California Oak Mortality Task Force Report
OCTOBER 2020

Diagnostics

Testing for COVID-19 has focused attention on national diagnostic capabilities. How does the U.S. handle plant pathogen testing for large outbreaks? For plant diseases, the National Plant Diagnostic Network (NPDN) serves as a nationally-distributed diagnostic partner to USDA-APHIS and state departments of agriculture during surge events such as the 2019 detection of *Phytophthora ramorum* in nurseries and retail stores across the Midwest (Figs. 1 & 2). As the regulatory agencies collect materials to delimit the sources of infection, the number of samples quickly grows into the hundreds and then thousands. The 2019 event resulted in more than 9,000 plant samples, resulting in 250 *P. ramorum* positives from 14 states. To determine whether *P. ramorum* was present, bits of leaves were funneled to NPDN laboratories in several states for triage with ELISA tests, ensuring no single lab was overwhelmed, while quickly clearing negative samples so regulatory authorities could release stock for sale. Plant samples suspected to be positive for the pathogen were then forwarded to three NPDN labs (Michigan State University, Cornell University, and the University of Florida) and the Pennsylvania Department of Agriculture lab for PCR testing. These four labs maintain certification of their diagnosticians through testing each year, provided by USDA-APHIS, National Plant Protection Laboratory Accreditation Program (NPPLAP), ensuring quality diagnosis and adherence to protocols. Any suspect-positive samples at these labs are then forwarded to APHIS confirmatory labs for further PCR and sequencing, and any resulting regulatory action is the result of these tests.

Figures 1 & 2. Technicians conducting surge triage and diagnostic testing at a NPDN laboratory.
Photos courtesy of Carrie Harmon, Univ. of Florida.

The NPDN, established in 2002, is built on the land-grant university extension system, though in a few states, the department of agriculture houses the NPDN laboratory. This system ensures a lab in every state, to serve local clientele from farmers and growers to homeowners and plant inspectors. These public services can be accessed by any citizen or organization. To learn more or find a lab near you, see https://www.npdn.org/home or contact Carrie Harmon, clharmon@ufl.edu.

WILDLANDS - OREGON

Due to COVID-19 concerns, the U.S. Forest Service, Pacific Northwest Region, Forest Health Protection and Oregon state cooperators have mutually decided to not fly the 2020 annual forest insect and disease aerial detection survey (ADS) of Oregon, which includes the special fixed-wing and helicopter flights for sudden oak death (SOD). Oregon Department of Forestry (ODF) and U.S. Forest Service staff are relying on high-resolution imagery interpretation to find new infestations inside and outside the quarantine area. The SOD Program is also using the new geospatial workflow developed by the U.S. Forest Service Geospatial Technology Application Center to guide image interpretation for dead and dying tanoaks.

Currently, 38 stream drainages both inside and outside the SOD quarantine are being monitored for the presence of *P. ramorum.* A stream bait approximately 2 miles south of the Rogue River, the northern quarantine boundary, tested positive for the pathogen. ODF SOD foresters have installed additional stream baits in the drainage to pinpoint the infestation, and a stream survey is planned for the area (Fig. 3).

With current high fire danger, SOD treatments are currently shut down, but will be restarted once the fall rains begin in the region. Given the COVID-19 related downturn in state revenues, a $70,000 general fund reduction for SOD treatment activities was approved by the state legislature last month. For more information, contact Sarah Navarro, sarah.navarro@usda.gov.

