August 2006

California Oak Mortality Task Force

Fire and *Phytophthora ramorum*: A Summary of Issues

Scientific interest has for some time been converging on the following questions: Are *Phytophthora ramorum* and Sudden Oak Death related to fire in California landscapes? What are the effects of prescribed fire on this pathogen? Does mortality caused by Sudden Oak Death significantly increase the risk of wildfire? Can fire prevent or reverse the pathogen's effects?

Researchers are just beginning to find ways to approach these questions. A myriad of factors complicate their efforts. For example, tremendous variability exists between sites infested with *P. ramorum* in California. This variability includes fuels conditions from one site to another. It is difficult to find sites and conditions that are safe to burn and that enable scientists to replicate their burning treatments for statistical confidence. Some preliminary work has appeared, in the areas of fire history, prescribed burning, smoke studies, and hazardous fuels, but this work provides no hard and fast answers. What we do know is summarized below.

Fire History (GIS) Studies. Researchers from UC Berkeley and UC Santa Barbara examined Geographic Information System (GIS) maps of areas that have burned in California within the past fifty years and compared them with maps of areas known to be infested by *P. ramorum*. In general, they found *P. ramorum* infesting areas that had not recently burned.

While this sounds promising, and the study represents an important initial exploration of the data related to Sudden Oak Death and fire, a caveat applies. Because of limitations inherent to the only available data, the researchers were unable to verify conclusively that the conditions represented by that data set match conditions on the ground. The study relied on a map of reported *P. ramorum*-infected trees that, although the most comprehensive available, did not necessarily cover all infected trees in California. The map grew not from a systematic survey, but from observations of individual infected trees made by people and reported to the mappers on a case-by-case basis. The distribution of *P. ramorum* in California has changed significantly since 2002, the year referenced in the study (in 2005 and 2006, for example, infestations have increased explosively because of wet winters that encourage prolific pathogen reproduction). A comparison of the two sets of maps today might reveal a different pattern than the comparison based on 2002 data.

Burning *P. ramorum*-infested foliage

Nor has the accuracy of fire perimeter maps for the past fifty years been verified. Robust studies of the relationship of fire history to *P. ramorum* distribution will require researchers to ground-truth their maps by establishing plots in the forest to verify the presence or absence of historical fires as well as *P. ramorum.* This kind of effort is now underway in Sonoma and Monterey Counties.

Also, *P. ramorum* is most common in and near urban areas, which coincidentally rarely burn because of active fire suppression. The presence or absence of fire may be associated with pathogen presence, but there is no direct evidence that one has any influence on the other; another factor, or several factors, may underlie the intriguing pattern discovered by the study. This GIS study's value lies primarily in its suggestion of a possible linkage between fire history and vegetation susceptibility to Sudden Oak Death. It points the

Prepared by Chris Lee, UC Cooperative Extension

way to further studies conducted on the ground. Such studies are currently underway by laboratories based at Sonoma State University and the University of North Carolina at Charlotte, both of which are studying possible relationships between past land-use history in general (not just fire) and *P. ramorum* infection, but it may be several years before they reach any conclusions.

Smoke Studies. Does smoke inhibit *P. ramorum* growth or development? Does smoke kill the pathogen? Researchers with the Wildlife Conservation Society, California Department of Food and Agriculture, and UC Berkeley conducted exploratory experiments in which they exposed *P. ramorum*-infected plant tissue to varying levels of smoke for varying lengths of time and then attempted to recover *P. ramorum* from the treated plant tissue. Although these projects weren't comprehensive enough to allow the researchers to draw definite conclusions, they did make two important observations. First, smoke exposure only prevented *P. ramorum* from growing if the pathogen was actively sporulating at the time of exposure. Second, the longer that plant materials were exposed to smoke, the more likely *P. ramorum* growth was inhibited.

These observations have not yet been replicated by further experimentation. However, they do raise some potentially troubling points for those who would like to use smoke for pathogen control. Smoke conditions in wildland or prescribed fires are rarely as consistent for long periods of time in the forest as in the laboratory, and wildfires do not burn during the wet winter conditions when *P. ramorum* is actively sporulating.

