

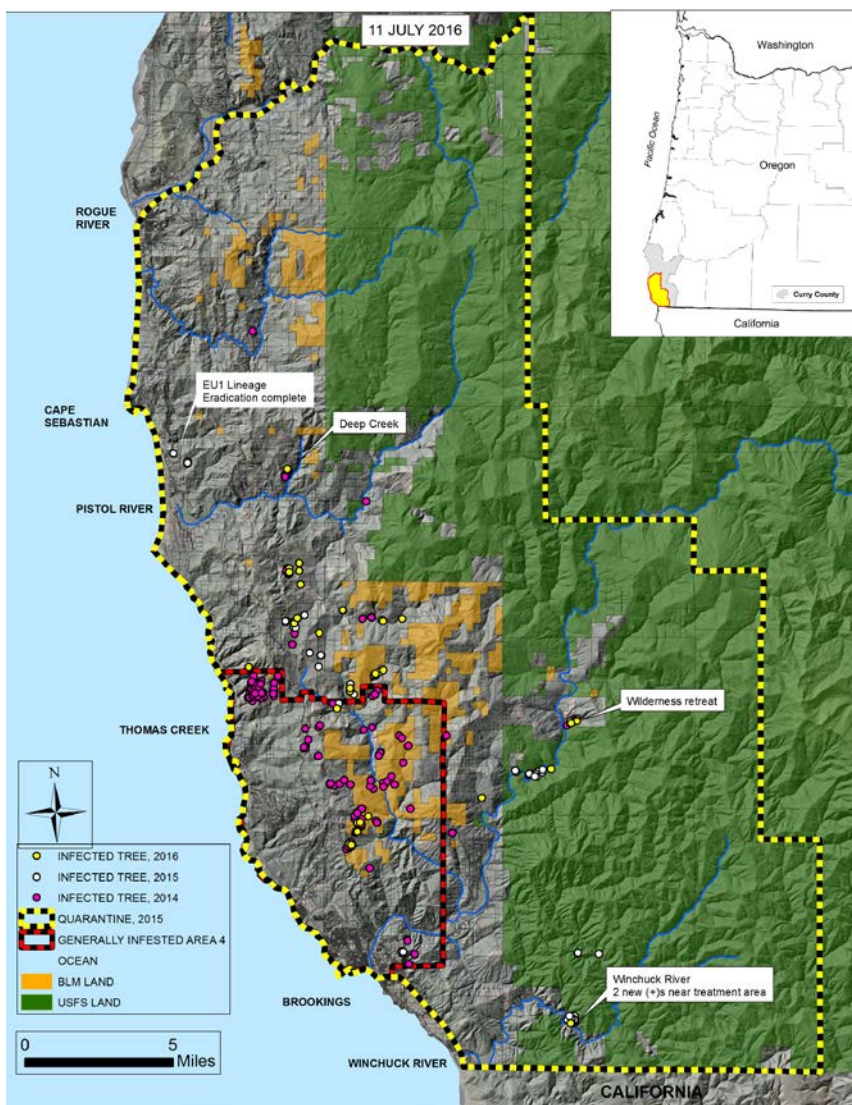


CALIFORNIA OAK MORTALITY TASK FORCE REPORT JULY 2016

MONITORING

Nine eastern states are participating in the 2016 National *Phytophthora ramorum* Early Detection Survey of Forests (AL, FL, GA, MS, NC, PA, SC, TN, and TX). Of the 308 samples collected this spring, 126 have been analyzed. To date, six samples from two locations have been *P. ramorum* positive - three from AL (first detection in 2009) and three from MS (first detection in 2008). All positive samples were collected from streams associated with previously positive nurseries.

Oregon has had 20 new infestations detected in 2016 that are at or beyond the boundary of the Generally Infested Area (Figure 1), yet well within the quarantine boundary established in 2015. Delimitations of the new infestations are underway. Once completed, treatment priorities will be determined.





Ten western Washington waterways were baited for *P. ramorum* this spring; all were negative for the pathogen. Waterways sampled were in Clallam, Grays Harbor, Jefferson, King, Lewis, and Mason Counties. Two of the waterways had tested positive in previous years for the pathogen and were associated with previously positive nurseries. The other eight waterways have never been found positive and are not associated with previously positive nurseries.

