2021 SOD Blitz Results

The 2021 Sudden Oak Death (SOD) Blitzes were an incredible success. In observance of Covid-19 health guidelines, the program was completely "contactless": training and registration was done online, collection materials were picked up observing social distancing and hand sanitation protocols at 30 open-air SOD blitz stations (Fig. 1) located throughout coastal Northern California, an collected plant materials were either returned at the same SOD Blitz station where they were collected or they were mailed in.

The number of participants was close to 500 and the number of collectors (usually one per family) who turned in samples was 267. Twenty-four local SOD blitzes were organized, including English-Spanish bilingual blitzes in Sonoma County and SOD Blitzes in First Nation lands across four counties (Siskiyou, Humboldt, Mendocino and Sonoma).

A total of 14,804 trees were surveyed, over no less than 170.000 acres, in 16 Counties. A total of 15000 leaves from 2067 trees (up from 2030 in 2020) were collected by volunteers and processed by trained personnel at the U.C. Berkeley Forest Pathology Laboratory. Samples from Del Norte County and from San Luis Obispo Counties were processed both by culturing and by PCR, all other samples were processed only by PCR. PCR testing is done using two different assays one based on the nuclear ITS locus and one based on the mitochondrial Cox I locus. Lineage of the pathogen is also determined based on the sequence of a portion of the Cox I locus.

Results from 2021 show clearly that disease incidence on bay laurel and tanoak leaves is at a historical low in California, comparable only to the incidence recorded in 2018 (Figure 2). In 2021, only 10.2 % of the samples processed was positive for the SOD pathogen, and the estimated infection rate was down to 3.3% compared to 7.4% in 2020. These values are for the entire sample, including leaves collected in counties that historically have always tested negative for SOD or have a limited outbreak (i.e. Siskiyou, San Luis Obispo and Del Norte). When looking at local disease incidence by ecoregion (Figure 3), and excluding the three counties above, infection rates ranged between 18.6% in East Sonoma (including Petaluma, Rohnert Park, Santa Rosa and Sonoma) and 0.5% in the residential portion of the San Francisco Peninsula (Peninsula East at the Eastern side of the Santa Cruz Mountains, but excluding mountain locations). The high disease incidence in East Sonoma was determined by high sampling rate on the well-infested Sonoma Mountain. Disease incidence in areas historically regarded as being significantly infested, and excluding the 18.6 outlier, ranged between 8.4% on the Western slopes of the Oakland-Berkeley Hills to 3.4% in Marin County. The two positives from Del Norte County belonged to the EU1 lineage, all other samples were NA1.

Given that sampling is haphazard, more valuable information can be gathered by analyzing the results mapped on Google Earth and available at www.sodbltz.org. The most notable results based on ana analysis of that map are listed below:

a)- Del Norte County: Two positive tanoaks were identified by PCR using two distinct assays (nuclear ITS and mitochondrial Cox I). Both belonged to the EU1 lineage based on Cox I sequence. While one tanoak was in close proximity to the location where the two EU1 Pram positive tanoaks were originally found in 2020, the second one was found one mile away from the original outbreak. Although these two samples could not be cultured, they were strong PCR positives. It is unclear whether the EU1 lineage may have spread in 2020-2021, in spite of the ongoing eradication efforts, or whether some trees that were already positive in 2020 may have been missed (or may have been infected but undetectable) in last year' s surveys

b)- San Luis Obispo County: despite the excellent sampling coverage all samples were culture and PCR negatives. Salmon Creek Canyon (Monterey County, just across the County line) however, was severely infested with multiple strong PCR positives. It is interesting that stream baiting in 2021 was negative from Salmon Creek, suggesting that in a drought year, rivers may be lightly infested due to the lack of sporulation on trees. Streams in fact need to be reinoculated each year (see Eyre and Garbelotto 2015) and rain is required for sporulation of the SOD pathogen (Garbelotto et al. 2017).

c)-Big Sur, Santa Lucia Mountains and Carmel Valley all had significant infestations, while the well-sampled Toro Park, northeast of the Carmel Valley was negative (all sites in Monterey County). Significant oak mortality reported in areas with unconfirmed SOD is likely to be associated with drought and native pathogens.

