



CALIFORNIA OAK MORTALITY TASK FORCE

CALIFORNIA'S 2006 *PHYTOPHTHORA RAMORUM* PROGRAM

Phytophthora ramorum, the pathogen known to cause Sudden Oak Death, poses a serious threat to forests and horticultural nurseries worldwide. While this pathogen is currently known to infect 85 different plant species, its natural distribution in California is limited, making an aggressive and comprehensive program necessary to minimize its spread. In North America, this quarantine pathogen is found in the redwood/tanoak and mixed-evergreen forests of 14 coastal California counties, as well as in Curry County, Oregon, where eradication efforts are ongoing. The quarantine pathogen has also been detected in hundreds of nurseries in 20 states as well as several nurseries in British Columbia. In Europe, *P. ramorum* has been found in nurseries in 11 countries, as well as in several wildland areas in the UK and the Netherlands.

This document outlines high-priority *Phytophthora ramorum* management, education, research, and monitoring projects that will be implemented in 2006 by various agencies and organizations in California. The California Oak Mortality Task Force (COMTF), comprised of public agencies, nonprofit organizations, and private interests, is coordinating California's response to this pathogen. Through a collaborative effort, California's *Phytophthora ramorum* program is working towards sustaining forests and landscapes, safeguarding the nursery industry, and promoting public safety.

The goals for California's 2006 *Phytophthora ramorum* program are to:

1. Minimize pathogen spread and promote public safety. Provide management strategies and information to sustain California forests, landscapes, and affected industries.

Minimizing Pathogen Spread

The potential for future infection and pathogen spread is not fully known, though concern is great. Currently, there is no known cure, and only limited preventative measures are available for susceptible oak and tanoak trees; therefore, the primary defense available at this time is to minimize the artificial spread of the pathogen to uninfested areas. To accomplish this, the following priorities have been identified for quarantine policy and enforcement:

- Continue implementing and strengthening regulations to prohibit human movement of the pathogen. Work to ensure enforcement is consistent throughout California by providing training sessions, written materials, and an up-to-date Task Force website (www.suddenoakdeath.org). Coordinate outreach activities, including training sessions for officials and affected parties in non-quarantine California counties. Provide research updates to regulatory officials so quarantine policies and enforcement guidelines reflect recent research findings. Identify funding and resource needs necessary for 2007 quarantine efforts. Provide technical, logistical,

and local support to international, federal, state, and county regulatory agencies as needed.

- Provide additional support to California coastal counties with limited infestations. Assist Humboldt County with their *P. ramorum* Slow-the-Spread Project and early detection program conducted via air, ground, and water-based observations. Refine the Humboldt County delimitation pilot project for use in counties with isolated infestations, such as Mendocino. Assist with *P. ramorum* management plan development for Monterey County. Promote strategies for inoculum reduction to limit long-distance spread.

Management Strategies

Effective management of *P. ramorum* infestations in California's wildland settings varies with local conditions. In Northern California, pathogen distribution is still limited. Del Norte County remains uninfested and the *P. ramorum* detections in Humboldt County are contained to 25-30 square miles in an area that is geographically isolated from other known infestations. Mendocino County has only five infested sites. Since the infested areas in Northern California are not widespread, a more aggressive, slow-the-spread and early detection monitoring program will be continued to protect forests and other resources in these areas. Along the Central California Coast (particularly Sonoma, Marin, Napa, Santa Cruz, and part of Monterey County), where the pathogen is common, management strategies will focus on containing the pathogen so new areas are not contaminated. To meet disease management goals, the following priorities have been identified:

- Provide protection to Northern California coastal areas with limited infestations. Continue to implement and determine how to fund the Slow-the-Spread Project in Humboldt County. Continue working with landowners of infested sites for early pathogen detection, as well as removal and treatment of infected plant material. Develop education strategies to help landowners better understand how vegetation treatments for *P. ramorum* fit into other appropriate land management goals. Continue monitoring water, soil, and vegetation in and around the project areas, as well as throughout the north coast.
- Support suppression efforts at the southern edge of the infested area, such as the Big Sur adaptive management/research project.
- Broaden outreach and monitoring efforts to counties bordering quarantined counties. Assist San Luis Obispo County and other border counties with increased monitoring, education, and outreach.
- Improve treatment protocols and develop additional treatments. Refine preventive pesticide application techniques with phosphonate, as well as improve training materials and guidelines for its use. Continue to establish research plots to evaluate limiting pathogen spread at the stand level by selectively removing California bay laurel and/or tanoak. Continue working to develop an effective treatment for use on California bay laurel trees. Evaluate the effectiveness of protecting tanoaks and oaks with phosphonate applications. Develop new treatment methods for the pathogen.