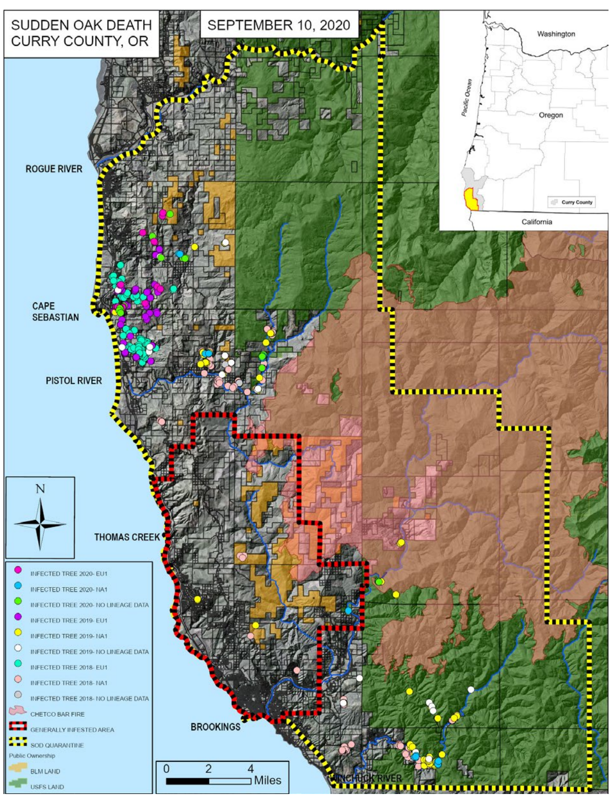

Figure 3. Map of *P. ramorum* detections and quarantine zones in Oregon.
Credit: Oregon Dept. of Forestry

MONITORING

Figure 4. Sudden oak death on tanoak in southwest Oregon.
Credit: Photo courtesy of Sarah Navarro, from GTAC-10211-RPT1, USFS.

Utilizing "Structure from Motion" (SfM) geospatial technology for the mapping of sudden oak death in Oregon. The August COMTF News included a project summary, but now a full report of SfM for *P. ramorum* is available, "Mapping Sudden Oak Death in Southwest Oregon." This trial showed that the high-resolution imagery available in the southwestern Oregon study area was not collected with the overlap necessary for SfM workflows, and the resulting data products were not sufficient for characterization of tanoak canopies. Supervised classification methods were unable to accurately differentiate dead tanoak from other dead species, and the bare ground was commonly confused with dead trees in classification outputs. The resulting classified products, however, could be used in conjunction with image mosaics to guide image interpretation efforts aimed at identifying dead and dying tanoaks (Fig. 4). For more information, contact Eric Rounds, eric.rounds@usda.gov.

NURSERIES

Oregon Department of Agriculture (ODA) *P. ramorum* program update. Spring compliance surveys were completed by the end of May with no *P. ramorum* detected. Ten nurseries were inspected and surveyed (6 interstate and 4 intrastate shippers). One intrastate shipper located in Tillamook Co. successfully fulfilled the *Phytophthora ramorum* Nursery Program requirements and has been released. To date, this is the fourth nursery to have completed the program in Oregon.

In August, soil steaming was conducted at three nurseries that previously had confirmed plants with *P. ramorum*, one located in Washington Co. and two in Marion Co. Steaming was successfully completed at the nurseries in Marion Co. (Fig. 5). ODA was unable to fully complete steaming at the nursery in Washington Co. due to irrigation issues. USDA-APHIS and ODA are working with the nursery to create an enhanced mitigation plan focusing on irrigation at the nursery.

In July, a North Carolina nursery reported positive *Rhododendron* 'Skookum' and 'Cynthia' plants that had been purchased from an Oregon nursery in Linn Co. During the traceback investigation, ODA

Figure 5. Steaming at a nursery with confirmed positive soil. This site had confirmed *P. ramorum* positive *Arctostaphylos uva-ursi* container stock that had been destroyed. Positive soil was also detected, and steaming was performed by ODA in August 2020.

detected positive *Rhododendron* 'Skookum' and 'Polarnacht' plants at the site. Further tracebacks have been triggered at the locations where this material was purchased from. The Linn Co. nursery has destroyed all material within quarantine and destruction zones. After a second round of delimitation surveys, no additional positive plants were found. No infested soil was detected. The nursery is undergoing the final assessment to sign a federal compliance agreement and will be added to the list of nurseries sampled by ODA in fall.

Additionally, over the spring, two new nurseries in Marion Co. underwent the USDA Confirmed Nursery Protocol after they were confirmed positive during a traceback investigation and a routine inspection. Both nurseries completed the required mitigation measures and are under federal compliance agreements. The total number of nurseries in the Oregon *P. ramorum* Program is now up to 13. Fall compliance surveys are scheduled to begin September 22nd. For more information contact Chris Benemann, sbenemann@oda.state.or.us.

