Final Report
Joint Fire Sciences Program

Project Title: Effects of disturbance history, landscape pattern, and weather on wildfire severity in southwestern Oregon: Implications for management of a fire-prone landscape

Project Number: 04-2-1-14

Project location: Biscuit Fire, Rogue-Siskiyou National Forest, Oregon and northern California and Corvallis, Oregon

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BRIEF SYNOPSIS OF WHAT HAS BEEN LEARNED

Biscuit fire burn severity (as defined by dNBR, a satellite-based measure) was strongly and positively correlated with canopy burn severity in areas that burned in the Silver Fire of 1987. Contrary to what has been observed in some other reburn areas in the western U.S., the occurrence of a prior wildfire about 15 years before did not cause the second wildfire to stop or decline in severity. On relatively productive sites in SW Oregon, fine live and dead fuels may accumulate rapidly after a fire creating dense patches of low vegetation that can burn with high severity in the next wildfire.

In places that burned with high severity in the Silver Fire, areas that were salvage-logged and planted burned with even higher severity in the Biscuit Fire than comparable unmanaged areas. This suggests that management in this case, including salvage logging and planting, did not reduce fire hazard at 15 years compared to unmanaged areas. It is premature to draw management implications from this finding, however. More needs to be learned about the fuel structure causes of this difference. It could be that the broadcast burning that was done after logging was not very effective in reducing fine fuels. It also suggests that high densities of fine live and dead fuels near the ground in dense plantations create a fire hazard that is greater than in naturally regenerated forests. While it has been generally known by field foresters that dense young plantations have a high hazard of burning, this observation has not been tested much in the peer-reviewed literature and, more importantly, no comparisons have been done with other types of young regenerating vegetation. It could be that in natural stands, which contain heterogeneous mixtures of shrubs, tree saplings and gaps, fire does not spread as easily as it does in plantations of similar age. This finding warrants further research to better understand the effects of post-fire manage on long-term fuel dynamics as well as the ecological significance of burn severity levels in mixed severity disturbance regimes.

Several factors explained variation in the severity of the Silver and Biscuit fires, including elevation, slope, plant association group, day-of-the burn, and topographic position. This finding indicates that despite the heterogeneity of the Biscuit and Silver fires, burn severity patterns can be partially understood in terms of known drivers of fire behavior. For example burns were more severe at higher elevations than lower elevations. Contrary to some other studies, weather from nearby RAWS stations was not statistically related to burn severity in the old Silver Fire portion of the Biscuit. More work needs be done to understand the influence of weather on Biscuit fire canopy damage.

Preliminary analysis indicates that hardwood stands are more likely to be burned at high severity than conifer stands on comparable sites. There is much speculation about the role of hardwoods in SW Oregon in explaining severity of the Biscuit fire. Preliminary results from the Silver fire area indicate that hardwoods may be at greater risk to canopy scorch and consumption than conifers.

The Biscuit fire burned in a few very large patches. Spatial patterns of canopy scorch and consumption in that part of the Biscuit fire that burned across the Silver fire were spatially autocorrelated out to 2,314 m (range in semivariogram). Some of this patchiness could be related to temporal patterns. For example, the daily progression maps of the fire indicate that three days accounted for 33-percent of the burn area.

Burn severity in terms of canopy scorch and consumption can be accurately predicted using the dNBR method in mixed conifer forest types in SW Oregon. Agencies have used dNBR in Westside forests without any evaluation of its effectiveness in these forest types. We found that the correlation with high resolution airphoto estimates of canopy mortality and dNBR scores was 0.83. This suggests that regression relationships between dNBR and canopy mortality could be used to develop more flexible classification procedure that allows users to select different canopy damage thresholds.

Generalized least squares models can provide a way to effectively incorporate spatial autocorrelation into statistical models relating fire severity to topography, vegetation, weather and management history. We used a spherical spatial correlation structure to account spatial autocorrelation. This approach avoids having to throw out lots of samples because they are highly correlated in space or being forced to ignore autocorrelation and produce statistical models that have questionable significance values.

RELATION TO ORIGINAL OBJECTIVES:

1. *Determine how fire severity is influenced by history of management actions and wildfire*. Our findings thus far indicate that management actions and previous wildfires in this forest type can influence severity in a subsequent fire. We are continuing research on this question, with other funding, to determine how management actions within the last 50 years (in addition to the last 15 years) influenced severity in the Biscuit fire.

2. *Evaluate the relative contribution of vegetation structure, topography, landscape pattern, and weather to variation in fire severity.* Our findings indicate that all of these can play a role in explaining variation in fire severity. Preliminary findings indicate that hardwood stands were more likely to be burned and work is continuing with other funding.

3. *Characterize the spatial pattern and spatial correlation of vegetation changes resulting from fire.* The fire burned in large patches. Some preliminary evidence suggests that riparian forests burned with lower severity than upland forests. Work is continuing on this topic with other funding.

Appendix 1. Deliverable crosswalk table.

