SOD BLITZes 2023: Results & New SOD Management Recommendations

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COLLEGE OF
Natural Resources
UNIVERSITY OF CALIFORNIA, BERKELEY

Funding and acknowledgements

- United States Forest Service
  - **State and Private Forestry: Phil Cannon**

- 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, Debbie Mendelson (Woodside), Kerry Winninger (UCCE Sonoma) and Kerri Frangioso (UC Davis). UC undergraduates and Lea Green

Donations can be done online at

www.mattelab.org

Click the “Donate” link

Fully tax deductible

Sudden Oak Death

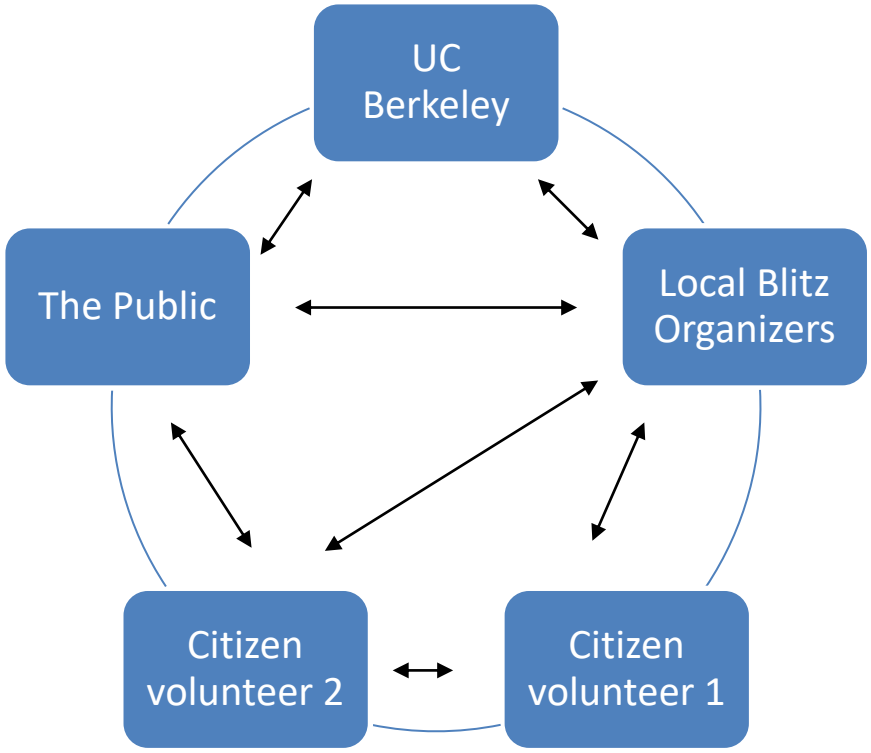
- Caused by the exotic pathogen *Phytophthora ramorum* introduced on infected ornamental plants in the 1980s

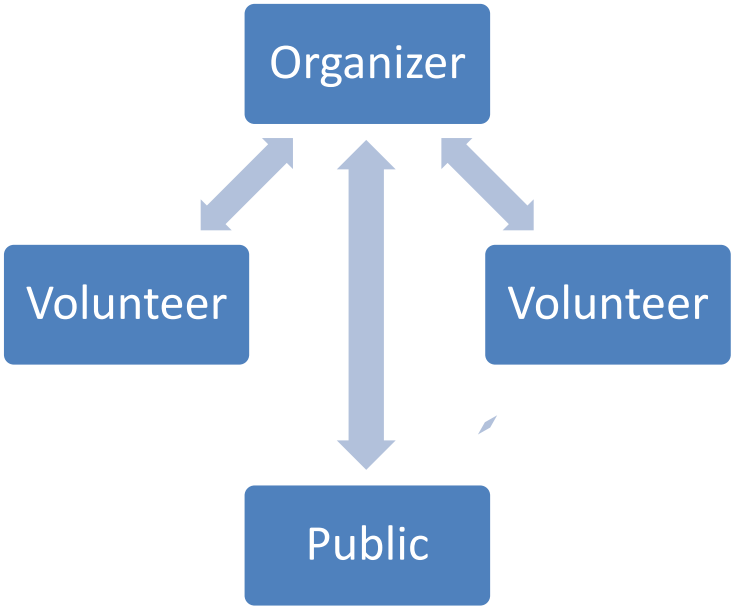
- Since the 1990s it has caused the mortality of tens of millions of oak species and of the related tanoak, but the disease affects a large number of native plants, some already threatened
  - Loss of native biodiversity, extirpation of entire tree populations
  - Declining and dead trees worsen fire hazard
  - SOD infected trees are at high risk of failing
  - Compromises the California Carbon offset program
  - Loss for native Californians
  - Loss of landscape trees
  - One of the worst tree epidemic in the world

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

SOD Blitzes vs. Other





Citizen Science and Covid-19 (I)

- We have switched to online training and NO in person meetings will be organized. Everything you need to know is posted on www.sodblitz.org

- You still have to run your SOD survey on the weekend assigned to your community (see the BLITZES schedule online)

- Collection packets with all necessary materials are available in the **left bin** at the pick up/drop off **Blitz station**. Pick one or two packets, each one allows you to sample ten trees

- **Blitz stations** are at the venue published on the schedule. Their exact location will be posted on the doors of the venue

SOD Blitz station

SOD BLITZ Station

Online
Training


SOD Blitz 2020 Collection Packet
Collection Materials and Instructions Inside
Collector
Estimated Number of Healthy Trees
You Looked at to Make This Collection
Estimated Number of Symptomatic Trees
You Looked at to Make This Collection
Lab Use Only
P
SB
To:
David Rizzo
SOD Blitz Project Area
El Centro, CA
Sudden Oak Death Symptoms on California Bay Laurel
SOD Symptoms on Tanoak
Asymptomatic Tanoak
Usually accompanied by yellow or brown leaf litter
POLY
SUNSET

BY mail

SURVEY RESULTS

2020	2021	2022	2023	Survey Question
3.1 ± 1.0	3.2 ± 0.9	3.4 ± 1.0	3.1 ± 1.0	What do you consider your knowledge level to be on Sudden Oak Death (SOD)? (1-Low - 5-High)
4.3 ± 0.7	4.5 ± 0.7	4.5 ± 0.7	4.4 ± 0.8	How do you rate the overall quality of this SOD Blitz meeting and of the presentation? (1-Low - 5-High)
4.0 ± 1.1	4.3 ± 1.1	3.8 ± 1.4	3.9 ± 1.1	Are you likely to take action if the SOD Blitz shows there are infected trees in your neighborhood? (1-Low - 5-High)

2020	**2021**	**2022**	**2023**	**Number of years participating in the SOD Blitz survey**
54	74.1	65.2	68.5	% of participant newcomers
9.0	8.3	13.5	5.6	% participating for > 3 years
10	11	12.4	8.3	% participating for > 5 years

UC Berkeley

Berkeley News Research People Campus & community

RESEARCH, SCIENCE & ENVIRONMENT

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

By Kara Manke | SEPTEMBER 24, 2019

Tweet Share 351 Email Print

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

RECONFIRMED THERE ARE TWO DISTINCT OUTBREAKS IN DEL NORTE COUNTY, 10 Km apart

1- NA1 lineage: Hiouchi
2- EU1 lineage: Fort Dick

Plant Disease • 2020 • 104:3173-3182 • https://doi.org/10.1094/PDIS-03-20-0619-RE

Citizen Science Uncovers *Phytophthora ramorum* as a Threat to Several Rare or Endangered California Manzanita Species

Matteo Garbelotto,[1,†] Tina Popenuck,[1] Brett Hall,[2] Wolfgang Schweigkofler,[3] Francesco Dovana,[1,4] Ruby Goldstein de Salazar,[1] Doug Schmidt,[1] and Laura Lee Sims[1,5]

[1] Department of ESPM, University of California, Berkeley, CA 94720, U.S.A.

Does weather explain natural infection in manzanita species?

To assess possible mechanisms explaining why these manzanita species had suddenly exhibited new symptoms, we analyzed relationships between rainfall and infestation intensity. Several studies have clearly shown a strong correlation between the amount of rainfall and the incidence of disease caused by *P. ramorum* (Eyre et al. 2013; Garbelotto et al. 2017); hence, we calculated average rainfall values for California as follows. Yearly precipitation data between 2008 and 2019 were collected from 28 National Oceanic and Atmospheric Administration (NOAA) weather stations (https:// canopies or branches at the time of sampling.

Table 2. Species tested at the University of Santa Cruz Arboretum and number of plants that were positive for the pathogen *Phytophthora ramorum*

Species sampled	Number of plants	*P. ramorum* positive
Arctostaphylos hookeri	1	0
A. hooveri	2	1
A. montereyensis	4	2
A. morroensis	1	1
A. ohloneana	3	0
A. pilosula	2	1
A. pumila	1	1
A. silvicola	8	8
Umbellularia californica	5	5

Fig. 2. Ramorum blight can cause both a leaf blight and branch anthracnose. **A,** Underbark lesion and **B,** canopy mortality caused by *Phytophthora ramorum* on *Arctostaphylos silvicola* at the University of California-Santa Cruz Arboretum. Photos: Laura Sims

OP-EDS

FRIDAY, OCTOBER 4, 2019

Citizen science making a difference for California

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

Department of Energy showcased our research and the SOD BLitzes

jgi.doe.gov/jgi-at-25-tracking-subduing-the-plague-of-californias-oak-woodlands/

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- Featured Profiles

Related Content:

Researching and Solving Real-World Problems with the 2023 JGI-UC Merced Interns

OCTOBER 27, 2023

Tracking & Subduing the Plague of California's Oak Woodlands

To mark the JGI's 25th anniversary in 2022, we revisited a number of notable achievements that showcase our collaborations and capabilities to enable great science that will help solve energy and environmental challenges.

Scanning the California oak woodlands from the air, large swaths of the bleached, skeletal remains of trees can be seen. These plagued patches have become kindling for the inevitable next firestorm.

The majestic sentinel oaks of the Golden State have been succumbing to a pathogen. This "'alien'" organism — one previously unseen — is, in fact, a microscopic water mold, genetically related to such

Sodblitz.org

- Summary table of 2023 SOD Blitzes (you can turn on previous years' data on sidebar)

- Google Earth map of 2023 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**

Calinvasives by Calflora

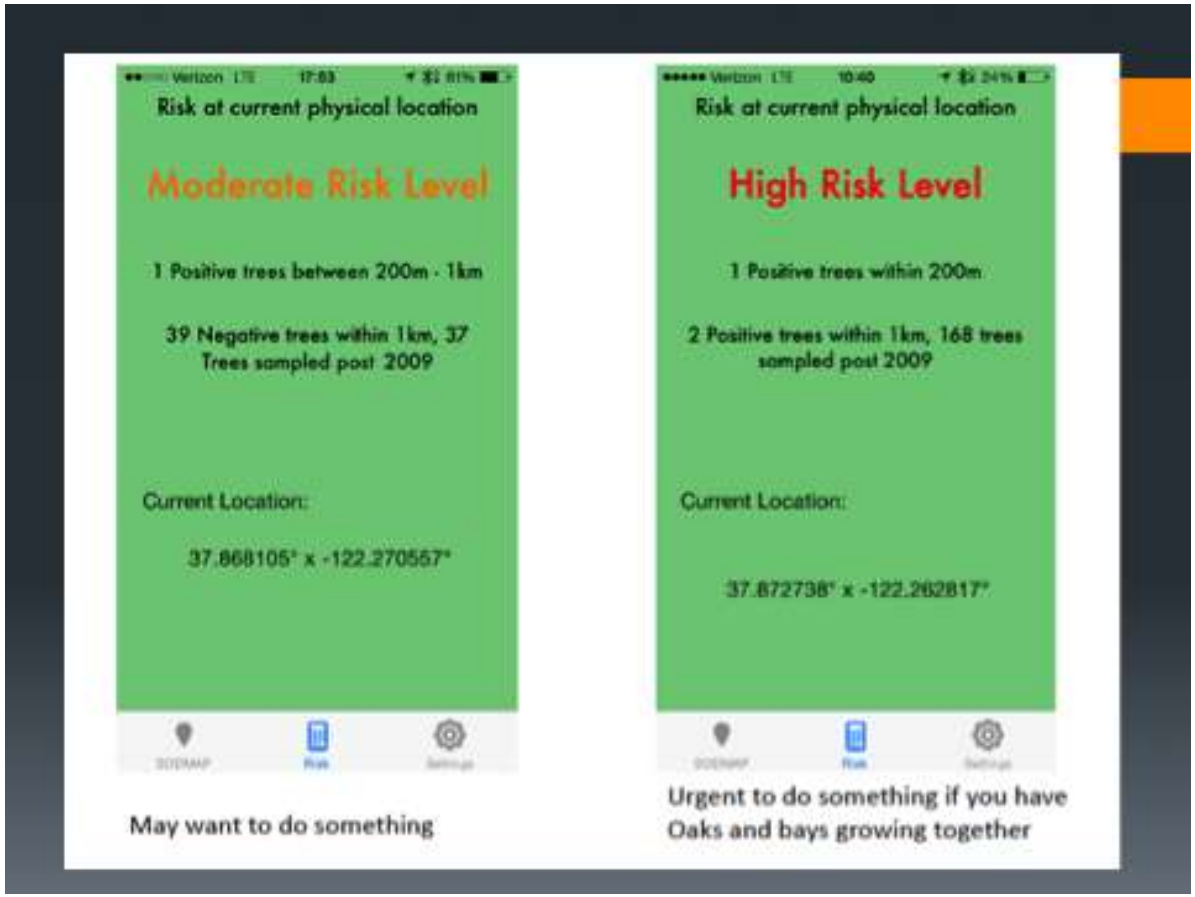
- Allows to look at the data by quadrant, resolving the issue of data overcrowding
- Allows to compare pathogen and host distributions
- Allows top calculate disease incidence by site, county, host and year

Matteolab.org

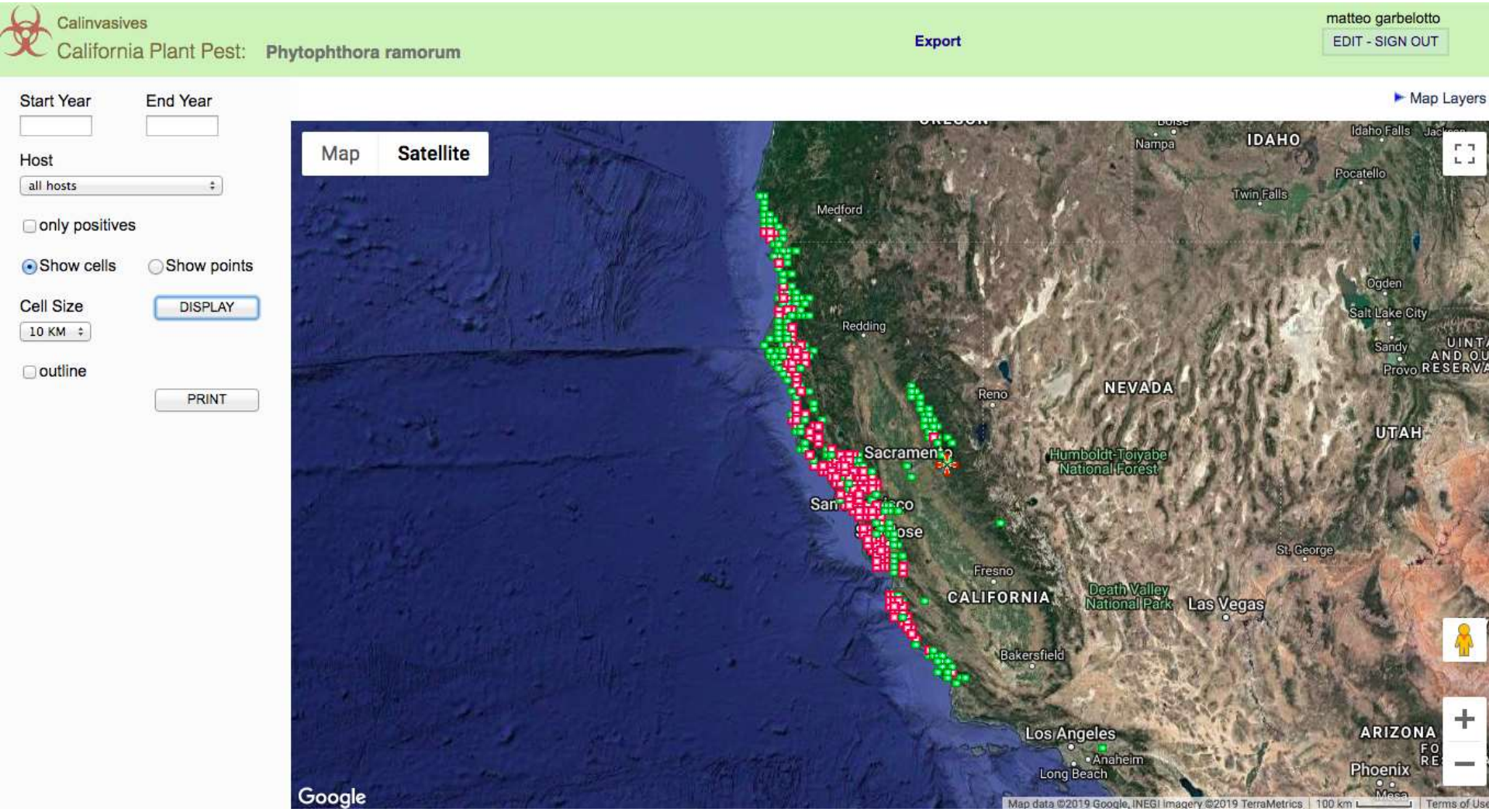
- All other websites contained in it
- New recommendations to manage SOD

Unique feature of SODmap mobile

- Risk of oak infection where user is standing



Calinvasives



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

www.sodblitz.org
(TOP)

Google Map of Results

Results in Table format

www.sodblitz.org
(MIDDLE)

SOD Blitz Community Meetings and Workshops Schedule

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

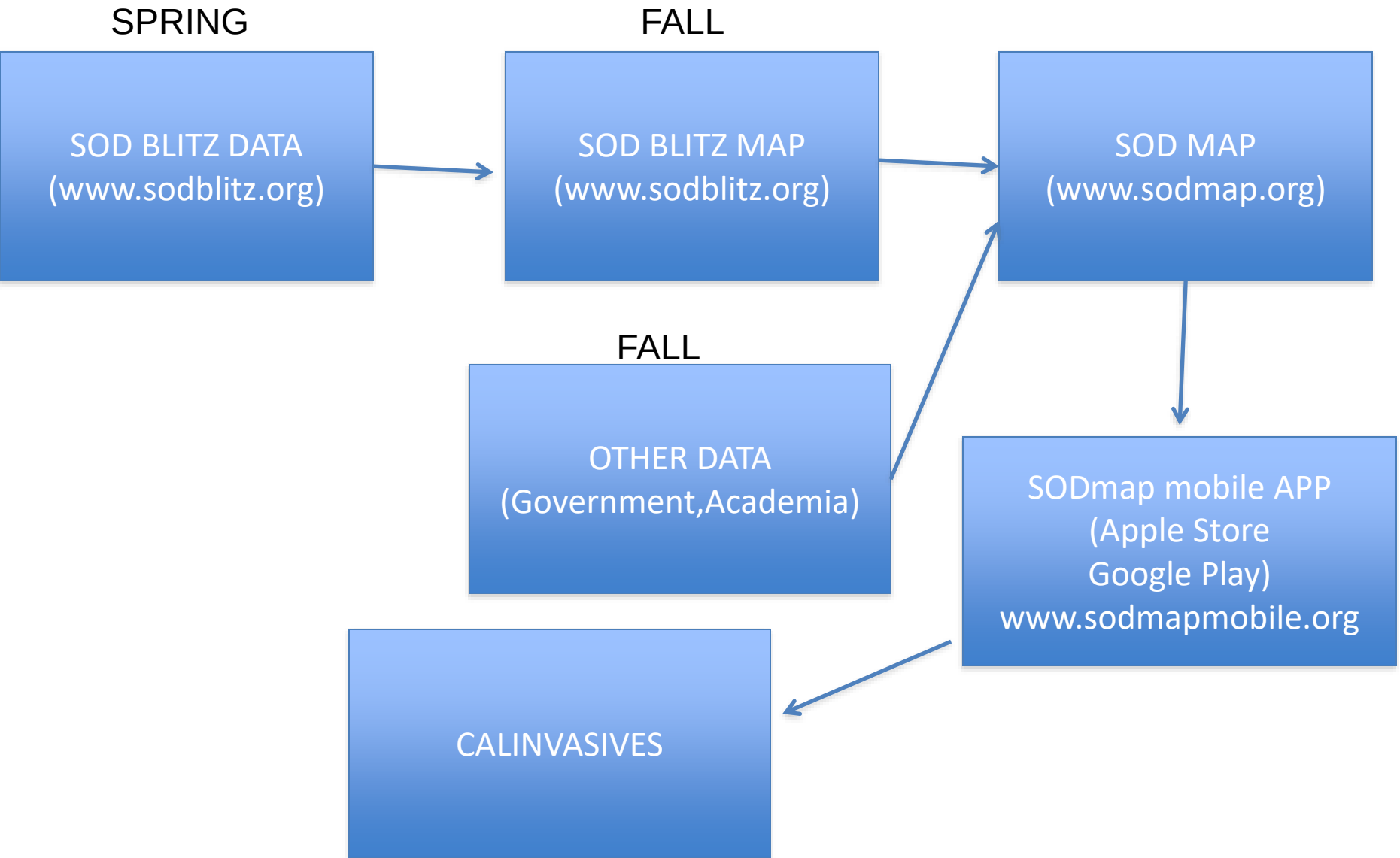
Link to 2012-2008 SOD Blitz Results

Previous years results

www.sodblitz.org
(BOTTOM)

