U.S. Department of the Interior
Bureau of Land Management

Fuels Guide for Sagebrush and Pinyon-Juniper Treatments: 10 Years Post-treatment

BLM Technical Note 451 | October 2019

Suggested Citation:

Wozniak, S.S., Strand, E.K. 2019. Fuels Guide for Sagebrush and Pinyon-Juniper Treatments: 10 Years Post-treatment. Technical Note 451. Bureau of Land Management, Boise, ID. BLM/OC/ST-19/002+9270

BLM/OC/ST-19/002+9270

Fuels Guide for Sagebrush and Pinyon-Juniper Treatments: 10 Years Post-treatment

Authors:

Samuel S. Wozniak, Soil Conservationist, USDA - NRCS

Eva K. Strand, Associate Professor, Department of Forest, Rangeland and Fire Sciences, University of Idaho

BLM Technical Note 451

October 2019

Acknowledgements

Thank you to Scott Schaff, Maggie Gray, and their field crews for collecting, entering data, taking photographs, and helping with the SageSTEP database. Thank you to Linda Schueck for answering questions regarding the SageSTEP database, and to Lael Gilbert for help with organizing and distributing photographs, and layout of the fuels guide.

This publication is contribution number 127 by the Sagebrush Steppe Treatment Evaluation Project (SageSTEP). It was supported by funds from the U.S. Joint Fire Science Program, Bureau of Land Management, and National Interagency Fire Center.

The written portions of this fuels guide are adapted from previous SageSTEP fuels guides (Stebleton and Bunting 2009; Bourne and Bunting 2011).

Table of Contents

Tables

Figures

Abstract

Increased woody plant dominance and degraded understory vegetation are important issues on rangelands in the Intermountain West. Land managers implement woody plant reduction treatments of sagebrush (*Artemisia* spp.), juniper (*Juniperus* spp.), and pinyon pine (*Pinus* spp.) to increase understory diversity and cover, restore wildlife habitat, increase forage, improve ecosystem functions, and reduce or manipulate fuels to increase ecosystem resilience to fire and resistance to invasive annual grasses. Woody plant reduction treatments alter fuel orientation, continuity, and loading, and therefore have important implications for wildfire behavior, effects, and management. Currently, there is a lack of knowledge of the longer-term implications of these treatments on fuel loads and vegetation structure. Using data collected as part of the Sagebrush Steppe Treatment Evaluation Project (SageSTEP), this guide summarizes fuel loads, vegetation cover by functional group, and shrub and tree stem density 10 years after sagebrush and pinyon-juniper reduction treatments. The data was collected at 16 study sites in Washington, Oregon, California, Nevada, and Utah, and is summarized by treatment type, region, and groups or woodland development phases based on pre-treatment vegetation. These summarized data can be used by land managers and fire behavior specialists to quickly estimate fuel loads in older treatments or to predict fuel loads 10 years after a potential treatment. These fuel loading data can be used to create custom fuel beds to model fire behavior and effects.

Introduction

In the past 160 years, there have been substantial changes in vegetation and fuel loads on rangelands in the Intermountain West. These changes are complex and vary along gradients of elevation and precipitation (Bradley 2010; Chambers et al. 2014). At higher elevations, pinyon-juniper (*Pinus* spp. and *Juniper* spp.) woodlands have expanded or infilled on more than 18 million ha in the Intermountain West (Miller et al. 2008). At lower elevations, there are many sagebrush-bunchgrass communities with dense Wyoming big sagebrush (*Artemisia wyomingensis* var. *wyomingensis*) and degraded understories. In both situations, disturbances (e.g. historic intensive livestock grazing) or lack of disturbance (due to active fire suppression and reduction in Native American set fires) have promoted the dominance of woody vegetation (Cottam and Steward 1940; Burkhardt and Tisdale 1976; Miller and Rose 1999; Gruell 1999; Miller and Tausch 2001; Miller et al. 2008; Chambers et al. 2014). Once woody plants become the dominant vegetation type in these ecosystems, there may be many consequences: reduced cover of bunchgrasses of forbs, reduced forage, degraded habitat for sagebrush-obligate species of wildlife, increased erosion, increased risk of higher severity fire, decreased resistance to cheatgrass invasion, and decreased ecosystem resilience in response to disturbances (Roundy et al. 2014; Miller et al. 2005; Baruch-Mordo et al. 2013; Pierson et al. 2015; Miller et al. 2013; Strand et al. 2013; Chambers et al. 2014).

When dense Wyoming big sagebrush or dense pinyon-juniper woodlands burn, they tend to burn with greater severity and result in a high mortality rate of the bunchgrasses that were left on the site (Boyd et al. 2015; Weiner et al. 2016). Areas dominated by cheatgrass are expensive and difficult to restore, and often contribute to increased fire frequencies that were not common prior to Euro-American settlement (Balch et al. 2013; Bradley et al. 2018). Therefore, land managers may choose to implement treatments that reduce sagebrush or pinyon-juniper cover in order to: increase bunchgrass and forb cover, promote ecosystem resilience before they burn, and create fuel breaks (Hulet et al. 2015). Common treatments to reduce sagebrush include prescribed fire, mowing, and herbicide, and treatments used to reduce pinyon-juniper woodlands include prescribed fire, cutting, and mastication. Although these treatments may provide many benefits, they can also result in an increase in invasive species in some areas (Davies et al. 2012; Bates et al. 2017).

The Sagebrush Steppe Treatment Evaluation Project (SageSTEP) was established to evaluate the changes in vegetation and fuel loads after several types of woody plant reduction treatments in low elevation Wyoming big sagebrush communities and in pinyon-juniper woodlands (McIver et al. 2014). There is currently a lack of knowledge of how post-treatment fuel loads change over the longer term. Land managers, fire behavior specialists and researchers use fuel loading data to predict fire behavior and effects using various modeling programs. Although there are some fuel loading data available to land managers working in the Intermountain West, there are very few published fuels guides (Bourne and Bunting 2011; Shinneman et al. 2015) detailing fuel loads of areas of the Intermountain West which have been treated with woody plant reduction treatments. Furthermore, there are no published fuels guides that quantify fuel loads in areas where sagebrush or pinyon-juniper woodlands were treated more than three years prior. This is important information because woody plant reduction treatments, such as mowed sagebrush fuel breaks, have been implemented on regional scales across the Intermountain West (Shinneman et al. 2018). Furthermore, some dead fuel types such as tree litter and duff will decompose over time, and live fuels such as shrubs and grasses will continue to increase past three years post-treatment (Williams et al. 2017). Over time, pinyon and juniper trees will also increase on treated sites.

