

**Burn Canyon Understory Monitoring Report  
2003-2006**

**Prepared for:  
The Burn Canyon Monitoring Work Group**

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## INTRODUCTION

The **overall goal** of this monitoring project was to measure the long-term effects of post-fire salvage harvest in Burn Canyon.

Specific **monitoring questions** identified in 2003 included:

- 1) Is there a difference in regeneration success between areas planted with seedlings versus areas designated for natural regeneration?
- 2) Is there a difference in understory vegetative cover and composition between logged and unlogged areas?
- 3) Is there a difference in the presence and abundance of wildlife between logged and unlogged areas?
- 4) Is there a difference in soil compaction and erosion between logged and unlogged areas?
- 5) Is there a difference in water quality between the logged and unlogged areas?

Ultimately, **only question 2 was addressed** with the current monitoring design.

## MONITORING DESIGN and DATA COLLECTION

The sampling area was stratified into 3 “treatment” areas: 1) burned, unlogged (“control” area); 2) burned, logged (“action” area); and 3) unburned, unlogged (“reference” area). Four monitoring plots were subjectively selected in the action area, 4 in the control area, and 1 in the reference area. Three 100-foot permanent transects were established in each of the 8 burned plots, and 1 was established in the reference plot. Twenty 20cm x 50cm Daubenmire plot frames were located at 5-foot intervals along each transect. In each frame, data were collected on the canopy cover of understory species using the Daubenmire cover class method, and on species frequency. Data on the percent cover of litter, bare soil, and downed wood were also recorded.

Frequency is defined as the number (or percentage) of sample units of equal size in which a given species occurs. For example, if Western wheat grass occurs in 10 out of 20 plot frames along each transect, it has a frequency of 50%.



Figure 1. Cover

Cover is the proportion of the ground area covered by vegetation (or other ground cover such as litter; Figure 1). Canopy cover is a vertical projection of the area of the perimeter of a plant canopy to the ground, ignoring small gaps.

Diversity has two important components: richness and evenness. Species richness refers to the number of species occurring in a community. Evenness refers to the degree to which % cover is distributed equally among all of the species present in a plant community.

## **DATA ENTRY and ANALYSIS**

Raw data were entered into Microsoft Office Excel (2003, Microsoft Corporation, Seattle, WA, 2003). Cover and frequency values were calculated for each species on each transect. These values were then entered into a final spreadsheet. New variables were created to represent the cover of each major plant functional group: annual grasses, perennial grasses, annual forbs, biennial forbs, perennial forbs, and shrubs, by summing the cover of the individual species in each functional group. Total vegetative cover (the sum of the cover of all species) was also calculated, as was species richness (the total number of species occurring on each transect). Diversity was calculated using the Shannon-Weaver diversity index ( $H' = -\sum P_i \ln P_i$  where  $P_i$  is the proportion of the total individuals in the  $i$ th species).

Descriptive statistics (averages and standard errors) were calculated for each of the functional groups in each treatment area for each year using SPSS (Version 15.0, SPSS Inc., Chicago, IL, 2006). The same was done for total vegetation cover, litter, bare soil, downed wood, species richness, and diversity. The data are displayed in graphs and two summary tables.

Inferential statistics (Repeated Measures of Analysis of Variance) were used to assess the differences in functional group cover and other variables between treatment areas and years. Because the variation among plots within each treatment differed among treatments (variances were not “homogeneous”), the raw data (with the exception of species richness and diversity, which followed a normal distribution) were transformed using an arc-sin square root transformation before statistical analyses were performed. The software program SAS (Version 9.1, SAS Institute Inc. Cary, NC, 2005) was used for this data transformation and analysis.

The statistical analyses provide an indication of the differences between action and control sites. A confidence level (alpha) of 0.10 was used for all statistical tests. This confidence level indicates that we can be 90% confident that the statistically significant results we obtained were due to real differences and not to random chance alone. Another way to think of this is that there is a 10% chance that we conclude there is a real difference when there actually was no difference. However, because the plot locations were not randomly selected and because the sample size was small, the probabilities associated with the comparisons between treatment areas are not reliable.

## **STATISTICAL RESULTS**

### ***Species Richness***

- Species richness did not differ significantly over time or between treatments.

