# The Effects of Fall and Spring Prescribed burns on the Control of Cheatgrass and Japanese Brome at Rabbit Mountain Open Space, Boulder County, Colorado U.S.A.

## 2004 PROJECT REPORT
## BOULDER COUNTY PARKS AND OPEN SPACE SMALL GRANTS PROGRAM 2004


Denver Botanic Gardens
Research, Herbaria and Records Department
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Denver Botanic Gardens

# The Effects of Fall and Spring Prescribed burns on the Control of Cheatgrass and Japanese Brome at Rabbit Mountain Open Space, Boulder County, Colorado U.S.A.

Prepared for Boulder County Parks and Open Space
By the Denver Botanic Gardens' Research, Herbaria and Records Department

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## ABSTRACT

In the spring of 2003, Denver Botanic Gardens (DBG) and Boulder County Parks and Open Space (BCPOS) initiated a multi-year project to study the effects of spring and fall prescribed burns as a tool to control the invasion of cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) at the Rabbit Mountain Open Space park. The area covered by the fall 2003 prescribed burn did not include the sampled transects and the project was delayed. In 2004, a new study site was identified and macroplots were installed and sampled for inclusion in the study. The spring 2004 prescribed burn occurred on March 22, and the three macroplots (control, spring burn, fall burn) were sampled during the summer, but the fall 2004 burn did not occur due to inclement weather and burn restrictions. This report summarizes the methods and data collected for both study sites, compares the two years of data for one site and discusses differences in the burned and unburned areas of the new study site. A third study site was installed and sampled at Lindsay Meadow (City of Boulder Mountain Parks and Open Space) in south Boulder County. Identical sampling methods were implemented at this site, although Boulder County funds were not utilized for the sampling. The Lindsay Meadow data is not included within this report, but will be submitted to Boulder County upon completion of analysis.

Cheatgrass and Japanese brome are the dominant invasive species of concern for this study, although several additional state-listed noxious weeds were documented during the 2003 and 2004 sampling. Cheatgrass is a winter annual, maturing before its native grass counterparts in early spring and out competing these species for water and space. Cheatgrass can alter the natural fire cycle by modifying the frequency, seasonality, and severity of natural and prescribed fires. These blazes may be disproportionately detrimental to natives and potentially beneficial to cheatgrass, although the prescribed burns may provide opportunities for native plants to out compete the exotics. Using ocular point-cover estimates and soil sampling; we intend to document the changes in species diversity and cover following spring and fall prescribed burns. Applied experiments such as this provide valuable information to promote effective methods of invasive species control and the conservation of existing natural areas. The fall 2003 and 2004 burns could not occur and therefore this project will be reviewed in conjunction with BCPOS to determine options for the continuation of the experimental restoration at Rabbit Mountain Open

Space. Within the spring burn area of site 1, decreases in the percent cover of annual bromes (non-native grasses) and small increases in native, perennial graminoids and forbs were documented between 2003 and 2004. Vegetation sampling at the second Rabbit Mountain site during 2004 documented a greater percentage of Western Wheatgrass (*Pascopyrum smithii*) in the spring burn treatment, versus the unburned areas. Overall, the non-native annual bromes still dominate both the burned and unburned areas, although their percent cover has decreased in some treatments, while desirable native species have increased in percent cover.

## INTRODUCTION

Much debate surrounds the success of using fire to control cheatgrass (*Bromus tectorum*). Many variables factor into this debate and effective management practices must be sensitive to specific sites and circumstances, including previous management actions, intensity of the invasion by exotics, and abiotic factors such as fine litter moisture content, climate, and soils. A disturbance, such as overgrazing or modification of a natural fire cycle, to native vegetation facilitates the initial invasion of adventives species such as *Bromus tectorum* and *Bromus japonicus* (Japanese brome). Removal of the disturbance will allow the natives to rebound, but will not result in displacement of the non-native species (Keeley, 2001). Controlled burns are often used as an effective, non-chemical method to control targeted adventive species. However, the timing of the controlled burn can have a detrimental effect on native species and can increase the fecundity of invasive species, especially in the case of cheatgrass. Optimal timing of the burn can decrease the production of cheatgrass, at least in the short-run (Young, 1978). Frequency of fires can also affect the spread and dominance of cheatgrass, as well as the amount of nitrogen in the soil. This research project will determine if differences occur in the frequency of cheatgrass and Japanese brome, based on spring versus fall prescribed burns. Soil samples will also be analyzed to determine the affect of fires on the soil nutrient composition. The fall 2003 and 2004 prescribed burns could not occur due to inclement weather and/or a fire ban by the Sheriff's department. This unexpected change in the application of the fall burn treatment will require BCPOS and DBG to determine a new plan and timeline for the Rabbit Mountain project. Options have been discussed with Claire DeLeo (BCPOS) and will be outlined in the 2005 small grant program proposal.

Spring fires occur at a time when the burn will destroy cheatgrass before it is able to release seeds, but will not harm the natives, which have yet to commence above ground growth. Overall, cheatgrass populations show an initial decline after these burns, but studies have shown that individual plants surviving these burns are more fecund and robust (Young, 1978). Fall burns have a similar effect of reducing the following generation, presumably by killing fall germinating seedlings of annual bromes or reducing the soil seed bank. In the absence of reseeding with native species or additional management, a return to infested, pre-burn conditions occurs after three to four years (Nature Conservancy, 1999). The soil seed bank plays an important role in the life cycle and establishment of annual bromes. Although this project does not study the seed bank or the effect of prescribed burns on the survivorship of dormant seeds in the soil; propagation of the soil seed bank from the experimental treatments (control, spring and fall burns) will be incorporated into the 2005 proposal.

Many organisms have evolved mechanisms to alter their environment to one more favorable to their needs. This process of niche construction allows invasive grass species to increase the frequency and intensity of the fire regime (Keeley, 2001). Cheatgrass, like many non-native species, completes its life cycle early in the growing season. This allows it to monopolize early season soil moisture and then senesce when natives are beginning their growing season. Dry cheatgrass is extremely flammable and can shorten the fire cycle dramatically by increasing the chance of ignition and the rate of spread of wildfires (Young, 1995). Wildfires release an abundance of nutrients, including nitrogen, from the volatized biomass. Cheatgrass is favored in nutrient rich soils, while natives and late seral species are more tolerant of lower nitrogen levels (Pyke, 2002). Therefore, the study of nutrient cycling and biogeochemistry following prescribed burns is an important aspect of the study. By examining the results of different prescribed burns (spring versus fall), Denver Botanic Gardens will be able to make management recommendations directed towards controlling the spread and dominance of this invasive and damaging species.

## METHODS

**Study Sites** – Upon acceptance of Denver Botanic Gardens' proposal in January of 2003, Claire DeLeo (BCPOS) and DBG staff began surveying BCPOS properties that match the requirements of the project. Currently, two study sites are being sampled at Rabbit Mountain Open Space.

**Study Site 1** – In 2003, a large southwest-facing hillside at Rabbit Mountain Open Space was chosen as the study site for both the spring and fall prescribed burns. The hillside is dominated by cheatgrass and Japanese brome, although many native forbs and graminoids are present. The study site is located due south of the intersection of the Eagle Wind trail and St. Vrain Supply Canal road. The approximate elevational range is 1706 to 1753 meters and the following coordinate marks the approximate center of the sampling area (UTM 4455178N 481585E NAD27, elevation 1737m).

**Study Site 2** – In 2004, a second study area was installed in an open meadow past the eastern edge of the Eagle Wind loop trail. In March of 2004, a prescribed burn occurred in Unit 53, but the adjacent fall burn could not be completed. The eastern portion of the meadow is dominated by non-native brome species, *Rhus trilobata* (Shunkbrush), and numerous native graminoids and forbs.

**Study Site 3** – Lindsay Meadow site on the City of Boulder Mountain Parks and Open Space property in south Boulder County. The sampling design is identical to study site 2, but the data is not included within this report. Upon completion of the data analysis, a Lindsay Meadow summary report will be submitted to Boulder County. Funds from Boulder County were not used to sample the Lindsay Meadow site.

**Prescribed Fires** - All prescribed burns were conducted by BCPOS or City of Boulder staff following submission of a burn request form.

