Managing *Phytophthora ramorum* at Bloedel Reserve[1]

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Abstract

Bloedel Reserve is a 150-acre botanical garden and nature preserve on the north end of Bainbridge Island in Washington on the Puget Sound. The grounds encompass undeveloped forest, pastures, a bird marsh, woodland plantings, and intensely maintained gardens within the limits of the City of Bainbridge Island. The garden is part of the Sentinel Plant Network, a partnership between the American Public Gardens Association and the National Plant Diagnostic Network that engages public garden professionals, volunteers, and visitors in the early detection of serious plant pests and diseases. With funding from the USDA Animal and Plant Health Inspection Service, the Sentinel Plant Network has trained hundreds of front-line garden staff on best practices for monitoring plant collections and host plants for signs and symptoms of regionally significant threats as well as the proper way to collect and submit diagnostic samples. The program also provides member gardens with a wide variety educational outreach and training materials for use in engaging communities about the impact of serious plant pests and diseases and the importance of early detection and rapid response. Since participating in their first Sentinel Plant Network training in 2011, staff at Bloedel Reserve have used the program's resources to intensify their monitoring efforts.

In early March of 2015, garden staff submitted a sample of a diseased *Pieris* exhibiting lower crown dieback and extensive leaf spotting to Washington State University (WSU) for diagnosis. Molecular tests confirmed infection by *Phytophthora ramorum.* Further sampling by the USDA, Washington State Department of Agriculture (WSDA), and WSU revealed additional infections on *Mahonia*, *Rhododendron*, *Viburnum*, *Gaultheria*, *Vinca*, *Vaccinium*, and *Camellia*. Most infections were in the Rhododendron Glen at the north end of the grounds while two *Camellia* infections were on the centrally located Camellia Trail.

After confirmation of the *P. ramorum* infection, eradication efforts began following recommendations from the USDA, WSDA, and WSU. All plants within an approximate 2-meter radius eradication zone were removed and destroyed per USDA requirements. Where appropriate, drainage was installed and trail grades were modified to prevent *P. ramorum* contaminated water from flowing over trails. Wood chips high in *Thuja plicata* material were applied as mulch. Visitor and worker access to eradication zones was severely limited and subjected to strict sanitation procedures. Bloedel Reserve has always asked visitors to stay on trails and not take plants, rocks, sticks, or other items home with them. Since pathogen confirmation, this policy has since been more intensely advertised and enforced. Standard operating procedures for maintenance practices were developed to deter introduction and spread of new infections.

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Quarantine and sanitation procedures were defined to guide propagation, nursery, and maintenance activities.

From July through September (2015), WSU performed post-removal soil steaming in eradication zones. Soil samples taken immediately following steaming were free of *Phytophthora* species. One month later, leaf litter and soil at one site was found with multiple non-*ramorum Phytophthora* species. This was likely due to disturbance of the soil while installing drainage post-steaming. Beginning in early winter (2016), biological and chemical controls were implemented. The bio-control fungus *Trichoderma atroviride* was applied via hand-pump backpack sprayer and lightly raked into the ground. A 2-inch aged dairy manure/wood chip mulch layer was applied immediately after application. Rotating foliar applications of mefenoxam, dimethomorph, and cyazofamid were used in an effort to deter further spread of *P. ramorum*. Applications will at least continue through the rainy season of 2016.

Eradication zones will be replanted with genera not on the USDA *P. ramorum* host list. All new plants will be subject to a minimum of 8 weeks of quarantine regardless of their susceptibility to the pathogen. Planting and maintenance activities within eradication zones will adhere to strict sanitation procedures on the assumption that *P. ramorum* might still be present. *P. ramorum* is likely to persist at Bloedel Reserve into the foreseeable future. Our efforts focus on containing the spread and impact of the disease and preventing its movement off of the grounds.