

Predicting Post-Fire Regeneration Needs: Spatial and Temporal Variation in Natural Regeneration in Northern California and Southwest Oregon

Final Report

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Joint Fire Science Program Project

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Overview

The final report for this project follows the recommendations listed on the Joint Fire Science Program website. A list of locations, by National Forest, is provided to indicate the region for which this research is most relevant. A list of proposed and accomplished deliverables, as of November 2007, is given. For deliverables still in progress, an expected delivery date is provided. Hard copy and electronic files (on CD) of specific deliverables are provided including a published manuscript (Journal of Forestry), annual reports, abstracts from meetings, and a MS thesis (Lopez 2007). Web sites are also indicated where copies of deliverables are also readily available.

Over the past 3 or more decades, surprisingly little research has taken place on the natural regeneration of conifers after wildfires in western North America. Forestry research in the mid 20th century became primarily focused on artificial regeneration due to obvious advantages in controlling stocking levels, growth and survival. Currently, managers are faced with large areas of burned forests, an ever expanding list of objectives and decreasing funds available to carry out work. Our research has provided an opportunity to revisit the role of natural regeneration in an ecological framework, considering environmental setting and time frame and placed it in a management context. This recognizes that natural regeneration has continued to play a large role in reforestation after wildfires. The output of our research will allow managers to incorporate natural regeneration in a more informed and integrated fashion.

Study Region

The study of post-fire natural regeneration took place across a range of forest types throughout southwest Oregon and northern California. The focal region was the Klamath National Forest in northern California, primarily the Happy Camp/Oak Knoll Ranger District (RD) from Yreka to the Siskiyou Wilderness west of Happy Camp, Ca. Additional sites came from the Six Rivers Recreation Area (Gasquet RD) and the Shasta-Trinity NF (Yolla Bolla RD). Samples from SW Oregon include portions of the Rogue-Siskiyou NF (Cave Junction RD) and the Umqua NF (Diamond Lake RD). Sites on Bureau of Land Management holdings include a small portion of the Medford District near Gold Hill, OR.

Key Findings:

- On most sites, natural regeneration of conifers was abundant 10 to 20 years after high severity forest fire in the Klamath-Siskiyou region of northern California and southwest Oregon.
- Natural regeneration was most limited on the drier, hotter sites (low elevation, eastern Klamath Mountains).
- Natural regeneration of conifers was usually abundant up to 450m from living trees. It was difficult to find places more than 450m from living trees.
- Conifers continued regenerating 10-15 years after the fire.
- While most conifers were still within the shrub matrix, many were already well above the shrub layer. Even those still within the shrub canopy had reasonable height growth and good live crown ratios (average 68%) suggesting they would survive and grow above the competing vegetation.

- Nine to 19 years after high severity wildfire, average conifer density varied among forest types, for example, the True Fir zone 2,454 (± 529 stderr) trees/ac. (median 2,104), Douglas-fir/Tanoak zone 1038.4 (\pm stderr 266.3, n=18) trees/ac. (median 725.4) and lowest in the mixed conifer zone at 775.3 (\pm stderr 181, n=62) trees/ac (median 223.5).
- Shrub cover was always dense.
- Hardwood regeneration as stump sprouts was also abundant except at higher elevations.

Key Implications:

- Most post-fire areas in the Klamath Mountains are well stocked with successful regeneration within 10 to 20 years of a fire so planting is not required to assure a future forest.
- The hottest, driest sites in the region require planting to either assure stocking or to secure a pine component to the forest.
- A companion study (Master's thesis) is showing that planting after these same fires did increase both conifer and hardwood tree size by age 20 but only by modest amounts.

Several managers have been instrumental in assisting with our research and have shown a keen interest in our results. These include:

Carol Sharp, Happy Camp Ranger Station, Happy Camp, Ca
530-493-1734

Michael Landram, Head Silviculturalist Region 5, USDA Forest Service
707-562-8688

