

New Proposal

TITLE: IMPACTS OF MANAGEMENT FOLLOWING BARK BEETLE OUTBREAKS ON FUELS AND PREDICTED FIRE BEHAVIOR UNDER VARYING CLIMATE SCENARIOS

LOCATION: National Forests in South Dakota and Wyoming

DURATION: 3 years

FUNDING SOURCE: Fire Plan EM

PROJECT LEADER & SPONSOR: Kurt Allen, Region 2 FHM, Rapid City, 605-716-2781, kallen@fs.fed.us

COOPERATORS: Carolyn Sieg, (USFS RMRS), Joel McMillin (USFS FHP), Chad Hoffman (U Idaho)

PROJECT OBJECTIVES:

1. Quantify fuels in forest stands experiencing a) high levels of bark beetle-caused ponderosa pine and Douglas-fir mortality, b) high tree mortality followed by management treatments, and c) no tree mortality.
2. Model fire behavior in these stands under different climate scenarios during the second stage of the fuels complex temporal gradient.

JUSTIFICATION: Previous studies in other geographic locations and with other bark beetle-host systems have suggested that bark beetle outbreaks can affect fire behavior attributes (predicted flame length, fire rate of spread, torching) due to increased surface fuel loading, higher wind speeds and quicker drying of fuel (reviewed by Jenkins et al. 2008). These findings can have profound implications for managing dead trees resulting from extensive bark beetle outbreaks and restoration of damaged ecosystems. However, published data quantifying temporal changes in fuels complexes and effects of post-outbreak management are not available for ponderosa pine and Douglas-fir forests. We have collected aerial and surface fuels data from these forest types in treated and untreated bark beetle-impacted stands during the first stage of changing fuels related to bark beetle outbreaks (1-3 year post mortality). Collecting additional data during the second stage of mortality (4-6 years post mortality) when larger surface fuels and herbaceous understory begin accumulating is critical to providing land managers with information on the fire behavior associated with bark beetle outbreaks.

Linkage to FHM Detection Monitoring: FHM aerial detection surveys (ADS) found more than 150,000 acres of ponderosa pine impacted by mountain pine beetle in the Black Hills between 2002 and 2008. Douglas-fir beetle outbreaks have been detected by ADS in both the Shoshone NF (120,000 acres) and Bighorn NF (10,000 acres) over the same time period. These events have had profound political, social, and ecological importance throughout the Black Hills and Wyoming and dramatic impacts on public perceptions of forest health. As a result of these landscape level impacts and the pervasive occurrence of high density overstocked stands, agencies and communities throughout the West are implementing various vegetation treatments to decrease standing and surface fuels. However, it remains unclear how these treatments are affecting fire behavior following a bark beetle outbreak.

Significance in terms of geographic scale: Landscape-level bark beetle outbreaks have occurred throughout the western US during recent years in response to dense forest conditions, drought, and fire (Fettig et al. 2007). Climate change has also been implicated as a primary factor contributing to the extent and magnitude of these outbreaks (Carroll et al. 2004). Results from our study will extend our knowledge of how these outbreaks and subsequent vegetation/fuels treatments influence fire behavior in ponderosa pine and Douglas-fir forests of the western US.

Biological impact and/or political importance of the issue related to fire: Wildland fires, bark beetle outbreaks, and forest management are politically charged issues throughout the West. With the extent of bark beetle outbreaks and post-outbreak vegetation treatments being implemented throughout the West, we need to improve our knowledge of how these outbreaks and treatments are influencing fuel loading,

fire behavior, and other aspects of forests. For example, if vegetation treatments (restoration, sanitation, salvage) reduce short- and long-term stand fire risk, we need to state that. Conversely, if they do not, we need to know why not. Furthermore, treatments may be having other important biological impacts on forest ecosystem function, such as changes in nutrient cycling, non-native invasive plant spread, and coarse woody debris.

Feasibility of the project being successfully completed within 1-3 years: We have already installed plots and recorded fuels data during the first stage of bark beetle-caused changes in fuels complexes in ponderosa pine and Douglas-fir stands, in areas that have had salvage/sanitation treatments, and in nearby areas without bark beetle attacks. Our team has experience in documenting the effects of bark beetle outbreaks, collecting and analyzing fuel loading, and modeling fire risk in a variety of forest types in a timely manner (McMillin and Allen 2003, McMillin et al. 2003, Hoffman et al. 2007, Negrón et al. 2009, Hoffman et al., in press, Hoffman et al., submitted).

Priority issues addressed from request for proposals: The proposed study will address four of the five Priority Issues listed: Climate change; Fire risk and fuel loading; Ecological impacts of fires; Restoration of ecosystems. We will quantify how bark beetle effects on fuel loading and simulated fire hazard can be modified by post-outbreak treatments under varying climate scenarios.

BACKGROUND: Increased surface fuels as a result of outbreaks can affect simulated fire behavior; however, studies examining these relationships have been limited to mid- to high-elevation forest types (reviewed by Jenkins et al. 2008). Similar work is essential in lower elevational forest types such as ponderosa pine that are widespread throughout the West (Jenkins et al. 2008). The proposed research will increase our ability to assess hazard (i.e., when and where post-outbreak treatments are needed to reduce fire hazard) and management planning (i.e., providing carbon for societal and ecosystem health and sustainability) under changing climatic conditions. Fuel hazard is hypothesized to peak immediately following the outbreak due to the retention of dead needles in the canopy (Figure 1). Fire hazard decreases in subsequent years as needles drop from the canopy. However, as larger surface fuels and herbaceous understory begin accumulating and stand density increases fuel hazard remains above pre-outbreak levels for many years. Salvage/sanitation treatments are hypothesized to decrease fuel hazard to levels similar to pre-outbreak conditions.

