TITLE: Evaluating and Monitoring Mountain Pine Beetle Infestation in Fire-Damaged Ponderosa and Lodgepole Pine Stands. INT-F-08-01

LOCATION: Intermountain Region, Ashley National Forest - Neola, Utah
DURATION: Year 2 of 3-year project **FUNDING SOURCE:** Fire Plan
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PROJECT OBJECTIVES:

1. Identify the species of bark beetles infesting fire-injured ponderosa and lodgepole pines in burned (prescribed- and wildfire-burn) stands.
2. Determine if mountain pine beetle attack rates are associated with the amount of tree injury (crown scorch, bole scorch, and cambial kill).
3. Use the above information to construct post-fire tree mortality models that can be used to develop fire salvage marking guidelines for forest managers and FIA surveyors.

JUSTIFICATION: FHM aerial detection surveys and ground surveys conducted by Forest Health Protection indicate that mountain pine beetle populations in the Intermountain Region are at record high levels. Portions of the Intermountain Region also experienced numerous high intensity and severe wildfires in 2007. Consequently, forest managers are faced with a significant amount of delayed tree mortality due to mountain pine beetle and other bark beetle species. The Neola North Fire on the Ashley NF in Utah burned over 40,000 acres containing lodgepole pine and ponderosa pine forests in an area with outbreak levels of mountain pine beetle. Additionally, there are several stands in this same area that are scheduled for prescribed burning operations. Information derived from this project can assist fire planners and forest managers in developing prescriptions for burn and salvage operations.

Previous research has quantified the relationship between various bark beetle species and fire-caused tree injury in forest systems such as Douglas-fir (Douglas-fir beetle) and ponderosa pine (western pine beetle and *Ips spp*.). However, there is little quantitative information that has investigated the relationship between mountain pine beetle attacks and fire injury for ponderosa and lodgepole pine systems in the Intermountain Region. In fact, many studies have suggested that mountain pine beetle does not preferentially attack fire-injured trees. Preliminary findings from ground surveys within the Neola North fire boundary suggest mountain pine beetle are attacking fire-injured trees. Data collected for this project will elucidate this relationship.

Linkage to FHM Detection Monitoring: As part of Phase 2 and 3 of the FIA inventory 3-phase sample, surveyors are faced with the task of quantifying and qualifying measurements that describe tree characteristics and stand disturbances to estimate tree and stand mortality. Ultimately, the data collected from this project can be used to develop predictors for post-fire mortality in ponderosa and lodgepole pine stands in the Intermountain Region, which could undoubtedly be used by FIA crews and forest managers in estimating tree and stand mortality following fire.

Significance in terms of geographic scale: The information derived from this study has broad

application in that it can be used by forest managers, FIA crews, and FHP crews in areas where ponderosa pine and lodgepole pine stands exist and have the potential to become infested by mountain pine beetle.

Feasibility or probability that the project will be successfully completed: Protocols for data collection have been used successfully in other studies (Hood et al. 2005, Hood and Bentz 2007, Hood et al. 2007, Davis and Bentz 2008). The staff and infrastructure proposed to carry out this project are well qualified and familiar with the protocols that will be used to complete this project.

DESCRIPTION:

a. Background: Forest fire occurrences are common in ponderosa pine forests of the western United States. Fire injury may affect a tree's physiological processes (Ryan 2000), making them more susceptible to bark beetle attacks (McHugh et al. 2003;Wallin et al. 2003; Hood and Bentz 2007). There is some evidence to support mountain pine beetle attacks on fire-injured trees, although not at significant levels (McHugh et al., 2003), and others have suggested that mountain pine beetle is not attracted to trees in burned areas (Rasmussen et al. 1996). There are currently outbreak levels of mountain pine beetle populations in Utah. The Neola North Fire of 2007 on the Ashley NF burned 40,000+ acres of pinyon, aspen, lodgepole, ponderosa, and Douglas-fir. Our initial ground surveys of portions of this burned area showed mountain pine beetle attacks on partially scorched lodgepole and ponderosa pines. This finding is remarkable, as this phenomenon has not previously been demonstrated. This project will provide important information for management decisions, including those related to silvicultural and salvage operations, on forests with mountain pine beetle activity and wildfire and prescribed burns.

c. Products: Post-fire mortality prediction models for lodgepole and ponderosa pines. Quantitative information describing the relationship between fire-caused tree injuries and mountain pine beetle attack and brood production. This information can also be used by FIA crews during surveys to estimate tree and stand mortality following fire disturbances.

d. Schedule of Activities:

Year 1: Set up permanent sampling plots inside, at the fringe, and outside a wildfire area (Neola North Fire) in both ponderosa and lodgepole pine stands. Protocols in this sampling design will follow those of recent studies targeted at other bark beetle species.