Dan S. Blessing, Silvics, Klamath NF, Yreka, Ca
530-841-4521

Proposed	Delivered	Status
Direct Mailing / -Emailing	A list of collaborators and interested agency personnel was compiled Including USFS Region 5 and 6, BLM Medford District, and Klamath Network Inventory and Monitoring Program of the National Park Service, Crater Lake National Park, Reports and peer reviewed article circulated electronically	Done
Annual & Final Report	Report of years activities, achievements, progress for both the Joint Fire Science Program and CFER Annual Report http://www.fsl.orst.edu/cfer/pdfs/CFER_ar.pdf http://www.fsl.orst.edu/cfer/products/06AnnualReport/pdfs/Shatford.pdf	Done
Workshops / Roving Seminar Series	<p>Recent Trends: Linking Research to Management, LaSells-Stewart Center, Oregon State Univeristy. November 6-7, 2007, Fire session with presentations by J. Agee, D. Hibbs, M. Cannon, and R. Gresswell. http://www.fsl.orst.edu/cfer/products/RecentTrends.html</p> <p>The Scientific Foundations of Post-fire Policy Symposium, LaSells-Stewart Center, Oregon State University. March 12, 2007. Shatford & Hibbs. A Paradigm of Natural Regeneration.</p> <p>US Forest Service Region 5 (California) Veg/Fuels Managers Annual Meeting, February 7, 2007, Reno, NV. Shatford & Hibbs, Natural Regeneration: 10-20 Years after Wildfire.</p> <p>US Forest Service, Ecosystem Management Workshop, Gold Beach, OR. Jan. 2007 Shatford & Hibbs, Natural Regeneration after Wildfire, Southwest Oregon</p> <p>US Forest Service, Ecosystem Management Workshop, Gold Beach, OR. Feb. 2006. Shatford & Hibbs, Natural Regeneration after Wildfire.</p> <p>Assisted Robin Darbyshire (USFS Gold Beach) in arranging speakers on Fire Ecology in the Klamath-Siskiyou Region for the Ecosystem Management Workshop in Feb. 2006.</p> <p>6th North American Forest Ecology Workshop, Vancouver BC June 18-20, 2007. D. Hibbs organized Ecology of Fire in the Klamath-Siskiyou region of Oregon and California. http://www.nafew2007.org/present_pdf_tues.html</p>	Done

Demonstration Site	Natural regeneration after wildfire, Biscuit 2002 and Longwood 1987 Fires- Field tour with the Joint Fire Science Program Director Erik Berg, forest managers from Siskiyou National Forest and Oregon State University students and PI's, Sept. 25, 2006.	Done
A windows driven statistical model with manual.	Changed to decision tree approach with supporting documentation and research to provide managers with guidelines to make informed decisions using ecological information. This will be made available through a journal article submitted to a management oriented journal such as Western Journal of Applied Forestry	In Progress Anticipated January 2008
Two articles for scholarly journals	Shatford, Hibbs & Puettmann. 2007. Conifer Regeneration Following Forest Fire in the Klamath-Siskiyou: How much, how soon? Journal of Forestry. 105 (3) pg 139-146 http://www.safnet.org/policyandpress/jof003072229p.pdf	Done
Additional	Early seral communities after Forest Fire in the Klamath-Siskiyou In addition, MS Thesis (anticipated scholarly articles to follow). <i>Plant Community Recovery after High Severity Wildfire and Post-fire Management in the Klamath Region.</i>	In progress Done
USGS Fact Sheet / CFER News Quarterly	Cooperative Forest Ecosystem Research fact sheet series produced in conjunction with the US Geological Survey. Available online at http://www.fsl.orst.edu/cfer/pdfs/Vol7_1.pdf	Done

Accomplishments (Highlights)

Knowledge of our research program amongst the forest management community has led to several invitations to present the details of our findings. At each of these (listed above), we were able to communicate with a large number of managers from federal and state agencies: the Bureau of Land Management, literally all vegetation and fuels managers in Region 5, USDA Forest Service and the three National Forest Units of Region 6 in southern Oregon. An upcoming article will highlight our work for managers in the National Parks Service thru the Klamath Kaleidoscope, a publication Inventory and Monitoring Program for the Klamath Network.

Our dependence on agency personnel to locate suitable study sites was both critical to our success but also allowed us to build up a network for distributing our research findings as well. Identifying and selecting candidate sites was a challenging and

time consuming process. Agency records over the period of interest (1970-1996) were abundant and invaluable guides in locating fires and understanding pre-fire conditions and post-fire management. In the course of accessing records and contacting agency personnel, we developed a wide network of contacts in many federal agency offices. This included management personnel in the Shasta-Trinity NF, Klamath NF, Winema-Fremont NF, Rogue-Siskiyou NF, Umpqua NF, the Medford District of the BLM and Crater Lake National Park. This included contacts from the supervisors office and out to the ranger district offices. Our annual reports and announcements were circulated to our contacts in these offices and from there to the relevant personnel in silviculture, wildlife and fire management.

Our reports have been cited at presentations to management meetings (Region 5 Veg Fuels Management, Reno, NV) and in legal defense proceedings by the Rogue Siskiyou NF during the Biscuit Fire salvage logging controversy and been discussed on regional radio debates (M. Landram, USFS Region 5 appeared on Sacramento Radio KXJZ, NPR affiliate) and call in shows. Tuesday, June 12th was a segment titled 'Forests and Fires'.

To date we have published one peer reviewed article in the Journal of Forestry (Shatford, Hibbs and Puettmann 2007) which has received considerable attention and is already being used to guide management decisions in northern California (pers.comm. Carol Sharp- District Silviculturalist, Happy Camp RD). The article has been distributed widely and is available at Journal of Forestry policy web site:

<http://www.safnet.org/policyandpress/jof003072229p.pdf>

The Pacific Northwest Interagency Ecology Office has also posted the article to its Ecoshare Website on Fire Issues.