Conversion file
To identify numerical code
For each tree

Data flow chart



SOD Blitzes 2023: some statistics

- A total of 28 Blitzes from Oregon border to San Luis Obispo (was 24 in 2022)

- Del Norte (Oregon border) the Northernmost
- San Luis Obispo (Santa Barbara border), Southernmost

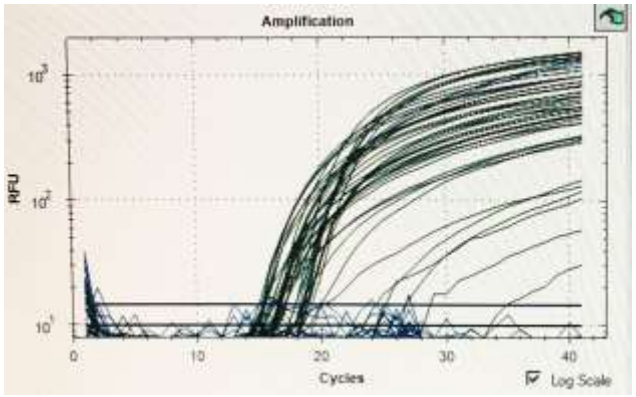
- 233 collectors, (was 254 in 2022), 408 participants (was 444 in 2022)
- Trees surveyed: 10,291 (was 10,656 in 2022)
- Trees sampled: 1901 (was 1805 in 2022)

- Statewide Rate of Positive trees 8.8% (was 7.1% in 2022)
- Statewide True Infection rate: 2.7% (was 2.9% in 2022)
- Oak mortality/symptoms 11.8% (was 14.3% in 2022)

SOD Blitz Analysis Schematic

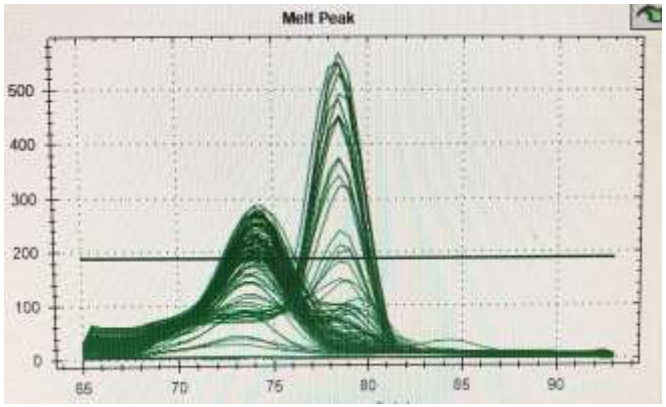
1. **TaqMan assay – ID of *P. ramorum* (ITS)**

   -Extract DNA with ROSE extraction
   -RTPCR 2nd round Taqman assay
   -Identify positives / “maybes” / negatives



2. **Confirm positive assay 1 (COX1)**

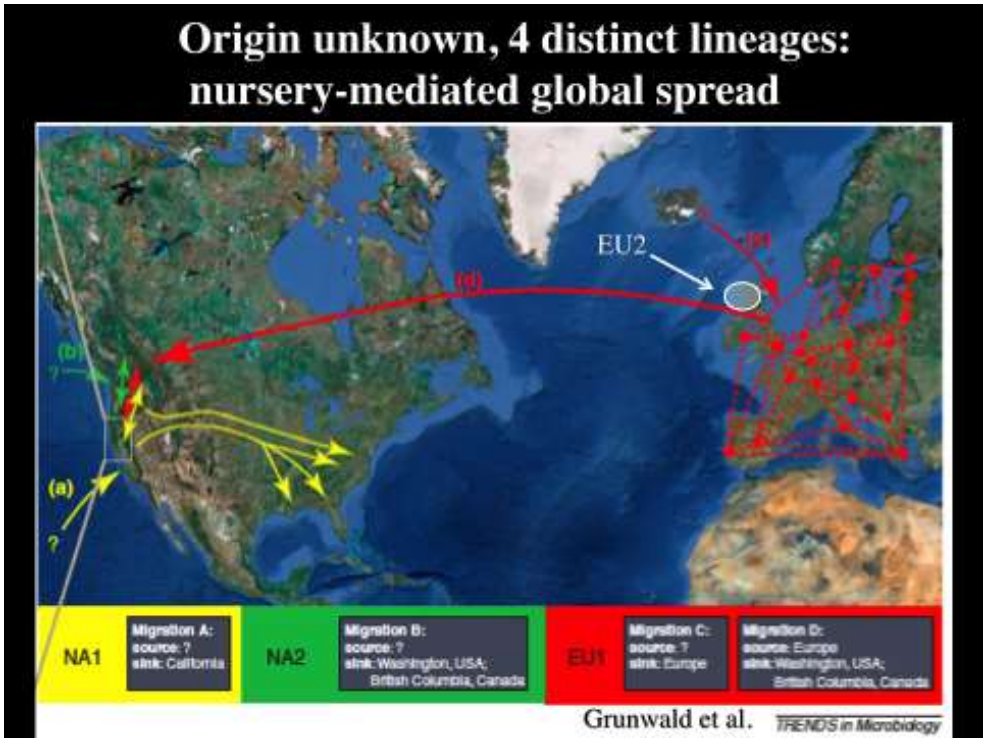
   -PCR the COX 1 gene
   -SYBR Green RTPCR assay melt curve
   -Confirm positives results for “maybes”



3. **Culturing for Del Norte and San Luis Obispo**

Phytophthora ramorum lineages

- Four different groups of variants (lineages) outside of Asia, where multiple, presumably native, lineages exist
- Each is different (mating type. virulence)
- BLITZ TESTS FOR LINEAGE!!!



ORIGINAL ARTICLE

Plant Pathology

WILEY

Pathogenicity and infectivity of *Phytophthora ramorum* vary depending on host species, infected plant part, inoculum potential, pathogen genotype, and temperature

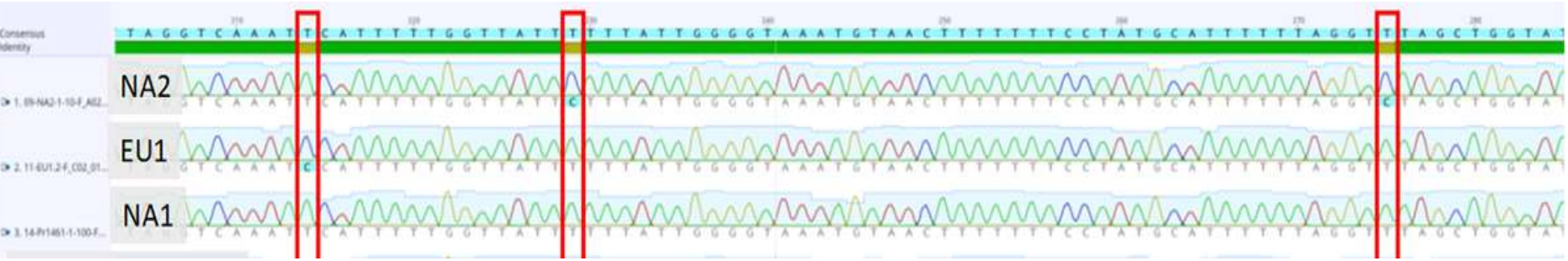
Matteo Garbelotto | Doug Schmidt | Tina Popenuck

3- SOD Blitz Lineage Test (PRNEST Cox 1 SNPs)

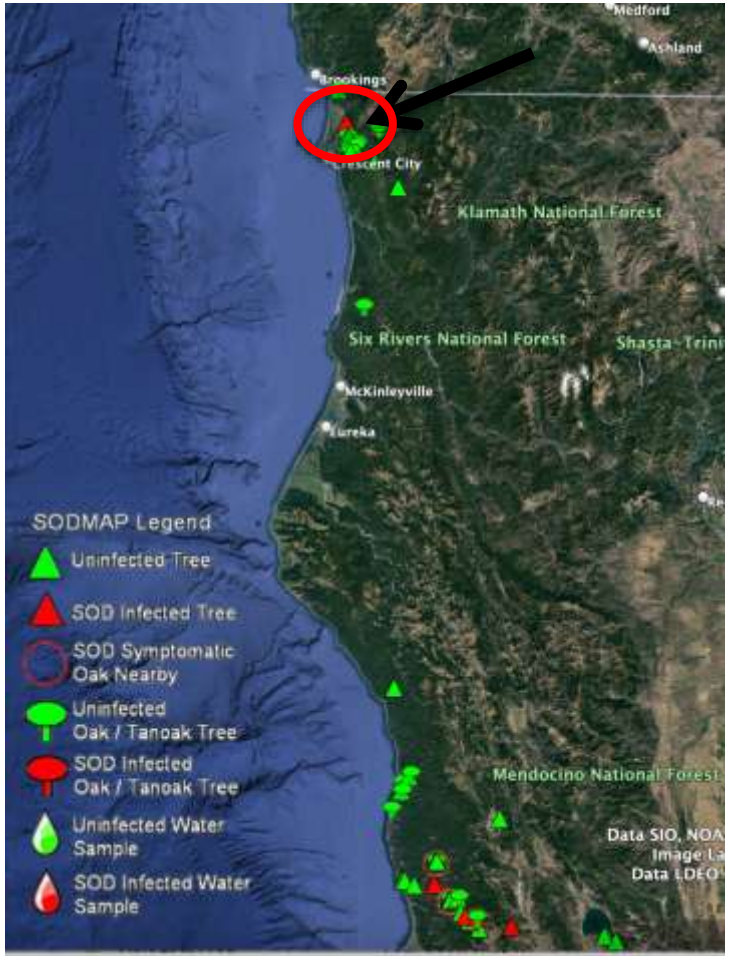
- PCR the PRNEST region of the COX 1 gene
- Sanger sequence PCR products
- Align and compare sequencing results

Key:
NA1 – T – T- T
NA2 = T – C - C
EU1 = C – T – T

The 3 locations in the COX1 gene that distinguish NA1, NA2, and EU1 are in bold (773bp, 788bp, and 834bp):

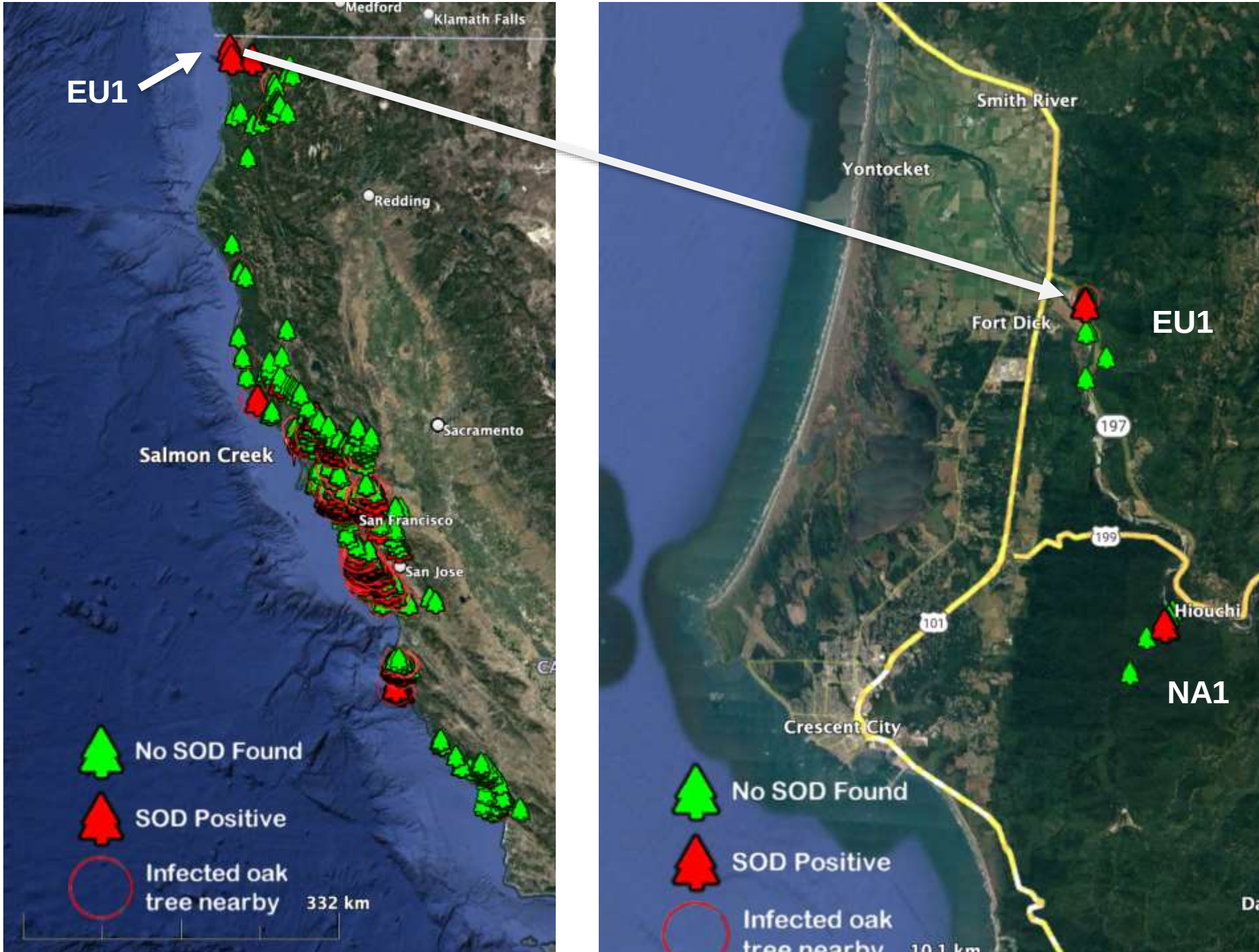


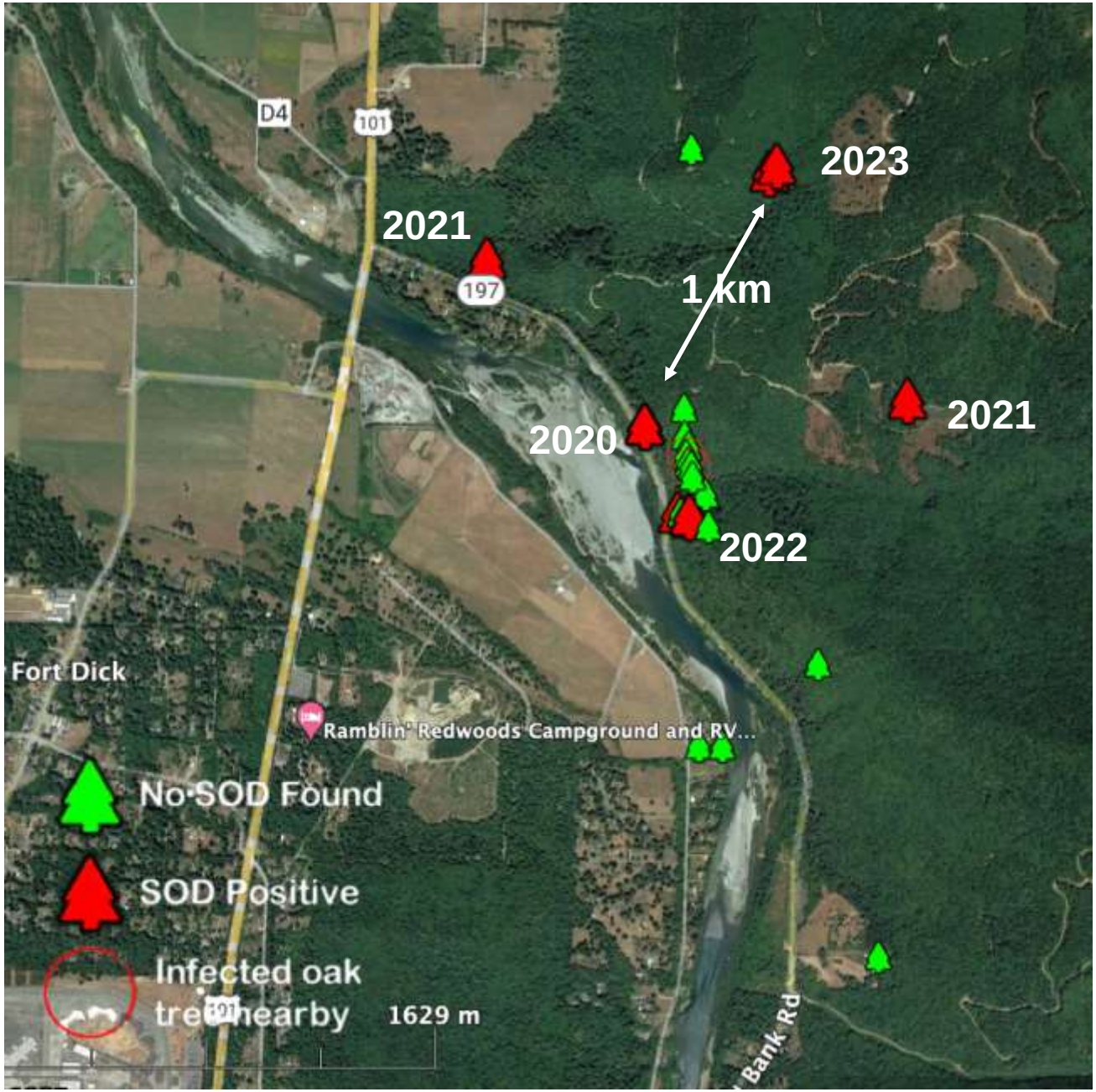
EU1 (European 1) strain identified by SOD Blitz in Del Norte County in 2020, 2021 , 2022 and 2023. Only NA1 was present in California before this discovery



Comparison	Pathogen genotype NA1	NA2	EU1	*p*
Leaf % successful pathogen reisolation; low inoculum	59.7 b	55.0 c	67.3 a	<.001
Leaf mean lesion length in mm (*SE*); low inoculum	13.7 (0.7) a	10.9 (0.6) b	13.4 (0.7) ab	<.02
Leaf % successful pathogen reisolation; high inoculum	62.8 b	84.8 a	81.5 a	<.001
Leaf mean lesion length in mm (*SE*); high inoculum	15.4 (0.6) a	11.4 (0.7) b	16.5 (0.8) a	<.001
Leaf mean number of sporangia (*SE*); high inoculum	177.0 (34.6) a	21.2 (4.7) b	32.7 (6.2) b	<.001
Stem % successful pathogen reisolation	58.8 b	76.1 a	58.4 b	<.001
Stem mean lesion length in mm (*SE*)	31.7 (4.1) a	21.7 (2) b	27.5 (3.3) ab	.009
Stem mean number of sporangia (*SE*)	6.1 (0.8) a	5.9 (0.7) a	5.1 (0.7) a	.6

EU1 lineage (Strain) is different from NA1 for all measurable metrics: this is a different threat!

