Assessing post-fire tree survival in Oregon and Washington

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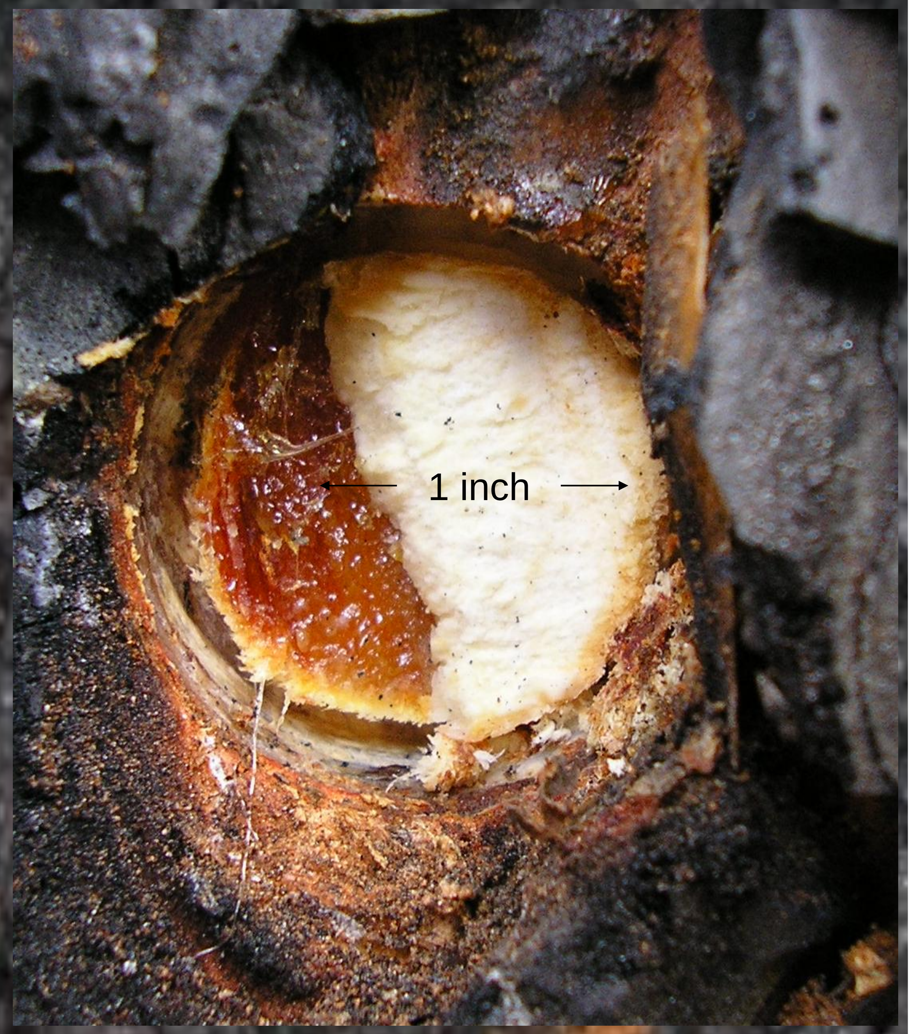
Introduction