Proposed	**Status**
Three Annual Reports	Completed
1-2 Draft manuscripts for scientific journals	Completed and published: Thompson, J. R., Spies, T. A., and L. M. Ganio. 2007. Reburn severity in managed and unmanaged vegetation in a large wilfire. Proceedings of the National Academy of Sciences 104 (25): 10743-10748. Three others in preparation: The relative influence of fire history, vegetation, topography, and weather on the severity of a reburn—for submission to Ecological Applications The association between disturbance history, landscape pattern, and weather on the Biscuit Fire in southwestern Oregon: Implications for management of fire-prone forests—for submission to Ecological Monographs Landscape characteristics of burn severity in large wildfire in southwestern Oregon—for submission to Landscape Ecology
Synthesis report for managers and policy makers	1. PNW Science Update on Post-fire Management (in press Summer 2007. 2. Additional syntheses in preparation
Workshop in year 3 to present findings of work	1. Presented preliminary findings at the Southwestern Oregon Wildfire Research Symposium, Gold Beach, OR. In February 2006. 2. Meeting in June 18, 2007 in Portland, Oregon with managers from R6 and BLM to discuss management implications and science of reburn and management study (PNAS paper). 3. Planned meeting with managers in Spring 2008 when other work is completed
Website for managers	1. PNW website on post-fire logging has been established http://www.fs.fed.us/pnw/research/postfire.shtml 2. Additional website planned for 2008

Other products not identified in proposal	
Guidance for FS and BLM managers on management implications of the reburn and management effects portion of study	Internal report to managers from R6 and BLM in response to questions about PNAS paper. Report has been distributed to all National Forests in R6 and BLM units.
Permanent rectified pre- and post-fire airphoto database	Completed: A multi-temporal photo interpretation of vegetation and burn status on 763 unmanaged and 200 managed photo-plots. Will be available to measure future changes in vegetation resulting from succession or future fires.
Presentations	Thompson J.R. and T.A. Spies. "Vegetation Community Structure Before and After the 2002 Biscuit Fire in Southwest Oregon" Northwest Scientific Association Annual Meeting, Corvallis, OR. (1/05) Thompson J.R., T.A. Spies and L. M. Ganio "Assessing the influence of multiple factors on Biscuit Fire Severity" Joint Fire Sciences Principle Investigators Meeting. San Diego, CA. (11/05) Thompson J.R. and T.A. Spies "Did the severity mosaic left by the 1987 Silver Fire influence the Biscuit Fire?" Invited Oral Presentation. Southwestern Oregon Wildfire Research Symposium. Gold Beach Resort, Gold Beach, OR. (2/06) Thompson J.R. and T.A. Spies "Analysis of the Biscuit Fire severity mosaic in a recently burned and logged landscape" National Commission on Science for Sustainable Forestry: Forest Disturbance Management and Biodiversity Symposium. Denver, Colorado. (5/06) Thompson J.R. and T.A. Spies "Wildfire severity on a recently burned and managed landscape." Ecological Society of America, 91st Annual Meeting. Memphis, TN. (8/06) Thompson J.R. and T.A. Spies "Accounting for spatial autocorrelation and confounding variables in a remote sensing study of burn severity." OSU College of Forestry, Spatial Data Management Group Meeting. Corvallis, OR. (9/06) Spies, T.A. "Forest Ecology and Fire; the challenge of variability and scale". OSU, Department of Geosciences, IGERT Program Seminar series. Corvallis, OR (10/06).

	Thompson J.R. and T. A. Spies. "Biscuit Fire severity in ten to fifteen year-old salvage units" Third International Fire Ecology and Management Congress. San Diego, CA. (11/06) Thompson J.R., K. Olsen, and T.A. Spies "Mapping wildfire severity: Digital aerial photography versus Landsat dNBR" Oregon Remote Sensing Workshop. Corvallis, OR. (2/07) Thompson J.R. "Re-burn severity in managed and unmanaged vegetation in a large wildfire" The Scientific Foundations of Post-fire Policy: New Findings, New Ideas. College of Forestry, Oregon State University, Corvallis, OR. (3/07) Spies, T.A. "Fire, forest dynamics and biodiversity" Australian National University, Canberra, ACT. Australia. (4/07) Spies, T.A. Landscape Ecology of Fire in the Pacific Northwest" University of Queensland, Brisbane, Australia (5/07) Thompson J.R. and T. A. Spies. "Drivers of Fire Severity in a Portion of the Biscuit Fire that Burned Fifteen Years Prior" North American Forest Ecology Workshop. Vancouver BC. (6/07)
Media interviews regarding findings of PNAS paper	Numerous media interviews between June 11th and July 23rd including staff reporter stories in The New York Times, Christian Science Monitor, The Oregonian, Oregon Public Broadcasting, Jefferson Public Radio, KOHO Radio (Leavenworth, Wash.), Capital Press, KEZI (Eugene) and AP Wire stories that were printed in over 60 newspapers across the country