CALIFORNIA OAK MORTALITY TASK FORCE REPORT
NOVEMBER 2018

RESEARCH

Question: How many trees in California and Oregon have been killed by the sudden oak death pathogen? Answer: Fifty million or so.

One of the most frequently asked sudden oak death questions is now very close to a science-based estimate. The rough estimate of 50 million trees killed is based on a study by Richard Cobb, Cal Poly-SLO; Sarah Haas, Ross Meentemeyer, North Carolina State University – Raleigh; and colleagues. The analysis leverages plot network data (from over 800 plots), SOD Blitz results and other records in a spatially-explicit probabilistic risk model to estimate tree mortality and infection levels for several *Phytophthora ramorum* tree hosts in California and Oregon. The estimate is approximate: for tanoak (*Notholithocarpus densiflorus*), roughly 29.4–44.5 million trees have died or 1.6–2.5% of its total host population in CA and OR. Coast live oak (*Quercus agrifolia*) and Shreve oak (*Quercus parvula* var. *shrevei*) populations combined have suffered a loss of 1.9–3.3 million trees or 0.4–0.7% of their population. California black oak (*Quercus kelloggii*) populations have lost 0.27–1.1 million trees (0.04–0.17%). For California bay laurel (*Umbellularia californica*), the species largely responsible for driving pathogen spread in California, an estimated 91.4 million infected trees are present.

These model estimates are conservative, as they are based only on trees that have been confirmed to be infected by direct, cultural isolation, and are current only to 2014. The number of dead and infected trees is expected to increase over time and most likely is higher given that 2014 is the most recent year when the required data to run the models were collected. The models for tanoak and bay laurel, which represent the majority of disease-impacted trees, are more robust compared to those for the oak species, which increases the confidence of the overall estimate. More details are pending publication, but for questions contact Richard Cobb, rccobb@calpoly.edu.

ART

In 7000 Marks, Sara Black & Amber Ginsburg transformed a Sudden Oak Death-infected tanoak tree into 7,000 pencils. The dying tree was harvested from Landels-Hill Big Creek Reserve in Big Sur, as part of the artists' vision to explore global industrial trade, quarantines and how, as explained at the Seerveld Gallery exhibit summary, "tightening of boundaries is a move toward conservation, but echoes a rising tide of nationalism, xenophobia and boundary reinforcement on a global scale". More about the project can be found at https://www.amberginsburg.com/projects/7000-marks/. The tanoak pencils are now available for purchase at https://www.amberginsburg.com/shop/.

MONITORING

The sudden oak death pathogen caused a noticeable pulse of mortality in CA coastal counties in 2018 (see entries in the May and September newsletters). Most of this mortality, as observed in aerial survey and ground observations, was likely the result of pathogen spread during the 2016-2017 winter, which saw slightly to greatly above-average precipitation in many coastal counties.

The most dramatic mortality in 2018 appeared in the wettest areas along the coast, such as areas of Big Sur, the Santa Cruz Mountains, Mount Tamalpais, and the first ridge inland from the coast in Sonoma County from Jenner to Fort Ross.

This seemingly contrasts with results from the 2018 "SOD Blitz" citizen science survey conducted by the Garbelotto Lab at UC Berkeley, which reported generally less prevalent infection incidence in 2018 in the wildland-urban interface (WUI) areas that were surveyed. In these surveys, 3.5% of trees sampled were infected with *P. ramorum*, a threefold drop from infection incidence in 2017. Several localities with trees positive in 2017 were not found positive in 2018, including Golden Gate Park, the Presidio of San Francisco, the UC Berkeley campus, and Mount Diablo State Park.

