SUDDEN OAK DEATH AND *PHYTOPHTHORA RAMORUM*
A COMPENDIUM OF 2013 MONTHLY NEWSLETTERS

PRODUCED BY
THE CALIFORNIA OAK MORTALITY TASK FORCE

Katie Palmieri, California Forest Pest Council, California Oak Mortality Task Force, UC Berkeley Center for Forestry

Susan J. Frankel, Sudden Oak Death Research
US Forest Service, Pacific Southwest Research Station, Albany

The California Oak Mortality Task Force (COMTF) is a volunteer coalition of research/educational institutions, public agencies, non-profit organizations, and private interests. Its primary purpose is to coordinate a comprehensive and unified program of research, management, monitoring, education, and public policy addressing elevated levels of oak mortality in California resulting from *Phytophthora ramorum*, cause of Sudden Oak Death and other diseases.

The Task Force was formed in August 2000 by joining two emerging efforts to address Sudden Oak Death statewide: 1) a resolution of the California Forest Pest Council (CFPC) and 2) an initiative from the California Department of Forestry and Fire Protection (CAL FIRE). The Task Force is overseen by the California Board of Forestry and Fire Protection and the Resources Agency. It is also a task force of the CFPC.

Cover Photo: Pt. Reyes National Seashore, Marin County, 2013 oak and tanoak mortality caused by sudden oak death
Credit: USDA Forest Service, Pacific Southwest Region, Forest Health Protection

TABLE OF CONTENTS

Phytophthora ramorum and Sudden Oak Death
2013 Significant Events

- The USDA FS 2013 annual aerial detection survey for California mapped 294,000 recently dead oak (*Quercus agrifolia*) and tanoak (*Notholithocarpus densiflorus*) trees over 47,500 acres in areas impacted by SOD.

- In 2013, eighteen nurseries were found *Phytophthora ramorum* positive in the US: CA(1), OR(10), WA(6), and NY(1), the lowest number since 2002.

- Federal regulations for the interstate movement of nursery stock from nurseries located in the regulated areas of CA, OR, and WA that do not contain nor ship host or associated plant nursery stock are no longer required to comply with Federal Regulation 7CFR 301.92.

- USDA APHIS added *Gaultheria procumbens* (eastern teaberry) to the list of *P. ramorum* regulated host plants.

- Two new *P. ramorum*-positive waterways were identified in western WA - the Dungeness River on the Olympic Peninsula (Clallam Co.) and Woodard Creek near Olympia (Thurston Co.). The inoculum source for Dungeness River is unknown.

- A new *P. ramorum*-positive waterway was confirmed outside of a Houston, TX nursery.

- Oregon's *P. ramorum* quarantine area increased to 264 mi^2, leading to the amendment of the OR quarantine since eradication was no longer deemed achievable.

- The pathogen continued to spread in CA, most notably:
  - *P. ramorum* was detected on Jackson State Demonstration Forest (Mendocino Co.) for the first time.
  - Kruse Rhododendron State Natural Reserve and Salt Point State Park (Sonoma Co.) watersheds were confirmed *P. ramorum* positive.
  - *P. ramorum* was confirmed on California bay laurel (*Umbellularia californica*) within 1.1 miles of the Six Rivers National Forest and 1.7 miles of the Trinity Co. line.

- The UK 2013 aerial survey revealed significant new areas of *P. ramorum*-infected Japanese larch, particularly in Wales and southwest Scotland. UK Forestry Commission updated its *P. ramorum* larch outbreak map to include Northern Ireland. A Galloway Red Zone in southwest Scotland was created to denote a region where the rate and severity of disease spread is too intense for control through tree felling. Control by statutory plant health notices requiring sanitation felling will continue elsewhere in Scotland and other areas of the UK.

MONITORING

***Phytophthora ramorum* was found on Japanese larch (*Larix kaempferi*) in Glen Dye,** east Scotland, for the first time in January. While it is unknown how the pathogen arrived at the location, there is suspicion that it may have been moved unintentionally on vehicles. The outbreak was far from the nearest known infected larch, and caused concern because the pathogen had previously been confined to the west coast of Scotland where conditions are wetter and more suited for disease establishment. There are now 137 positive larch sites in Scotland impacting approximately 1,038 acres. (3/13)

Texas cooperators in the National *P. ramorum* Early Detection Survey of Forests identified a new positive waterway outside a Houston nursery. This was the first new positive site of the 2013 survey year and the second new site in the Houston area in the past 3 months. A second, separate positive was also obtained in February from a site first identified positive in December 2012. All three positives were obtained from stream baiting. (5/13)

SODMAP mobile is an app available for free at the Apple App Store that is intended for field use and allows the user to identify the locations of trees sampled for *P. ramorum* and determine the health of each tree at the time of sampling. The app also can calculate the risk of infection at the location where the user is by using the number of sampled trees in the area and proximity of positive trees. High- or moderate-risk ratings indicate action may be needed to preventively protect oak trees; however, other factors must be taken into consideration, such as host distribution, weather patterns, and land management goals. (5/13)

Sudden oak death continued to be the primary cause of tree mortality in coastal CA from Monterey Co. north to Humboldt Co., according to 2013 USFS aerial summer surveys. Tanoak mortality was severe in the Santa Cruz Mountains as well as along the coast in Sonoma, Marin and Monterey Cos., with the worst impacted areas in Jenner/Guerneville (Sonoma Co.) and Big Sur and Mill Creek (Monterey Co.). Less severe areas of tanoak mortality were seen in coastal Mendocino Co.; however, new pockets of mortality were seen in and near Fort Bragg. Intense coast live oak mortality was mapped in the Oakland hills (Alameda Co.) and east of Watsonville (Santa Cruz Co.), about 9 miles from the closest SOD confirmation. No tanoak mortality was observed in Del Norte Co. (7/13)

***Phytophthora ramorum*-positive tanoak and California bay laurel trees were** identified as close as 1.1 miles from the Six Rivers National Forest (SRNF) boundary and 1.7 miles from the Trinity Co. line. The confirmations were within patches of tanoak mortality delineated by the 2012 aerial survey and from an adjacent area approximately 1/3 of a mile away. Preliminary 2013 aerial surveys identified more patches of tanoak mortality consistent with SOD within 1.5-2 miles from where ground sampling was done, and as close as 0.4 miles from the SRNF boundary.

Stream baiting in 2013 at the mouth of north Dobbyn Creek from February through May confirmed that the watershed containing the dead tanoak was positive for the pathogen, and in May, ground surveys of two of the larger mortality patches confirmed *P. ramorum* presence, making this the eastern front of the Humboldt Co. infestation. The pathogen was also detected further north in the Larabee Creek corridor, approximately 7.5 miles south of the town of Bridgeville. (7/13)

Intensive sampling in the South Fork of the Noyo River (SFNR) watershed during the 2013 *P. ramorum* stream monitoring season led to the first *P. ramorum* culture-positive water sample in Jackson Demonstration State Forest (JDSF) (in April 2013). Specifically, pathogen presence was confirmed in the North Fork of the SFNR and Peterson Gulch drainages. Parlin Creek, which tested PCR positive in 2012, remained negative for the pathogen via culturing techniques during the 2013 monitoring season. *Phytophthora ramorum* was first detected via culturing methods from a JDSF waterway sample collected in April 2012 from the SFNR.

Early results from UK 2013 aerial survey revealed significant new areas of *P. ramorum*-infected Japanese larch, particularly in Wales and southwest Scotland. Most were contiguous with existing known areas of infection. Initial estimates included approximately 6,178 acres in Wales and 4,942 acres in Scotland. England had a more modest increase, with approximately 988 new acres of infection. Factors that likely contributed to the significant increases were unusually wet and windy weather throughout 2012 as well as the inability to complete required sanitation felling in previous years in some locations. (7/13)

***Phytophthora ramorum* continued to spread on Japanese larch (*Larix kaempferi*) in** Wales according to 2013 summer surveys. Initial results indicated that nearly 4,450 acres of new infection were identified and included further areas within South Wales. Infected larch have been found in all four UK countries as well as the Republic of Ireland. Since 2009, approximately 8.5 million infested Japanese larch trees over nearly 22,000 acres (England - 6,300; Scotland - 1,120; Wales - 12,445; Northern Ireland - 1,567) have been, or are in the process of being, felled in the UK. (9/13)

The USFS PSW Region, Forest Health Protection 2013 aerial survey final flyover was completed in September and covered areas of the Klamath, Shasta-Trinity, and Mendocino National Forests as well as private lands in Humboldt and Mendocino Cos. In total, the aerial survey identified more than 294,000 dead trees on approximately 47,500 acres. While slightly lower than 2012 totals, elevated mortality levels did continue into 2013. (11/13)

The UK Forestry Commission updated its *P. ramorum* larch outbreak map to include Northern Ireland. The Galloway Red Zone in southwest Scotland has also been added to the map. The Red Zone is the region of Scotland where the rate and severity of disease spread is too intense for control through tree felling; consequently, this region will have requirements put in place regarding the movement of infected timber and bark.

