

Approaches to Protect Against Phytophthoras at the Presidio

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The Presidio, a 1,500 acre National Park on a former military post at the foot of the Golden Gate Bridge, is a major outdoor and cultural recreation hub in northwest San Francisco. As part of the Golden Gate National Recreation Area, it is among the most visited urban national parks, but also home to twelve species of rare, threatened or endangered plants, many associated with serpentine soils, as well as habitat for over 300 bird species and other wildlife.

In 2015, the Presidio initiated a *Phytophthora* management program to protect endangered plant species and native habitat. Dieback associated with *Phytophthora pseudocryptogea* on Raven's manzanita (*Arctostaphylos hookerii* ssp. *ravenii*), an endangered species with only one known wild individual, underscored the resources at risk given the threat of human-assisted introductions from plantings for large-scale construction and restoration projects. The program is also informed by the Presidio's native plant nursery program and underlying value of natural resource stewardship.

The *Phytophthora* management program includes mapping *Phytophthora*, and pre-plant *Phytophthora* screening of incoming landscape plants. Best management practices are used for fieldwork to promote sanitation and thereby lower the likelihood of *Phytophthora* introductions on imported soil or on workers' or visitors' shoes, and to educate staff and tourists in the role they can play in reducing the spread of plant pathogens. The program represents a significant effort, with 80% time of an IPM specialist and an intern for at least 3 months in the spring and summer and other costs associated with rejected container plant lots, construction delays, etc.

The evaluation of *Phytophthora* species on purchased, incoming landscape plants and determination of resident *Phytophthoras* in restored areas demonstrates the complexity and difficulty of managing these pathogens. Pre and post restoration sampling on eleven sites indicates that the recovery of *Phytophthora* in some areas is undesirably high. The patterns of species recovery present many questions that propel further adaptive management.