d)- San Francisco County: both the Presidio and Golden Gate Park (including their nurseries) were negative. Burlingame Hills immediately South of San Francisco was also negative.Angel Island was also negative.

e)- Southern and southeastern Napa County: well sampled and negative

f)- Mount Diablo, Eastern and Southern Alameda County: negative.

g)-Mendocino County: southern sites were positive while central sites in the interior were negative.

h)- Suburban parks in the North Peninsula and in the South Bay (San Mateo and Santa Clara County) were negative, while multiple significant outbreaks were identified in the Santa Cruz Mountains in both San Mateo and Santa Cruz Counties, including at Filoli, Portola Redwoods, Huddart Park, El Corte De Madera Creek, Russian Ridge Open Space Preserve, Portola Redwoods State Park and campground, Castle Rock Sate Park, Sanborn County Park

i)- Multiple outbreaks identified in South and West Marin County

j)-Oakland Hills: multiple outbreaks in the area between Mount Wanda to the Northeast and Anthony Chabot Regional Park to the Southwest

k)- Sonoma County multiple outbreaks throughout the County, but woodlands around Sonoma were negative

l)-First Nation tribal land in Humboldt and Siskiyou Counties negative, but those in Sonoma and Southern Mendocino were positive.

In summary, in spite of the drought, the Big Sur coastline and the Santa Lucia Mountains all the way to the Southern side of the Carmel Valley were positive for the SOD pathogen with high foliar disease incidence. The same was true for the Santa Cruz Mountains, the Oakland-Berkeley Hills all the way North to John Muir National Monument, and the area included between Southern Marin and Southern Mendocino Counties. In drier sites such as those East of Monterey (Monterey County); the eastern part of the Peninsula (San Mateo and Santa Clara Counties); Mount Diablo, Danville and Sunol (Contra Costa and Alameda County), Napa and Solano Counties, the easternmost part of Sonoma County and Central Mendocino, although these sites are known to be infested by SOD, the pathogen was undetectable. We expect that lack of detection of the pathogen may be associated with drier weather unfavorable to the microbe in areas known to be significantly infested (for instance in Eastern Sonoma and Napa Counties), or low disease incidence to start with, further lowered by the dry weather (e.g. Central Mendocino, Mount Diablo). In San Francisco, it is remarkable that the Golden Gate Park Nursery, once consistently positive for the pathogen is now negative, and has been so for three years. The lack of positives in Angel Island and Burlingame Hills is surprising, given that once they were both experiencing significant foliar outbreaks, but likely it is driven by the climate. Given the record low detection of the pathogen in 2021, it may be a good idea to remove bay laurels that were positive for SOD in 2021, as these trees may be a major source of the pathogen when the next rainy year arrives. Only remove SOD positive bay laurels if safe and if away from a riparian corridor and from steep unstable slopes.

References:

Eyre, C., Garbelotto, M. (2015) Detection, diversity, and population dynamics of waterborne *Phytophthora ramorum* populations. Phytopathology 105:57-68

Garbelotto, M., Schmidt, D., Swain, S., Hayden, K., Lione, G. 2017. The ecology of infection between a transmissive and a dead-end host provides clues for the treatment of a plant disease. *Ecosphere*, 8(5):e01815 10.1002/ecs2.1815

Figure 1. SOD Blitz station

Figure 2

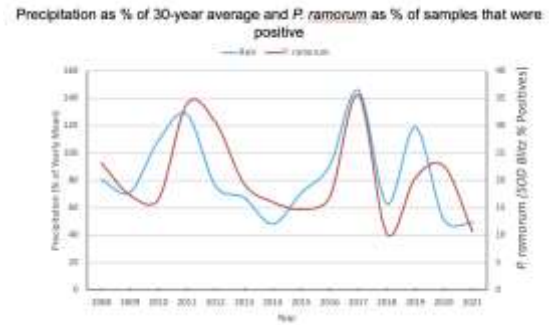

Figure 3. Ecoregions used to present SOD blitz data, different colors identify different regions