CALIFORNIA OAK MORTALITY TASK FORCE REPORT
OCTOBER 2019

MONITORING

First detection of the sudden oak death pathogen in Del Norte County. *Phytophthora ramorum* has been isolated from two tanoaks (*Notholithocarpus densiflorus*), located among old-growth redwoods, in Jedediah Smith Redwoods State Park. The infected trees are about five miles east of Crescent City, and distant from known *P. ramorum* infestations--to the north, more than 20 miles from Curry County, Oregon and to the south, approximately 50 miles from infested sites in northern Humboldt County. Forest health specialists conducted follow-up testing on surrounding trees in the area but no additional cases of the pathogen were found.

Figure 1. Symptoms of *P. ramorum* infection on tanoak sampled from Jedediah Smith Redwoods State Park, Del Norte County.
Photo courtesy Matteo Garbelotto, UC Berkeley.

The samples were collected by Chris Lee, Cal Fire, as part of a SOD Blitz; the pathogen was cultured and identified by morphology and PCR, and genotyped as the NA1 strain, by Matteo Garbelotto's lab at UC Berkeley. The trees have been resampled by the County Agriculture Department and sent to the California Department of Food and Agriculture (CDFA) for confirmation. The detection needs official CDFA and USDA APHIS confirmation before it would trigger changes to the quarantine area; this find has no regulatory implications until the results are officially confirmed.

NURSERIES

California Department of Agriculture (CDFA) *P. ramorum* program update - Introduction of the Voluntary *Phytophthora ramorum* Pre-Quarantine Program. In September, the California Department of Food and Agriculture (CDFA) offered a voluntary inspection program specifically for *P. ramorum* to nurseries in counties not currently regulated for *P. ramorum*. The Voluntary *Phytophthora ramorum* Pre-Quarantine Program (PQP) requires the same inspection and sampling requirements as the Federal Domestic Quarantine 7 CFR 301.92. Participating nurseries with negative inspection results will avoid interruption of inter/intrastate shipping privileges of host and associated host plants if the partial state quarantine for *P. ramorum* expands to include their county. Inspections and sampling will be administered by county regulatory officials and samples will be processed by the CDFA Plant Pest Diagnostics Center. If *P. ramorum* is detected at a participating nursery, the PQP nursery may become a federally

regulated establishment and the USDA Official Regulatory Protocol for Nurseries Containing Plants Infected with *Phytophthora ramorum* Confirmed Nursery Protocol Version 8.2, including trace activities, would be initiated.

Oregon Department of Agriculture *P. ramorum* program update. By mid-August, all results for "*P. ramorum* in Commerce" trace investigations, related to Oregon, were finalized. Of the 48 samples that tested positive for the genus *Phytophthora,* a single *Rhododendron* 'Holden', from a retail nursery in Multnomah County, was confirmed positive for *P. ramorum*. Both the Oregon Department of Agriculture (ODA) and USDA-APHIS confirmed this positive sample, and the Confirmed Nursery Protocol has been completed. At the time of detection, the positive plant was in a discounted sale area and the nursery agreed to destroy it immediately. The plant was on a concrete floor, so no environmental water or soil samples were taken. No other host or associated plants (HAP) were located in the vicinity that would have otherwise been placed in a quarantine zone. All remaining HAP on the property were inspected, with eight *Rhododendron* plants sampled (varieties: Mary Ann, Manda Sue, Strawberry Chiffon, and Holden). During a follow-up inspection, it was found that all plants that were associated with the initial trace sampling had been destroyed, even though diagnostic tests for *P. ramorum* turned up negative.
One *Rhododendron* 'Holden' tested as inconclusive by the ODA and USDA-APHIS. Inconclusive results require a re-sampling and testing of the plant in question. Inspectors found that the inconclusive plant had already been destroyed by the grower. ODA plans to monitor this business by conducting monthly inspections.

Since the "*P. ramorum* in Commerce" announcement (July 2019), the ODA has seen a spike in *P. ramorum* Shipment Notifications sent out by the Cooperative Agricultural Pest Survey (CAPS) for the five host genera. ODA inspectors are following up on those shipments. Last week ODA received a trace-back notification of a positive *Rhododendron* 'Boursault' from Oklahoma. The plant was shipped from a nursery in Columbia County. The trace-back investigation is in progress. Compliance surveys for the fall 2019 season are scheduled to begin in early October. For more information, contact Chris Benemann, sbenemann@oda.state.or.us.