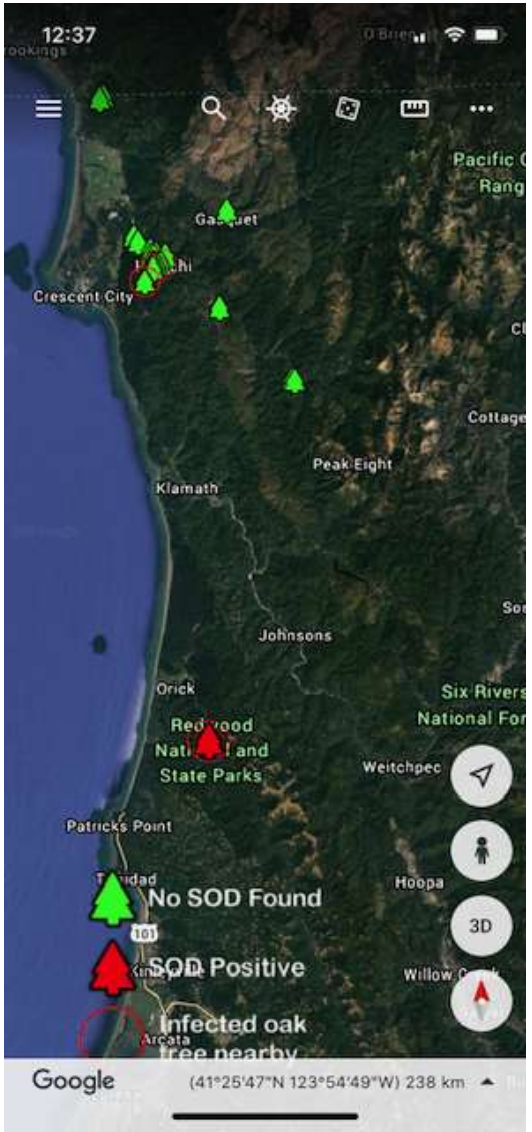

EU1
Medford
Klamath Falls
Redding
Sacramento
Salmon Creek
San Francisco
San Jose
No SOD Found
SOD Positive
Infected oak tree nearby
332 km
Smith River
Yontocket
Fort Dick
EU1
197
199
101
Hiouchi
NA1
Crescent City
No SOD Found
SOD Positive
Infected oak tree nearby
10.1 km


D4
101
2023
2021
197
1 km
2021
2020
2022
Fort Dick
Ramblin' Redwoods Campground and RV...
No SOD Found
SOD Positive
Infected oak tree nearby
1629 m
Bank Rd

EU1 in time

NA1 was confirmed in 2023 in Del Norte Co., outbreak comparable in size to EU1

Del Norte (site 1)



Both % positives and true infection rates are still close to the lowest levels historically

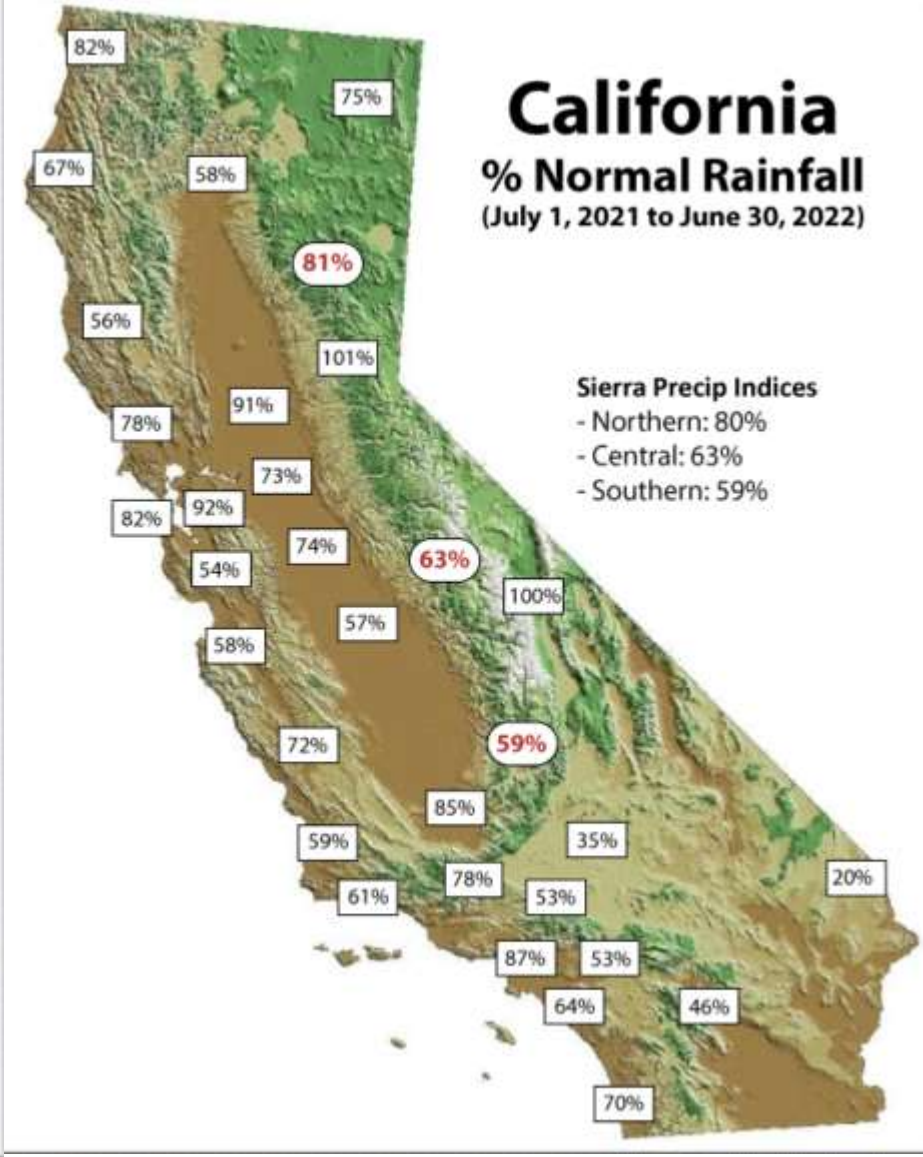
A total of 145,000 acres in 18 counties were surveyed!

False negative rate= 0%
False positive rate=2.3%

	Summary Table 2021 - 2016					
Year	Surveyed Trees	Syptomatic Oaks Nearby? (%)	Sampled Trees	SOD Positive sampled Trees %	Estimated True infection rate (%)	Symptomatic surveyed trees (%)
2023	10291	11.8	1901	8.8	2.7	31.1
2022	10698	14.33	1805	7.1	2.9	43.8
2021	14804	10.6	2067	10.2	3.3	32.0
2020	21943	13.5	2030	21.5	7.4	34.3
2019	17287	12.4	1732	19.5	6.1	31.1
2018	13504	12.2	2012	9.8	3.5	35.7
2017	14379	9.4	2009	31.5	12.8	40.5
2016	14305	11.9	1878	16.1	5.7	35.7

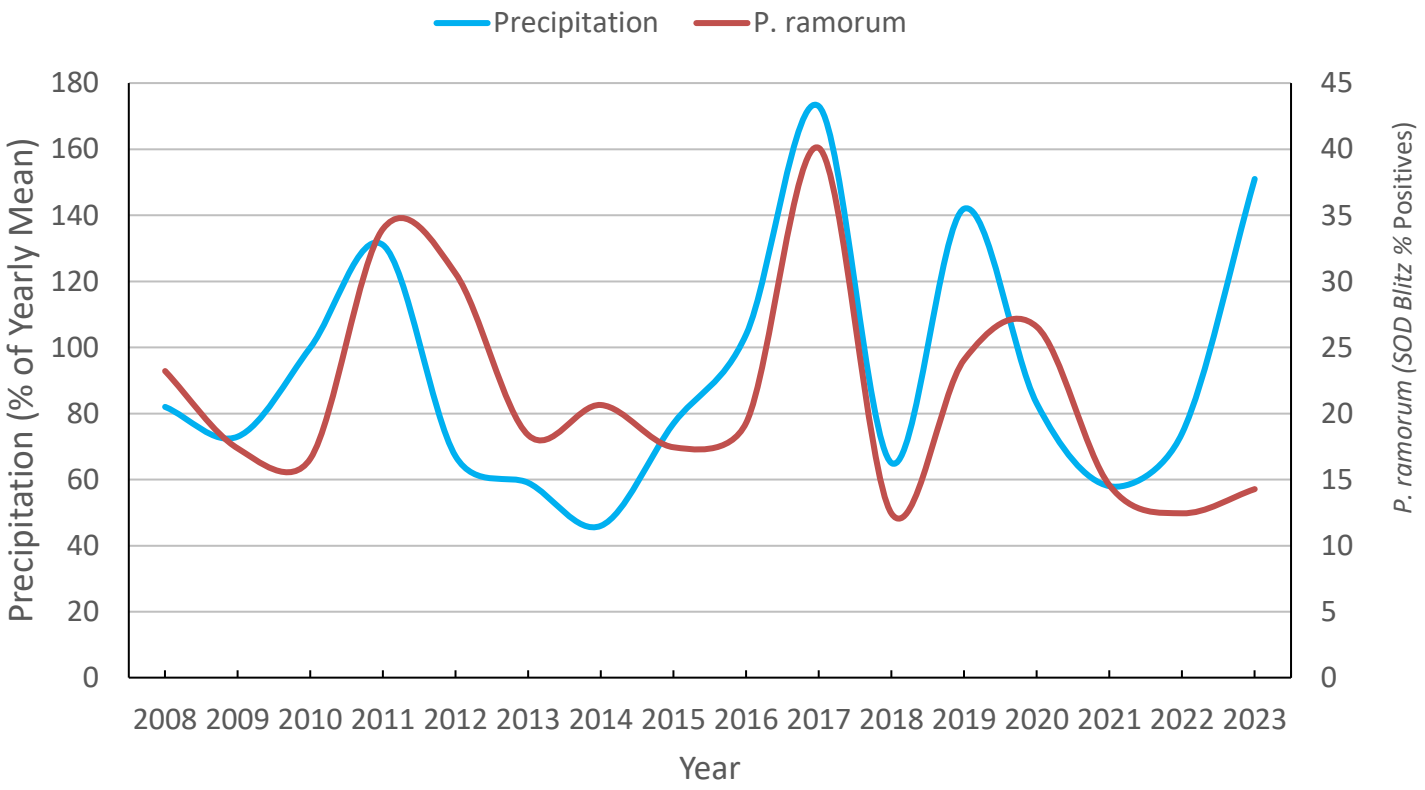
2023

2022



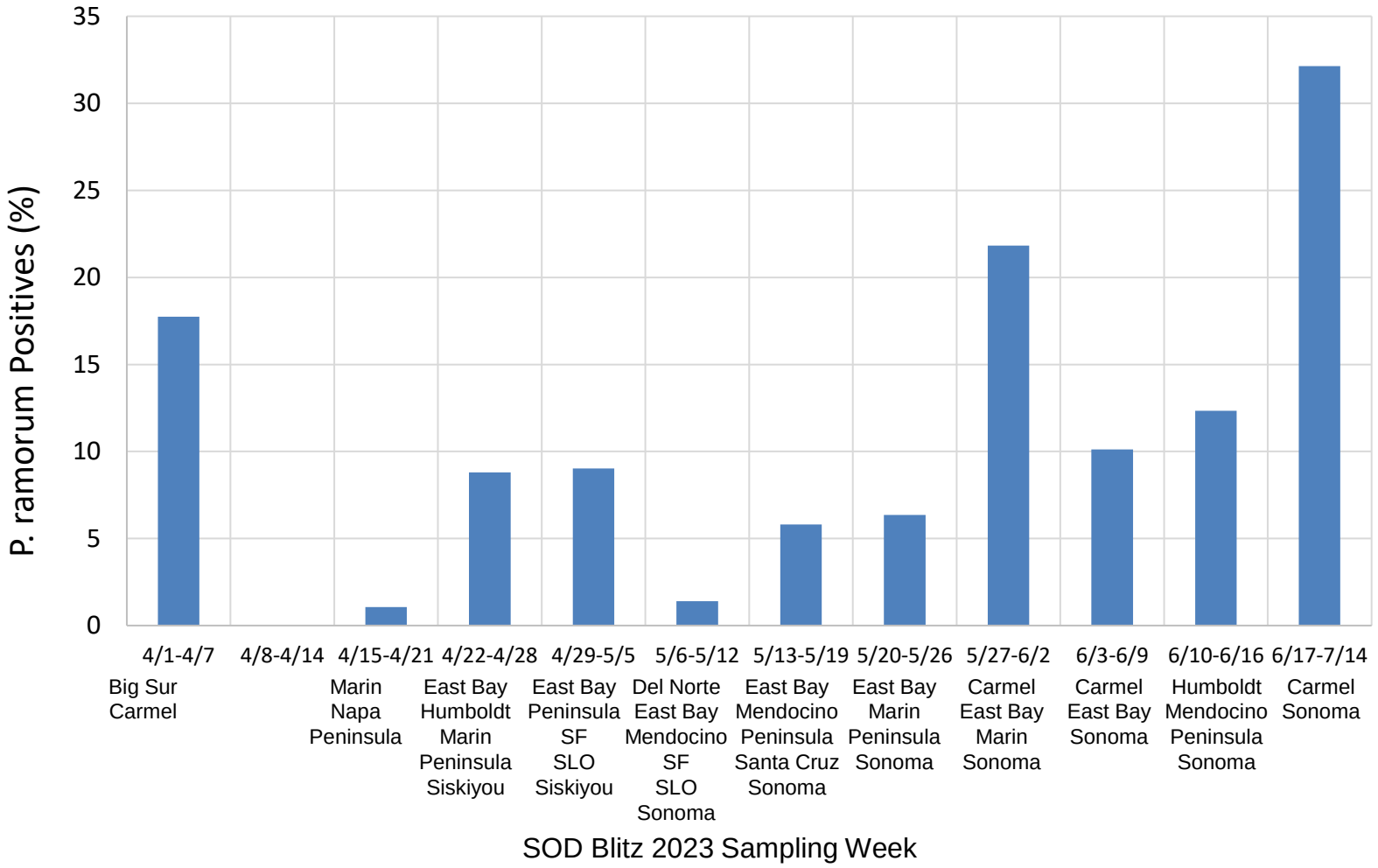
RAINFALL

Precipitation and *P. ramorum*



Blitzes with 0 Pr Positives removed and revised noaa data

Like 2020/2011 SOD may peak next year. Many blitzes in 2023 were done before The warm rains


P. ramorum Positives (%)
35
30
25
20
15
10
5
0
4/1-4/7
Big Sur
Carmel
4/8-4/14
4/15-4/21
Marin
Napa
Peninsula
4/22-4/28
East Bay
Humboldt
Marin
Peninsula
Siskiyou
4/29-5/5
East Bay
Peninsula
SF
SLO
Siskiyou
5/6-5/12
Del Norte
East Bay
Mendocino
SF
SLO
Sonoma
5/13-5/19
East Bay
Mendocino
Peninsula
Santa Cruz
Sonoma
5/20-5/26
East Bay
Marin
Peninsula
Sonoma
5/27-6/2
Carmel
East Bay
Marin
Sonoma
6/3-6/9
Carmel
East Bay
Sonoma
6/10-6/16
Humboldt
Mendocino
Peninsula
Sonoma
6/17-7/14
Carmel
Sonoma
SOD Blitz 2023 Sampling Week

The SOD blitz regions


SOD Blitz Sampling Locations Central
Mendocino
Lake
Sonoma North
Napa
Sonoma West
Sonoma East
Marin
EB East
SF
EB West
EB South
Peninsula East
Peninsula West
Peninsula South
Santa Cruz

Comparison between 2022 and 2023

→ = indicates infections on the rise

Location	Number of Surveyed Trees		Syptomatic Oaks Nearby? (%)		Number of Sampled Trees		SOD Positive Sampled Trees (%)		Estimated True Infection Rate (%)	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Big Sur	43	68	8.3	6.3	24	16	45.8	68.8	44.8	65.7
Carmel	278	303	4.1	9.9	218	204	7.8	16.7	2.1	4.6
Del Norte	8	46	0.0	7.4	8	27	25.0	14.8	25.0	4.2
East Bay East	619	313	12.7	2.3	236	175	3.4	3.4	1.3	1.4
East Bay South	10	50	0.0	0.0	13	10	7.7	10.0	7.7	4.0
East Bay West	558	196	17.6	15.3	102	124	10.8	6.5	4.4	3.0
Humboldt	74	730	0.0	1.6	21	64	0.0	0.0	0.0	0.0
Lake										
Marin	402	355	24.0	18.9	150	111	13.3	18.9	5.2	4.0
Mendocino	661	266	1.8	3.0	55	67	0.0	1.5	0.0	0.3
Napa	147	192	10.5	11.7	76	77	0.0	0.0	0.0	0.0
Peninsula East	216	529	28.9	15.4	45	65	4.4	0.0	1.3	0.0
Peninsula North	19	104	0.0	33.3	7	3	0.0	0.0	0.0	0.0
Peninsula South	481	83	39.3	25.0	56	32	1.8	9.4	0.9	4.1
Peninsula West	1472	2102	28.0	25.1	346	442	9.0	12.0	5.9	4.7
San Fancisco	159	834	0.0	0.9	41	106	0.0	0.0	0.0	0.0
San Luis Obispo	451	508	0.0	1.2	77	83	0.0	0.0	0.0	0.0
Santa Cruz	250	2035	10.0	20.0	40	5	0.0	0.0	0.0	0.0
Siskiyou	197	230	0.0	14.8	24	27	0.0	0.0	0.0	0.0
Sonoma East	4269	762	6.9	0.9	131	134	18.3	13.4	0.8	5.4
Sonoma North	85	44	3.3	6.7	30	15	0.0	6.7	0.0	2.8
Sonoma West	257	541	8.6	6.1	105	114	1.9	3.5	0.5	1.8
Trinity										
Total	10656	10291	14.3	11.8	1805	1901	7.1	8.8	2.9	2.7

Note that:

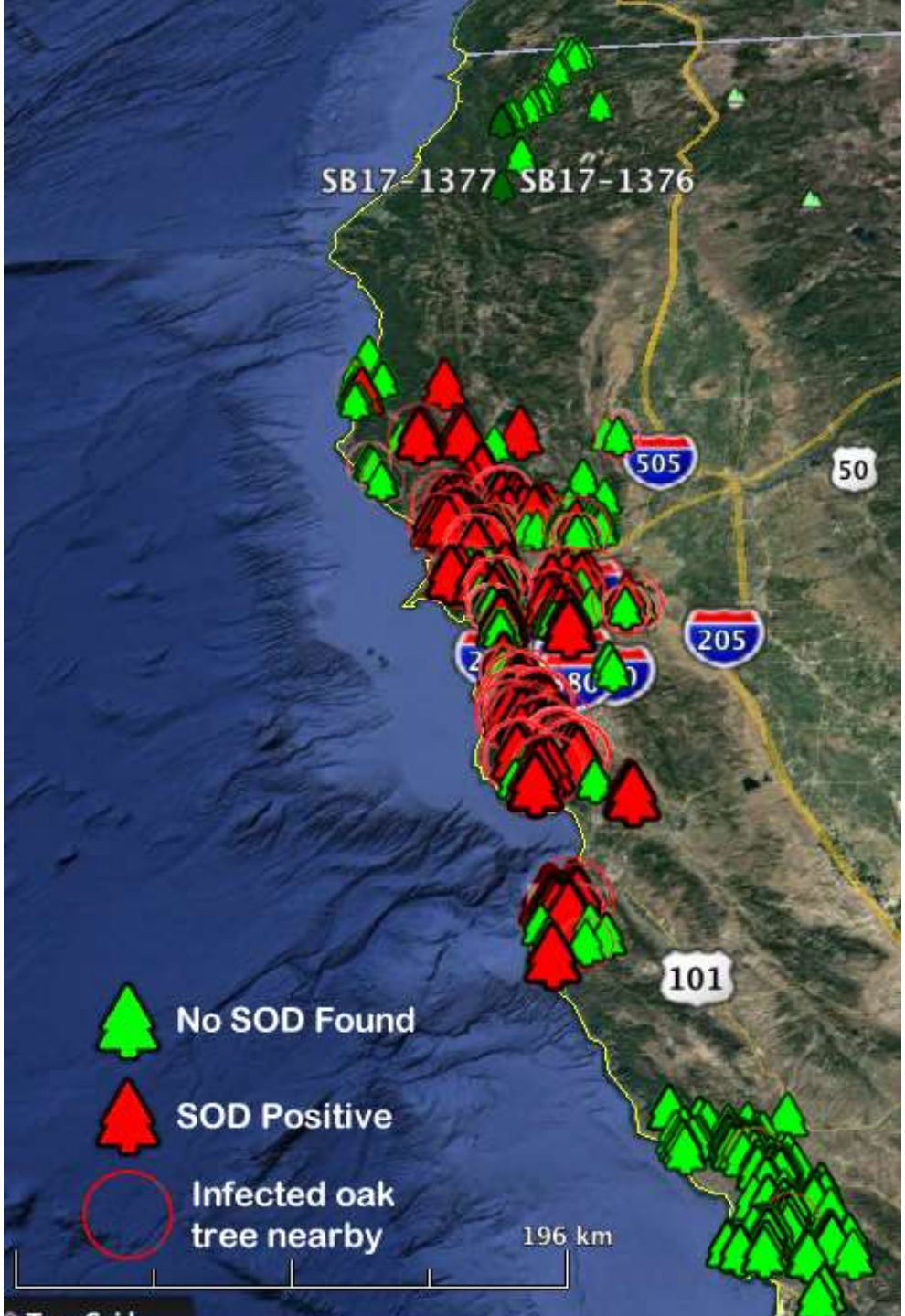
- Probably only statewide % positives is easily comparable between years, due to “haphazard” sampling approach of SOD Blitzes

- If a region has few samples (<20) then calculations of true infection rate are “iffy”, results should be taken as +/-