FUNDING

The open period for submitting fiscal year (FY) 2017 Farm Bill suggestions to implement Plant Pest and Disease Management and Disaster Prevention Programs is from July 11 to August 19, 2016. There will be \$62.5 million available with at least \$5 million going to the National Clean Plant Network (NCPN). The open period for submitting NCPN project suggestions will be announced separately. The USDA Animal and Plant Health Inspection Service (APHIS) is soliciting suggestions earlier than last year in an effort to establish agreements with cooperators in the first and second quarters of the new fiscal year. This will allow cooperators to plan and conduct activities that need to start in the spring and early summer of 2017. Questions regarding the FY 2017 open period should be directed to farbillsection10007@aphis.usda.gov.

NURSERIES

Two CA interstate shipping nurseries were found *P. ramorum* positive during spring inspections. One *Loropetalum* plant was confirmed at a Santa Clara County facility. The confirmed nursery protocol (CNP) yielded no additional plant, water, or soil positives. The other nursery was in Sacramento County and was found to have positive *Loropetalum* plants and drainage water. Follow-up sampling yielded one additional positive *Loropetalum* sample. CNP is underway.

A retail nursery in Humboldt County was found with a *P. ramorum*-positive *Leucothoe* plant during a routine annual nursery inspection. This facility has previously been positive for the pathogen. CNP is underway; subsequent samples are still being processed. The nursery does not ship interstate.

Monthly surveys of the Kitsap County, WA botanical garden where *P. ramorum*- positive plants were detected throughout 2015 were conducted this spring. In April, a perimeter and riparian area survey was conducted in the outlying areas of the garden; all samples were negative. The May and June surveys near previously positive sites were also negative.

Samples collected at WA's two nurseries participating in the USDA APHIS *P. ramorum* interstate shipping certification program (opt-in nurseries) were negative for the pathogen during their spring certification surveys. A previously positive King County nursery (not participating in the USDA APHIS interstate shipping certification program) also completed its 2-year follow-up inspection as part of the confirmed nursery protocol. Samples were collected from both wholesale and retail areas of the nursery. All samples were negative for the pathogen.

**REGULATIONS**

As of June 1st, USDA APHIS revised conditions for the interstate movement of regulated soil from *P. ramorum* quarantined areas when the soil is moving to an APHIS-approved soil laboratory for physical or chemical analysis. This action removes the certification requirement and authorizes movement under a compliance agreement. The movement of bulk soil for other purposes (e.g., disposal, landscaping, use in potting media) is not included in this action and will continue to require certificates per the Code of Federal Regulations (7 CFR 301.92). This action does not include soil to be moved for the isolation of plant pests, which is regulated in accordance with 7 CFR, Part 330. For more information, go to

https://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/pdf_files/DA-2016-34.pdf.

USDA APHIS is seeking input on draft international phytosanitary standards for: international movement of seeds; national surveillance systems; arrangements for verification of compliance consignments; international movement of growing media in association with plants for planting; international movement of wood; international movement of vehicles, machinery, and equipment; temperature treatments as phytosanitary measures; glossary of phytosanitary terms; and diagnostic protocols for *P. ramorum*, *Fusarium circinatum*, and Candidatus *Liberibacter solanacearum*. These standards facilitate safe trade in plants and plant products, harmonize plant protection policies and practices among trading partners, and provide a critical framework for addressing phytosanitary trade issues and negotiating market access requests. U.S. input is important to ensure the development of technically sound standards and to advance U.S. harmonization goals. Comments are due August 26, 2016. For more information, go to <https://content.govdelivery.com/accounts/USDAAPHIS/bulletins/153e852> or contact Marina Zlotina at Marina.A.Zlotina@aphis.usda.gov.

The *P. ramorum* Safeguarding Working Group and the *P. ramorum* Regulated Plant Working Group met in June at the National Ornamental Research Site at Dominican University of California (NORS-DUC). The Safeguarding meeting provided the National Plant Board *P. ramorum* Committee members and state and plant protection and quarantine *P. ramorum* regulatory experts an opportunity to exchange and receive updates regarding positive nurseries, the implementation of the Federal Order (DA-2014-02), and protocols, including proposed protocols developed in response to a positive detection in a new, non-nursery location in 2015. The *P. ramorum* Regulated Plant Working Group met to finalize discussions on criteria proposed for the addition of new plant species to the USDA APHIS regulated *P. ramorum* host list. The meeting also resulted in the formation of a working group that will review plants currently on the regulated list.

