CALIFORNIA OAK MORTALITY TASK FORCE REPORT
FEBRUARY 2020

RESEARCH

New findings concerning the origin of *Phytophthora ramorum* in north Vietnam have been published by Thomas Jung and associates in **Forests**. *P. ramorum* was detected in the Fansipan and Sau Chua Mountains in eight forest streams, with both the A1 and A2 mating types present. The lack of disease symptoms on potentially susceptible Ericaceae, Fagaceae, or Lauraceae suggests the pathogen is native there, in equilibrium with the northern Vietnamese vegetation as a consequence of long term co-evolution. Further support for *P. ramorum*'s origin being in Vietnam, or nearby, is the genetic variability in the sequences of the Vietnamese isolates. Because of the implications both for the origin of the pathogen and for international biosecurity, a detailed comparative phenotypic and molecular analysis of the *P. ramorum* isolates and the known EU1, EU2, NA1, and NA2 lineages is currently ongoing. Further surveys are recommended in areas with similar biogeography including southern Yunnan, northern Laos, and the eastern Himalayas.

The authors point out the biosecurity issues their findings highlight, stating, "… the annual importation of over three billion plants-for-planting into Europe, the large numbers of previously unknown *Phytophthora* species in natural and horticultural ecosystems being identified in Asia, South and Central America and the occurrence of at least 47 exotic *Phytophthora* species in European nurseries and associated outplantings represents a significant biosecurity risk for forestry, horticulture, and natural ecosystems in Europe and North America. Many recent epidemics of trees and horticultural crops have been caused by introduced pathogens that were previously unknown to science, probably due to the organisms being co-evolved and benign in their centers of origin. Although often introduced via the plants-for-planting pathway, none of them has ever been intercepted pre-emptively during routine phytosanitary controls at the ports of entry. Despite overwhelming scientific evidence, current sanitary and phytosanitary (SPS) protocols largely ignore the risks from unknown, benign, co-evolved and unescaped organisms. However, preventing further introductions of potentially harmful invasive Phytophthoras is a key issue for international forest biosecurity…" The researchers propose a global regulatory system with "a sophisticated pathway regulation approach using pathway risk analyses, risk-based inspection regimes and molecular high-throughput detection tools."

For further information, **Jung, T.; Scanu, B.; Brasier, C.M.; Webber, J. and others. 2020.** A survey in natural forest ecosystems of Vietnam reveals high diversity of both new and described *Phytophthora* taxa including *P. ramorum.* Forests. 11(1): 93; https://doi.org/10.3390/f11010093.

WILDLANDS

Sudden oak death (SOD)/*P. ramorum* in Oregon wildlands - 2019 summary. Since 2001, in Oregon, approximately 7,300 acres (2,954 hectares) have been treated to eradicate *P. ramorum* and slow its spread. Treatments include cutting and burning of infected host material and exposed hosts. From 2001 to 2009, treatments were conducted on all SOD infested sites across all land ownerships. In 2010, the Oregon SOD quarantine was revised to designate a Generally Infested Area (GIA) within the quarantine area where eradication treatment is no longer required. The GIA now covers 89 square miles (231 square kilometers) of disease establishment and

intensification within the quarantine area, approximately 14 miles (23 km) north-south and 9 miles (14 km) east-west. The current quarantine area for *P. ramorum* has reached 515 square miles (1,334 km^2), 31% of Curry County (fig. 1).

