Selective Thinning of California Bay Laurel is a Cost-Effective way to Control *Phytophthora ramorum* in Mixed-Oak Woodlands

Doug Schmidt, Laura Sims, Guglielmo Lione, Melina Kozanitas, and **Matteo Garbelotto,** Department of Environmental Science, Policy and Management**,** University of California, Berkeley, dschmidt@berkeley.edu

It has been long determined that *Umbellularia californica* (California bay laurel) is the key transmissive host for the sudden oak death pathogen (SOD, *Phytophthora ramorum*) in mixed-oak woodlands, however the parameters of bay to oak disease transmission have not been fully clarified (Garbelotto et al. 2003). Here, we concisely present results of three studies: one clarifying the parameters of bay to oak transmission, and two testing whether two cost-effective approaches involving selective removal of a limited number of California bay laurel trees may reduce disease incidence in naturally infested oak stands.

Study 1 consisted of a multi-year survey of approximately 900 bay laurels and two thousand oaks (mostly *Quercus agrifolia*, coast live oak) across 63 transects in the San Francisco Public Utilities Commission (SFPUC) mixed-oak woodlands in San Mateo County. Results identified an inverse relationship between bay to oak distance and oak infection, with infection levels approaching zero as distance between bays and oaks approaches 20 m. Oak size (stem diameter), was positively correlated with likelihood of SOD infection. Study 1 also identified that bay infection levels dropped dramatically during dry years.

Study 2 (Garbelotto et al. 2017) consisted of a stand manipulation trial in which the frequency of Inoculum Pressure Events (IPE) above the threshold levels necessary to infect oaks was monitored every 3 weeks for 7 years in 64 "treatment" and in 64 "control" plots located in the Soquel Demonstration Forest (Santa Cruz County). After 2 years, all bay laurels were removed from "treatment" plots, generating bay-free buffer zones around plots of 10 and 20 m. Results showed that inoculum pressure was strongly affected by rainfall and by bay absence/presence. IPE frequency was reduced to zero during drought years, while in wet years, IPE frequency was significantly lower in treatment than in control plots, with a stronger effect in plots with a 20 m bay-free buffer around them. Results thus provided additional experimental evidence that selectively removing bays 10 and 20 m around oaks reduces the likelihood of oak infection.

Study 3 was performed in 4 "treatment" and 4 "control" plots in SFPUC lands between 2014 and 2015, as follows. Eight plots with low bay disease incidence at the end of a 4-year long drought were identified. In each plot, SOD disease incidence was recorded on 25 bay laurels. The 2014 results identified all bays still carrying SOD infection during a drought, and in 2015 these bays (5 to 8 per plot) were herbicide-killed in the four treatment plots. In 2016, despite extremely high rainfall, disease incidence was significantly lower in treatment than in control plots, and the same result was obtained in 2017. Conversely, in 2018, a dry year, disease incidence dropped to very

low levels both in treatment and control plots. These results indicate that selectively removing the small numbers of bay laurels that are infected by *P. ramorum* after a prolonged drought effectively reduces SOD disease incidence. The selection of bays to be removed can be either driven by their proximity to oaks or by their infection status at the end of a drought.
This finding thus provides a cost-effective way to manage SOD in mixed-oak woodlands.

References

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