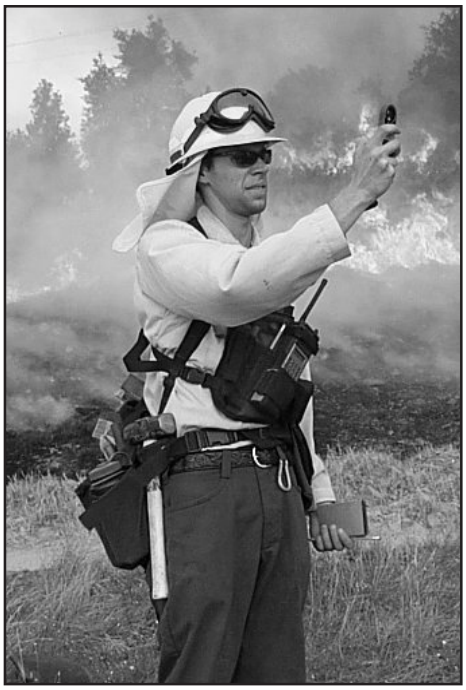
Fire in California Landscapes

Native American and other land managers before the era of fire suppression often burned forested and meadow areas to keep those areas open and free of brush, to encourage the growth of young plant shoots, to make traveling easier and visibility better, and for various other reasons. Much of the forested landscape we see today, overstocked with shade-tolerant hardwoods and brush, has grown in the absence of regular fires. It is logical to wonder: since regular, low-intensity fires play an important role in maintaining forest health and keeping stands of trees open and vigorous, can these fires also play a role in alleviating the effects of *P. ramorum* or eliminating the pathogen altogether?

Prescribed Fires. In Marin County, land managers have used prescribed fire on some properties infested with *P. ramorum*. Working in a landscape featuring both coast live oak and tanoak, the Marin County Fire Department observed that infected tanoaks in these forests were more susceptible to large amounts of crown scorch than were uninfected tanoaks (this pattern did not hold for coast live oaks). The Fire Department has also observed some instances in which *P. ramorum* has become established in stands of trees where prescribed burns formerly took place.

Smoke from burn piles

In the Brookings area of southwestern Oregon, land managers cut the vegetation on several sites and then broadcast burned the sites in an attempt to eradicate a *P. ramorum* infestation. The following year, most new tanoak sprouts (>90%) growing from the stumps of trees that had been infected were themselves infected, although no one completely understands the mechanism of this reinfection. This discouraging development has since forced the Oregon



Checking prescribed burn conditions

managers to support their eradication efforts with herbicide treatments to kill the tanoak root systems that remain in the ground.

Additional information about burning could come from a study of the effects of various silvicultural management techniques on *P. ramorum* in Humboldt County, where pile burning of infested branches, leaves, and brush as well as broadcast burning will hopefully provide information about the effects of this burning on inoculum levels and disease incidence in infested forests.

Hazardous Fuels. A further area of concern—in some places an urgent concern—involves how tree mortality caused by *P. ramorum* might alter the amount, condition, and configuration of fuels in those stands, potentially putting them and nearby communities at greater risk of severe wildfire. Like most wildfire threats to human lives and structures, this one imperils those who live at the interface between town and forest, where roads are narrow, small trees and brush have proliferated both before and after *P. ramorum's* arrival, and now *P. ramorum* is adding fuels by killing numerous tanoaks. Community concern over the growing fire hazard has inspired a nascent effort in Sonoma County to characterize the ways in which *P. ramorum*-caused mortality can change standard vegetation fuel models. Agencies such as the U.S. Forest Service and the California Department of Forestry and FireProtection use these models to simulate and predict the behavior of fires in order to assess potential damage and formulate best responses. An understanding of how *P. ramorum* changes these models is a basic first step toward understanding the pathogen's effects on fire dynamics and fire hazards in infested ecosystems. However, plot- or transect-based inventories of fuels, and other kinds of other long-term studies, will be necessary to deepen that understanding.

Smoke exposure only prevented P. ramorum from growing if the pathogen was actively sporulating at the time of exposure.

In Summary: These preliminary studies suggest a need for further fire-based research projects as the overall study of *P. ramorum* evolves. Possible techniques to manage *P. ramorum* in wildlands may be limited since most fire-use methods are very difficult to apply over entire watersheds. Although the results of prescribed fire studies so far are limited, they don't invalidate enthusiasm for fire as a landscape management tool. Fire naturally dominates California plant communities, most of which have adapted to some degree to periodic burning (which has been greatly restricted over the last century). Whether or not prescribed fires truly prevent or remedy the damage caused by *P. ramorum*, they will continue to be a preferred option for many landscape managers. New studies, such as those in development in Humboldt County and Big Sur, will continue to be implemented to study the value of prescribed fire in controlling Sudden Oak Death, although it will likely be many years before definitive results are available.

For More Information

The California Oak Mortality Task Force is a 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.

Flaming tanoak
Photo courtesy of Marin County Fire Dept

You can find out more information about *P. ramorum* research, regulations, management, and impacts at the website of the Task Force, www.suddenoakdeath.org. There you will find, among other resources related to *P. ramorum*:

- History and background
- Plant hosts
- Pathogen and host photographs
- Distribution maps
- Pertinent regulations
- A monthly newsletter
- Local contacts
- Information for and about nurseries
- A library of research
- Free educational publications to download (right):

And more!

A Safety Message for Firefighters: Precautions Regarding Sudden Oak Death

Distribution of *P. ramorum* in North American forests

P.ramorum symptoms on young tanoak