Control by statutory plant health notices requiring sanitation felling will continue elsewhere in Scotland. (11/13)

In 2013, 136 CA waterway sites distributed throughout Del Norte, Humboldt, Mendocino, Sonoma, Monterey, San Luis Obispo, and San Benito Cos. were monitored for *P. ramorum.*

In Humboldt Co., *P. ramorum* was detected for the first time in Roaring Gulch, an upper tributary of Redwood Creek in Redwood Valley. In the McKinleyville area, a new site on Widow White Creek (located upstream from all but two residences on the creek) tested positive for *P. ramorum*, and in southern Humboldt Co., a new site along the southwestern border of the Six Rivers National Forest (North Dobbyn Creek) was consistently positive.

In Mendocino Co., a new site on a tributary of the South Fork of the Eel River (Hollow Tree Creek) tested *P. ramorum* positive once in March and in JDSF the pathogen was recovered from the North Fork of the South Fork of the Noyo River and from a small tributary of the South Fork of the SFNR (Peterson Gulch). The Little North Fork of the Big River, sampled in Mendocino Woodlands State Park, tested *P. ramorum* positive for the first time in May and June.

In Sonoma Co., multiple watersheds in the Kruse Rhododendron State Natural Reserve and Salt Point State Park were sampled in response to a terrestrial *P. ramorum* detection in 2012. *P. ramorum* was recovered from all sampled waterways.

There were no new positive water confirmations in Monterey Co. In 2012, *P. ramorum* was detected through PCR-based diagnostics in San Carpoforo Creek, a watershed spanning both Monterey and San Luis Obispo Cos.; however, no samples from this watershed were positive in 2013. (12/13)

The WA Department of Natural Resources conducted *P. ramorum* stream baiting along several waterways in western WA in 2013. The Dungeness River (on the Olympic Peninsula, Clallam Co.) and Woodard Creek (Thurston Co.) were found *P. ramorum* positive. The Woodard Creek find is downstream from a previously positive nursery; however, the inoculum source for Dungeness River is unknown. (12/13)

MANAGEMENT

The UK Technical Review of the DEFRA *Phytophthora* Disease Management Program was posted online ([Phytophthora Review - Final Report]). Findings took into consideration the science and modelling work that has informed the 5-year program as well as issues of implementation and knowledge transfer to growers, the wider horticultural industry, forest managers, and other key stakeholders. It will be used to inform future control strategies as well as for decisions on further management and funding. (8/13)

Big Sur - Forests in the Big Sur region that burned in 2008 during the Basin and Chalk Fires have very high fuel levels as well as lush basal resprouting in redwood, tanoak, madrone, and California bay laurel. Burned areas that were infested with *P. ramorum* prior to the fires are slowly becoming re-infested with the pathogen as well as other *Phytophthora* species. Reinvasion has been especially common where overstory bay trees survived the fire.

To address the increased fuel loads from *P. ramorum* and the 2008 wildfires, several programs are underway. The Los Padres National Forest and the Nature Conservancy's Fire Learning Network initiated FireScape Monterey in spring 2011, which brings community members and 27 public and private organizations together to work on local fire issues. Participants visited the Santa Lucia Preserve in Carmel Valley to view a fuel reduction project completed 2 years ago in an area severely affected by SOD. Hundreds of standing dead tanoaks were felled and chipped on site. Following the treatment, native understory vegetation, including ferns and coffeeberry, recolonized the site. The Preserve also provided demonstration areas where bay removal and Agri-Fos® are being used to manage for the pathogen. Additionally, CAL FIRE was supporting multiple fuel reduction projects in the Big Sur region, and the Palo Colorado community and Mid-Coast Fire Brigade pooled resources to implement a project with no outside funding, collectively removing fuels along 4 miles of shared roadway.

Phytophthora ramorum continued to spread southward along the Big Sur coast, with tanoak mortality intensifying in Landels-Hill Big Creek Reserve as well as in the Mill, Plaskett, and Willow Creek watersheds. The San Carporforo watershed, which represents the southern boundary of Monterey Co., has not been culture positive for the pathogen even though four consecutive *P. ramorum*-positive PCR water positives were recovered from the watershed in 2012 (March –June 2012). (10/13)

Jackson Demonstration State Forest - Tanoak and California bay laurel trees were found *P. ramorum* positive in August on JDSF, confirming the pathogen's presence on the forest. The positive trees were identified in the North Fork of the South Fork of the Noyo River, adjacent to the remote Trestle Trail. The nearest known infestations are 10 miles northwest at MacKerricher State Park and Ingelnook. Due to the terrain, size, and location of the infestation, eradication and containment efforts are not feasible for this site. Seasonal trail closures and other BMPs will be utilized to minimize pathogen spread. (10/13)

Oregon Forests - Expansion and intensification of SOD in late 2012 triggered a revision of OR's quarantine in March 2013 and increased the quarantine area to 264 mi^2 (figure 1). The revised rule established a "Generally Infested Area" (GIA) within the quarantine boundary where *P. ramorum* treatment is no longer required. It also defined high-priority sites where eradication treatments are required and increased utilization of tanoak within the quarantine area, permitting it and other host plants to be transported out of the quarantine zone if they are from a disease-free area (surveyed within the past 6 months and located more than ¼ mile from any infested site).

The GIA (48 mi^2) has had a large increase in the number of dead tanoak over the past year, creating hazardous conditions for wildfire and tree failure. As of September 2013, approximately 14 new infested sites were found outside of the GIA, but none were outside of the quarantine area (fig. 1). Eradication treatments are no longer being conducted on private land inside the GIA, but federal agencies continue to treat infestations on federal lands. Infested sites outside of the GIA are being cut and burned in order to slow pathogen spread; however, treatment size varies according to fund availability.

The initial goal of *P. ramorum* eradication from Curry County forests is no longer achievable. Therefore, the program redirected efforts to slow disease spread through early detection and eradication of new high-risk infestations that pose threats to greater disease spread; reducing inoculum levels through cost-share projects and BMPs; and education and outreach. Concern persists over increased tree mortality posing hazardous conditions to people, dwellings, and roadways if standing dead trees and fuels are not removed.

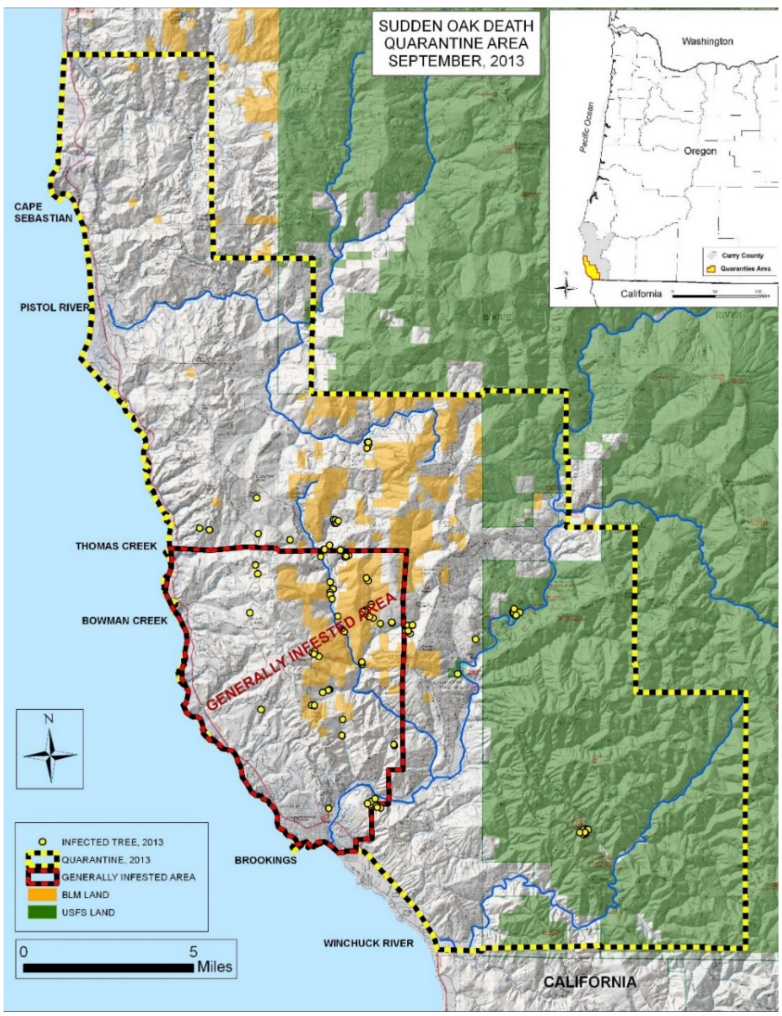

Figure 1. Location of sites infested with *P. ramorum* in southwest OR that were discovered in 2013 (as of September). Sites enlarged for visibility. (10/13)

FEATURED REPORT

A Review of Threats to Eastern Oaks, By Chris Lee and Steve Oak - The invasion of *P. ramorum* into CA and OR has not only threatened tanoaks, coast live oaks, California black oaks, Shreve oaks, and canyon live oaks throughout the region, but it has also brought to light the political and practical difficulties involved in trying to limit the spread of a pathogen that can travel hundreds of miles on commonly traded ornamental plants. The discovery of the pathogen on plants distributed by a large wholesale producer of ornamentals in CA in 2004 sparked energetic debate and momentary distrust between state governments in the western and eastern US. In the eastern part of the country, many oak species are potentially vulnerable to *P. ramorum*-caused mortality if the pathogen were to become established in forests there. Even without the threat of SOD, there are other threats to *Quercus* (oak) species in the eastern US that keep anxiety levels high. A survey of many of those threats can help to remind us why continued vigilance and strong trade regulation between the states is still necessary.