- Strengthen Sudden Oak Death management in known infested areas. Work with land managers and owners to develop *P. ramorum* management plans for infested private parcels, parks, and forests. Identify needs for monitoring, employee and public education, and quarantine compliance, sanitation practices, and restoration for infested parks, open spaces, and forest lands.
- Promote best management practices to limit pathogen spread. Artificial pathogen spread may be limited by sanitation practices and other best management practices (BMPs). Continue to update the best management practices handouts and continue outreach to outdoor enthusiasts, forest users, land managers, landowners, and related industries.
- Work toward identifying effective treatments for pathogen elimination in horticultural plants and efficient tracking methods of individual plants in the nursery industry.
- Develop mitigation strategies to restore areas severely impacted by *P. ramorum*, especially where the loss of trees may result in the conversion of areas to invasive plant species.

Information to Sustain California Forests and the Nursery Industry

As Sudden Oak Death has spread to more counties and jurisdictions, the need to facilitate communication between disparate entities has greatly increased. Through a coordinated approach, impacted groups will be afforded a platform to express concerns and explain issues, develop strategies and pool resources, define funding needs, and cooperatively implement ideas. To meet the goal of providing information and coordination in a timely and up-to-date manner, the following priorities have been identified:

- Synthesize, organize, and update information on *Phytophthora ramorum*. Maintain and expand the Task Force website (www.suddenoakdeath.org) so photos, maps, and other documents are current, downloadable, and easy to locate. Expand the research web page to include information on outcomes of funded research as well as other research updates. Expand the management web page, providing more user-specific information for affected entities, such as pesticide applicators and nursery industry professionals, as well as information on Slow-the-Spread projects and other management efforts. Develop educational tools to communicate rationales for treatments. Include a look-alike symptoms page for host plants affected by other diseases, as well as a new section addressing sampling techniques. Publish a diagnostic key and other aides to assist with accurate diagnosis. Revise and highlight FAQs to address commonly asked questions. Address the use of herbicides for control of *P. ramorum*, such as using herbicides to kill tanoaks instead of cutting to remove them for suppression. Update *P. ramorum* briefing papers and provide documentation on funding, research, and outreach activity. Update pest alerts and other outreach material to reflect current research findings. Assist other entities in development of outreach materials for a broader audience, including other state and national organizations.
- Improve coordination with industries, agencies, and professional associations, such as the Western Chapter of the International Society of Arboriculture, Society of American Foresters, Pesticide Applicators Professional Association, Society of

Ecological Restoration, and American Nursery and Landscape Association, to get information into workshops and newsletters.

- Work with State, local parks, and land managers to get information out to visitors by displaying signs and providing materials that provide disease information as well as contacts for more information.
- Provide direction for California's *Phytophthora ramorum* program. Develop California's long-term *Phytophthora ramorum* Strategic Plan and update the annual Strategic Plan. Define goals, objectives, and a work plan for 2007. Provide a funding needs document.
- Continue ongoing assessment of *Phytophthora ramorum*-related needs for industries impacted by the pathogen, including the nursery industry, arboriculture, forestry, utility companies, green waste and cottage industries, public agencies, horticulture industry, and others. Concerns of homeowners, landowners, outdoor enthusiasts, media, environmentalists, Native Americans, policy makers, and the general public will also continue to be determined and addressed. Continue to build ties with the CA nursery industry.
- Offer outreach and assistance to affected parties. Continue to provide assistance to Tribal Nations to prevent pathogen spread and protect Tribal lands and resources. Focus training efforts in non-quarantine California counties, prioritizing them according by proximity to natural infection in regulated counties. Continue to provide training sessions for all other interested persons on pathogen recognition, treatment, sanitation, and regulations.
- Try to determine the effectiveness of COMTF efforts to inform the public and reduce the spread of *P. ramorum* in California and beyond.

2. Further the understanding of Sudden Oak Death, *Phytophthora ramorum*, associated organisms, and environmental factors contributing to tree and plant mortality, in addition to identifying ecological impacts.

Sudden Oak Death research and monitoring are the basis for policy, management, and education. Trees, shrubs, and herbaceous plants are all susceptible to *Phytophthora ramorum*. As each of the more than 40 affected genera responds differently to the pathogen, research is required for each to understand how it is impacted by the infection and the role it plays in spreading disease. Additional research is also needed to develop practical treatments. Research priority areas include: pathogen biology, transmission and epidemiology, impacts of *Phytophthora ramorum* on ecosystem components, management and disposal, pathogenicity and resistance, plant nursery issues, and monitoring.

Current research needs (many needs listed below do have preliminary projects underway, but still require additional research) include:

- Compare the behavior and genetics of the North American and European populations of *P. ramorum*. Determine pathogen origin and how it was introduced to Europe and North America.
- Determine mechanisms for short- and long-distance spread in wildlands.

