

Protecting Whitebark Pines Through a Mountain Pine Beetle Epidemic With Verbenone—Is It Working?

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We initiated a multi-year project to protect individual cone-bearing whitebark pines (*Pinus albicaulis*) from mountain pine beetle (MPB), *Dendroctonus ponderosae* (Hopkins), attack with the anti-aggregating pheromone, verbenone (4,5,5-trimethylbicyclo [3.1.1] hept-3-en-2-one). Our objective was to protect trees through the course of the epidemic that began ca. 2000 in central Idaho. The study population was a subalpine stand of whitebark pine at 9,400 feet elevation near Clayton, ID. Associated conifer species included lodgepole pine, Douglas-fir and subalpine fir.

Initially, we followed the methods of Kegley and others (2003) and Kegley and Gibson (2004). These studies had shown effective individual tree protection from mountain pine beetle using verbenone over one season. However, unlike Kegley and others (2003) we monitored the trees for consecutive years and did not use beetle attractants to provide beetle pressure. We identified 149 trees, greater than 8" diameter at breast height,

spaced at least 130 feet apart and randomly assigned one of three treatments: (1) a control - no verbenone pouches; (2) two pouches or "low" dose (5 g verbenone/pouch) applied early summer; and (3) two pouches or "high" dose applied early summer and replaced in August. These three treatments were implemented in 2005 and 2006. Our methods were altered in 2007 when the manufacturers of verbenone stopped producing 5-g pouches and increased the pouch dose to 7.5 g of verbenone. Therefore, in 2007 we replaced the "high" dose treatment with two pouches of 7.5 g of verbenone applied once in early summer. And in 2008 and 2009, all previously verbenone treated study trees received one treatment of two pouches of 7.5 g of verbenone applied in early summer. As a result of the industry standard changing from year to year, all levels of verbenone treatments were combined to one treatment, "verbenone," for the analysis. Verbenone

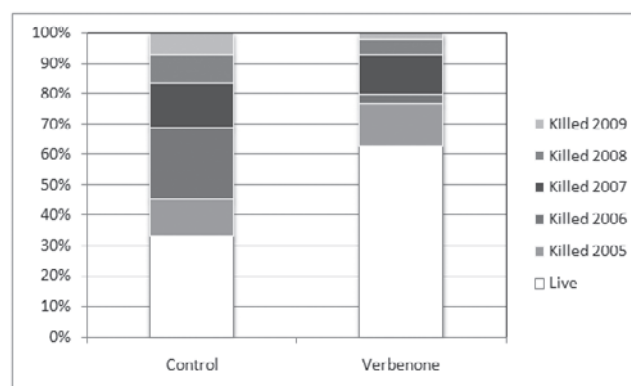


Figure 1. Percent of trees killed by year in control and verbenone treatments for 2005-2009. In 2009, trees treated with verbenone had a 66% survivorship as compared with control trees with 34% survivorship.

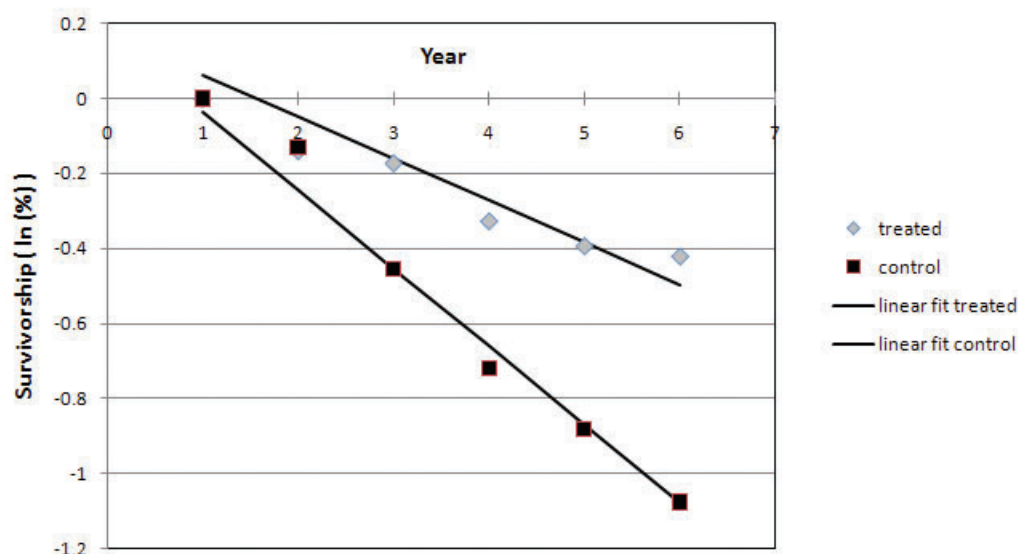


Figure 2. A linear model fit to the natural log of the survivorship proportions beginning in 2005 (year 1). Verbenone treatment: $y = 0.172233 - 0.1115x$ (slope SE = 0.013); control treatment: $y = 0.172233 - 0.2086x$ (slope SE = 0.013). Verbenone treated trees had a higher rate of survivorship.

pouches were stapled approximately 6-8 feet above the ground on the northwest and northeast sides to the bole of each selected tree. On multiple stemmed tree clumps, the pouches were stapled to the largest stem in the cluster. Trees were evaluated each fall after peak MPB flight for their condition or MPB-attack status (live, partial attack,

pitchout or mass attack/dead). Partial attacks and pitchouts were grouped with live trees in this analysis.

Results from 2005 through 2009 indicate whitebark pines treated with verbenone had a 66% survival compared to 34% survival of untreated trees and that the MPB-caused mortality varied from year to year (Fig. 1). A linear model fit to the natural log of the survivorship proportions showed the mortality rate was greater in control than treated trees (Fig. 2). The 95% CI on the mortality rate for control (0.20 ± 0.03) and treated (0.11 ± 0.03) trees do not overlap and so provides evidence that verbenone conferred some protection. According to the point estimates from these CIs, on average, 20% of control trees died each year while only 11% of treated trees died each year.

We plan to continue this verbenone treatment and monitoring until MPB-caused mortality subsides at the study site.

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