ESA 2012 ABSTRACT

Douglas-fir beetle impacts on fire severity and postfire tree regeneration in lower montane forests of Greater Yellowstone

Brian J. Harvey, Zoology, University of Wisconsin, Madison, WI*
Monica G. Turner, Zoology, University of Wisconsin, Madison, WI
William H. Romme, NREL, Colorado State University, Fort Collins, CO
Daniel C. Donato, Zoology, University of Wisconsin, Madison, WI

Background/Question/Methods:
Bark beetle outbreaks in fire-prone western conifer forests have increased in extent in recent years, raising concern about potential effects on fire severity and tree regeneration following both disturbances. While modeling studies have indicated that fuel structures and simulated fire behavior may be altered following bark beetle outbreaks, very few empirical studies have been conducted following fire in beetle-killed forests to test impacts on fire severity (the effects of fire on an ecosystem) and early postfire response. Further, little is known about Douglas-fir beetle (*Dendroctonus pseudotsugae*) outbreaks in Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) forest, which covers over 30% of forested area in the Greater Yellowstone Ecosystem (Wyoming, USA). To address this knowledge gap, we sampled 85 0.07-ha plots in a large fire (27,200 ha) that burned in 2008 in an area where beetle outbreaks had occurred ~3-5 years prefire ("grey stage") to determine whether fire severity and postfire tree establishment were influenced by prefire beetle disturbance severity (which ranged from 0 to > 90 % of basal area killed by beetles prior to fire). Burn severity and postfire seedling density were evaluated against field measures of prefire beetle-induced tree mortality, prefire stand structure, topography, and fire weather conditions.

Results/Conclusions:

We found no significant relationship between fire severity and prefire beetle outbreak severity ($P > 0.05$). Fire severity was instead largely driven by topographic position and weather at the time of burning. Postfire Douglas-fir seedling density was very low 3 years following fire; most plots had no tree regeneration and when present, seedling density was strongly related to proximity to unburned patches of live trees ($P < 0.05$). The only areas to experience relatively high postfire tree regeneration (> 500 seedlings ha^{-1}) were those with low prefire beetle outbreak severity and low fire severity. Either high prefire beetle outbreak severity or high fire severity resulted in very low postfire Douglas-fir seedling density. These results support the understanding that patterns of fire severity in the Greater Yellowstone Ecosystem are largely driven by climate, weather, and topography, whereas beetle outbreaks may not substantially affect fire severity. However, prefire beetle outbreak severity interacts with fire severity to impact postfire regeneration of Douglas-fir, presumably by decreasing the available seed source at the time of fire. As Douglas-fir does not maintain a persistent aerial seedbank, severe prefire Douglas-fir beetle outbreaks can affect early postfire succesional trajectories in lower montane forests.