<http://www.reo.gov/ecoshare/news-issues/index-issues.asp>

MS Thesis

In addition to the study of natural regeneration of conifers after wildfire, a concurrent research project was developed to compare forest regeneration after wildfire among sites with and without post-fire management (logging, planting and brush control). This project was carried out with additional funding provided by the Fulbright Program (scholarship to M J Lopez Ortiz) and the Cooperative Forest Ecosystem Research Program (USGS, the Bureau of Land Management, the Oregon Department of Forestry and Oregon State University).

Thesis title : *Plant Community Recovery after High Severity Wildfire and Post-fire Management in the Klamath Region.* By Maria Jose Lopez Ortiz. Dept of Forest Science, Oregon State University. Nov. 19, 2007. A Copy of this work is provided.

An annual report on this project is available at:

<http://www.fsl.orst.edu/cfer/products/06AnnualReport/pdfs/Lopez.pdf>

Lopez Thesis Abstract

Disturbance and microclimate interact to play a central role in the composition and structure of plant communities. In this thesis, I examined plant community composition and structure twenty years after high severity wildfires with and without post-fire management (salvage logging, fuel treatment, tree planting, and shrub release) under contrasting microclimatic conditions in the Klamath region of northern California. The general distribution of cover among the main life form groups: shrubs, hardwoods, and conifers, was similar between unmanaged and managed sites. The abundance of key species within each group, however, changed as a result of post-fire management. *Ceanothus integerrimus* and *Pinus ponderosa* responded positively to post-fire management, while *Arctostaphylos viscida* responded negatively. At the community level, a general pattern was a reduction of heterogeneity in managed sites both on the vertical structure and on the species composition. Based on regeneration strategies after fire, species were assigned to three regeneration behavior groups or regenerative traits, reflecting, in part, responses to disturbance. Strong correlations were found between species that regenerate from the seed bank and increasing levels of heat load. Positive interactions were also found between post-fire management and aspect on the abundance of N-fixing, *Ceanothus* spp., which increased in abundance on managed sites on south aspects.

In a second study, I evaluated tree composition in the same areas. Aspect and elevation were important factors controlling conifers and hardwood composition. No effect of post-fire management was detected on composition. Frequency and density of conifers were higher on north aspects relative to south aspects. Post-fire management had no significant effect on density of conifers species; however, results suggested a positive effect of post-fire management on *Pinus ponderosa* density on south aspects. Conifer frequency was higher on managed sites relative to unmanaged sites. These results suggest that post-fire management did not change the number of conifers but increased their spatial evenness on the sites. Results from these studies suggest that post-fire management had changed composition and structure of the early seral communities under study. Furthermore, these results suggest that post-fire management effects on plant community were stronger on southerly aspect sites.

Additional Research

The unique set of study sites identified during the course of our work has provided additional opportunities for research. Starting in June 2007, treatment plots were installed onto a subset of sites in the Klamath to investigate the affect of early successional plant communities on forest soil and nutrient pools.

Post fire nitrogen Fixation by Shrubs (Ceanothus intergerrimus)

Funding from USGS, Oregon BLM, and Oregon Department of Forestry
PI : Steve Perakis, USGS

from <http://fresc.usgs.gov/staff/perakis/research/fireNfix.html>

Nitrogen (N) fixing shrubs are frequent components of early successional, post-fire forest communities. Functionally, these shrubs can contribute to ecosystem recovery after fire by replenishing soil nitrogen and carbon that is lost to combustion. High rates of N-fixation by shrubs can restore lost nitrogen in as little as 10 years, in comparison to roughly 1000 years from precipitation alone. The absence of N-fixing shrubs after fire (whether by management, or by chance) can therefore result in a loss of long-term soil fertility and forest productivity.

To date, no studies have evaluated shrub N-fixation in the Klamath-Siskiyou Douglas-fir forest zone of southwestern Oregon and northwestern California. Fire is frequent and sometimes intense in this region, and Douglas-fir forests growing here are strongly N-limited. Post-fire forests can also have significant cover of N-fixing shrubs, yet field rates of N-fixation by shrubs are unknown, which makes it difficult to evaluate their role in aiding forest recovery after fire.

We are characterizing the rates and significance of N-fixation by shrubs, primarily *Ceanothus integerrimus* (deerbrush), in forests burned by intense wildfire 10-20 years ago. N-fixation will be determined using stable isotope ^{15}N tracers, and the method will be applied to evaluate the roles of site moisture and soil phosphorus in regulating N-fixation. Results of this work will enable improved decision-making of how to manage fire-prone forests to maintain long-term forest fertility and productivity.