Quantifying the Short- and Long-term Impacts of Mountain Pine Beetle Outbreaks on Forest Fuels and Other Stand Attributes in the Intermountain West

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Introduction

Bark beetles influence forest ecosystem structure and function by regulating certain aspects of primary production, nutrient cycling, ecological succession and the size, distribution and abundance of trees (Fettig et al. 2007, For. Ecol. Manage. 238: 24-53). Currently, mountain pine beetle (MPB), *Dendroctonus ponderosae* Hopkins, outbreaks are widespread across the western United States (Cain 2009, *in* Man, G. (ed.), FS-919) requiring evaluation of ecological impacts (Fig. 1) and development of resource strategies that will address future forest conditions.

Figure 1. Mountain pine beetle-caused tree mortality, Montana, 2010.

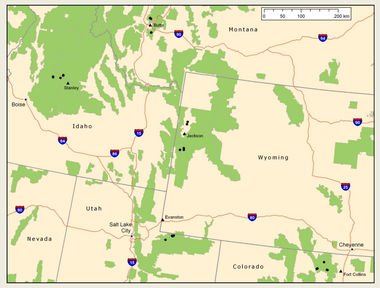

Figure 2. Plots (filled circles, n = 25/state, but many overlapped). Green = National Forest.

Methods

Twenty-five 0.08-ha circular plots were established in each of five states (CO, ID, MT, UT, WY; Fig. 2) in areas of recent MPB-caused tree mortality (N = 125). Aspect, elevation, slope and coordinates were recorded at plot center. Within each plot, all trees ≥7.6 cm dbh were tagged with species, dbh, height, height to base crown, status (live or dead), and year since death (Klutsch et al. 2008, For. Ecol. Manage. 258: 641-649) recorded. Three 16.1-m Brown's transects (Brown 1974, INT-GTR-16) were established at 0°, 120° and 240° from plot center to estimate surface fuels (Fig. 3). A 1-m² plot was established at the end of each Brown's transect (n = 3/plot) to determine forest floor composition (Fig. 4), and a 0.004-ha plot was established at plot center to estimate tree regeneration. Increment cores were collected from the three tallest trees on each plot (N = 375) to determine stand age and site productivity.

Figure 3. 16.1-m Brown's transect used for estimating surface fuel loads, Idaho, 2010.

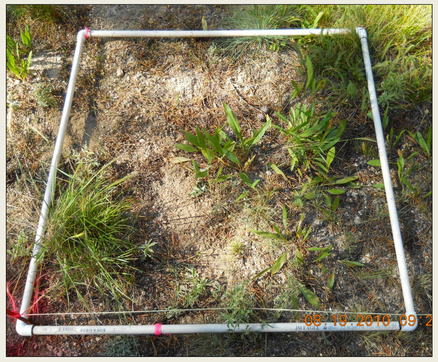

Figure 4. 1-m² plot used for determining forest floor composition, Idaho, 2010.

Preliminary Results

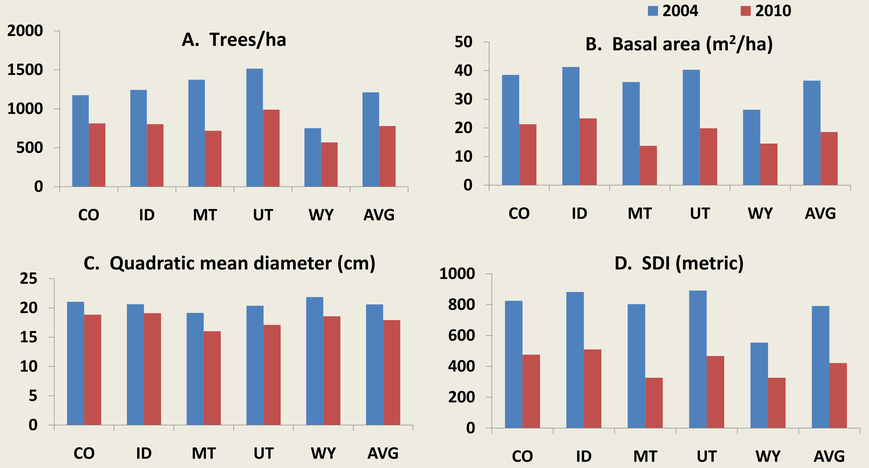

Figure 5. Average stand conditions (all tree species) in 2004 and 2010.

While there were reductions in stand density between 2004 and 2010 (Fig. 5), there was little change in stand composition (Fig. 6). Reductions in QMD (Fig. 5C) reflect the preference of MPB for colonizing larger diameter lodgepole pines.

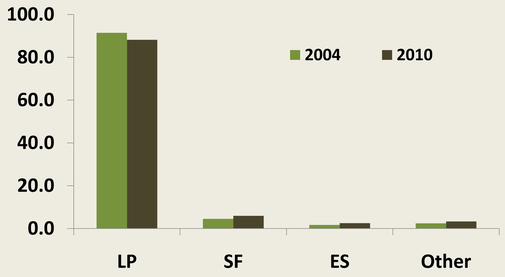

Figure 6. Mean percentage of stems in 2004 and 2010 (N = 125 plots). **LP** = lodgepole pine, **SF** = subalpine fir, **ES** = Engelmann spruce, and **Other** = Douglas-fir, quaking aspen, and limber, ponderosa and white bark pines.

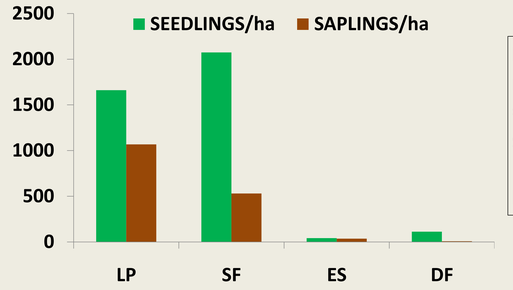

Figure 7. Average regeneration in 2010. **LP** = lodgepole pine, **SF** = subalpine fir, **ES** = Engelmann spruce, and **DF** = Douglas-fir.

Currently, regeneration consists primarily of lodgepole pine saplings and subalpine fir seedlings (Fig. 7), but may change due to the effects of tree mortality (Fig. 5) on microclimate and light penetrating the forest floor. Surface fuel loads varied considerably among states ranging from 9.8 (MT) to 32.5 (ID) t/ha (Fig. 8). Litter and duff depths averaged 2.9 and 3.3 cm, respectively for all plots.

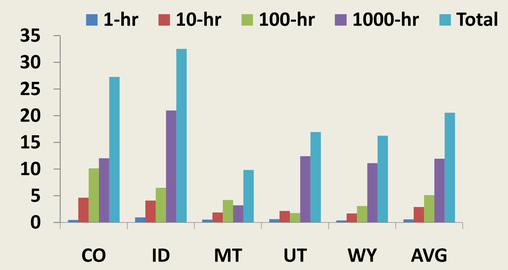

Figure 8. Average surface fuel loads (t/ha) by time lag categories, 2010.

Ongoing Efforts

Increment cores are being processed to determine stand age, site index, and growth rates over time. Analyses will be conducted to quantify relationships between stand measures and levels of tree mortality attributed to MPB attack. Plots will be visited annually to record new mortality; determine fall rates of trees; and measure changes in fuel loads. In 2011, additional plots will be added to the assessment.

Acknowledgments

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