### ***Diversity***

- Diversity varied significantly with treatment.

### ***Functional Group Cover***

- Annual grass cover did not differ significantly over time or between treatments. Although annual grass cover appeared to increase dramatically on the action plots from 2003 to 2005 and then decrease from 2005 to 2006, there was too much variability in the data to detect a difference. Increasing the number of plots would help detect a change or increase our confidence that there isn't one.
- Annual forb cover varied significantly over time and between treatments. The effect of treatment on annual forb cover also differed significantly between years. Annual forb cover increased dramatically on both action and control plots from 2003 to 2004, but has since declined among all treatments.
- Biennial forb cover did not differ significantly over time or between treatments.
- Perennial grass cover did not differ significantly over time or between treatments.
- Perennial forb cover did not differ significantly over time or between treatments.
- Shrub cover varied significantly with treatment. Shrub cover tripled on the control sites from 2003 to 2005, but remained the same on the action sites. There is virtually no shrub cover on the reference site.
- The total vegetation cover varied significantly with year and with treatment. The effect of treatment on total vegetation cover differed significantly with year. Total vegetation cover remained constant in the reference plot and the action plots, but increased in the control plots.

### ***Ground Cover***

- Litter cover varied significantly with year and among treatments. Litter cover was 2-4 times greater in the reference plot than the action and control plots. Litter increased in the action and control plots over time.
- Bare soil varied significantly with treatment. The % cover of bare soil was much greater in the action and control plots than the reference plot. Bare soil appears to be decreasing in the action and control plots over time, although there was too much variability in the data to detect a difference.
- Woody ground cover varied significantly with year and with treatment, increasing dramatically on the action plots between 2003 and 2006. The effect of treatment on % cover of wood varied significantly between years.

### **PRELIMINARY INTERPETATIONS and QUESTIONS**

- The increase in annual forb cover on both the action and control plots between 2003 and 2004 suggests a typical post-disturbance plant community response, in which annual weedy species colonize immediately following a disturbance such as a fire. Annual forb cover has been decreasing on the action and control plots since 2004. This would be expected as time since disturbance increases and more perennials become established. Continued monitoring will be useful in determining if this trend persists.
- Perennial forbs may also increase in abundance following disturbance. While perennial forb cover was not statistically different between years or among

treatments, it should be monitored closely. Increasing the number of plots would help detect a change or increase our confidence that there wasn't one.

- Annual grass cover appeared to increase on the action site from 2003 to 2005 and then decrease between 2005 and 2006, although this difference is not statistically significant. Because the plots are not randomly located and the sample sizes are small, the statistical results may be misleading. Overall cover of annual grasses is still very low, but should be carefully observed, since the species in question is the invasive annual *Bromus tectorum* (cheat grass).
- The dramatic increase in shrub cover on the control sites may be due to post-fire resprouting, while the absence of shrub cover on the reference site may be due to overstory shading.

### **STRENGTHS OF EXISTING MONITORING DESIGN**

- The monitoring objectives were clearly stated and reflected questions developed collaboratively by a diverse group.
- This diverse group continued to meet to discuss data collection, preliminary results and interpretations, and share personal observations about what was occurring at the monitoring sites.
- Replicate plots and subsamples (transects) were located in the action and control areas.
- Pre-treatment data were gathered (i.e. before logging took place).
- Data are recorded at the species level.

### **CONSIDERATIONS FOR FUTURE MONITORING AT BURN CANYON**

- Document key environmental variables at each plot or transect (slope, aspect, elevation).
- Continue monitoring existing transects.
- Monitor at roughly the same time each year.
- Consider gathering data by functional group (instead of species), unless species richness is a key variable. Cover and frequency of invasive species can still be assessed by species.
- Data on regeneration could be collected easily by counting the density of seedlings (and over time, poles and trees) in belt transects.

### **CONSIDERATIONS FOR FUTURE MONITORING AT OTHER SITES**

- Select plot locations randomly, if statistical generalizations are desired. If there is a lot of variation across the site in vegetation structure or composition, soils, slope, etc., we recommend stratifying the area by the relevant environmental variable and then randomly selecting plots within each stratum (or within the strata that are most important to the monitoring questions).
- Conduct a pilot study to determine if there are a sufficient number of sample units (plots) to detect a real change if there is one. Several formulas are available to calculate the necessary sample size from a pilot data set.
- Assess overstory as well as understory attributes: e.g. canopy cover by species, tree density by species and age class, basal area, dead and downed wood. Consider looking at other attributes related to habitat quality.