Washington State Department of Agriculture *P. ramorum* program update. In August, a Washington retail nursery had four Rhododendron samples confirmed positive for *P. ramorum.* The nursery was placed under the Confirmed Nursery Protocol and delimitation sampling found two additional positive Rhododendrons. All Rhododendrons on site were destroyed. Ground steaming of the container lot areas is planned for October. All of the positive Rhododendrons were traced to an out-of-state nursery.

During the first week of October, a Critical Control Points (CCP) assessment will be conducted at a Washington interstate shipping nursery found positive for *P. ramorum* in May. Required and voluntary mitigation for *P. ramorum* will be implemented to meet the requirements of a DA-2014-2 compliance agreement. An extensive fall certification survey is planned at the nursery for early October. For more information, contact Scott Brooks, SBrooks@agr.wa.gov.

Canadian Food Inspection Agency *P. ramorum* update. The Canadian Food Inspection Agency (CFIA) annual, national *Phytophthora ramorum* survey focuses on propagation facilities that produce high-risk hosts and wholesale facilities that grow high-risk hosts across Canada. In

these CFIA national nursery surveys, *P. ramorum* has only been detected in British Columbia. The 2019 national survey will conclude this fall and to date has detected *P. ramorum* at three nurseries.

In Canada, post-eradication monitoring is conducted at nurseries where *P. ramorum* was detected in the previous two years. Post-eradication surveys for 2019 are complete and resulted in the detection of *P. ramorum* at three nurseries. The CFIA "Regulatory Response Protocol for Nurseries Confirmed with *P. ramorum"* was implemented at all sites where the pathogen was detected. Trace investigations revealed that no trace-forward activities were required to the U.S. or to the rest of Canada.

Additionally, trace-back investigations were conducted from detections of *P. ramorum* at U.S. nurseries. Based on information provided by USDA-APHIS, CFIA conducted trace-back investigations at two Canadian nurseries. *P. ramorum* was not detected. CFIA has reviewed the investigation process and results with APHIS.

Last year, *P. ramorum* was detected at one nursery during the 2018 Canada *P. ramorum* national survey. Five nurseries are undergoing post-eradication monitoring. Eradication activities were implemented at each of the five sites.

See more information on CFIA's *P. ramorum* program HERE.

RESEARCH

Feia, S.; Morin, R.S.; Oswalt, C.M.; Liebhold, A.M. 2019. Biomass losses resulting from insect and disease invasions in US forests. Proceedings of the National Academy of Sciences. 116 (35):17371-17376. doi:10.4231/82EJ-B095.

Worldwide, forests are increasingly affected by nonnative insects and diseases, some of which cause substantial tree mortality. Forests in the United States have been invaded by a particularly large number (>450) of tree-feeding pest species. While information exists about the ecological impacts of certain pests, regionwide assessments of the composite ecosystem impacts of all species are limited. Here we analyze 92,978 forest plots distributed across the conterminous United States to estimate biomass loss associated with elevated mortality rates caused by the 15 most damaging nonnative forest pests. We find that these species combined caused an additional (i.e., above background levels) tree mortality rate of 5.53 TgC per year. Compensation, in the form of increased growth and recruitment of nonhost species, was not detectable when measured across entire invaded ranges but does occur several decades following pest invasions. In addition, 41.1% of the total live forest biomass in the conterminous United States is at risk of future loss from these 15 pests. These results indicate that forest pest invasions, driven primarily by globalization, represent a huge risk to US forests and have significant impacts on carbon dynamics. [*P. ramorum* is one of the 15 pests included in the study.]

Panda, A.; Chaudhari, N.M.; Mukherjee, M.; Ghosh, S.; Sarangi, A.N. and others. 2019. Genome/transcriptome collection of plethora of economically important, previously unexplored organisms from India and abroad. Data in brief. 25. doi.org/10.1016/j.dib.2019.104099.

