Detection and Eradication of *Phytophthora ramorum* From Oregon Forests, 2001-2011[1]

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Abstract

Sudden oak death (SOD), caused by *Phytophthora ramorum,* is lethal to tanoak (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos, Cannon & S.H. Oh), and threatens this species throughout its range in Oregon. The disease was first discovered in coastal southwest Oregon forests in July 2001. Since then an interagency team has been attempting to eradicate the pathogen through a program of early detection surveys followed by destruction of infected and nearby host plants. Eradication treatments eliminated disease from many infested sites, but the disease continued to spread slowly, predominantly northward, in the direction of winds that prevail during storms and wet weather. During the 10-year period, the disease spread from the initial infestations southward 1.9 km (1.2 mi), and northward and eastward 28 km and 7.6 km (17.3 mi and 4.7 mi), respectively. The area under quarantine has expanded five times, from 22 km^2 (9 mi^2) in 2001 to 505 km^2 (202 mi^2) in early 2012. Continued spread of SOD is attributed to the slow development of symptoms in infected trees which hinders early detection, and to delays in completing eradication treatments due to inconsistent funding. A sharp increase in disease in 2010 and 2011 necessitated major changes to the SOD management program and quarantine regulations.

Keywords: *Phytophthora ramorum*, sudden oak death, eradication, Oregon, tanoak

Introduction

Sudden oak death (SOD) is caused by *Phytophthora ramorum,* a pathogen of unknown origin and world-wide importance. It has been causing widespread mortality of coast live oak (*Quercus agrifolia* Née), tanoak (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos, Cannon & S.H. Oh), and California black oak (*Quercus kelloggii* Newb.) in California for nearly 2 decades, where it now occurs in 14 counties (Rizzo and Garbelotto 2003, Rizzo et al. 2002). In Europe, where the pathogen formerly occurred only in the nursery trade, it has spread to trees and forests (Brasier and Webber 2010). The pathogen has potential to spread throughout coastal forests of the United States west coast (Meentemeyer et al. 2004, Vaclavik et al. 2010) and to cause considerable ecological and economic damage to the forestry and nursery industries (Hall 2009). Risk models show that many forests of the world, including the hardwood forests of the eastern United States, are highly susceptible to this pathogen. Accordingly, the pathogen is highly regulated through international and domestic quarantines.

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Sudden oak death was first discovered in Oregon forests in July 2001 near the coastal city of Brookings, 8 km (5 mi) north of the California border. Archival aerial photographs revealed tanoak mortality in at least one of the infested sites, suggesting that disease probably was present there since 1998 or 1999. At the time of discovery in Oregon, we knew of five infested sites encompassing a total of 14.6 ha (36 ac) distributed over an oblong area 4 km (2.5 mi) (north-south) by 1.9 km (1.2 mi) (east-west). Soon after the initial detection, we convened an emergency meeting of personnel from the Oregon Department of Agriculture (ODA), Oregon Department of Forestry (ODF), Oregon State University (OSU), and the U.S. Department of Agriculture Forest Service (USDA FS). Because of the apparently small number of infestations and the unknown potential for damage, we decided to attempt eradication of the pathogen by cutting and burning all infected and symptomatic host plants in the infested sites. Also at that time, the ODA established an emergency quarantine area of 22.5 km^2 (9 mi^2) from which movement of all host material was prohibited (Goheen et al. 2002).

Ten years later, it is clear that we failed in our initial goal of complete eradication of the pathogen from Oregon forests. The program now continues with a revised goal of containment and slowing spread, using early detection and eradication as the primary tools for reducing inoculum available for disease intensification and spread.