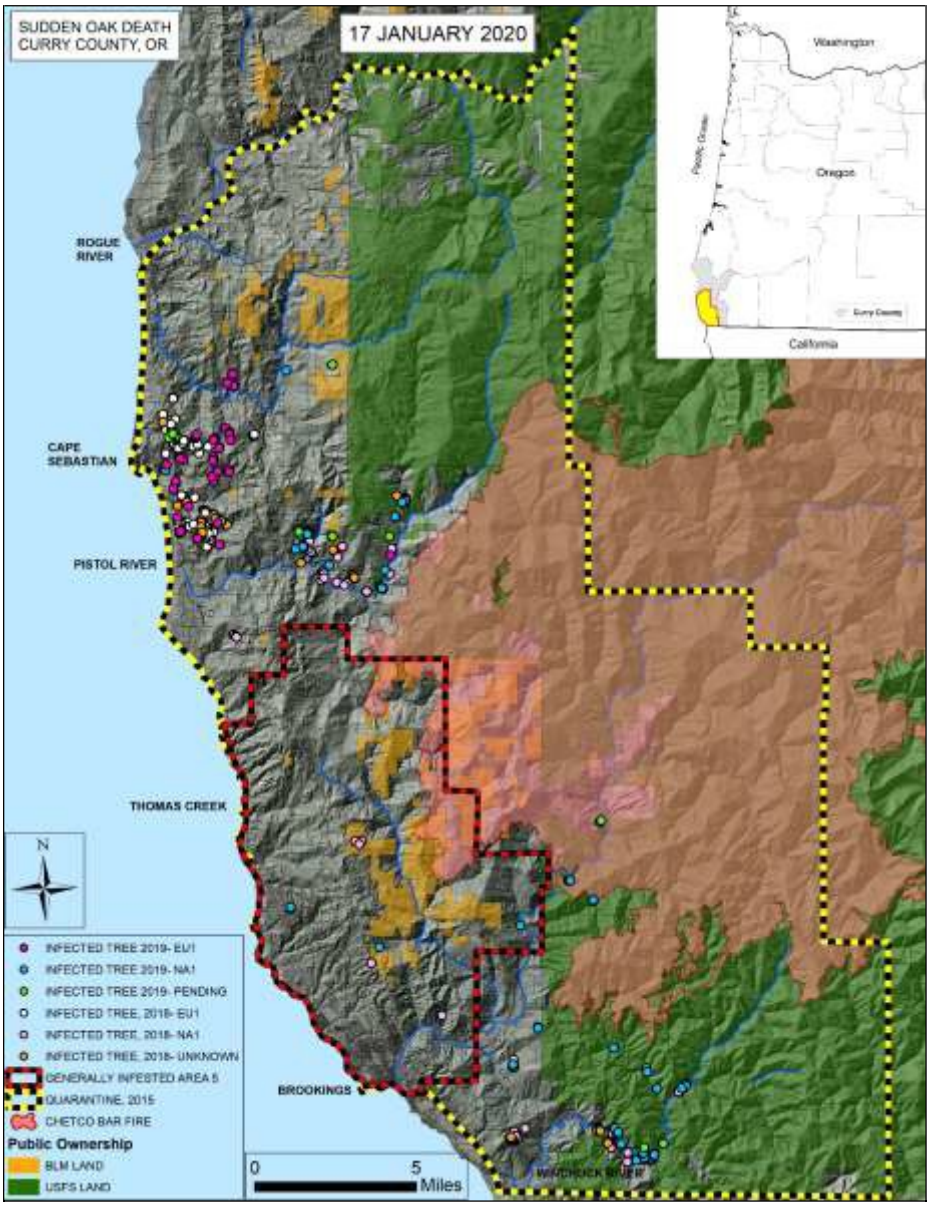

Figure 1. Current status of *P. ramorum* in Oregon wildlands

Since 2016, Oregon Department of Forestry (ODF) has given highest priority for treatment to sites with the EU1 lineage, treating priority NA1 sites when resources are available. ODF has recently started working with Natural Resources Conservation Service (NRCS) on an Environmental Quality Incentives Program (EQIP) project to treat EU1 sites and high priority NA1 sites. From 2018-2019, ODF treated 306 acres (124 ha) for SOD; the Bureau of Land Management (BLM) treated 249 acres (101 ha); and the US Forest Service (USFS) treated 128 acres (52 ha). ODF currently has 420 acres (170 ha) of SOD treatments in progress with plans to complete them in 2020. The treatments are located in three areas within the SOD Quarantine

zone: Myers/Hunter Creek drainages, Pistol River drainage, and the Winchuck River. For 2020, BLM plans to finish two 40 acre (16 ha) host removal areas in the Meyers Creek (EU1) and Pistol River drainages. The BLM also plans to respond and treat any new sites detected outside the GIA. The BLM is working to develop an effective way to deal with infested lands inside the GIA, as acreage exceeds funding and workforce capacity and much of the area is remote with limited road access. The BLM plans to continue surveying and monitoring and identify possible priority areas to treat (pending funding). For 2020, the USFS has 94 acres (38 ha) under consideration for treatment and anticipates the treatment acreage to increase to 150 acres (61 ha) as surveys are conducted throughout the year.

A SOD citizen science pilot project is monitoring *P. ramorum* in southern Oregon. For this collaboration between ODF and Norma Kline, Oregon State University Extension, volunteers set up monitoring bait stations, collected, recorded and sent samples to the OSU LeBoldus Forest Pathology lab for disease screening every two weeks for a three-month period. Citizen scientists deployed 20 bucket baits on 5 sites at the leading edge of the disease and baited 4 stream reaches in the first year. The second year of the project is currently underway.