RESEARCH

Due to the early call for FY2017 Farm Bill proposals, early draft research proposals are being accepted by NORS-DUC. As NORS-DUC is designed to facilitate research on quarantined soil-borne pathogens, all research must be reviewed to confirm the work



meets all federal and state permit requirements in advance of Farm Bill Committee reviews. Submitted draft proposals will remain completely confidential. Early submission will allow for researchers to make any necessary adjustments required for admission to NORS-DUC prior to proposal submission for Farm Bill funding. Proposals should be submitted by July 27th to Karen Suslow at karen.suslow@dominican.edu.

A patent (US 9,320,283 B2) has been approved for the use of *Trichoderma asperellum* to remediate *P. ramorum*-infested soil following evidence that a specific isolate of *T. asperellum* reduced *P. ramorum*-infested soil to non-detectable levels after 8 weeks under mock nursery conditions at NORS-DUC. Under greenhouse conditions, potting mix amended with *T. asperellum* significantly reduced the number of *Viburnum tinus* plants that had infected roots when compared to non-amended controls following *P. ramorum* soil inoculation. Infected roots in the amended substrates also had a significant reduction in secondary sporangia production measured in water run-off. This product will serve as another mitigation option for *P. ramorum*-positive nurseries. Information is being assembled for EPA registration to license its commercial and public use as a biological control agent against *P. ramorum*.

Cobb, R.C.; Meentemeyer, R.K.; and Rizzo, D.M. 2016. Wildfire and Forest Disease Interaction Lead to Greater Loss of Soil Nutrients and Carbon. *Oecologia*. pp 1-12. DOI: 10.1007/s00442-016-3649-7.

Abstract: Fire and forest disease have significant ecological impacts, but the interactions of these two disturbances are rarely studied. We measured soil C, N, Ca, P, and pH in forests of the Big Sur region of California impacted by the exotic pathogen *Phytophthora ramorum*, cause of sudden oak death, and the 2008 Basin wildfire complex. In Big Sur, overstory tree mortality following *P. ramorum* invasion has been extensive in redwood and mixed evergreen forests, where the pathogen kills true oaks and tanoak (*Notholithocarpus densiflorus*). Sampling was conducted across a full-factorial combination of disease/no disease and burned/unburned conditions in both forest types. Forest floor organic matter and associated nutrients were greater in unburned redwood compared to unburned mixed evergreen forests. Post-fire element pools were similar between forest types, but lower in burned-invaded compared to burned-uninvaded plots. We found evidence disease-generated fuels led to increased loss of forest floor C, N, Ca, and P. The same effects were associated with lower % C and higher PO₄-P in the mineral soil. Fire-disease interactions were linear functions of pre-fire host mortality which was similar between the forest types. Our analysis suggests that these effects increased forest floor C loss by as much as 24.4 and 21.3 % in redwood and mixed evergreen forests, respectively, with similar maximum losses for the other forest floor elements. Accumulation of sudden oak death-generated fuels has potential to increase fire-related loss of soil nutrients at the region-scale of this disease, and similar patterns are likely in other forests where fire and disease overlap.

Kasuga, T.; Bui, M.; Bernhardt, E.; Swiecki, T.; Aram, K.; Cano, L.M.; Webber, J.; Brasier, C.; Press, C.; Grünwald, N.J.; Rizzo, D.M.; and Garbelotto, M. 2016. Host-



Induced Aneuploidy and Phenotypic Diversification in the Sudden Oak Death Pathogen *Phytophthora ramorum*. BMC Genomics. 17:385. DOI: 10.1186/s12864-016-2717-z.