The most widespread and damaging threat to oaks in eastern forests is oak decline. Large-scale decline and mortality have been described since the early 1900s in many states in the Eastern Broadleaf Forest Province, Appalachian Mountains, and Ozark Mountains. Red oak species such as scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*), and northern red oak (*Quercus rubra*) suffer the greatest impact. After predisposition by advanced physiologic age, decline events are incited by stress from combinations of prolonged drought, spring frost, and spring insect defoliation. This triggers attacks by opportunistic pests and pathogens like *Armillaria* root disease, red oak borer, Hypoxylon canker, and two-lined chestnut borer. Slow, progressive dieback of the crown ends in the death of susceptible trees. Defoliation by gypsy moth can be a particularly effective inciting factor since duration, severity, and periodicity of outbreaks of this non-native insect differ from native defoliators. While oak decline incidence does not correlate well with pollutant deposition at large regional scales, it has been linked in some areas of WV and PA along with soil nutrient status and aluminum toxicity.

Similarly, several states, such as KY, OH, MI, and WV, have recently seen dramatic increases in white oak (*Quercus alba*) mortality. In some places, this increase in mortality paradoxically occurs on sites with high moisture availability and deep, fertile soils. At a subset of these sites this mortality has been associated with populations of pathogenic *Phytophthora* species in the soil, especially *P. cinnamomi* and *P. cambivora*. In others, it is speculated that oak wilt (caused by *Ceratocystis fagacearum*) may be the primary cause, although white oaks are usually more resistant than red oaks to oak wilt mortality.

There are a number of other pests and pathogens causing problems with oaks (such as bur oak blight, jumping oak gall, and variable oakleaf caterpillar), but in many places the greatest threat to oak conservation is a failure to manage the oak resource appropriately. Oaks grow slowly during early establishment and are relatively shade intolerant. Historic disturbance patterns (harvesting, light-intensity fire, woods grazing by livestock) provided conditions that gave a competitive advantage for oak establishment and early growth, particularly after the elimination of American chestnut as a canopy species from eastern hardwood forests by chestnut blight (caused by the non-native pathogen *Cryphonectria parasitica*). These patterns no longer prevail, leaving oaks at a competitive disadvantage. For example, throughout the central hardwood region, oak trees making up open woodlands are well-adapted to periodic, light-intensity fires. These fires historically maintained open forest structure for shade-intolerant, fire-resistant oaks. Currently, an ongoing lack of such periodic fires in many areas is encouraging invasion by dense stands of shade-tolerant tree species such as sugar maple (*Acer saccharum*). The lack of fire has many reasons, among them narrow seasonal burning windows and a misunderstanding of the potentially beneficial role that prescribed burning can play in maintaining forest health in these areas. Fortunately, regional prescribed burning councils and newly formed fire-science consortia are increasingly stepping in to educate land managers and residents about the issue and provide needed support.

This brief listing of threats to oak health in the eastern US serves as a quick reminder of why all the economic sacrifice and strenuous control efforts for *P. ramorum* and other forest pests in the West are so greatly appreciated by those in the other half of the country. With oaks throughout the country imperiled by changing management, species composition, and climate, it's imperative to try to restrict the movement of *P. ramorum* and other damaging pathogens and pests as much as possible.

For more information:

Abrams, M.D. 1992. Fire and the Development of Oak Forests. BioScience. 42:346-353.

Balci, Y.; Long, R.P.; Mansfield, M.; Balser, D.; MacDonald, W.L. 2009. Involvement of *Phytophthora* Species in White Oak (*Quercus alba*) Decline in Southern Ohio. Forest Pathology. 40:430-442.

Bruhn, J.N.; Wetteroff, J.J. Jr.; Mihail, J.D.; Kabrick, J.M.; Pickens, J.B. 2000. Distribution of *Armillaria* Species in Upland Ozark Mountain Forests With Respect to Site, Overstory Species Composition and Oak Decline. European Journal of Forest Pathology. 30:43-60.

Demchik, M.C.; Sharpe, W.E. 2000. The Effect of Soil Nutrition, Soil Acidity and Drought on Northern Red Oak (*Quercus rubra* L.) Growth and Nutrition on Pennsylvania Sites With High and Low Red Oak Mortality. Forest Ecology and Management. 136:199-207.

Haavik, L.J.; Jones, J.S.; Galligan, L.D.; Guldin, J.M.; Stephen, F.M. 2012. Oak Decline and Red Oak Borer Outbreak: Impact in Upland Oak-Hickory Forests of Arkansas, USA. Forestry. 85(3):341-352.

Hutchinson, T.F.; Long, R.P.; Ford, R.D. 2008. Fire History and the Establishment of Oaks and Maples in Second-Growth Forests. Canadian Journal of Forest Research. 38:1184-1198.

Kabrick, J.M.; Dey, D.C.; Jensen, R.G.; Wallendorf, M. 2008. The Role of Environmental Factors in Oak Decline and Mortality in the Ozark Highlands. Forest Ecology and Management. 255:1409-1417.

Loftis, D.L. 1990. A Shelterwood Method for Regenerating Red Oak in the Southern Appalachians. Forest Science. 36(4):917-929.

Oak, S.; Tainter, F.; Williams, J.; Starkey, D. 1996. Oak Decline Risk Rating for the Southeastern United States. Annals of Forest Science. 53:721-730.

Starkey, D.A.; Oak, S.W.; Ryan, G.W.; Tainter, F.H.; Redmond, C.; Brown, H.D. 1989. Evaluation of Oak Decline Areas in the South. US Department of Agriculture Forest Service Southern Region, Protection Report R8 PR 17. Atlanta, GA, USA, 36 p. (4/13)

FEATURED RESEARCH

NORS-DUC Research Update on Soil Solarization – Dr. Jennifer Parke and Fumiaki Funahashi (graduate student), OSU

In 2012, two field trials were conducted at NORS-DUC to determine the effectiveness of soil solarization (with and without a subsequent *Trichoderma* biocontrol agent amendment) in reducing survival of *P. ramorum* inoculum in infested nursery soil. Treatments included solarized and non-solarized plots, each 2.5 x. 2.5 m, with six replicates. Rhododendron leaf disks infested with *P. ramorum* were buried in soil at 5 cm, 15 cm, and 30 cm, and plots were either solarized (covered with a clear plastic sheet) or not solarized (left uncovered). Leaf disks were removed at regular intervals and monitored for outgrowth of *P. ramorum* on a *Phytophthora* selective medium (PARPH).

In the first trial, initiated in mid-July and sampled 4 weeks later, there was no recovery of *P. ramorum* from the solarized plots at any soil depth; whereas, average recovery in the non-solarized plots was 78% at 5 cm, 98% at 15 cm, and 97% from the 30 cm depth. Solarization increased the daily maximum soil temperature by 6-10°C at each depth. In the second trial initiated in mid-August, plots were sampled at 2 and 4 weeks. By 2 weeks, there was no recovery of *P. ramorum* from the 5 cm or 15 cm depth, but *P. ramorum* was recovered from 65% of the leaf disks at the 30 cm depth, even after 6 weeks of solarization. Recovery was not affected by application of the biocontrol agent in either experiment.

Soil solarization under the test conditions in CA appears to offer an effective means of eliminating *P. ramorum* from at least the upper layers (top 15 cm) of the soil profile, where most of the naturally occurring inoculum is located. Efforts are underway to model the survival of *P. ramorum* in relation to soil temperature and moisture. Additional research in 2013 is aimed at understanding how to maximize the effectiveness of solarization in killing soilborne *Phytophthora* species in CA, OR, and WA, and to determine how the presence of crushed rock on the soil surface affects soil heating. (6/13)

Coast redwoods are nearly four times more likely to die during forest fires in SOD-infested forests than in non-infested forests, according to a recent study conducted by UC Davis researchers.

Since 2006, the UC Davis Rizzo lab and colleagues have been monitoring 280 field plots over nearly 200,000 acres in the Big Sur region of CA. The plots encompass several forest types that are susceptible to invasion by *P. ramorum* (mixed-evergreen, redwood). In 2008, wildfires burned almost half of the plots in the study area. The Basin Complex fire burned more than 234,000 acres in June, and the Chalk Fire burned an additional 16,000 acres south of the Basin Complex in September. In 2009, one year after the fires, 46 burned redwood plots were re-surveyed (23 each infested and uninfested). Every live or dead stem that was identified, mapped, measured, and assessed for pathogen infection upon plot establishment in 2006–2007 was reassessed for survival in 2009. For 29 of these plots tree level indicators of burn severity (e.g., stem char height, percent crown scorch, and changes to soil structure) were collected immediately following the Basin Fire from September through October 2008. Findings indicate that tanoak killed by SOD result in more fuel for wildfires as well as decreased moisture levels in affected forests as shade diminishes in the absence of trees. These dynamics make SOD-infested forests dryer and allow flames to travel into the canopy by way of the standing dead tanoaks, allowing fire to scorch nearby redwood crowns and leading to redwood die-off rates nearly four times those of the healthy plots that burned.