Ecology of *P. ramorum* in Oregon Forests

Phytophthora ramorum produces aerial propagules under wet conditions and mild temperatures. In the wet, mild climate of Curry County, spore production has been documented year-round and disease can spread anytime suitable weather conditions occur. In Oregon, the primary host is tanoak, which is killed by the pathogen and acts as a source of inoculum throughout the year (Hansen et al. 2008). The disease spreads locally by rain splash and over long distances (several km) via wind and wind-driven rain from the canopy of infected tanoak trees (Reeser et al. 2010). Many other forest plant species are also susceptible to the pathogen when growing close to tanoak. These include Pacific rhododendron (*Rhododendron macrophyllum* D. Don ex G. Don), Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), evergreen huckleberry (*Vaccinium ovatum* Pursh), red huckleberry (*Vaccinium parvifolium* Sm.), Oregon myrtle (*Umbellularia californica* (Hook. & Arn.) Nutt.), cascara (*Rhamnus purshiana* DC.), and poison oak (*Rhus diversiloba* Torr. & A. Gray) (Hansen et al. 2005). They do not appear to be important for disease spread in Oregon forests, at least under the climatic conditions prevailing during the past 10 years. Humans also can spread disease by transporting infected plants or infested materials, but this has not been documented in Oregon forests.

The time between initial infection of tanoak and the development of disease symptoms is not clearly understood in natural forest conditions. Infections on leaves and fine twigs can become apparent within weeks of infection as leaf blotches and small lesions, but these are difficult or impossible to detect in standing tanoak trees until infection is abundant and causes discoloration of foliage en masse. The time between initial infection in the crown of tanoaks and the development of trunk cankers and tree death appears to range from several months to several years (McPherson et al. 2005, McPherson et al. 2010). This latent period, when the pathogen is present but not readily detectable, is extremely important to the early detection and eradication program because spore production can occur throughout this period, potentially compromising the effectiveness of eradication treatments.

Early Detection Surveys

The detection program consists of several types of survey, each with their own strengths and limitations. As a group, these surveys have proven highly effective. Even though inconsistent funding has impeded the treatment program, we have maintained a consistent detection survey effort since 2001.

Aerial Survey Followed by Ground Checks

Aerial surveys provide the most extensive, but least "early" detection. Four surveys are conducted annually (February, May, July, and October) that extend from the California border north to the Rogue River, an area of approximately 1250 km^2 (500 mi^2). In the first stage of the survey, observers in a fixed-wing aircraft record the approximate location of recently killed tanoak trees (red-brown foliage) on maps. These records are then used to guide a helicopter to the dead trees. While hovering over the dead trees, the number and condition of the trees are noted and the geographic coordinates determined with hand-held Global Positioning System (GPS) units. Ground crews then use maps, GPS units, and compasses to find the dead trees. All dead-tree locations are visited and trees and plants in the vicinity are checked for symptoms of SOD or other disease. If symptoms are present, two samples of symptomatic plant tissue are collected. One is plated in the field onto *Phytophthora*-selective agar and the other sample is taken to the laboratory for plating and polymerase chain reaction analysis (PCR).

Because aerial surveys are based on the presence of dead trees, they do not offer true early detection. Infested sites detected by this method will have had *P. ramorum* present for months or years prior to the detection. However, because the surveys are flown at frequent intervals and detect recently killed trees, they typically capture new infestations in relatively early stages of development.

Ground Surveys

Ground surveys are very labor intensive, but allow detection of an infestation before dead trees are present or visible to aerial observers. They are conducted by two- or three-person crews walking transects spaced 30 to 50 m (100 to 150 ft) apart while looking for symptoms such as bleeding cankers, stem lesions, wilting shoots, leaf spots, and branch dieback on understory plants and live trees. Samples are collected and treated as described for ground checks associated with aerial surveys.

Ground surveys supplement the aerial surveys and provide data necessary to certify areas as "disease-free" to fulfill quarantine requirements for transporting host material. They are undertaken in areas where landowners request surveys or where presence of the disease is likely based on risk maps or proximity to known infestations.