Woody plant reduction treatments are being implemented at landscape scales in sagebrush steppe and pinyon-juniper woodlands to restore habitat for sagebrush obligate species, increase forage, and to create fuel breaks. There is a lack of information, however, on treatment effectiveness and quantification of post-treatment fuel loads. This guide will offer a longer-term view of the vegetation and fuel load response to these treatments.

It is intended to help land managers and fire behavior specialists quantify fuel loads at 10 years post-treatment and can be used to compare the effects of treatments to each other and to an untreated control. The data provided in this guide can be used to create custom fuel beds in fire behavior and effects modeling programs. This fuels guide can also be used to compare the effects of treating pinyon-juniper woodlands during different phases of woodland development, and to better understand the variability of changes in sagebrush and pinyon-juniper tree cover at 10 years post-treatment. It is important to note that the woodland sites treated in this study were pinyon-juniper expansion sites and not pre-settlement or old-growth, climax sites. Old-growth pinyon-juniper woodlands provide important habitat and have cultural values, and treating old-growth sites is not recommended (Waichler et al. 2001).

This guide is divided into four sub-guides (one sagebrush and three woodland guides) based on regional differences in site physiognomy and ecology: Sagebrush Steppe, Pinyon-Juniper, Utah Juniper, and Western Juniper. Sections are aggregated into groups by total pre-treatment sagebrush cover and total grass cover in the Sagebrush Steppe Guide, and by pre-treatment woodland development phases (Miller et al. 2005) in the Woodland Guides (refer to Methods section for further explanation). Groups and phases are further subdivided by treatment: a control, prescribed fire, mowing, and herbicide for the low elevation Wyoming big sagebrush sites, and a control, prescribed fire, cutting, and mastication treatment for the pinyon-juniper woodland sites. Two photographs show the range in cover by plant functional group within the group or phase. The information displayed to the left of each photograph shows the canopy cover by plant form of the subplot depicted in the photograph.

Methods

Data from 16 of the SageSTEP study sites were used to create this fuels guide (see Figure 1). Sagebrush study sites were at least 200 acres (80.9 ha) with 160 subplots, and woodland study sites ranged from 25-50 acres (10.1-20.2 ha) with 45-60 subplots (Bourne and Bunting 2011). Each subplot was 98.4 by 108.3 ft (30 m by 33 m), and contained six transects, 5 of which were used for vegetation and woody fuels sampling. The sixth transect was used for herbaceous fuel sampling, and the location of this transect varied between two locations in subsequent years due to destructive sampling. Transects were set up parallel to each other and were 108.3 ft (30 m) in length.

For the purpose of organizing the fuels guide, subplots at sagebrush sites were categorized into four descriptive groups based on pre-treatment shrub and grass cover:

- Group 1 consists of subplots with 0-25% pre-treatment shrub cover and 0-25% pre-treatment total grass cover,
- Group 2 consists of subplots with 0-25% pre-treatment shrub cover and >25% pre-treatment total grass cover,
- Group 3 consists of subplots with >25% pre-treatment shrub cover and 0-25% pre-treatment total grass cover,
- Group 4 consists of subplots with >25% pre-treatment shrub cover and >25% pre-treatment total grass cover.

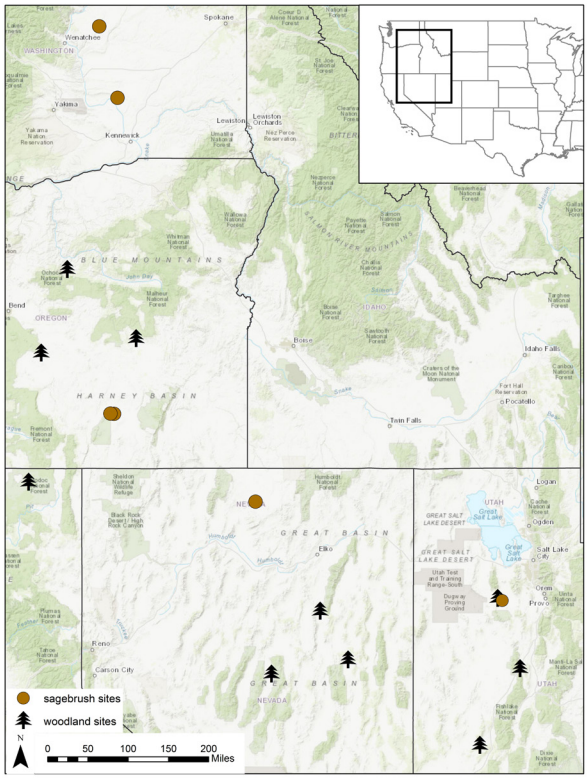


Figure 1. Map of sagebrush and woodland sites.

This grouping system was created by Stebleton and Bunting (2009) to allow users to quickly assign a group to a user's pre-treatment study site based on ocular estimates of grass and shrub cover. This system was continued in Bourne and Bunting (2011) and was continued for this 10-year post-treatment guide so that users can compare the three fuels guides. For all sagebrush steppe study sites, the dominant shrub is Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*), and the precipitation zone is 10-12" (254 – 305 mm).

Four treatments were implemented at the sagebrush study sites: untreated control, prescribed burn, mechanical mowing, and tebuthiuron herbicide treatment. The intent of these treatments was to reduce sagebrush cover and promote understory grasses and forbs. Prescribed fire treatments were implemented in the fall by federal agencies, with the intent of broadcast burning 100% of each subplot. At many sites, 20-90% of each subplot was burned due to environmental conditions at the time of burning such as fuel moisture and wind. Follow-up burns were implemented at the subplot scale. The objective of mechanical mowing and herbicide treatments was to reduce sagebrush cover by 50% (Bourne and Bunting 2011). The mowing treatment reduced sagebrush height to 12-15 in (31-38 cm) from a pre-treatment mean height of 27 in (68 cm). The tebuthiuron herbicide treatment was aerially applied in the form of pellets at a rate of 1-1.5 lbs/acre (1.1-1.7 kg/h; Bourne and Bunting 2011), and resulted in a high variability of sagebrush mortality among subplots at the same site.