**Study Site 1 Prescribed Burns**
Spring burn treatment – March 10, 2003
Fall burn treatment – September 24, 2003*
***Burn did NOT overlap with sampled transects**

**Study Site 2 Prescribed Burns**
Spring Burn treatment (Burn Unit 53) – March 22, 2004
Fall 2004 prescribed burn could **NOT** be implemented

**Study Site 3 Prescribed Burns** (Lindsay Meadow – City of Boulder)
Fall burn treatment – September 16, 2004
Spring burn treatment – planned for 2005

**Sampling Methods** – Point cover using an ocular scope and 25 meter transects is the primary sampling technique. This type of cover measurement is useful for assessing vegetation based upon the ease of implementation and the morphology of the plants, especially graminoid leaf morphology (Elzinga, 1998). Point-cover measurements allow all species (native and non-native) and abiotic elements to be monitored. Additionally, point-cover measurements are generally stable regardless of the timing of data collection, i.e. spring versus late summer (Elzinga, 1998). At half-meter intervals, the point-cover was noted on both sides of the transect. Subjectivity of 'hit' placement is diminished by using the ocular point-cover devices borrowed from Boulder County Parks and Open Space and the City of Boulder Mountain Parks and Open Space. The plant species or abiotic object found at the junction of the cross hairs is considered the "hit" for the point-cover data point and each transect contains 100 'hits', although some variation occurs within the total number of hits per transect due to human error. Percent cover for all plant material, rock, standing dead vegetation, litter and bare soil was measured on both the left and right side of the transect every half meter. Standing dead refers to last year's remaining upright growth, while litter is any dead, loose plant material on the ground.

**Study Site 1** – A central point of origin was selected in the spring burn and another within the fall burn area. The starting point of each 25 meter transect was determined from these points of origin by a randomly chosen compass bearing (degrees) and distance (between 0 and 30m). From this point, another randomly chosen compass bearing was selected for the orientation (direction) of the transect; therefore transect placement and direction is random. A total of 21 transects were installed and sampled at this site in 2003, although only four transects were resampled in 2004 due to time constraints and prioritization of site 2 over site 1. Paired T-Tests were used to compare the percent cover of the three dominant plant species within the spring burn treatment between the two years of data. Density of cheatgrass and Japanese brome were measured in five transects during 2003, although this sampling technique was abandoned due to the large amount of time required to complete and the collection of data similar to the point-cover method. Five density sub-plots were selected within five transects by a stratified random sampling method for the determination of cheatgrass and Japanese brome density. At each plot a 25cm X 100cm frame was used to count the number of individual cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) plants, therefore determining density (number of plants per area). To avoid over counting, the left and bottom side (when oriented towards the end of the transect) were included in the count while the right and top sides were excluded. Graminoid blades were included if their basal growth fell within the plot.

**Study Site 2** – An identical ocular point-cover sampling technique was implemented at the second site in 2004, but the positioning of transects was modified to facilitate overlap with the prescribed burns. Three large macroplots (each 11 x 25 meters) were installed along the eastern edge of the meadow. Each macroplot contains ten parallel and randomly positioned 25 meter transects, therefore the sampling method is identical to Study Site 1, but the parallel placement of transects within macroplots made it easier to incorporate the sampled areas into BCPOS' burn plan. Each macroplot receives a specific burn treatment (control, spring burn, or fall burn).

**Study Site 3** – Identical sampling design and methodologies as study site 2.

All 2003 transects were tested for soil nutrients including nitrate and nitrogen ($NO_3$-N), phosphorus (P), potassium (K), zinc (Zn), iron (Fe), magnesium (Mn), copper (Cu) as well as pH, electrical conductivity (EC mmhos/cm), lime, organic matter (%OM), and texture within the burned and unburned areas. A soil auger was used to remove soil cores (approximately 20cm deep) every 5 meters along each transect. All samples from a transect were combined and air-dried in a cool, dry environment. Two pints of soil from each transect was removed and sent to the Soil, Water and Plant Testing Laboratory at Colorado State University. The results from these samples will aid in examining the soil nutrient changes due to burning. Additional soil sampling is planned for 2005.

## RESULTS

**Study Site 1 (2003-2004) -** Study Site 1 data analysis compares eleven 2003 transects and four 2004 transects, all within the 2003 spring burn treatment. Little difference could be identified between the two years' total cover data. The majority of cover consists of abiotic and dead plant materials (rock, bare soil, litter, and standing dead plant material). In 2003, 57% of the vegetation cover was abiotic or dead, whereas in 2004, 56% of the cover was abiotic or dead (Figure 1). The percent cover by bare soil decreased in 2004 and the rock cover increased, although the total vegetation remained similar between the two years of sampling, 42.96% and 43.46%. During both years of the study, cheatgrass and Japanese brome ranked highest in the spring burn treatment for percent cover by plant species, followed by *Heterotheca villosa* in both 2003 and 2004. Percent cover by vegetation classes is illustrated in Figure 2. The 'adventive annual graminoids' class consists of cheatgrass and Japanese brome; this class dominated the percent vegetation cover during both years of the spring burn. Appendix A lists the plant species within each vegetation class. The annual bromes decreased from 25.61% in 2003 to 13.28% in 2004, while native perennial forbs and graminoids increased slightly (Figure 2). Detailed percent cover data by species for both the 2003 and 2004 treatments are listed in Table 1. The unburned area of study site 1 was also dominated by cheatgrass and Japanese brome, with the third largest biotic component being *Stipa comata*. Both *H. villosa* and *S. comata* are desirable natives species for the Rabbit Mountain ecosystem. The percent cover of the annual bromes was higher in the unburned areas (25.92%). In 2004, the percent cover of native plants increased within the spring burn area.

Paired T-Tests compared the percent cover of an individual species within the spring burn treatment between 2003 and 2004. The three dominant plant species (cheatgrass, Japanese brome, *Heterotheca villosa*) were analyzed individually to determine if percent cover increased or decreased. A small sample size exists (n = 4) since few of the original site 1 transects were resampled in 2004 due to prioritization of sites 2 and 3. Cheatgrass cover per transect decreased from 2003 to 2004, 12.9% to 2.25% respectively, and was statistically significant ($P = 0.015$, n = 4, alpha = 0.05). Neither the Japanese brome or *Heterotheca* were significant, although the Japanese brome decreased from a mean cover of 18.4% in 2003 to 9.5% in 2004 and the *Heterotheca* increased from 2.7% to 4.5%. Table 2 displays the results of the Paired T-Test (two-tailed).

Soil analysis from the Soil, Water and Plant Testing Laboratory at Colorado State University are summarized in Figure 3. The majority of the nutrient levels and factors are fairly consistent between the burned and unburned areas of Study Site 1. There is an average pH of 5.9 across both sites. The spring burn area has an average of 3.5% organic material while the fall burn area (did not receive burn treatment) contains an average of 3.2% organic material. Two-sample T-test revealed that the nitrogen levels are significantly different between the burned and unburned areas ($P = 0.0028$, n = 22, alpha = 0.05), with the unburned treatment having higher amounts of nitrogen. The electrical conductivity is significantly different between the two sites ($P = 0.15$, n = 22, alpha = 0.05). Electrical conductivity measures the amount of salt in the soil, as well as the amount of sand, clay and organic matter and was slightly higher in the spring burn treatment (Ehsani and Sullivan, 2002). No other soil components were statistically significant.

Density was only recorded within 5 transects of the 2003 spring burn area. Table 3 summarizes the density data. On average there was more cheatgrass (mean of 486.4 plants) than Japanese brome (mean of 363 plants), but the amount of cheatgrass was more varied from transect to transect than Japanese brome, illustrated by a standard deviation of 374.7 for cheatgrass and 139.4 for Japanese brome. Density measurements were aborted in 2003 due to time restraints, although these five transects will be resampled in 2005 to determine if density is changing over time following the spring burn treatment.

**Study Site 2 (2004)** – Results from the 2004 sampling of study site 2 form the baseline data for comparison of experimental treatments over time, although comparisons between the spring burn and control treatments (including the area that was scheduled for a fall burn) can be analyzed since the overall area is believed to be fairly homogeneous. Each macroplot (treatment) had ten transects installed and approximately 1,000 data points collected. Table 4 lists the percent cover for individual species and treatments in 2004. As would be expected, the control and fall burn macroplots, both unburned in 2004, were very similar in total cover and only had 49.25% and 57.87% vegetation cover, respectively (Figure 4). These macroplots both had large proportions of dead material (43% in control, 40% in fall burn) and the following non-natives species were dominant: cheatgrass, Japanese brome and *Poa pratensis* (Kentucky bluegrass). The spring burn had much higher vegetation cover (80.22%) than the fall burn and control treatments (Figure 4). Standing dead material was much less in the spring burn treatment than the two unburned areas. Surprisingly, the percentage of litter and bare soil was highest in the spring burn treatment, although the treatment had much less standing dead material.

Analysis of site 2's total vegetation cover revealed the highest proportion of adventive, annual graminoids and native, perennial graminoids in the spring burn treatment (Figure 5). Surprisingly, the control treatment had much less adventive, perennial graminoids than either the unburned fall or spring burn treatments. This highlights a basic difference in the unmanipulated macroplots (control and fall) vegetation composition and documents variation within the site's overall vegetation. These three vegetation classes consist of a majority of each treatment's vegetation composition. Appendix A lists the plant species within each vegetation class. All three treatments are dominated by the following non-native species: cheatgrass, Japanese brome, and Kentucky Bluegrass (*Poa pratensis*). Table 4 lists the mean percent cover per treatment for individual species documented within each macroplot. The native plants with the highest percent cover in the control and fall burn treatments are an unidentifiable wheatgrass species (3%)(presumable Western Wheatgrass) and *Symphyotrichum falcatum* (White Prairie Aster)(3%), respectively. In comparison, the spring burn macroplot was dominated by *Poa pratensis* (25%), Cheatgrass (13%) and Japanese brome (12%). Within the spring burn macroplot one native, *Pascopyrum smithii* (western wheatgrass), ranked third 9 (tied) in the vegetation cover with 12%. This is the highest percent cover of any native species at either of the study sites or years of sampling.