Funding for this research was provided by the National Science Foundation and National Institute of Health Ecology and Evolution of Infectious Diseases Program, the USFS PSW Research Station and SPF, and the Gordon & Betty Moore Foundation. The results appear in: Metz, M.R.; Varner, J.M.; Frangioso, K.M.; Meentemeyer, R.K.; and Rizzo, D.M.. 2013.Unexpected Redwood Mortality from Synergies Between Wildfire and an Emerging Infectious Disease. Ecology. 94:2152–2159. (9/13)

RESEARCH

Boyd, I.L.; Freer-Smith, P.H.; Gilligan, C.A.; Godfray, H.C.J. 2013. The Consequence of Tree Pests and Diseases for Ecosystem Services. Science. 342(6160). DOI: 10.1126/science.1235773.

Brittain, I.; Selby, K.; Taylor, M.; and Mumford, R. 2013. Detection of Plant Pathogen Spores of Economic Significance on Pollen Trap Slides. Journal of Phytopathology. 161(11-12):855-858. (7/13)

Burdon, J.J.; Thrall, P.H.; and Ericson, L. 2013. Genes, Communities, and Invasive Species: Understanding the Ecological and Evolutionary Dynamics of Host–Pathogen Interactions. Current Opinion in Plant Biology. 16:1–6. (7/13)

Chandelier, A.; Heungens, K.; and Werres, S. 2014. Change of Mating Type in an EU1 Lineage Isolate of *Phytophthora ramorum*. Journal of Phytopathology. 162(1):43–47. (8/13)

Cobb, R.C.; Eviner, V.T.; and Rizzo, D.M. 2013. Mortality and Community Changes Drive Sudden Oak Death Impacts on Litterfall and Soil Nitrogen Cycling. New Phytologist. 200(2):422–431. (8/13)

Chen, W.; Djama, Z.R.; Coffey, M.D.; Martin, F.N.; Bilodeau, G.J.; Radmer, L.; Denton, G.; and Lévesque, C.A. 2013. Membrane-Based Oligonucleotide Array Developed from Multiple Markers for the Detection of Many *Phytophthora* Species. Phytopathology. 103(1):43-54. (2/13)

Croucher, P.J.P.; Mascheretti, S.; and Garbelotto, M. 2013. Combining Field Epidemiological Information and Genetic Data to Comprehensively Reconstruct the Invasion History and the Microevolution of the Sudden Oak Death Agent *Phytophthora ramorum* (Stramenopila: Oomycetes) in California. Biological Invasions. 15(10):2281-2297. (7/13)

Elliott, M. and Chastagner, G.A. 2013. Susceptibility of Rhododendrons to *P.* *ramorum*. B&B 65(3):14-17. (5/13)

Eyre, C.A.; Kozanitas, M.; and Garbelotto, M. 2013. Population Dynamics of Aerial and Terrestrial Populations of *Phytophthora ramorum* in a California Forest Under Different Climatic Conditions. Phytopathology. 103(11):1141-1152. (7/13)

Fahlgren, N.; Bollmann, S.R.; Kasschau, K.D.; Cuperus, J.T.; Press, C.M.; et al. 2013. *Phytophthora* Have Distinct Endogenous Small RNA Populations That Include Short Interfering and MicroRNAs. PLoS ONE. 8(10):e77181. (11/13)

Frankel, S.J.; Kliejunas, J.T.; Palmieri, K.M.; and Alexander, J.M. tech. coords. 2013. Proceedings of the Sudden Oak Death Fifth Science Symposium. Gen. Tech. Rep. PSW-GTR-243. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 169 p. Available online at http://www.fs.fed.us/psw/publications/documents/psw_gtr243/. For a free copy, email rschneider@fs.fed.us with your name and address, and include "PSW-GTR-243" in the subject line.

Tanoak: History, Ecology and Values. Madroño 60(2):62-164. 2013. Includes papers presented at "Tanoak Wild: A Celebration," June 22, 2012, as part of the Fifth Sudden Oak Death Science Symposium. 2013. The issue is available at from the California Botanical Society at http://www.calbotsoc.org/special_issues.html. (9/13)

Hayden, K.J.; Garbelotto, M.; Dodd, R.; and Wright, J.W. 2013. Scaling up from Greenhouse Resistance to Fitness in the Field for a Host of an Emerging Forest Disease. Evolutionary Applications. 6(6):970–982. (9/13)

Hearst, C.; Nelson, D.; McCollum, G.; Sharma, S.; and Rao, J.R. 2013. Forest Fairy Ring Fungi *Clitocybe nebularis*, Soil *Bacillus* spp., and Plant Extracts Exhibit *in Vitro* Antagonism on Dieback *Phytophthora* Species. Natural Resources. 4:189-194. (11/13)

Hummel, R.L.; Elliott, M.; Chastagner, G.; Riley, R.E.; Riley, K.; and DeBauw, A. 2013. Nitrogen Fertility Influences Growth and Susceptibility of Rhododendrons to *Phytophthora ramorum*. HortScience. 48(5):601–607. (6/13)

Kelsey, R.G.; Beh, M.M.; Shaw, D.C.; and Manter, D.K. 2013. Ethanol Attracts Scolytid Beetles to *Phytophthora ramorum* Cankers on Coast Live Oak. Journal of Chemical Ecology. 39:494-506. (5/13)

Mathew, S.K. and Beena, S. 2012. A New Record of *Phytophthora ramorum* Causing Leaf Fall and Shoot Rot of Nutmeg (*Myristica fragrans*). Journal of Mycology and Plant Pathology. 42(4):529-530. (3/13)

McPherson, B.A.; Erbilgin, N.; Bonello, P.; and Wood, D.L. 2013. Fungal Species Assemblages Associated with *Phytophthora ramorum*-Infected Coast Live Oaks Following Bark and Ambrosia Beetle Colonization in Northern California. Forest Ecology and Management. 291:30–42. (3/13)

McPherson, B.A.; Mori, S.R.; Opiyo, S.O.; Conrad, A.O.; Wood, D.L.; and Bonello, P. 2014. Association Between Resistance to an Introduced Invasive Pathogen and Phenolic Compounds That may Serve as Biomarkers in Native Oaks. Forest Ecology and Management. 312:154-160. (11/13)

Osmundson, T.W.; Eyre, C.A.; Hayden, K.M.; Dhillon, J.; and Garbelotto, M.M. 2013. Back to Basics: An Evaluation of NaOH and Alternative Rapid DNA Extraction Protocols for DNA Barcoding, Genotyping, and Disease Diagnostics from Fungal and Oomycete Samples. Molecular Ecology Resources. 13:66–74. (11/13)

Osterbauer, N.K.; Lewis, S.; Hedberg, J.; and McAninch, G. 2013. Assessing Potential Hazards for *Phytophthora ramorum* Establishment in Oregon Nurseries. J. Environmental Horticulture. 31(3):133–137. (9/13)

Pautasso, M. 2013. *Phytophthora ramorum* – A Pathogen Linking Network Epidemiology, Landscape Pathology and Conservation Biogeography. CAB Reviews. 8(024):1-14. (7/13)

Potter, C. 2013. Ten Years of Land Cover Change on the California Coast Detected Using Landsat Satellite Image Analysis: Part 1—Marin and San Francisco Counties. Journal of Coastal Conservation. 17(4):697-707. (7/13)

Preuett, J.A.; Collins, D.J.; Luster, D.G.; and Widmer, T.L. 2013. Screening Selected Gulf Coast Forest Species for Susceptibility to *Phytophthora ramorum*. Online. Plant Health Progress. DOI: 10.1094/PHP-2013-0730-01-RS. (11/13)

Prospero, S.; Vercauteren, A.; Heungens, K.; Belbahri, L.; and Rigling, D. 2013. *Phytophthora* Diversity and the Population Structure of *Phytophthora ramorum* in Swiss Ornamental Nurseries. Plant Pathology. 62(5):1063–1071. (3/13)

Purse, B.V.; Graeser, P.; Searle, K.; Edwards, C.; and Harris, C. 2013. Challenges in Predicting Invasive Reservoir Hosts of Emerging Pathogens: Mapping *Rhododendron* *ponticum* as a Foliar Host for *Phytophthora ramorum* and *Phytophthora kernoviae* in the UK. Biological Invasions. 15:529–545. (5/13)

Rooney-Latham, S.; Honeycutt, E.; Ochoa, J.; Grünwald, N.J.; and Blomquist, C.L. 2013. First Report of Camphor Tree (*Cinnamomum camphora*) as a Host of *Phytophthora ramorum*. Plant Disease. 97(10):1377-1377. (10/13)

Schwenkbier, L.; König, S.; Wagner, S.; Pollok, S.; Weber, J.; Hentschel, M.; Popp, J.; Werres, S.; and Weber, K. 2013. On-Site Detection of *Phytophthora* spp.—Single-Stranded Target DNA as the Limiting Factor to Improve On-Chip Hybridization. Microchimica Acta. DOI: 10.1007/s00604-013-1107-3. (12/13)

Shrestha, S.K.; Zhou, Y.; and Lamour, K.H. 2013. Oomycetes Baited from Streams in Tennessee 2010-2012. Mycologia. 105(6):1516-23. (9/13)

