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Mapping Mountain Pine Beetle and White Pine Blister Rust in White Bark Pine on the Helena National Forest

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Introduction

Mountain pine beetle, *Dendroctonus ponderosae* Hopkins, (MPB) populations have been increasing in Montana over the past ten years, with outbreaks in all host species extending to one million acres in the Northern Region. Unusually high levels of MPB caused mortality of whitebark pine (WBP), totaling 143,000 acres were recorded in 2005 in the Region. More than 8,600 acres with WBP mortality were recorded on the Helena National Forest (NF) in 2005.

During July and August 2005, we assisted the Helena NF map mortality of WBP in 32 stands on the Townsend Ranger District (RD). The areas we evaluated were Edith Peak, Baldy Mountain, and Occidental Mountain-Bluebird Meadow. We conducted walk-through surveys to maximize the number of stands evaluated. Our objectives were: 1) to provide training and assistance in identifying tree mortality from MPB and white pine blister rust, *Cronartium ribicola* Fisch, and 2) to evaluate mortality in WBP from MPB. We also noted the presence or absence of white pine blister rust in stands evaluated.

Methods

Stands were selected for mapping beetle-caused mortality from different compartments for three geographic areas: Edith Peak, Baldy Mountain, and Occidental Mountain-Bluebird Meadow. Stands within compartments were selected that were close to roads or trail systems. A few stands were also selected that were located in the center of compartments to represent variation in beetle and stand conditions.

The approximate center for each stand was located using landmarks and topography from stand compartment maps. Starting at the center point, a walk-through survey was conducted to estimate WBP mortality and other stand parameters. This was done by walking several transects radiating from the center to the stand perimeter and noting information on the following parameters: 1) stand composition-WBP versus WBP as a component of a two or three species stands, 2) an ocular estimate of %

mortality of whitebark pine, 3) presence/absence of mountain pine beetle, 4) presence/absence of blister rust on white bark pine, and 6) remarks on the regeneration, including trees per acre by species or only as presence or absence of regeneration by species. Blister rust was rated only as present or absent with no severity recorded. We did not include trees in the WBP mortality estimate that had been dead a very long time as evidenced by the lack of bark..

The definition of a WBP stand for this effort was one that comprised >60% of the total trees per acre > 5 inches DBH in WBP. Two-species stands are defined as ones in which two species dominated more than 80% of total trees per acre greater than 5 inches DBH. Three species stands are defined as those where three species were dominant.

In addition to providing assistance with the mapping survey, we also established a series of FINDIT plots (Bentz 2000) near Edith Peak to evaluate trends in MPB activity. Seventeen variable radius (BAF 10) plots were established at three chain intervals in two areas near Edith Peak; the southeast side of Edith Peak (7 plots) and along the trail going towards Edith Lake (10 plots).

Table 1. Stands mapped on Edith Peak.

Stand ID	Species Composition	%Mortality of WBP	White Pine Blister Rust (P/A)	Mountain Pine Beetle (P/A)	Regeneration TPA
12302061	WBP	90	P	P	0
12302057	SAF/LP/WBP	60	P	P	SAF-88
12302061	LP/SAF/WBP	90	P	P	--
12302051	LP/WBP	65	P	P	SAF-200
12302042	LP/WBP	25	P	P	SAF-400
12302043	LP/WBP	15	P	P	SAF-600;WBP-500
12302052	WBP/LP/SAF	95	P	P	SAF
12202059	WBP	50	P	A	WBP-300
12202042	WBP	50	P	P	WBP-300
12202039	WBP	0	P	P	WBP-300
12202017	LP	0	A	A	LP
12202016	LP	0	A	A	WBP-400
12202153	WBP	10	P	A	WBP-1000
12202035	WBP	60	P	A	SAF-WBP-450
12302032	SAF/LP	1	P	P	SAF-88
14303010	WBP	60	P	P	SAF/WBP-400

Table 2. Stands mapped on Occidental Mountain-Bluebird Meadow.

Stand ID	Species Composition	%Mortality of WBP	White Pine Blister Rust (P/A)	Mountain Pine Beetle (P/A)	Regeneration TPA
32303033	LP/SAF/WBP	5	P	A	SAF-WBP-450
32303083	LP/SAF	1	P	P	SAF/LP
32303034	WBP/SAF	20	P	P	WBP/SAF-1300
32303020	LP	5	P	A	SAF/DF/WBP/LP-2800
32303013	WBP/LP	5	P	**A**	SAF/DF-6400
32303057	LP	5	P	A	WBP
32303064	LP	50	P	P	WBP
32303063	LP	50	P	P	WBP
32303058	LP	25	P	P	WBP
32303040	LP	25	P	A	WBP
32303032	LP	25	P	A	WBP
32303050	LP	25	P	A	WBP

Table 3. Stands mapped on Baldy Mountain.

