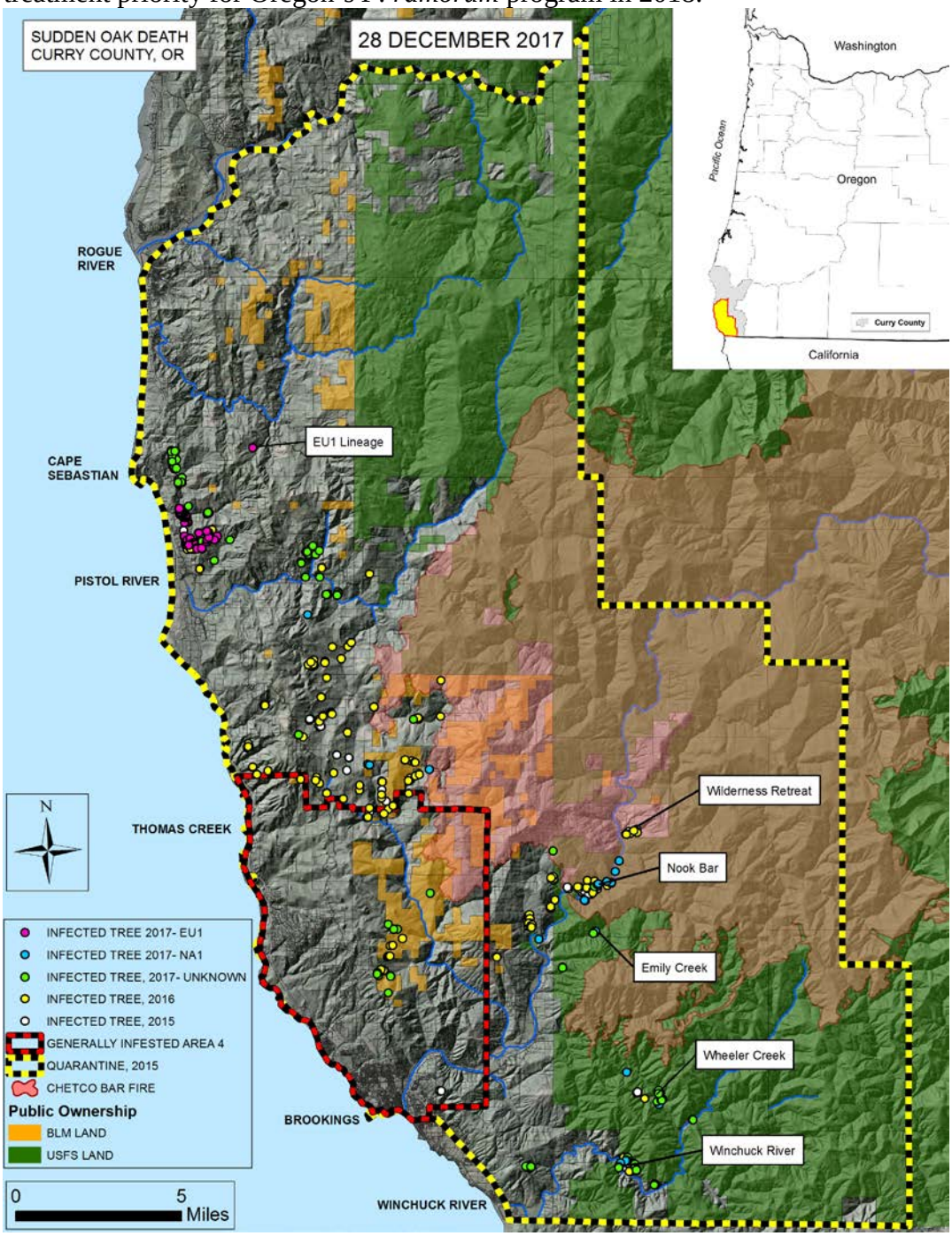
CALIFORNIA OAK MORTALITY TASK FORCE REPORT
JANUARY 2018

MONITORING

In 2017, Oregon detected 36 new *P. ramorum* infestations at or beyond the Generally Infested Area (GIA) boundary, but well within the 2015 established quarantine area (see map). The Oregon Department of Forestry has begun eradication treatments of 107 plants on the seven 2017 sites (over 330 acres) identified as having the EU1 strain. EU1 eradication is the top treatment priority for Oregon's *P. ramorum* program in 2018.



