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EVALUATING THE EFFICACY AND ECOLOGICAL IMPACTS OF BAER SLOPE STABILIZATION TREATMENTS ON THE POT PEAK/DEEP HARBOR WILDFIRE COMPLEX

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INTRODUCTION:

Post-fire slope stabilization treatments are often prescribed for severely burned areas of a wildfire, through burned area emergency response (BAER), to reduce erosion, maintain soil productivity, protect water quality, and reduce risks to human life and property. Prescribed slope stabilization treatments can include seeding of cereal grains or grasses, fertilization, mulching, and installation of physical barriers across slope contours (e.g., contour-felled logs and straw wattles). Seeding and fertilization treatments have been proposed following several high severity wildfires in the Pacific Northwest. These treatments are designed to reduce erosion by supplementing native vegetation recovery with additional populations of fast-growing species (seeding) and increasing productivity (fertilizing).

Despite the widespread use of post-fire slope stabilization treatments, and rapidly increasing costs of treatment with more frequent large and severe wildfires, there is little data establishing the general effectiveness of many commonly used treatments, especially in coniferous forests (Robichaud 2000, Beyers 2004). Effectiveness monitoring is often informal and the results are not widely reported. Additionally, some treatments may interfere with natural vegetation recovery or introduce exotic species (Beyers 2004, Keeley 2004, Kruse et al. 2004). Experimental and observational studies are needed for testing the effectiveness of new, innovative treatments, while science-based effectiveness monitoring plans are needed to assess the variability in treatment effectiveness across time and space.

In response to Joint Fire Sciences AFP 2005-1, Task 2, we undertook a two-year study of BAER soil stabilization treatments that assessed 1) the relative efficacy of seeding and fertilizing treatments for providing protective soil cover (live plant and litter cover), and 2) the effects of soil stabilization treatments on post-fire vegetation dynamics, including native vegetation recovery and weed population dynamics.

OBJECTIVES:

1. Test the effectiveness of different seeding treatments and fertilization levels for increasing plant and litter cover during the first two years after high severity wildfire.

2. Assess the effects of seeding and fertilization treatments on native vegetation recovery and weed dynamics.

PROJECT LOCATIONS:

1. ***Pot Peak Wildfire:*** Experimental plots were initially established in 2005 at eight sites, spanning a wide range of environments within the perimeter of the Pot Peak Wildfire (47°55' N, 120°18' W) on the Chelan Ranger District, 22 km NW of Chelan, Washington.
2. ***Dirtyface Wildfire:*** Efficiencies and extraneous funding during FY2005 allowed us to establish experimental plots with the same treatments at two sites within the Dirtyface Wildfire (47°50' N, 120°47' W) on the Wenatchee Valley Ranger District, 27 km N of Leavenworth, Washington, and 32 km W of the Pot Peak Wildfire.
3. ***Deer Point Wildfire:*** In fall 2002, a pilot study of seeding and fertilization treatment effectiveness was established on four sites within the perimeter of the Deer Point Wildfire (48°3' N, 120°15' W) on the Chelan Ranger District, 15 km N of Chelan, WA. Seeding treatments for this pilot study differed somewhat from those on Pot Peak, but the study provides some comparable results for assessing variability in treatment effects across sites.
4. ***Tripod Wildfire:*** In spring 2007, fertilization treatment trials were established at six sites within the Tripod Wildfire (~48°35' N, ~120°0' W) on the Methow Valley Ranger District, N and E of Winthrop, Washington. Funding for the fertilization trials was received based on promising results from this study. As with the study sites at Deer Point and Dirtyface, results from these sites will contribute to a regional meta-study of seeding and fertilization effects on soil cover and vegetation recovery.