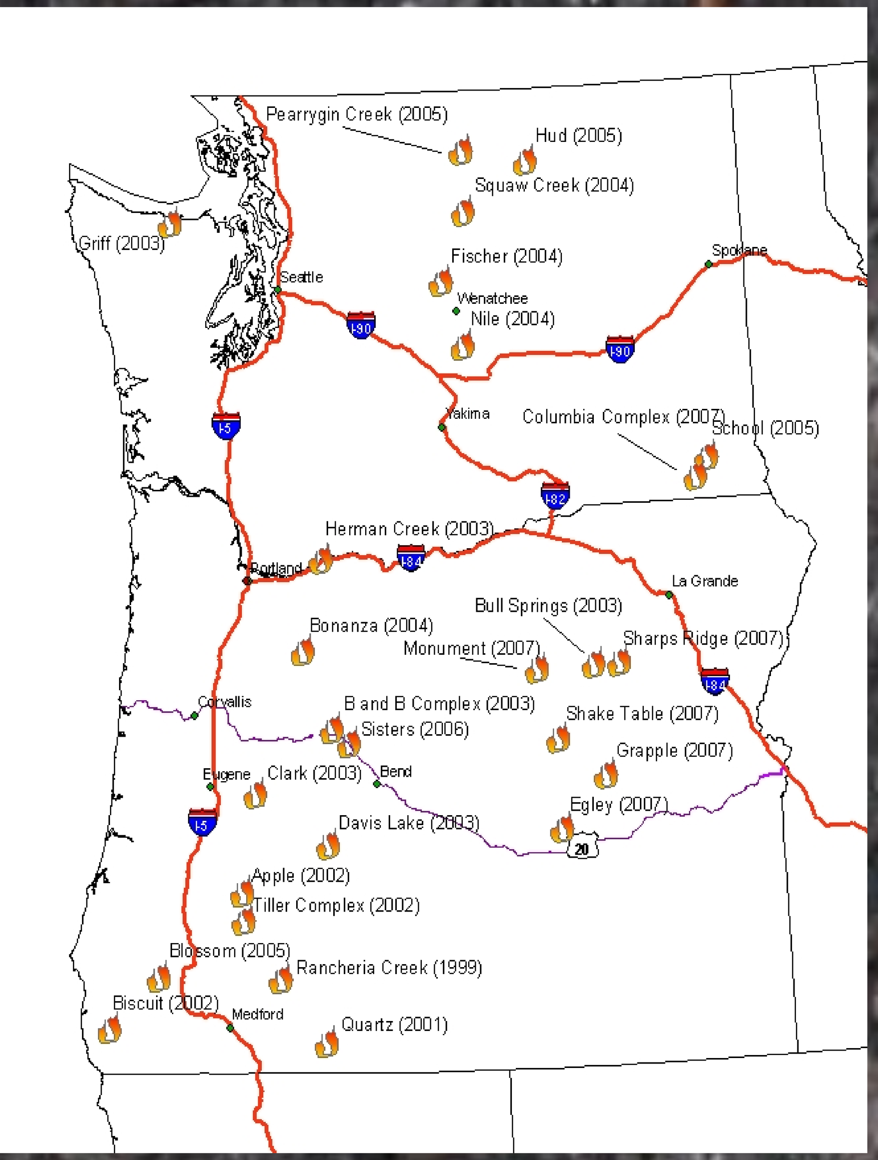
This project was initiated to refine/calibrate/develop guidelines to assess the survival of trees after fire (wildfire or prescribed burn) in Oregon and Washington. There are many models and methods of evaluating the survival of trees following injury by fire in the western US. Few have been developed to evaluate tree survival in the Pacific Northwest. Even fewer of the methods used by forest managers have been evaluated for accuracy.

The unknown ability of these models or rating systems to accurately predict tree survival across a range of habitat and soil types, conifer species, fire conditions, and various other factors has created the need for validation and calibration of existing models. The objectives of this project are to (1) assess mortality of trees in R6 caused by direct fire injury, and secondary mortality caused by insects attacking injured trees, and the causal impacts of factors such as time, spatial correlation, precipitation, elevation, and species; and (2) to assess the application of existing survival models in Oregon and Washington.

Red turpentine beetle (*D. valens*) is a significant indicator of stress in California.



Cambium condition was sampled from each quadrant.



Study trees are located in wild and prescribed fires throughout Oregon and Washington.

Table 1. We will evaluate the 14 models below to assess their accuracy in determining tree survival/mortality in Oregon and Washington. These models were chosen based on their compatibility with our data. Means and (ranges) are listed if reported in the publications. N/R = not reported, N/A = not accessed.

Published model	model tree species and details	Diameter at breast height (cm)	Species bark thickness (cm)	Duff consumption	Bud kill %	Live crown %	Needle scorch %	Basal char severity (0-4)	Bole scorch %	Cambium kill rating	% crown volume scorched/killed	Percent of crown length scorched or killed	Total scorch height	Beetle presence
		Variables included in models that are all included in the project's database												
Hood et al. 2007 (Western)	PSME	.	2.1 (0.6-6.6)	.	.	.	.	.	.	.	35 (0-100)	.	.	.
Hood et al. 2007 (Western)	PIPO/PIJE	.	2.6 (0.4-11.2)	.	.	.	.	.	.	.	58 (0-100)	.	.	.
Hood 2007 (CA)	PIPO/PIJE pre bud	62 (25-160)	.	.	.	.	.	.	.	2.4 (0-4)	.	85 (0-100)	.	.
Hood 2007 (CA)	PIPO/PIJE post bud	62 (25-160)	.	.	.	.	.	.	.	2.4 (0-4)	.	85 (0-100)	.	N/R
Hood et al. 2008	PIPO/PIJE a	.	.	.	.	.	.	.	.	N/R	62 (0-100)	.	.	N/R
Hood et al. 2008	PIPO/PIJE b	.	.	.	.	.	.	.	.	N/R	62 (0-100)	.	.	N/R
Hood et al. 2008	PSME	33 (10-105)	.	.	.	.	.	.	.	N/R	33 (0-100)	.	.	N/R
Ryan and Reinhardt 1988	PSME	.	2.7 (0.5-10.8)	.	.	.	.	.	.	.	10.6 (0-100)	.	.	.
Ryan and Reinhardt 1988	all species	.	2.2 (0.5-7.8)	.	.	.	.	.	.	.	17.0 (0-98)	.	.	.
Scott et al. 2002	PIPO <180 yo	.	.	N/A	.	.	.	.	N/A	.	N/A	.	N/A	.
Scott et al. 2002	PIPO >180 yo	.	.	N/A	.	.	.	.	N/A	.	N/A	.	N/A	.
Scott et al. 2002	PSME <20" dbh	.	.	N/A	.	.	.	N/A	.	.	N/A	.	N/A	.
Scott et al. 2002	PSME >20" dbh	.	.	N/A	.	.	.	N/A	.	.	N/A	.	N/A	.
Thies et al. 2006	PIPO	.	.	.	0	1	0.3	0.66	0.14	.	.	.	.	.