EDUCATION AND OUTREACH

Pencils made from a tanoak tree that had sudden oak death were featured at the opening of a School of the Art Institute of Chicago and University of Chicago art exhibit in Cleveland, Ohio on December 1st, 2017. Attendees learned about the origin of the pencils, sudden oak death, and issues surrounding global trade and invasive species spread as well as local immigration issues. They then used the pencils for the first time to write letters to local Congressional representatives encouraging immigration reform.

Tanoak pencils. Photo by: K. Frangioso, UC Davis

The tanoak from which the pencils were made was removed from the UC Santa Cruz Landel Hill Big Creek Reserve (Big Sur) in 2015. Artists Sara Black and Amber Ginsburg had the 7,000 pencils made to be used in classrooms and at town hall meetings as a centerpiece of their *7000 Marks* project. The project was inspired by the 7,000 oak trees planted throughout Kassle, Germany in 1982 by the late German artist Joseph Beuyes as a call for environmental and social change. Paired and contrasted with stable basalt stones, Beuyes' trees were a symbol of change and growth. The intent of the *7000 Marks* project is also to inspire environmental and social change. Just as Beuyes' trees changed over time, so too will the pencils. Each time someone uses one, they will learn about sudden oak death and the impacts of invasive species spread. For more information contact Kerri Frangioso at kfrangioso@ucdavis.edu.

Sudden oak death collaborators in the north coast plan to host a one-day forest health information workshop in Eureka late this winter or early spring. Half the day's talks will focus on sudden oak death and half will address other forest health issues of interest to the region, including the threat of the goldspotted oak borer and invasive shot hole borers, Port Orford-cedar root disease, and more. Information on the training date and location will be available soon. For questions, contact Dan Stark at stark@ucanr.edu. Those interested can also monitor www.suddenoakdeath.org or www.cehumboldt.ucanr.edu for posting of the date and other details.

Washington State University Extension has posted "Ramorum Blight: A Washington Story" to YouTube at https://youtu.be/70pvsFZ_5Kc. The video chronicles the discovery of *P. ramorum* at the Kitsap County Botanical Garden in Washington and the collaborative steps taken to contain the pathogen and work toward its eradication.

NURSERIES

***P. ramorum* was not recovered from the 324 samples taken during the fall 2017 quarterly** survey of the Kitsap County Botanical Garden in Washington (first found positive in 2015). The two-day survey included sampling previously positive areas of the garden as well as a large buffer area (approximately ¼ mi), which includes the adjacent woodland. Water baiting at nine locations throughout the garden was also negative for the pathogen.

RESEARCH

Cobb, R.C.; Hartsough, P.; Frangioso, K.; Klein, J.; Swezy, M.; Williams, A.; Sanders, C.; Frankel, S.J.; and Rizzo, D.M., 2017. Restoration Management in Redwood Forests Degraded by Sudden Oak Death. Gen. Tech. Rep. PSW-GTR-258. Albany, CA: US Department of Agriculture, Forest Service, Pacific Southwest Research Station. pp.429-434.

Abstract: We describe the foundation, objectives, and initial results from a stand -level experiment focused on restoration of redwood (*Sequoia sempervirens* (D. Don) Endl.) forests impacted by sudden oak death (SOD), caused by *Phytophthora ramorum*. Our study stands were primed for heavy impacts by SOD. Extensive harvesting which ended circa 1910 on Mt Tamalpais (Marin County, California) resulted in high densities of tanoak trees with interspersed residual redwood. The arrival of *P. ramorum* and subsequent emergence of SOD transformed these stands into tanoak shrublands with interspersed redwood trees. Pretreatment understory tanoak densities were extremely high relative to redwood forests of the north coast which have not been invaded by *P. ramorum* but both redwood advanced regeneration and overstory tree densities were low in the same respects. Mastication and hand -crew piling treatments were applied in 2015 on a randomly selected group of plots and each treatment type substantially reduced tanoak densities suggesting redwood establishment may now be possible. Our study is designed to assess tradeoffs of treatment costs with benefits resulting from fuels reduction, redwood regeneration, carbon sequestration, and water provisioning. We cannot yet make strong conclusions about these tradeoffs given the preliminary nature of our datasets. Instead, we describe areas of uncertainty and identify critical questions that must be evaluated to understand the utility and appropriateness of applying these treatments across a broader portion of the redwood forest landscape.

McCartney, M.M.; Roubtsova, T.V.; Yamaguchi, M.S.; Kasuga, T.; Ebeler, S.E.; Davis, C.E.; and Bostock, R.M., 2017. Effects of *Phytophthora ramorum* on Volatile Organic Compound Emissions of *Rhododendron* Using Gas Chromatography–Mass Spectrometry. Analytical and Bioanalytical Chemistry. pp.1-13.