Subplots at the woodland sites are organized by region (Pinyon-Juniper, Utah Juniper, and Western Juniper), and three woodland development phases as defined by Miller et al. (2005):

- In Phase I, trees are present on the site, but the shrub and herbaceous components drive the ecological processes occurring on the site (hydrology, and nutrient and energy cycling).
- In Phase II, trees co-dominate the site with the shrub and herbaceous components, and all three influence ecological processes occurring on the site.
- In Phase III, trees dominate the ecological processes on the site, and shrubs, grasses, and forbs have declined in cover and density.

Subplots were assigned to a woodland development phase prior to treatment, and subplots are still grouped by pre-treatment woodland phase in this guide so that users can assess the influence that pre-treatment phase has on 10-year post-treatment changes in vegetation and fuels. The Pinyon-Juniper study sites are located in Nevada (Figure 1), and the dominant tree species are Utah Juniper (*Juniperus osteosperma*) and single-leaf pinyon-pine (*Pinus monophylla*). The Utah Juniper study sites are located in Utah (Figure 1), and the dominant tree species are Utah Juniper (*Juniperus osteosperma*) and Colorado pinyon-pine (*Pinus edulis*). The Western Juniper study sites are located in Oregon and California (Figure 1), and the dominant tree species is Western Juniper (*Juniperus occidentalis*). All woodland sites are the in the 12-14" (305-356 mm) precipitation zone.

The woodland data are also grouped by treatment. Three treatments—untreated control, prescribed fire, mechanical cutting—were implemented at all woodland sites, and an additional mechanical mastication treatment was implemented at the study sites in the Utah Juniper region. Prescribed fires were implemented in the fall and were intended to burn 100% of the area of each subplot, but the percentage of each subplot burned was highly variable. Surviving trees were individually burned in a follow-up treatment. For the cutting treatment, all trees > 1.6 ft (0.5 m) in height were cut at the base with a chainsaw and left onsite. For the mastication treatment, all trees > 1.6 ft (0.5 m) in height were masticated with a tractor equipped with a Fecon® Bullhog® mulching head. All masticated debris was left onsite.

This guide provides statistics on canopy cover, height, density, fuel load, and bulk density of several fuel load components and functional groups. Mean, 10th percentile, and 90th percentile statistics are provided to demonstrate the average and range of variability. Minimum and maximum were not used because these

values were often extreme. Plant species codes, common names, and scientific names according to the USDA Plants Database (USDA - NRCS 2019) are available at the beginning of each subguide. This guide provides photographs for each region/treatment/phase or group combination so that there are two photographic examples that accompany each table of summarized data. A table with the previously mentioned statistics is also provided for each region/treatment/phase or group combination.

Trees

Height, crown base height, longest canopy diameter, and perpendicular canopy diameter were measured in the field for all trees greater than 0.5 m in height. To estimate tree cover, the area of each tree greater than 0.5 m was estimated from canopy diameter measurements, and tree canopy area was divided by the area of subplot. Canopy base height was calculated by taking the mean of the crown base heights measured within a subplot. All trees greater than 0.5 m in height were counted within the subplot for tree density measurements. Trees less than 0.5 m in height were measured using three belt transects 2 m wide along transects 2, 4, and 6 (Krebs 1989; Figure 2, Table 1). Tree fuel loads were estimated using allometric equations developed by Sabin (2008) and Tausch (2009).

Shrubs

Shrub cover was estimated from 300 points collected using line-point intercept (Bonham 1989) along five transects (Figure 2, Table 1). Densities of common shrubs were estimated by counting shrubs within three belt transects 2 m wide along transects 2, 4, and 6 (Krebs 1989; Figure 2.1). The process of estimating shrub fuel loads involved destructive sampling and the development of allometric relationships (Stebleton and Bunting 2009). At each study site in 2007, height, longest canopy diameter, and perpendicular canopy diameter were measured for each common species of shrub found outside of subplots. Shrub canopy volume was estimate using the height and canopy diameter measurements. These shrubs were then destructively sampled, oven-dried at 50°C for 48 hours and weighed to determine fuel load. Site- and species-specific regression equations were developed using height, canopy dimensions, and shrub volume as covariates (Pechanec and Pickford 1937; Riser 1984; Stebleton and Bunting 2009). At 10 years post-treatment, shrub volume measurements were collected for shrubs taller than 15 cm within five nested-circular frames with a radius of 1, 2, or 3 m so that at least 10 shrubs of each common species were measured per subplot (Bonham 1989; Young et al. 2015). Then the site-specific allometric equations were used to estimate shrub fuel loads from shrub volume data. R^2 values for these equations are available in Stebleton and Bunting (2009) and Bourne and Bunting (2011). At 10 years post-treatment, standing dead shrubs fuels were sampled as downed woody debris.

Herbaceous Fuels

For each subplot, canopy cover of perennial grass, annual grass, forbs, and interspace litter were derived from 300 points per subplot (5 transects with 60 points per transect) using the line-point intercept method (Bonham 1989; Figure 2, Table 1). Herbaceous fuel loads were estimated from destructive sampling that occurred along the herbaceous fuels transect. All live herbaceous material, standing dead herbaceous material, and interspace litter were collected from a 0.5 by 0.5 m quadrat (Bonham 1989) at 15 sampling locations in woodland sites, and 8 sampling locations in the sagebrush sites. Heights of the tallest grass and forb within the quadrat were recorded prior to clipping. All herbaceous vegetation within 0.01 m of the ground was removed and sorted as live herbaceous, standing dead herbaceous, and interspace litter. Samples were oven-dried at 50°C for 48 hours and weighed. Bulk density was calculated by dividing the total fuel load by the landscape average of all grass and forb heights.