- Assess soil characteristics such as compaction (if appropriate to monitoring questions). Compaction can be measured with an inexpensive pocket penetrometer.
- Assess regeneration in belt transects (if appropriate to monitoring questions).

### **CONSIDERATIONS FOR CITIZEN INVOLVEMENT IN FUTURE MONITORING**

- The multiparty process used initially to identify monitoring questions and objectives should be replicated in future efforts to the extent feasible. Similarly, the on-going updates on the monitoring results, including discussion of the interpretations among participants is also strongly encouraged.
- If vegetation data (cover and frequency) are recorded by functional group, volunteers may be trained to gather the data. However, they should be well trained, and, at least initially, supervised by someone experienced in plant identification and the use of the selected sampling methods.
- Volunteers can be readily trained to gather data on attributes such as tree density, age class, basal area, dead and downed wood, seedling regeneration, and soil compaction. However, thorough training and consistent supervision are needed to make sure that monitoring protocols are carried out consistently on all plots over time.
- If vegetation data are recorded by species, volunteers will need to have strong species identification skills or be willing to participate in significant training, and periodic review and testing of their skills.
- Plant identification (either by functional group or species) can be aided by developing a set of “flash cards” to assist in field identification.
- Data entry can also be readily accomplished using a trained volunteer.
- If inferential statistics are used to compare among treatments over time, we recommend contracting out the statistical analysis or finding a volunteer who is already skilled in this area. Training a lay volunteer to conduct the inferential statistical analysis is not realistic. It is sometimes possible to find a college student who needs a data set to analyze for a statistics or monitoring class. Such students can gain valuable “real life” experience analyzing and reporting results on your data, and the group gets its data analyzed for free under the supervision of a professional statistician.

## **ADDITIONAL USEFUL RESOURCES ON ECOLOGICAL MONITORING**

NOTE: resources 1 through 6 are available from the following website:

[http://www.warnercnr.colostate.edu/class\\_info/rs332/](http://www.warnercnr.colostate.edu/class_info/rs332/)

1. Elzinga, C.L., W. Salzer, and J.W. Willoughby. 1998. *Measuring and Monitoring Plant Populations*. BLM Technical Reference 1730-1. Denver: USDI, BLM.
2. Herrick, J. E., J. W. Van Zee, K.M. Havsted, L.M. Burkett, W.G. Whitford. 2005. *Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems, Volume I: Quick Start*. Las cruces, NM: USDA-ARS Jornada Experimental Range.
3. Herrick, J. E., J. W. Van Zee, K.M. Havsted, L.M. Burkett, W.G. Whitford. 2005. *Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems, Volume II: Design, Supplementary Methods and Interpretation*. Las cruces, NM: USDA-ARS Jornada Experimental Range.
4. Interagency Technical Reference. 1996. *Sampling Vegetation Attributes*.
5. Interagency Technical Reference. 1996. *Utilization Studies and Residual Measurements*.
6. Pellant, M., P. Shaver, D.A. Pyke and J.E. Herrick. 2000. *Interpreting Indicators of Rangeland Health, Version 3*. Denver: USDI, BLM.
7. Forest Trust. 2003. *Multiparty Monitoring and Assessment Guidelines for Community Based Restoration in Southwestern Ponderosa Pine Forests*. Santa Fe, NM: Forest Trust.
8. Pilz, D., E.T. Jones, and H. Ballard. 2005. *Manager's Manual for Participatory Biological Monitoring Projects*. Portland, OR: Institute for Culture and Ecology.

## **APPENDICES**

1. Bar graphs of results for species richness, diversity, and cover of functional groups, total vegetation, litter, bare soil, and wood with significance indicated.
2. Tables of means and standard errors for species richness, diversity, and cover of functional groups, total vegetation, litter, bare soil, and wood.
3. Tables of means and standard errors for species cover (%) for each treatment by year.
4. Tables of means and standard errors for species frequencies (%) for each treatment by year.
5. A master list of the species names, codes, and corresponding functional group classification.