METHODS:

We established eight study sites within moderate and high fire severity portions of the Pot Peak Wildfire in spring 2005. We chose study sites that were at least two acres in size; had relatively uniform soils, topography, pre-fire stand structure, and fire severity; and spanned a wide range of biophysical environments (slope, elevation, and aspect) within the fire perimeter. At each site, we established a grid of 96 contiguous study plots (48 m^2 each, with 2-m wide buffer strips between plots). We randomly assigned each plot to one of 12 unique treatment combinations, including one of four seeding treatments and one of three fertilization levels (see Table 1), giving eight replicated plots per treatment combination per site. We applied seeding and fertilizing treatments in May 2005, shortly after snowmelt. We broadcast seeds and fertilizer onto plots from the plot buffer strips using a hand-held spreader (Whirlybird).

Table 1. Seeding and fertilization treatments tested in factorial combinations within experimental study sites.

Treatment	Type/Level	Description
Seeding	Control	No seed applied.
	Wheat	Apply a monoculture of: Soft white winter wheat (*Triticum aestivum*) at a density of ~15 seeds/ft^2.
	Warm	Apply a mixture of: Snake River wheatgrass (*Elymus wawawaiensis*) Sandberg's bluegrass (*Poa secunda*) Sheep fescue (*Festuca ovina*) Common yarrow (*Achillea millefolium*) at a density of ~50 seeds/ft^2.
	Cool	Apply a mixture of: Idaho fescue (*Festuca idahoensis*) Thick-spike wheatgrass (*Elymus lanceolatus*) Fireweed (*Chamerion angustifolium*) at a density of ~50 seeds/ft^2.
Fertilizing	Control	No fertilizer applied.
	N50	Apply ammonium nitrate sulfate fertilizer (30-0-0-6) at a rate of 50 lbs N/acre (10 lbs S/acre).
	N100	Apply ammonium nitrate sulfate fertilizer (30-0-0-6) at a rate of 100 lbs N/acre (20 lbs S/acre).

We surveyed cover of live vascular plants, bare soil, and organic litter on all sites during each of the first two growing seasons following fire. We calculated total plant cover as the sum of individual species covers and species richness as the total number of vascular plant species present on a plot. We analyzed these data to assess treatment effects on seeded species cover, total plant cover, bare soil cover, plant species richness, and exotic species cover and richness.

KEY FINDINGS:

1. ***Fertilization and seeding together increased plant cover and reduced bare soil the most.***

   Seeding and fertilizing together increased seeded species cover and reduced bare soil more than either seeding or fertilizing alone. In particular, the "warm" seed mixture combined with 50-100 lbs N/acre produced the largest effect on seeded species cover (Figure 1). This treatment combination produced further increases in seeded species cover in the second growing season following wildfire.

