

# Eradication Effectiveness Monitoring in Oregon Tanoak Forests<sup>1</sup>

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## Introduction

*Phytophthora ramorum* was first discovered in Oregon forests in July 2001 where it was killing tanoak (*Lithocarpus densiflorus*) and infecting Pacific rhododendron (*Rhododendron macrophyllum*) and evergreen huckleberry (*Vaccinium ovatum*). At that time, nine infested forest sites were identified ranging in size from 0.2 to 5 hectares, and totaling 16 hectares on non-industrial private forest lands, industrial private forest lands, and federal forest land administered by the Coos Bay District, Bureau of Land Management (BLM). A 23 square kilometer quarantine area was established around the area of infestation. *P. ramorum* has since been the focus of an intense eradication effort on approximately 81 hectares of infested forest land distributed in patches over an area of approximately 155 square kilometers.

Initial eradication treatments involved cutting, piling, and burning infected plants and all nearby potentially infected or exposed host vegetation within a 15 to 30 meter radius buffer zone. Treatment monitoring revealed that the buffer area was inadequate to capture localized spread of the pathogen. In late 2004, buffer zones were increased to a minimum of a 100 meter radius from known infected plants. Monitoring also revealed that newly emerged sprouts from cut infested tanoak stumps were highly susceptible to infection and were maintaining the pathogen on infested sites. A variety of methods to control tanoak sprouting were attempted between 2003 and 2005, including backpack spraying of new sprouts; manually cutting, piling, and burning new sprouts; and stump-top application of herbicides to prevent sprouting. Injecting herbicides (imazapyr or glyphosate) in all tanoak stems 2.5 cm diameter and larger prior to cutting has been used on private, state, and U.S. Department of Agriculture, Forest Service (USDA FS) land since late 2005. On BLM land where herbicide treatments are currently prohibited, sprouts are monitored for disease and are mechanically destroyed if necessary. Upon completion of burning, most sites have been planted with non-host or conifer seedlings.

Monitoring the effectiveness of eradication treatments requires intensive site examinations. The Oregon Department of Agriculture (ODA) has surveyed all treated

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sites for the presence of *P. ramorum* since the initial treatments began in 2001. Some sites have been declared disease-free post-treatment based on inability to recover the pathogen for two consecutive years. However, the large number of treated sites available provides an opportunity to systematically sample most treated sites within a given time frame to:

- describe the overall effect of eradication treatments on the survival and persistence of *P. ramorum* in forest situations (in soil, vegetation, and streams);
- describe the amount and species of vegetation that either survived the treatments or colonized the treated sites following treatment; and
- compare the effects of herbicide (non-federal, state parks, and USDA FS lands) and non-herbicide (BLM) treatments on vegetation and pathogen survival.

In 2008 we began the first of a two year project to revisit most treated sites to sample soil and vegetation in plots centered on stumps of known infected trees.

## Methods

Plots were established around stumps of known infected trees. At each plot a 1 liter composite soil sample was collected from within 2 meters of the known infested stump. An additional nineteen 1 liter soil samples were collected across a 0.02 hectare circular plot. Samples were split; a 0.5 liter portion of each sample was assayed for *P. ramorum* as quickly as possible by the Oregon State University (OSU) lab and the remaining 0.5 liter soil sample was placed in cold storage and sampled approximately one month after collection by the ODA lab. Soil samples were wetted and baited using either rhododendron or viburnum leaf pieces. *P. ramorum* was confirmed by PCR and culturing of baits.

On the same 0.02 hectare plot, tanoak stumps were tallied by condition (live with sprouts or dead), and diameter and standing trees of all species greater than 12 cm diameter were also tallied by species and diameter. Host vegetation was examined for symptoms of *P. ramorum*. A minimum of five vegetation samples were collected from each plot and sent to the labs for confirmation of *P. ramorum* infection via ELISA, PCR, and culture.

A 0.008 hectare circular plot centered on the infested stump was used to describe percent cover of shrubs and forbs. Tree seedlings and saplings were also tallied on this smaller plot.

## Preliminary Results

A total of 119 plots that had received eradication treatments between 2001 and 2007 were sampled in late 2008 to spring 2009. Based on one round of soil baiting only (OSU/immediate baiting) we did not recover *P. ramorum* in soil or vegetation from 70 (59 percent) of the 119 plots sampled. Thirty-seven (31 percent) of the plots yielded cultures of *P. ramorum* from soils only, eight plots (7 percent) yielded *P. ramorum* from soils and vegetation, and on four (3 percent) plots, *P. ramorum* was recovered only from vegetation. On those plots where *P. ramorum* was baited from soil, recovery was generally low; on 22 of 45 plots, only one of 20 soil samples

yielded *P. ramorum*. When all soil samples were combined, 96 percent of 2380 soil samples collected were negative for *P. ramorum* based on the first round of baiting. Fifteen of the 88 (17 percent) *P. ramorum*-positive soil samples were collected adjacent to the identified infested stump.

Twelve (10 percent) of the plots had vegetation samples that were positive for *P. ramorum*. Eight of these plots (75 percent) also had soil that yielded *P. ramorum*. A total of 19 vegetation samples out of 595 (3 percent) collected were positive for *P. ramorum*. All positive samples were tanoak; most of the diseased material was collected from tanoak basal sprouts.

No *P. ramorum* was recovered from plots on sites treated in 2002; all other treatment years yielded some *P. ramorum*. Most of the *P. ramorum*-positive plots were associated with more recent treatment years (2006 and 2007).

Some herbicide use was associated with 106 of the plots sampled; 13 plots had no herbicide treatment history. Sample sizes are decidedly unequal, nonetheless, where herbicide was used, 62 percent of the 106 plots yielded no *P. ramorum*, in 31 percent of plots *P. ramorum* was recovered in soil only, 5 percent of plots yielded *P. ramorum* in soil and vegetation, and in 2 percent of the plots *P. ramorum* was recovered from vegetation only. Where herbicide was not used, 31 percent of the 13 plots yielded no *P. ramorum*, in 31 percent of plots *P. ramorum* was recovered in soil only, 23 percent of plots yielded *P. ramorum* in soil and vegetation, and in 15 percent of the plots *P. ramorum* was recovered from vegetation only.

The next steps in this continuing study will be to evaluate the results of soil baiting done after cold storage and to analyze the vegetation data. We plan to establish additional plots in 2009 and 2010 as well as revisit a subset of plots visited in 2008 and 2009.