- 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



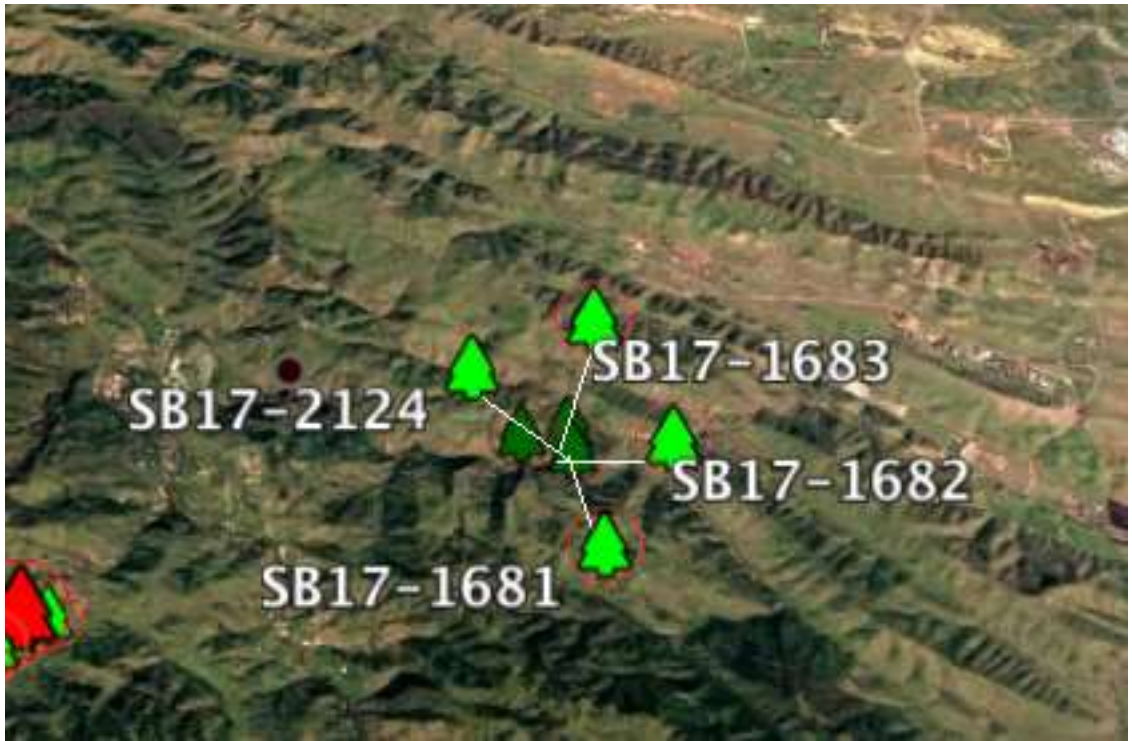
- Google Earth Platform
- All colored icons were tested
- Red= has SOD
- Green= had symptoms but not SOD
- Circle means oaks dying but for any reason (e.g drought)

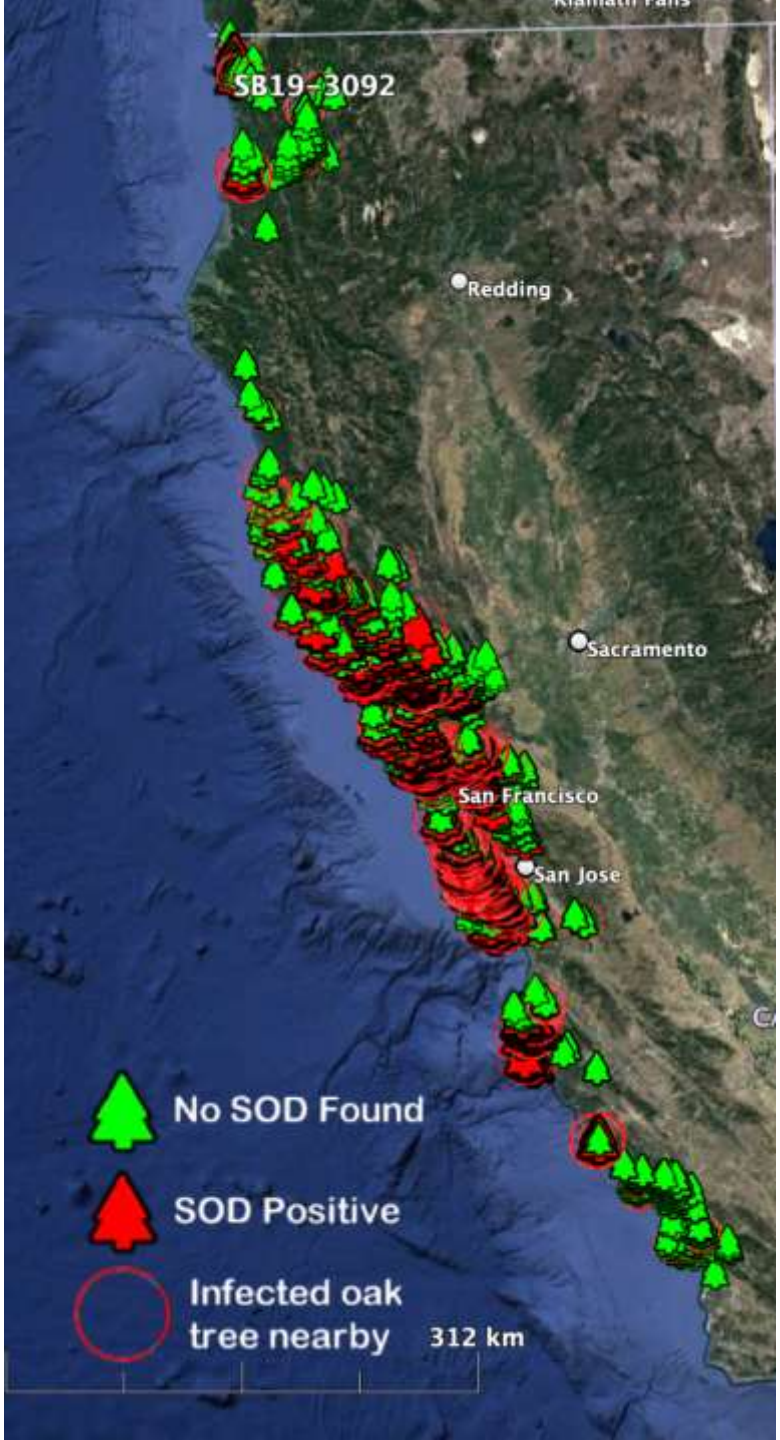
Use these commands to:

move around map

enlarge it

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





Overall 2023 Results:

Number of positives is stable compared to that of 2022

Most Interesting Findings of 2023 Blitzes- I

- EU1 still present in Del Norte: outbreak about one mile in diameter. Appears to be spreading Northwards. All other California samples were NA1

- NA1 outbreak in Del Norte confirmed, also 1 mile in diameter

- Most areas in Trinity, Siskiyou, Mendocino, and North Sonoma, including tribal lands, were negative.

- Yorkville and Gualala positives. Both have been positive previously. Yorkville for a very long time. This is different from last year

Most Interesting Findings of 2023 Blitzes- II

- SOD **on the rise** in Sonoma countywide, but Geyserville and Cloverdale, which normally are positive in wet years, were not positive. Comparable to last year

- Napa **was negative** as it normally is in dry years. MidApril collection was before the warm late season rains. Comparable to last year

- South Marin positive, North and West Marin negative. Comparable to last year

Most Interesting Findings of 2023 Blitzes- III

- East Bay stable in terms of outbreaks, western slopes of the Berkeley-Oakland hills are more prone to infection even if more urbanized

- San Francisco and North Peninsula negative like last year

- Five nurseries/parks (GG, Presidio, UC Botanical Garden and Native Here Nursery, Filoli) are all negative.

Most Interesting Findings of 2023 Blitzes- IV

- Peninsula: Outbreaks undetectable away from the slopes of the Santa Cruz Mountains, as it normally happens in a dry year. Lower eastern slopes of the mountains are also negatives.

- SOD blitzes reveal a large number of SOD outbreaks on the Sant Cruz Mountains, involving several parks and open space lands: Huddart, Teague Hill, El Corte de Madera, La Honda and La Honda Creek, Los Trancos, Monte Bello, Skyline Ridge, Long Ridge, Upper Stevens Creek, Saratoga Gap, Portola Redwoods, Las Cumbres

Most Interesting Findings of 2020 Blitzes- V

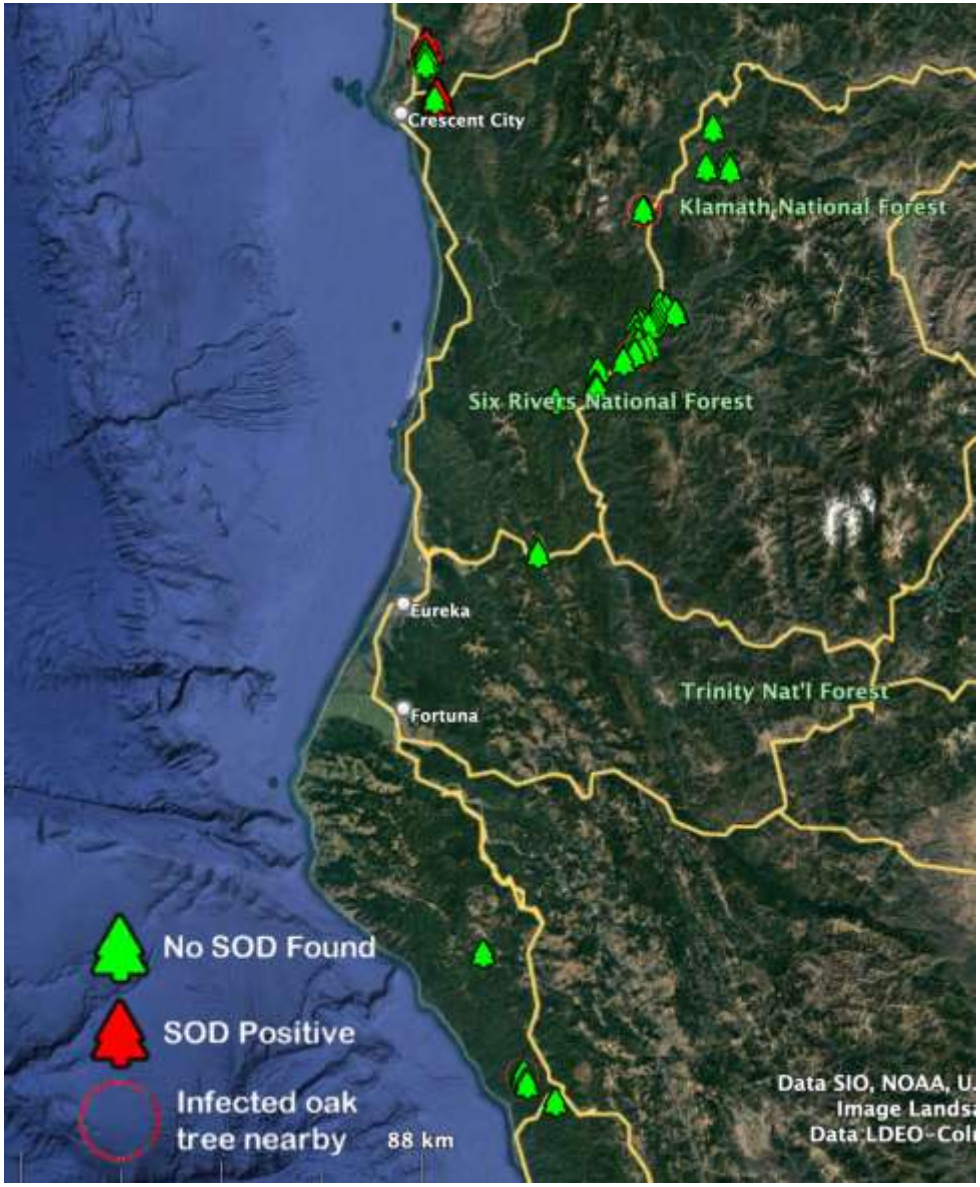
- Santa Cruz County mostly negative, but poorly sampled.
  Summit Road area has positives

- Carmel valley: canyons on the slopes of the Santa Lucia Mountains remain positive and new outbreaks are discovered, but in patchy mixed oak woodlands it is absent. Disease incidence on the rise compared to last year

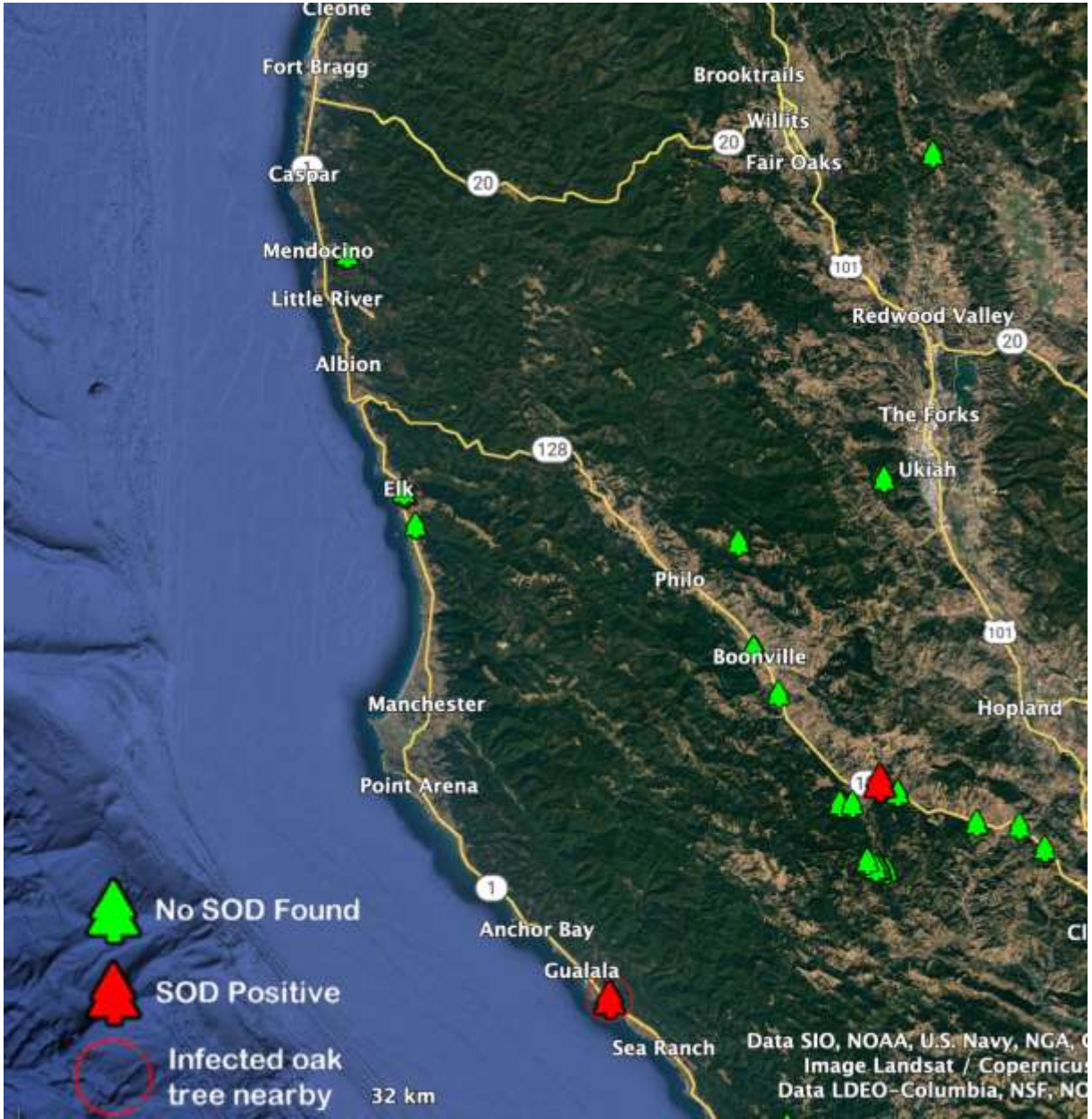
- Big Sur region confirmed as a constant hotspot. Disease incidence on the rise compared to last year, but some outbreaks are now negative

- San Luis Obispo still negative

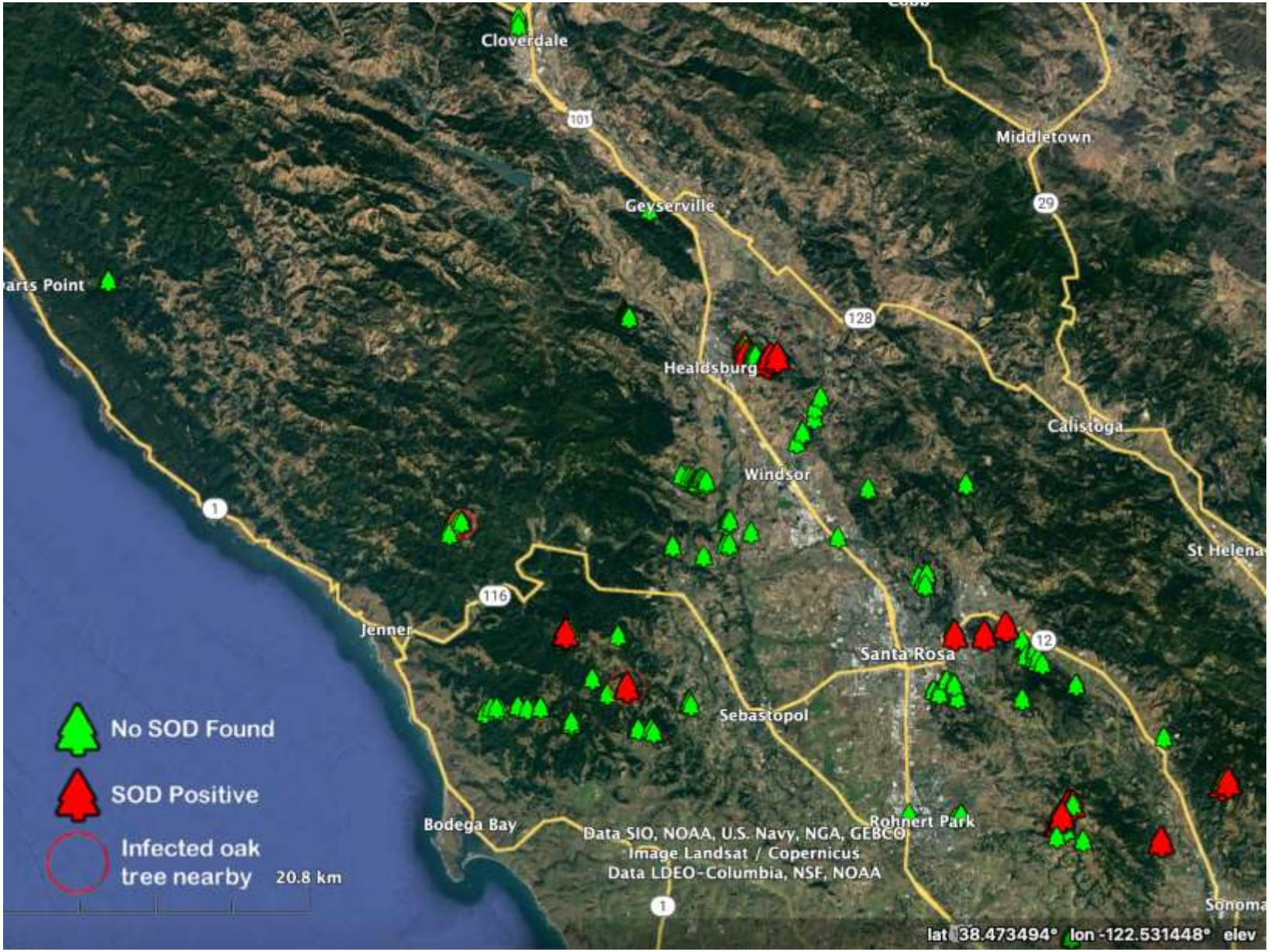
North Coast

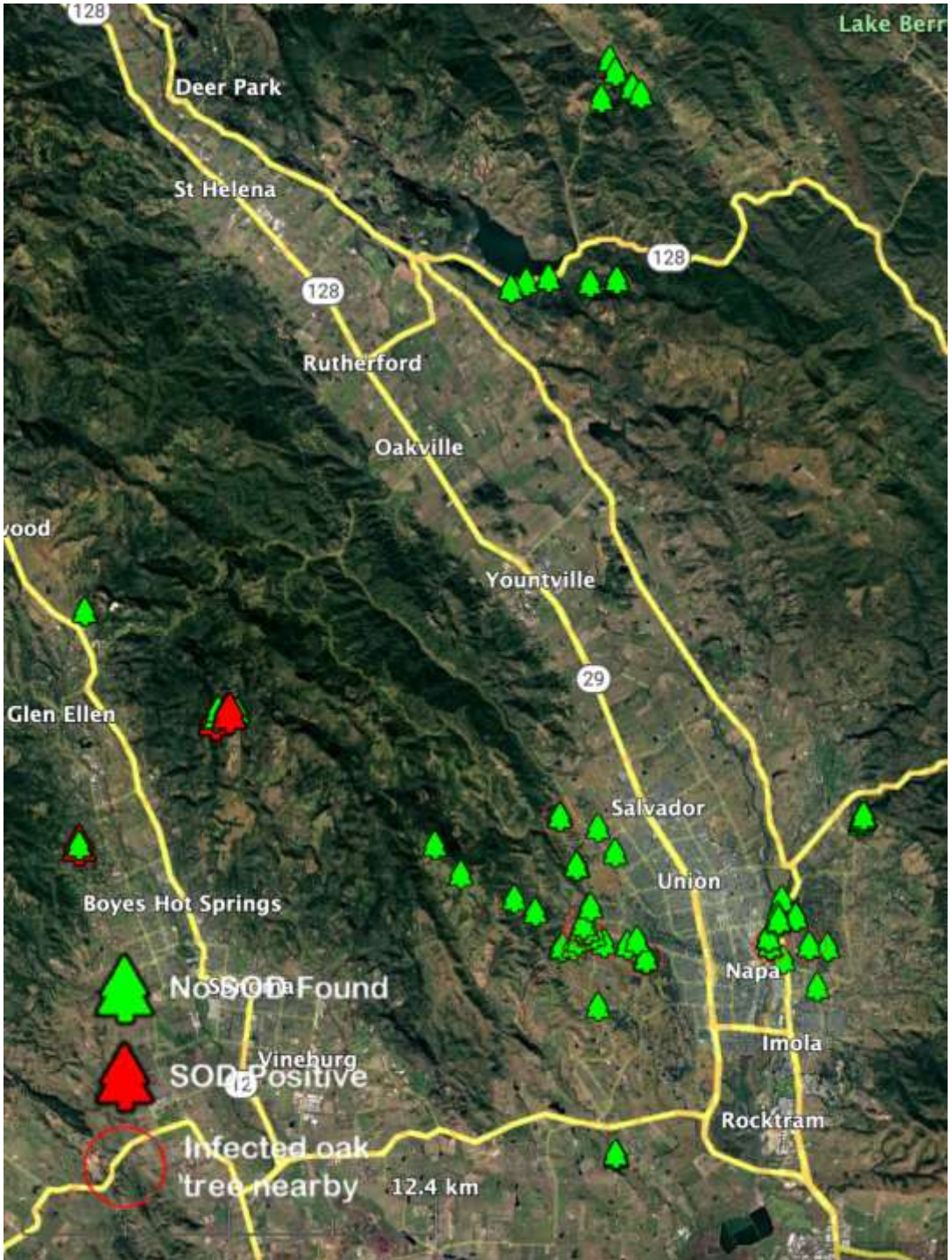

Crescent City
Klamath National Forest
Six Rivers National Forest
Eureka
Trinity Nat'l Forest
Fortuna
No SOD Found
SOD Positive
Infected oak tree nearby
88 km
Data SIO, NOAA, U.
Image Lands
Data LDEO-Col

