

Early Detection Monitoring of *Phytophthora ramorum* in High-Risk Forests of California¹

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Abstract

Early detection monitoring is essential for successful control of invasive organisms. Detection of invasions at an early stage of establishment when a population is small and isolated makes eradication more feasible and less costly. Sudden oak death, caused by the recently described pathogen *Phytophthora ramorum*, is an emerging forest disease that has reached epidemic levels in coastal forests of central and northern California. To control the spread of the pathogen and protect susceptible habitats, California has established an extensive monitoring program focused on early detection of pathogen activity at isolated locations, where it may be possible to apply chemical treatments or attempt eradication. It is also essential to understand when and where the risk of establishment is elevated in order to effectively monitor the pathogen and manage threatened forests in a state as large (408,512 km²) and environmentally variable as California. Funded by the USDA Forest Service and California Department of Forestry and Fire Protection, the objectives of this research are to: (1) use GIS-based risk modeling to target early detection sampling efforts in the most threatened forests across the state of California; and (2) discover emergent infections of *P. ramorum* before they become well-established. Here, we present two years (2003-04) of results from California's early detection survey of *P. ramorum*.

The risk model used to target sampling incorporates the effects of spatial and temporal variability of multiple variables on the pathogen's persistence based on current knowledge of host susceptibility, pathogen reproduction, and pathogen transmission with particular regard to host species distribution and climate suitability (Meentemeyer *et al.* 2004). Maps of host species distributions and monthly weather conditions are spatially analyzed in a GIS and parameterized to encode the magnitude and direction of each variable's effect on disease establishment and spread.

A total of 496 locations were assessed for the presence of *P. ramorum* on public land across 38 counties (n = 138 in 2003; n = 347 in 2004). One hundred nineteen of these sites were located within 10 km of a known occurrence of *P. ramorum* and 376 sites were further than 10 km. Along two transects at each

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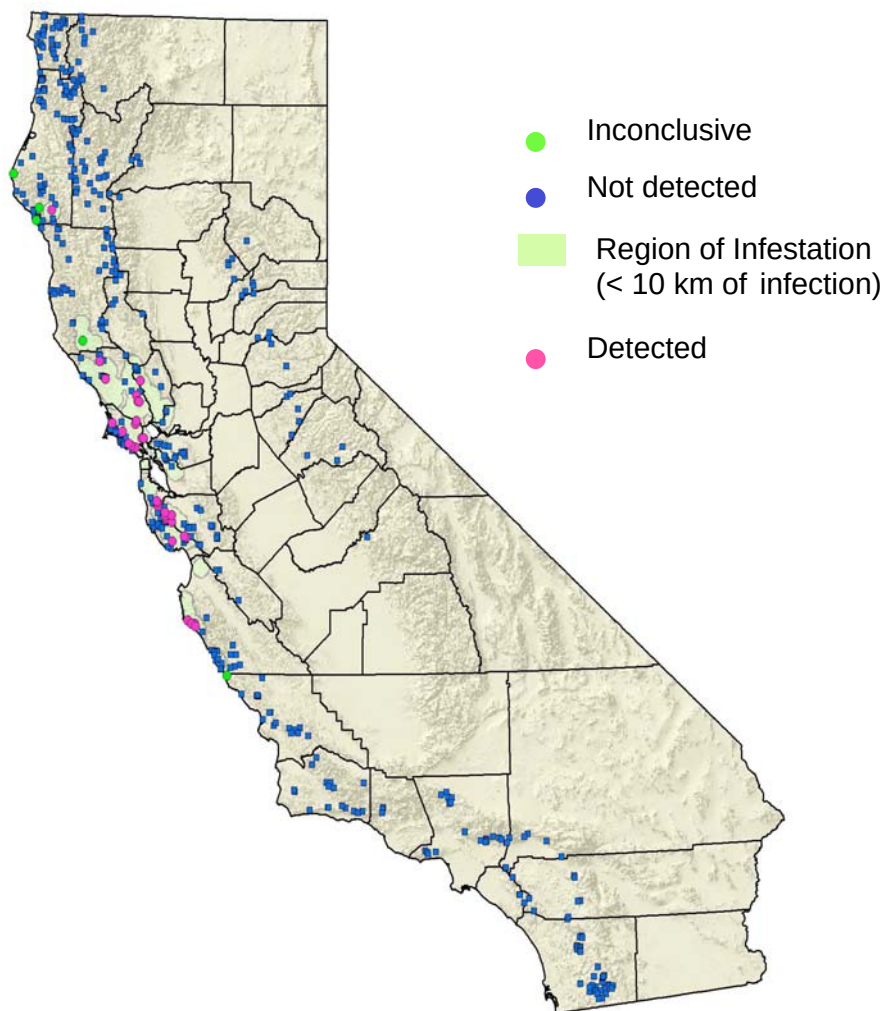
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site, leaf and canker samples were collected from all host plants showing potential symptoms of *P. ramorum* and examined using culture and PCR methods. Samples from infested counties were examined by California Department of Food and Agriculture (CDFA) for pathogen identification and by University of California, Davis in un-infested counties. Of the 496 sites assessed, *P. ramorum* was found at 32 of the 119 sites occurring within 10 km of a known occurrence, but only one of the 376 sites occurring further than 10 km from an already confirmed occurrence of *P. ramorum*. The pathogen was not discovered in any un-infested counties. These results suggest that *P. ramorum* has not spread significant distances over the past two years in California's forest environments. While these results are encouraging, the extensive size of California allowed us to assess only a small fraction of the state's high-risk habitats even with targeted sampling and a relatively large sample size. Moreover, almost 80 percent of California's most threatened forests are privately owned, which presents challenging access issues for early detection and management of disease spread. Given the extensive number and diversity of threatened habitats in California, risk-based site selection is an effective tool for early detection monitoring and protection. This strategy may play an especially important role in identifying emergent infections before they have established significantly.

Figure 1—Distribution of site locations and results of the early detection across the state of California.



References

Meentemeyer, R.K.; Rizzo, D.; Mark, W.; and Lotz., E. 2004. **Mapping the risk of establishment and spread of Sudden Oak Death in California.** *Forest Ecology and Management.* 200: 195-214.