On behalf of the Oregon SOD Task Force, ODF contracted with Highland Economics and Mason, Bruce and Girard to complete an economic assessment of SOD's impacts on Oregon forests and associated industries. The analysis found that up until now the disease has not had a significant impact on the Curry County economy. There has been no decline in timber harvest, export or log prices or on recreation or tourism revenue. However, it appears certain private properties where tanoaks (*Notholithocarpus densiflorus*) have died may have lost real estate value. The assessment concluded that current efforts are keeping the infestation's spread to between 0.5 - 4.5 miles (0.8 – 7.2 km) a year. With continued treatment, *P. ramorum*'s spread north of the Rogue River could be delayed until about 2028. Without any treatment, the disease would most likely appear north of the Rogue River just a few years from now (2023) and enter Coos County by 2028. Other impacts from discontinuing treatment that could happen as early as 2028 include:

- Sanctions on southwest Oregon timber exports by China, Japan, and/or Korea;
- Loss of 1,200 jobs related to timber export, translating to $57.9 million in lost annual wages;
- Reduction of timber harvest by 15%, with proportional loss of forest products harvest tax revenue, and forest sector jobs and wages;
- Collapse of rural property value and loss of real estate transaction revenues; and
- Decline in recreation and tourism income out of proportion to the extent of SOD infestation if an unfavorable public perception of the region takes hold.

The report also highlighted that the disappearance of tanoak from southwest Oregon forests is impacting the local ecology and Native American culture in ways not reflected in purely economic terms.

For more information, contact Sarah Navarro, Sarah.Navarro@oregon.gov.

SOD/*P. ramorum* in California wildlands--2019 summary. Outbreaks of SOD continued to cause high levels of mortality throughout much of the pathogen's known distribution in fifteen California coastal counties in 2019 (fig. 2). The USFS Pacific Southwest Region, Forest Health Monitoring aerial detection survey found tanoak mortality, attributed to SOD, remained highly elevated compared to the exceptional drought years from 2012-2016. A record wet spring in 2017 ended the drought but also provided conditions conducive to *P. ramorum* spread and infection. Following contagion, it takes one or more years for trees to die, so mortality continues to appear.

Figure 2. Sudden oak death mortality of tanoak in north coastal California in 2019.
Credit: USFS, PSW Region, Forest Health Protection.

For 2019, the aerial survey recorded an estimated 885,000 recently killed trees across 92,000 acres (37,231 ha), as compared to 2018, where about 1.6 million dead trees were observed across 106,000 acres (42897 ha). In comparison, approximately 21,000 dead trees were recorded across 18,000 acres (7284 ha) in 2017. Increases in tree mortality extent and severity were observed in the known infested areas along the Pacific Coast from Monterey County to Humboldt County. Note that these figures are based on aerial observations which only detect dead trees visible in the overstory tree canopy; understory tanoak are obscured so are not included in this estimate. Ground checks found tanoak saplings and seedlings in infested areas are also heavily infected and dying. For more information on the California Aerial Detection Survey, contact Jeff Moore, jeffrey.moore@usda.gov.

Ground-based observations in the north coast detected *P. ramorum* for the first time in trees in Del Norte County, in Jedediah Smith State Park near Mill Creek, a tributary to the main stem Smith River where a stream bait had yielded a PCR positive in 2012. At that time, the pathogen

was not isolated from the stream bait and the stream didn't subsequently test positive. The 2019 detection does not change the quarantine boundary since the samples were not collected by a regulatory official. Further sampling is planned for the area.

Notably, Monterey County exhibited intensified SOD tanoak mortality in 2019. The Big Creek, Mill Creek, Plaskett Creek, and Willow Creek watersheds showed levels of tree death comparable to those of the early 2000s, and increased coast live oak (*Quercus agrifolia*) mortality was also noted. Farther south, *P. ramorum* was recovered in the Santa Rita and San Simeon Creek drainages in San Luis Obispo County. Although these drainages are infested, San Luis Obispo County does not fall under quarantine because no terrestrial infections have been detected by the California Department of Food and Agriculture or County Agricultural officials.

EASTERN U.S. WILDLAND MONITORING

In 2019, 48 streams in seven eastern U.S. states (AL, FL, GA, MS, NC, SC, and TX) were surveyed in the USFS, Cooperative Sudden Oak Death Early Detection Stream Survey (table 1).

Table 1. Number of streams surveyed in eastern states for USDA-FS, Cooperative Sudden Oak Death Early Detection Stream Survey in 2019.

State	AL	FL	GA	MS	NC	SC	TX	Total
No. Streams	9	3	14	5	5	7	5	48

Of 495 baited stream samples, *P. ramorum* was detected from seven streams—five in Alabama, one in Mississippi, and one in North Carolina (fig. 3). All positive streams were associated with nurseries previously positive for *P. ramorum*.