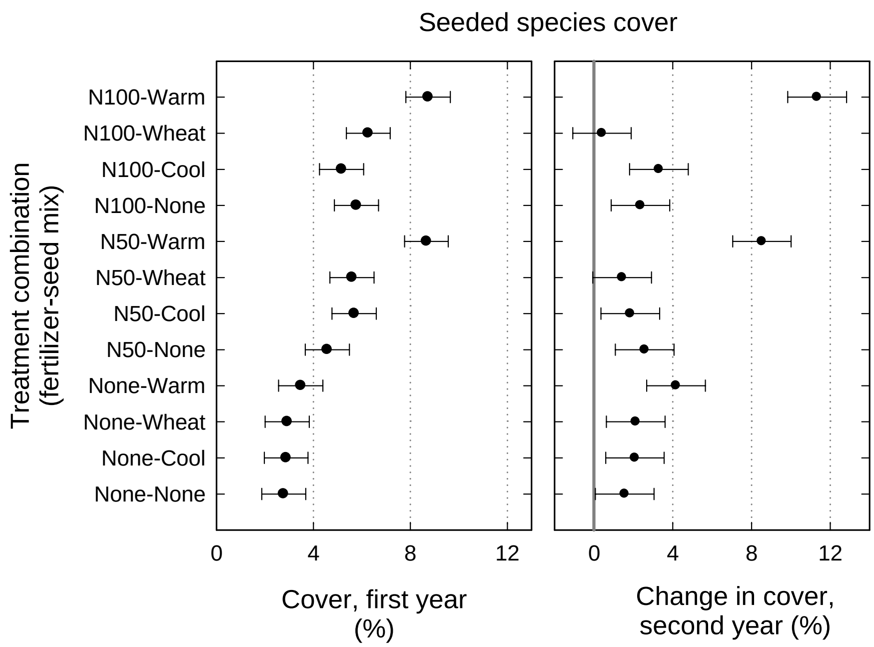

Figure 1. Treatment effects on seeded species cover (least square means +/- one standard error) across all Pot Peak study sites.

2. ***Fertilization alone increased plant cover more than seeding alone.***

   When applied individually, fertilization increased total plant cover and reduced percent bare soil more than any seeding treatments. Fertilization treatment effects persisted into the second growing season after wildfire, producing further increases in total plant cover relative to plots not receiving fertilizer.

3. ***Two native forbs – yarrow and fireweed – produced the most seeded species cover.***

   Of the seeded species, yarrow and fireweed provided the greatest and most consistent cover across all sites. Yarrow (a native species) proved to be a fast-growing species that produced significant cover in the first growing season after fire, benefited significantly from fertilization, and increased in cover during the second year. Fireweed (another native species) was present on virtually all plots, but was more abundant on seeded plots and contributed more cover than wheat or the seeded perennial grasses during the first two years.

4. ***Fertilization and seeding effects varied considerably among sites.***

Estimates of treatment effect sizes varied considerably among sites, as was expected given our intentional selection of sites that spanned a wide range of biophysical settings (low to high elevation and varying aspects). Pre-fire vegetation structure and composition also appeared to influence treatment responses, particularly for fertilization, which appears to benefit species that persist intact through fires or resprout quickly after fires. Although we designed seed mixes to perform optimally in cool-mesic (cool) and warm-xeric (warm) sites, we found no consistent effects of elevation, aspect, or heat-load index on seeding treatment effectiveness.

5. ***Seeding reduced cover and species richness of native non-seeded species.***

One concern about seeding treatments is that seeded species will use resources that would otherwise be available to recovering and establishing native vegetation. Our study showed that seeding had little effect on native non-seeded species cover or species richness during the first growing season after fire. In the second growing season, however, plots seeded with the warm seed mix gained less additional cover of native non-seeded species and fewer new species than other plots (Figure 2). This effect was particularly evident when plots received the warm mix along with 50 or 100 lbs N/acre of fertilizer. Although the N50-warm and N100-warm treatment combinations produced high seeded species cover (particularly for yarrow), some of that increased cover comes at the expense of other native species. High cover of yarrow may also inhibit establishment of colonizing species.