Genome and transcriptome sequencing data are extremely useful resources for researchers in carrying out biological experiments that involves cloning and characterizing genes. We are presenting here genome sequence data from different clades of life including photosynthetic prokaryotes; oomycetes pathogens; probiotic bacteria; endophytic yeasts and filamentous fungus and pathogenic protozoa *Leishmania donovani*. In addition, we are also presenting paired control and treated stress response transcriptomes of Cyanobacteria growing in extreme conditions. The Cyanobacterial species that are included in this dataset were isolated from extreme conditions including desiccated monuments, hot springs and saline archipelagos. The probiotic *Lactobacillus paracasei* was isolated from Indian sub-continent. The Kala azar causing protozoan *Leishmania donovani*, whose early infectious stage is also included in this dataset. The endophyte *Arthrinium malaysianum* was isolated as a contaminant has significant bio-remediation property. Our collaborators have isolated endophyte *Rhodotorula mucilaginosa* JGTA1 from Jaduguda mines, West Bengal, India infested with Uranium. Our collaborators have isolated a heterozygous diploid oomycetes pathogen, *Phytophthora ramorum* causing sudden oak death in CA, USA coast is also part of the data. These dataset presents a unique heterogeneous collection from various sources that are analyzed using "Genome Annotator Light (GAL): A Docker-based package for genome analysis and visualization" and are presented in a web site automatically created by GAL at http://www.eumicrobedb.org/cglab.

Wong, B.; Leal, I.; Feau, N.; Dale, A.; Uzunovic, A.; Hamelin, R.C. ***Preprint.*** Molecular assays to detect the presence and viability of *Phytophthora ramorum* and *Grosmannia clavigera*. BioRxiv. doi: http://dx.doi.org/10.1101/736637.

To determine if living microorganisms of phytosanitary concern are present in wood after eradication treatment and to evaluate the efficacy of such treatments, the method of choice is to grow microbes in petri dishes for subsequent identification. However, some plant pathogens are difficult or impossible to grow in axenic cultures. A molecular methodology capable of detecting living fungi and fungus-like organisms in situ can provide a solution. RNA represents the transcription of genes and can therefore only be produced by living organisms, providing a proxy for viability. We designed and used RNA-based molecular diagnostic assays targeting genes essential to vital processes and assessed their presence in wood colonized by fungi and oomycetes through reverse transcription and real-time polymerase chain reaction (PCR). A stability analysis was conducted by comparing the ratio of mRNA to gDNA over time following heat treatment of wood infected with the Oomycete *Phytophthora ramorum* and the fungus *Grosmannia clavigera*. The real-time PCR results indicated that the DNA remained stable over a period of 10 days post treatment in heat-treated wood samples, whereas mRNA could not be detected after 24 hours for *P. ramorum* or 96 hours for *G. clavigera*. Therefore, this method provides a reliable way to evaluate the viability of these pathogens and test the effectiveness of existing and emerging wood treatments. This can have important phytosanitary impacts on assessing both timber and non-timber forest products of commercial value in international wood trade.

MANAGEMENT

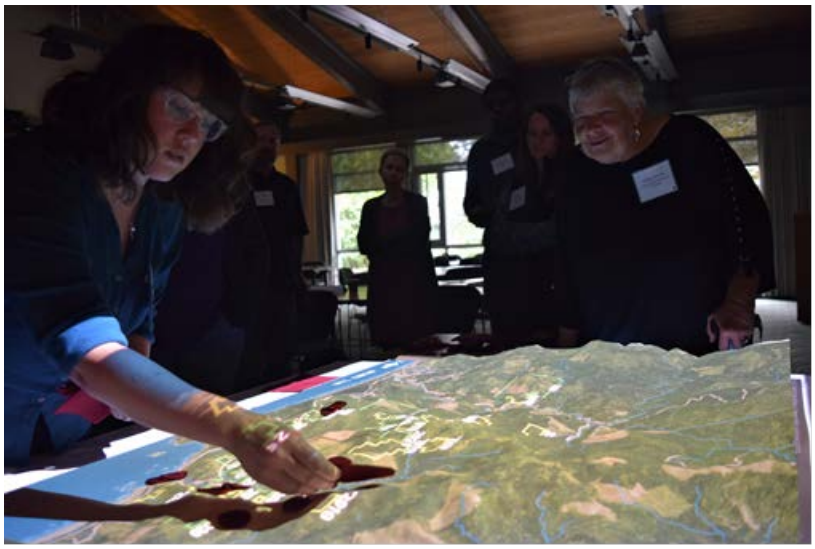

Figure 2. Sarah Navarro, Oregon Department of Forestry, compares outcomes of sudden oak death management approaches with Tangible Landscape.
Photo: Vaclav Petras, North Carolina State University.