Species richness at site 2 varied little between the treatments. Both the control and spring burn treatments had 31 plant species, of which 7 were adventive (22.5%). The fall burn treatment, which was not burned, had 27 species, of which 5 were adventive (18.5%). The species richness count includes samples that are unidentifiable or unknown.

## DISCUSSION

Baseline data collected in the summers of 2003 and 2004 will be used to compare the effects of spring and fall burns on the control of *Bromus tectorum* and other non-native, invasive species. Since the fall burn treatments could not be completed at either of the Rabbit Mountain study sites during 2003 and 2004, this report can only summarized the baseline data collected to date, except for the site 1 spring burn treatment. General comparisons between the spring burn and control treatment can be analyzed for Study Site 2, since the macroplots are in close proximity and the vegetation composition is assumed to be somewhat homogeneous. Additionally, temporal changes within the spring burn treatment of Study Site 1 can also be identified and simple statistics used to compare the vegetation between the two years of data.

The percent cover of each species found within our study sites was determined by taking 100 ocular data points in each transect. *Bromus tectorum* germinates in the fall or late winter, over winters as a seedling and then flowers in the spring and was more abundant than all of the native perennials and annuals. In the summer of 2003, twenty-one 25m transects were sampled within the spring and fall burn areas of site 1, although the fall burn did not occur. Please reference Denver Botanic Gardens' 2003 project report for a detailed summary of the 2003 site 1 results. Only transects that were resampled in 2004 are discussed within this report and all resampled transects were within the 2003 spring burn treatment. During 2004, 30 transects were sampled at site 2, 10 for each treatment. Although the fall burn could not be implemented. Density measurements were aborted in 2003 due to time restraints, although these transects will be resampled in 2005 to determine if density is changing over time

Our preliminary data has shown that cheatgrass and Japanese brome are more abundant than native species at the two study sites within Rabbit Mountain Open Space. All of the macroplots and treatments are dominated by cheatgrass, Japanese brome and assorted abiotic elements (rocks, litter, standing dead plant material). Diverse native plant species are present, but the cover percentages are generally small. At site 1, we documented a statistically significant decline in cheatgrass, although our sample size is small (n = 4 transects). Figure 2 illustrates an increase in native, perennial graminoids of 5% between the two years and a decrease of over 12% in the adventive, annual graminoids. All 21 transects at site 1 will be resampled in 2005, assuming DBG's grant proposal is accepted. Currently, site 2 provides baseline data for the three treatments, although some general comparisons can be made between the spring burn and control treatments (including the unburned fall burn treatment). The spring burn has more vegetation cover and less dead material (Figure 4); therefore we assume that the fire consumed the litter and dead plant material and stimulated additional plant growth or productivity. Precipitation and the Boulder region's slow advance out of a drought period are also important factors to consider. Additional sampling of site 2 is necessary to determine the short-term (2 years) affects of the prescribed burn.

Since both study sites contain a diverse number of native species, there should be an adequate seed bank of natives that could thrive in the absence or reduction of competition from cheatgrass and Japanese brome. Nitrogen may be a significant factor in the ability of the native grasses and forbs to compete with cheatgrass and Japanese brome. In the first year following the fire, it was assumed that soil nitrogen would increase and then be leached away in following years, although the results of our soil samples show a significant decrease in nitrogen within the spring burn treatment (Figure 3). This may be due to changes in the form or availability of nitrogen that our soil tests are not able to detect (Sanford, personal communication). Another possibility may relate to the soil temperatures reached during the burn. Choromanska and DeLuca (2002) have shown that higher temperatures (360ºC versus 160ºC) reduce the amount of mineralizeable nitrogen. This aspect of the study needs additional research and review of published data. High levels of nitrogen deposition have been shown to favor growth of non-native grass species (Giessow, 1996). It may be the initial increase in available soil nitrogen and the removal of competition by fire that poses the threat of further invasion of noxious annuals such as *Bromus tectorum,* instead of the desired control effect. If this is the situation, it becomes very important that prescribed fires are timed precisely to damage the non-natives, while giving the natives an opportunity to establish with reduced competition. Growth of root-sprouting perennials and robust perennial forbs is stimulated following a fire, which can mean a year of vigorous growth for native species. However, this depends on the reduction of competition from the adventive species and favorable growing conditions (ie – sufficient water). Therefore drought conditions, must be factored into the ability for natives to establish and/or increase in density following a fire. Reduction of weed seeds in the soil depends on the intensity of the fire and prescribed burns may not burn at a uniform intensity or be hot enough to kill the soil seed bank. Soil seed bank analysis will be incorporated into the 2005 grant proposal to determine if burned areas have reduced viability or number of annual brome seeds.

The goal of this study is to analyze the short to medium-term effects (one to four years) of prescribed fires on the control of *Bromus tectorum* and *Bromus japonicus.* In order to understand the efficacy of a spring versus a fall burn on removing these non-native, invasive grasses; additional time and data are required, especially considering the lack of a fall burn treatment at study sites 1 and 2. Without the application of a fall burn treatment, this project will quantitatively document changes in vegetation composition between spring burns and control treatments, including multiple sites and several years of data. Although, the goal of this multi-year project is to document the affects of seasonal prescribed burns on vegetation composition and develop management practices that provide the most efficient results for the conservation of natural, functioning ecosystems.

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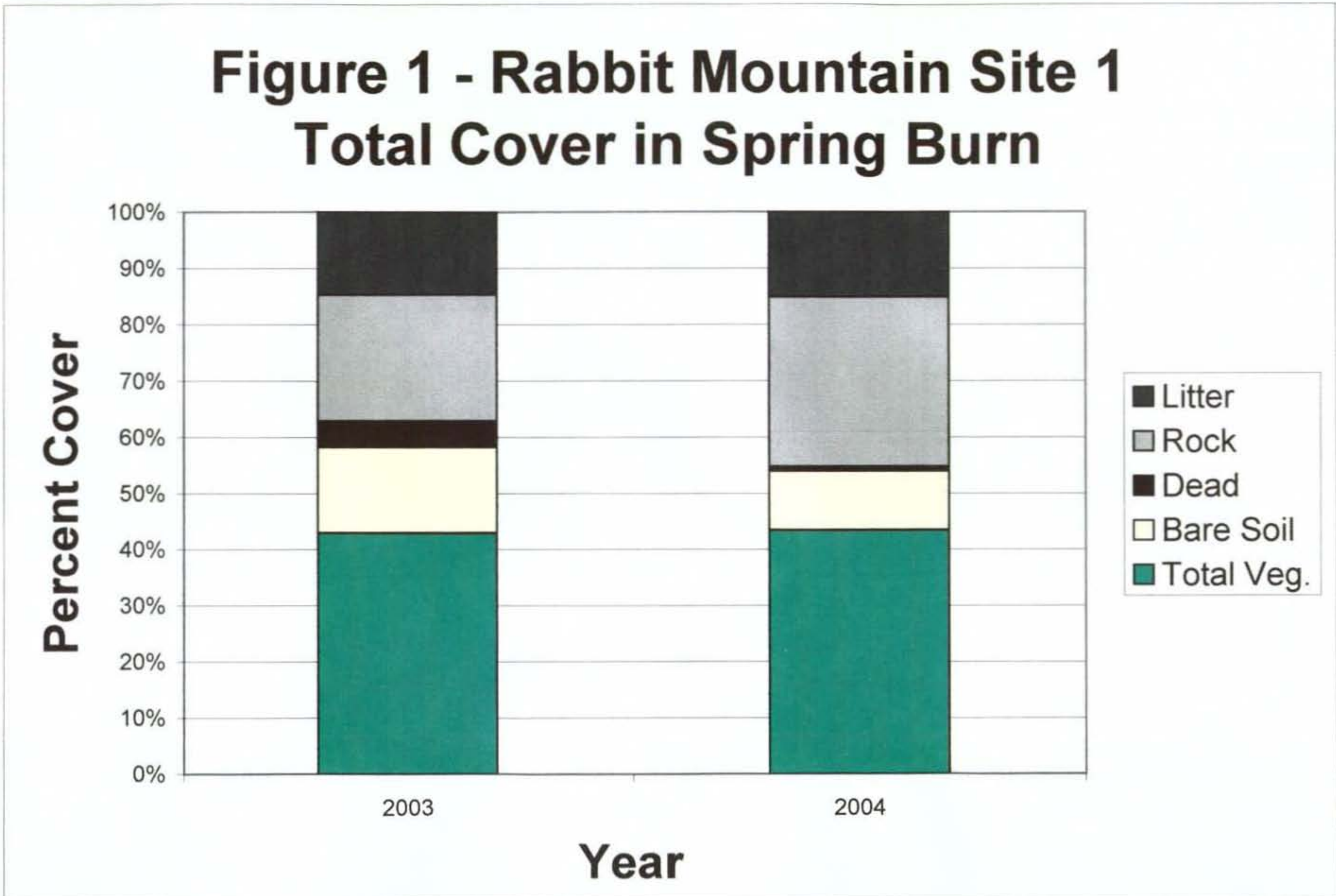


Figure 1 - Rabbit Mountain Site 1
Total Cover in Spring Burn
Percent Cover
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2003
2004
Year
Litter
Rock
Dead
Bare Soil
Total Veg.

