



PROTECTING RESTORATION PLANTINGS FROM PATHOGENS

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Over the past six years, inadvertent plant pathogen introductions into restoration plantings have stunned and frustrated vegetation ecologists. Sticky monkeyflower (*Diplacus aurantiacus*), toyon (*Heteromeles arbutifolia*), sages (*Salvia* spp.), and other common restoration plants have been found to harbor soilborne *Phytophthora* species, relatives of the sudden oak death pathogen (*Phytophthora ramorum*).

Detections in native plant nurseries and restoration sites have included *Phytophthora* species new to the United States (*P. tentaculata*, *P. quercina*), previously undescribed species (*P. taxon agrifolia*), and new pathogen-host plant combinations that threaten restoration success and present numerous challenges for ecologists determined to keep restored habitats healthy and pathogen-free (Frankel et al. 2020). Since these pathogens infect roots and survive in soil, they are very difficult to eradicate once introduced; residual material from the organism may infect subsequent plantings. Native plants' summer drought adaptations, which may cause diseased plants to go unnoticed, can complicate the problem.

The sudden oak death pathogen arrived in California on infected ornamental nursery stock. Over the past three decades, it has spread and killed approximately 50 million trees (Cobb et al. 2020). Similar invasive species pathways threaten areas under restoration, where plants, compost, soil, and other potentially infested materials are transported to sites of high ecological value. Studies and observations demonstrate that they present a threat to wildland health in California and worldwide.

To prevent introductions and manage infestations, the Phytophthoras in Native Habitats Work Group has developed best management practices (BMPs) for restoration nurseries and plantings. These BMPs have been incorporated into Accreditation to Improve Restoration, a voluntary program that combines

careful plant monitoring with systematic sanitation to prevent pathogen development in restoration nurseries. The program is currently being piloted in the San Francisco Bay Area and in Southern California; several participating nurseries have grown *Phytophthora*-free plants for more than three years.

Additionally, restoration project design can incorporate prevention strategies to minimize the likelihood of pathogen introduction and spread, such as reduced plant density and selecting upland sites with good drainage. Use of natural regeneration and direct seeding, where practical, also reduces risk. Proactive measures can prevent pathogen introductions and thereby sustain habitat health. For more information, see the Phytophthoras in Native Habitats Work Group website, www.calphytos.org.

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Above: Madrone mortality on Old Cañada Road near Woodside, CA. [Photograph courtesy of Phytosphere Research]