Stong, R.A.; Kolodny, E.; Kelsey, R.G.; González-Hernández, M.P.; Vivanco, J.M.; and Manter, D.K. 2013. Effect of Plant Sterols and Tannins on *Phytophthora ramorum* Growth and Sporulation. Journal of Chemical Ecology. 39(6):733-43. (6/13)

Tooley, P.W.; Browning, M.; and Leighty, R.M. 2013. Inoculum Density Relationships for Infection of Some Eastern US Forest Species by *Phytophthora ramorum*. Journal of Phytopathology. 161(9):595–603. (6/13)

Vannini, A.; Bruni, N.; Tomassini, A.; Franceschini, S.; and Vettraino, A.M. 2013. Pyrosequencing of Environmental Soil Samples Reveals Biodiversity of the *Phytophthora* Resident Community in Chestnut Forests. FEMS Microbiology Ecology. 85(3):433-442. (7/13)

Widmer, T.L. and Dodge, S.C. 2013. Can Fungal Epiphytes Reduce Disease Symptoms Caused by *Phytophthora ramorum*? Biological Control. 65(1): 135-141. (7/13)

Tanoak was the focus of the spring 2013 special issue of Madroño, a publication of the California Botanical Society. Several of the papers were presented orally at "Tanoak Wild: A Celebration," held June 22, 2012 in Petaluma, CA, as part of the Fifth SOD Science Symposium. "Tanoak: History, ecology, and values" highlights much of what has been learned over the past 10 years about this important SOD host. The issue documents how conservation of tanoak as a resource is a challenge that requires consideration of botany, ecology, forestry, and the conflicting values of diverse populations, all confounded by an emerging exotic pathogen. The following articles were published in May 2013.

Bowcutt, F. 2013. Tanoak Landscapes: Tending to a Native American Nut Tree. Madroño. 60(2):64-86.

Wright, J.W. and Dodd, R.S. 2013. Could Tanoak Mortality Affect Insect Biodiversity? Evidence for Insect Pollination in Tanoaks. Madroño. 60(2):87-94.

Bergemann, S.; Kordesch, N.C.; VanSant-Glass, W.; Metz, T.A.; and Garbelotto, M. 2013. Implications of Tanoak Decline in Forests Impacted by *Phytophthora ramorum*. Girdling Decreases the Soil Hyphal Abundance of Ectomycorrhizal Fungi Associated with *Notholithocarpus densiflorus*. Madroño. 60(2):95-106.

McDonald, P.M.; Zhang, J.; Senock, R.S.; and Wright, J.W. 2013. Morphology, Physiology, Genetics, Enigmas, and Status of an Extremely Rare Tree: Mutant Tanoak. Madroño. 60(2):107-117.

Shelly, J.R. and Quarles, S.L. 2013. The Past, Present, and Future of *Notholithocarpus densiflorus* (Tanoak) as a Forest Products Resource. Madroño. 60(2):118-125.

Nielsen, B. and Alexander, J. 2013. Foods from the Tanoak Forest Ecosystem. Madroño. 60(2):126-129.

Dodd, R.S.; Nettel, A.; Wright, J.W.; and Afzal-Rafii, Z. 2013. Genetic Structure of *Notholithocarpus densiflorus* (Fagaceae) from the Species to the Local Scale: A Review of our Knowledge for Conservation and Replanting. Madroño. 60(2):130-138.

Dillon, W.W.; Meentemeyer, R.K.; Vogler, J.B.; Cobb, R.C.; Metz, M.R.; and Rizzo, D.M. 2013. Range-Wide Threats to a Foundation Tree Species from Disturbance Interactions. Madroño. 60(2):139-150.

Cobb, R.C.; Rizzo, D.M.; Hayden, K.J.; Garbelotto, M.; Filipe, J.A.N.; Gilligan, C.A.; Dillon, W.W.; Meentemeyer, R.K.; Valachovic, Y.S.; Goheen, E.; Swiecki, T.J.; Hansen, E.M.; and Frankel, S.J. 2013. Biodiversity Conservation in the Face of Dramatic Forest Disease: An Integrated Conservation Strategy for Tanoak (*Notholithocarpus densiflorus*) Threatened by Sudden Oak Death. Madroño. 60(2):151-164.

The following 12 abstracts on *P. ramorum* were presented at the 2013 American Phytopathological Society–Mycological Society of America (APS-MSA) Joint Meeting in Austin, TX, August 10th – 14th.

Conrad, A.O.; McPherson, B.; Wood, D.; and Bonello, P. 2013. Can Constitutive Phenolic Biomarkers be Used to Predict Coast Live Oak Resistance to *Phytophthora ramorum*? Phytopathology. 103(Suppl. 2):S2.29.

Dale, A.L.; Everhart, S.E.; Feau, N.; Bilodeau, G.J.; Grunwald, N.J.; and Hamelin, R.C. 2013. Genome-Wide Patterns of Diversity in Four Lineages of the Sudden Oak Death Pathogen, *Phytophthora ramorum*. Phytopathology. 103(Suppl. 2):S2.32.

Everhart, S.E.; Larsen, M.M.; and Grunwald, N.J. 2013. Where is *Phytophthora ramorum* Now? An Update on Clonal Populations in the U.S. Phytopathology. 103(Suppl. 2):S2.41.

Funahashi, F. and Parke, J.L. 2013. Effects of Solarization and Biocontrol on Soilborne *Phytophthora* spp. in Container Nurseries. Phytopathology. 103(Suppl. 2):S2.46.

Goss, E.M. 2013. Migration and Evolution of *Phytophthora* Plant Pathogens in the Age of Globalization. Phytopathology. 103(Suppl. 2):S2.177.

Kozanitas, M.; Osmundson, T.; and Garbelotto, M. 2013. Epidemiology and Ecology of the Sudden Oak Death Epidemic: Disease Progression and the Population Genetics of *P. ramorum* Within a CA Watershed. Phytopathology. 103(Suppl. 2):S2.75.

Larson, E.; Eberhart, J.; and Parke, J. 2013. Potential Treatments for Disinfesting Runoff Water from Nurseries Contaminated With *Phytophthora ramorum*. Phytopathology. 103(Suppl. 2):S2.77.

Lichter, F.; Blasioli, K.; Gleeson, G.; Coats, K.; Elliot, M.; Hammett, C.; Hamelin, R.; Shamoun, S.; and Broders, K. 2013. Comparative Genomic Analysis of Phenotypically and Genotypically Diverse Isolates of *Phytophthora ramorum*. Phytopathology. 103(Suppl. 2):S2.82.

Roubtsova, T.V. and Bostock, R.M. 2013. Interaction of Root Stress, Chemical Management, and Ramorum Blight Development from Soilborne Inoculum in Potted Rhododendron Plants. Phytopathology. 103(Suppl. 2):S2.124.

Schweigkofler, W.; Kosta, K.; Suslow, K.; Huffman, V.; and Ghosh, S. 2013. Steaming is a Sustainable Method to Eradicate the Quarantine Pathogen *Phytophthora ramorum* From Infested Nursery Soil. Phytopathology. 103(Suppl. 2):S2.129.

Shishkoff, N. 2013. The Concentration of Sporangia or Zoospores of *Phytophthora ramorum* Required for Infection of Host Roots. Phytopathology. 103(Suppl. 2):S2.132.

Snover-Clift, K.L.; Daughtrey, M.L.; Swartwood Towne, M.; King, K.; and Kelly, M. 2013. Initial Detection of *Phytophthora ramorum* at Two New York Nurseries Through Sampling of Water in Retention Ponds. Phytopathology. 103(Suppl. 2):S2.136. (8/13)

NURSERIES

Oregon added blueberry (*Vaccinium)* fields to their Federal *P. ramorum* Certification Program in 2013 because of international concern that blueberry plants could become infected with the pathogen.

A Washington Co., OR nursery was found positive in March. It was also positive in 2010 and 2011. (4/13)

The National Plant Board has been working on developing national standards for a voluntary systems approach to nursery certification as its members recognize the opportunity to reduce pest risk and improve assurances by building on and improving existing programs. This effort is moving forward with industry, extension, and federal partner collaboration. (4/13)

A Gilroy nursery (Santa Clara Co.) was confirmed positive for *P. ramorum* in April. The facility was also positive in 2004 and 2005. (5/13)

Oregon had three *P. ramorum*-positive nurseries identified in April - a Clackamas Co. facility (first positive detection) and two Washington Co. nurseries (both previously positive, with one positive annually from 2006 through 2010 and the other positive in 2012). (5/13)

***Phytophthora ramorum*-positive *Rhododendron* plants were identified at a Lane Co.,** OR retail nursery in May. The facility ships interstate and also tested positive in 2006, 2009, 2011, and 2012. (6/13)

As of August 2013, 17 nurseries in four states had been found *P. ramorum* positive: CA(1), OR(9), WA(6), and NY(1). Twelve were interstate shippers and 5 were retail establishments. Positive plants included: *Camellia* (2); *Choisya* (1); *Gaultheria* (1); *Kalmia* (4); *Loropetalum* (2); *Magnolia* (1); *Pieris* (6); *Rhododendron* (50); *Trachelospermum* (1); and *Viburnum* (8). Cull piles (1), potting media (1), soil samples (3), and water samples (1) were also found positive in one retail (soil, water) and two interstate (soil, cull pile, potting medium) shipping nurseries. (8/13)