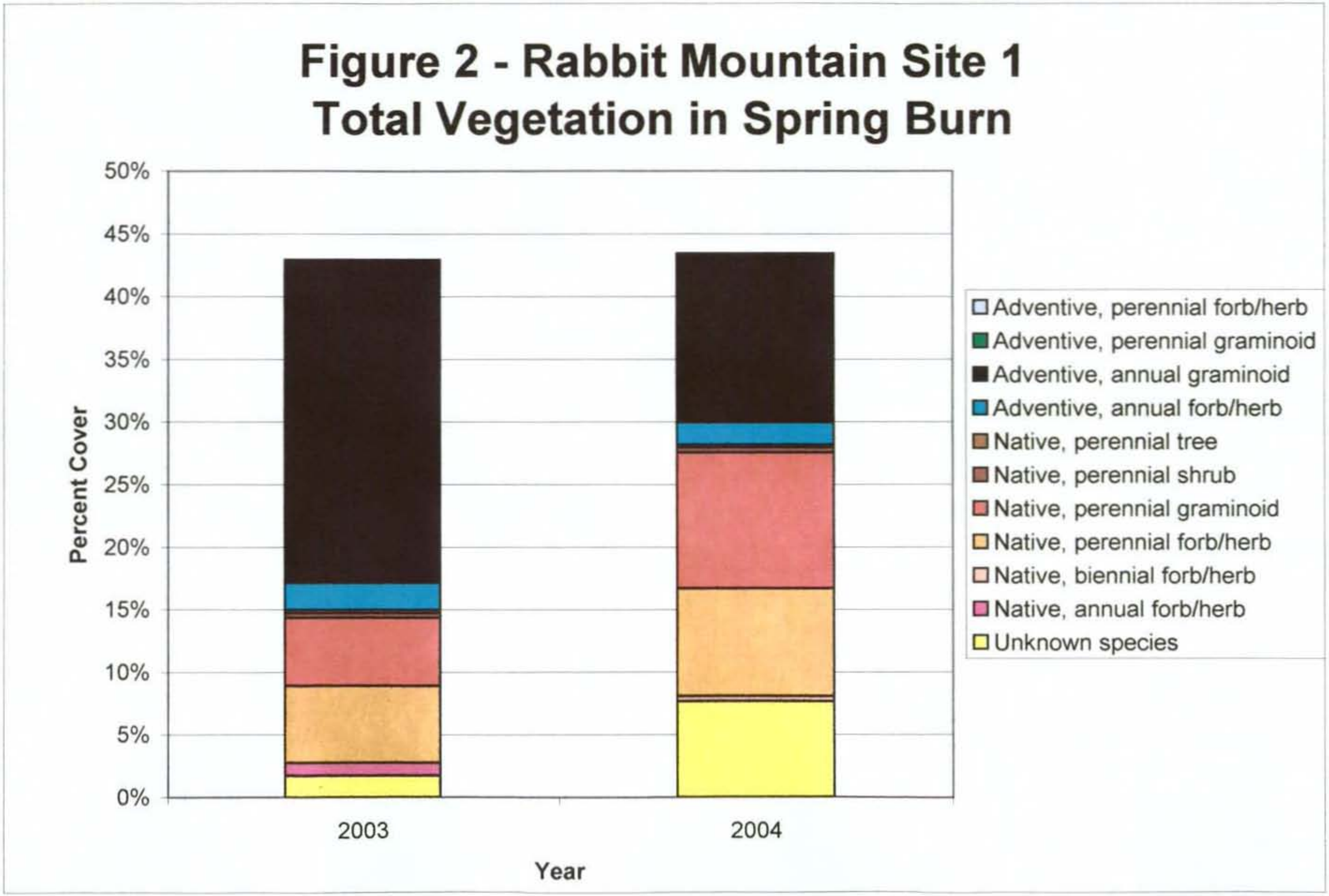
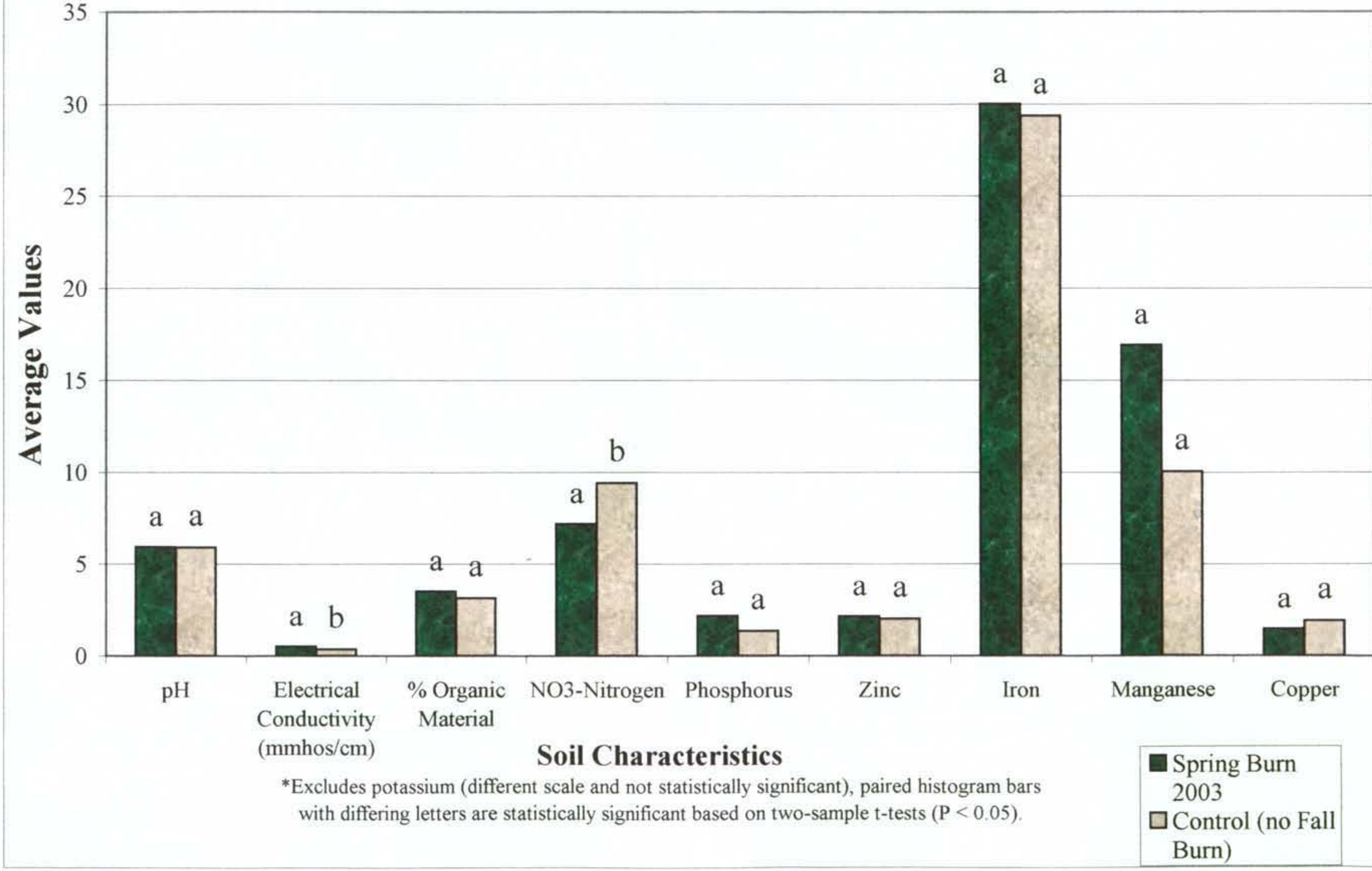


Figure 2 - Rabbit Mountain Site 1
Total Vegetation in Spring Burn
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Percent Cover
2003
2004
Year
Adventive, perennial forb/herb
Adventive, perennial graminoid
Adventive, annual graminoid
Adventive, annual forb/herb
Native, perennial tree
Native, perennial shrub
Native, perennial graminoid
Native, perennial forb/herb
Native, biennial forb/herb
Native, annual forb/herb
Unknown species

# Figure 3 - Rabbit Mountain Site 1 - 2003 Soil Analysis




*Excludes potassium (different scale and not statistically significant), paired histogram bars with differing letters are statistically significant based on two-sample t-tests ($P < 0.05$).