Washington State Department of Agriculture (WSDA) *P. ramorum* program update. The Washington State Department of Agriculture currently has four residential locations in King Co. under the Confirmed Residential Protocol. The positive sites are a result of a trace-forward from an out-of-state positive nursery. In August, soil in the destruction and quarantine blocks at two of these residential sites tested positive. Steam treatment of the ground has been conducted at one location, with the second site to be steamed in October.

This summer, a two-day survey was conducted at the Kitsap Co. botanic garden first found positive for *P. ramorum* in 2015. A total of 229 samples were collected near previously positive sites and around the perimeter of the garden. All samples were negative for *P. ramorum*. For more information contact Scott Brooks, SBrooks@agr.wa.gov.

RESEARCH (ABBREVIATED ABSTRACTS)

Blomquist, C.L.; Rooney-Latham, S.; Soriano, M.C.; Ochoa, J. and Zwart, D. 2020. First detection of leaf blight and stem canker caused by *Phytophthora ramorum* on Brisbane box in the United States. Plant Disease. https://doi.org/10.1094/PDIS-05-20-1115-PDN.

Brisbane box, *Lophostemon confertus* (Myrtaceae) is a frost tender evergreen tree planted for its upright form, large ovate leaves and attractive white flowers which bloom in the spring. In June of 2017, the Plant Pest Diagnostics Center lab received a call from an arborist who described Brisbane box street trees dying in central Sausalito, Marin Co., California. Trees ranged from containing 10% to nearly 80% dead hanging leaves. Six trees along the same street were affected. Wilted brown leaves remained attached to branchlets covered in black cankers. Some healthy branchlets had leaves with angular spots which crossed the veins and were surrounded by yellow halos. Isolations were made onto CMA-PARP (Jeffers and Martin, 1986) from the canker and leaf spot margins. A *Phytophthora* species resembling *Phytophthora ramorum* grew on CMA-PARP media with coralloid coenocytic hyphae, chlamydospores, and ellipsoidal semi-papillate sporangia. … Pathogenicity was confirmed by inoculating 3, initially 1.8-meter-tall trees in 18.9-liter pots. Leaf spots were visible 4 days later, with inoculated leaves turning necrotic and abscising after 3 weeks. Cankers from inoculated branchlets measured from 12 to 60 mm long after 60 days. *P. ramorum* was isolated from the margin of every inoculated canker and leaf spot. No *P. ramorum* was isolated from the control tree. To our knowledge, this is the first report of *P. ramorum* on *L. confertus*, in the world. Natural inoculum presumably came from infected California bay laurel, *Umbellularia californica,* trees located less than 800 m west of the trees in Sausalito. This detection will further limit the planting choices of arborists and landscapers in *P. ramorum* infected locations.

Petrasova, A.; Gaydos, D.A.; Petras, V.; Jones, C.M.; Mitasova, H. and Meentemeyer, R.K. 2020. Geospatial simulation steering for adaptive management. Environmental Modelling & Software: 104801. https://doi.org/10.1016/j.envsoft.2020.104801.

Spatio-temporal simulations are becoming essential tools for decision makers when forecasting future conditions and evaluating effectiveness of alternative decision scenarios. However, lack of interactive steering capabilities limits the value of advanced stochastic simulations for research and practice. To address this gap we identified conceptual challenges associated with steering stochastic, spatio-temporal simulations and developed solutions that better represent the realities of decision-making by allowing both reactive and proactive, spatially-explicit interventions. We present our approach, in a participatory modeling case study engaging stakeholders in developing strategies to contain the spread of a tree disease [sudden oak death] in Oregon, USA. Using intuitive interfaces, implemented through web-based and tangible platforms, stakeholders explored management options as the simulation progressed. Spatio-temporal steering allowed them to combine currently used management practices into novel adaptive management strategies, which were previously difficult to test and assess, demonstrating the utility of interactive simulations for decision-making.