Stream Baiting

Stream baiting with native rhododendron and tanoak leaves is an extensive survey that offers the possibility of detecting *P. ramorum* before tree mortality is evident (Sutton et al. 2009). Stream baiting is carried out in areas considered at risk of new infestation within and beyond the quarantine area. Streams draining known infested sites also are sampled as positive controls. Year-round sampling of approximately 60 bait stations at 2-week intervals is interrupted only by summer drought or winter floods. The area of drainages sampled ranges in size from 8 to 3634 ha (20 to 8,980 ac) and totals 32 192 ha (80,000 ac).

In several cases, stream baiting indicated an infestation in a drainage area before we detected it by any other means. However, there have been a few cases where an infestation occurred in a drainage, but the stream baits were negative for *P. ramorum* (false negative). Conversely, there have been a few instances (very rare) where we recovered *P. ramorum* from stream baits, but have not found upstream infected plants. We do not fully understand the ecology of *P. ramorum* in streams.

Eradication Treatments

Mandatory eradication began in the autumn of 2001 under the statutory authority of the ODA. Funding initially was provided by the USDA FS and in subsequent years by ODF, U.S. Department of the Interior Bureau of Land Management (USDI BLM), and USDA Animal and Plant Health Inspection Service (USDA APHIS). Although there was no direct cost to landowners, no compensation was made for loss of timber or other values. All eradication activities on federal lands

managed by the USDI BLM or USDA FS have been funded by the respective agencies and have been uninterrupted to date.

After initial detection of *P. ramorum*, each infested site is surveyed for symptomatic plants and a treatment area delimited. In 2001 and 2002, the treatment area boundary was 15 to 30 m (50 to 100 ft) from infected or symptomatic plants. In subsequent years it was increased to 100 m (300 ft), reflecting monitoring data showing that smaller treatment areas often were not large enough to capture the extent of the infestation.

On private and USDA FS land, eradication treatments consist of felling and burning all host plants within the treatment area as soon as possible after detection. Cutting, piling, and burning are accomplished by hand crews, heavy and light equipment, broadcast burning, and any combination thereof. On USDI BLM land, host plants are cut, piled, partially covered with plastic, allowed to cure, and burned 6 to 14 months later. In early 2011, USDI BLM modified this approach by cutting and burning the actual infected trees immediately and making piles of everything else in the treatment area for burning later.

After the first 2 years of treatments, tanoak stumps had sprouted prolifically and *P. ramorum* was occasionally isolated from the new shoots. In 2004 and 2005, all sprouts from previously burned sites were sprayed with herbicide to kill sprouts. Since 2004, all tanoaks in treated areas (other than those on USDI BLM land where herbicide use was restricted prior to 2011) have been injected with herbicide (imazapyr or glyphosate) prior to felling to prevent sprouting. Follow-up treatments often are necessary to destroy residual host material and stump sprouts that may harbor the pathogen. Upon completion of burning, most sites are planted with non-host or conifer seedlings.

Infestations detected in February to May often can be treated immediately if fire precaution levels allow burning and if funds are available. We make this a priority because late winter and early spring are important times for disease spread and intensification. For infestations found in summer and fall, we often start cutting immediately and finish burning when fall rains begin. Our goal has been to complete treatments by the end of December to minimize inoculum availability during winter and spring. It is a good plan, but operationally and administratively it has been difficult to achieve, especially in recent years when funding was inconsistent and the amount of disease had increased.

Eradication treatments on private lands were delayed several times because of lack of funds. Treatments were suspended from January to May, 2008, from April to September, 2009, and from November 2009 to April 2010. During these periods we observed disease intensification and spread in several areas. By the time new funds became available in 2010, we had accumulated a large backlog of untreated or partially treated sites. Priority was given to treating outlying sites and sites considered most important in terms of spread outside the quarantine area, while allowing sites near the center and western part of the quarantine area to remain untreated or partially treated for many months. As funds again became limiting in late 2010 and 2011, we gave priority to treating sites nearest the quarantine boundary, once again allowing sites near the center of the quarantine area to remain untreated or partially treated for extended periods of time.

