

# Preservation of *Lithocarpus densiflorus* diversity on California's central coast: a cooperative project with area residents<sup>1</sup>

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## Abstract

The tanoak (*Lithocarpus densiflorus*) stands of California's central coast have suffered high mortality rates due to infection by *Phytophthora ramorum*. Treatment programs were put in place to test the efficacy of phosphonate compounds in real world situations, to preserve some germplasm and ecosystem elements for future research, and to help mitigate the buildup of standing fuels for local homeowners. Two approaches were involved, one using experimental plots distributed over a range from Marin County to Monterey County, and another involving a cooperative treatment arrangement with Big Sur residents. Preliminary results from the experimental plots suggest that tanoaks near the infection front, in spite of being asymptomatic, may not respond to treatment with phosphonate compounds. Our informal observations suggest that a cooperative treatment and research program with local area residents produces more community involvement and enthusiasm, and therefore higher treatment rates than informational approaches alone.

Keywords: *Phytophthora ramorum*, treatment, phosphonate, efficacy, homeowner

## Introduction

In recent years tanoak (*Lithocarpus densiflorus*) stands in the Big Sur region of California's central coast have suffered extensive mortality due to the introduction of the pathogen *Phytophthora ramorum*. Aside from the risk of extirpation and the inevitable loss of genetic resources this poses, loss of significant numbers of tanoak may result in habitat degradation, particularly for those species dependent on tanoak acorns for survival. From a local homeowner perspective, the increased risk of fire from standing fuels is another cause for concern. In spite of extensive outreach efforts, it appears that most property owners do not attempt to treat their tanoaks until they show bleeding symptoms, at which point it is likely to be too late for treatment to be effective.

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This project sets out to investigate the real-world efficacy of phosphonate treatments on tanoak, and to encourage local property owners to treat their trees prophylactically before symptoms are apparent, with the ultimate goal of preserving some tanoak diversity.

## Materials and methods

The project consists of two treatment programs, both of which will require long-term post-treatment survival monitoring. All trees and/or plots in this study have confirmed infections within the immediate vicinity (within 200 m). None of the *Quercus* and/or *L. densiflorus* within the five main plot pairs were symptomatic at the start of the experiments, while only the very first symptoms of infection were visible on two remaining plot pairs (analyzed separately). Infection in the vicinity was confirmed first by plating symptomatic portions of *Umbellularia californica* leaves onto PARP selective media (Erwin and Ribeiro 1996), and if these tested negative, re-testing the leaves using CSL taqman molecular methods (Hughes and others 2006). The uninfected *Quercus* or *L. densiflorus* trees were treated with a phosphonate solution (Agri-Fos™, Agrichem Manufacturing Industries, Queensland, Australia) mixed with an organo-silicate surfactant (Pentrabark™, Agrichem Manufacturing Industries, Queensland, Australia) allowing penetration of the material into trunk tissues without drilling. The solution was applied with a commercially available model 425 Solo hand-pump backpack sprayer (Solo™, Newport News, VA, USA) at low to moderate pressures to a height of approximately 3 m until runoff began to occur.

## Treatment plots

The first program consists of clusters of one to five paired 20x20 m treatment and control plots (*table 1*). These were established by June 2006 and cover a range from Marin County in the north to Monterey's Big Sur coast in the south. Comparisons are to be made between treatment and control plots to assess treatment effectiveness under comparatively undisturbed real-world conditions. Additionally, two paired 20x20 m treatment and control plots were established at the same time in the Carmel Highlands under similar circumstances, except that the tanoaks in these plots had just begun to show the first symptoms of infection at the time of treatment (*table 1*).

## Cooperative treatments

The second treatment program is a cooperative agreement with private property owners in the Big Sur and Carmel Valley regions (*table 1*). Participants in the program have individual, high risk trees which receive two phosphonate treatments within the first year at no cost. Property owners are then responsible for applying the subsequent three treatments over five years. The treatments are uncontrolled.

## Results

## **Title of the document**

While data is still being collected on the trees within the treatment plots and involved in the cooperative agreements, some trends have already become apparent.

### **Treatment plots**

Within one year of treatment, all *L. densiflorus* trees within the two “symptomatic” plot pairs in Carmel Valley were strongly symptomatic of disease, regardless of whether they were in treatment or control plots, or whether or not they were symptomatic at the time of treatment.

### **Cooperative treatments**

We visited more than 20 properties to test for presence of the disease, and 13 of them, collectively containing more than 100 trees, both tested positive for the presence of the pathogen and contained asymptomatic trees that had not yet been treated with phosphonate.

## **Discussion**

### **Treatment plots**

The high levels of infection in the Carmel Valley plots which contained only a few mildly symptomatic trees at the time of plot establishment suggests that asymptomatic tanoaks close to the geographic disease front may in fact be seriously infected, and therefore cannot be expected to respond to treatment with phosphonate compounds. Treatment recommendations should be re-evaluated to insure that there is no expectation that asymptomatic tanoaks will respond if treated with phosphonate compounds when growing among infected trees. In the future, survival data from these trees will provide us with real-world treatment effectiveness on symptom-free stands when treatment was applied.

### **Cooperative treatments**

We used a “hands-on” approach, designed to increase public interest and participation in the treatment process while simultaneously striving to reach an ecologically important goal. To the best of our knowledge, prior to this program only a few property owners had prophylactically treated their tanoaks with phosphonate, totaling perhaps a few score of trees. This situation persisted despite educational outreach efforts and high tanoak mortality in the area. By engaging in a cooperative research and treatment venture with local property owners, this program appears to have increased the number of individuals prophylactically treating their trees by several fold, and we estimate that it at least doubled the number of treated trees over a one year period. If successful, this will have the effect of preserving some local germplasm and acorn production for future work, and may help to stabilize some of

the ecological changes that may affect the Big Sur region. While we are not social scientists and subjective qualities like “public interest” are difficult to quantify, it does not mean that these aspects of treatment are not significant from an epidemiological perspective. There is an opportunity for further research here.

## Literature cited

**Erwin, D.C.; Ribeiro, O.K. 1996.** *Phytophthora* diseases worldwide. St. Paul, MN, American Phytopathological Society: 39-41.

**Hughes, K.J.D.; Tomlinson J.A.; Griffin, R.L.; Boonham, N.; Inman, A.J.; Lane, C.R. 2006.** Development of a one step real-time polymerase chain reaction assay for diagnosis of *Phytophthora ramorum*. *Phytopathology*. 96: 975-981.

**Table 1—Phosphonate treatment sites.**

<b>Plot pair distribution and tally</b>			
<b>County</b>	<b>Sites</b>	<b># of plot pairs (treatment &amp; control)</b>	<b>Total # of trees</b>
Monterey	4	5 (plus 2 symptomatic pairs)	176
Marin	1	5	249
Santa Cruz	1	2	100
Monterey	13	homeowners treatments (uncontrolled)	107