Special Technology Development Program
New Project Proposal

PROJECT NUMBER: R6-2002-03

PROJECT TITLE: Guidelines for predicting insect-caused tree mortality following prescribed and wildfires in mixed-conifer type in eastern Oregon.

PROJECT STATUS: New

EXPECTED PROJECT DURATION: 5 years

EXPECTED COMPLETION DATE OF THE PROJECT: FY 2007

SUBJECT:

1. Total Suppression/Prevention Technology	**65%**		1. Survey and Monitoring Technology	**35%**	
a. Total Biological Control i. Microbial % ii. Parasitoides % iii. Synthetic hormones/pheromones % iv. Other %		%	a. Advancements in Detection Technology		
			b. Landscape Level Assessment Technology i. Data Visualization		%
b. Total Modeling i. Pesticide (Insecticide) Application % ii. Disturbance % iii. Growth and Yield % iv. Organism % v. Population % vi. Terrain %	20 10	**30%**	c. Remote Sensing i. Aerial % ii. Hyperspectral % iii. Satellite %		%
			d. Other post-fire monitoring		35%
c. Genetic, Cultural and Silvicultural Innovations For Controlling Pest Species i. Fire % ii. Methyl Bromide Alternatives % iii. Thinning/Regeneration Techniques and other Silvicultural Guidelines % iv. Resistance, Screening, and Breeding %		**35%**	3. Assessment Technology	%	
	35		a. GIS % b. Spatial Analysis % c. Landscape Analysis % d. Decision Support % Risk and Hazard % Expert Systems %		
d. Pesticide Application		%	4. Social Values	%	

(Spray) Technology i. Equipment innovations % ii. Methods and Guidelines %			5. Technology Transfer Innovations	%	
e. Other		%	6. Other	%	

STATUS OF SUBJECT SPECIES: native

PROJECT OBJECTIVES: 1) Which parameters best predict which fire-injured trees will be killed by insects? Management guidelines will be developed to predict tree mortality due to insects following prescribed burning and wildfire in mid-elevation, mixed-conifer stands. Guidelines will be based on stand and tree characteristics; fire season and severity; and for prescribed fires, resident insect levels; 2) What measures can be taken to minimize fire injuries that are most likely to lead to subsequent insect-caused tree mortality?; and 3) Develop a probability model of post-fire pest-caused mortality compatible with existing fire models (Fire and Fuels Extension (FFE) of the Forest Vegetation Simulator (FVS) model and First Order Fire Effects Model (FOFEM)).

BRIEF DESCRIPTION OF PROJECT:

FY 2002: 1) Select prescribed burning units; and 2) Establish pre-burn stand and insect inventory plots.

FY 2003: 1) Prescribe burn half of the units in fall 2002 and half in spring 2003; 2) Conduct post-burn fire severity and insect evaluations; and 3) Data entry of prescribed and previously collected wildfire data.

FY 2004 - FY 2006: 1) Conduct insect evaluations; 2) Data entry; and 3) Examine preliminary results.

FY 2007: 1) Develop stand tables and conduct logistic regression analysis; 2) Develop burning guidelines; and 3) Construct a probability model to predict post-fire insect mortality.

FHP LEAD CONTACT & INVOLVEMENT:

Name	Affiliation	Phone, E-mail, Fax
Don Scott	Wallowa-Whitman NF	541-962-6545 dscott@fs.fed.us 541-962-6504
	Role	**Time Commitment**
	FHP coordination	5 weeks/yr

PRINCIPAL INVESTIGATOR & INVOLVEMENT:

Name	Affiliation	Phone, E-mail, Fax
Chris Niwa	PNW Research Station, Corvallis, OR	541-750-7370 cniwa@fs.fed.us 541-750-7329
	Role	**Time Commitment**
	Project coordination	8 wks/yr

COOPERATORS & INVOLVEMENT:

Name	Affiliation	Phone, E-mail, Fax
Brett Thomas	Burnt Powder Fire Zone, Unity RD, Wallowa-Whitman NF	541-523-1913 bthomas@fs.fed.us
Kathy Sheehan	FHP, R-6, Portland, OR	503-808-2674 ksheehan@fs.fed.us 503-808-246
Roger Ottmar	PNW Research Station, Seattle, WA	206-732-7826 rotmar@fs.fed.us 206-732-7801

Nick Crookston	RMS, Moscow, ID	208-883-2317 ncrookst@fs.fed.us
Name	**Role**	**Time Commitment**
Brett Thomas	Locate burning units, local coordination	1 person wk/yr
	Contribute crews for constructing fire lines & collecting fuels and fire information	2 person wks/yr
	Contribute crews for assessments	4 person wks/yr
	Conduct prescribed fires	Contract burning crews
Kathy Sheehan	Develop predictive model	2 weeks
Roger Ottmar	Consult & advise on fuels consumption	1 week
Nick Crookston	Consult & advise on FFE model	1 week

JUSTIFICATION: There is a growing need for FID to provide land managers with information that will help them predict which trees, and under what conditions, will succumb to insects following fire. The potential for pest-caused mortality to trees is currently high due to the steady increase in the number of acres undergoing prescribed burning and the extent of wildfires in recent years. Specifically, the preponderance of prescribed burning in the spring, which occurs just before the peak flight of many beetle species, and at a time when plants are physiologically most active, may contribute to a higher incidence of tree mortality. In addition to predicting tree mortality after fires, knowledge of the severity and season of fire damage that make a tree susceptible to pest attack will help managers to write burning prescriptions that minimize damage. Some guidelines predicting insect-caused tree mortality presently exist (Weatherby et al. 1994, Flanagan 1996, Scott et al. 1996, Steele et al. 1996), but the database is small and has been collected almost exclusively following wildfires.

