CALIFORNIA OAK MORTALITY TASK FORCE REPORT
MAY 2006

RESEARCH

The USDA Forest Service, Pacific Southwest Research Station (PSW) 2006 *P. ramorum* Request for Proposal (RFP) process is complete. In total, 46 proposals seeking over $5 million in research funds were received. However, due to limited funding, only nine projects were awarded, totaling approximately $665,000. For a list of funded projects, go to: http://nature.berkeley.edu/comtf/html/fy06_funded_research.html. For more information on the 2006 RFP awards and award process, contact Susan Frankel, PSW Sudden Oak Death Research Program Manager, at sfrankel@fs.fed.us.

On April 24th, Washington State University celebrated the completion of a new, $250,000 biocontainment laboratory at the Washington State University Puyallup Research and Extension Center. Elected officials joined leaders of the state's forest products, nursery, and Christmas tree industries for the dedication. The centerpiece of the new facility was the biocontainment unit, which consists of an anteroom and growth chamber. This facility will allow researchers at WSU Puyallup to complete whole plant inoculation studies, increasing the capacity of WSU to address critical research questions relating to the establishment, spread, and management of *P. ramorum.* For more information, contact Gary Chastagner, Washington State University, at: chastag@wsu.edu.

Barrett, T.M., Gatziolis, D., Fried, J.S., and Waddell, K.L. March 2006. Sudden Oak Death in California: What Is the Potential? *Journal of Forestry* pp. 61-64.

Abstract: Sudden oak death, a disease associated with the pathogen *Phytophthora ramorum*, has a large number of shrub and tree host species. Three of the tree species most susceptible to mortality from the disease, California black oak (*Quercus kelloggii*), coast live oak (*Quercus agrifolia*), and tanoak (*Lithocarpus densiflorus*), are estimated to predominate by basal area on 1.52 (±0.10) million ac in 12 counties that currently are under quarantine for the disease. The variety, prevalence, and importance of host species to wildlife indicate a high potential for impact on forest ecosystems in California.

Ivors, K., Garbelotto, M., Vries, I.D.E., Ruyter-Spira, C., Hekkert, B.Te., Rosenzweig, N., and Bonants, P. 2006. Microsatellite markers identify three lineages of *Phytophthora ramorum* in US nurseries, yet single lineages in US forest and European nursery populations. *Molecular Ecology* 15, 1493–1505. OI:10.1111/j.1365-294X.2006.02864.x.

Abstract: Analysis of 12 polymorphic simple sequence repeats identified in the genome sequence of *Phytophthora ramorum*, causal agent of 'sudden oak death', revealed genotypic diversity to be significantly higher in nurseries (91% of total) than in forests (18% of total). Our analysis identified only two closely related genotypes in US forests, while the genetic structure of populations from European nurseries was of intermediate

complexity, including multiple, closely related genotypes. Multilocus analysis determined populations in US forests reproduce clonally and are likely descendants of a single introduced individual. The 151 isolates analyzed clustered in three clades. US forest and European nursery isolates clustered into two distinct clades, while one isolate from a US nursery belonged to a third novel clade. The combined microsatellite, sequencing and morphological analyses suggest the three clades represent distinct evolutionary lineages. All three clades were identified in some US nurseries, emphasizing the role of commercial plant trade in the movement of this pathogen.

Linderman, R.G., Davis, E.A., and Marlow, J.L. 2006. Response of selected nursery crop plants to inoculation with isolates of *Phytophthora ramorum* and other *Phytophthora* species. *HortTechnology* 16(2):216-224.

Summary: Many nursery crops are susceptible to root and foliage diseases caused by numerous species of *Phytophthora*. *Phytophthora ramorum* causes sudden oak death of trees and ramorum leaf blight and shoot dieback on numerous nursery plants, including rhododendron (*Rhododendron* spp.), viburnum (*Viburnum* spp.), pieris (*Pieris* spp.), and camellia (*Camellia* spp.) in Europe, the United States, and British Columbia, Canada. We sought to evaluate relative susceptibility of a selection of ornamental nursery crops by inoculating detached leaves with several species of *Phytophthora* known to infect rhododendrons, and to compare the relative virulence on those species to isolates of *P. ramorum*. The results indicated that many plants were susceptible under these experimental conditions, while others were not. On a given host, symptoms caused by all species of *Phytophthora* were identical except for differences in pathogen virulence. Plant species within genera or cultivars within species varied in susceptibility to isolates of *P. ramorum* and other species of *Phytophthora*. *P. ramorum*, *P. citricola*, *P. citrophthora*, and *P. nicotianae* were the most virulent pathogens on most of the host plants inoculated. Some plants were susceptible to several species of *Phytophthora*, while others were susceptible only to *P. ramorum*. Inoculation of detached leaves of 'Nova Zembla' rhododendron, lilac (*Syringa vulgaris*), or doublefile viburnum (*Viburnum plicatum* var. *tomentosum*) under controlled conditions with different species of *Phytophthora* or isolates of *P. ramorum* (both mating types) indicated significant relative differences in species or isolate virulence.