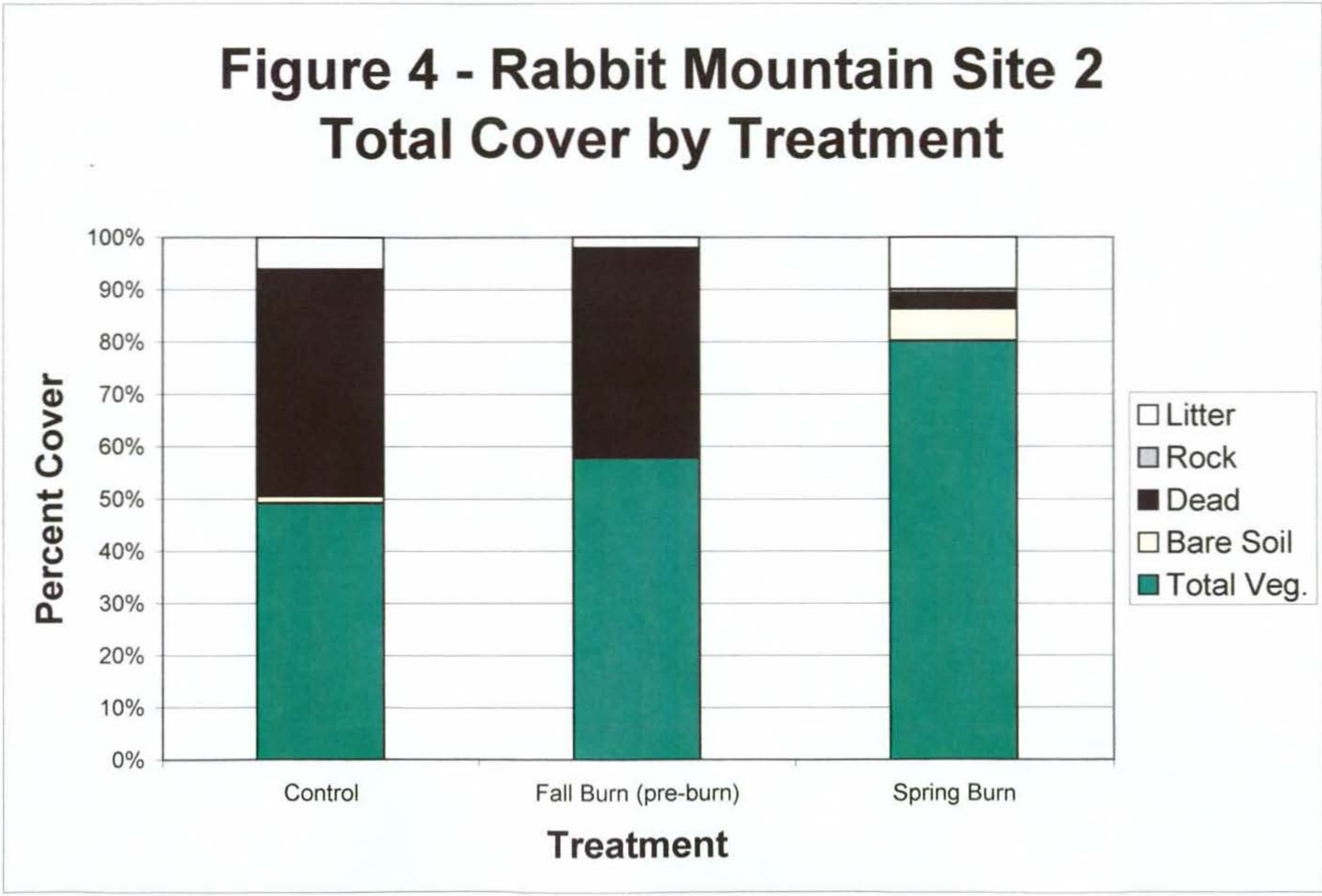


Figure 4 - Rabbit Mountain Site 2
Total Cover by Treatment
Percent Cover
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Control
Fall Burn (pre-burn)
Spring Burn
Treatment
Litter
Rock
Dead
Bare Soil
Total Veg.

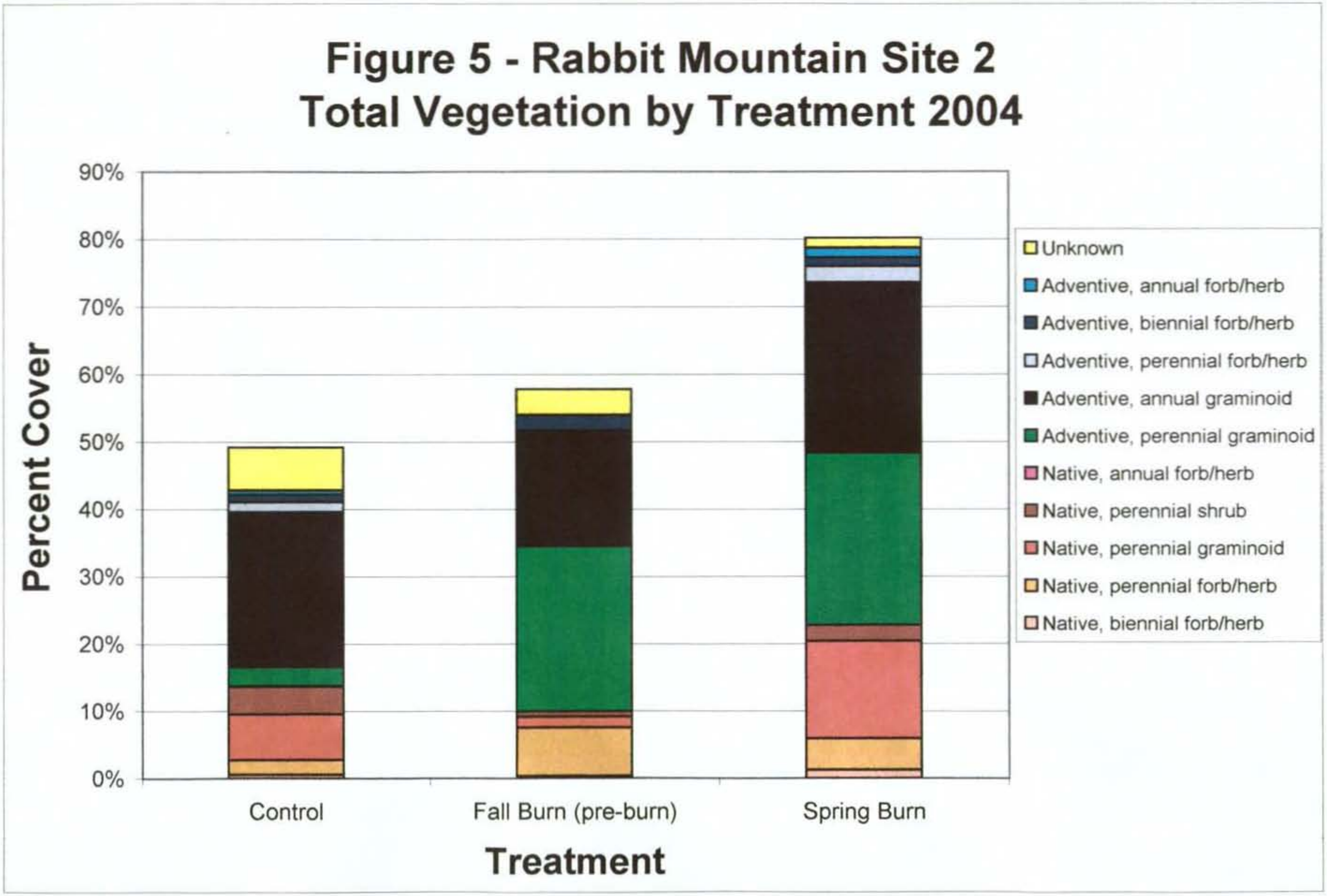


Figure 5 - Rabbit Mountain Site 2
Total Vegetation by Treatment 2004
Percent Cover
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Control
Fall Burn (pre-burn)
Spring Burn
Treatment
Unknown
Adventive, annual forb/herb
Adventive, biennial forb/herb
Adventive, perennial forb/herb
Adventive, annual graminoid
Adventive, perennial graminoid
Native, annual forb/herb
Native, perennial shrub
Native, perennial graminoid
Native, perennial forb/herb
Native, biennial forb/herb

