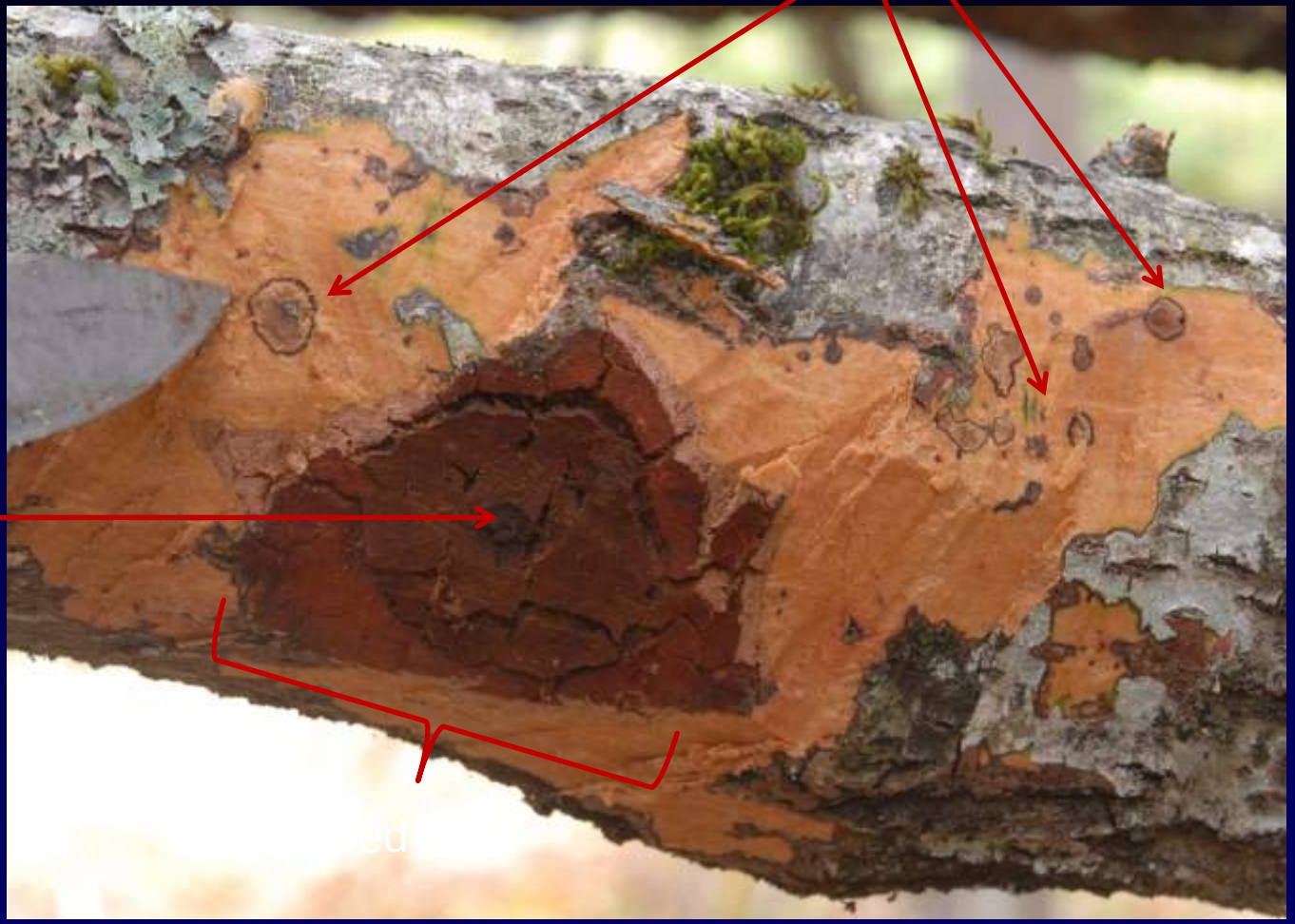


Positive control (infected but not scribed) lesion

Infected/scribed lesion

New lesions outside scribed area ? Maybe

≈ 1cm



Initial infection site

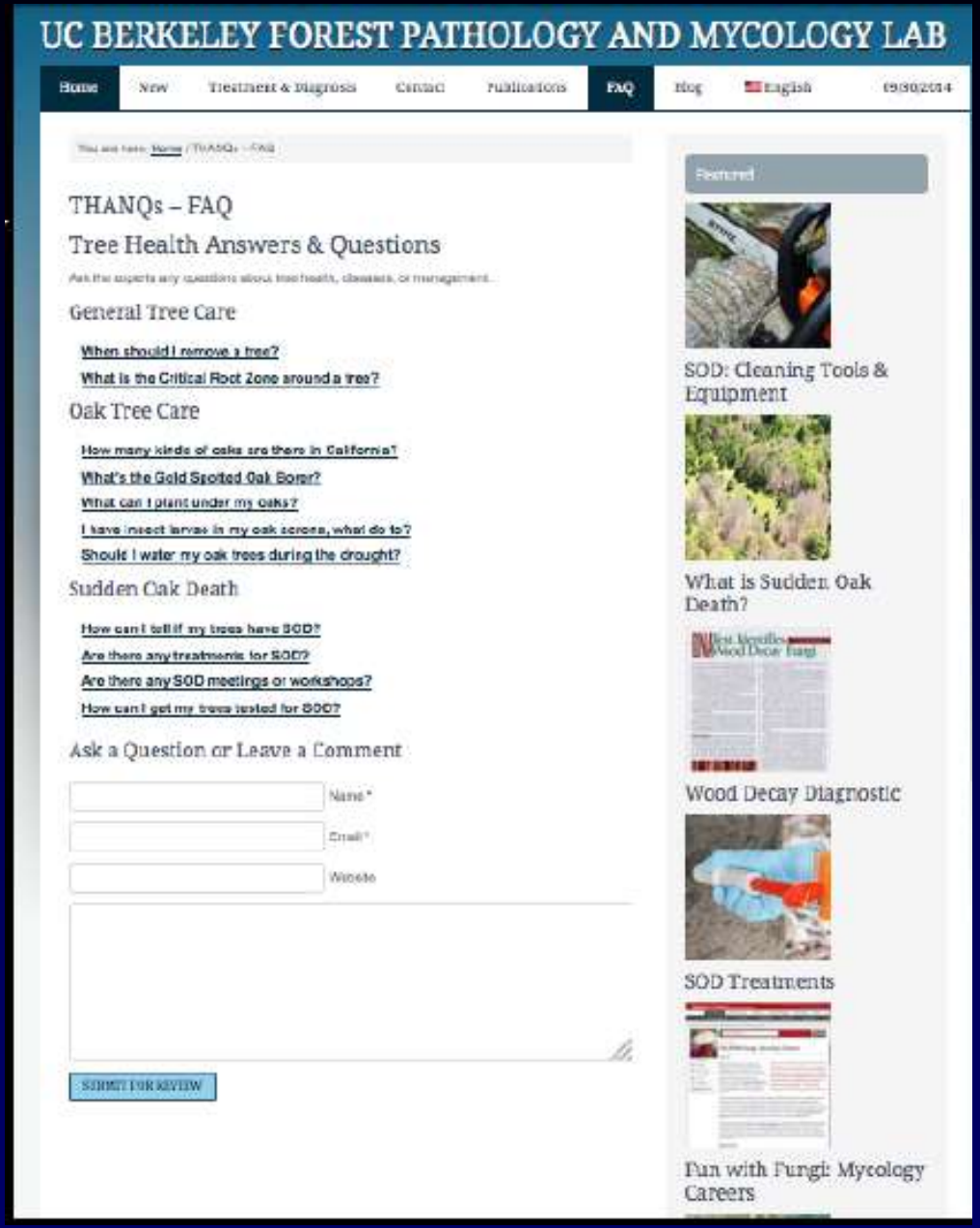
Scribing

- 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

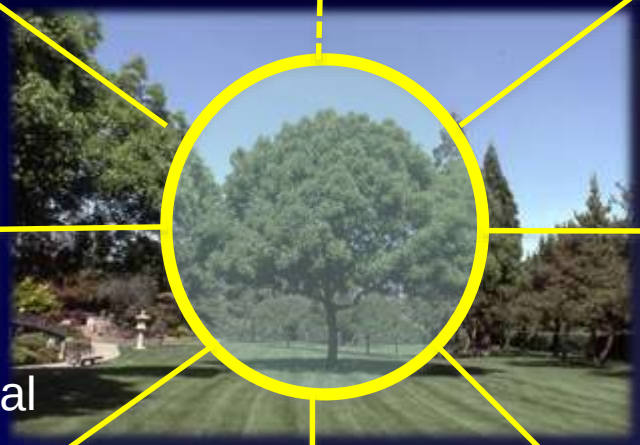
- Water deficiency due to prolonged diminished precipitation and increasing temperatures
- Physiological changes:
  - Direct effects such as thinner canopy, leaf abscission, stunted growth
  - Indirect effects: secondary pathogens and pests
- Some effects reversible: direct physiological changes, branch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

Stunted growth

Fungal twig dieback
Cryptocline

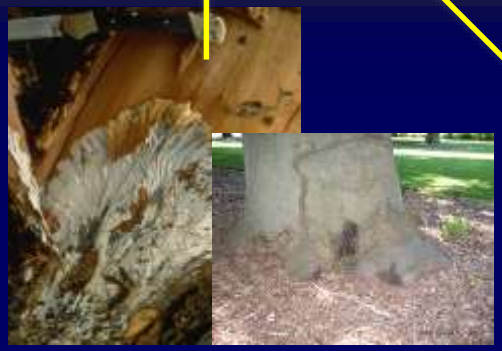
Fungal branch dieback
Diplodia

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.