Lessons from 15 Years of Monitoring Sudden Oak Death and Forest Dynamics in California Forests[1]

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Abstract

Monitoring host composition and disease impacts began 15 years ago in what would become a network of permanent forest monitoring plots throughout the known and predicted range of *Phytophthora ramorum* in California coastal forests. Stretching ~500 miles from Big Sur to the Oregon border, the network captures variation in interactions among the pathogen, its potential hosts, and the environment across wide gradients in climate, topography, land use, and host species abundance. Within each plot, standardized methodology has been used to track forest dynamics and disease impacts of individual trees and at the forest stand level. From early plot censuses of this and other similar networks, information was gained about how forest diversity and stand composition mediate disease risk, how the presence of the pathogen alters competitive dynamics and mortality rates among hosts, and how disease impacts alter rates of coarse woody debris accumulation. The full ecological impact of most other destructive pathogens is difficult to quantify because of a lack of baseline data at the earliest stages of an invasion and through multiple subsequent decades of forest change.

Investment in the establishment and repeat censuses of these plots has facilitated the tracking of disease dynamics at a number of temporal and spatial scales. The importance of interannual climate variation was observed as an overarching driver of disease dynamics and tree mortality, and we have seen the impact of this variation differ across host communities and climatic gradients. Monitoring included at least two multi-year periods of above average rainfall with consequent short-term increases in sudden oak death (SOD) prevalence. Waves of associated tree mortality have followed at a lag of 2-5 years after the appearance of symptoms, when environmental conditions may appear out of sync with those favorable for disease spread. Monitoring has also included two multi-year drought periods associated with lower rates of pathogen expansion, but potential increases in tree mortality. When wildfires in 2008 occurred for the first time in SOD-impacted forests, data collected in the Big Sur section of the monitoring network facilitated capitalizing on the natural experiment of comparing the individual, joint, and potentially interacting effects of disease and fire. Findings included learning that disease-fire interactions are complex and dependent on changing fuel characteristics as the disease progresses in a stand. Additionally, unexpected synergies were identified that spilled over to affect species not normally impacted by either disturbance alone. Since then, at least three other fires have occurred in parts of the monitoring network, adding to the growing understanding of forest change under novel disturbance regimes.

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With continued monitoring of forest regeneration and pathogen range expansion or contraction, there is hope to develop a fuller understanding of disease dynamics and environmental change on the multi-year or multi-decadal time scales appropriate to turnover in long-lived hosts. Monitoring across the diverse assemblage of host communities in the pathogen's range permits an understanding of how and whether disease dynamics at the advancing front of the pathogen differ from areas of long-term pathogen establishment.