Bark beetle effects on fuel profiles and wildfire severity in Douglas-fir forests of Greater Yellowstone

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Consequences of bark beetle outbreaks for forest wildfire potential are receiving heightened attention, but little research has considered ecosystems with mixed-severity fire regimes. Such forests are widespread, structurally variable, and often fuel-limited, suggesting that beetle outbreaks could substantially alter fire potentials. In two related studies, we evaluated how outbreaks of the Douglas-fir beetle affect 1) fuel profiles over post-outbreak time, and 2) the severity of a recent large wildfire, in lower montane Douglas-fir forests of Greater Yellowstone, USA. In the first study, we quantified changes in fuel structure over 30 years of post-outbreak time, comparing these changes to the range of fuel profiles present in the absence of beetle disturbance. After accounting for background variation, there were significant reductions in canopy fuel mass and continuity (beginning in and continuing beyond the red-needle stage), and relatively few detectable changes in surface fuels. Outbreak effects on fuels were comparable to background variation in stand structure. The gradual and partial nature of beetle outbreaks mitigated some commonly expected changes to fuel profiles (canopy moisture reduction, surface fuel accumulation). In the second study, we sampled 85 plots in a large wildfire (27,200 ha) that burned in 2008 in an area where beetle outbreaks had occurred ~3-5 years prefire, to determine whether fire severity and postfire tree establishment were influenced by prefire beetle activity.

We found no significant relationship between fire severity and prefire beetle outbreak severity; fire severity was instead largely driven by topographic position and weather at the time of burning. Postfire conifer seedling density was strongly related to proximity to live trees that survived both disturbances. These studies suggest that wildfire potentials and effects in lower montane forests are driven as much or more by background structural variation, along with weather and topography, than by prior bark beetle outbreaks.