Down woody debris

Down woody debris fuel loads were sampled using a modified planar-intercept method (Brown et al. 1982). Down woody debris of the 10- and 100-hr time lag fuel moisture classes were tallied along 3 transects for a

total of 90 m in each subplot (Figure 2, Table 1). Standing dead shrubs were sampled as down woody debris. Down woody debris of the 1000-hr time lag fuel moisture classes were tallied along 5 transects for a total of 150 m in each subplot. When sampling 1000-hr fuels, a decay class (sound or rotten) and the diameter of down woody fuel where the fuel intersected the transect were recorded for each fuel (Brown 1974).

Equations developed by Brown (1974) were used to estimate fuel load by time lag fuel moisture class from the sampled woody fuel data. Down woody debris of the 1-hr size class was sampled only in the mastication treatment. In the mastication treatment, 1-hr and 10-hr fuels were collected within 0.25 m by 0.25 m quadrats placed every other meter along two 30 m transects (30 quadrats per subplot), but 100- and 1000-hr fuels were sampled in the same manner as described in the previous paragraph. The method for sampling 1-hr and 10-hr fuels in the mastication treatment is not the same as the method used in the two years post-treatment fuels guide (Bourne and Bunting 2011), so be cautious when comparing these masticated fuels between the two fuels guides.

Litter, Duff, and Bare Ground

Within each subplot, duff and tree litter were collected from six, 0.25 by 0.25 m quadrats placed at one-third the distance from the bole of the tree (standing live, cut, masticated, or standing dead) to the edge of the tree canopy. The six sampled trees were the two trees closest to the center of the subplot and four trees closest to the corners of the subplot that were greater than 2 m in crown diameter and rooted within the subplot. Sub-samples of the litter and duff were oven-dried at 50°C for 48 hours and weighed. Depth of tree litter and duff was not measured at 10 years post-treatment, so it was not possible to estimate tree litter and duff bulk density in this fuels guide. Cover and fuel load of interspace litter was estimated using methods described in the Herbaceous Fuels subsection. Bare ground cover for each subplot was derived from 300 points per subplot (5 transects with 60 points per transect) using the line-point intercept method (Bonham 1989; Figure 2, Table 1). Bare ground cover (%) is the only measure of fuel continuity.

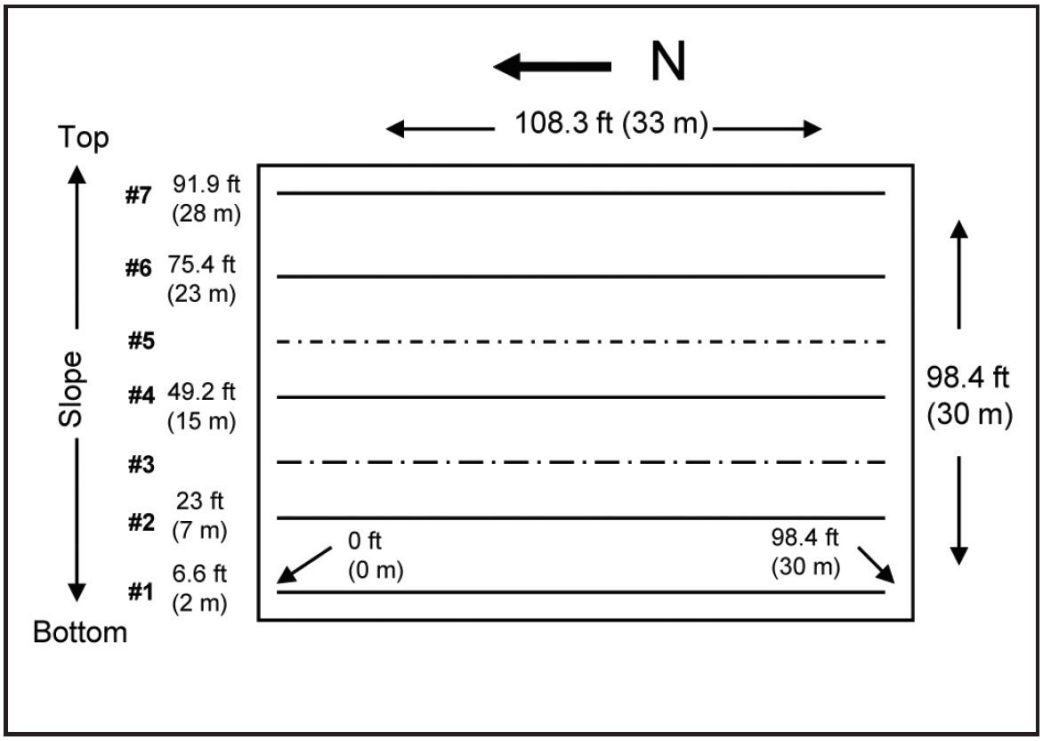


Figure 2. Sampling plot layout.

Table 1. Summary of data collection methods.

Stratum	Variable	Method	Transect #
Trees	Cover	Canopy Area/Plot Area (Young et al. 2015)	NA
	Density	Belt Transect (Krebs 1989)	2, 4, 6
		Census Data	NA
	Height	Census Data	NA
	Fuel Load & Bulk Density	Allometric Equations (Sabin 2008; Tausch 2008)	NA
			NA
Shrubs	Cover	Line Point Intercept (Bonham 1989)	1, 2, 4, 6, 7
	Height	Nested circular frame (Bonham 1989)	4
	Density	Belt Transect (Krebs 1989)	2, 4, 6
		Nested circular frame (Bonham 1989)	4
	Fuel Load & Bulk Density	Harvest (Pechanec & Pickford 1937; Riser 1984)	NA
		50 x 50 cm quadrat (Bonham 1989)	4
Herbaceous	Cover	Line-Point Intercept (Bonham 1989)	1, 2, 4, 6, 7
	Height	50 x 50 cm quadrat (Bonham 1989)	3 in 2016 & 2018; 5 in 2017
	Fuel Load & Bulk Density	Harvest (Pechanec & Pickford 1937; Riser 1984)	3 in 2016 & 2018; 5 in 2017
		50 x 50 cm quadrat (Bonham 1989)	3 in 2016 & 2018; 5 in 2017
Masticated Down Woody Debris	1-hr Fuel Load	25 x 25 cm quadrat (Young et al. 2015)	2, 6
	10-hr Fuel Load	25 x 25 cm quadrat (Young et al. 2015)	2, 6
	100-hr Fuel Load	Planar Intercept (Brown et al. 1982)	2, 4, 6
	1000-hr Fuel Load	Planar Intercept (Brown et al. 1982)	1, 2, 4, 6, 7
Down Woody Debris	10-hr Fuel Load	Planar Intercept (Brown et al. 1982)	2, 4, 6
	100-hr Fuel Load	Planar Intercept (Brown et al. 1982)	2, 4, 6
	1000-hr Fuel Load	Planar Intercept (Brown et al. 1982)	1, 2, 4, 6, 7
Litter & Duff	Cover	Line Point Intercept (Bonham 1989)	1, 2, 4, 6, 7
	Interspace Litter Fuel Load	Harvest (Pechanec & Pickford 1937; Riser 1984)	3 in 2016 & 2018; 5 in 2017
		50 x 50 cm quadrat (Bonham 1989)	3 in 2016 & 2018; 5 in 2017
	Tree Litter & Duff Fuel Load	Harvest (Pechanec & Pickford 1937; Riser 1984)	NA
		50 x 50 cm quadrat (Bonham 1989)	NA