Thirty-four representatives from the Oregon Sudden Oak Death Task Force joined forces to evaluate what-if scenarios of sudden oak death spread in Curry County at a Sudden Oak Death Management Scenarios Workshop in Salem, on September 10th, organized by researchers from The Center for Geospatial Analytics at North Carolina State University. On display were two interactive disease modeling technologies: Tangible Landscape, a tool that lets users collaboratively guide a disease simulation with their hands, and PoPS, a web platform for developing simulations and evaluating management scenarios. In addition to testing management strategies, the participants gave valuable feedback that will help guide the development of these two tools. For more information contact, Devon Gaydos, dagaydos@ncsu.edu.

RELATED RESEARCH

Harris, A.R.; Webber, J.F. 2019. Insights into the potential host range of *Phytophthora foliorum*. Forest Pathology. e12556. https://doi.org/10.1111/efp.12556.

Parke, J. L., Redekar, N.R.; Eberhart, J.L.; Funahashi, F. 2019. Hazard analysis for *Phytophthora* species in container nurseries: three case studies. HortTechnology. 29: https://doi.org/10.21273/HORTTECH04304-19.

Scott, P.; Bader, M. K.-F; Burgess, T.; Hardy, G.; Williams, N. 2019. Global biogeography and invasion risk of the plant pathogen genus *Phytophthora*. Environmental Science and Policy. 101: 175–182.

Simler-Williamson, A.B.; Rizzo, D.M.; Cobb, R.C. 2019. Interacting Effects of Global Change on Forest Pest and Pathogen Dynamics. Annual Review of Ecology, Evolution, and Systematics. 50: 16.1–16.23.

Thakur, M.P.; van der Putten, W.H.; Cobben, M.M.; van Kleunen, M.; Geisen, S. 2019. Microbial invasions in terrestrial ecosystems. Nature Reviews Microbiology. 17: 621–631.

RESOURCES

Parke, J.L.; Peterson. E.K. 2019. Sudden oak death, sudden larch death, and ramorum blight. The Plant Health Instructor. DOI: 10.1094/PHI-I-2019-0701-02.

IDphy: Molecular and morphological identification of *Phytophthora* based on the types includes fact sheets, photos, molecular and morphological tools to aid in identification of 161 culturable species of *Phytophthora.* The web tool facilitates accurate identification of *Phytophthora* to species, using type specimens from the original descriptions for reference wherever possible. It includes a fact sheet on *P. ramorum* and other species of high economic impact and regulatory concern for the U.S. IDPhy was developed by Dr. Gloria Abad, USDA APHIS Plant Protection and Quarantine, Beltsville Lab; the USDA Fort Collins Lab Identification Technology Program, and collaborators. For questions about content, contact Dr. Gloria Abad, gloria.abad@usda.gov. For questions about access or functionality, contact Amanda Redford, amanda.j.redford@usda.gov.

JOB OPENINGS

A postdoctoral scholar and a graduate student (PhD) position are now available in the laboratory of Dr. Jared LeBoldus, Oregon State University in Corvallis. Both positions will investigate *P. ramorum*, in southwestern Oregon and California, to develop approaches to mitigate the impacts of this exotic pathogen. Focus areas include host-parasite interactions, disease resistance, epidemiology, and population genomics. The PhD position would begin September 2020 or sooner depending on the availability of the candidate. For more information, contact jared.leboldus@oregonstate.edu.

CALENDAR OF EVENTS

November 13 -14, 2019. California Forest Pest Council (CFPC) 2019 Annual Meeting, UC Davis. "Forest Health Management: Technological and Conventional Approaches" is the theme of the 68th CFPC Annual Meeting. Registration is now open and the agenda is available online HERE.