The Effects of Hazardous Fuel Reduction Treatments in the Wildland Urban Interface on the Activity of Bark Beetles Infesting Ponderosa Pine

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Abstract—*Selective logging, fire suppression, forest succession, and climatic changes have resulted in high fire hazards over large areas of the western United States. Federal and state hazardous fuel reduction programs have increased accordingly to reduce the risk, extent and severity of these events, particularly in the wildland urban interface. In this study, we examined the effect of mechanical fuel reduction treatments on the activity of conifer-infesting bark beetles in ponderosa pine,* (Pinus ponderosa *Dougl ex. Laws.*)*, stands. Treatments were applied in both late spring (April-May) and late summer (August-September) and included: (1) thinned biomass chipped and randomly dispersed within each plot, (2) thinned biomass chipped, randomly dispersed, and raked 2 m from the base of residual trees within each plot, (3) thinned biomass lop-and-scattered within each plot, and (4) an untreated control. The mean percentage of trees attacked by bark beetles ranged from 2.0% (untreated control) to 30.2% (plots thinned in spring with all biomass chipped). A three-fold increase in the proportion of trees attacked by bark beetles was observed in chipped versus lop-and-scattered plots. Higher levels of bark beetle activity were associated with spring treatments, which in general corresponded with periods of peak adult beetle activity. Raking chips away from the base of residual trees did not significantly affect attack rates. Several bark beetle species were present including the roundheaded pine beetle,* (Dendroctonus adjunctus *Blandford*)*, western pine beetle,* (D. brevicomis *LeConte*)*, mountain pine beetle,* (D. ponderosae *Hopkins*)*, red turpentine beetle,* (D. valens *LeConte*)*, Arizona fivespined ips,* (Ips lecontei *Swaine*)*, California fivespined ips,* (I. paraconfusus *Lanier*)*, and pine engraver,* (I. pini (*Say*)). Dendroctonus valens *was the most common bark beetle infesting residual trees. A significant correlation was found between number of trees chipped per plot and the percentage of residual stems with* D. valens *attacks. At present, no significant difference in tree mortality exists among treatments. In a laboratory study, monoterpene elution rates declined sharply over time in chipped treatments, but were relatively constant in lop-and-piled treatments. The quantity of* α*-pinene,* β*-pinene, 3-carene, and myrcene eluding from chips exceeded that of lop-and-piled slash during each of 15 sample periods. These laboratory results may, in part, explain the bark beetle response observed in regard to chipping treatments. The implications of these results to sustainable forest management are discussed in detail.*

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