



Severity and impact of Douglas-fir beetle infestations in northern Wyoming

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INTRODUCTION

The Douglas-fir beetle (DFB) *Dendroctonus pseudotsugae* infests and kills Douglas-fir throughout its range in the west. Typically, the Douglas-fir beetle reproduces in scattered Douglas-fir (*Pseudotsuga menziesii*) that are highly stressed, such as windfall, defoliated or fire-scorched trees (Furniss 1962, Furniss 1965). If enough suitable host material is present, the beetles can infest nearby healthy trees. Previous research on Douglas-fir beetle has looked at forest stand conditions and site characteristics that lead to beetle infestations (Furniss 1965, Furniss et al. 1979, Negron 1998, Negron et al. 1999). Also, we have previously looked at the impacts on forest overstory and understory conditions in areas attacked by Douglas-fir beetle 4-5 years prior to study (McMillin and Allen 2003). Significant changes to both the overstory and understory conditions were documented.

Aerial and ground surveys indicate a rapidly increasing Douglas-fir beetle outbreak in the Bighorn Mountains of northern Wyoming (Figure 1). While the beetle typically reproduces in stressed trees, no stressor such as blowdown or fire is evident to have initiated this outbreak.

The objectives of this study are to: 1. Quantify the severity and impacts of Douglas-fir beetle infestations at the stand level through a plot network on the Bighorn National Forest. This includes both overstory and understory changes. 2. Describe in detail the forest conditions present in areas that have experienced high levels of mortality over the past few years. 3. Provide information to forest managers and planners in the northern Rocky Mountains on potential impacts of Douglas-fir beetle based on stand conditions examined.



Figure 1. Douglas-fir tree mortality caused by Douglas-fir beetle on the Bighorn National Forest, WY in the (A)Tensleep Canyon and (B)Shell Canyon areas.

METHODS

56 plots were installed in stands that are predominantly Douglas-fir throughout three areas along the western edge of the Bighorn National Forest in north central Wyoming: Shell Canyon, Battle Park, and Tensleep Canyon (Figure 2). Fixed radius plots were installed in stands that had been impacted by Douglas-fir beetle and those that were currently unaffected. Within each plot the following measurements were taken on all trees >4 inches diameter at breast height (DBH): tree species, DBH, crown class and condition/damages. Year of attack was determined for those trees colonized by Douglas-fir beetle. The species and number of established seedlings (6 inches and taller) and saplings were counted within an 11.8 foot radius plot (1/100th acre) around plot center. Line transects were used to determine understory conditions. The number of total inches covered by grass, forb and shrub species was measured along a 10 foot line north, south, east and west off of plot center. Understory canopy height was measured at its highest point along each of the cardinal directions. In 2005 the plots were revisited. Plot tree DBH, condition/damages and understory conditions were remeasured.

Three of the infested and eight of the uninfested plots were not relocated in 2005. Eight of the remaining uninfested plots suffered current Douglas-fir beetle attack, but have remained within the "Uninfested Plot" group for analysis. The plots will be relocated in 2006 and remarked for future remeasurement. The plan is to return to them after a longer time period has passed, in about 5 years, and look at changes over that time frame.

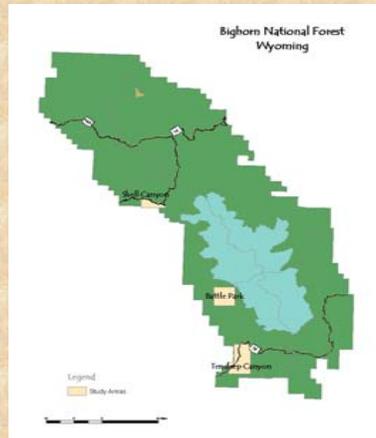


Figure 2. Location of study sites on the Bighorn National Forest WY.