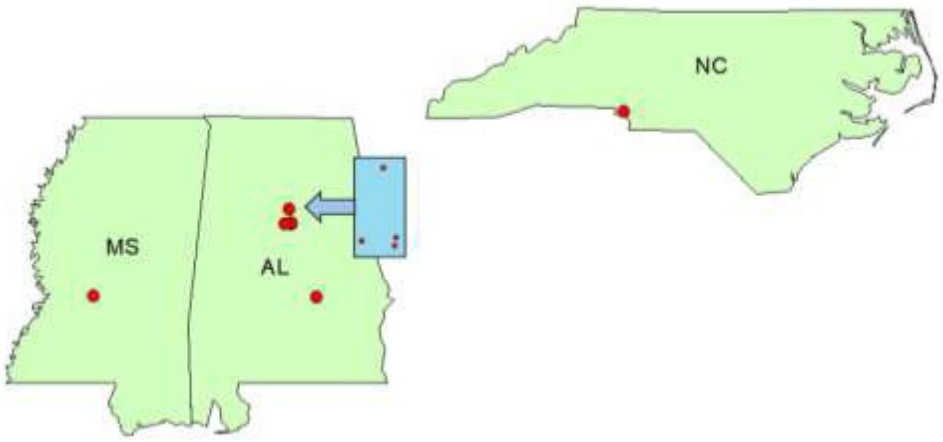

Figure 3. Location of streams in eastern states positive for *P. ramorum* from USFS, Cooperative Sudden Oak Death Early Detection Stream Survey in 2019.

For more information, contact Jaesoon Hwang, jaesoon.hwang@usda.gov.

NURSERIES

California Department of Food and Agriculture (CDFA) *P. ramorum* Program 2019 Summary. The CDFA receives funding from the United States Department of Agriculture (USDA) to administer the cooperative *P. ramorum* program. The CDFA assists and reimburses the County Agricultural Commissioners as they enforce Federal Domestic Quarantine 7 CFR 301.92 regulations at the 289 establishments regulated for *P. ramorum* in California (table 2). Program funding allocated to the CDFA for the *P. ramorum* program has not changed since fiscal year 2015-16.

Table 2. Establishments under compliance for *P. ramorum* in California

Establishment Type	Number of Establishments
Host/Nonhost Nursery Stock In Soil (*Exhibit B and Exhibit J)*	166
Greenery, Garlands, and Wreaths *(Exhibit D*)	9
Soil *(Exhibit F*)	1
Tree Farm *(Exhibit I*)	11
Wood and Wood Products *(Exhibit C*), Green Waste Origin Facility *(Exhibit E*), Compost Facility *(Exhibit G*), Green Waste Transporter *(Exhibit H*)	102
Total	**289**

Approximately 7,600 *P. ramorum* program regulatory samples were submitted to the CDFA Plant Pest Diagnostics Laboratory for processing in 2019. A total of 155 samples were determined to be positive for *P. ramorum*, 152 from leaves and three from soil. Positives were from the following hosts: *Arbutus marina, A. unedo, Camellia* sp*., Laurus nobilis, Loropetalum, Pieris* sp*., Rhododendron* sp. and *Viburnum* sp.

Table 3. *P. ramorum*-positive nurseries in California by year.

	Non-quarantine Counties		Quarantine Counties		Total
	Production	Retail	Production	Retail	
2019	2	3	5	5	15
2018	2	3	2	4	11
2017	1	3	5	7	16
2016	1			1	2
2015					0
2014	1				1
2013			1		1

Fifteen nurseries were confirmed positive for *P. ramorum* in California in 2019. This number is up from eleven positive nurseries in 2018 (table 3). The USDA Official Regulatory Protocol for Nurseries Containing Plants Infected with *Phytophthora ramorum* Confirmed Nursery Protocol (CNP) was implemented at all positive nurseries as directed by the CDFA Nursery Advisory No.

02-2018 (published May 2018). The CNP outlines vetted enforcement actions to prevent the further spread of *P. ramorum* through nursery stock trade, containing the protocols for delimitation, mitigation, and disposal of nursery stock, soil, and other articles at nurseries which are infested with or may have been exposed to *P. ramorum*.

At previously positive nurseries, the recently amended Federal Domestic Quarantine 7 CFR 301.92 requires enhanced biannual inspections including samples from soil and water. One interstate shipper was found to be positive for *P. ramorum* in 2019. The positive interstate shipper was previously positive and is already in compliance with quarantine regulations. This nursery will continue to receive biannual inspections. Four nurseries found to be newly positive for *P. ramorum* in 2019 will begin receiving biannual inspections in 2020. This brings the total number of California nurseries receiving biannual inspections to 10.

For more information, contact Carolyn Lambert, Carolyn.Lambert@cdfa.ca.gov.