Recommendations for Use

For the user to most effectively use this guide, we recommend accounting for the assumptions and limitations listed below:

- Sampling on all sites took place from April to August (see Guide Notes in the sub-guides for more specifics). No distinction for seasonality was made in the reported data. When comparing field sites to photographs and reported values, be sure to account for the difference in seasonality. This is especially critical regarding the fuel loads of live and dead herbaceous fuels.
- 10th percentile and 90th percentile values are included to capture the range of variability within groups or phases. Ten percent of the data is less than 10th percentile statistic, and 90% of the data are less than the 90th percentile statistics. These statistics were chosen rather than minimum and maximum because the minimum was often 0 and the maximum was often extreme.
- It is difficult to distinguish woody fuels, litter, and duff fuels in the photographs. Independent sampling or observations may be required to gain the most accurate values for these strata.
- Down woody debris of the 1-hr fuel class were not sampled except for the mastication treatment—see methods. If this information is required for other treatments, the user should make this measurement.
- The organization and layout of this guide is based on pre-treatment conditions, with a similar layout to the other two SageSTEP Fuel Guides (Stebleton and Bunting 2009; Bourne and Bunting 2011) so that users can use all three fuel guides together.

Literature Cited

Balch, J.K., Bradley, B.A., Dantonio, C.M., Gómez-Dans, J., 2013. Introduced annual grass increases regional fire activity across the arid western USA (1980-2009). Global Change Biology 19, 173–183. doi:10.1111/gcb.12046

Baruch-Mordo, S., Evans, J.S., Severson, J.P., Naugle, D.E., Maestas, J.D., Kiesecker, J.M., Falkowski, M.J., Hagen, C.A., Reese, K.P., 2013. Saving sage-grouse from the trees: A proactive solution to reducing a key threat to a candidate species. Biological Conservation 167, 233–241. doi:10.1016/j.biocon.2013.08.017

Bates, J.D., Svejcar, T., Miller, R., Davies, K.W., 2017. Plant Community Dynamics 25 Years After Juniper Control. Rangeland Ecology & Management 70, 356–362. doi:10.1016/j.rama.2016.11.003

Bonham, C.D. 1989. Measurement for Terrestrial Vegetation. New York, NY: John Wiley and Sons, Inc.

Bourne, A., Bunting, S. 2011. Guide for Quantifying Post-treatment Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin. Bureau of Land Management, Denver, CO. Technical Note 437. BLM/ID?PT-11/003+2824

Boyd, C.S., Davies, K.W., Hulet, A., 2015. Predicting fire-based perennial bunchgrass mortality in big sagebrush plant communities. International Journal of Wildland Fire 24, 527. doi:10.1071/wf14132

Bradley, B.A. 2010. Assessing ecosystem threats from global and regional change: hierarchical modeling of risk to sagebrush ecosystems from climate change, land use and invasive species in Nevada, USA. Ecography 33, 198-208. doi: 10.1111/j.1600-0587.2009.05684.x

Bradley, B.A., Curtis, C.A., Fusco, E.J., Abatzoglou, J.T., Balch, J.K., Dadashi, S., Tuanmu, M.N., 2018. Cheatgrass (Bromus tectorum) distribution in the intermountain Western United States and its relationship to fire frequency, seasonality, and ignitions. Biological Invasions 20, 1493–1506. doi:10.1007/s10530-017-1641-8

Brown, J.K. 1974. Handbook for inventorying downed woody material. INT-GTR-16. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 26p.

Brown, J.K., R.D. Oberheu, and C.M. Johnston. 1982. Handbook for inventorying surface fuels and biomass in the Interior West. National Wildfire Coordinating Group NFES-2125. 48p.6

Burkhardt, J.W., Tisdale, E.W., 1976. Causes of Juniper Invasion in Southwestern Idaho. Ecology 57, 472–484. doi:10.2307/1936432

Chambers, J.C., Miller, R.F., Board, D.I., Pyke, D.A., Roundy, B.A., Grace, J.B., Schupp, E.W., and Tausch, R.J., 2014. Resilience and Resistance of Sagebrush Ecosystems: Implications for State and Transition Models and Management Treatments. Rangeland Ecology & Management 67, 440–454. doi:10.2111/rem-d-13-00074.1

Cottam, W.P., Stewart, M. 1940. Plant Succession as a Result of Grazing and Meadow Dessication by Erosion Since Settlement in 1862. Journal of Forest 38 (8). 613-626. doi: 10.1093/jof/38.8.613

Caudle, D., J. DiBenedetto, M. Karl, H. Sanchez, and Talbot, C. 2013. Interagency ecological site handbook for rangelands. Available at: http://jornada.nmsu.edu/sites/jornada.nmsu.edu/files/InteragencyEcolSiteHandbook.pdf

Davies, K.W., Bates, J.D., Nafus, A.M., 2012. Mowing Wyoming Big Sagebrush Communities With Degraded Herbaceous Understories: Has a Threshold Been Crossed? Rangeland Ecology & Management 65, 498–505. doi:10.2111/rem-d-12-00026.1

Gruell, G.E. 1999. Historical and modern roles of fire in pinyon-juniper. In: Monsen, S.B.; Stevens, R. comps. Proceedings, ecology and management of pinyon-juniper communities within the interior West; 1997 September 15-18; Provo, UT. Proc. RMRS-P-9: Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 24-28.

