CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Effects of sudden oak death on fuels and fire behavior

Valachovic, Y.S., Lee, C.A., Scanlon, H., Varner, J.M., Glebocki, R., Graham, B.D., and D.M. Rizzo. Sudden oak death-caused changes to surface fuel loading and potential fire behavior in Douglas-fir-tanoak forests. Forest Ecology and Management, 262: 1973-1986.
http://www.cafiresci.org/storage/papers/psw.2011.valachovic.SODcausedchanges.FEM.pdf

Management Implications

- SOD will result in increased fuel loading over time, as trees die and snags are recruited to the forest floor; however, accumulations may take place over an extended period of time, following pulses of mortality and disease-related stem and branch failure.
- Increased fuels in SOD-infested areas may intensify flame lengths and rates of spread during wildfire, calling for changed suppression tactics and increased reliance on indirect attack strategies.

It is widely recognized that different forest disturbances – including disease, insect activity, wildfire, and wind – relate to and influence one another. For example, wildfire-caused mortality can attract insect activity, insect activity can invite forest disease, and disease can make trees more vulnerable to wind-throw, resulting in major fuel buildups and rendering forests more vulnerable to wildfire. There is a wide range of potential disturbance interactions, and these interactions shape forest structure and composition over time.

However, the relationships between forest disturbances can be complex, especially when exotic pests are introduced to an area. Sudden oak death (SOD), a forest disease caused by the pathogen *Phytophthora ramorum*, is a good example of a recently introduced disease with unknown implications for forest health and future disturbances. In the dry tanoak forests of northern California, the potential relationships between SOD and fire are of particular concern.

This study examined the influence of SOD on fuels and fire behavior in the Douglas-fir (*Pseudotsuga menziesii*)-tanoak (*Notholithocarpus densiflorus*) forests of northwestern California, and it also related findings to potential wildfire response activities.

Methods

This study took place in Sonoma, Mendocino, and Humboldt counties, where Douglas-fir-tanoak forests are prevalent and *P. ramorum* is present. Study sites included SOD-infested areas, uninfested (control) areas, and areas treated with herbicide. Herbicide areas contained complete tanoak mortality and were considered surrogates for long-term SOD-infested areas, which do not currently exist in California due to the relatively recent (<20 years) establishment of the disease.

Plots were stratified by cause of mortality (SOD or herbicide) and time since pathogen arrival or application of herbicide, which was broken into 3 categories: early phase (2-5 years), mid phase (5-8 years), and late phase (8-12 years). Plots were confined to south-facing slopes and to Douglas-fir-tanoak forests where tanoak was dominant or co-dominant.

In each plot, overstory data were collected (tree species, live or dead), as well as fuels data (woody fuels, litter and duff depths, fuelbed depth). Plots were also qualitatively categorized by whether the majority of fuels were on the ground (surface) or in the canopy (aerial).

Fire behavior was modeled in BehavePlus. Custom fuel models based on this study's data were compared with standard fuel models to determine applicability of standard models to the relatively novel fuelbeds found in SOD-infested areas.

Predicted rates of spread were compared with standard sustained line production rates for a Type I Handcrew, and predicted flame lengths were compared with standard values for successful suppression action. Results indicated whether or not a standard crew could maintain effective fireline production rates in different forest conditions (diseased or herbicide-treated; early, mid, or late phase).

Elevated surface fuels in a Douglas-fir-tanoak forest, typical of a late phase SOD-infested stand or a mid to late phase herbicide-treated stand.

Results

The number of dead trees in SOD-infested sites steadily increased over time. The basal area of dead tanoak peaked in the early stage of the disease, then dropped through the mid and late stages as snags fell to the ground. This process was similar in herbicide-treated stands, though it was accelerated, with widespread mortality occurring very soon after treatment.

Surface fuel accumulations in herbicide-treated stands were rapid and significant; in the SOD-infested stands, changes in surface fuels were not discernible until the mid and late stages of the disease, and even then, accumulations were slower and less dramatic than those in the herbicide-treated stands.

Fire behavior models suggested that while standard activity and slash fuel models (e.g., model SB2 and models 11, 12, and 13) may be acceptable for predicting conditions in control plots or early stage disease plots, custom models were necessary to accurately characterize the unique fuels arrangements in mid and late stage herbicide plots and late stage disease plots.

The surface/aerial fuels distinction provided a simple, practical way to characterize fire behavior – when aerial fuels predominated, relatively lower intensity surface fire was predicted; when surface fuels predominated, surface fire behavior was predicted to be much more intense. Fire behavior in the latter scenario (which tended to occur in late stage SOD plots and mid to late stage herbicide plots) exceeded thresholds for direct attack under even the lowest windspeeds, necessitating suppression activities by engines and/or bulldozers rather than by handcrews.

Discussion and conclusion

The relationship between SOD and fire in Doug-fir-tanoak forests is complex, depending on the stage of the disease and the arrangement of fuels. Unlike herbicide-treated stands, which are subject to a one-time pulse of mortality, SOD-infested areas experience cycles of mortality and delayed accumulations of fuels, which complicate efforts to outline a trajectory of the disease's impacts.

However, it is clear from this research that SOD does have an impact on fuel loading and fire behavior, especially in areas where the disease has been present for over a decade. Given projections of disease spread – which predict imminent infestations across much of northwestern California and beyond – SOD-related fuels will be of increasing concern over time, and both fuels management and fire suppression strategies will need to account for and adapt to the enduring influence of the disease.