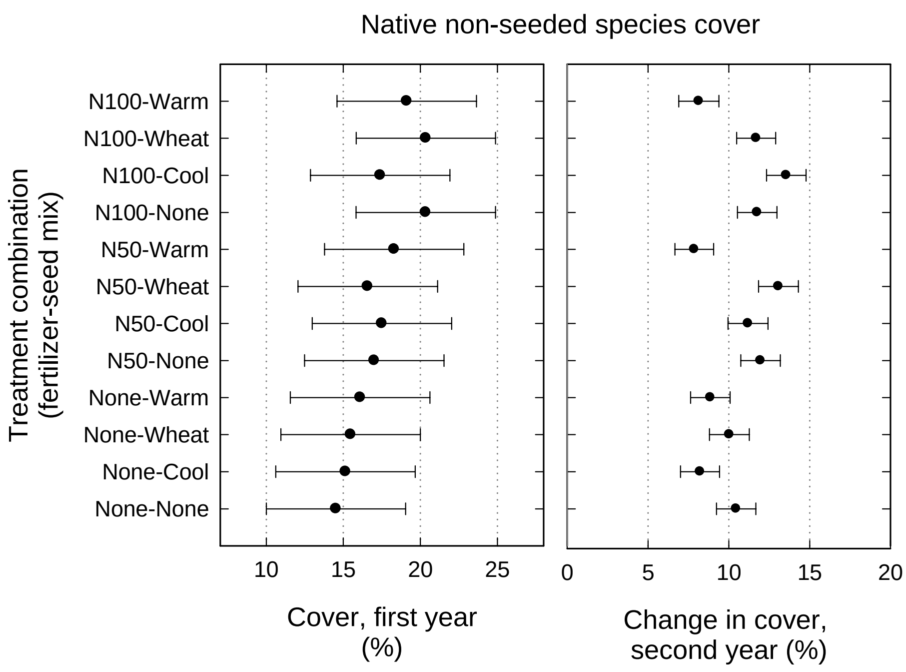

Figure 2. Treatment effects on cover of native non-seeded species (least square means +/- one standard error).

6. ***Fertilization had no effect on native species richness.***

Fertilization alone increased native species and total plant cover, but did not negatively impact species richness in either the first or second year.

7. ***Seeding and fertilization each increased weed cover and richness by small amounts.***

Although increasing plant cover and productivity was the primary objective for our treatments, we were also concerned about introducing new populations of exotic species or promoting the spread of extant populations during the vegetation recovery period. Exotic species contributed little to plant cover or species richness for any treatment combination in this study, but were influenced somewhat by treatments. Seeding and fertilization treatments both increased exotic species cover (Figure 3), but by an average of less than 0.5%. These treatments also increased exotic species richness relative to controls, but added less than two species (Figure 4). Exotic plant cover declined somewhat during the second growing season, particularly for the N100-Warm and N50-Warm treatment combinations (Figure 3).

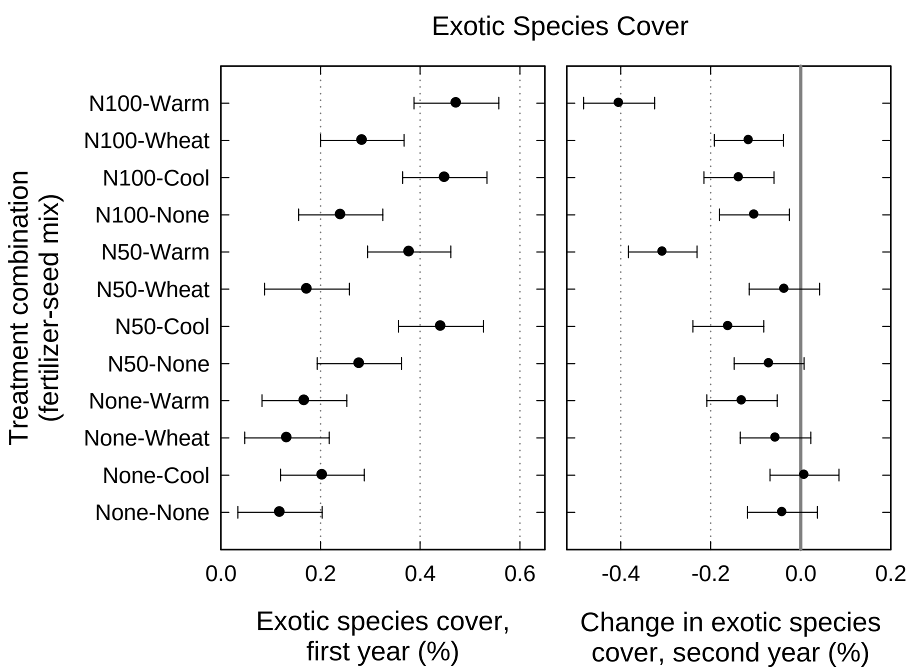

Figure 3. Treatment effects on cover of exotic species (least square means +/- one standard error).