Hulet A, C.S. Boyd, K.W. Davies, T.J. Svejcar. 2015 Prefire (Preemptive) Management to Decrease Fire-Induced Bunchgrass Mortality and Reduce Reliance on Postfire Seeding. Rangeland Ecology and Management 68, 437–444.

Krebs, C.J. 1989. Ecological Methodology. New York, NY: Harper and Row.

McIver, J., Brunson, M., 2014. Multidisciplinary, Multisite Evaluation of Alternative Sagebrush Steppe Restoration Treatments: The SageSTEP Project. Rangeland Ecology & Management 67, 434–438. doi:10.2111/rem-d-14-00085.1

Miller, R.F., Bates, J.D., Svejcar, T.J., Pierson, F.B., Eddleman, L.E. 2005. Biology, ecology, and management of western juniper. Oregon State University Agricultural Experiment Station. Technical Bulletin 152. 77 p.

Miller, R. F., Chambers, J. C., Pyke, D. A., Pierson, F. B., & Williams, C. J. 2013. A review of fire effects on vegetation and soils in the Great Basin Region: response and ecological site characteristics. Fort Collins, CO, USA: United States Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miller, R.F., Rose, J.A., 1999. Fire History and Western Juniper Encroachment in Sagebrush Steppe. Journal of Range Management 52, 550. doi:10.2307/4003623

Miller, R.F., Tausch, R.J. 2001. The role of fire in pinyon and juniper woodlands: a descriptive analysis. In: Galley, K.E.M.; Wilson, T.P. eds. Invasive Species: the Role of Fire in the Control and Spread of Invasive Species symposium. Miscellaneous Publication No. 11, Tall Timbers Research Station, Tallahassee, FL. 15-30.

Miller, R.F., Tausch, R.J., McArthur, E.D., Johnson, D.D., Sanderson, S.C. 2008. Age Structure and Expansion of piñon-juniper woodlands: a regional perspective in the Intermountain West. U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Pechanec, J.F., Pickford, G.D. 1937. A weight-estimation method for the determination of range or pasture production. Journal of American Society of Agronomists 29: 894-904.

Pierson, F.B., Williams, C.J., Kormos, P.R., Al-Hamdan, O.Z., Hardegree, S.P., Clark, P.E., 2015. Short-Term Impacts of Tree Removal on Runoff and Erosion From Pinyon- and Juniper-Dominated Sagebrush Hillslopes. Rangeland Ecology & Management 68, 408–422. doi:10.1016/j.rama.2015.07.004

Riser, P.G. 1984. Method of inventory and monitoring of vegetation, litter, and soil surface condition. Developing strategies for rangeland monitoring. National Research Council – National Academy of Sciences.

Roundy, B. A., Young, K., Cline, N., Hulet, A., Miller, R. F., Tausch, R. J., Chambers, J.C., and B. Rau. 2014. Pinon–juniper reduction increases soil water availability of the resource growth pool. *Rangeland Ecology and Management* 67:495-505.

Sabin, B.S., 2008. Relationship between allometric variables and biomass in Western Juniper (Juniperus occidentalis). MS Thesis, Oregon State University, Corvallis, OR.

Shinneman, D.J., Welty, J.L., Arkle, R.S., Pilliod, D.S., Glenn, N.F., McIlroy, S.K., and Halford, A.S., 2018. Fuels guide and database for intact and invaded big sagebrush (*Artemisia tridentata*) ecological sites—User manual: U.S. Geological Survey Data Series 1048, 9 p., https://doi.org/10.3133/ds1048.

Stebleton, A., and S. Bunting., 2009. Guide for quantifying fuels in the sagebrush steppe and juniper woodlands of the Great Basin. Technical Note 430. Bureau of Land Management, Denver, CO BLM/ID/PT-09/002+2824. 81p.

Tausch, R.J. 2009. A structurally based analytic model for estimation of biomass and fuel loads of woodland trees. Natural Resource Modeling 22: 463–488.

USDA - NRCS. 2019. The PLANTS Database. National Plant Data Team, Greensboro, NC 27401-4901 USA. http://plants.usda.gov

Young, K.R., Roundy, B.A., Bunting, S.C., Eggett, D.L., 2015. Utah juniper and two-needle piñon reduction alters fuel loads. International Journal of Wildland Fire 24, 236. doi:10.1071/wf13163

Waichler, W.S., Miller, R.F., Doescher, P.S., 2001. Community Characteristics of Old-Growth Western Juniper Woodlands. Journal of Range Management 54, 518–527. doi:10.2458/azu_jrm_v54i5_waichler

Weiner, N.I., Strand, E.K., Bunting, S.C., Smith, A.M.S., 2016. Duff Distribution Influences Fire Severity and Post-Fire Vegetation Recovery in Sagebrush Steppe. Ecosystems 19, 1196–1209. doi:10.1007/s10021-016-9994-x

Williams, R.E., Roundy, B.A., Hulet, A., Miller, R.F., Tausch, R.J., Chambers, J.C., Matthews, J., Schooley, R., Eggett, D., 2017. Pretreatment Tree Dominance and Conifer Removal Treatments Affect Plant Succession in Sagebrush Communities. Rangeland Ecology & Management 70, 759–773. doi:10.1016/j.rama.2017.05.00

Wozniak, S.S., Strand, E.K., Johnson, T.R., Hulet, A., Roundy, B., Young, K. *In prep*. Treatment Longevity and Changes in Surface Fuel Loads after Pinyon-Juniper Mastication.