Liu, D., Kelly, M., and Gong, P. 2006. A Spatial-temporal approach for monitoring forest disease dynamics using multi-temporal high spatial resolution imagery. *Remote Sensing of Environment* 101(2): 167-180.

Abstract: Sudden Oak Death is a new disease affecting hardwood forests in coastal California. The spatial–temporal dynamics of oak mortality at the landscape scale are crucial indicators of disease progression. Modeling disease spread requires accurate mapping of the dynamic pattern of oak mortality in time through multi-temporal image analysis. Traditional mapping approaches using per-pixel, single-date image classifications have not generated consistently satisfactory results. Incorporation of spatial–temporal contextual information can improve these results. In this paper, we propose a spatial–temporally explicit algorithm to classify individual images using the spectral and spatial–temporal information derived from multiple co-registered images.

This algorithm is initialized by a spectral classification using Support Vector Machines (SVM) for each individual image. Then, a Markov Random Fields (MRF) model accounting for ecological compatibility is used to model the spatial–temporal contextual prior probabilities of images. Finally, an iterative algorithm, Iterative Conditional Mode (ICM), is used to update the classification based on the combination of the initial SVM spectral classifications and MRF spatial–temporal contextual model. The algorithm was applied to two-year (2000, 2001) ADAR (Airborne Data Acquisition and Registration) images, from which three classes (bare, dead, forest) are detected. The results showed that the proposed algorithm achieved significantly better results (Year 2000: Kappa = 0.92; Year 2001: Kappa = 0.91), compared to traditional pixel-based single-date approaches (Year 2000: Kappa = 0.67; Year 2001: Kappa = 0.66). The improvement from the contributions of spatial–temporal contextual information indicated the importance of spatial–temporal modeling in multi-temporal remote sensing in general and forest disease modeling in particular.

Sun, W, Kelly, M., and Gong, P. 2005. Separation of dead tree crowns from the oak woodland forest mosaic by integrating spatial information. *GeoCarto International* 20(2): 15-20.

Abstract: A stratified method of separating dead tree crowns from the forest mosaic, especially bare soil, is proposed. Both spectral and spatial information extracted from 1m high-resolution digital airborne imagery was used. First, spectrally homogeneous objects were recognized based on a Normalized Difference Vegetation Index (NDVI) image. From this image, large patches of bare soil and small patches of noise were excluded by object-size thresholding. Next, an incomplete bare soil image was generated from thresholding the red band using a histogram-based method. A region-based subtraction algorithm was developed and performed on the homogeneous object image and the bare soil image to remove most small patches of bare soil. Finally, medium-sized patches of bare soil were deleted using the assumption that bare soil areas are spatially much closer to larger, pure bare soil areas. The method proved to be effective. The classification accuracy of dead tree crowns was increased from 21% to 75%.

Garbelotto, M., Hüberli, D., and Shaw, D. 2006. First Report on an Infestation of *Phytophthora cinnamomi* in Natural Oak Woodlands of California and its Differential Impact on Two Native Oak Species. *Plant Disease* 90:685. Published on-line as DOI:10.1094/PD-90-0685C. Accepted for publication 9 February 2006.

NURSERIES

Florida confirmed two *P. ramorum*-positive nurseries in March. Of the 23 *Camellia* plants found infected, five species were identified, including *japonica*, *sasanqua*, *sinesis*, *hiemalis*, and *vernalis*. Both of the Tallahassee nurseries were also found positive in 2004 surveys, following trace-forward investigations as a result of the inadvertent shipping of infested Camellia plants by a Southern California wholesale facility. Investigations have not determined if the pathogen was re-introduced or if it has persisted at the nurseries in soil and/or water since the initial findings. In total, 2,570 plants were destroyed to

achieve Confirmed Nursery Protocol (CNP) standards. It is anticipated that the confirmations will result in trace-back and –forward surveys in Florida and possibly other locations in the southeast.