The CA nursery industry has developed voluntary BMPs to assist nursery crop producers in implementing effective preventive action and monitoring plans to reduce the risk of introducing quarantine pests and pathogens into their operations. Six workshops sponsored by UC Nursery and Floriculture Alliance were held throughout CA to assist growers in customizing site-specific BMPs through the use of an online tool which incorporates information such as county location as well as the pests and pathogens under quarantine or of concern in the local area. (8/13)

***Phytophthora ramorum* was detected infecting a *Parrotia persica* (Persian ironwood)** plant in a Multnomah Co., OR nursery. The nursery was previously positive in 2010. (9/13)

Washington identified six *P. ramorum*-positive nurseries in 2013. Of the 22 previously positive nurseries surveyed, four were found positive again for the pathogen. A retail garden center in Kitsap Co. with positive plants was also found to have infested runoff water and soil. This facility has been positive in previous years. Additionally, a King Co. re-wholesaler (buys finished stock from other nurseries and resells it to landscapers or nurseries) was found to have positive soil as well as infected plants. One positive WA nursery shipped out of state (to Canada); no trace forwards were identified. (12/13)

REGULATIONS

As of 12/10/12, USDA APHIS amended the FO regarding advance notification for interstate shipments of *P. ramorum* high-risk host nursery stock. Interstate shipments of *Camellia, Kalmia, Pieris, Rhododendro*n, and *Viburnum* nursery stock from all 14 quarantine CA counties and Curry County, OR must continue to provide written notification to non-regulated states. However, only previously (since 2010) or newly positive nurseries in the regulated areas of CA, OR, and WA shipping any species of *Camellia, Kalmia, Pieris, Rhododendro*n, and *Viburnum* to non-regulated states are now required to pre-notify. These nurseries must comply with the requirement while under the CNP and for two years after release. Nurseries located in the regulated areas with no positive detections for the last 3 consecutive years are no longer required to pre-notify. In the future, if *P. ramorum* is detected at a nursery in the regulated area, it will also be required to provide pre-notifications. (2/13)

Federal regulations for the interstate movement of nursery stock from nurseries located in the regulated areas of CA, OR, and WA that do not contain nor ship host or associated plant nursery stock are no longer required to comply with Federal Regulation 7CFR 301.92. This FO did not change the requirements for *P. ramorum* host nurseries in the regulated areas and all interstate shipping nurseries located in quarantine areas, including those that contain only non-host nursery stock. USDA APHIS issued the order (DA-2013-27) on 7/3/13. (8/13)

USDA APHIS and the CFIA sought feedback from stakeholders on the draft *Canada-United States Perimeter Approach to Plant Protection* framework, which proposes details on how the two agencies can work together on regulations and alignment of policies where possible for safe and efficient plant and plant product trade between Canada and US. (9/13)

USDA APHIS and State Plant Regulatory Agency representatives met in December in Aurora, CO to discuss how survey, inspection, sampling, testing, response, mitigation, and compliance protocols for *P. ramorum*-positive nurseries can be achieved under proposed changes to the federal *P. ramorum* regulatory framework.

Highlights of the regulatory concepts include regulating nurseries shipping host plants interstate for the presence of *P. ramorum* on diseased plants as well as in soil/media, water, and associated articles, such as pots, etc. Nurseries located in the 14 quarantine CA counties, as well as Curry Co., OR that ship host and non-host plants interstate will continue to be regulated, even if they are negative for the pathogen. *P. ramorum*-positive interstate shipping nurseries, irrespective of where they are located, will have to address critical control points via BMPs and/or mitigations in order to resume shipping. (12/13)
Effective November 27, 2013, USDA APHIS added *Gaultheria procumbens* to the list of regulated *P. ramorum* host plants. Nurseries previously not under a *P. ramorum* compliance agreement that ship *Gaultheria procumbens* interstate are now required to obtain a compliance agreement if they are to continue shipments. (12/13)

The Republic of Korea issued a Notification of Emergency Measures Addendum to their *P. ramorum* Phytosanitary measures, adding *Gaultheria procumbens* to their list of regulated associated host plants. As of November 22, 2013, all imported *Gaultheria procumbens* from prohibited and regulated areas must have a phytosanitary certificate verifying the shipment was inspected and found free of *P. ramorum*. (12/13)

FUNDING

Farm Bill Section 10201 funding for fiscal year 2013 provided over $1.6 million for *P. ramorum* work. Sixteen states collectively received $370,287 to participate in the *P. ramorum* National Survey. Additionally, NORS-DUC received funding. (4/13)

The 2013-14 RFP for NORS-DUC provided approximately $200,000 for projects ranging from $15,000 to $50,000. (4/13)

The Scottish government allocated nearly $1.5 million to help tackle the outbreak of *P. ramorum* on Japanese larch in Scotland, which has progressed so rapidly in the southwest that most of the Japanese larch trees in Galloway will likely need to be felled over the next 2 to 3 years. (11/13)

MEETINGS

Resources remain the primary limiting factor in the effectiveness of biosecurity measures, according to one of the key points from the e-conference "Pathways Into Policy: International knowledge exchange on biosecurity governance and implications for tree pest introductions and spread." The conference focused on three themes, comparing biosecurity interventions implemented in different countries to regulate tree pests.

Theme 1. "Defining Key Pathways and Assessing Their Significance" – Findings: There is a growing acceptance and understanding of the 'pathways' approach. Various types of pathways exist, along with various ways to engage with and analyze them. Adopting a pathway approach can bring significant advantages, including the capacity to address multiple and unknown pests, cost efficiencies, and shifting some of the biosecurity cost burden. The pathways approach is not a 'silver bullet' solution; resources remain the main limit on effectiveness. The pathways approach should be seen as an additional element of biosecurity regulation and management, strengthening existing practices.

Theme 2. "Comparing Approaches to Pathway Management and Pest Prevention" – Findings: The pathway approach to biosecurity is clearly well developed in some countries. One significant obstacle to the development of the pathways approach is the need to overlay, adapt, and fit with pre-existing regulatory and management structures. There will always be layers of competing local priorities and limits on resources available to implement biosecurity measures. Biosecurity processes should be evidence-based, transparent, and participatory.

Theme 3. "Underlying Justifications for Pathway Management and Pest Prevention" – Findings: There is a need for more pre-emptive and deliberative stakeholder engagement to set the framework and priorities for biosecurity measures and pest management responses. Each jurisdiction faces unique issues in regard to the rights and responsibilities involved in managing pathways and outbreaks, and the vulnerabilities of different forests found there. More research is required to better comprehend the sociocultural impacts of biosecurity management on a variety of stakeholders, which are currently not well understood.

The e-conference was organized by Imperial College London, Forest Research UK, the Food and Environment Research Agency, and others. (4/13)

EDUCATION AND OUTREACH

"Best Management Practices Programs for CA Nurseries: Review and Outlook" training sessions were held in California in 2013. Trainings covered BMP components and benefits to the nursery industry; projects at NORS-DUC that validate and develop BMPs; current status of the CANGC BMP grant for multiple plant pests in CA; and provided an update on the NPB's SANC program. (4/13)

The Chelsea Flower Show in London featured a "Stop the Spread" garden complete with an avenue of bare and lifeless trees and a border of threatened species. UK FERA sponsored the garden at the Royal Horticulture Society's centennial flower show, the most prestigious in the UK. The garden was awarded a silver medal. (6/13)

A webinar series on irrigation pathogens and recycled water quality was offered through Virginia Tech from Oct. 8, 2013 – Nov. 4, 2013. The latest research was presented on issues surrounding crop health, agricultural water security, and our environmental footprint. This project was a partnership between seven institutions and the ornamental horticultural industry in pursuit of better plant quality and productivity while promoting containment and recycling of irrigation water to protect and conserve natural water resources. (9/13)

A voluntary, industry-developed "Best Management Practices Online Tool" has been made available to assist nursery crop producers in developing an effective preventive action and monitoring plan to reduce the risk of introducing CA quarantine pests and pathogens into their operations. Growers/shippers are able to create a set of BMPs unique to their nursery based on county locations and the pests/pathogens under quarantine or of concern in those counties. For more information, go to http://ucanr.edu/sites/UCNFA/CANGC_Unified_BMPs_Project/Pests/. (10/13)

In its sixth year, the 2013 SOD Blitzes were the largest to date, with over 500 participants surveying more than 13,000 trees and collecting samples from over 2,000 of them in 16 regions. Community members living near areas known to be impacted by SOD were encouraged to attend a Blitz to learn how to monitor for the disease in their community, facilitating early detection of new outbreaks. Participants were trained to identify and collect symptomatic bay leaves and record sample locations. Samples were taken to the Garbelotto lab at UC Berkeley to determine the presence or absence of the pathogen. Attendees learned how to correctly use the distribution maps, determine risk of infection for their oaks and tanoaks, and learned science-based recommendations to help prevent and manage SOD. Follow-up treatment training workshops were offered in the fall in communities that participated in the blitzes, with each session having covered basic SOD information, IPM approaches, selection of candidate trees for treatment, and proper preventative treatment application.