Stand ID	Species Composition	%Mortality of WBP	White Pine Blister Rust (P/A)	Mountain Pine Beetle (P/A)	Regeneration TPA
13403021	WBP	20	P	P	WBP/SAF/ES
13403012	WBP	50	P	P	WBP/SAF-500
13403016	LP/WBP	30	P	P	SAF/WBP-7100
13403015	LP/WBP	1	P	P	WBP/SAF-2200

Table 4. MPB in WBP in vicinity of Edith Peak (FINDIT plot data):

Area	Green Trees per Acre	'05 Attacks per Acre	'04 Attacks per Acre	Older Dead per Acre	Total Dead per Acre	% of stand killed to date
Edith Peak (7 plots)	107	32	82	103	185	72%
Edith Lake Trail (10 plots)	118	11	17	42	59	44%

Mortality from Mountain Pine Beetle and White Pine Blister Rust

Although there are stands in all three areas surveyed where almost all WBP has been killed by beetles, there are others with little beetle-caused mortality. Mortality of WBP on Edith Peak ranged between 0 and 95%; and 5 and 50% and 1 and 50% on Occidental and Baldy mountains, respectively (Tables 1-3). MPB was present in 20 out of 32 stands surveyed and was found attacking both WBP and lodgepole pine. Beetle-caused mortality was higher on Edith Peak than on Occidental and Baldy mountains. In all three areas surveyed, recent mortality from MPB occurred within the past three years, with the majority occurring in 2004. There was also beetle-caused mortality in all three areas that probably occurred sometime during the 1950s or earlier.

Similar to the results from the mapping survey, FINDITS showed stands near the peak of Edith Mountain had the highest mortality from MPB (Table 4). Stands surveyed along the trail still have a high number of attacked trees per acre, but this number has been also declining over the past few years. To date, 44% of trees in stands near the trail and 72% of trees in stands near Edith Peak have been killed by MPB. Both numbers will most likely be higher at the end of the outbreak because there are still green trees available and the remaining stands are still susceptible to beetle attack. Beetle-caused mortality in both areas is declining due to host depletion.

In the stands surveyed, 30 out of 32 stands had evidence of blister rust. Damage from blister rust was most severe on Edith Peak. We observed significant top-kill in mature trees from blister rust in stands in all three areas surveyed. Because of this we expect less WBP cone and seed production in the future in these stands. We also found a few dead trees that were not killed by MPB but we suspected were killed by blister rust. In the Occidental Mountain area, there were considerable numbers of sapling and pole size WBP with limited amounts of blister rust.

We recorded WBP regeneration in almost all of the stands surveyed. However, many of the stands also had a healthy and large component of subalpine fir seedling and advanced regeneration. Without management intervention to reduce competition from subalpine fir, the potential of WBP to survive may be compromised.

Conclusions

Many of the stands we surveyed did not resemble the typical spreading canopies and the majestic, wind-battered growth forms of WBP that are common in upper subalpine fir zones. Instead, they phenotypically resembled more densely stocked, mixed lodgepole pine stands that are found in those same zones.

In areas where fire suppression has resulted in an abundance of late-successional forests, susceptibility of both lodgepole and WBP to

MPB has increased. In these densely stocked stands, WBP is likely to be attacked by MPB because of stress from competition with subalpine fir. The absence of fire also leads to increasing age of the lodgepole and whitebark component which further escalates their susceptibility to MPB infestations (Tomback et al. 2001; Marsden 1983; McGregor & Cole 1985).

There are several silvicultural and prescribed fire techniques to manage whitebark pine at the stand and landscape level that have been little tested. These include techniques such as thinning and removing the subapline fir component, to reduce competition and stress and increase openings necessary for whitebark pine regeneration. Incorporating fire, either prescribed or wildland fire use, can provide long-term benefits to WBP survival if planned and implemented properly with well-described objectives and prescriptions.

Thinning from below to 80 square feet of basal area is a very effective silvicultural technique that reduces lodgepole and ponderosa pine stand susceptibility to MPB. Although this technique has been shown to reduce stand susceptibility of lodgepole pine to MPB, it has not been evaluated for WBP stands. Thinning from below may be a reasonable management strategy where there is a mix of lodgepole and WBP in a stand, or when WBP is growing in densely stocked stands to reduce the future activity of MPB.

Other management techniques to reduce losses due to MPB incorporate the use of synthetic insect pheromones. Verbenone is an antiaggregant pheromone for MPB that has successfully protected WBP trees from attack (Kegley et al. 2003; Kegley and Gibson 2004). There are many examples of the use of verbenone to protect individual high- value WBP across the Region. Trees can also be protected from MPB attack by preventative applications of the chemical insecticide carbaryl. Carbaryl provides protection against MPB attacks for up to two years when it is properly applied. Either of these tools provide short-term protection during outbreak conditions, but do not provide the long-term protection as does vegetative management.

Edith Peak is part of a proposed project area on the Townsend RD and would warrant evaluation as an area to treat, especially in stands that have limited MPB-caused mortality. Recent increases in precipitation will improve tree vigor and may lessen the magnitude of mortality from MPB over the next few years on the Helena NF. However, it may be several more years before MPB populations return to more endemic levels.

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