- Continue to investigate the role of *P. nemorosa*, *P. pseudosyringae*, and other *Phytophthora* species with habitats similar to *P. ramorum* and their possible interactions with *P. ramorum*.
- Use the elucidation of the *P. ramorum* genome to improve diagnostic tests, understand pathogen virulence, and develop effective treatments.
- Continue to develop a network of research plots in coastal redwood/tanoak and mixed-evergreen forests to determine pathogen spread, intensification, and impact.
- Determine factors driving pathogen spread in horticultural nurseries, including shipping practices, the effect of plant density, irrigation, potting mix composition, fertilization, and fungicides.
- Determine susceptibility of various cultivars of rhododendrons, Pieris, camellia, and other horticultural plants.
- Determine the viability of chlamydospores in soil, potting mix, compost, woody and herbaceous tissues.
- Investigate frequency and importance of root infection in horticultural hosts.
- Determine economic impacts from *P. ramorum*.
- Determine accuracy and precision of diagnostic methods used for *P. ramorum*.
- Determine extent of host resistance for coast live oak and tanoak and evaluate application in a resistance breeding program.
- Develop and test landscape-level treatments for *P. ramorum* in wildlands.
- Develop adaptive management plans for landowners so science-based recommendations may be determined and improved.
- Determine if ridges are the most important areas for strategic treatments.
- Quantify or characterize the level of expected mortality in infested stands.
- Determine if there is a need to establish seed banks for potentially vulnerable or resistant species.
- Determine the effects of prescribed burning treatments on infested stands, especially those recently infested.
- Determine level of risk posed by soil movement.
- Determine the importance of tool sanitation, such as cleaning chainsaws.
- Determine the likelihood of spread out of streams, including the risks posed by low-water ford use.
- Determine the distance spores can travel across open areas from infested stands.
- Determine if potting media and/or its components harbor *P. ramorum* propagules.
- Develop rapid field detection techniques/protocols for sampling of irrigation water and soil for the presence of *P. ramorum* at nursery facilities.
- Determine if the regulated hosts are dead-end hosts or inoculum sources (dead-end host can not be the source of secondary infection). Of the host and associated host plants, determine the different levels of risk.
- Determine the effectiveness of fungicide treatments to control *P. ramorum* in nursery stock. Evaluate application rates and methods.
- Determine if *P. ramorum* can successfully move from the soil or from leaf litter in a potted plant to infect and cause disease in another plant, thereby demonstrating pathogen spread.
- Determine what inoculum load is needed in irrigation water to cause plant infection.

- Determine what impact pruning of host and association host plants has on their susceptibility to infection.
- Determine if *P. ramorum* can be detected in chemically treated plants via molecular diagnostics.
- Determine if there are conditions when *P. ramorum* infections may be latent.
- Develop field diagnostics kits for *P. ramorum*, i.e. *P. ramorum*-specific ELISA.
- Analyze repeat confirmed nurseries to determine what commonalities exist in their nursery operations, layout, procedures and protocols, environment, physical location, etc., and determine if there are similarities. Once a nursery is found positive for *P. ramorum*, determine the best method to eradicate the pathogen so that repeat finds do not occur.
- Determine what sanitation methods are effective for disinfecting nursery beds, propagation facilities, pruning shears, etc.
- Identify environmental conditions, physiological state of the host, and cultural practices that can influence disease development and incidence.
- Clearly establish pathogen differences (if any) based on host range and aggressiveness, and better understand the potential consequences should A1 strains become established in North America.
- Determine the role of airborne dispersal (i.e., free movement of sporangia on air currents) versus wind driven rain in nursery and natural situations.

Monitoring

California's *P. ramorum* monitoring program will include early detection of the pathogen in new areas, as well as mapping of pathogen distribution in areas with limited infestation and new locations within heavily infested areas. Early detection will facilitate pathogen containment, and in some cases, eradication. To meet monitoring goals, the following priorities have been identified:

- Focus aerial and ground-based surveys on uninfested areas bordering infestations such as Del Norte and San Luis Obispo Counties.
- Maintain a web-accessible database of pathogen distribution.
- Quantify forest impacts of *P. ramorum* in CA, including the long-term ecological consequences of elevated tree mortality on the ecological functioning of affected ecosystems. Develop estimates for the number of trees killed and infected.
- Refine monitoring and inspection protocols for use in nurseries. Evaluate monitoring of water, soil, pots, and plants. Evaluate sample size for visual inspection surveys and dependence on symptomology for ability to detect low levels of *P. ramorum* in commercial settings. Determine if symptom-based survey method is sufficient for *P. ramorum* detection. Determine the factors that limit the effectiveness of nursery inspections: do local weather conditions make pathogen detection less likely or is presence of actively growing host plants all that is needed?
- Within nurseries, determine the impact of microclimate and forced plant growth on the ability to detect *P. ramorum* during non-conductive environmental conditions.

- Increase early detection monitoring in Humboldt County so new infestations are detected while relatively small in scope.

For more information on California's 2006 *Phytophthora ramorum* program, go to the COMTF website at: www.suddenoakdeath.org or contact Katie Palmieri, COMTF Public Information Officer, at palmieri@nature.berkeley.edu or by phone at (510) 847-5482.