Abstract: *Phytophthora ramorum* is an invasive and devastating plant pathogen that causes sudden oak death in coastal forests in the western United States and ramorum blight in nursery ornamentals and native plants in various landscapes. As a broad host-range quarantine pest that can be asymptomatic in some hosts, *P. ramorum* presents significant challenges for regulatory efforts to detect and contain it, particularly in commercial nurseries. As part of a program to develop new detection methods for cryptic infections in nursery stock, we compared volatile emissions of *P. ramorum*-inoculated and noninoculated *Rhododendron* plants using three gas chromatography–mass spectrometry methods. The first used a branch enclosure combined with headspace sorptive extraction to measure plant volatiles in situ. Seventy-eight compounds were found in the general *Rhododendron* profile. The volatile profile of inoculated but asymptomatic plants (121 days post-inoculation) was distinguishable from the profile of the noninoculated controls. Three compounds were less abundant in inoculated *Rhododendron* plants relative to noninoculated and mock-inoculated control plants. A second method employed stir bar sorptive extraction to measure volatiles in vitro from leaf extractions in methanol; 114 volatiles were found in the overall profile with 30 compounds less abundant and one compound more abundant in inoculated *Rhododendron* plants relative to mock-inoculated plants. At 128 days post-

inoculation, plants were asymptomatic and similar in appearance to the noninoculated controls, but their chemical profiles were different. In a third technique, volatiles from water runoff from the soil of potted healthy and inoculated *Rhododendron* plants were compared. Runoff from the inoculated plants contained four unique volatile compounds that never appeared in the runoff from mock-inoculated plants. These three volatile detection techniques could lead to innovative approaches that augment detection and diagnosis of *P. ramorum* and oomycete pathogens in nurseries and other settings.

Shamoun, S.; Rioux, D.; Callan, B.; James, D.; Hamelin, R.; Bilodeau, G.; Elliott, M.; Levesque, C.A.; Becker, E.; McKenney, D.; Pedlar, J.; Bailey, K.; Brière, S.C.; Niquidet, K.; and Allen, E.2017. An Overview of Canadian Research Activities on Diseases caused by *Phytophthora ramorum*: Results, Progress and Challenges. Plant Disease. https://apsjournals.apsnet.org/doi/abs/10.1094/PDIS-11-17-1730-FE.

Abstract: International trade and travel are the driving forces behind the spread of invasive plant pathogens around the world, and human-mediated movement of plants and plant products is now generally accepted as the primary mode of their introduction, resulting in huge disturbance to ecosystems and severe socio-economic impact. Here, we report an overview of the Canadian research activities on *Phytophthora ramorum* (Werres, de Cock & Man in't Veld; Werres et al. 2001). Since the first discovery and subsequent eradication of *P. ramorum* on infected ornamentals in nurseries in Vancouver, British Columbia in 2003, a research team of Canadian government scientists representing Canadian Forest Service (CFS), Canadian Food Inspection Agency (CFIA) and Agriculture and Agri-Food Canada (AAFC) worked together over a 10-year period and have significantly contributed to many aspects of research and risk assessment on this pathogen. The overall objectives of the Canadian research efforts were to gain a better understanding of the biology, management options, host-pathogen interaction, and molecular diagnostics of *P. ramorum*. With this information it was possible to develop pest risk analyses and assess the environmental and economic impact and future research needs and challenges relevant to *P. ramorum* and other emerging forest *Phytophthora* spp.

Widmer, T.L.; Johnson-Brousseau, S.; Kosta, K.; Ghosh, S.; Schweigkofler, W.; Sharma, S.; and Suslow, K. 2017. Remediation of *Phytophthora ramorum*-Infested Soil with *Trichoderma asperellum* Isolate 04-22 under Ornamental Nursery Conditions. Biological Control. https://doi.org/10.1016/j.biocontrol.2017.12.007.