Sagebrush Steppe Fuels Guide User Notes

Site Notes

- All sites are characterized by the Loamy 10-12” ecological type (Caudle et al. 2013).
- General site information:
  - During the course of the study (2006-2018), the average annual precipitation across the sites was 10.0 in. (25.3 cm), and ranged 4.9-16.5 in (12.5-42.0 cm; PRISM Climate Group)
  - Slopes range 0-10%, and sites occur on all aspects;
  - Loamy soil surface texture, with soil depths >20 in. (50.8 cm) and minimal stoniness.
- Rock Creek and Gray Butte are the only sites that are not within active grazing allotments. All other sites may have been grazed prior to construction of exclosures at the beginning of the SageSTEP (Figure 3).
- The four treatments (control, prescribed fire, mow, and tebuthiuron herbicide) were implemented at each site.
- Site names, number of subplots, and elevation ranges for data used are available in Table 2. Site locations are shown in Figure 3.

Guide Notes

- The guide is organized by four treatments (control, prescribed fire, mowing, and tebuthiuron herbicide) and four groups organized by pre-treatment total shrub and total grass cover, with perennial and annual grasses combined (Stebleton and Bunting 2009):
  - Group 1: Shrub cover = 0-25%, Grass cover = 0-25%;
  - Group 2: Shrub cover = 0-25%, Grass cover > 25%;
  - Group 3: Shrub cover > 25%, Grass cover = 0-25%;
  - Group 4: Shrub cover > 25%, Grass cover > 25%.
- The caption to the left of each photo denotes the canopy cover (%) by functional group for subplot depicted in the photo.
- Sampling took place between late April and June in 2016, 2017, and 2018.
- Dominant graminoids include: ACHY, ACTH7, BRTE, ELEL5, HECO26, LECI4, PASM, POBU, POCU3, POSE, PSSA2, PSSP6 (see Table 3 for common and scientific names)
- Annual grasses include: BRAR5, BRTE, VUOC (see Table 3 for common and scientific names)
- Each statistic includes a mean, 10th percentile, and 90th percentile. The 10th percentile column indicates that 10% of the data was less than the 10th percentile statistic, and the 90th percentile indicates that 90% of the data were less than the 90th percentile statistic. The 10th and 90th percentiles were used instead of minimum and maximum because there were extreme values in the dataset.
- The designation of “NA” indicates data were not collected or available.
- A table of species codes can be found in Table 3.

Table 2. Summary of subplot information for the Sagebrush Steppe Subguide.

Group	Treatment	# of Sampling Plots	Elevation Range (ft)	Elevation Range (m)	Sites
1	Control	8	4925-4961	1501-1512	Gray Butte, Rock Creek
	Prescribed Fire	9	4902-4954	1494-1510	Gray Butte, Rock Creek
	Mow	7	4915-4951	1498-1509	Gray Butte, Rock Creek
	Tebuthiuron	7	4905-5531	1495-1686	Gray Butte, Onaqui, Owyhee, Rock Creek
2	Control	21	906-5341	276-1628	Gray Butte, Moses Coulee, Owyhee, Rock Creek, Saddle Mtn.
	Prescribed Fire	7	846-5499	258-1676	Onaqui, Rock Creek, Saddle Mtn.
	Mow	31	899-5505	274-1678	Gray Butte, Moses Coulee, Onaqui, Owyhee, Rock Creek, Saddle Mtn.
	Tebuthiuron	28	879-5531	268-1686	Gray Butte, Moses Coulee, Onaqui, Owyhee, Rock Creek, Saddle Mtn.
3	Control	8	4925-5341	1501-1628	Gray Butte, Owyhee
	Prescribed Fire	15	4902-5377	1494-1639	Gray Butte, Owyhee
	Mow	6	5371-5505	1637-1678	Onaqui, Owyhee
	Tebuthiuron	9	4905-5318	1495-1621	Gray Butte, Owyhee
4	Control	23	906-5482	276-1671	Moses Coulee, Onaqui, Saddle Mtn.
	Prescribed Fire	20	846-5499	258-1676	Gray Butte, Onaqui, Owyhee, Saddle Mtn.
	Mow	16	899-5505	274-1678	Gray Butte, Onaqui, Owyhee, Saddle Mtn.
	Tebuthiuron	16	879-5531	268-1686	Onaqui, Owyhee, Saddle Mtn.

Figure 3. Location of study sites in Sagebrush Steppe Subguide.

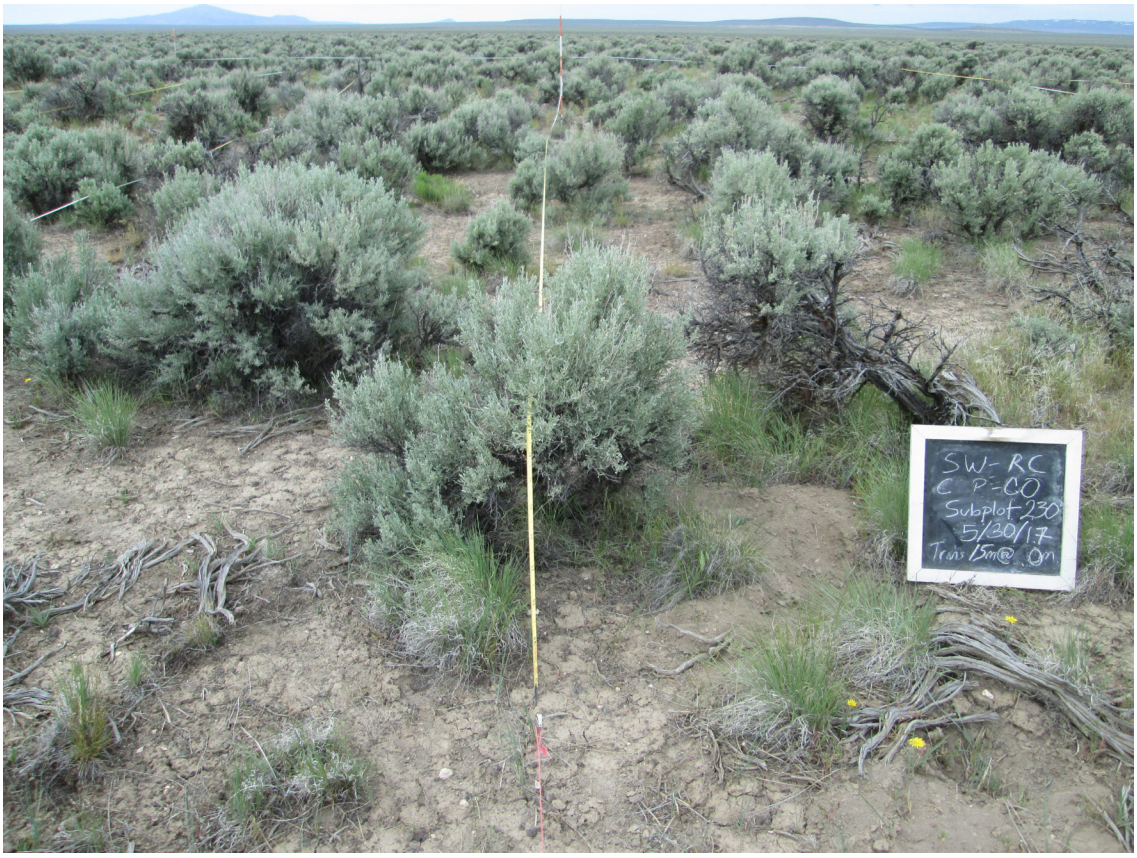
Table 3. USDA Plant codes used in the Sagebrush Steppe Subguide.