The seeming discrepancy between observed mortality and infection this year is accounted for by noting that the mounting mortality seen in 2018 results from a typical 2-3 year lag between tree infection and mortality, whereas the SOD Blitzes monitor the current year's infection, largely on California bay laurel but also on tanoak. Observed mortality could remain constant or increase in 2019 as the effects of the wet season of 2016-2017 play out. Based on the SOD Blitz data, it is possible that mortality will then decrease for a time, although it is also possible that patterns in wildland areas may not match those from the WUI areas surveyed by the SOD Blitzes.
The SOD Blitzes did note new urban-area outbreaks in several areas, including several areas of Alameda and Marin Counties, southern Mendocino County near Yorkville, the city of Napa, several Silicon Valley locations, Boulder Creek in Santa Cruz County, and cities in inland Sonoma County. Additionally, the survey found *P. ramorum*-infected trees in the Salmon Creek watershed near the border of Salmon Creek in southern Monterey County, where the pathogen had been previously detected in stream water but never in wildland trees. For more information about this year's SOD Blitz results, see the Garbelotto Lab press release at http://www.suddenoakdeath.org/wp-content/uploads/2018/10/10.9.18_News-Release-SOD-Blitz-Results.pdf.

In September, a two-day survey was conducted at the Kitsap County Botanical Garden in Washington state where *P. ramorum* was first detected in 2015. Host plants were heavily sampled near previous positive sites and around the perimeter areas of the garden. A total of 251 samples were collected. All samples were negative for *P. ramorum*, with the exception of one inconclusive *Gaultheria* sample. The inconclusive sample was forwarded to the USDA for a final determination. Results are still pending. The last survey at the Botanical Garden for 2018 will be conducted in November. Surveys will continue in 2019 at an interval yet to be determined.

NURSERIES

Upcoming USDA APHIS *P. ramorum* quarantine (DA-2014-02) Compliance Inspections in California. Six California nurseries that were previously positive for *Phytophthora ramorum* (*P. ramorum*) and that ship *P. ramorum* host material interstate are now required to participate in bi-annual sampling to be compliant with Federal Order DA-2014-02. The DA-2014-02 compliance inspections take place during times of the year when climatic conditions are most conducive to *P. ramorum* symptom expression. The optimal temperature range for inspection is between 37.4°

F and 82.4° F (optimum 68°F) with free moisture present on host tissue for at least 12 hours over 10 or more days. The DA-2014-02 compliance inspections will take place in October, November, and December in four counties with assistance from the United States Department of Agriculture, the California Department of Food and Agriculture, and county departments of agriculture. For more details of "*Phytophthora ramorum* Domestic Quarantine Regulatory Requirements for Certain Host Nurseries", DA-2014-02 requirements, see https://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/pdf_files/DA-2014-02.pdf.

The Systems Approach to Nursery Certification (SANC) Program continues its Pilot Program with eight nurseries now SANC-certified and shipping plants under the program. These facilities are located in PA, WI, WA, OR, MO, OK and KS. Seven facilities are at the mid-point of SANC certification processes and another two are finishing their SANC certification agreements. The SANC program emphasizes plant health and quality. Nursery and greenhouse plants grown under the SANC program are now shipped to virtually all 50 states.

SANC Training classes for the NPB Western Regional Plant Board inspectors were conducted in July 2018 in California and for Central Regional Plant Board inspectors in September 2018 in Indiana. Between the two classes, over 50 inspectors received 1.5 days of training with a focus on conducting SANC risk assessments in nursery/greenhouse environments.

An application is being developed to facilitate use of the risk assessment module of the SANC program. The application will assist nursery and inspectors in completing a risk assessment, an important first step in obtaining SANC certification. Beta-testing of the application is planned for December 2018. For more information on the SANC program, see http://sanc.nationalplantboard.org/.

RESEARCH

Cobb, R.; Ross, N.; Hayden, K.J.; Eyre, C.A.; Dodd, R.S.; Frankel, S.; Garbelotto, M. and Rizzo, D.M. 2018. Promise and pitfalls of endemic resistance for cultural resources threatened by *Phytophthora ramorum*. Phytopathology. Early view. https://apsjournals.apsnet.org/doi/abs/10.1094/PHYTO-04-18-0142-R