Oregon Department of Agriculture (ODA) *P. ramorum* Program 2019 summary report.
In 2019, fourteen nurseries participated in the Oregon *Phytophthora ramorum* Certification Program. Of these, eight are interstate shippers regulated at the federal level (DA-2014-02). Six nurseries, intrastate shippers including one retailer, are regulated by Oregon state quarantine requirements (7 CFR 301.92 and OAR 603-052-1230). The fourteen nurseries are located in eight counties (Washington, Columbia, Tillamook, Marion, Multnomah, Lane, Lincoln, and Polk).

Four nurseries were confirmed positive for *P. ramorum* in Oregon in 2019. The nursery detections occurred at two interstate shippers (Washington and Marion Counties), one intrastate shipper (Marion County), and one retail nursery (Multnomah County). Over the summer, the retail nursery signed a state compliance agreement as a result of the nationwide "*P. ramorum* in Commerce" trace investigations. The interstate shipper in Marion County was confirmed positive as part of a traceback survey in December. This nursery will be surveyed under a federal compliance agreement in spring 2020.

Each positive location went through the USDA Confirmed Nursery Protocol (CNP) with all sampling completed and results finalized. In spring, two plants (*Camellia japonica* 'Nuccio's pearl' & *C. japonica* 'April Tryst') were confirmed *P. ramorum* positive. As part of the CNP, soil taken from underneath both the positive plants was found to be infested. The grower opted to destroy all plants within the destruction and quarantine zones by burning directly on top of the infested location. The soil was re-tested and no *P. ramorum* was detected. The grower added more gravel on top of the area and will leave this area fallow going forward.

A *Rhododendron* 'Holden' was confirmed positive at the retail nursery in Multnomah County. An additional *Rhododendron* 'Cunningham's blush' and soil were confirmed positive during the CNP surveys. The nursery destroyed all host material located in the block where the positives had been located. ODA staff is evaluating mitigation options to disinfest the soil. As a result of this positive find, a trace back survey was performed at a nursery in Marion County. In total, six *Rhododendron* spp. were confirmed positive. No infested soil or water were detected. The CNP has been completed and the grower is undergoing critical control point evaluations and grower

education training. Further investigation indicated that the grower likely bought in the infested plants several years ago. This was a first-time detection at this location.

Several positive plants were detected at a nursery in Washington County. In total, 22 plants were confirmed positive (20 *Gaultheria* spp., one *Arctostaphylos uva-ursi* "Vancouver', and one *Prunus laurocerasus*). Confirmed plants were located both outside and within greenhouses. Follow-up surveys have been completed and the grower destroyed all material both within destruction and quarantine zones. No additional positive plants were detected. Infested soil was confirmed, and ODA staff is evaluating mitigation options. Both *Gaultheria* spp. *and A. uva-ursii* were bought in from other nurseries.

Upon successfully fulfilling the program requirements, one nursery in Marion County was released from the *P. ramorum* certification program after nine years of inspections. To date, this is the third Oregon nursery to be released from the program.

Approximately 2,995 foliar, eleven soil, and seven water samples were submitted to the ODA Plant Health Laboratory for diagnosis (table 4). Samples were taken as part of compliance surveys, USDA Confirmed Nursery Protocol surveys, and the "*P. ramorum* in Commerce" trace investigations.

Table 4: Summary of samples submitted to the ODA Plant Health Laboratory in 2019.

	Compliance Survey	CNP Survey	Trace Survey	**Total**
Foliar	2,690	57	248	**2,995**
Soil	0	11	0	**11**
Water	4	2	1	**7**

Funding for the Oregon *P. ramorum* program is provided by the United States Department of Agriculture to cover costs associated with field operations, laboratory diagnostic work, and staff salaries. Funding has remained constant over the past several years, and no changes are anticipated for upcoming years. For more information, contact Chris Benemann, sbenemann@oda.state.or.us.

Washington State Department of Agriculture (WSDA) *P. ramorum* Program 2019 summary. In May 2019, WSDA conducted a trace-back investigation at a large wholesale shipping nursery. Samples collected from a *Rhododendron* 'Wojnar's Purple' were confirmed positive by the USDA and the nursery was placed under the Confirmed Nursery Protocol. Delimitation surveys throughout June and July uncovered 13 additional positive Rhododendrons and 2 positive *Kalmia*. All positive plants were destroyed by steam sterilization and the nursery voluntarily destroyed plants in the 10-meter quarantine radius and beyond. A Critical Control Points (CCP) assessment was performed in October by WSDA, USDA and Washington State University (WSU) personnel and a Federal compliance agreement for interstate shipping nurseries was signed. The nursery has implemented required mitigation for sanitation, plant handling and plant buy-ins. Throughout 2019, 54,210 plants were destroyed at the nursery, most

of those voluntarily. All confirmed positive plants at the nursery have been determined to be the NA2 lineage. Many of the positive *Rhododendron* varieties originated from a Canadian nursery. Trace back investigations by Canadian Food Inspection Agency (CFIA) at the Canadian nursery were negative. These positives are part of the "*P. ramorum* in Commerce" detections.

