

Assessing the Incidence and Diversity of *Phytophthora* Species in Planned Restoration Areas of the Angeles National Forest¹

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Abstract

The Angeles National Forest (ANF), located in the greater Los Angeles metropolitan area encompasses approximately 700,000 acres (238,230 ha), comprising a vital biodiversity hot spot. From 2002 to 2008, the ANF was affected by three major fires, the Copper (2002), Ranch (2007) and Sayre (2008). Together, these fires affected approximately 40,000 acres (16,187 ha) of coastal sage scrub, montane chaparral, grassland, riparian corridor, as well as isolated big cone Douglas-fir (*Pseudotsuga macrocarpa*) stands. Droughts and floods in the subsequent years, plus off-highway vehicle use, aggravated erosion and altered chaparral vegetation regeneration. As a mitigation effort, restoration attempts were initiated in these areas including planting native nursery stock.

In 2016 - 2017, prompted by concerns that *Phytophthora* species may have been introduced on restoration plantings, *Phytophthora* surveys were conducted in several restoration locations associated with utility project mitigation on ANF lands. The inadvertent outplanting of infested nursery stock is considered one of the main pathways for exotic *Phytophthora* to enter into natural areas. These preliminary surveys detected numerous *Phytophthora* species associated with outplanted native plants and at the source nurseries. The ANF has a typical Mediterranean climate and averages about 15 – 20 inches (28 to 50 cm) of precipitation per year with long dry periods in late spring into early fall. The ability of *Phytophthora* species to survive and become established under these conditions is not known.

To better understand the *Phytophthora* distribution on arid lands of the ANF, three *Phytophthora* surveys were performed between May 2018 to March 2019 in areas that had burned in the Copper, Sayre and Ranch fires and were prioritized for restoration. From the three areas, a total of 508 soil samples were collected from 27 sites to determine the incidence and distribution of *Phytophthora* pathogens. A range of forest types and conditions were sampled including four sites which had been planted with container nursery stock. Thirteen *Phytophthora* species were

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detected from 15 sites (*P. borealis*, *P. cactorum*, *P. chlamydospora*, *P. crassamura*, *P. gonapodyides*, *P. inundata*, *P. lacustris*, *P. riparia*, *P. lacustris x riparia* hybrid, *P. multivora*, *Phytophthora* sp. cadmea, *Phytophthora* sp. NJB-2015, and an undescribed *Phytophthora* species provisionally named *P. taxon agrifolia* 2). *Phytophthora* was not detected in the outplanted areas. *Phytophthora* detections were primarily associated with dry stream beds. *Pythium* species were recovered from all 27 sites, which suggests that *Pythium* may be resident to ANF lands. Among the 13 detected species, *P. crassamura* was found to be the most widely distributed *Phytophthora* species on ANF lands, present on eight of the 27 sampled sites. Previous studies have associated *P. crassamura* with a Mediterranean climate and with dieback during restoration activities, thus indicating the potential danger that this species could have on the ANF, but the pathogenicity of this species is not fully known.

Sampling will be repeated seasonally in all three fires areas to determine what additional factors could be correlated with the incidence of *Phytophthora* pathogens. Further research is on-going to explore the ecological factors affecting the survival and distribution of *Phytophthora* species on arid ecosystems and fire-affected areas of the ANF.