Since 2001, eradication treatments have been completed on approximately 1215 ha (3,000 ac) of land, at a cumulative cost of $7.5 million. There has been no compensation to landowners for the value of timber or other resources lost as a result of the eradication treatments. For the period 2001 to 2009, the area treated for eradication was distributed among landowner groups as follows: private industrial (72 percent); non-industrial private forests (18 percent); rural-residential (6 percent); USDI BLM (3 percent); USDA FS (<1 percent); and state of Oregon (<1 percent).

Preventive Host Removal

Since 2001, 565 ha (1,400 ac) of tanoak forest have been felled or killed with herbicide in advance of the disease in areas of probable disease spread, mostly in the northern part of the quarantine area. These host removal activities were voluntary landowner activities supported in part by state or federal funding.

Eradication Post-Treatment Monitoring

Eradication of *P. ramorum* from individual infested forest sites is difficult, but not impossible. The disease usually does not persist on infested sites following cutting and burning, but the pathogen frequently can be recovered from soil several years after treatment. From 2008 to 2010 we surveyed treated sites to determine the presence of *P. ramorum* in soil or vegetation. Soils samples and vegetation were collected from sample plots established around stumps of known infected trees on sites treated between 2001 and 2008. We established 145 plots in 2008 and 2009 and 143 plots in 2010 (Goheen et al. 2009, Goheen et al. 2010).

In the sample period from 2008 and 2009, *P. ramorum* was not recovered from soil or vegetation on 51 percent of the plots sampled. *Phytophthora ramorum* was present in soil only on 32 percent of plots, in soil and vegetation on 12.5 percent of plots, and in vegetation only on 4.5 percent of plots. In the 2010 sampling, *P. ramorum* was not recovered from soil or vegetation on 63 percent of plots sampled. *P. ramorum* was present in soil only on 25 percent of plots, in soil and vegetation on 7 percent of plots, and vegetation only on 5 percent of plots.

Almost all infected vegetation was tanoak stump sprouts. On plots where *P. ramorum* was baited from soil, recovery was generally low, usually only one of 20 soil samples. The pathogen was recovered from soil up to 8 years post treatment. Further analysis of these data and additional data collected in 2012 is underway (Goheen et al., Monitoring the effectiveness of *Phytophthora ramorum* eradication treatments in Oregon tanoak forests, this proceedings).

Disease Spread, 2001 to June 2012

Continued spread of SOD is attributed to the slow development of symptoms in infected trees which hinders early detection and to delays in completing eradication treatments which allow disease spread from known infestations. From 2001 to 2004, the number of new infested sites discovered in surveys remained steady or decreased, suggesting modest success at containment and eradication. In 2005 and 2006, the number of new infested sites and the distance between them began increasing, possibly the result of 2 consecutive years of unusually wet spring weather which favored spread of the pathogen. Several new sites found during this period were more than 3 km (2 mi) from previously known infected trees and outside of the existing quarantine boundary. From 2007 to 2009 the trend in occurrence of new infested sites appeared to stabilize at approximately 60 new disease patches per year, with no new sites outside of the existing quarantine boundary (fig. 1).