Mendocino County



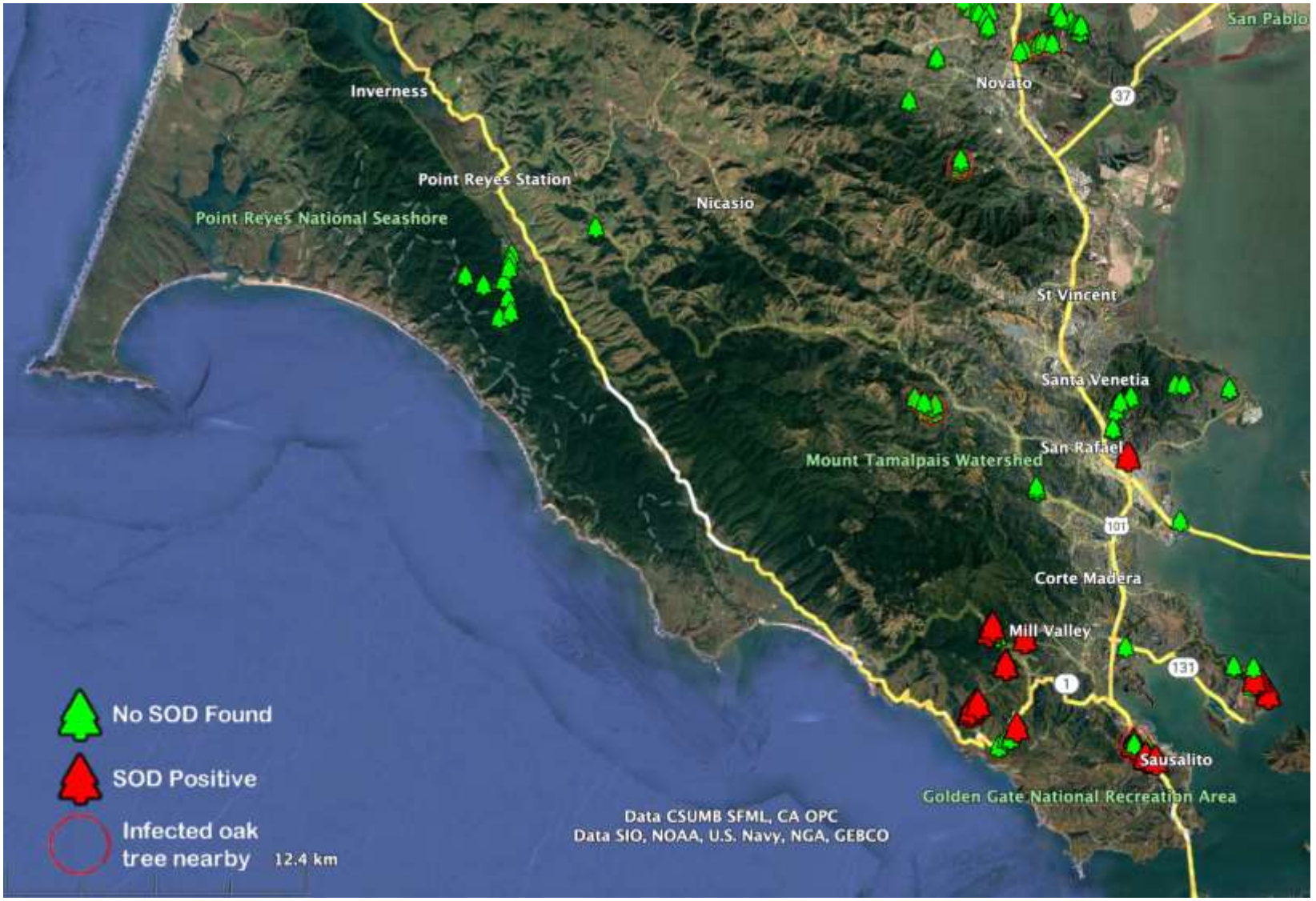
Sonoma


Cloverdale
101
Middletown
29
Geyserville
arts Point
128
Healdsburg
Calistoga
Windsor
1
St Helena
116
Jenner
Santa Rosa
12
Sebastopol
No SOD Found
SOD Positive
Infected oak tree nearby
20.8 km
Bodega Bay
Rohnert Park
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Data LDEO-Columbia, NSF, NOAA
1
Sonoma
lat 38.473494° lon -122.531448° elev



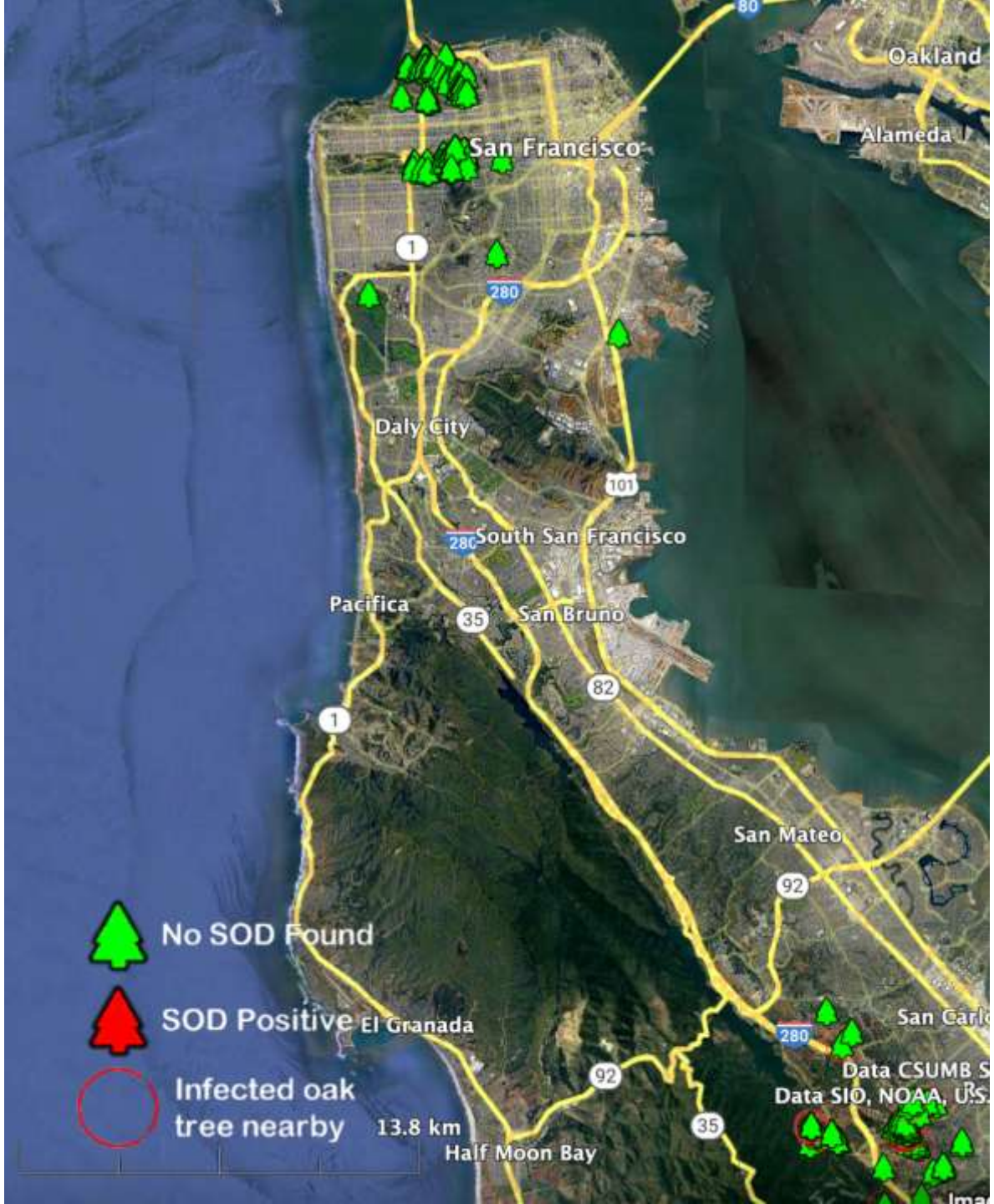
Napa was negative

Marin

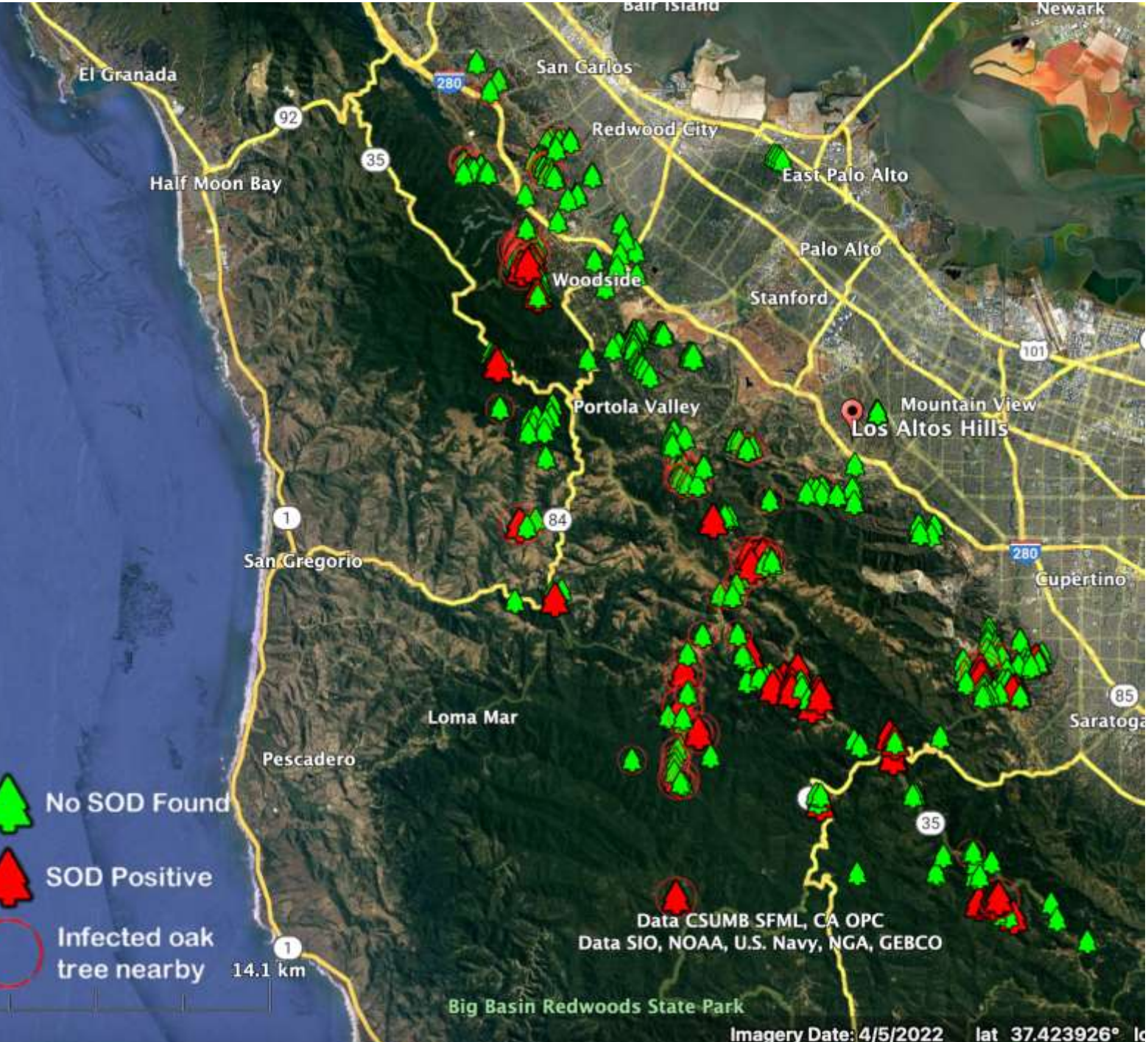

San Pablo
Inverness
Novato
37
Point Reyes Station
Nicasio
Point Reyes National Seashore
St Vincent
Santa Venetia
San Rafael
Mount Tamalpais Watershed
101
Corte Madera
Mill Valley
131
1
Sausalito
Golden Gate National Recreation Area
No SOD Found
SOD Positive
Infected oak tree nearby
12.4 km
Data CSUMB SFML, CA OPC
Data SIO, NOAA, U.S. Navy, NGA, GEBCO


Martinez
Pinole
Bay Point
Pittsburg
Concord
Pleasant Hill
Clayton
Richmond
El Cerrito
Walnut Creek
Albany
Lafayette
Orinda
Berkeley
Mt Diablo
Alamo
Emeryville
Moraga
Danville
Blackhawk
Oakland
Alameda
San Ramon
San Leandro
Dublin
Castro Valley
Hayward
Pleasanton
Verona
Union City
Sunol
Fremont
Newark
No SOD Found
SOD Positive
Infected oak tree nearby
19.6 km

East Bay

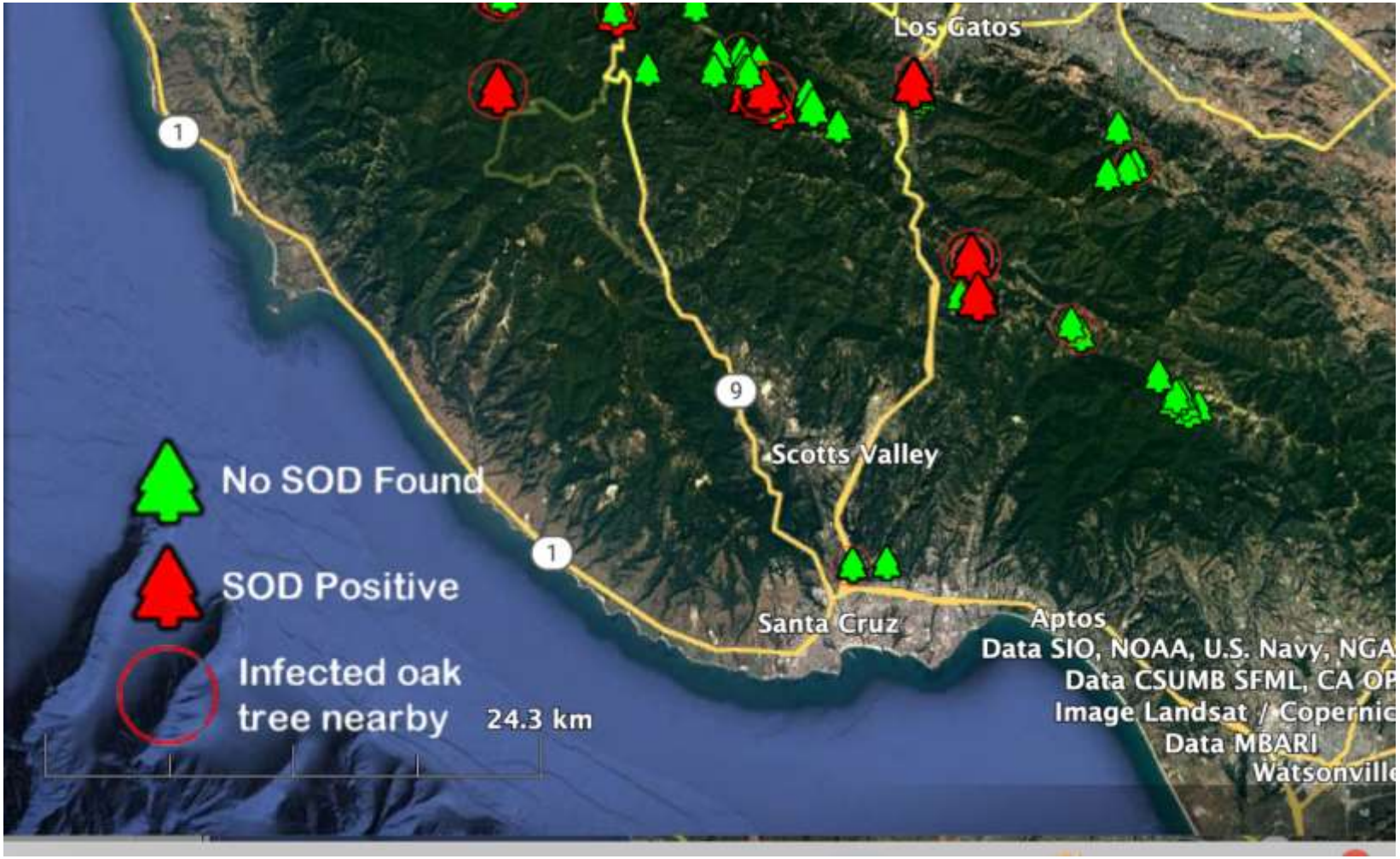


San Francisco and North Peninsula were negative

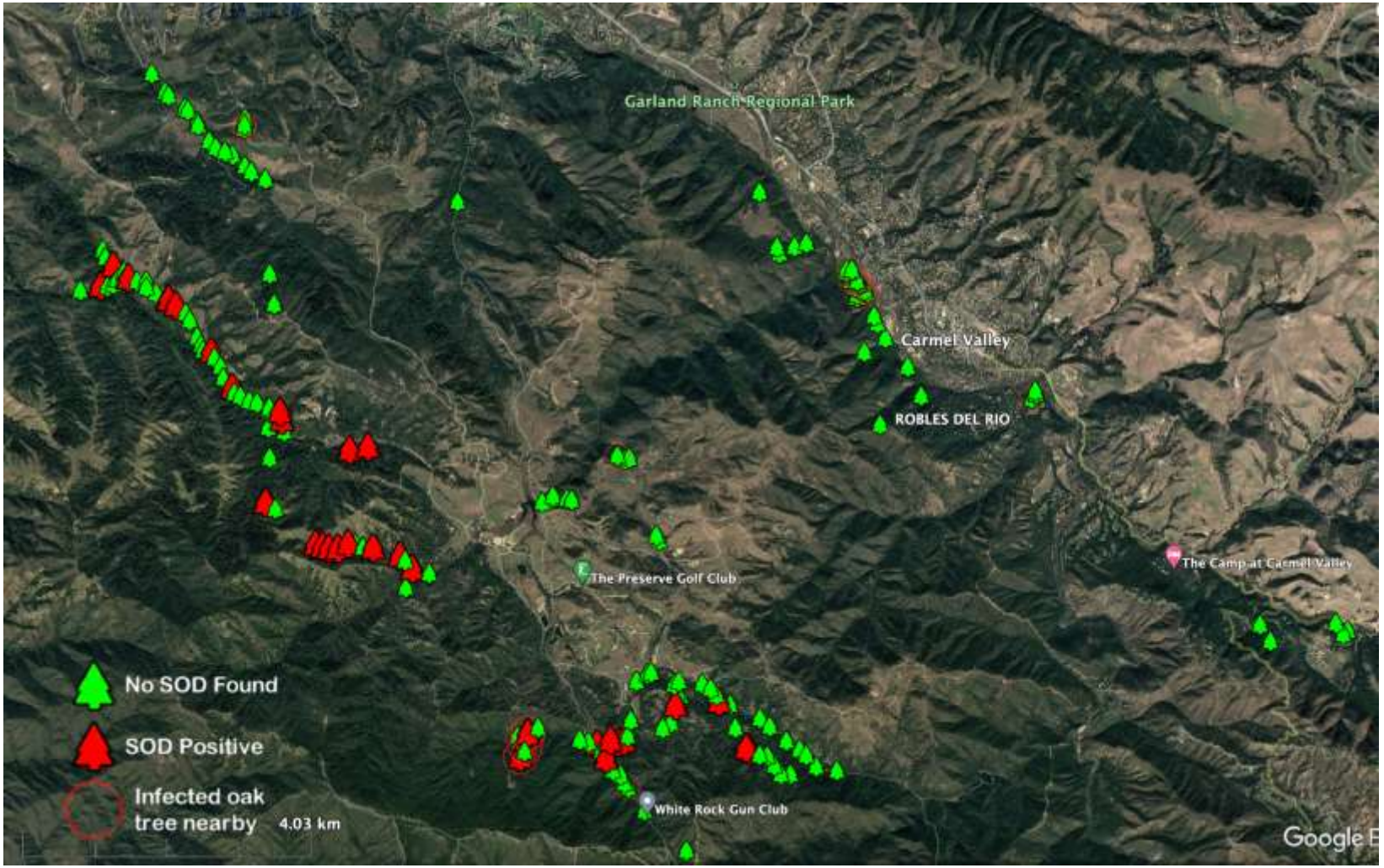

El Granada
Half Moon Bay
San Carlos
Redwood City
East Palo Alto
Palo Alto
Woodside
Stanford
Portola Valley
Mountain View
Los Altos Hills
San Gregorio
Cupertino
Loma Mar
Pescadero
Saratoga
Big Basin Redwoods State Park
No SOD Found
SOD Positive
Infected oak tree nearby
14.1 km
Data CSUMB SFML, CA OPC
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Imagery Date: 4/5/2022
lat 37.423926°