# TABLE 1 - Rabbit Mountain Study Site 1
# 2003 Percent cover sampling results

| Percent of treatment | Species | Nativity |
|---|---|---|
| **Fall Burn** | | |
| 24.82% | Litter | abiotic |
| 13.01% | Bromus tectorum L. | adventive |
| 12.91% | Bromus japonicus Thunb. Ex Murray | adventive |
| 10.31% | Rock | abiotic |
| 6.81% | Bare Soil | abiotic |
| 5.61% | Stipa comata Trin. & Rupr. | native |
| 4.10% | Pascopyrum smithii (Rydberg) Love | native |
| 2.50% | Dead | abiotic |
| 1.50% | Linaria genistifolia (L.) Miller subsp. dalmatica (L.) Maire et al. | adventive |
| 1.40% | Andropogon gerardii Vitman. | native |
| 1.40% | Rhus aromatica Aiton subsp. trilobata (Nuttall) Weber | native |
| 1.30% | Tragopogon dubius Scopoli subsp. major (Jacquin) Vollmann | adventive |
| 1.20% | Aster porteri Gray | native |
| 1.20% | collection #3, 7/3/03 | |
| 0.90% | Artemisia frigida Willdenow | native |
| 0.80% | Hesperostipa neomexicana (Thurb. ex Coult.) Barkworth | native |
| 0.80% | Heterotheca villosa (Pursh) Shinners | native |
| 0.80% | Linum lewisii Pursh | native |
| 0.70% | Cerastium strictum L. emend. Haenke | native |
| 0.70% | Unknown #1, 6/24/03 | |
| 0.70% | Yucca glauca Nuttall. | native |
| 0.60% | Cercocarpus montanus Raf. | native |
| 0.60% | Tithymalus peplus (L.) Hill | adventive |
| 0.50% | Bromus ciliatus L. | native |
| 0.50% | Lappula redowskii (Hornemann) Greene | native |
| 0.40% | Elymus lanceolatus (Scribner & Smith) Gould | native |
| 0.40% | Erodium cicutarium (L.) L' Heritier | adventive |
| 0.40% | Tragia ramosa Torr. | native |
| 0.30% | Psoralidium tenuiflorum (Pursh) Rydberg | native |

| Percent of treatment | Species | Nativity |
|---|---|---|
| 0.20% | Alyssum desertorum Stapf | adventive |
| 0.20% | Collection #11, 7/7/03 | |
| 0.20% | Collection #9, 7/7/03 | |
| 0.20% | Eriogonum umbellatum Torrey | native |
| 0.20% | Silene antirrhina L. | native |
| 0.10% | Artemisia ludoviciana Nuttall | native |
| 0.10% | Asclepias pumila (Gray) Vail | native |
| 0.10% | Dalea candida Michx. ex Willd. | native |
| 0.10% | Descurainia pinnata (Walt.) Britt. | native |
| 0.10% | Drymocallis fissa (Nuttall) Rydberg | native |
| 0.10% | Geranium caespitosum James subsp. caespitosum (Rydberg) Weber | native |
| 0.10% | Lesquerella montana (Gray) Watson | native |
| 0.10% | Liatris punctata Hooker | native |
| 0.10% | Medicago lupulina L. | adventive |
| 0.10% | Opuntia polyacantha Haw. | native |
| 0.10% | Poa compressa L. | adventive |
| 0.10% | Pterogonum alatum (Torrey) Gross | native |
| 0.10% | Ratibida columnifera (Nutt.) Woot. & Standl. | native |
| 0.10% | Schizachyrium scoparium (Michaux) Nash | native |
| 0.10% | Unknown #2, 7/14/03 | |
| 0.10% | Unknown #4, 7/14/03 | |
| 0.10% | Unknown #5, 7/14/03 | |
| 0.10% | Unknown Forb | |
| **Spring Burn** | | |
| 20.19% | Rock | abiotic |
| 16.38% | Dead | abiotic |
| 13.00% | Litter | abiotic |
| 12.88% | Bare Soil | abiotic |
| 9.81% | Bromus japonicus Thunb. Ex Murray | adventive |
| 9.81% | Bromus tectorum L. | adventive |
| 1.94% | Heterotheca villosa (Pursh) Shinners | native |
| 1.94% | Lichen | |
| 1.50% | Elymus lanceolatus (Scribner & Smith) Gould | native |

| Percent of treatment | Species | Nativity |
|---|---|---|
| 1.13% | Erodium cicutarium (L.) L' Heritier | adventive |
| 0.88% | Pascopyrum smithii (Rydberg) Love | native |
| 0.88% | Pinus ponderosa Douglas subsp. scopulorum (Watson) Weber | native |
| 0.75% | Trail bare soil | abiotic |
| 0.69% | Andropogon gerardii Vitman. | native |
| 0.69% | Stipa comata Trin. & Rupr. | native |
| 0.69% | Tragopogon dubius Scopoli subsp. major (Jacquin) Vollmann | adventive |
| 0.63% | Drymocallis fissa (Nuttall) Rydberg | native |
| 0.63% | Yucca glauca Nuttall. | native |
| 0.50% | Cerastium strictum L. emend. Haenke | native |
| 0.50% | Silene antirrhina L. | native |
| 0.44% | Seedling Forb | |
| 0.44% | Trail rock | abiotic |
| 0.38% | Alyssum sp. | |
| 0.31% | Artemisia ludoviciana Nuttall | native |
| 0.19% | Alyssum desertorum Stapf | adventive |
| 0.19% | Aster porteri Gray | native |
| 0.19% | BD/MDL#1 6/23/03 | |
| 0.19% | Koeleria macrantha (Ledebour) Schultes | native |
| 0.19% | Lappula redowskii (Hornemann) Greene | native |
| 0.19% | Ribes cereum Douglas | native |
| 0.13% | Echinocereus viridiflorus Englemann | native |
| 0.13% | Linaria genistifolia (L.) Miller subsp. dalmatica (L.) Maire et al. | adventive |
| 0.13% | Opuntia sp. | |
| 0.13% | TAG2, 6/24/03 | |
| 0.13% | Unknown Forb | |
| 0.13% | Zinnia grandiflora Nuttall. | native |
| 0.06% | Allium sp. | |
| 0.06% | Alyssum parviflorum Bieberstein | adventive |
| 0.06% | Artemisia frigida Willdenow | native |
| 0.06% | BD3 Unknown Grass | |
| 0.06% | BD6 6/26/03 | |
| 0.06% | collection #4, 7/10/03 | |

| Percent of treatment | Species | Nativity |
|---|---|---|
| 0.06% | Collection1, 6/20/03 | |
| 0.06% | Echinocereus reichenbachii (Terscheck) Haage var. perbellus (Britton & Rose) B | native |
| 0.06% | Erigeron compositus Pursh | native |
| 0.06% | Eriogonum umbellatum Torrey | native |
| 0.06% | Geranium caespitosum James subsp. caespitosum (Rydberg) Weber | native |
| 0.06% | Leucocrinum montanum Nutt. ex Gray | native |
| 0.06% | Linum lewisii Pursh | native |
| 0.06% | Rosa woodsii Lindley | native |
| 0.06% | Schizachyrium scoparium (Michaux) Nash | native |
| 0.06% | Tithymalus peplus (L.) Hill | adventive |
| 0.06% | Trail litter | abiotic |
| 0.06% | Unknown Aster sp. | |
| 0.06% | Unknown Graminoid | |

# TABLE 1 - Rabbit Mountain Study Site 1
# 2004 Percent cover sampling results
# (Data only includes the spring burn treatment

| Percent of treatment | Species | Nativity |
|---|---|---|
| **Spring Burn** | | |
| 30.59% | Rock | abiotic |
| 13.78% | Litter | abiotic |
| 9.48% | Bromus japonicus Thunb. Ex Murray | adventive |
| 8.85% | Bare Soil | abiotic |
| 7.08% | Bromus tectorum L. | adventive |
| 5.44% | Heterotheca villosa (Pursh) Shinners | native |
| 4.05% | Andropogon gerardii Vitman. | native |
| 3.41% | Elymus sp. | |
| 2.28% | Dead | abiotic |
| 1.39% | Artemisia ludoviciana Nuttall | native |
| 1.39% | Schizachyrium scoparium (Michaux) Nash | native |
| 1.26% | Oligosporus pacificus (Nuttall) Poljakov | native |
| 1.14% | Unknown Forb | |
| 1.01% | Bouteloua curtipendula (Michx.) Torr. | native |
| 1.01% | Lycurus phleoides Kunth | native |
| 0.76% | Elymus lanceolatus (Scribner & Smith) Gould | native |
| 0.76% | Tragopogon dubius Scopoli subsp. major (Jacquin) Vollmann | adventive |
| 0.63% | Alyssum alyssoides (L.) L. | adventive |
| 0.63% | Drymocallis fissa (Nuttall) Rydberg | native |
| 0.63% | Opuntia sp. | |
| 0.51% | Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths | native |
| 0.38% | Cerastium sp. | |
| 0.38% | Sorghastrum nutans (L.) Nash | native |
| 0.38% | Stipa comata Trin. & Rupr. | native |
| 0.25% | Ambrosia psilostachya de Candolle var. coronopfolia (Torrey & Gray) Farwell | native |
| 0.25% | Aristida purpurea Nuttall | native |
| 0.25% | Artemisia frigida Willdenow | native |
| 0.25% | Erigeron flagellaris Gray | native |