Abstract:

Background: Aneuploidy can result in significant phenotypic changes, which can sometimes be selectively advantageous. For example, aneuploidy confers resistance to antifungal drugs in human pathogenic fungi. Aneuploidy has also been observed in invasive fungal and oomycete plant pathogens in the field. Environments conducive to the generation of aneuploids, the underlying genetic mechanisms, and the contribution of aneuploidy to invasiveness are underexplored. We studied phenotypic diversification and associated genome changes in *Phytophthora ramorum*, a highly destructive oomycete pathogen with a wide host-range that causes Sudden Oak Death in western North America and Sudden Larch Death in the UK. Introduced populations of the pathogen are exclusively clonal. In California, oak (*Quercus* spp.) isolates obtained from trunk cankers frequently exhibit host-dependent, atypical phenotypes called non-wild type (*nwt*), apparently without any host-associated population differentiation. Based on a large survey of genotypes from different hosts, we previously hypothesized that the environment in oak cankers may be responsible for the observed phenotypic diversification in *P. ramorum*.

Results: We show that both normal wild type (*wt*) and *nwt* phenotypes were obtained when *wt P. ramorum* isolates from the foliar host *California bay (Umbellularia californica)* were re-isolated from cankers of artificially-inoculated canyon live oak (*Q. chrysolepis*). We also found comparable *nwt* phenotypes in *P. ramorum* isolates from a bark canker of Lawson cypress (*Chamaecyparis lawsoniana*) in the UK; previously *nwt* was not known to occur in this pathogen population. High-throughput sequencing-based analyses identified major genomic alterations including partial aneuploidy and copy-neutral loss of heterozygosity predominantly in *nwt* isolates. Chromosomal breakpoints were located at or near transposons.

Conclusion: This work demonstrates that major genome alterations of a pathogen can be induced by its host species. This is an undocumented type of plant-microbe interaction, and its contribution to pathogen evolution is yet to be investigated, but one of the potential collateral effects of *nwt* phenotypes may be host survival.

Potter, C. and Urquhart, J. *In press*. Tree Disease and Pest Epidemics in the Anthropocene: A Review of the Drivers, Impacts and Policy Responses in the UK. DOI: 10.1016/j.forpol.2016.06.024.

Abstract: The growing incidence of new tree pest and disease epidemics, many of them with the potential to radically reshape our native woodlands and forests, is closely linked to a significant upsurge in global trade and transportation in recent decades. At the same time, interventions designed to actually manage any pest and disease outbreaks that occur can reshape forest landscapes in a variety of ways. In this review-based paper we argue that disease-driven interactions between biology, public policy and human agency along



pathways of introduction and at outbreak sites will become increasingly common in the Anthropocene, where the latter is understood as an era in which human influence over non-human nature is ever more pervasive. We discuss the nature of these interactions in terms of the increased risk of disease introduction via various trade pathways and through the subsequent policy and behavioral responses to two disease outbreaks made by policymakers and stakeholders in the UK (*Phytophthora ramorum* and ash dieback (*Hymenoscyphus fraxineus*)). Human influence is evident both in terms of the underlying risk drivers and in the subsequent course and management of these and other outbreaks.

Rollins, L.; Coats, K.; Elliott, M.; and Chastagner, G. 2016. Comparison of Five Detection and Quantification Methods for *Phytophthora ramorum* in Stream and Irrigation Water. Plant Disease. 100(6): 1202-1211.

Abstract: Propagules of *Phytophthora ramorum*, the causal agent of sudden oak death (SOD) and ramorum blight, can be recovered from infested stream and nursery irrigation runoff using baiting and filtration methods. Five detection methods, including pear and rhododendron leaf baits, Bottle O' Bait, filtration, and quantitative polymerase chain reaction (qPCR) performed on zoospores trapped on a filter were compared simultaneously in laboratory assays using lab or creek water spiked with known quantities of *P. ramorum* zoospores. The detection threshold for each method was determined and methods that could be used to quantify zoospore inoculum were identified. Filtration and qPCR were the most sensitive at detecting low levels of zoospores, followed by wounded rhododendron leaves, rhododendron leaf disks, and pear baits. Filtration, qPCR, and leaf disks were able to quantify *P. ramorum* zoospores ranging from 2 to 451 direct-plate CFU/liter while wounded leaves and pear baits appeared to be better at detection rather than quantification. The ability to detect and quantify *P. ramorum* inoculum in water will assist scientists, regulatory agencies, and nursery personnel in assessing the risk of spreading *P. ramorum* in nurseries and landscape sites where untreated infested water is used for irrigation.