As a result of the positive wholesale nursery, WSDA conducted 54 trace forward inspections at receiving locations across Washington. Two retail nurseries were found to have infected plants. Both locations were placed under the retail Confirmed Nursery Protocol and both met the conditions for release by the end of 2019. Follow up inspections at all trace-forward sites will occur in 2020. Sample summary tables for Washington for 2019 are provided below (table 5).

Table 5. 2019 Sample Summary –Washington State

TOTAL SAMPLING IN 2019

Total number of regulatory samples collected (all sites)	3,444
Total number of nursery samples collected	2,445
Total number of non-nursery samples collected	999
Total number of confirmed positive samples (all sources 2019)	**45**

SAMPLING (Wholesale Nursery)

Total number of samples collected (Trace-Back, Delimitation, Perimeter, Certification)	2,365
Total number of confirmed positive plant samples	20
Total number of confirmed positive water samples	1

SAMPLING (Trace Forward Nurseries)

Total number of samples collected	80
Total number of confirmed positive plant samples	14
Total number of confirmed positive soil samples	2

SAMPLING (Botanical Garden)

Total number of samples collected	806
Total number of confirmed positive plant samples	0
Total number of confirmed positive water samples	6

SAMPLING (WA Department of Natural Resources Stream Baiting)

Total number of DNR stream baiting samples collected	87
Total number of DNR confirmed positive water samples	2

In 2019, WSDA inspected eight of the nine 'opt-out' nurseries. These are nurseries that 'opted-out' of the Federal DA-2014-2 regulations and can no longer ship interstate. Host material appeared free of symptoms, and no samples were collected. WSDA confirmed the nine 'opt-out' nurseries are not shipping interstate.

WSDA continues to assist the USDA at a botanical garden in Kitsap County found positive for *P. ramorum* in 2015. Two vegetation surveys were performed in 2019. Surveys were conducted

in areas near previous positive sites and in large buffer areas around previous positive sites. All plant samples collected were negative for *P. ramorum*. Six water baits from a small pond below the mitigated areas of the garden were confirmed positive in 2019. Water baiting and bi-annual vegetation surveys will continue in 2020. The last positive plant sample detected at this site was in February 2016.

In 2019, two stream baits from the Sammamish River in King County were confirmed positive for *P. ramorum*. The Washington Department of Natural Resources conducts stream baiting on various waterways in Washington; the Sammamish River has been positive since 2007.

For more information, Scott Brooks, SBrooks@agr.wa.gov.

2019 Federal and state cooperative *P. ramorum* nursery survey. In 2019, USDA APHIS and state cooperators conducted *P. ramorum* nursery surveys in 14 states (AL, KY, LA, MI, NC, NV, NY, OH, OR, PA, SC, TN, VA, WV). The survey funds, totaling $352,945, were awarded to states as part of the Plant Protection Act, Section 7721, formerly called "The Farm Bill".

REGULATIONS

The USDA APHIS posted "*Phytophthora ramorum* Domestic Regulatory Program Manual" First Edition, Issued 2020. The manual consists of 12 chapters explaining APHIS's *P. ramorum* protocols for inspection and sampling for nurseries, trace forwards and trace backs, confirmed nurseries, as well as background information and photos.

RESEARCH

Conrad, A.O.; Crocker, E.V.; Li, X.; Thomas, W.R.; Ochuodho, T.O.; Holmes, T.P. and Nelson, C.D. 2020. Threats to Oaks in the Eastern United States: Perceptions and Expectations of Experts. Journal of Forestry. 118(1): 14-27.

Tree species across the world are facing widespread mortality because of a range of biotic and abiotic threats. From the arrival of invasive species to changing climate patterns and increased drought, these threats can have devastating economic and ecological impacts. It is important to anticipate, prepare for, and guard against potential threats to key trees species. Oak species (*Quercus* spp.) are vitally important to the eastern United States, acting as essential components of forest ecosystems and timber markets. Better understanding of current and future threats to oaks is critical for informing research needs and prioritizing the actions of policymakers, regulators, and land managers. Results of this study suggest that forest researchers and policymakers should work with on-the-ground experts to monitor and manage current oak threats such as gypsy moth, oak wilt, sudden oak death, oak decline, or the introduction of some new currently unknown insect or pathogen. In the future, these and other threats should also be considered in light of a changing climate that may have impacts on oaks that are variable and hard to predict. Taking a proactive approach to ensuring long-term oak health is key to avoiding future problems from new or emerging threats.

