Do mountain pine beetle outbreaks reduce the risk of active crown fires in the Greater Yellowstone Ecosystem?

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Fire and bark beetle outbreaks have increased in frequency and extent across the western US in recent decades, raising concerns among forest managers and land owners about fire hazard in beetle-killed forests. Although it is often believed that bark beetle outbreaks increase fire hazard by producing high loads of surface and canopy dead fuels, little empirical research has addressed this question and results are ambivalent. The goal of this study was to determine how mountain pine beetle (*Dendroctonus ponderosae*) infestations may influence fire behavior in lodgepole pine (*Pinus contorta* var. *latifolia*) forests of Greater Yellowstone (WY, USA). Field studies and fire behavior modeling were used to predict potential fire behavior in 25 stands representing a time-since-beetle outbreak chronosequence from undisturbed to 35-yr post-outbreak stands that had similar pre-outbreak conditions. In each stand, we noted tree characteristics, understory cover, and surface and canopy fuel loads and distribution using standard methods. Field data were used to parameterize the fire behavior model NEXUS and predict potential fire behavior at each site under similar abiotic conditions (wind, slope, fuel moisture, etc.).

The beetle chronosequence data showed that immediately (1-4 yrs) after the outbreak, the most significant changes in fuels were a 50% decrease in available canopy fuel load and bulk density, and a doubling of needle litter depth. After 25-35 yrs, canopy bulk density was still low, biomass of large dead surface fuels increased, and canopy base height decreased with understory vegetation growth. Fine and medium-sized dead surface woody fuels (1-hr to 100-hr timelag fuels) varied widely throughout the chronosequence. Fire behavior modeling suggested that the short-term effect of bark beetle outbreaks was to reduce the probability of active crown fires under moderate to strong wind conditions because of low canopy bulk density. Several decades (25-35 yrs) after beetle infestation, probability of active crown fire was still low, but passive crown fires were predicted because of abundant ladder fuels. Compared to undisturbed stands, all post-beetle stands showed reduced fireline intensity and flame length, suggesting that fires burning in beetle-killed stands may be easier to control than those in undisturbed forests. By thinning the forest canopy, mountain pine beetle infestations may reduce the probability of intense active crown fires in lodgepole pine forests in Greater Yellowstone for at least 35 yrs.