RELATED RESEARCH

Hubbart, J.A.; Guyette, R.; and Muzika, R.M. 2016. More than Drought: Precipitation Variance, Excessive Wetness, Pathogens and the Future of the Western Edge of the Eastern Deciduous Forest. Science of the Total Environment. Vol. 566-567: 463–467. Available online at <http://www.sciencedirect.com/science/article/pii/S0048969716310385>.

Lovett, G.M.; Weiss, M.; Liebhold, A.M.; Holmes, T.P.; Leung, B.; Lambert, K.F.; Orwig, D.A.; Campbell, F.T.; Rosenthal, J.; McCullough, D.G.; Wildova, R.; Ayres, M.P.; Canham, C.D.; Foster, D.R.; LaDeau, S.L.; and Weldy, T. 2016. Nonnative Forest Insects and Pathogens in the United States: Impacts and Policy Options. Ecological Applications. DOI: 10.1890/15-1176.1.

McKeever, K.M. and Chastagner, G.A. 2016. A Survey of *Phytophthora* spp. Associated with *Abies* in U.S. Christmas Tree Farms. Plant Disease. 100(6): 1161-1169.



Sanfuentes, E.; Fajardo, S.; Sabag, M.; Hansen, E.; and González, M. 2016.

Phytophthora kernoviae Isolated from Fallen Leaves of *Drymis winteri* in Native Forest of Southern Chile. Australasian Plant Disease Notes. 11: 19. DOI: 10.1007/s13314-016-0205-6.

Tkaczyk, M.; Kubiak, K.A.; Sawicki, J.; Nowakowska, J.A.; and Oszako, T. 2016.

The Use of Phosphates in Forestry. Forest Research Papers. 77(1): 76–81. DOI: 10.1515/frp-2016-0009.

MEETINGS

The “Sixth Sudden Oak Death Science Symposium: Biosecurity, Plant Trade, and Native Habitats,” held June 20-23rd at Ft Mason in San Francisco included over 170 participants. Thank you to everyone who attended. Presentations will be posted to the website (<http://ucanr.edu/sites/sod6/>) this month for those interested in accessing them. An online evaluation form is available for anyone wanting to provide meeting feedback at <http://ucanr.edu/survey/survey.cfm?surveynumber=18361>.

Presenters (oral and poster) are encouraged to publish their presentation in the symposium proceedings, which will be published (online only) by the USDA Forest Service Pacific Southwest Research Station. The submission deadline is July 29, 2016. Author instructions are available online at <http://ucanr.edu/sites/sod6/Proceedings/>. For questions, contact Katie Harrell at kpalmieri@berkeley.edu.

PERSONNEL

Amber Morris has left her position as the California Department of Food and Agriculture (CDFA) Environmental Program Manager to accept a promotion as the new CDFA Chief of the Medical Cannabis Cultivation Program. We wish her the best of luck! John Heaton has taken over Morris’ role as the Environmental Program Manager for *P. ramorum*. He can be reached at john.heaton@cdfa.ca.gov. Other personnel new to *P. ramorum* at CDFA include Terra Walber, Senior Environmental Scientist overseeing *P. ramorum*-related issues as well as other statewide projects (terra.walber@cdfa.ca.gov) and Carolyn Lambert, Environmental Scientist focusing on all *P. ramorum*-related issues, including questions regarding nurseries and regulations (carolyn.lambert@cdfa.ca.gov).

Ryan Porter has joined the Oregon Department of Forestry (ODF) staff in

Brookings as a SOD Forester. He has worked recently for ODF as a Forest Management Technician with the Forest Health Team. He joins Randy Wiese, SOD Forester, in Brookings as the local staff responsible for SOD survey, detection, and treatment in Curry County. He can be reached at ryan.c.porter@oregon.gov.

CALENDAR

7/29 – 6th Sudden Oak Death Science Symposium Proceedings submission deadline;

Author instructions are available at <http://ucanr.edu/sites/sod6/Proceedings/>. For more information, contact Katie Harrell at kpalmieri@berkeley.edu.