Peninsula

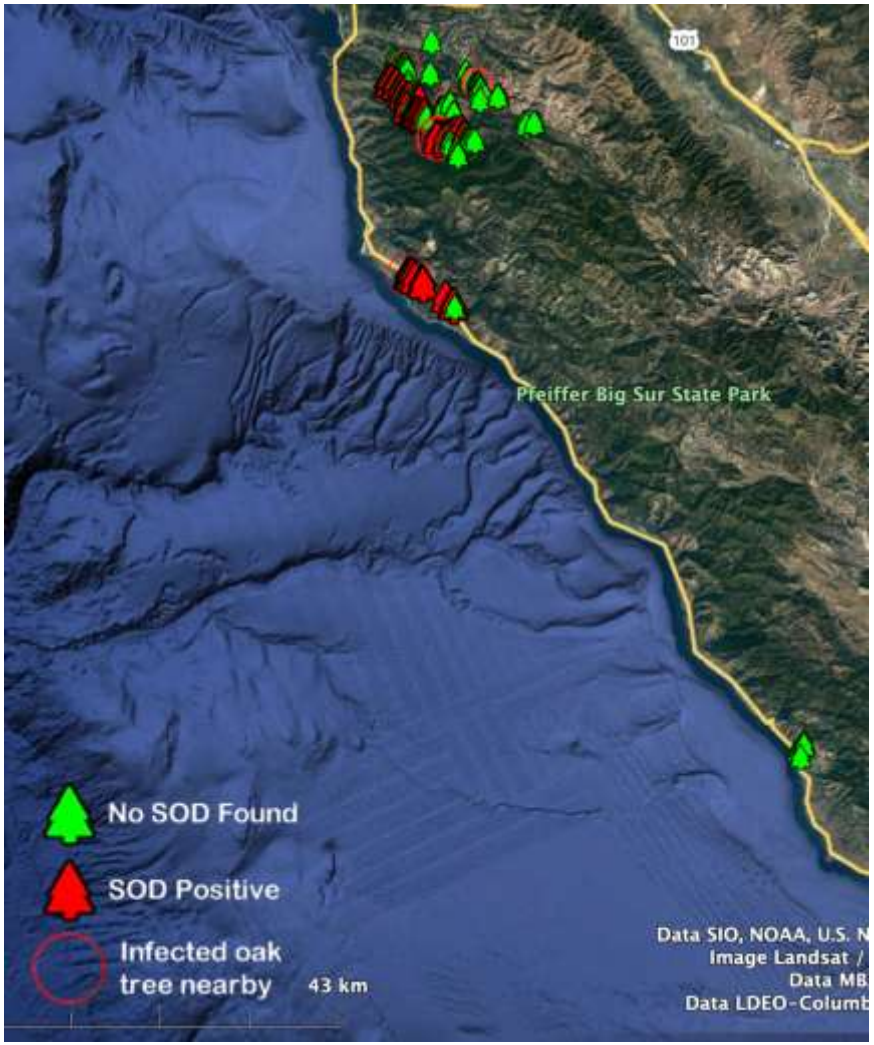
South Peninsula and Santa Cruz



Carmel valley: higher disease incidence but no new outbreaks



Big Sur: San Carpoforo, once positive, was negative



San Luis Obispo was negative

What is driving Pram infections in mixed oak woodlands?

pathogens MDPI

Article

The Epidemiology of Sudden Oak Death Disease Caused by *Phytophthora ramorum* in a Mixed Bay Laurel-Oak Woodland Provides Important Clues for Disease Management

Melina Kozanitas [1], Margaret R. Metz [2], Todd W. Osmundson [3], Maria Socorro Serrano [1] and Matteo Garbelotto [1,*]

Tree, stand, topography, bay density, rainfall

RESEARCH COMMUNICATIONS RESEARCH COMMUNICATIONS

Citizen science helps predict risk of emerging infectious disease

Ross K Meentemeyer[1,2*], Monica A Dorning[2], John B Vogler[2], Douglas Schmidt[3], and Matteo Garbelotto[3,4]

Landscape, disease, rainfall, temperature, bay density, urbanization

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,*]

Bay laurel recovery

SOD up

- Eastern slopes
- Larger oaks
- High bay density
- High Oak-bay proximity+++
- High infection previous year
- High Rainfall

SOD down

- Low bay density+++
- Smaller oaks
- Larger bays
- High Tmax +++
- More urbanized

RECOVERY OF over 50% of BAYS OCCURS

- When temperatures are up (ave max >23 C)
- When rainfall is low (less than 500 mm)+++
- When terrain is flat

Oakstep.org

- Oakstep program was started because

- Confirmation of SOD on oak is important given that:

  - 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

Home Donate New Treatment & Diagnosis Contact Publications TreeFAQs SM

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?

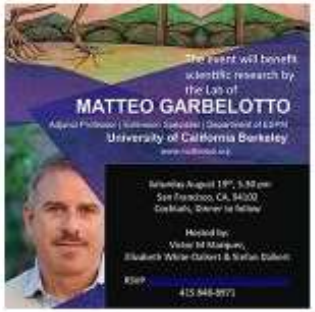
OakSTeP stands for "**Oak S**OD **Te**sting **P**rogram". It is a program directed at licensed tree care workers to provide them with all that is needed to sample symptomatic oaks at a fraction of the cost. By enrolling in the program, a licensed tree care worker will have access to the following:

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 Survey 2023 Results

- 64 Responses
- 6,878 Trees were protected
- 715 Acres
- Average success rate 88% : Range 10-100%
- Average cost per tree $56

Five steps to control SOD

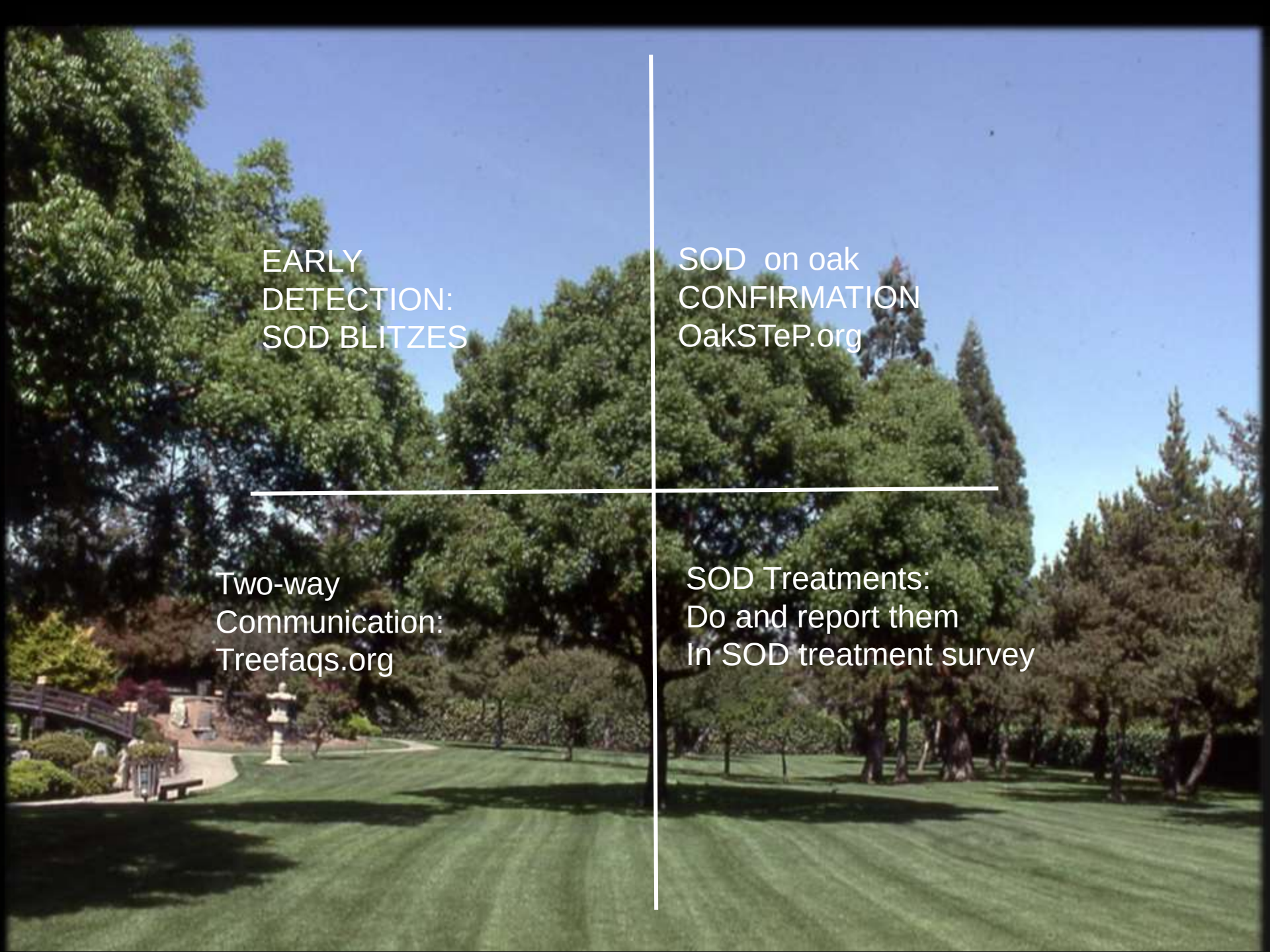
- Use the APP Sodmap mobile to determine whether the location you are at is at risk of SOD infection (moderate or high)

- In the Fall, remove bay laurels if their foliage is closer than 30 feet to oak stems or large branches. Need to treat stumps with herbicides

- For high value trees: broadcast anhydrous gypsum around the base of trunk (do not let the gypsum touch the trunk. Use 3-5 lbs per tree depending on tree size) . 1-2 weeks later apply phosphonates as sprays with Pentrabark (trees under 25 inches diameter) or injections (trees with diameter > 25 inches)

- If bays regrow, they need to be recut. Phosphite treatment every two year, however if your neighborhood was well sampled two years in a row with no positive in both year you can skip a year

- Do major pruning and yard work in the late Summer early to mid Fall


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

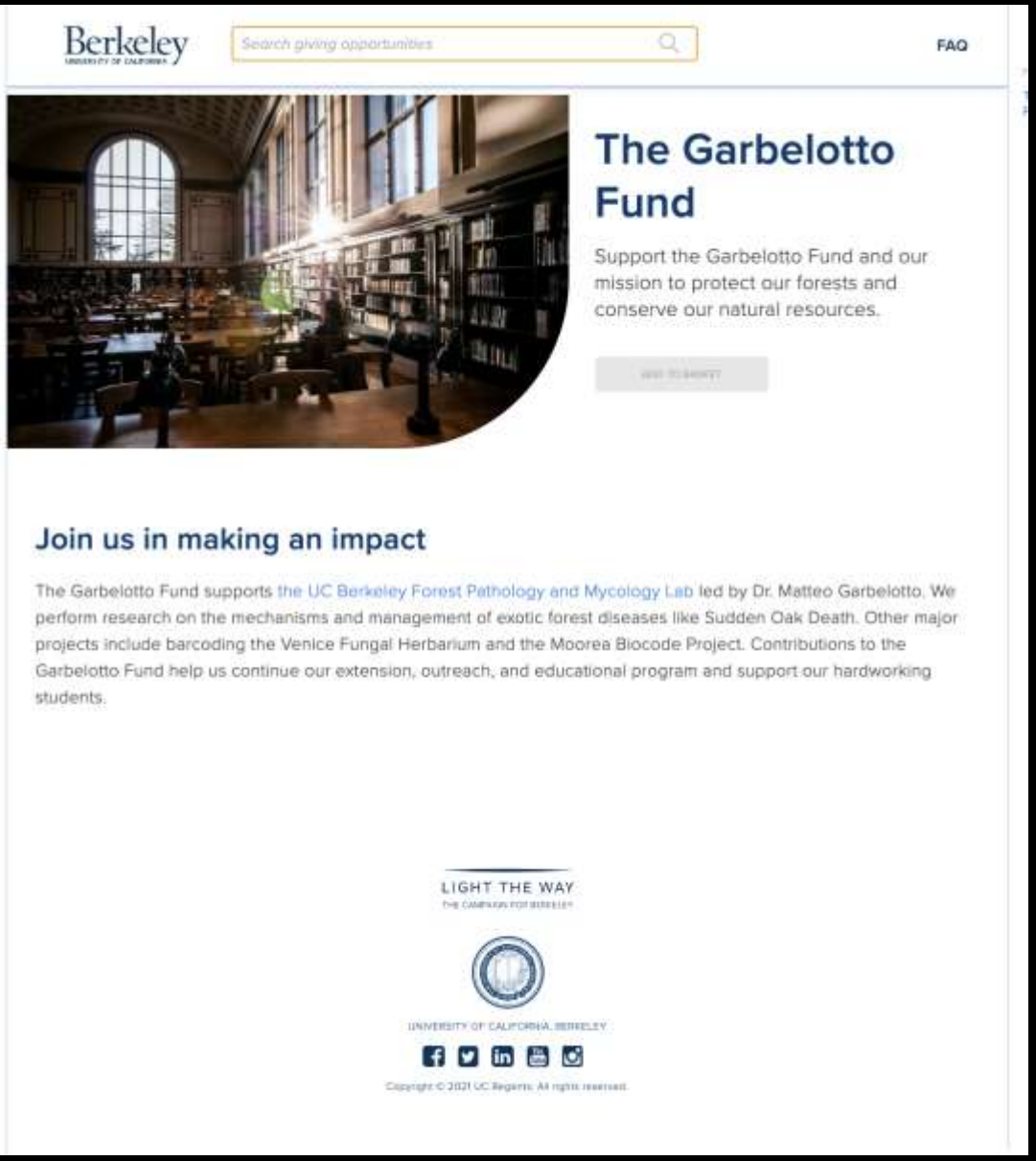
www.sodblitz.org
www.oakstep.org

Reporting and questions

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

Learn SOD Treatments

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



Donations can be done online at

www.matteolab.org

Click the “Donate” link

Fully tax deductible

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

Important websites

- www.sodblitz.org SOD blitzes 2020 & soon 2021
- www.sodmap.org all data on SOD
- Sodmap mobile (App) all data on SOD plus risk calculator
- www.oaskstep.org how to diagnose oaks with SOD
- www.sodquest.org let us know what you have done to control SOD

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

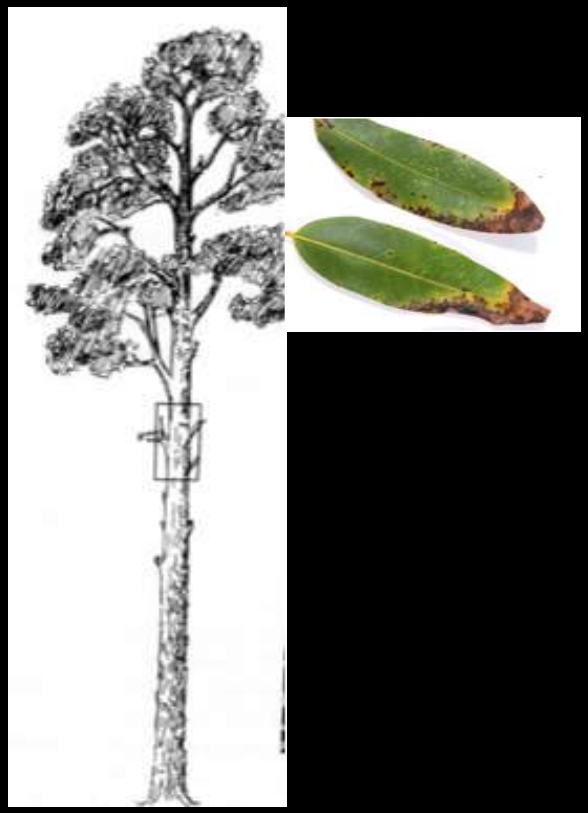
Need to have a fine-scale map of pathogen distribution





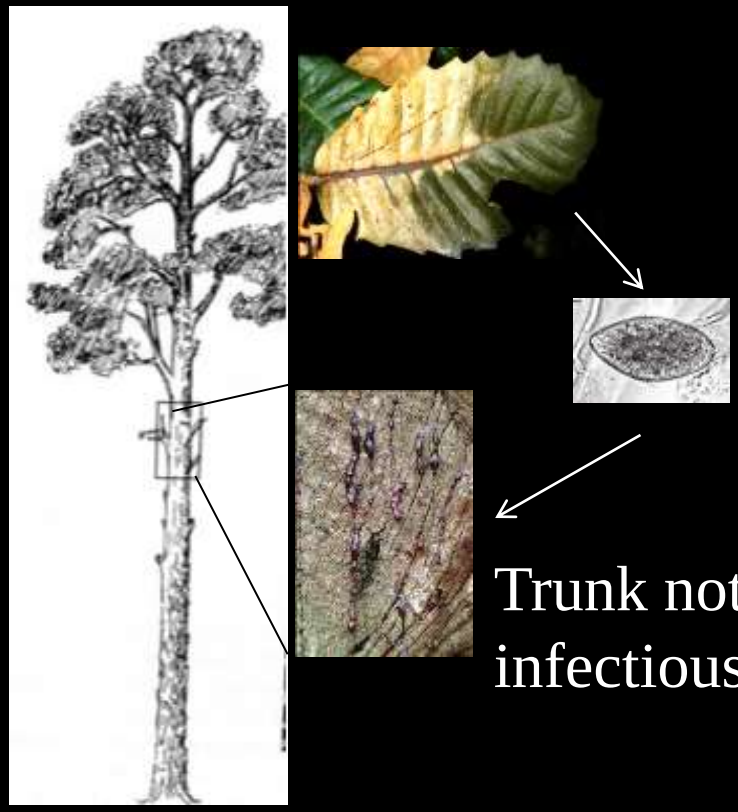
Infectious hosts in CA forests

- CA Bay Laurel



Only leaves,
highly infectious

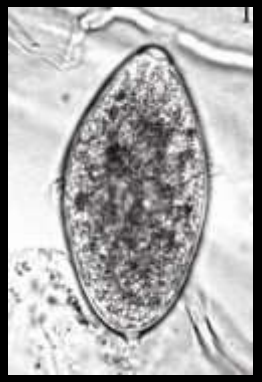
- Tanoaks



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:

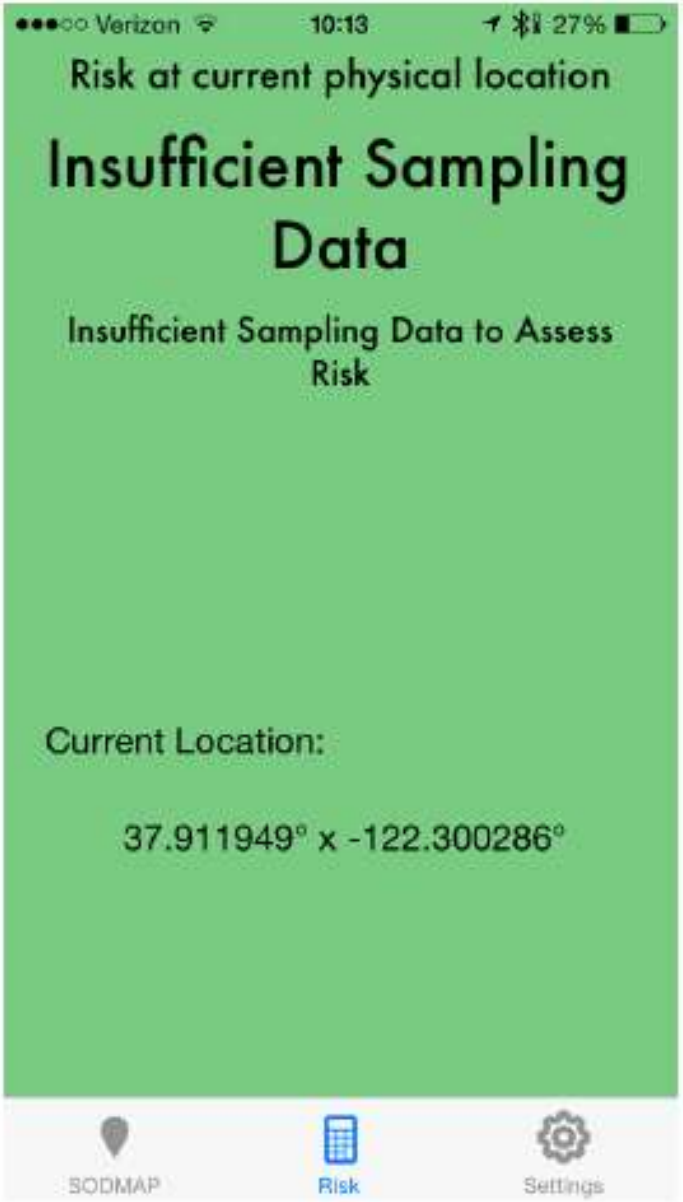
SODMAP Mobile

U.C. Berkeley
Forest Pathology
and Mycology
Laboratory

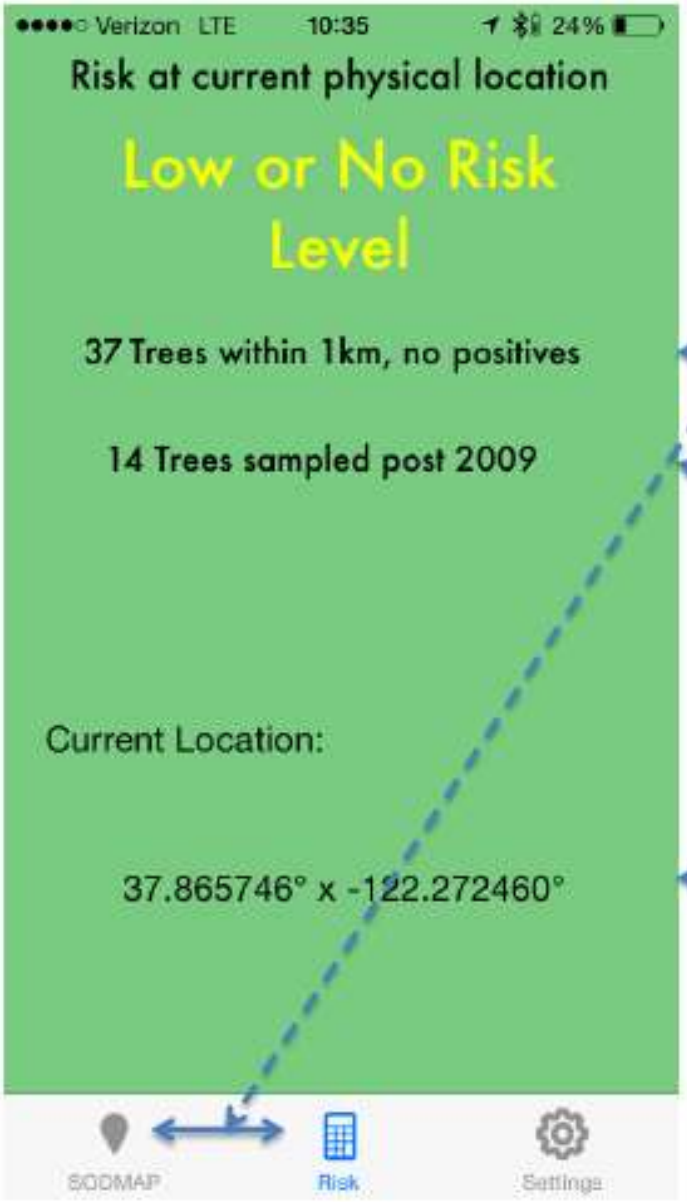
Enlarge screen view using your Index and thumb fingers

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

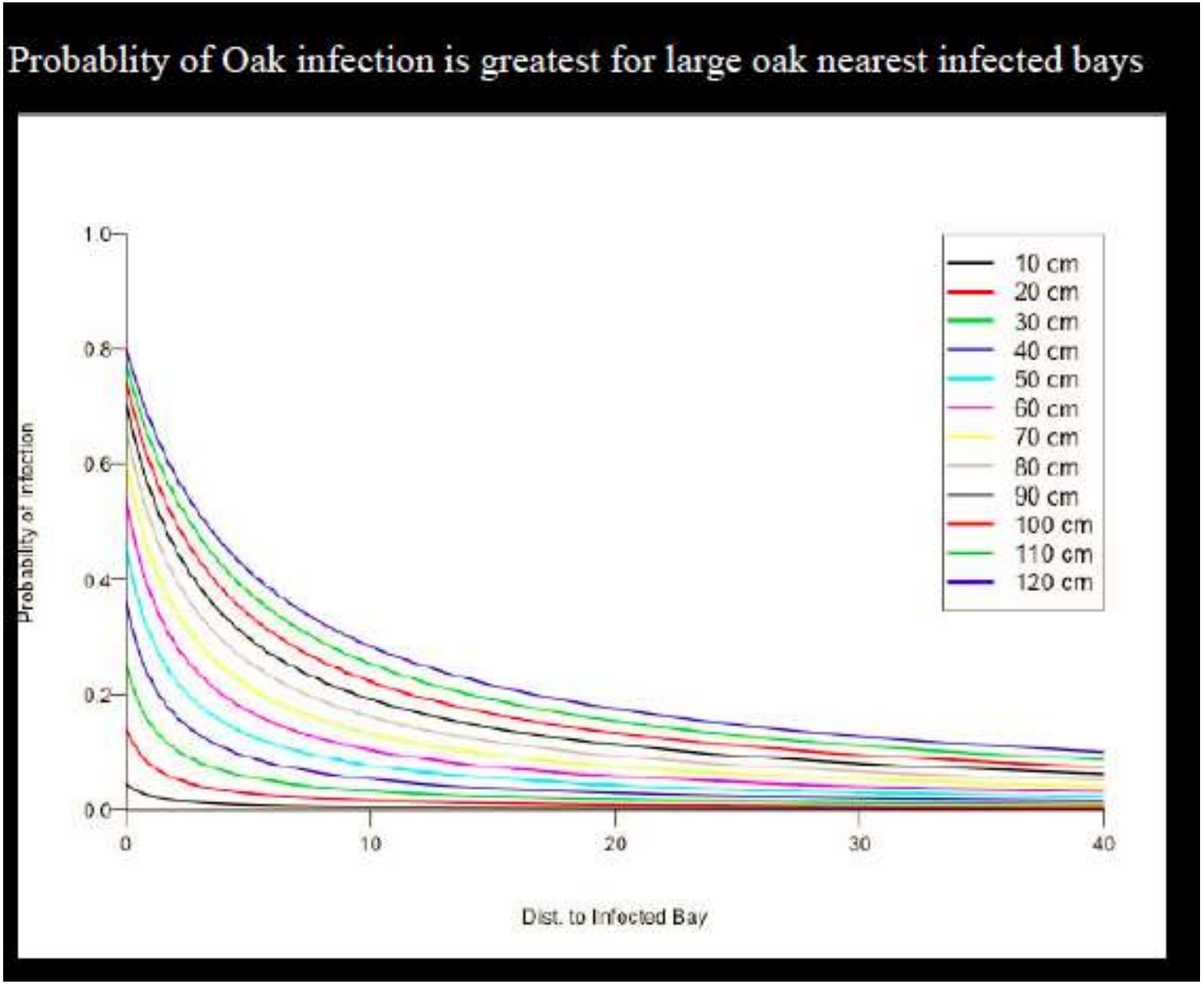
- Oaks are infected by spores produced on leaves of California Bay laurels
  - Selectively remove bay laurels around high value oaks
  - Reduce overall bay density in property

Symptomatic CA bay laurel

+ rainfall (over 400 mm)= oak infection

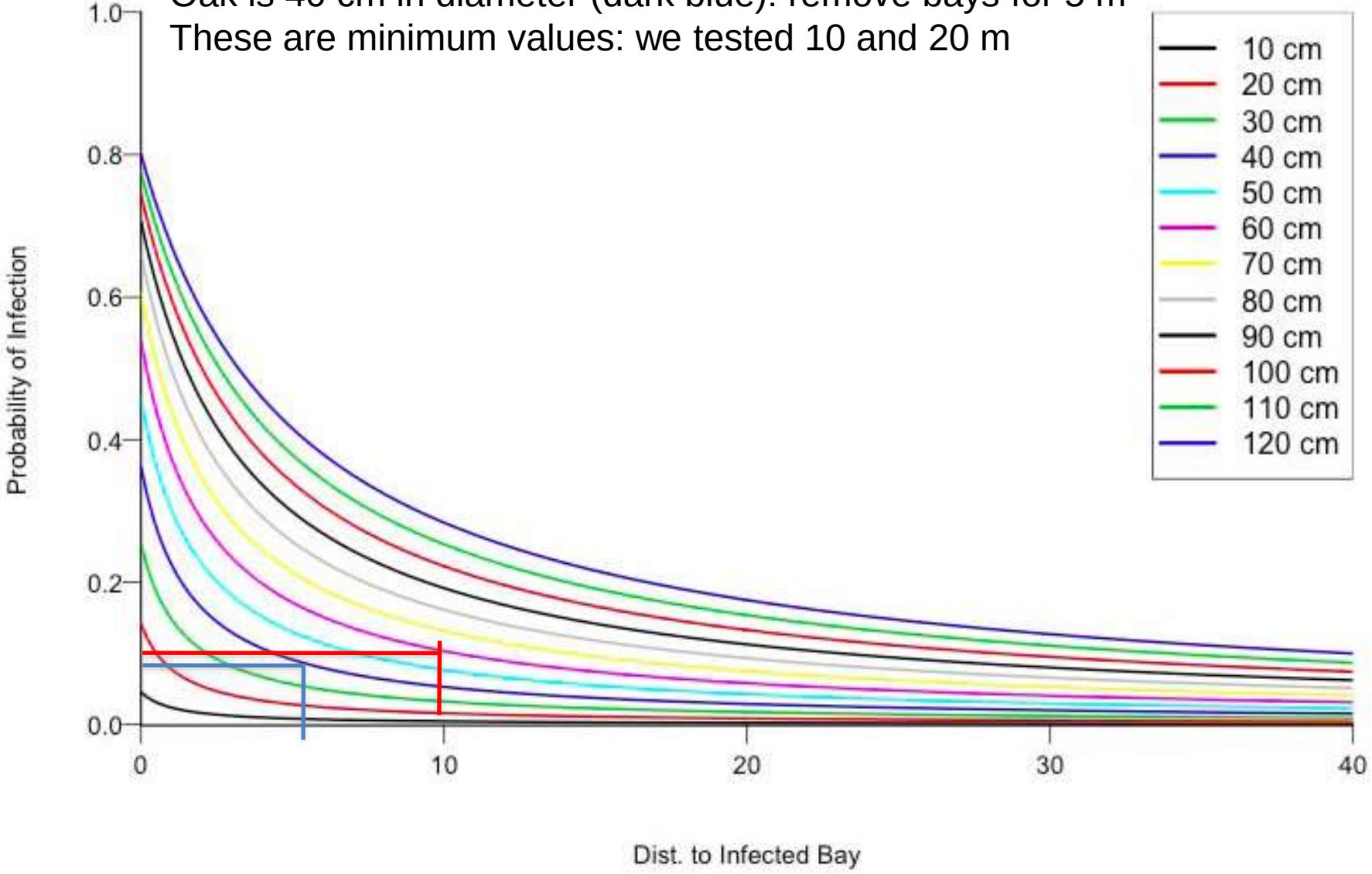
Probablity of Oak infection is greatest for large oak nearest infected bays

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

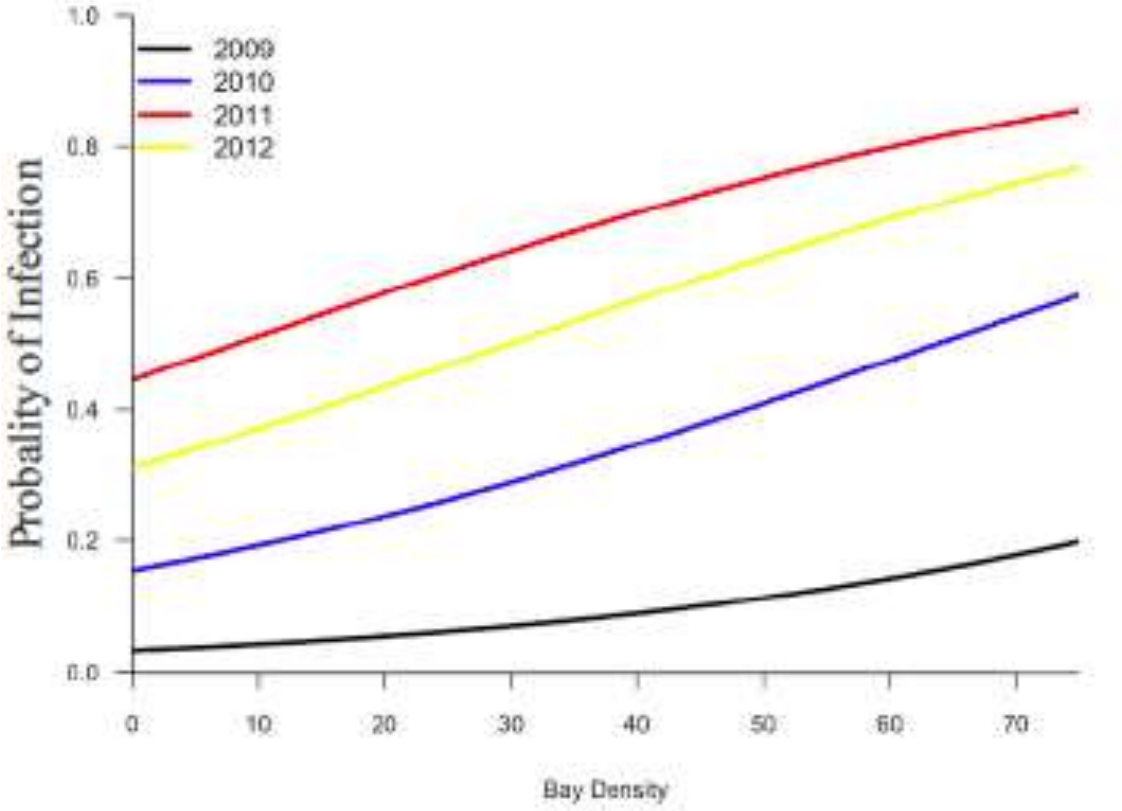


Drip-line to trunk distance (DTD)

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

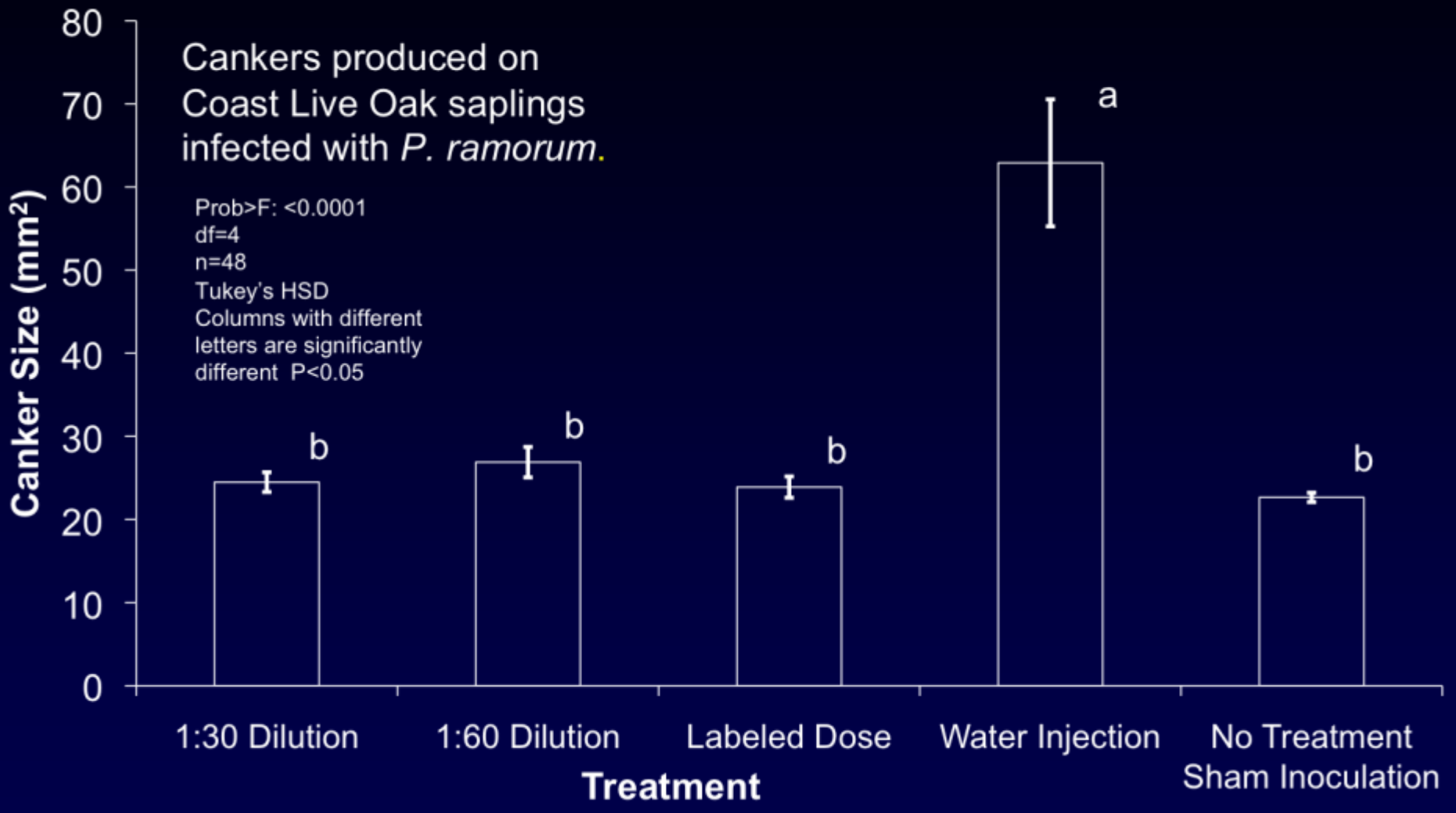


Figure 1. Efficacy of labeled dose vs updated dilution ratios. Smaller lesions = higher efficac