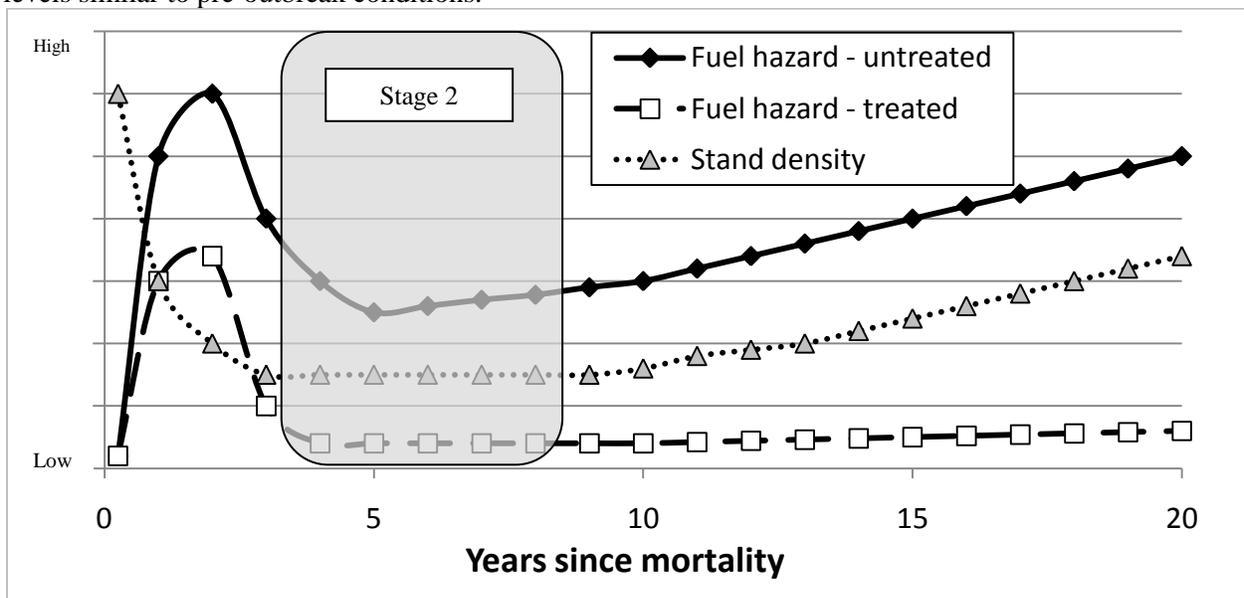


Figure 1. Hypothetical change in fuel hazard and live stand density for stands impacted by bark beetles with or without salvage treatments as a function time since outbreak. This proposal focuses on fuel accumulation and structure in stage 2, or years 4-6 since mortality occurred.

METHODS: We will resample permanent fixed-radius plots with similar pre-mortality stand and site conditions, but varying levels of tree mortality, time since mortality, and post-mortality treatments. Canopy and surface fuels will be quantified using standardized methodology (Brown 1974, Fulé et al. 2001). We will model simulated fire behavior across the treatments and over a range of climatic scenarios using the NEXUS Fire Behavior and Hazard Assessment system (Scott and Reinhardt 1999). This system estimates fire intensity, spread, flame length, wind speeds required for fires to transition from surface to crown fires, and the proportion of various fire types (such as surface or crown). NEXUS, which links separate models of surface and crown fire behavior to assess crown fire potential of a given stand, relies on Rothermel's (1991) equations to predict fire rate of spread and Byram's (1959) equation to predict fire line intensity. These are the most commonly used equations in the United States for estimating fire behavior attributes (Pastor et al. 2003). We successfully used this approach to assess bark beetle outbreaks (Hoffman et al., in press; Hoffman et al., submitted) and dwarf mistletoe (Hoffman et al. 2007) effects on fuel loading in ponderosa and piñon pine stands in Arizona.

Products: Primary products will be technical reports and peer-reviewed manuscripts. Transfer of information to land managers through local and regional meetings, and via web-based media products. In addition, our goal is to use these findings: 1) to ground truth surface fuel data captured using LiDAR, and 2) in the development of physics-based models (HIGHGRAD/FIRETEC) that account for impacts of bark beetle outbreaks on predicted fire behavior under heterogeneous landscapes, fuels, and winds.

Schedule of Activities:

Years 1&2 (2011&2012). Collect plot data on fuel loading from ponderosa pine forests in the Black Hills, South Dakota and from Douglas-fir forests in Wyoming. Enter data and run fire behavior models. Complete progress report and summarize findings in a poster at the FHM Working Group meeting.
 Year 3 (2013). Complete final report, technical reports, peer-reviewed manuscripts, and web-based tools.

	Item	Requested FHM EM Funding	Other-Source Funding	Source
YEAR 1				
Administration	Salary	20,000*	20,000	FHP, RMRS, U of ID
	Travel	6,000*	1,500	FHP Base
Procurements	Supplies	2,000		
Total, Year 1		28,000	21,500	
YEAR 2				
Administration	Salary	21,000*	20,000	FHP, RMRS, U of ID
	Travel	6,000*	1,500	FHP Base
Procurements	Supplies	2,000		
Total, Year 2		29,000	21,500	
YEAR 3				
Administration	Salary	17,000**	20,000	FHP, RMRS
	Travel	2,000**		
Procurements	Supplies	2,000		
Total, Year 3		21,000	21,500	

*Costs for hiring two GS-4/5 seasonal biological technicians and their travel expenses to collect plot data and enter data. **Costs for part-time post-doc salary to analyze data, run fire behavior models, draft manuscripts and reports, develop web-based tools, and present results at meeting.