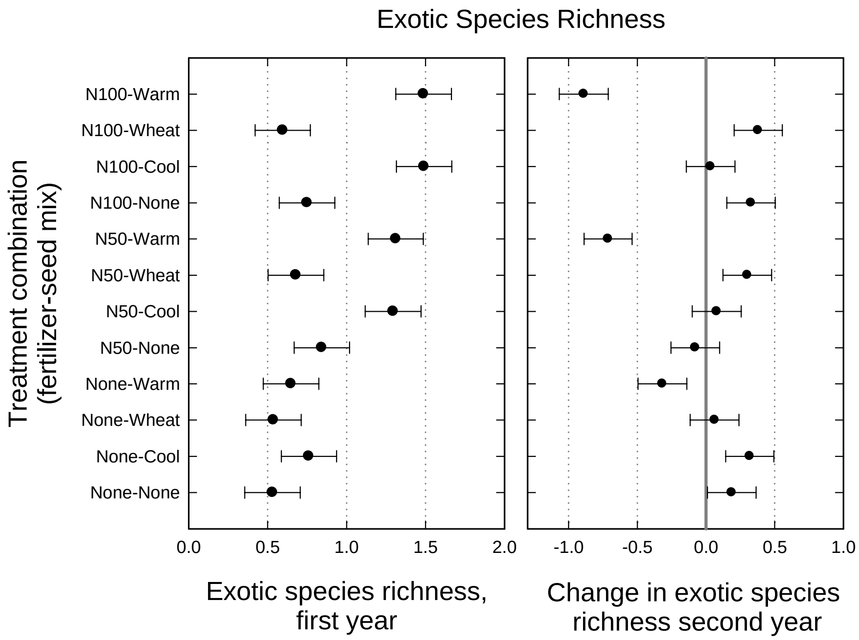

Figure 4. Treatment effects on exotic species richness (least square means +/- one standard error).

DELIVERABLES:

Table 2. Proposed and delivered products for the BAER treatment effectiveness study.

Proposed	Delivered	Status
Web site	We created a web page with the project description, status, and links to publications, available at: http://www.fs.fed.us/r6/wenatchee/fire/baer/baer-study.shtml	Done
Monitoring plan	We developed a plan for conducting effectiveness monitoring of BAER treatments that uses a simple experimental design to permit statistical analysis of results within and among BAER project sites. We included the plan in a larger document that proposes criteria and methods for monitoring effectiveness of BAER and other post-fire treatments. A draft document is currently being reviewed by Forest Service and BLM BAER personnel. We expect to revise the document in response to comments in spring 2008, with publication in a General Technical Report in late 2008 or early 2009 (see below).	Draft document completed, in review; December, 2008
Research papers	PETERSON, D.W., E.K. DODSON, AND R.J. HARROD. 2007. Assessing the effectiveness of seeding and fertilization treatments for reducing erosion potential following severe wildfires. In: Butler, B.W.; Cook, W. (comps.) 2007. The fire environment – innovations, management, and policy; conference proceedings. 26-30 March, 2007; Destin, FL. Proceedings RMRS-P-46CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 662 p. CD-ROM. Available at: www.fs.fed.us/rm/pubs/rmrs_p046/rmrs_p046_465_474.pdf	Done
	DODSON, E.K., D.W. PETERSON, AND R.J. HARROD. *In prep.* Slope stabilization treatment effects on plant community recovery and succession following a severe wildfire. Target journal: Journal of Applied Vegetation Science.	In progress; March 2008
	PETERSON, D.W., E.K. DODSON, AND R.J. HARROD. *In prep.* Evaluating the effectiveness of seeding and fertilizing treatments for increasing vegetation cover following severe wildfire in north-central Washington State. Target journal: Forest Ecology and Management.	In progress; March 2008
	PETERSON, D.W., C. CRAY, AND R.J. BARBOUR. *In prep.* Guidelines for monitoring effectiveness of emergency rehabilitation activities after wildfires in forests and rangelands. Target outlet: PNW Gen. Tech. Rep.	In review; May 2008