| Percent of treatment | Species | Nativity |
|---|---|---|
| 0.25% | Lactuca serriola L. | adventive |
| 0.25% | Pinus ponderosa Douglas subsp. scopulorum (Watson) Weber | native |
| 0.13% | Artemisia campestris L. | native |
| 0.13% | Dalea sp. | |
| 0.13% | Drymocallis sp. | |
| 0.13% | Echinocereus viridiflorus Englemann | native |
| 0.13% | Eriogonum umbellatum Torrey | native |
| 0.13% | Gaura coccinea Nutt. ex Pursh | native |
| 0.13% | Geranium caespitosum James subsp. caespitosum (Rydberg) Weber | native |
| 0.13% | Lepidium densiflorum Schrader | adventive |
| 0.13% | Linaria genistifolia (L.) Miller subsp. dalmatica (L.) Maire et al. | adventive |
| 0.13% | Poa compressa L. | adventive |

## TABLE 2 - Rabbit Mountain Study Site 1
t-Test: Paired Two Sample for Means

| ***Bromus japonicus*** **Thunb. Ex Murray** | *2003* | *2004* |
|---|---|---|
| Mean | 0.184480198 | 0.095520833 |
| Variance | 0.001999761 | 0.004038585 |
| Observations | 4 | 4 |
| Pearson Correlation | 0.028431895 | |
| Hypothesized Mean Difference | 0 | |
| df | 3 | |
| t Stat | 2.320882705 | |
| P(T<=t) one-tail | 0.051500558 | |
| t Critical one-tail | 2.353363016 | |
| P(T<=t) two-tail | 0.103001116 | |
| t Critical two-tail | 3.182449291 | |

| ***Bromus tectorum*** **L.** | *2003* | *2004* |
|---|---|---|
| Mean | 0.129628713 | 0.0225 |
| Variance | 0.000447416 | 0.000825 |
| Observations | 4 | 4 |
| Pearson Correlation | -0.475452036 | |
| Hypothesized Mean Difference | 0 | |
| df | 3 | |
| t Stat | 4.981197005 | |
| P(T<=t) one-tail | 0.007776091 | |
| t Critical one-tail | 2.353363016 | |
| P(T<=t) two-tail | 0.015552182 | |
| t Critical two-tail | 3.182449291 | |

| ***Heterotheca villosa*** **(Pursh) Shinners** | *2003* | *2004* |
|---|---|---|
| Mean | 0.027450495 | 0.045 |
| Variance | 0.000292667 | 0.0015 |
| Observations | 4 | 4 |
| Pearson Correlation | 0.532728551 | |
| Hypothesized Mean Difference | 0 | |
| df | 3 | |
| t Stat | -1.064718602 | |
| P(T<=t) one-tail | 0.182548743 | |
| t Critical one-tail | 2.353363016 | |
| P(T<=t) two-tail | 0.365097486 | |
| t Critical two-tail | 3.182449291 | |

**Table 3**: Density of *Bromus tectorum* and *Bromus japonicus* at Rabbit Mountain Study Site 1 (post spring 2003 burn, summer sampling, Five transects sampled with five random 0.25m$^2$ plots per transect)

| Transect # | Total of *Bromus tectorum per 1.25m$^2$* | Total of *Bromus japonicus per 1.25m$^2$* |
|---|---|---|
| 1 | 96 | 322 |
| 2 | 105 | 198 |
| 5 | 906 | 293 |
| 6 | 549 | 555 |
| 7 | 776 | 447 |
| | | |
| Mean density per 0.25m$^2$ | 97.28 | 72.6 |
| Extrapolated Density per 1.0m$^2$ | 389.12 | 290.4 |
| Standard deviation | 374.74 | 139.40 |

# TABLE 4 - Rabbit Mountain Study Site 2
## 2004 Percent cover sampling results
## (control, spring burn and fall burn treatments)

| Percent of treatment | Species | Nativity |
|---|---|---|
| **Control** | | |
| 43.32% | Dead | abiotic |
| 11.96% | Bromus japonicus Thunb. Ex Murray | adventive |
| 11.06% | Bromus tectorum L. | adventive |
| 6.13% | Litter | abiotic |
| 3.12% | Wheatgrass species | |
| 2.91% | 20: LM Sample 20, Gutierrezia Lag. | |
| 2.21% | Poa pratensis L. | adventive |
| 2.11% | Schizachyrium scoparium (Michaux) Nash | native |
| 1.81% | Artemisia frigida Willdenow | native |
| 1.71% | Pascopyrum smithii (Rydberg) Love | native |
| 1.51% | Linaria genistifolia (L.) Miller subsp. dalmatica (L.) Maire et al. | adventive |
| 1.51% | Rosa woodsii Lindley | native |
| 1.31% | Bare Soil | abiotic |
| 1.11% | Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths | native |
| 1.11% | Buchloe dactyloides (Nutt.) Engelm. | native |
| 1.11% | Psoralidium tenuiflorum (Pursh) Rydberg | native |
| 1.11% | Verbascum blattaria L. | adventive |
| 0.80% | Rhus trilobata Nutt. | native |
| 0.60% | Poa compressa L. | adventive |
| 0.50% | Erigeron flagellaris Gray | native |
| 0.50% | Erodium cicutarium (L.) L' Heritier | adventive |
| 0.50% | Lithospermum incisum Lehmann | native |
| 0.40% | Aster porteri Gray | native |
| 0.30% | Aristida purpurea Nuttall | native |
| 0.20% | Bouteloua curtipendula (Michx.) Torr. | native |
| 0.20% | Sporobolus cryptandrus (Torrey) Gray | native |
| 0.10% | Ambrosia psilostachya de Candolle var. coronopfolia (Torrey & Gray) Farwell | native |
| 0.10% | Elymus lanceolatus (Scribner & Smith) Gould | native |
| 0.10% | Gutierrezia sarothrae (Pursh) Britt. & Rusby | native |
| 0.10% | Helianthus annuus L. | native |
| 0.10% | Opuntia sp. | |
| 0.10% | Ratibida sp. Raf. | |
| 0.10% | Tragopogon dubius Scopoli subsp. major (Jacquin) Vollmann | adventive |
| 0.10% | Unknown Forb | |

| Percent of treatment | Species | Nativity |
|---|---|---|
| 0.10% | Unknown Graminoid | |
| 0.00% | Comandra umbellata (L.) Nuttall | native |
| **Fall Burn** | | |
| 39.62% | Dead | abiotic |
| 24.47% | Poa pratensis L. | adventive |
| 10.93% | Bromus tectorum L. | adventive |
| 6.22% | Bromus japonicus Thunb. Ex Murray | adventive |
| 2.71% | Symphyotrichum falcatum (Lindl.) Nesom var. falcatum | native |
| 2.21% | Verbascum blattaria L. | adventive |
| 2.11% | Litter | abiotic |
| 1.91% | Ambrosia L. | |
| 1.81% | Psoralidium tenuiflorum (Pursh) Rydberg | native |
| 1.60% | Wheatgrass species | |
| 0.80% | Stipa comata Trin. & Rupr. | native |
| 0.70% | Artemisia ludoviciana Nuttall | native |
| 0.70% | Gaura coccinea Nutt. ex Pursh | native |
| 0.70% | Lithospermum incisum Lehmann | native |
| 0.50% | Rosa woodsii Lindley | native |
| 0.40% | Bare Soil | abiotic |
| 0.40% | Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths | native |
| 0.40% | Elymus lanceolatus (Scribner & Smith) Gould | native |
| 0.30% | Artemisia frigida Willdenow | native |
| 0.30% | Aster porteri Gray | native |
| 0.20% | Aristida sp. | |
| 0.20% | Erigeron flagellaris Gray | native |
| 0.10% | Artemisia campestris L. | native |
| 0.10% | Convolvulus arvensis L. | adventive |
| 0.10% | Erigeron divergens Torr. & Gray | native |
| 0.10% | Geranium caespitosum James subsp. caespitosum (Rydberg) Weber | native |
| 0.10% | Oligosporus pacificus (Nuttall) Poljakov | native |
| 0.10% | Poa compressa L. | adventive |
| 0.10% | Stipa sp. | |
| 0.10% | Unknown Graminoid | |
| **Spring Burn** | | |
| 25.40% | Poa pratensis L. | adventive |
| 13.45% | Bromus tectorum L. | adventive |
| 12.05% | Pascopyrum smithii (Rydberg) Love | native |
| 11.75% | Bromus japonicus Thunb. Ex Murray | adventive |
| 9.94% | Litter | abiotic |