Table 2. Averages (and ranges) were calculated for 9730 trees that have been measured for the 3 years following fire. Each variable was calculated for each tree species and mean and range (in parentheses) are reported. Bark thickness coefficients were obtained from Reinhardt and Crookston 2003. Data from 5 out of 26 species is shown.

tree common names	number of trees sampled	dbh (cm)	bark thickness (cm)	live crown proportion before the fire	volume of the crown scorched after fire (%)	length of the crown scorched after fire (%)	height of the bole (before the fire) (m)	height on the bole scorched (m)	Bole scorch proportion/Basal char severity (classes:0-3)	ground char (classes:0-3)	cambium mortality (0=live, 1=dead)	Total scorch height
ponderosa pine	3858	48 (13-125)	3 (0.8 - 7.9)	0.6 (0.2 - 1)	34 (0-100)	30 (0 - 100)	9.1 (0.3 - 48.2)	4.7 (0 - 27.4)	1.9 (0 - 3)	1.7 (0 - 3)	0.2 (0 - 1)	13.7 (0.6 - 48.2)
Douglas-fir	3522	578(13-211)	3.7 (0.8 - 13.3)	0.6 (0 - 1)	22.8 (0-100)	20 (0 - 100)	14.7 (0 - 47.5)	5.3 (0 - 36.6)	1.7 (0 - 3)	1.7 (0 - 3)	0.2 (0 - 1)	18.3 (0.3 - 57.9)
western hemlock	574	48 (13-132)	1.9 (0.5 - 5.3)	0.6 (0 - 1)	29.2 (0-99)	30 (0 - 100)	12.3 (0.6 - 31.1)	2.2 (0 - 26.2)	1.7 (0 - 3)	1.8 (0.5 - 3)	0.9 (0 - 1)	17.2 (2.4 - 39.6)
white fir	493	47 (13-113)	1.9 (0.5 - 4.5)	0.7 (0.1 - 1)	40.3 (0-100)	40 (0 - 100)	8.5 (0.3 - 30.8)	3.7 (0 - 14.9)	1.7 (0 - 3)	1.8 (0 - 3)	0.7 (0 - 1)	15.4 (2.1 - 38.4)
western larch	356	36 (14-111)	2.2 (0.9 - 7)	0.6 (0.2 - 0.9)	23.6 (0-100)	10 (0 - 100)	11 (1.2 - 22.9)	4 (0 - 32.6)	1.9 (0 - 3)	1.7 (0 - 2.8)	0.3 (0 - 1)	12.8 (1.2 - 32.6)

Methods

We established transects in 25 fires across Oregon and Washington (see map).Fire severity data consistent with most of the published tree survival models was collected for 3-5 years after fire. We also surveyed for bark beetle and wood borer activity and disease presence. Each tree is evaluated annually for condition (live/dead) and insect activity.

Results & Discussion

This project has generated the most comprehensive data set to date for assessing tree survival after fire injury. After five years, data on more than 13,000 trees have been measured and are monitored annually from 25 wild and prescribed fires in Oregon and Washington.

We are currently processing the relevant variables in our data for incorporation into the survival models presented in Table 1. This evaluation will be complete in spring 2010.

Following the 2010 field season and data collection we will develop a model of tree survival following fire injury by tree species that encompasses spatial, temporal, and elevation variables in addition to first and second order fire effects inherent to forest/fire conditions in Oregon and Washington.

Literature cited

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