Analysis of fire spread rates between seeded and unseeded areas in the Snake River plains of Idaho, USA using the Behave© fire model

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Introduction Wildfire has played an important ecological role throughout the history of the sagebrush-steppe ecosystems of the Snake River Plains of Idaho. In pre-settlement times fires were probably small and spotty, which helped maintain a patchy, heterogeneous landscape (Bunting, 1996). In the post-settlement era, fires in Wyoming Big Sagebrush (*Artemesia tridentata ssp. Wyomingensis*) have been more frequent and larger resulting in the conversion of large areas within the Snake River Plains to exotic annual grasslands of cheatgrass (*Bromus tectorum*). Managers generally reseed a suite of perennial species to reduce erosion and invasive species potential after these wildfires. Seeding with perennial species is believed to reduce the likelihood of future wildfires due to the reduction in cheatgrass. This study examines the effects of revegetation on wildfire spread rates and examines the usefulness of a commonly used fire prediction model (Behave Plus) in predicting fire spread rates in sagebrush-steppe ecosystems. Seeded and unseeded sites have been evaluated for significant differences in fuel continuity, plant canopy cover, fuel load, and fuel bed depth, and rates of fire spread with the Behave Plus© fire model.

Materials and methods Sixteen previously burned sites with seeded and unseeded components were selected in the Snake River Plains of southern Idaho, USA for study. Wildfires on the study sites occurred between June and September from 1987—2002. All study sites were reseeded at least two years previous to the study to allow for community stabilization. Reseeding was primarily accomplished using a rangeland drill in the fall following the wildfire. Common species seeded included *Agropyron cristatum* (crested wheatgrass), *Agropyron sibericum* (Siberian wheatgrass), *Elymus cinerus* (Great Basin wildrye), *Achillea millefolium*, (common yarrow), *Atriplex canescens*, (fourwing saltbush), and *Medicago sativa* (alfalfa). All samples and observations were taken during the months of June August in 2004 and 2005. Fire spread rate estimates were calculated using the Behave Plus 3.1 fire model, with fuel load and fuel bed depth data from seeded and unseeded portions of each site used to provide a comparison of fire spread rate. Fire spread rates were calculated both with and without litter added as part of the total fuel load. A paired sample t-test was used to analyze any differences in fire spread rate, fuel loading, and fuel bed depth. SAS 9.3.1 was used for the analysis. Fuel continuity was measured using the line intercept method for foliar cover. Each gap in canopy coverage along a 100 m transect greater than 5 cm was measured and recorded. A paired sample t-test (Proc Univariate) was performed using SAS 9.3.1 to compare mean gap values between foliar cover of plants for the seeded and unseeded sections. P-values are significant at the 0.05 level.

Results There were no statistically significant differences between seeded and unseeded portions of sites for fire spread rate (p-value: without litter 0.31; with litter 0.11), fuel loading (p-value: with litter 0.69; without litter 0.74), and fuel bed depth (p-value: 0.08). Although there was no significant difference in fuel loading between seeded and unseeded areas, there was a dramatic difference in the composition of plants. Annual forbs and annual grasses comprised 12.5% and 63% of total fuel load in the seeded and unseeded areas, respectively. Mean gap values for each treatment were used to compare sites for fuel continuity. The paired t-test demonstrated statistically significant differences between seeded and unseeded treatments (p-value 0.0084). Average gap size in the seeded areas was 15.78 cm as compared to 12.30 cm in the unseeded areas. On average, there were more gaps in the seeded areas (158) than in the unseeded areas (120).

Conclusions Although no significant differences were found for fire spread rates when using fuel load and fuel bed depth data, there was considerable variation in the plant composition and fuel continuity between seeded and unseeded sites. Fuel continuity is more discontinuous in seeded areas as compared to unseeded areas. Not only are the gaps in canopy cover larger on average in seeded areas, there are also more gaps in the seeded areas than in the unseeded areas. The larger gap size and number of gaps in the seeded areas are indicative of more discontinuous fuels than in the unseeded annual grass dominated areas. This difference in fuel continuity would be influential in reducing wildfire rate of spread although the Behave© model did not substantiate this difference. The Behave© model should be modified to include fuel continuity to better predict fire behavior in rangeland situations.

Reference

Bunting, S.C. 1996. The use and role of fire in natural areas. Pages 277-301 *in* R.G. Wright, editor. National Parks and Protected Areas: Their Role in Environmental Protection. *Blackwell Science*, Cambridge, Massachusetts, USA.