Filipe, J.A.; Cobb, R.C.; Salmon, M.; Gilligan, C.A. 2019. Management strategies for conservation of tanoak in California forests threatened by sudden oak death: A Disease-Community Feedback Modelling Approach. Forests. 10(12): 1103.

We use a new modelling approach to predict the cumulative impact of *Phytophthora ramorum* on the dynamic distribution of tanoak (*Notholithocarpus densiflorus*) and other tree species in coastal-Californian forest-communities. We explore the effectiveness of disease-management strategies for the conservation of tanoak at stand level. Forest resources are increasingly threatened by emerging pathogens such as *P. ramorum*, a generalist that kills hosts and has altered ecosystems in the USA and Europe. In coastal California, *P. ramorum* has the greatest impact on tanoak through leaf sporulation and lethal bole infections, but also sporulates on the common overstory-tree bay laurel (*Umbellularia californica*) without significant health impact. Such epidemiological differences impede host-species coexistence and challenge pathogen management. For most disease-impacted natural systems, however, empirical evidence is still insufficient to identify effective and affordable pathogen-control measures for retaining at-risk host populations. Yet, landscape-scale tree mortality requires swift actions to mitigate ecological impacts and loss of biodiversity. We apply a mathematical model of the feedback between disease and forest-community dynamics to assess the impacts of *P. ramorum* invasion on tanoak under stand-scale disease-management strategies by landowners aiming to retain tanoak and slow disease progression: (1) removal of inoculum through reduction of bay laurel abundance; (2) prevention of tanoak infection through chemical protection (acting epidemiologically like a vaccine); and (3) a combination strategy. The model results indicate that: (1) both bay laurel removal and tanoak protection are required to help maintain tanoak populations; (2) treatment effectiveness depends on forest composition and on threshold criteria; (3) sustainable tanoak conservation would require long-term follow-up of preventive treatments; (4) arresting basal sprouting upon tree removal may help to reduce inoculum. These findings suggest potential treatments for specific forest conditions that could be tested and implemented to reduce *P. ramorum* inoculum and disease and to conserve tanoak at stand level.

Serrano, M.S.; Eyre, C.; Garbelotto, M. 2020. Epidemiology and microevolution of *Phytophthora ramorum* during a controlled disease outbreak in a simulated plant production facility. Plant Pathology. 69(2): 320-333.

Phytophthora ramorum outbreaks have been documented to occur in natural settings during favorable environmental conditions, and to be caused by the overdominance of highly infectious genotypes. However, little is known about the dynamics of outbreaks in nursery settings. Through the description and quantification of symptoms, as well as through systematic pathogen isolation and genotyping, this study examines the scale and dynamic of spread of four different genotypes of *P. ramorum* in soil, water and leaves among *Rhododendron* plants in a nursery setting. *Phytophthora ramorum* isolation success was highest from leaves and intermediate from soil, reaching peak values at the end of the wet-warm season. The observed disease outbreak was of moderate intensity, and abundance among the four genotypes used as inoculum varied, depending on substrate and isolation time. The spread mechanism of the disease was mostly through leaf-to-leaf contagion, followed by leaf-to-soil, and the scale of pathogen spread was less than 2 m in the 20 months of the experiment. Surprisingly, a large number of novel genotypes were detected during the experiment, and all were clearly derived from the four used as inoculum. The frequency of two such novel genotypes in the post-outbreak phase was

comparable to the frequency of some of the original four genotypes, suggesting they may be competitive. The creation of new genotypes in a nursery setting poses a threat to the industry itself, as well as to wildlands, due to the increase in pathogen adaptability often associated with new genetic variation.

Simler-Williamson, A.B.; Metz, M.R.; Frangioso, K.M.; Meentemeyer, R.K. and Rizzo, D.M. 2019. Compound disease and wildfire disturbances alter opportunities for seedling regeneration in resprouter-dominated forests. Ecosphere. 10(12): E02991. 10.1002/Ecs2.2991.