Abstract: *Phytophthora ramorum*-infested nurseries pose a risk in the artificial spread of this pathogen into unaffected wildlands. Maintaining a pathogen-free nursery can be difficult and expensive once *P. ramorum* is detected in the soil. Previously, *P. ramorum* was successfully remediated under greenhouse conditions by incorporating *Trichoderma asperellum* 04-22 (Ta 04-22) into potting mix. This study was conducted to validate these previous studies under common ornamental nursery practices. Over a 2-year period, microplots were inserted into artificially-infested *P. ramorum* field soil. The soil was treated with wheat bran colonized by Ta 04-22, a soil fungicide, or two biologically-based commercial products. After a 12-week period, the Ta 04-22 treatment was significantly different than the other treatments, except the fungicide treatment, reducing *P. ramorum* to non-detectable levels. Another trial, set up in the same manner, compared different formulations of Ta 04-22. After 12 weeks, there was no difference

between the colonized wheat bran formulation and the commercially-produced wettable powder. Both remediated *P. ramorum*-infested soil compared to the non-treated control. A separate trial was conducted in a commercial nursery where sections, naturally infested with *P. ramorum*, were placed under USDA/APHIS quarantine. The quarantine sections were treated with wheat bran colonized by Ta 04-22 or left non-treated as a control. After 5 weeks, samples were collected and baited with rhododendron leaves to detect *P. ramorum*. No *P. ramorum* was detected in the Ta 04-22-treated section. These results demonstrate that Ta 04-22 can be used as a biological control agent to remediate *P. ramorum*-infested soil under common nursery practices in an open environment.

RELATED RESEARCH

Brar, S.; Tabima, J.F.; McDougal, R.L.; Dupont, P.Y.; Feau, N.; Hamelin, R.C.; Panda, P.; LeBoldus, J.M.; Grünwald, N.J.; Hansen, E.M.; and Bradshaw, R.E. Genetic Diversity of *Phytophthora pluvialis*, a Pathogen of Conifers, in New Zealand and the West Coast of the United States of America. Plant Pathology. Accepted Author Manuscript. DOI: 10.1111/ppa.12812.

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Burgess, T.I.; Simamora, A.V.; White, D.; Wiliams, B.; Schwager, M.; Stukely, M.J.C.; and St. J. Hardy, G.E. 2018. New Species from *Phytophthora* Clade 6a: Evidence for Recent Radiation. Persoonia 41: 1–17. https://doi.org/10.3767/persoonia.2018.41.01.

Cobb, R.C.; Ruthrof, K.X.; Breshears, D.D.; Lloret, F.; Aakala, T.; Adams, H.D.; Anderegg, W.R.; Ewers, B.E.; Galiano, L.; Grünzweig, J.M.; and Hartmann, H., 2017. Ecosystem Dynamics and Management after Forest Die- Off: A Global Synthesis with Conceptual State-and- Transition Models. Ecosphere. 8(12).

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Engelbrecht, J.; Duong, T.A.; and vd Berg, N. 2017. New Microsatellite Markers for Population Studies of *Phytophthora cinnamomi*, an Important Global Pathogen. Scientific Reports. *7*(1): 17631.

Garbelotto, M. and Gonthier, P. 2017. Variability and Disturbances as Key Factors in Forest Pathology and Plant Health Studies. Forests. 8(11): 441. DOI: 10.3390/f8110441.

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Lee, C.; Valachovic, Y.; and Stark, D. 2017. The Political Ecology of Forest Health in the Redwood Region. Gen. Tech. Rep. PSW-GTR-258. Albany, CA: US Department of Agriculture, Forest Service, Pacific Southwest Research Station. pp.333-341.

Longmuir A.L.; Beech P.L.; and Richardson M.F. 2017. Draft Genomes of Two Australian Strains of the Plant Pathogen, *Phytophthora cinnamomi* [version 1; referees: 2 approved, 1 approved with reservations]. F1000Research. 6:1972. DOI: 10.12688/f1000research.12867.1.

Redondo, M.A.; Boberg, J.; Stenlid, J.; Oliva, J. 2018. Functional Traits Associated with the Establishment of Introduced *Phytophthora* spp. in Swedish Forests. Journal of Applied Ecology. https://doi.org/10.1111/1365-2664.13068

Sena, K.; Crocker, E.; Vincelli, P.; and Barton, C. 2018. *Phytophthora cinnamomi* as a Driver of Forest Change: Implications for Conservation and Management. Forest Ecology and Management. 409: 799-807.

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Widmer, T.L.; McMahon, M.; and Frederick, R. 2017. *Phytophthora stricta* Isolated from *Rhododendron maximum* in Pennsylvania. Plant Disease. https://doi.org/10.1094/PDIS-09-17-1435-PDN.

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Yang, X.; Tyler, B.M.; and Hong, C. 2017. An Expanded Phylogeny for the Genus *Phytophthora*. IMA FUNGUS. 8(2): 355-398.

CALENDAR OF EVENTS

2/1 – 2/3 – 2018 California Native Plant Society Conservation Conference; Los Angeles Airport Marriott; 5855 West Century Boulevard, Los Angeles; For more information, go to https://conference.cnps.org/.