Year 2: Conduct data analysis using data collected in Year 1. Prepare and present poster at the annual FHM conference. Revisit all permanent plots, monitoring tree mortality, bark beetle attacks and mountain pine beetle brood production.

Year 3: Conduct data analysis. Revisit all plots and monitor tree mortality and bark beetle attacks. Develop post-fire tree mortality and mountain pine beetle attack models. Complete final analysis and report. Prepare and present poster at the annual FHM conference.

PROGRESS / ACCOMPLISHMENTS

Year 1: Neola North Fire boundary delineations and vegetation maps were obtained from the Ashley NF and used to identify sites within burned ponderosa and lodgepole pine stands. Prior to beetle flight in May 2008, four sites were established in each tree species. At each site, 16 fixed radius plots (size varied with tree density) were systematically assigned (64 plots/ species and 128 total plots).

Individual trees within plots were assessed for fire injury according to the methods of Hood et. al. (2007), and assessed for bark beetle presence (Lodgepole: 1176 trees; Ponderosa: 567 trees). Additionally, four passive traps were hung within each site to estimate background bark beetle pressure. Five trees each of varying degrees of scorch and bole char were caged on their northern and

southern bole aspect to determine mountain pine beetle success.

A preliminary summary of the data is shown in the table below. For simplicity, this table shows beetle relationships with just two categories of one measure of fire injury, bole char. Subsequent and integrated measures, and full statistical analyses are underway. The totals for attacked trees represent all species of bark beetles. The following beetles were observed infesting ponderosa and/or lodgepole pine: *Dendroctonus ponderosae, D. valens, D. murrayanae, Ips spp., Pityogenes spp.* Members of Cerambycidae and Buprestidae were also found, but are not included in this table.

Overall, charred trees appeared more likely to be attacked than non-charred trees. However, it should be noted that few ponderosa pines had no bole char.

	Lodgepole Pine n=1176			**Ponderosa Pine** n=567	
	Attacked	**Not Attacked**		**Attacked**	**Not Attacked**
Charred	551	218		245	319
No Char	102	305		0	3

The caging studies showed that charred trees can be suitable hosts for mountain pine beetle. Successful brood production occurred in some charred trees of both species. However, in severely charred trees, it appeared that mountain pine beetle is more successful in ponderosa than lodgepole pine. Analyses will continue, and include additional measures of tree fire-injury and correlations with mountain pine beetle brood success.

COSTS:

A graduate student studying at the University of Wisconsin, Andy Lerch, was brought on to the project in May 2008. The presence of mountain pine beetle in fire-injured stands of lodgepole and ponderosa pine provided an ideal opportunity to evaluate if fire-injured trees will be sinks or sources for mountain pine beetle population growth following fire. To do this, we used emergence cages and passive traps in 2008 to quantify the effects of host tree fire-injury on mountain pine beetle population success. We plan to continue these efforts in 2009 and 2010, in addition to monitoring attacks and delayed tree mortality, and request a slight increase in years 2 (+$4,000) and 3 (+$4,000) to hire a seasonal technician to assist with these tasks.

	Item	**Requested FHM EM Funding**			**Other-Source Funding**			**Source**
YEAR		Yr 1	Yr 2	Yr 3	Yr 1	Yr 2	Yr 3	
Administration	Salary	31,052	34,381	34,381	18,000	18,000	18,000	FHP/RMRS/UDF/Ashley NF
	Overhead							
	Travel	500	1,619	1,619	5,000	5,000	5,000	FHP/RMRS/UDF/Ashley NF
Procurements	Contracting							
	Equipment		0	0	1,000	1,000	1,000	FHP/RMRS/UDF/Ashley NF
	Supplies	448	0	0	1,000	1,000	1,000	FHP/RMRS/UDF/Ashley NF
Total		**32,000**	**36,000**	**36,000**	**25,000**	**25,000**	**25,000**	