Proposed	Delivered	Status
	Peterson, D.W., E.K. Dodson, and R.J. Harrod. *In prep.* Soil resource and propagule limitations on vegetation recovery following severe wildfires in dry coniferous forests. Target journal: Ecological Applications (meta-study/synthesis).	In progress; October 2008
Presentations, scientific & management groups (tech. transfer)	Peterson, D.W. 2005. Efficacy of Post-fire Seeding and Fertilization Treatments in North-Central Washington. 23rd Tall Timbers Fire Ecology Conference: Fire in Grassland & Shrubland Ecosystems, Bartlesville, Oklahoma. October 17-20, 2005. (poster)	Done
	Peterson, D.W. 2006. Forest restoration after wildfire: managing future disturbances. 2006 Washington State Society of American Foresters Annual Meeting, "Living with Wildfire – Lessons Learned, " Chelan, Washington. April 6-8, 2006. (oral)	Done
	Peterson, D.W., and R.J. Harrod. 2006. Biodiversity and other ecological considerations in post-fire forest rehabilitation and restoration. 2006 Biodiversity conference, Corvallis, Oregon, June 5-7, 2006. (oral)	Done
	Peterson, D.W.; Dodson, E.K.; Harrod, R.J. 2007. Effects of BAER seeding and fertilization treatments on vegetation recovery following the Pot Peak wildfire. Presented at 2nd Fire Behavior and Fuels Management Conference, March 26-30, 2007, Destin, Florida. (oral)	Done
	Peterson, D.W.; Dodson, E.K.; Harrod, R.J. 2007. Assessing the effectiveness of erosion control treatments after wildfire: experimental and monitoring approaches. Presented at: 2007 EastFIRE Conference, June 5-8, 2007, George Mason University, Fairfax, Virginia. (oral)	Done
	Peterson, D.W.; Dodson, E.K. 2007. Resource and propagule limitations on vegetation recovery after wildfire. Presented at: North American Forest Ecology Workshop 2007, June 18-20, 2007, University of British Columbia, Vancouver, BC, Canada. (oral)	Done
Technology transfer	Peterson, D.W. 2006. Research update: fuel treatments and post-fire rehabilitation and restoration. Presentation to Okanogan-Wenatchee Forest Leadership Team Meeting on Research-Management Collaboration, Wenatchee, Washington, January 26, 2006.	Done

Proposed	Delivered	Status
JFSP progress reports	Progress reports were submitted annually in summers of 2005 and 2006.	Done
JFSP final report	Peterson, D.W., and R.J. Harrod. 2008. Evaluating the efficacy and ecological impacts of BAER slope stabilization treatments on the Pot Peak/Deep Harbor Wildfire Complex. JFSP Final Report.	Done

ACKNOWLEDGEMENTS:

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LITERATURE CITED:

Beyers, J.L. 2004. Postfire seeding for erosion control: effectiveness and impacts on native plant communities. Conservation Biology 18:947-956.

Keeley, J.E. 2004. Ecological impacts of wheat seeding after a Sierra Nevada wildfire. International Journal of Wildland Fire 13:73-78.

Kruse, R., E. Bend, and P. Bierzychudek. 2004. Native plant regeneration and introduction of non-natives following post-fire rehabilitation with straw mulch and barley seeding. Forest Ecology and Management 196:299-310.

Peterson, D.W., E.K. Dodson, and R.J. Harrod. 2007. Assessing the effectiveness of seeding and fertilization treatments for reducing erosion potential following severe wildfires. In: Butler, B.W.; Cook, W. (comps.) 2007. The fire environment – innovations, management, and policy; conference proceedings. 26-30 March, 2007; Destin, FL. Proceedings RMRS-P-46CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 662 p. CD-ROM. Available at: www.fs.fed.us/rm/pubs/rmrs_p046/rmrs_p046_465_474.pdf

Robichaud, P.R., J.L. Beyers, and D.G. Neary. 2000. Evaluating the effectiveness of postfire rehabilitation treatments. USDA Forest Service General Technical Report RMRS-GTR-63.