Interactions between bark beetle outbreaks and wildfire potential in Douglas-fir forests of Greater Yellowstone

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Abstract

Wildfires and bark beetle outbreaks are key disturbances affecting western forests, but their interactions have received little study. Bark beetle epidemics are reaching unprecedented levels in Rocky Mountain landscapes, and it is often presumed that such outbreaks increase the probability of active crown fire by generating abundant dead trees. Published research on bark beetle effects on fire in pine forests has reached variable conclusions, and almost no data exist for more fuel-limited forest types with mixed-severity fire regimes, such as Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* v.*glauca*). We sampled fuel loads and stand structure across a chronosequence of Douglas-fir forests affected by the Douglas-fir beetle (*Dendroctonus pseudotsugae*) in Greater Yellowstone, evaluating how fire potentials change with time since beetle outbreak. The chronosequence (n=20 plots) included undisturbed conditions and stands affected by active (0-2 yr post-attack), recent (3-5 yr), and old (20-30 yr) outbreaks. Stands ranged from open parkland to dense closed-canopy forest, with mean basal area 46 m^2/ha (range 27-81 m^2/ha) dominated (93%) by Douglas-fir. Beetle mortality averaged 51% of basal area (range 38-81%), primarily in stems >20 cm diameter. Mechanisms of snag-fall and surface fuel accumulation included fragmentation and whole-tree falling, with 44% of snags broken-topped and 24% fallen by 20-30 years post-outbreak. Post-outbreak canopy fuels became very sparse and discontinuous in parkland stands, and markedly reduced in dense stands. Tree regeneration increased from median 51 to 809 stems/ha over the chronosequence. Initial analysis of fuel profiles suggests the likelihood of active crown fire may be diminished following beetle outbreak.