Blitz findings included identifying new outbreaks in southern Mendocino Co., northern Sonoma Co., and Golden Gate Park as well as significant increases in bay infection in Santa Cruz and San Matteo Cos. (around South Skyline Blvd). Oak infections were also detected in the East Bay hills on eastern and western slopes, with the infection on the western slopes initially detected on bay during the 2011 SOD Blitz. This year, blitz participants tagged bay trees to track infection status over time on individual trees that are continuously infected (especially in dry years), as they are a key source of sustainable pathogen inoculum.

The continuous and increasing SOD Blitz volunteer effort has helped improve SOD spread prediction accuracy and an understanding of which factors most affect spread. Additionally, the large blitz database has facilitated the creation of SODmap (a detailed disease distribution map) and SODmap Mobile (a smart phone app used to identify trees infected at the time of sampling and to determine risk of oak infection). (11/13)

RESOURCES

A new UK biosecurity poster was posted to the DEFRA website for those who own or work in woodlands and forests. The poster raises awareness about pest and disease threats to trees and provides landowners and contractors with information on BMPs to minimize the risks of introducing pests and diseases into woodlands as well as to reduce the risk of spreading them further. To access the poster, go to: http://www.fera.defra.gov.uk/plants/plantHealth/documents/woodlandsPoster.pdf. (3/13)

Landis, T.D. 2013. *Phytophthora ramorum*: Impacts on Forest, Conservation, and Native Plant Nurseries. USDA Forest Service Forest Nursery Notes. 33(1):15-24. The article has been posted online at http://www.rngr.net/publications/fnn/2013-winter/2013-winter-forest-nursery-notes-publication-by-article. (4/13)

"Protecting Australia from Sudden Oak Death" a 34-second outreach video on Kylie Ireland's PhD project at Murdoch University, Perth has been posted online at http://www.youtube.com/watch?v=HgsKC3XAgO4&sns=fb. (4/13)

The "Sudden Oak Death and *Phytophthora ramorum* 2011 – 2012 Summary Report, A Compendium of 2012 Monthly Newsletters" was posted to the Task Force website at http://www.suddenoakdeath.org/wp-content/uploads/2013/04/2012-Newsletter-Summary-Report.pdf. (5/13)

SODMAP was updated to include 2012 SOD Blitz results as well as new information from CA researchers, adding an additional 2,151 data points to the map. To access the updated map in Google Earth, go to www.sodmap.com. (5/13)

"Trade in forest commodities and the role of phytosanitary measures," a free online training course, is now available from the Food and Agriculture Organization of the UN and the International Plant Protection Convention Secretariat. The course provides a checklist to help producers comply with phytosanitary requirements in international markets as well as a review of the most common pests. To access the course, go to http://www.fao.org/forestry/foresthealthguide/82418/en/. (5/13)

***Phytophthora*: A Global Perspective is a compendium of *Phytophthora* species** impacting crops, forests, nurseries, greenhouses and natural areas worldwide. Chapters cover major hosts, identification, epidemiology, management, current research, future perspectives, and the impacts of globalization on *Phytophthora*. For more information, go to http://bookshop.cabi.org/?page=2633&pid=2611&site=191. (6/13)

Oregon posted a revised "Stop the Spread of Sudden Oak Death" brochure at http://scholarsarchive.library.oregonstate.edu/xmlui/bitstream/handle/1957/37904/ec1608.pdf?sequence=1. The document was updated to include new *P. ramorum* quarantine information for the state as well as to provide information on how to prevent disease spread and to show disease symptoms on various host plants. (7/13)

University of Illinois Extension specialists created a series of free online IPM Training Modules (http://mg.cropsci.illinois.edu/) on newly emerging, exotic, or invasive pests (including SOD) as well as pests or diseases which have generated significant questions or concerns. Each module features information about the distribution/history of the pathogen or pest; host plant(s); pathogen or vector information; diagnostics; symptoms; look-alike diseases; management; and references. Developed for Master Gardeners, the modules can also be used by gardeners and green industry professionals. (8/13)

Dobson, A.; Barker, K.; Taylor, S.L. 2013. Biosecurity: The Socio-Politics of Invasive Species and Infectious Diseases. Routledge. 256 pages. ISBN-10: 0415534771. ISBN-13: 978-0415534772.

This book addresses biosecurity as it relates to the protection of indigenous biological organisms, agricultural systems, and human health from invasive pests and diseases. It describes the ways in which biosecurity is understood and theorized in different disciplines, including anthropology, political theory, ecology, geography, and environmental management. It examines the different practices connected to biosecurity governance, such as legal regimes, ecology, and risk management, and assesses it in the context of future risk and uncertainties, such as globalization and climate change. (8/13)

RELATED RESEARCH

Aguayo, J.; Adams, G.C.; Halkett, F.; Catal, M.; Husson, C.; Nagy, Z.Á.; Hansen, E.M.; Marçais, B.; and Frey, P. 2013. Strong Genetic Differentiation Between North American and European Populations of *Phytophthora alni* subsp. *uniformis.* Phytopathology. 103(2):190-199. (2/13)

Carmichael, P. and Tscholl, M. 2013. Cases, Simulacra, and SemanticWeb Technologies. Journal of Computer Assisted Learning. 29(1):31–42.

Sudden oak death in CA is presented as an example of an interactive exhibit-based SemanticWeb application displaying distribution of affected species, possible co-factors, and climate data. A 'pop-up' allows users to introduce further data from other online sources and see them displayed on the map. (11/13)

De Vita, P.; Serrano, M.S.; Ramo, C.; Aponte, C.; García, L.V.; Belbahri, L.; and Sánchez, M.E. 2013. First Report of Root Rot Caused by *Pythium spiculum* Affecting Cork Oaks at Doñana Biological Reserve in Spain. Plant Disease. 97(7):991-991. (7/13)

Gao, R. and Zhang, G. 2013. Potential of DNA Barcoding for Detecting Quarantine Fungi. Phytopathology. 103(11): 1103-1107.(11/13)

Huai, W.-x.; Tian, G.; Hansen, E.M.; Zhao, W.-x.; Goheen, E.M.; Grunwald, N.J.; and Cheng, C. 2013. Identification of *Phytophthora* Species Baited and Isolated from Forest Soil and Streams in Northwestern Yunnan Province, China. Forest Pathology. 43(2):87–103. (3/13)

Hüberli, D.; St. J. Hardy, G.E.; White, D.; Williams, N.; Burgess, T.I. 2013. Fishing for *Phytophthora* from Western Australia's Waterways: A Distribution and Diversity Survey. Australasian Plant Pathology. 42(3):251-260. (2/13)

Jung, T.; Colquhoun, I.J.; and St. J. Hardy, G.E. 2013. New Insights into the Survival Strategy of the Invasive Soilborne Pathogen *Phytophthora cinnamomi* in Different Natural Ecosystems in Western Australia. Forest Pathology. 43(4):266–288. (3/13)

Kasuga, T. and Gijzen, M. 2013. Epigenetics and the Evolution of Virulence. Trends in Microbiology. 11:575-82.

The paper reviews progress in understanding genome-embedded transposable elements for *P. ramorum* and other *Phytophthora* species. (11/13)

Kong, P. 2013. Carbon Dioxide as a Potential Water Disinfestant for *Phytophthora* Disease Risk Mitigation. Plant Disease. 97(3):369-372. (3/13)

Kriticos, D.J. and Venette, R.C. 2013. Advancing Risk Assessment Models to Address Climate Change, Economics, and Uncertainty. NeoBiota Special Issue. 18:218 pgs. This special issue was published following the 2012 meeting of the International Pest Risk Mapping Workgroup. The 13 papers presented focus on interactions between pest risk and climate change, policy, and economics as well as pest control research and surveillance and pest risk uncertainty. (10/13)

Leonberger, A.J.; Speers, C.; Ruhl, G.; Creswell, T.; and Beckerman, J.L. 2013. A Survey of *Phytophthora* spp. in Midwest Nurseries, Greenhouses, and Landscapes. Plant Disease. 97(5):635-640. (5/13)

Lynch, S.C.; Zambino, P.J.; Mayorquin, J.S.; Wang, D.H.; and Eskalen, A. 2013. Identification of New Fungal Pathogens of Coast Live Oak in California. Plant Disease. 97(8):1025-1036. (8/13)

Machado, P. da S.; Alfenas, A.C.; Coutinho, M.M.; Silva, C.M.; Mounteer, A.H.; Maffia, L.A.; Freitas, R.G. de; and Freitas, C. da S. 2013. Eradication of Plant Pathogens in Forest Nursery Irrigation Water. Plant Disease. 97:780-788. (6/13)

Mayfield III, A.E.; MacKenzie, M.; Cannon, P.G.; Oak, S.W.; Horn, S.; Hwang, J.; and Kendra, P.E. 2013. Suitability of California Bay Laurel and Other Species as Hosts for the Non-Native Redbay Ambrosia Beetle and Granulate Ambrosia Beetle. Agricultural and Forest Entomology 15:227–235. (8/13)

Mazur, R.; Klimley, A.P.; and Folger, K. 2013. Implications of the Variable Availability of Seasonal Foods on the Home Ranges of Black Bears, *Ursus americanus*, in the Sierra Nevada of CA. Animal Biotelemetry. 1:16.

