

Effects of landscape heterogeneity on the emerging forest disease sudden oak death

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JOURNAL OF ECOLOGY Volume: 95 Issue: 2 Pages: 364-375 Published: MAR 2007

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Abstract: Sudden oak death is an emerging forest disease caused by the pathogen *Phytophthora ramorum* that is invading the west coast of the United States and semi-natural areas in Europe. This disease causes lethal stem infections in oaks (*Quercus* spp.) and tanoak (*Lithocarpus densiflorus*), as well as non-lethal foliar infections in a range of other species.

We investigated two questions to evaluate the effect of landscape structure on the spread of *P. ramorum*: (i) does the spatial pattern of forested habitat predict *P. ramorum* disease severity, and is this relationship scale-dependent; and (ii) what influence does spatial pattern have on the optimal microclimate conditions for *P. ramorum* reproduction?

We mapped the spatial distribution of suitable forest habitat for *P. ramorum* and established 86 randomly located field plots within a 20-km² region of northern California. For each plot, we quantified *P. ramorum* disease severity and measured the abundance of woody species. Disease severity in each plot was examined in relation to the surrounding landscape structure measured for nested landscapes of increasing scale.

P. ramorum disease severity was greatest in plots surrounded by a high proportion of contiguous forest, after accounting for plot-level variables of host abundance, elevation, canopy cover and microclimate. The explanatory power of the model increased with increasing scale up to 200 m, but was not significant at scales less than 50 m.

High disease severity was associated with lower temperatures in the field than the laboratory-determined optimal range for pathogen reproduction. Variation in microclimate conditions was explained by elevation, not the pattern of host vegetation, indicating that spatially varying disease severity was not a function of microclimate-related edge effects on pathogen growth and survival.

Both landscape-scale configuration and local composition of host habitat are related to the severity of this destructive forest disease. Increased disease severity within contiguous woodlands may have a considerable impact on the composition of such woodlands, with cascading effects on the population dynamics of both host and pathogen.