Human-altered disturbance regimes and changing climatic conditions can reduce seed availability and suitable microsites, limiting seedling regeneration in recovering forest systems. Thus, resprouting plants, which can persist in situ, are expected to expand in dominance in many disturbance-prone forests. However, resprouters may also be challenged by changing regimes, and the mechanisms determining facultative seedling recruitment by resprouting species, which will determine both the future spread and current persistence of these populations, are poorly understood. In the resprouter-dominated forests of coastal California, interactions between wildfire and an emerging disease, sudden oak death (SOD), alter disturbance severity and tree mortality, which may shift forest regeneration trajectories. We examine this set of compound disturbances to (1) assess the influence of seed limitation, biotic competition, and abiotic conditions on seedling regeneration in resprouting populations; (2) investigate whether disease-fire interactions alter postfire seedling regeneration, which have implications for future disease dynamics and shifts in forest composition. Following a wildfire that impacted a preexisting plot network in SOD-affected forests, we monitored seedling abundances and survival over eight years. With pre- and postfire data, we assessed relationships between regeneration dynamics and disturbance severity, biotic, and abiotic variables, using Bayesian generalized linear models and mixed models. Our results indicate that postfire seedling regeneration by resprouting species was shaped by contrasting mechanisms reflecting seed limitation and competitive release. Seedling abundances declined with decreasing postfire survival of mature, conspecific stems, while belowground survival of resprouting genets had no effect. However, where seed sources persisted, seedling abundances and survival generally increased with the prefire severity of disease impacts, suggesting that decreased competition with adults may enhance seedling recruitment in this resprouter-dominated system. Species' regeneration responses varied with their relative susceptibility to SOD and suggest compositional shifts, which will determine future disease management and forest restoration actions. These results additionally highlight that mechanisms related to biotic competition, seed limitation, and opportunities for seedling recruitment beneath mature canopies may determine possible shifts in the occurrence of resprouting traits. This result has broad applications to other systems impacted by human-altered regimes where asexual persistence may be predicted to be a beneficial life history strategy.

RELATED RESEARCH

Cacciola, S.O. and Gullino, M.L. 2019. Emerging and re-emerging fungus and oomycete soil-borne plant diseases in Italy. Phytopathologia Mediterranea 58(3): 451-472. doi: 10.13128/Phyto-10756.

Hamelin, R.C. and Roe, A.D. 2020. Genomic biosurveillance of forest invasive alien enemies: A story written in code. Evolutionary Applications. 13(1): 95-115.

Peterson, E K.; Rupp, F.; Eberhart, J.L.; Parke, J.L. First Look. Root rot of *Juniperus* and *Microbiota* by *Phytophthora lateralis* in Oregon horticultural nurseries. Plant Disease. https://doi.org/10.1094/PDIS-04-19-0808-RE.

Redekar, N.R.; Eberhart, J.L.; Rooney-Latham, S.; Blomquist, C.L.; Parke, J.L. First Look. First report of *Phytophthora tropicalis* causing foliar blight and shoot dieback of *Pieris japonica* in Oregon. Plant Disease. https://doi.org/10.1094/PDIS-10-19-2179-PDN.

RESOURCES

A website for SOD in Oregon is now available at https://www.oregonsod.org/. The site contains a map, management recommendations, photos and reports by the Oregon Sudden Oak Death Task Force, representing over 40 organizations working to protect Oregon against *P. ramorum*.

OTHER PHYTOPHTHORAS - RESOURCES

Note. We're expanding the COMTF Newsletter to include information on other *Phytophthora* species (in addition to *P. ramorum*) provided by the Phytophthoras in Native Habitats Work Group. For more background on *Phytophthora* detections in restoration areas, native plant nurseries and wildlands see http://www.suddenoakdeath.org/welcome-to-calphytos-org-phytophthoras-in-native-habitats/.

A list of **publications on *Phytophthora* species in nurseries, restoration areas or wildlands** has been posted at http://www.suddenoakdeath.org/welcome-to-calphytos-org-phytophthoras-in-native-habitats/. This is a companion to our *P. ramorum* bibiliography of sudden oak death related-publications.

Updated instructions for how to conduct leachate baiting tests for *Phytophthora* detection on container nursery stock are now available at http://phytosphere.com/BMPsnursery/test3_4bench.htm. This irrigation-based test is recommended for use to monitor plant health in the Phytophthoras in Native Habitats Work Group best management practices for restoration nurseries. Information on pear baiting (http://phytosphere.com/soilphytophthora/pearbaitingPhytophthora.htm), and the zoospore collection system (http://phytosphere.com/gear/zoosporecollector.htm) have also been posted on the Phytosphere Research website.

Events - OAK HEALTH WORKSHOPS

Oak health workshops will be held Monday, April 20 (UC Hopland Research and Extension Center, Mendocino County) and Tuesday, April 21 (Sonoma State University Fairfield Osborn Preserve, Sonoma County). In these free workshops, oak researchers and educators will present the latest information on a variety of oak-related topics ranging from oak woodland conservation to sudden oak death to a new pest of valley oak (*Quercus lobata*) and blue oak (*Quercus douglasii*). These workshops, organized by UC Cooperative Extension and CAL FIRE, are intended for anyone interested in working with and learning more about California's native oaks and tanoaks, including private landowners, public and private land managers, agency personnel, and the general public. The workshops will run from 9 am to 1:30 pm and encompass both indoor presentations and short outdoor demonstration walks. For more information, contact Kerry Wininger (kwininger@ucanr.edu; 707-888-5616) or Chris Lee (christopher.lee@fire.ca.gov; 707-726-1254).