| Percent of treatment | Species | Nativity |
|---|---|---|
| 6.12% | Bare Soil | abiotic |
| 3.01% | Dead | abiotic |
| 2.41% | Convolvulus arvensis L. | adventive |
| 2.01% | Lithospermum incisum Lehmann | native |
| 1.41% | Tragopogon dubius Scopoli subsp. major (Jacquin) Vollmann | adventive |
| 1.31% | Elymus lanceolatus (Scribner & Smith) Gould | native |
| 1.31% | Verbascum blattaria L. | adventive |
| 1.20% | Erigeron flagellaris Gray | native |
| 1.00% | Aristida purpurea Nuttall | native |
| 1.00% | Artemisia frigida Willdenow | native |
| 0.70% | Rhus trilobata Nutt. | native |
| 0.70% | Rock | abiotic |
| 0.70% | Rosa woodsii Lindley | native |
| 0.60% | Geranium caespitosum James subsp. caespitosum (Rydberg) Weber | native |
| 0.50% | Artemisia ludoviciana Nuttall | native |
| 0.50% | Opuntia sp. | |
| 0.50% | Psoralidium tenuiflorum (Pursh) Rydberg | native |
| 0.40% | Gutierrezia sarothrae (Pursh) Britt. & Rusby | native |
| 0.40% | Sphaeralcea coccinea (Nuttall) Rydberg | native |
| 0.30% | Ambrosia L. | |
| 0.20% | 20: LM Sample 20, Gutierrezia Lag. | |
| 0.20% | 32: LM Sample 32, Erigeron | |
| 0.20% | Unknown Forb | |
| 0.10% | 27: RM Sample 27, Erigeron | |
| 0.10% | Andropogon gerardii Vitman. | native |
| 0.10% | Artemisia campestris L. | native |
| 0.10% | Bromus inermis Leyss. | adventive |
| 0.10% | Heterotheca villosa (Pursh) Shinners | native |
| 0.10% | Physalis virginiana Miller | native |
| 0.10% | Poa compressa L. | adventive |

# Appendix A - Rabbit Mountain Sites 1 and 2
## Species Classification

| Scientific Name | Status | Duration | Growth habit |
|---|---|---|---|
| Pinus ponderosa Douglas subsp. scopulorum (Watson) Weber | native | perennial | tree |
| Artemisia frigida Willdenow | native | perennial | shrub |
| Cercocarpus montanus Raf. | native | perennial | shrub |
| Opuntia polyacantha Haw. | native | perennial | shrub |
| Rhus aromatica Aiton subsp. trilobata (Nuttall) Weber | native | perennial | shrub |
| Rhus trilobata Nutt. | native | perennial | shrub |
| Ribes cereum Douglas | native | perennial | shrub |
| Rosa woodsii Lindley | native | perennial | shrub |
| Andropogon gerardii Vitman. | native | perennial | graminoid |
| Aristida purpurea Nuttall | native | perennial | graminoid |
| Bouteloua curtipendula (Michx.) Torr. | native | perennial | graminoid |
| Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths | native | perennial | graminoid |
| Bromus ciliatus L. | native | perennial | graminoid |
| Buchloe dactyloides (Nutt.) Engelm. | native | perennial | graminoid |
| Elymus lanceolatus (Scribner & Smith) Gould | native | perennial | graminoid |
| Hesperostipa neomexicana (Thurb. ex Coult.) Barkworth | native | perennial | graminoid |
| Koeleria macrantha (Ledebour) Schultes | native | perennial | graminoid |
| Lycurus phleoides Kunth | native | perennial | graminoid |
| Pascopyrum smithii (Rydberg) Love | native | perennial | graminoid |
| Schizachyrium scoparium (Michaux) Nash | native | perennial | graminoid |
| Sorghastrum nutans (L.) Nash | native | perennial | graminoid |
| Sporobolus cryptandrus (Torrey) Gray | native | perennial | graminoid |
| Stipa comata Trin. & Rupr. | native | perennial | graminoid |
| Ambrosia psilostachya de Candolle var. coronopfolia (Torrey & Gray) Farwell | native | perennial | forb/herb |
| Artemisia campestris L. | native | perennial | forb/herb |
| Artemisia ludoviciana Nuttall | native | perennial | forb/herb |
| Asclepias pumila (Gray) Vail | native | perennial | forb/herb |
| Aster porteri Gray | native | perennial | forb/herb |
| Cerastium strictum L. emend. Haenke | native | perennial | forb/herb |
| Comandra umbellata (L.) Nuttall | native | perennial | forb/herb |
| Dalea candida Michx. ex Willd. | native | perennial | forb/herb |
| Descurainia pinnata (Walt.) Britt. | native | perennial | forb/herb |
| Drymocallis fissa (Nuttall) Rydberg | native | perennial | forb/herb |

| | | | |
|---|---|---|---|
| Echinocereus reichenbachii (Terscheck) Haage var. perbellus (Britton & Rose) Benson | native | perennial | forb/herb |
| Echinocereus viridiflorus Englemann | native | perennial | forb/herb |
| Erigeron compositus Pursh | native | perennial | forb/herb |
| Eriogonum umbellatum Torrey | native | perennial | forb/herb |
| Gaura coccinea Nutt. ex Pursh | native | perennial | forb/herb |
| Geranium caespitosum James subsp. caespitosum (Rydberg) Weber | native | perennial | forb/herb |
| Gutierrezia sarothrae (Pursh) Britt. & Rusby | native | perennial | forb/herb |
| Heterotheca villosa (Pursh) Shinners | native | perennial | forb/herb |
| Lesquerella montana (Gray) Watson | native | perennial | forb/herb |
| Leucocrinum montanum Nutt. ex Gray | native | perennial | forb/herb |
| Liatris punctata Hooker | native | perennial | forb/herb |
| Linum lewisii Pursh | native | perennial | forb/herb |
| Lithospermum incisum Lehmann | native | perennial | forb/herb |
| Oligosporus pacificus (Nuttall) Poljakov | native | perennial | forb/herb |
| Physalis virginiana Miller | native | perennial | forb/herb |
| Psoralidium tenuiflorum (Pursh) Rydberg | native | perennial | forb/herb |
| Pterogonum alatum (Torrey) Gross | native | perennial | forb/herb |
| Ratibida columnifera (Nutt.) Woot. & Standl. | native | perennial | forb/herb |
| Sphaeralcea coccinea (Nuttall) Rydberg | native | perennial | forb/herb |
| Symphyotrichum falcatum (Lindl.) Nesom var. falcatum | native | perennial | forb/herb |
| Tragia ramosa Torr. | native | perennial | forb/herb |
| Yucca glauca Nuttall. | native | perennial | forb/herb |
| Zinnia grandiflora Nuttall. | native | perennial | forb/herb |
| Erigeron divergens Torr. & Gray | native | biennial | forb/herb |
| Erigeron flagellaris Gray | native | biennial | forb/herb |
| Helianthus annuus L. | native | annual | forb/herb |
| Lappula redowskii (Hornemann) Greene | native | annual | forb/herb |
| Silene antirrhina L. | native | annual | forb/herb |
| Bromus inermis Leyss. | adventive | perennial | graminoid |
| Poa compressa L. | adventive | perennial | graminoid |
| Poa pratensis L. | adventive | perennial | graminoid |
| Convolvulus arvensis L. | adventive | perennial | forb/herb |
| Linaria genistifolia (L.) Miller subsp. dalmatica (L.) Maire et al. | adventive | perennial | forb/herb |
| Medicago lupulina L. | adventive | perennial | forb/herb |
| Verbascum blattaria L. | adventive | biennial | forb/herb |
| Bromus japonicus Thunb. Ex Murray | adventive | annual | graminoid |
| Bromus tectorum L. | adventive | annual | graminoid |

| | | | |
|---|---|---|---|
| Alyssum alyssoides (L.) L. | adventive | annual | forb/herb |
| Alyssum desertorum Stapf | adventive | annual | forb/herb |
| Alyssum parviflorum Bieberstein | adventive | annual | forb/herb |
| Erodium cicutarium (L.) L' Heritier | adventive | annual | forb/herb |
| Lactuca serriola L. | adventive | annual | forb/herb |
| Lepidium densiflorum Schrader | adventive | annual | forb/herb |
| Tithymalus peplus (L.) Hill | adventive | annual | forb/herb |
| Tragopogon dubius Scopoli subsp. major (Jacquin) Vollmann | adventive | annual | forb/herb |
| Bare Soil | abiotic | | |
| Dead | abiotic | | |
| Litter | abiotic | | |
| Rock | abiotic | | |
| Trail bare soil | abiotic | | |
| Trail litter | abiotic | | |
| Trail rock | abiotic | | |