STDP R6-00-02 is examining the impact of spring and fall prescribed underburning on beetles in pure ponderosa pine stands. The current proposal seeks to advance our knowledge of insect-driven tree mortality after fire into the mixed-conifer type. It will utilize the same study design and sampling methodology as in ponderosa pine to: 1) examine fire related insect damage in additional tree species (Douglas-fir, grand fir, Engelmann spruce and others); and 2) compare beetle-caused tree mortality under prescribed and natural fire conditions. While ponderosa pine stands have received the highest priority for prescribed burning treatments, other tree species may be more susceptible to fire and pest injury, which could subsequently lead to infestations that could spread to surrounding unburned stands (Rasmussen et al. 1996, Scott et al. 1996, Gibson & Ping (1999), Weatherby et al. 2001).

Three eastern Oregon wildfires monitored since 1996 provide a database that could immediately be developed into stand tables and a predictive model with minimal cost. Since the wildfire data were collected in a method and geographic area similar to the proposed prescribed burning, it would provide resource managers with a realistic comparison of tree mortality following natural and prescribed fires.

URGENCY: As decisions are made to implement ecosystem management, it becomes increasingly important to know that proposed activities will move forested communities toward the desired future condition. Management activities, such as prescribed burning, must be planned with full knowledge of the influence that such an activity will have on the development and spread of insect infestations. Even if burning is conducted within prescription boundaries, subsequent tree mortality caused by insects attacking fire injured hosts may well cause impacts that were neither foreseen or desired, including mortality of larger diameter trees and the spread of beetle infestations to neighboring green stands.

NATIONAL FHP TECHNOLOGY DEVELOPMENT PRIORITY: Priorities 2 & 3

Objective 2 specifically addresses Priority 2 in the development of guidelines for minimizing fire injuries caused during prescribed burning in order to reduce the adverse impacts of bark beetles. Objective 1 examines the interaction of fire damage and subsequent insect impacts on forest structure following prescribed and wildfires.

TECHNICAL COMMITTEE DEVELOPMENT PRIORITY: Priority 5

Objective 3 involves the development of a probability model to predict the impact of insect-caused tree mortality based on stand and tree characteristics; fire season and severity; and for prescribed fires, resident insect levels.

SCOPE OF APPLICATION: Management guidelines developed as a result of this project will be immediately usable for interior, mid-elevation, mixed-conifer type (R-1, R-3, R-4, R-5 & R-6). The study will assess bole infesting beetles (bark beetles and wood borers) in several host tree species. The tools developed in this project will be applied as long as prescribed burning is used as a management practice in mixed-conifer stands.

RESEARCH BASIS: Volatiles released by stressed host trees following burning are likely to make stands more attractive to bole infesting beetles. In addition, trees scorched or wounded by fire are weakened and are less resistant to insect attack. In many regions of the Northwest, wildfire has been followed by outbreaks of bark beetles (Mitchell & Martin 1980, Geiszler et al. 1984, Ryan & Amman 1996, McCullough et al. 1998). The fact that the majority of prescribed burning occurs in the spring rather than in the late summer and fall when wildfires historically burned is a reason for concern. Spring burns occur when trees are actively growing, a time when fire injury would be most deleterious, and just before or during peak flight of many beetle species. Harrington (1987) found higher ponderosa pine mortality following spring and summer prescribed fires compared to fall prescribed burns. Other conifer species tend to have shallower rooting habits than ponderosa pine (Burns & Honkala 1990), which may increase the likelihood of root damage caused by early season prescribed burning and in turn increase susceptibility to insect infestation.

While the thick bark of Douglas-fir makes it relatively resistant to fire, Douglas-fir beetle caused mortality has been found to increase with increasing tree diameter of fire-injured trees (Weatherby et al. 1994, Weatherby et al. 2001). Both Douglas-fir and Engelmann spruce have demonstrated a high potential for drawing large numbers of beetles into fire damaged stands (Scott et al. 1996, Gibson et al. 1999).

METHODS: Six pairs of units designated for prescribed burns will be selected on the Wallowa-Whitman NF. In each pair, one unit will be underburned in fall 2002 and the other will be burned in spring 2003. Establishment of six study blocks will help ensure that adequate replication exists incase some of the units are lost to circumstances beyond our control.