RESULTS

Figure 3 shows the results of aerial surveys done in 2001 and 2004 and the subsequent change in tree mortality caused by Douglas-fir beetle. The outbreak increased dramatically in this 3 year period. Table 1 lists the results from the infested and uninfested plots measured in the summer of 2005. There are significant differences in pre and post infestation basal area and DBH between the infested and uninfested plots. There are also differences in the amount of ground vegetation present in the infested and uninfested plots (Figure 4). DBH, % Douglas-fir, and Douglas-fir basal area all decreased in infested plots (Figures 5 and 6). Amount of understory species has increased in the infested plots in a relatively short time.

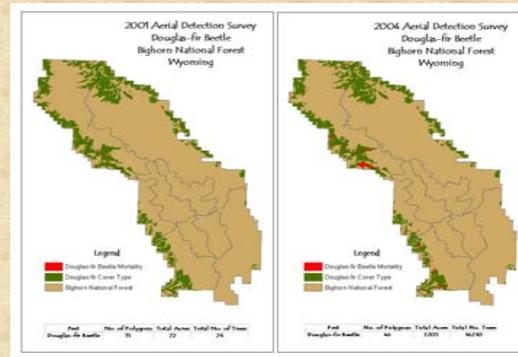


Figure 3. Comparison of the extent of Douglas-fir beetle activity in the Bighorn National Forest, WY between 2001 and 2004 based on aerial detection surveys.

Table 1. Summary (mean +/- SEM) of Douglas-fir beetle impacts on stand conditions

Variable	Uninfested	Infested
Total Basal Area (ft ² /ac)	205 (16.5)	300 (16.0)
Live Basal Area (ft ² /ac)	151.9 (16.9)	54 (9.1)
Total DBH (inches)	10.1 (.3)	13.3 (.6)
Live DBH (inches)	9.4 (.4)	6.4 (.7)
Percent DF (pre-infested)	87.8 (3.1%)	86.7 (3.5)
Percent DF (post-infested)	87.6 (3.8%)	54.0 (8.0)
Understory Height (inches)	6.0 (1.5)	7.1 (1.0)
Regeneration (per 0.01 ac plot)	1.9 (.4)	3.0 (.6)

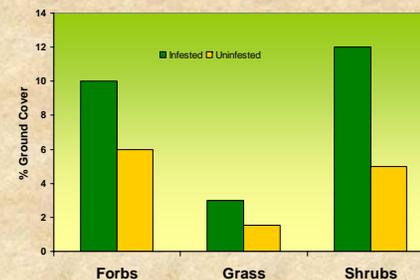


Figure 4. Impact of Douglas-fir beetle on understory ground cover in the Bighorn National Forest, WY.

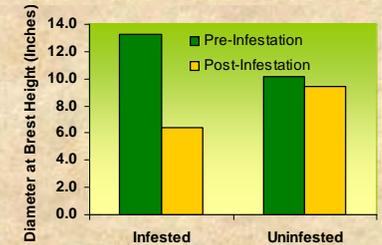


Figure 5. Changes in average DBH caused by Douglas-fir beetle infestation in infested plots compared to changes in uninfested plots.

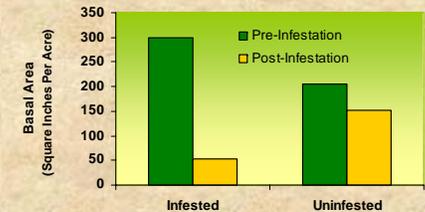


Figure 6. The impact of Douglas-fir beetle on basal area in infested plots compared to uninfested plots.

CONCLUSIONS

1. There is a rapidly increasing Douglas-fir beetle outbreak in these areas.
2. This outbreak has the potential to significantly change forest conditions in the Douglas-fir type. Significant differences have been found in pre and post infestation basal area and DBH in infested versus uninfested plots. This indicates that pre outbreak average stand DBH and basal area could be factors in initial stand susceptibility and intensity of infestation caused by Douglas-fir beetle.
3. Changes are already showing in the understory. Infested plots have shown an increase in understory component versus uninfested plots. These changes are likely to intensify as more trees are killed and DFB killed trees lose their needles.
4. There are changes in the Douglas-fir forested landscape as a DFB epidemic proceeds. Land managers will need to make decisions on desired future conditions based on the likelihood of these changes occurring.

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