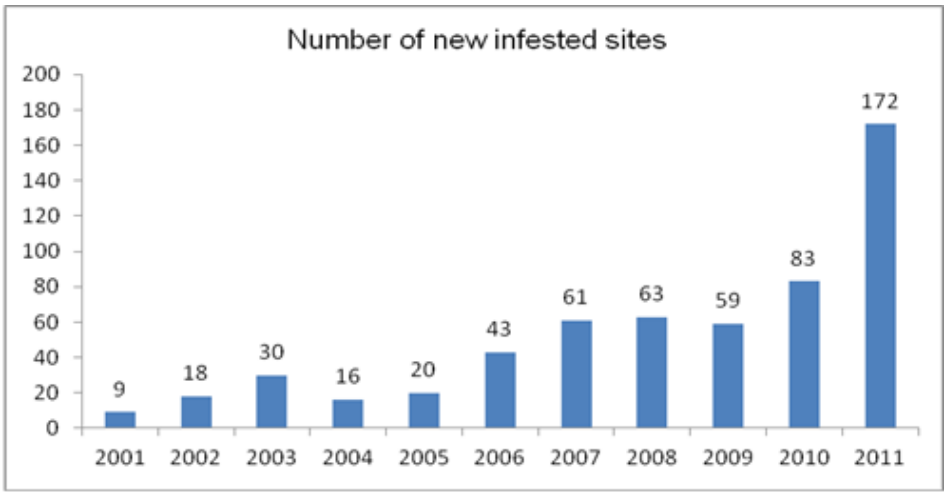

Figure 1—Number of new sites infested with *Phytophthora ramorum* discovered annually between 2001 and 2011 in Curry County, Oregon forests.

By the end of 2010, the number of new infested sites had increased to 83. All were well within the existing quarantine area, and most were small with few infected trees, suggesting relatively early detection. Distribution of new sites was uneven with noticeable intensification at Cape Ferrelo in the Taylor-Duley creek drainages (west side of quarantine area) where treatment delays had occurred in prior years.

In 2011 we detected 172 new infested sites, nearly triple the 3-year average. The majority of new sites were in the core of the quarantine area, mostly on private land and mainly in the Cape Ferrelo area. Many new sites were very close to previous infestations, probably a result of delays in completing treatments promptly. One of the sites (Cape Sebastian) detected in September 2011 was 10.5 km (6.5 mi) north of the quarantine boundary and 19.3 km (12 mi) from the nearest known infested site. At least 25 infected trees were identified at the site, suggesting that the pathogen had been there for at least a year. We do not know if this infestation was the result of natural or human-assisted spread.

In May, 2012, a new infestation was confirmed on USDA FS land along Wheeler Creek, just outside of the southwest corner of the quarantine area. The area is remote and rugged, with very little human activity other than occasional hikers. Treatment of the 19 ha (48 ac) unit began in June immediately following delimitation surveys. An emergency quarantine area of 68 km^2 (27 mi^2) was established to include the Wheeler Creek infestation.

Apparent long-distance spread has been observed several times with distances of 3 to 5 km (2 to 3 mi) (in one case 20 km) between infested sites with little evidence of infestations between them. The likelihood of long-distance spread increases with the amount of source inoculum and the length of time it is present on the landscape. As untreated infestations intensify and expand, we expect an increasing number of long-distance spread events.

New infestations often occur very close to eradication sites within a year of treatment. In most cases we believe this is due to latency of the pathogen rather than spread during the treatment process or failure to detect symptomatic trees at the time of delimitation. This problem can be solved somewhat by large treatment area buffers to capture pre-symptomatic or cryptic infections. In at least three instances where we found the disease in early stages and used large treatment areas of 10 to 16 ha (25 to 40 ac). the disease has not appeared in the adjacent forest 4 years post treatment. Treatment area buffers of 200 m (600 ft) or more from infected or symptomatic plants probably are necessary to capture most nearby (but not readily detectible) infected plants.

Disease spread during the 10-year period has been predominantly northward, following the prevailing wind direction during storms and wet weather. The disease has spread from the initial infestations southward 1.9 km (1.2 mi), and northward and eastward 28 km and 7.6 km (17.3 mi and 4.7 mi), respectively. The area under quarantine has expanded five times: from 22 km^2 (9 mi^2) in 2001 to 505 km^2 (202 mi^2) in early 2012. The current quarantine area and distribution of the disease are shown in fig. 2.