California had four *P. ramorum* nursery confirmations during April. **One of the** facilities was a San Mateo County producer confirmed positive during a nursery stock cleanliness inspection. The positive plants identified were *Camellia sasanqua* 'Jean May,' *Camellia sasanqua* 'Showa-No-Sake,' *Camellia sasanqua* 'Kanjiro,' and *Camellia sasanqua* 'Bonanza.' This nursery was also found positive in 2004 and 2005, is not under compliance, and does not ship out of the quarantined counties. A second facility identified was a Sacramento County producer, found positive as part of a trace-back investigation (resulting from a positive *Camellia* detected 3-8-06 at another Sacramento County facility). The positive plant was a *Camellia japonica* 'Mrs. Charles Cobb.' This nursery was also found positive in 2005 as part of an annual compliance agreement sampling and completed the USDA CNP in August of 2005. This nursery does ship interstate, but only to Nevada. Trace-forward and -back investigations are underway. A third confirmation was made at an Alameda retail nursery during a nursery stock cleanliness inspection. The positive plants identified were *Rhododendron* 'Edith Bosley,' *Camellia japonica* 'Tom Knudsen,' and *Pieris japonica* 'Shojo.' This nursery was also found positive in 2005 trace-forward investigations. The nursery does not ship any plants out of the quarantined counties. The final April confirmation was at an Alameda County retail nursery confirmed positive during a nursery stock cleanliness inspection. The positive plant was a *Camellia japonica* 'Debutante.' The nursery does not ship plant material out of the quarantined counties and has not been found *P. ramorum*-positive in the past. The addition of these 4 confirmed facilities brings the state's 2006 total to 12.

The Oregon Department of Agriculture (ODA) has completed approximately 50 percent of its *P. ramorum* 2006 Federal Order inspections. As of April 14th, 15,025 samples have been collected from 267 sites and analyzed for the presence of the pathogen. *P. ramorum* was found at 4 (2%) of the sites surveyed with *Phytophthora* species detected at 45 (17%) of the surveyed sites. Three of the confirmed sites were small grower facilities located in Polk, Washington, and Lane Counties. The fourth confirmed site was a small retail facility located in Lane County. Plants found positive included *Camellia japonica, Rhododendron,* and *Pieris japonica*. Two of the small grower nurseries did ship a small volume of host plants out-of-state; trace-forward investigations are underway. The USDA CNP has been initiated at all sites.

Eight blocks of plants (six from the confirmed locations and two from other locations) that tested nested-PCR positive for *P. ramorum* and culture negative were determined by USDA to be *P. hibernalis*. Six were sampled as part of delimitation surveys and two sampled for annual certification. The ODA anticipates completing Federal Order *P. ramorum* certification by June 30th. Christmas tree and retail nursery *P. ramorum* surveys are scheduled to begin surveys statewide in May.

REGULATIONS

On April 27-28 in Orlando, Florida, the USDA Animal and Plant Health Inspection Service (APHIS) *P. ramorum* program convened a "mini" science panel to address soil and water treatments, as well as pathways of *P. ramorum* infection. A group of scientists and regulators from across the country discussed: best methods, based on current science, to mitigate *P. ramorum* in soil and water; and the primary pathways of infection from soil or water to plants. The meeting was prompted by recent detections in standing and flowing water. For more information contact Philip Berger, National Science Program Leader - Molecular Diagnostics & Biotechnology at Philip.H.Berger@aphis.usda.gov.

The Washington State Department of Agriculture and USDA APHIS officials met on April 18 and 19 to develop options to address a Washington nursery soil detection and detection of *P. ramorum* in an adjacent stream. A monitoring strategy and treatment alternatives were formulated. For more information, contact Brad White, WA State Department of Agriculture, at: bwhite@agr.wa.gov.

MONITORING

Redwood National and State Park (RNSP) has hired two seasonal botanists to implement a Sudden Oak Death (SOD) Early Detection Survey this spring/summer. The botanists will be conducting non-random surveys for SOD/*P. ramorum* symptoms within specific areas of the park. The focus of the monitoring will be park areas where host species, in particular tanoak, CA bay laurel, and rhododendron, intersect visitor use areas such as campgrounds, day use facilities, and trails. The intent of this early detection monitoring program is to increase our awareness of symptomatic host species in areas of the park where SOD is likely to appear. While it is not feasible to cover all 130,000 acres of parkland in one season, the park will conduct monitoring in high priority visitor use areas, where the disease is likely to be seen first in the park. Moreover, aerial flyovers conducted by the Forest Service will monitor areas of the parks away from visitor use facilities. RNSP will be working closely with aerial detection survey crews to coordinate any ground-level reconnaissance of symptomatic hosts within the parks. For a second year water sampling of key locations within the parks to detect *P. ramorum* in specific watersheds will also be implemented. The combination of aerial, aquatic, and non-random monitoring should give park managers some measure of confidence that if *P. ramorum* is present in RNSP, and likely detect its presence early. This monitoring effort is being funded by the Biological Resource Management Division of the National Park Service. For more information, contact Leonell Arguello, Supervisory Botanist, Redwood National and State Parks, at: Leonel_Arguello@nps.gov.