Before burning, a series of variable radius plots will be established and permanently marked. In each treatment unit, there will be 10 stand exam plots (stand, tree and beetle data) and 20 insect plots (dbh and beetle data only). This information will provide a data set to run the FVS model as well as determine the resident level of insects in each unit. District fire personnel will collect fire and fuel measurements in a manner that is compatible with the FFE model. After prescribed burning is completed all trees will be monitored for fire severity (duff consumption, bole char and crown scorch) and beetle infestation. Assessment of insect damage will continue to be monitored until four years post-fire. Wildfire data collection was similar to the methods discussed above.

The primary question being asked is: which stand, tree, fire, and resident beetle parameters best predict which fire-injured trees will be killed by insects? Recent advances in statistical methods make possible the analysis of this experimental design, which is a split-split-split plot (split on season of burn, plot within burn, and tree within plot). Logistic regression can be used to answer a multitude of specific questions such as: holding all other factors constant, what are the odds of beetle attack given a spring vs. a fall burn?

Standard measures will be taken to assure that data is properly entered, analyzed and archived.

MEASURES OF SUCCESS:

Standard of Success: The project will be successful if sound recommendations can be made based on the stand, fire and insect data collected. The likelihood of success is high because the work is based upon widely used methodologies and because treatment replication is relatively robust.

Expected Outcomes: Fire/fuels managers will modify prescribed burning prescriptions to minimize types of tree damage that raise the incidence of subsequent beetle attack. Increased capability of resource managers to predict beetle-caused tree mortality following prescribed and wildfire.

Implementation of Products/methods: This will be the most comprehensive assessment of fire in mixed-conifer stands, which should lead to immediate and rapid implementation of burning guidelines. Compatibility with existing fire models will further enhance implementation.

PRODUCTS AND DUE DATES:

FY 2006/7: GTR of fire/insect management guidelines.

FY 2007/8: GTR describing the probability model.

PUBLICATIONS: Results will be published in a peer-reviewed journal and in the form of GTR's.

TECHNOLOGY TRANSFER: Technology will be transferred to FHP and state entomologists and resource managers (silviculture and fire/fuels). Results will be transferred by oral/poster presentations at conferences and workshops beginning in FY 2004, and final results will be reported in GTR's as described above.

PRODUCT LEVERAGING: This proposal builds on STDP R6-00-02. It expands the approach to include additional host tree and beetle species. It also provides a comparison to insect response to wildfire by utilizing an available, compatible dataset.

LONG-TERM BUDGET REQUEST: PNW = Pac. NW Res. Sta.; W-W = Wallowa-Whitman NF

	Item	Requested FHP STDP Funding	Other-Source Funding	Source
FY 2002				
Administration	Salary	27,597	14,408/7,699	PNW / W-W
	Overhead	9,753	12,126/2,990	PNW / W-W
	Travel	14,168	4,348/828	PNW / W-W
Procurements	Contracting	0	0	
	Equipment	500	0	
	Supplies	500	0	
YEAR TOTALS		52,518	30,882/11,517	PNW / W-W

FY 2003				
Administration	Salary	22,516	14,984/62,006	PNW / W-W
	Overhead	9,627	9,540/3,109	PNW / W-W
	Travel	15,016	2,304/876	PNW / W-W
Procurements	Contracting	0	0	
	Equipment	0	0	
	Supplies	500	0	
YEAR TOTALS		47,659	26,828/65,991	PNW / W-W

FY 2004				
Administration	Salary	17,285	15,584/5,229	PNW / W-W
	Overhead	7,491	9,922/2,150	PNW / W-W
	Travel	11,934	2,442/620	PNW / W-W

Procurements	Contracting	0	0	
	Equipment	0	0	
	Supplies	200	0	
YEAR TOTALS		36,910	27,948/7,999	PNW / W-W

FY 2005				
Administration	Salary	17,952	16,208/5,437	PNW / W-W
	Overhead	7,805	9,765/2,234	PNW / W-W
	Travel	12,648	2,588/656	PNW / W-W
Procurements	Contracting	0	0	
	Equipment	0	0	
	Supplies	200	0	
YEAR TOTALS		38,605	28,560/8,327	PNW / W-W

FY 2006				
Administration	Salary	18,653	16,856/5,655	PNW / W-W
	Overhead	8,217	10,156/2,324	PNW / W-W
	Travel	13,410	2,744/696	PNW / W-W
Procurements	Contracting	1,000	0	
	Equipment	0	0	
	Supplies	200	0	
YEAR TOTALS		41,480	29,756/8,675	PNW / W-W
PROJECT TOTALS		217,172	143,975/102,509	PNW / W-W

LONG-TERM BUDGET REQUEST EXPLANATION: The budget request for FY 2002 is to select study areas and establish plots; the FY 2003 request will cover costs of fire severity and insect assessments; and the requests for FY's 2004-2006 will cover annual insect assessments and data analysis.

BENEFITS: 1) Improved ability to predict beetle-caused tree mortality following prescribed burns and wildfires in mixed-conifer forests; and 2) Prescribed burning recommendations to minimize fire damage that contributes to subsequent insect infestation.

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