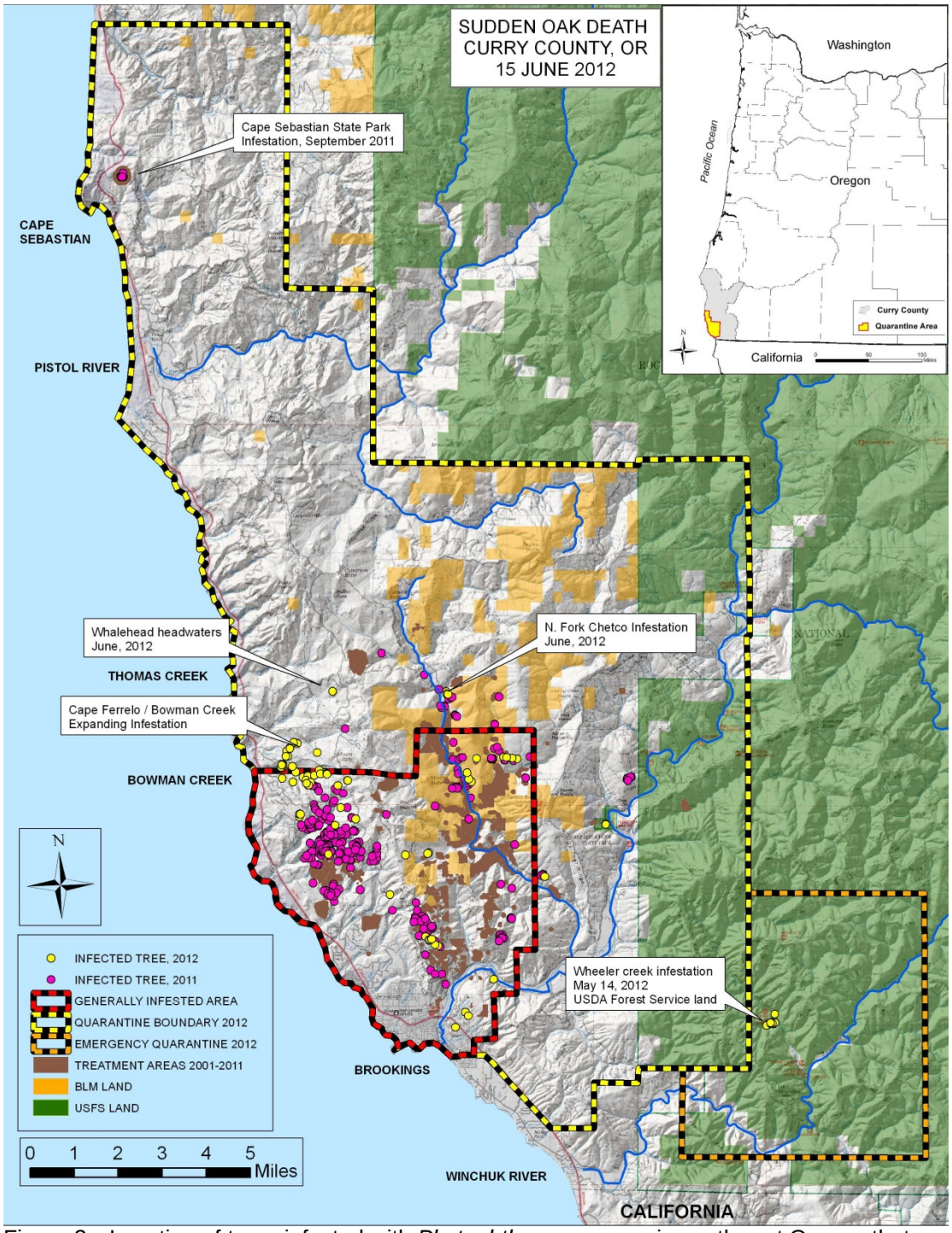

Figure 2—Location of trees infected with *Phytophthora ramorum* in southwest Oregon that were discovered in 2011 through June 2012 (enlarged for visibility). Brown polygons indicate eradication treatment areas.