Nelson, E.V.; Fairweather, M.L.; Ashiglar, S.M.; Hanna, J.W.; and Klopfenstein, N.B. 2013. First Report of the Armillaria Root Disease Pathogen, *Armillaria gallic*a, on Douglas-fir (*Pseudotsuga menziesii*) in Arizona. Plant Disease. 97(12):1658-1658. (12/13)

Olson, H.A.; Jeffers, S.N.; Ivors, K.L.; Steddom, K.C.; Williams-Woodward, J.L.; Mmbaga, M.T.; Benson, D.M.; and Hong, C.X. 2013. Diversity and Mefenoxam Sensitivity of *Phytophthora* spp. Associated with the Ornamental Horticulture Industry in the Southeastern United States. Plant Disease. 97(1):86-92. (2/13)

Pagliaccia, D.; Pond, E.; McKee, B.; and Douhan, G.W. 2013. Population Genetic Structure of *Phytophthora cinnamomi* Associated with Avocado in California and the Discovery of a Potentially Recent Introduction of a New Clonal Lineage. Phytopathology. 103(1):91-97. (2/13)

Parnell, S.; Gottwald, T.R.; Riley, T.; and van den Bosch, F. *In press*. A Generic Risk-Based Surveying Method for Invading Plant Pathogens. Ecological Applications. DOI: 10.1890/13-0704.1. (11/13)

Ploetz, R.C.; Hulcr, J.; Wingfield, M.J.; and de Beer, Z.W. 2013. Destructive Tree Diseases Associated with Ambrosia and Bark Beetles: Black Swan Events in Tree Pathology? Plant Disease. 97(7):856-872. (7/13)

Quinn, L.; O'Neill, P.A.; Harrison, J.; Paskiewicz, K.H.; McCracken, A.R.; Cooke, L.R.; Grant, M.R.; and Studholme, D.J. 2013. Genome-Wide Sequencing of *Phytophthora lateralis* Reveals Genetic Variation Among Isolates from Lawson Cypress (*Chamaecyparis lawsoniana*) in Northern Ireland. FEMS Microbiology Letters. 344(2): 179–185. (6/13)

Scanu, B.; Hunter, G.C.; Linaldeddu, B.T.; Franceschini, A.; Maddau, L.; Jung, T.; and Denman, S. 2013. A Taxonomic Re-evaluation Reveals that *Phytophthora cinnamomi* and *P. cinnamomi* var. *parvispora* are Separate Species. Forest Pathology. DOI: 10.1111/efp.12064. (9/13)

Schoebel, C.N.; Jung, E.; and Prospero, S. 2013. Development of New Polymorphic Microsatellite Markers for Three Closely Related Plant-Pathogenic *Phytophthora* Species Using 454-Pyrosequencing and Their Potential Applications. Phytopathology. 103(10): 1020-1027. (10/13)

Stam, R.; Jupe, J.; Howden, A.J.M.; Morris, J.A.; Boevink, P.C.; Hedley, P.E.; and Huitema, E. 2013. Identification and Characterization CRN Effectors in *Phytophthora capsici* Shows Modularity and Functional Diversity. PLOS ONE. 8(3):e59517. (7/13)

Than, D.J.; Hughes, K.J.D.; Boonhan, N.; Tomlinson, J.A.; Woodhall, J.W.; and Bellgard, S.E. 2013. A TaqMan Real-Time PCR Assay for the Detection of *Phytophthora* 'taxon Agathis' in Soil, Pathogen of Kauri in New Zealand. Forest Pathology. 43(4):324–330. (6/13)

Voggesser, G.; Lynn, K.; Daigle, J.; Lake, F.K.; and Ranco, D. 2013. Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. 120: 615–626. (11/13)

The following 6 abstracts on related research topics were presented at the 2013 APS–MSA Joint Meeting in Austin, TX, August 10th – 14th.

Clement, D.L.; Malinoski, M.K.; Dawson, N.; and Bargeron, C. 2013. Development of a Smartphone App to Increase Accuracy and Early Detection of New or Invasive Diseases. Phytopathology. 103(Suppl. 2):S2.28.

Gutierrez, W. 2013. Free Trade, Fair Trade, Safe Trade: The role of Plant Pathology in Filling Regulatory Gaps. Phytopathology. 103(Suppl. 2):S2.180.

Martin, F.N.; Douhan, G.W.; Grunwald, N.J.; and Coffey, M.D. 2013. Evaluating the Correlation Between Mitochondrial Haplotype and Nuclear Genotype of *Phytophthora cinnamomi*. Phytopathology. 103(Suppl. 2):S2.91.

McConnell, M.E. and Balci, Y. 2013. *Phytophthora cinnamomi* as a Possible Contributor to White Oak (*Quercus alba*) Decline in Mid-Atlantic Forests. Phytopathology. 103(Suppl. 2):S2.191.

Schreier, S. and Jeffers, S.N. 2013. Characterization of *Phytophthora cinnamomi* from Ornamental Crops in South Carolina. Phytopathology. 103(Suppl. 2):S2.128.

Widmer, T. 2013. Use of a Fungal "Cocktail" to Inhibit Growth of *Phytophthora cinnamomi*. Phytopathology. 103(Suppl. 2):S2.160. (8/13)

Science for Environment Policy (a journal of the European Commission), Invasive Alien Species special issue. September 2013. Issue 41. Available online at http://ec.europa.eu/environment/integration/research/newsalert/pdf/41si.pdf. (11/13)

PERSONNEL

Sibdas Ghosh left his position with NORS-DUC in March 2013 for a position as the Dean of the School of Arts and Science at Iona College in New Rochelle, NY. (2/13)

Ron Rhatigan was selected as the new Field Coordinator for the SOD program in Brookings, OR, replacing Stacy Savona who is now a Stewardship forester in the area. (3/13)

Karen Suslow has been assigned the principal investigator for NORS-DUC. (4/13)

Dan Stark was hired as the new SOD Project Coordinator for UCCE Humboldt and Del Norte Cos. In his new role, he will monitor for SOD across public, private, and tribal lands; explore and implement best-available management practices for the control of SOD; and encourage a multi-stakeholder dialogue and participation in the SOD program through outreach and educational opportunities. Dan can be reached at (707) 445-7351 or stark@ucdavis.edu. (5/13)

Jack Marshall retired from CAL FIRE as a Forest Pest Specialist in May. Jack covered forest health for California's northern and central coast and served on the front line of early detection and response to *P. ramorum* in Mendocino, Humboldt, and other counties. (5/13)

CALENDAR OF EVENTS

2/13 - SOD Treatment Workshop; UC Berkeley
3/6 - SOD Treatment Workshop; UC Berkeley
4/10 - SOD Treatment Workshop; UC Berkeley
4/12 - Santa Cruz SOD Blitz; Santa Cruz
4/20 - Marin County SOD Blitz; San Rafael
4/27 – Marin ReLeaf Work Day; China Camp State Park
4/27 - East Bay SOD Blitz, Option 1; Orinda
4/27 – East Bay SOD Blitz, Option 2; Berkeley
5/1 - SOD Treatment Workshop; UC Berkeley
5/3 - San Luis Obispo SOD Blitz; San Luis Obispo
5/4 - Carmel Valley and Monterey SOD Blitz; Carmel Valley
5/7 - San Francisco SOD Blitz; San Francisco
5/11 - Mendocino SOD Blitz; Fort Bragg
5/14 - Best Management Practices Programs for CA Nurseries: Review and Outlook Training Session; Salinas
5/18 - South Bay SOD Blitz, Option 1; Montalvo
5/18 - South Bay SOD Blitz, Option 2; South Skyline
5/18 - Protect the Value of Your Forest: A Workshop for Forest Landowners; Ukiah
5/25 - Peninsula SOD Blitz, Option 1; Burlingame
5/25 - Peninsula SOD Blitz, Option 2; Woodside
5/29 - Protect the Value of Your Forest: A Workshop for Forest Landowners; Ukiah
6/1 - Atherton SOD Blitz; Atherton
6/8 - Los Altos Hills SOD Blitz; Los Altos Hills
6/15 – Sonoma SOD Blitz, Option 1; Santa Rosa
6/15 - Sonoma SOD Blitz, Option 2; Sonoma
6/15 - Sonoma SOD Blitz, Option 3; Sebastopol
6/15 - Napa SOD Blitz; Napa
6/15 - Protect the Value of Your Forest: A Workshop for Forest Landowners; UC Berkeley
6/22 - Protect the Value of Your Forest: A Workshop for Forest Landowners; Auburn
10/3 - SOD-Blitz Spring 2013 Results Live Webcast
10/12 – Humboldt Co. SOD Workshop; McKinleyville
10/12 - SOD Treatment Training Workshop; Burlingame
10/20 - SOD Treatment Training Workshop; Orinda
10/23 - SOD Treatment Workshop; UC Berkeley

11/1 - SOD Treatment Training Workshop; Los Altos
11/2 - SOD Treatment Training Workshop; Sonoma
11/9 - SOD Treatment Training Workshop; Los Altos Hills
11/12 - SOD Treatment Training Workshop; San Francisco
11/12 - SOD Treatment Training Workshop; Fort Bragg
11/13 - SOD Treatment Training Workshop; Carmel
11/16 - SOD Treatment Training Workshop; San Rafael
11/16 - SOD Treatment Training Workshop; Napa
11/17 - SOD Treatment Training Workshop; Los Gatos
11/23 - SOD Treatment Training Workshop; Saratoga
11/24 - SOD Treatment Training Workshop; Oakland