Simler-Williamson, A.B.; Metz, M.R.; Frangioso, K.M. and Rizzo, D.M. 2020. Wildfire alters the disturbance impacts of an emerging forest disease via changes to host occurrence and demographic structure. Journal of Ecology. Early View. https://doi.org/10.1111/1365-2745.13495

1. Anthropogenic activities have altered historical disturbance regimes, and understanding the mechanisms by which these shifting perturbations interact is essential to predicting where they may erode ecosystem resilience. Emerging infectious plant diseases, caused by human

translocation of nonnative pathogens, can generate ecologically-damaging forms of novel biotic disturbance. Further, abiotic disturbances, such as wildfire, may influence the severity and extent of disease-related perturbations via their effects on the occurrence of hosts, pathogens, and microclimates; however, these interactions have rarely been examined.

2. The disease "sudden oak death" (SOD), associated with the introduced pathogen *Phytophthora ramorum*, causes acute, landscape-scale tree mortality in California's fire-prone coastal forests. Here, we examined interactions between wildfire and the biotic disturbance impacts of this emerging infectious disease. Leveraging long-term datasets that describe wildfire occurrence and *P. ramorum* dynamics across the Big Sur region, we modeled the influence of recent and historical fires on epidemiological parameters, including pathogen presence, infestation intensity, reinvasion, and host mortality.

3. Past wildfire altered disease dynamics and reduced SOD-related mortality, indicating a negative interaction between these abiotic and biotic disturbances. Frequently-burned forests were less likely to be invaded by *P. ramorum*, had lower incidence of host infection, and exhibited decreased disease-related biotic disturbance, which was associated with reduced occurrence and density of epidemiologically-significant hosts. Following a recent wildfire, survival of mature bay laurel, a key sporulating host, was the primary driver of *P. ramorum* infestation and reinvasion, but younger, rapidly regenerating host vegetation capable of sporulation did not measurably influence disease dynamics. Notably, the effect of *P. ramorum* infection on host mortality was reduced in recently-burned areas, indicating that the loss of tall, mature host canopies may temporarily dampen pathogen transmission and "release" susceptible species from significant inoculum pressure.

Related Research

Chepsergon, J.; Motaung, T.E.; Bellieny-Rabelo, D. and Moleleki, L.N. 2020. Organize, don't agonize: Strategic success of *Phytophthora* species. Microorganisms. 8(6): 917.

Khdiar, M.Y.; Burgess, T.I.; Scott, P.M.; Barber, P.A. and Hardy, G.E.S.J. 2020. Pathogenicity of nineteen *Phytophthora* species to a range of common urban trees. Australasian Plant Pathology. https://doi.org/10.1007/s13313-020-00734-4.

Rojas-Estevez, P.; Urbina-Gómez, D.A.; Ayala-Usma, D.A.; Guayazan-Palacios, N.; Mideros, M.F., Bernal, A.J. and others. 2020. Effector Repertoire of *Phytophthora betacei*: In search of possible virulence factors responsible for its host specificity. Frontiers in Genetics. 11: 579. https://doi.org/10.3389/fgene.2020.00579. [Effectors of *Phytophthora betacei* are compared to those found in *P. ramorum* and other *Phytophthora* species.]

Resources

A webinar focusing on the current status of sudden oak death in California wildlands is now available**.** This recording of a California Oak Mortality Task Force Executive Committee, meeting held July 29, 2020, also features an update on *P. ramorum* on Japanese Larch in the UK and sudden oak death in Oregon.

Public perceptions of tree pest concerns are presented in "The Nature Conservancy's Don't Move Firewood Campaign: An Analysis of the 2005-2016 Survey Data" (July 2020). After a decade of national public opinion polling, the authors conclude, "It appears that awareness surrounding forest health, forest insect and disease dispersal, and the movement of firewood is relatively low …". For sudden oak death, 72% of respondents had not heard the problem was infesting or killing trees.

CALENDAR

November 18-19, 2020. The 69th Annual Meeting of the California Forest Pest Council - 2020**,** online. More details will be available shortly or contact Kim Corella, Kim.Corella@fire.ca.gov.