

# ***Phytophthora* Species Associated with Decline and Mortality of Native Vegetation in California Wildlands**

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Before *Phytophthora ramorum* was identified as the causal agent of sudden oak death in 2000, *P. lateralis*, cause of Port-Orford-Cedar root disease, was the only introduced *Phytophthora* that had been associated with widespread plant decline and mortality in California wildlands. The soil-borne *P. lateralis* is closely associated with riparian or high-rainfall sites with high soil moisture. In 2003, the well-known root pathogen *P. cinnamomi* was found to be causing extensive mortality of manzanita (*Arctostaphylos myrtifolia*, *A. vicida*) in dry upland habitats of the lower Sierra Nevada foothills. This find expanded the search image for *Phytophthora* root diseases in California wildlands. Subsequent investigations have associated *P. cinnamomi* with decline and mortality of native trees and woody shrubs in a variety of other California plant communities across a range of climate zones and soil types. As symptomatic native vegetation in additional sites have been assayed for the presence of *Phytophthora*, other soil-borne *Phytophthora* species have been associated with decline and /or mortality of native species in a variety of habitats. *P. cactorum*, *P. cambivora*, *P. crassamura*, *P. cryptogea*, *P. pseudocryptogea*, *P. pseudotsugae*, and others have been associated with symptomatic native hosts that include conifers, hardwood trees, and woody to nonwoody shrubs and perennials. Some non-*Phytophthora* oomycetes may also be involved in observed declines (e.g., *Elongisporangium* (=Pythium) *undulatum* and *Phytopythium* spp.).

Establishing a clear connection between pathogen presence and plant symptoms is difficult. Baiting of root/soil samples has been a reliable method for detecting these soil-borne pathogens, but detection efficiency can be low and can vary seasonally. Direct isolation from affected plant tissues often yields false-negative results. Although some highly susceptible hosts die rapidly when infected, other hosts appear to have long latent periods followed by progressive decline. Dates of pathogen introduction are generally unknown, which complicates the interpretation of symptom progress and the roles of other stressors or secondary agents that may be present. Human activities appear to be associated with introductions of these pathogens to virtually all affected sites, and in some cases, *Phytophthora* species have likely been directly introduced via infected stock used in habitat restoration or forestry activities. Management options for affected stands are few; steps to prevent further spread are the only options in many sites. The examples discussed here illustrate that *Phytophthora* and other oomycete pathogens pose increasing threats to California forest health. Increased efforts are needed to improve detection, impact assessment, and management of these pathogens.