Costs and Funding

Program expenditures from 2001 to 2011 totaled $11.5 million for detection surveys, eradication treatments, and administration (does not include university research or the *P. ramorum* nursery program). Approximately $7.5 million of this went toward eradication treatments. Current annual cost

of detection surveys and administration is $400,000 (Brookings staff, Salem staff, aerial surveys, lab support). Eradication treatments average approximately $6,200 per ha ($2,500 per ac). The major sources of funds were: USDA FS, $7 million (59 percent); USDI BLM, $2.2 million (18 percent); USDA APHIS, $470,000 (4 percent); state of Oregon, $2.2 million (18 percent); and private industry, $80,000 (1 percent).

Despite consistent high levels of support from the USDA FS, several aspects of funding have hindered the eradication effort. Many times funds that were expected early in a federal fiscal year were not available until the federal budget was officially passed, often as late as spring or summer of the following year. Unfortunately, the waiting period was during winter and spring when most disease spread occurs. At other times, federal funds were available, but the state could not secure the required non-federal matching funds, so we could not accept the funds. Nearly $1 million in federal funds were forfeited for this reason. In addition, when the economy declined in 2008, the state chose to offset budget reductions by returning $265,000 of state general funds specifically allocated for SOD treatments. The net effect of these funding problems was that we fell farther and farther behind in our eradication treatments, allowing sites that should have been treated promptly to carry over into the following year, creating a backlog of sites requiring treatment. Meanwhile, new, often higher priority sites (in terms of disease spread) continued to appear.

In an attempt to recover lost ground and begin host removal in advance of the disease front, we applied for $4.4 million through the American Recovery and Reinvestment Act, the so called "stimulus program." We were awarded $2.7 million (no requirement for matching funds), which finally became available in April 2010, allowing us to add staff in Brookings, resume work on the backlog of untreated sites, and complete treatment of all high-priority sites identified in 2010. But it may have been too late. The previous delays had allowed the disease to intensify and spread, and by mid-2011 it was clear that the area requiring treatment on private land would exceed available or expected funds, and a major program change would be necessary.

Finding non-federal funds to match available federal dollars remains a challenge. In 2011 we were able to obtain matching funds from private landowners through a 50-50 cost share program for treatments and in-kind services for work related to SOD management. Even with ample matching funds, the combined state and federal fund sources were not sufficient to continue treating all sites. At the 2010 levels of disease and staffing, we estimated an annual program cost of $2 million to $2.5 million dollars to continue the early detection surveys and treat infested sites with 100 m (300 ft) treatment buffers. The expected budget, however, was approximately half of that.

Changes to the Sudden Oak Death Program

In early 2011, the Oregon SOD "task force" (ODA, ODF, USDA FS, and OSU) and stakeholders met and considered various options for a sustainable SOD management program. Options included stopping the program altogether, establishing a broad host-free zone north of the current infestation, extensive aerial application of fungicides, and numerous variants of the existing eradication program.

With funding as a major constraint, we settled on a program with the goal of slowing spread of the disease. Pest spread models suggest that slowing spread is best accomplished by early detection and rapid suppression of new infestations that occur beyond the leading edges of the main infestation. This approach is analogous to treating spot fires when controlling wild fire. Additional benefit can be gained by reducing overall inoculum levels elsewhere within the quarantine area by destroying infected host plants. Reducing inoculum lowers the chance that disease will intensify on site or be spread long distance naturally or by human activities.

The base function of the program and highest priority for funding is the early detection of infected trees through a variety of survey methods. Eradication treatments will be scaled to funding levels. The highest priority sites (in terms of potential for disease spread) will be treated first with treatment costs paid by the state and federal agencies. Lower priority sites will remain untreated or be treated voluntarily by landowners. Federal agencies will continue eradication on all infested sites on their

land. Treatment priorities are assessed bi-monthly by agency staff conference (ODF, ODA, and USDA FS).