The USDA Forest Service and collaborators will begin their 6th year of Sudden Oak Death aerial survey monitoring in mid-May. Aerial surveys in central and southern California will take place in Monterey, Western San Benito, San Luis Obispo, and Santa Barbara Counties, and surveys in Northern CA will take place in Del Norte, Humboldt, and Mendocino. Areas found to have oak mortality will be followed up with ground-check surveys. Samples of symptomatic host species, including oaks, tanoaks, and California bay laurel trees will then be collected for laboratory diagnosis. Cooperation

from landowners, by granting access to their property for the ground surveys, will be crucial to the success of the monitoring program. Informational meetings are being held for community members and landowners to learn more about the program and the importance of their participation. For more information on the USDA FS monitoring program, please contact Lisa Bell, USDA-FS, SOD Monitoring Outreach Coordinator at: (866) GOT-OAKS or lisabell@fs.fed.us.

RESOURCES

The OakMapper has been expanded, providing visitors with even more options for accessing Sudden Oak Death/*P. ramorum* (SOD) spatial data. In addition to the traditional OakMapper website and static map downloads, confirmations can also be viewed via Google Maps and Google Earth, allowing for high spatial resolution imagery in areas with *P. ramorum*, such as viewing dead crowns around *P. ramorum* confirmation points. For all options, go to: http://kellylab.berkeley.edu/SODmonitoring/whereisSOD.htm. Stay tuned for more changes to the OakMapper this year! Submit OakMapper comments and feedback to: http://kellylab.berkeley.edu/OakMapper/UserSurvey/.

"Regulated Forest Hosts" and "Sudden Oak Death Guidelines for Forestry" documents have been posted to the CA Oak Mortality Task Force website homepage at: www.suddenoakdeath.org. The forest host document lists federally regulated hosts and associated hosts found in California's forests and the forestry guidelines provides best management practices for those working in forests affected by *P. ramorum*.

PERSONNEL

The University of California Cooperative Extension (UCCE) office in Marin is recruiting a student Sudden Oak Death Outreach Assistant for $11/hour this summer. Under the supervision of Janice Alexander, the Sudden Oak Death Outreach Coordinator, the student assistant will update and revise outreach materials as suggested by responses to an outreach survey conducted last year. Student status and education/outreach experience are required. Resumes are due by May 10, 2006, and should be mailed to Janice Alexander at: jalexander@ucdavis.edu. For more information on the position, contact UCCE Marin at (415) 499-4204 or email Janice Alexander at: jalexander@ucdavis.edu.

Ken Wong replaced Rob Ormrod in April as the Canadian Food Inspection Agency *P. ramorum* National File Leader. Prior to his new position, Ken led the *P. ramorum* survey and eradication programs at the field-level in the Vancouver/lower mainland area. Ken may be reached at (604) 666-7777 or via email at: wongkw@inspection.gc.ca. Rob Ormrod returned to his former position as the Western Area Horticulture Specialist, and may still be reached at (250) 470-4893 or ormrodr@inspection.gc.ca.

CALENDAR OF EVENTS

5/4 – Sudden Oak Death Aerial Monitoring Informational Meeting; Intended for community members and landowners to learn more about the program and

importance of participation; 10:00 – 11:00 a.m.; San Luis Obispo County Sheriff's Department Offices, Conference Room; 356 North Main Street; Templeton, CA 93465; For more information, contact Lisa Bell, USDA Forest Service Sudden Oak Death Monitoring Outreach Coordinator at: (866) GOT-OAKS.

5/5 – Sudden Oak Death Aerial Monitoring Informational Meeting; Intended for community members and landowners to learn more about the program and importance of participation; 9:30 – 10:30 a.m.; San Luis Obispo County Agricultural Commissioner's Office, Downstairs Auditorium; 2156 Sierra Way; San Luis Obispo, CA 93401; For more information, contact Lisa Bell, USDA Forest Service Sudden Oak Death Monitoring Outreach Coordinator at: (866) GOT-OAKS.

10/9 – 12 – 6th California Oak Symposium, titled "California's oaks: Today's challenges, tomorrow's opportunities;" Intended for academics, planners, conservation practitioners, foresters, arborists, land owners, and oak enthusiasts; For more information, visit the Symposium website at: http://danr.ucop.edu/ihrmp/symposium.html.