Phosphonate Damage to Wood

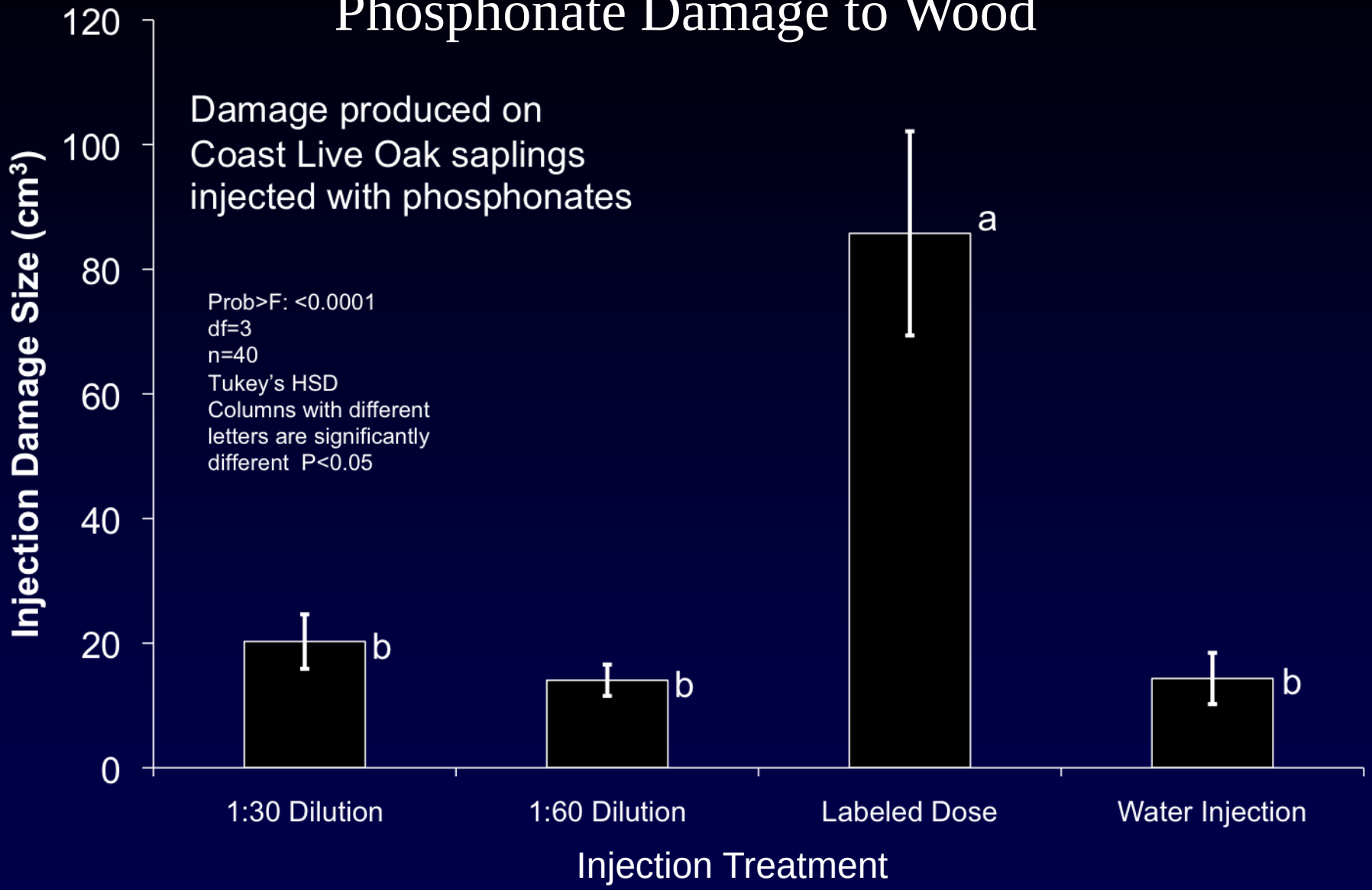


Figure 2. Injection damage caused by labeled dose vs updated dilution ratios. Note that updated dosage damage is indistinguishable from damage caused by only injecting water.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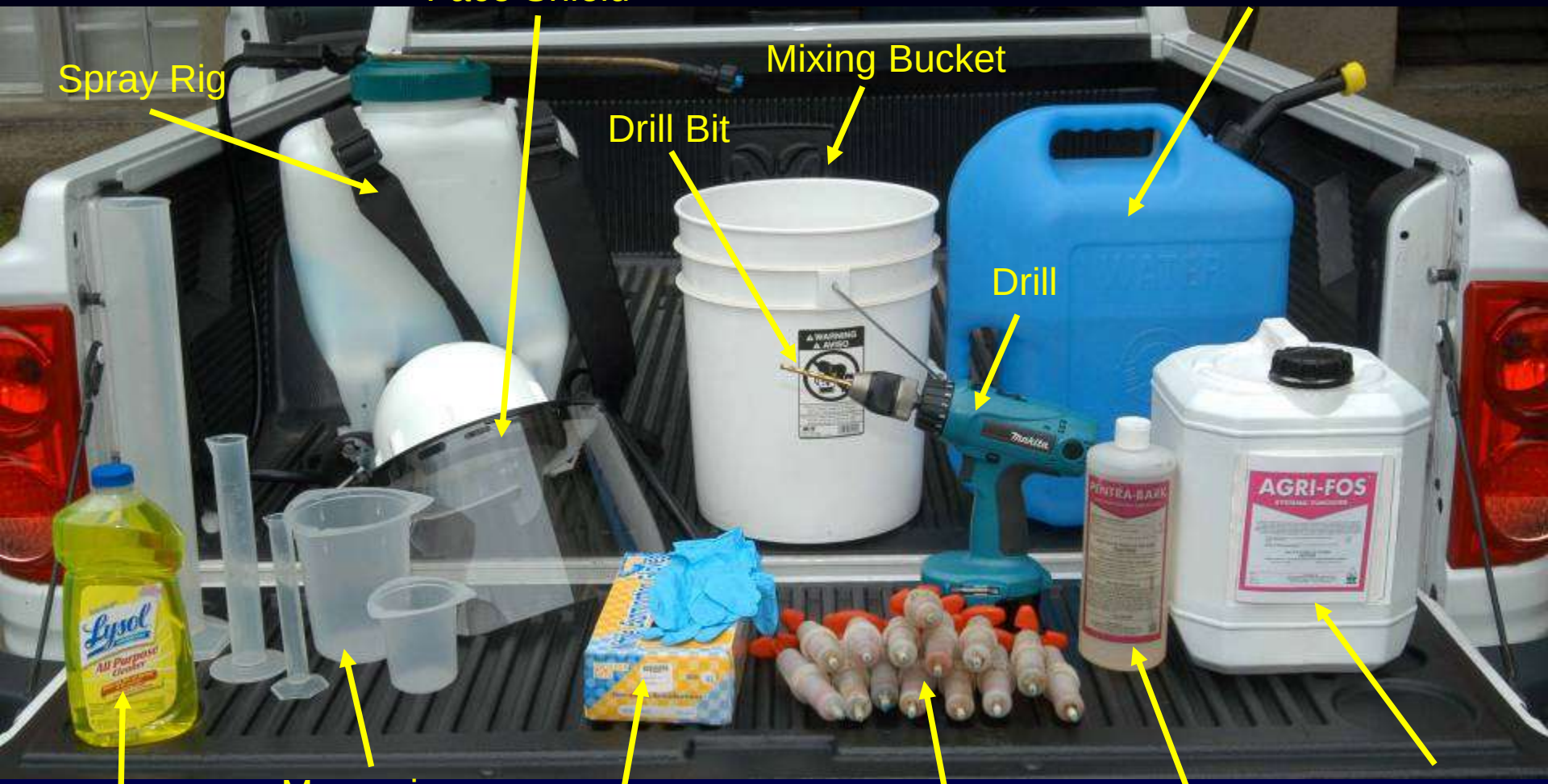
Topical Treatment

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.

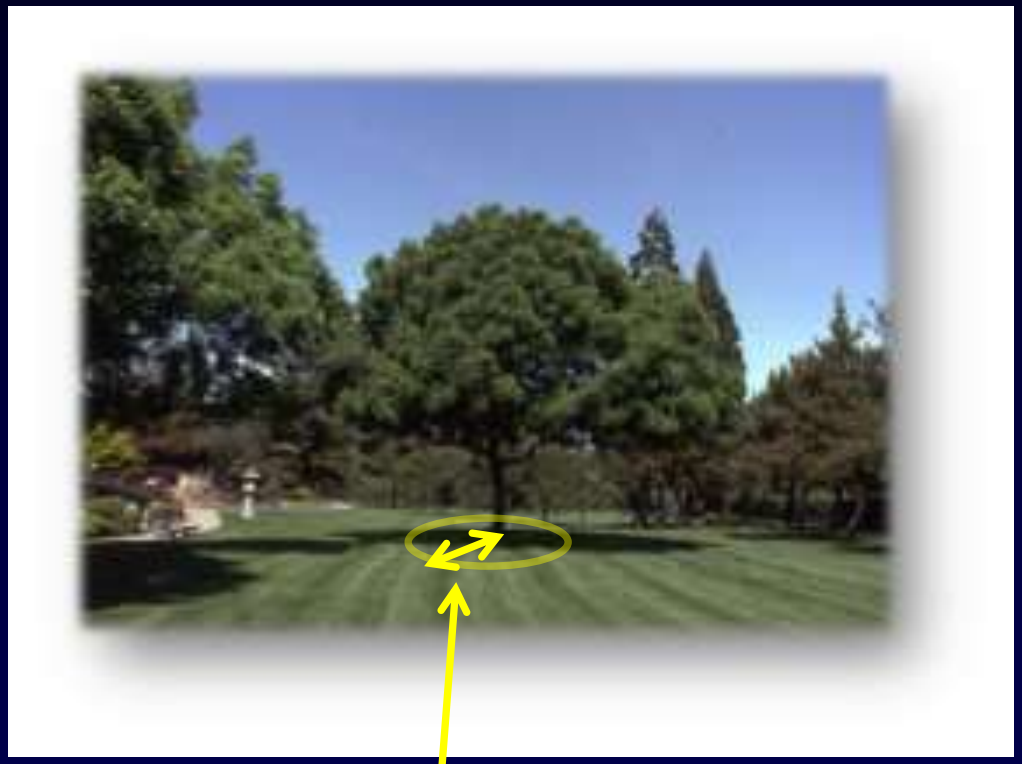
Phosphonate Application Materials and Supplies



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 red Gtpsum

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

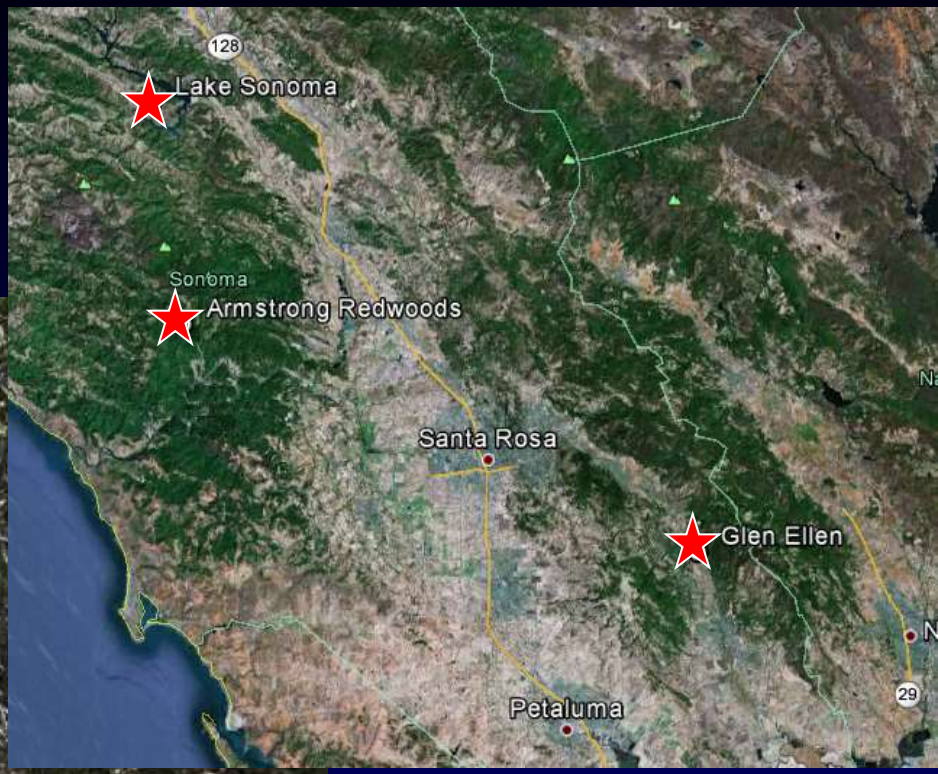
  n=68

  Scribing positives= 14; negatives 54

  Untreated positives= 12; negatives 56

  P=0.66

SOD Canker Scribing Experiments

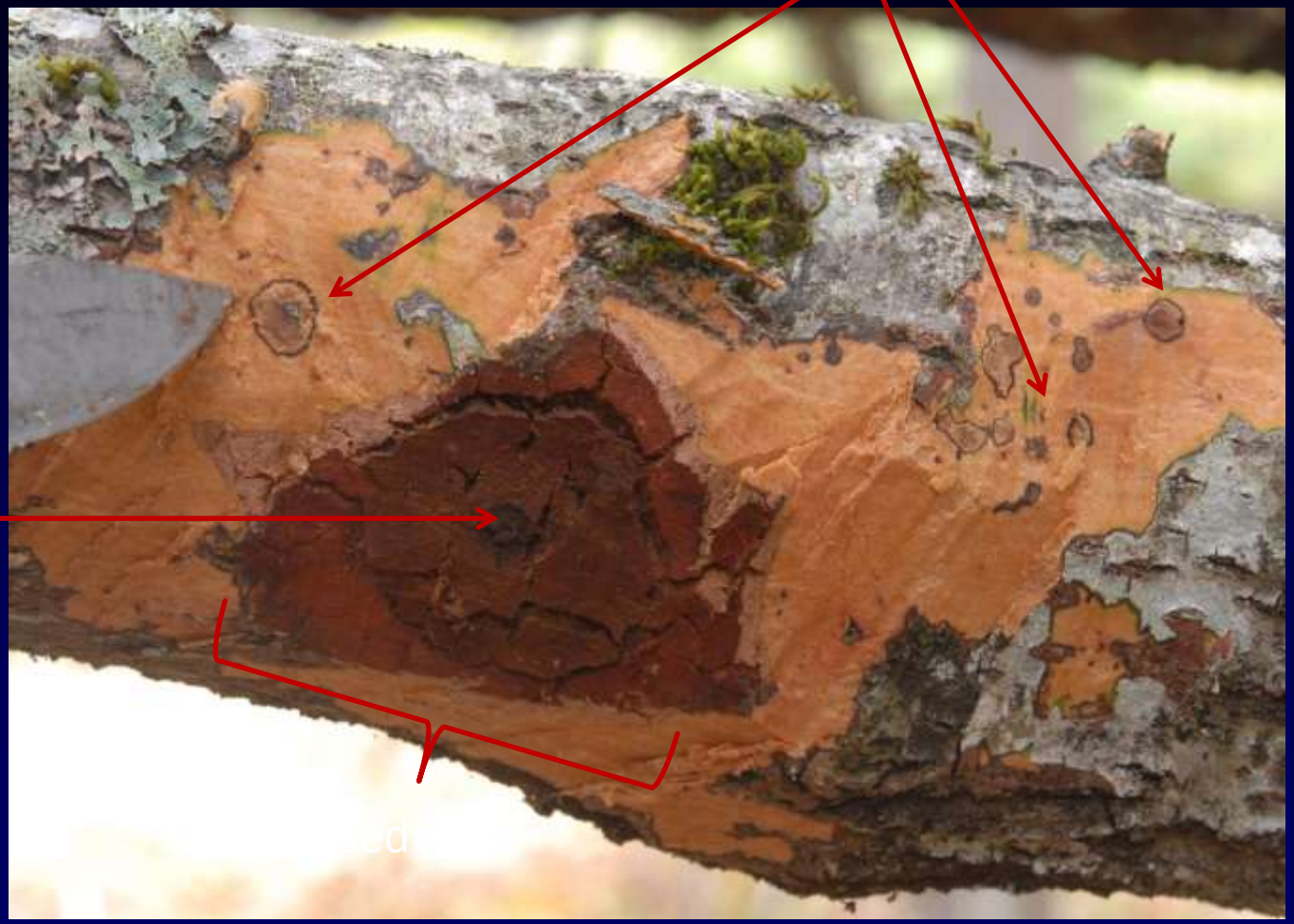


Positive control (infected but not scribed) lesion

Infected/scribed lesion

New lesions outside scribed area ? Maybe

≈ 1cm



Initial infection site

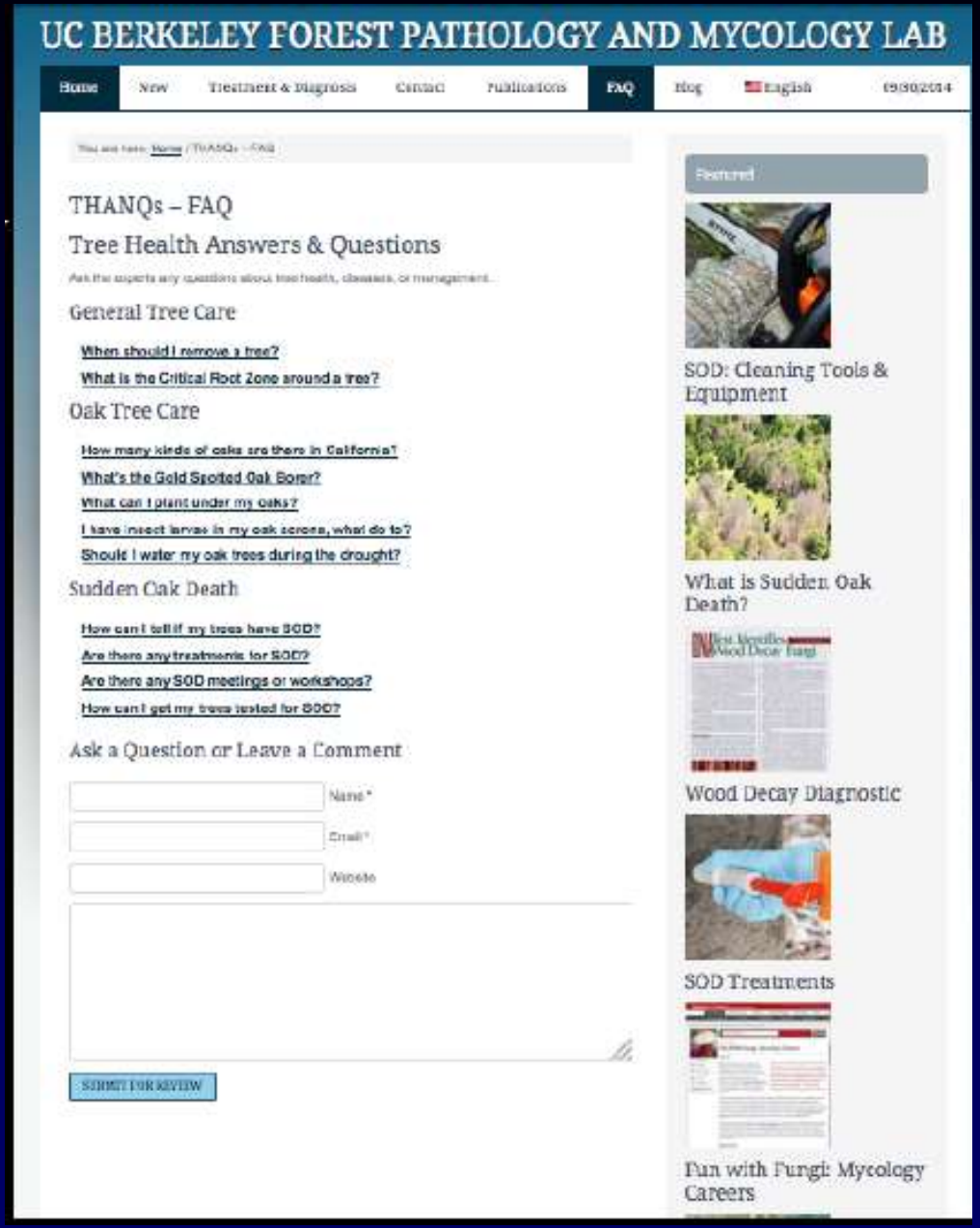
Scribing

- 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

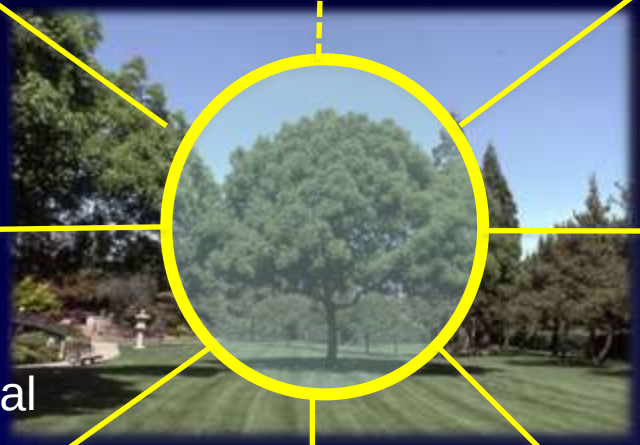
- Water deficiency due to prolonged diminished precipitation and increasing temperatures
- Physiological changes:
  - Direct effects such as thinner canopy, leaf abscission, stunted growth
  - Indirect effects: secondary pathogens and pests
- Some effects reversible: direct physiological changes, branch 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.