Invasive forest pathogens can harm cultural, economic, and ecological resources. Here we demonstrate the potential of endemic tree pathogen resistance in forest disease management using *Phytophthora ramorum*, cause of sudden oak death, in the context of management of tanoak (*Notholithocarpus densiflorus*), an ecologically unique and highly valued tree within Native American communities of northern California and southern Oregon, USA. We surveyed resistance to *P. ramorum* on the Hoopa Valley Indian Reservation and Yurok Indian Reservation in a set of study sites with variable management intensities. Variation in resistance was found at all sites with similar mean and variation across stands, tended to have a random spatial distribution within stands, but was not associated with previous stand management (thinning, prescribed fire) or structural characteristics such as tree density, basal area, or pairwise relatedness among study trees. These results did not suggest host, genetic, management, and/or environment interactions that could be easily leveraged into treatments to increase the prevalence of resistant trees. We applied epidemiological models to assess the potential application of

endemic resistance in this system and to examine our assumption that in planta differences in lesion size – our measure of resistance – reflect linkages between mortality and transmission (resistance) vs reduced mortality with no change in transmission (tolerance). This assumption strongly influenced infection dynamics, but changes in host populations – our conservation focus – was dependent on community-level variation in transmission. For *P. ramorum,* slowing mortality rates (whether by resistance or tolerance) conserves host resources when a second source of inoculum is present; these results are likely generalizable to pathogens with a broader host. However, when the focal host is the sole source of inoculum, increasing tolerant individuals led to the greatest stand-level pathogen accumulation in our model. When seeking to use variation in mortality rates to affect conservation strategies, it is important to understand how these traits are linked with transmission because tolerance will be more useful for management in mixed-host stands that are already invaded, compared to single-host stands with low or no pathogen presence where resistance will have the greatest conservation benefits.

RELATED RESEARCH

Rooney-Latham, S., Blomquist, C.L., Kosta, K.L., Guo, Y.Y., Woods, P.W. and Soriano, M.C., 2018. *Phytophthora* species are common on nursery stock grown for restoration and revegetation purposes in California. Plant Disease. Early View. https://apsjournals.apsnet.org/doi/10.1094/PDIS-01-18-0167-RE

PERSONNEL

After more than 15 years, the California Oak Mortality Task Force (COMTF) bids farewell to Katie Harrell, public information officer. Katie now works for the California Board of Forestry in Sacramento but plans to keep in touch with the California Forest Pest Council and COMTF. Katie may be reached at 916-698-1035 or katie.harrell@bof.ca.gov.

William (Bill) Wesela has replaced Karen Maguylo as *P. ramorum* program, National Policy Manager, for the USDA APHIS, Plant Protection and Quarantine in Riverdale, Maryland. Bill may be contacted at 301-851-2229 or William.D.Wesela@aphis.usda.gov.

RESOURCES

"Sudden Oak Death: Prevention, Recognition, Restoration; A guide for homeowners, small woodland owners, resource managers, and conservation groups to recognize, prevent, and manage Sudden Oak Death" is now available from Oregon State University Extension Service https://catalog.extension.oregonstate.edu/em9216.

Swiecki, T.J.; Bernhardt, E.A.; Frankel, S.J. 2018. *Phytophthora* root disease and the need for clean nursery stock in urban forests. Part 1. *Phytophthora* invasions in the urban forest and beyond. Western Arborist. Fall 2018. Pgs. 54-62.

MEETINGS

Submit an abstract for a presentation or poster at "Healthy Plants in a World with *Phytophthora,* The Sudden Oak Death Seventh Science and Management Symposium" (SOD7). The symposium will be held June 25- 27, 2019 in the Presidio, San Francisco and feature research and field activities for *Phytophthora ramorum* as well as progress to address Phytophthoras in native habitats, restoration areas and damage to native California plants.

Submissions are due December 15, 2018 and should be submitted to Janice Alexander at jalexander@ucanr.edu. More information on format is available at the conference website, https://ucanr.edu/sites/sod7/.

CALENDAR OF EVENTS

11/13 - 14– 2018 California Forest Pest Council Annual Meeting at UC Davis. For more details, see http://caforestpestcouncil.org/2018/07/cfpc-annual-meeting-november-13-14-2018/

06/25 - 27– 2019 Sudden Oak Death Seventh Science and Management Symposium. The Presidio, San Francisco. For more information, and the call for papers or posters, see https://ucanr.edu/sites/sod7/.

Note. The next California Oak Mortality Task Force newsletter will be issued in February 2019.