The new program required several changes to the Oregon quarantine regulations which became effective in March 2012. The key provisions of the quarantine rule are:

1. Establishes a "generally-infested area" within the quarantine boundary where *P. ramorum* has been commonly found or where the disease has persisted or intensified and complete eradication of the pathogen is impossible or impractical (fig. 2). Parts of the generally infested area currently are uninfested, but these likely will become infested over time if host plants are present. The size and shape of the generally infested area will be updated periodically by the ODA and ODF depending on disease distribution and funding available for treatments, and will be available as a map or shape file on the ODA/ODF website. Within the generally infested area, eradication treatments are no longer required by the state.

2. Defines two types of infested sites based on their importance for spread of disease.

A. Type 1 sites are infested sites considered to be of highest risk for spread of *P. ramorum* into previously uninfested areas. They typically are located <u>outside</u> of the generally infested area. The highest priority sites are those closest to or beyond the existing quarantine boundary. Eradication treatments are required: all host plants within 15 to 100 m (50 to 300 ft) of infected or symptomatic plants must be cut and burned as soon as possible after the treatment areas have been delimited. Cost of treatment will be borne by the state if funds are available.

B. Type 2 sites are infested sites considered to be of less risk for spread of *P. ramorum* into previously uninfested areas. Type 2 sites typically are located <u>inside</u> of the generally infested area. Eradication treatments are not required, but disease suppression through best management practices is encouraged. A 50-50 cost-share program may be available through ODF to help defray costs of implementing best management practices to reduce disease spread. Host trees within a Type 2 treatment area may be used as firewood within the treatment area.

3. Allows increased utilization of tanoak within the quarantine area.

A. Inside the generally infested area, tanoak maybe used as non-commercial firewood, but it cannot leave the generally infested area.

B. Outside of the generally infested area, tanoak cannot leave an infested site or eradication treatment area, but it can be transported out of the quarantine area if from a "disease-free area," which is defined as an area located more than 402 m (1/4 mile) from the generally infested area or any other infested site, and which has been officially surveyed within the past 6 months and found free of *P. ramorum*.

Changes to the quarantine regulations reflect the financial reality of managing an expanding new disease. The initial goal of complete eradication in Curry County is unachievable. Our goal now is to slow spread by 1) early detection and rapid eradication of new infestations that are epidemiologically important; 2) reducing inoculum levels wherever practical through cost-share projects and using best management practices; and 3) improved education and outreach to prevent spread by humans. The current planned annual budget for the program is approximately $1 million to $1.2 million.

Conclusions

Spread at the landscape level continues because latency of the pathogen and cryptic infections hinder early detection. Delays in completing eradication treatments allow disease to intensify and spread between the time of detection and completion of treatments. In the wet, mild climate of Curry County, disease can spread anytime suitable weather conditions occur. Delays anywhere in the detection-treatment process are very costly.

Phytophthora ramorum eventually may spread throughout range of tanoak and possibly farther on other host species such as rhododendron and evergreen huckleberry. Pest risk models predict that without control, it could eventually spread to 19 western Oregon counties. As the disease spreads, the quarantine area and associated regulations will expand with it. These regulations likely will increase

production and shipping costs for the nursery and forest industries, especially when moving host plant material out of the quarantine area or out of state. Markets may be lost as importers of Oregon products enact their own quarantines or decide not to purchase Oregon products because of perceived risk. This already has happened to log exporters and lily bulb growers. The economic justification for slowing spread of the disease is based on the value of preventing or delaying these costs (Hall 2009).

Despite continued spread and intensification of disease, the program has by no means been a failure. In the 10 years since first detected, SOD still is confined to a relatively small quarantine area near Brookings. Disease spread and mortality are less than they would be without treatment. Although *P. ramorum* will not be eradicated from Oregon forests, an ongoing well-funded disease management program will slow its progress, prevent or delay environmental and economic damage, and reduce the probability of spread to other forests.

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