	USDA Code	Scientific Name	Common Name
Shrubs	ARTRW8	*Artemisia tridentata* ssp. *wyomingensis*	Wyoming big sagebrush
	CHVI8	*Chrysothamnus viscidiflorus*	yellow rabbitbrush
Grasses	ACHY	*Achnatherum hymenoides*	Indian ricegrass
	ACTH7	*Achnatherum thurberianum*	Thurber's needlegrass
	BRAR5	*Bromus arvensis*	field brome
	BRTE	*Bromus tectorum*	cheatgrass
	ELEL5	*Elymus elymoides*	bottlebrush squirreltail
	HECO26	*Hesperostipa comata*	needle-and-thread
	LECI4	*Leymus cinereus*	basin wildrye
	PASM	*Pascopyron smithii*	western wheatgrass
	POBU	*Poa bulbosa*	bulbous bluegrass
	POCU3	*Poa cusickii*	Cusick's bluegrass
	POSE	*Poa secunda*	Sandberg bluegrass
	PSSP6	*Pseudoroegneria spicata*	bluebunch wheatgrass
	VUOC	*Vulpia octoflora*	sixweeks fescue

Sagebrush Steppe: Control, Group 1

Gray Butte 1501 m | 4925 ft 6/13/2018	
Cover (%)	
Shrubs	20
Perennial Grass	8
Annual Grass	19
Bare Ground	36

Rock Creek 1512 m | 4961 ft 5/30/2017	
Cover (%)	
Shrubs	20
Perennial Grass	21
Annual Grass	9
Bare Ground	34

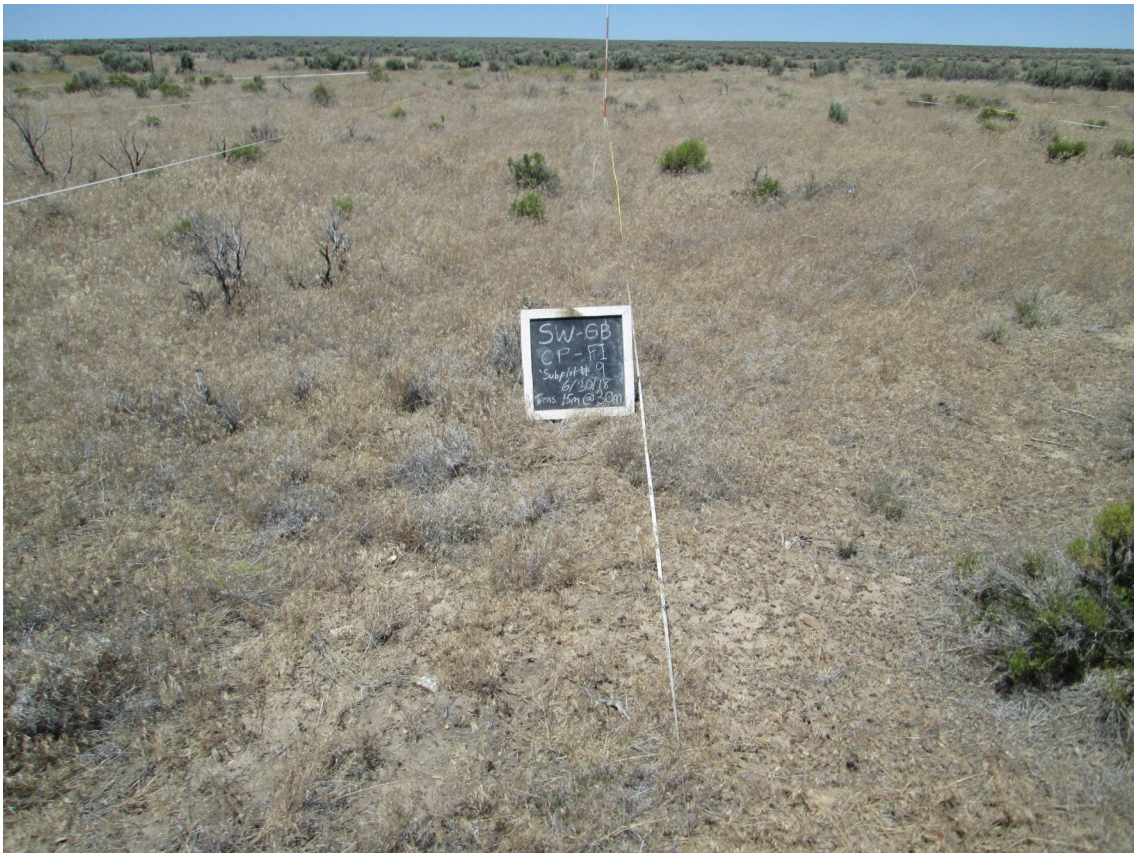


Sagebrush Steppe: Control, Group 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	13	18	21
		CHVI8	0	<1	2
	Herbaceous	Perennial Grass	7	15	25
		Annual Grass	1	10	20
		Forb	1	5	11
	Litter & Duff	Interspace Litter	9	13	15
	Bare Ground	Bare Ground	35	41	50
Density (#/acre)	Shrub	ARTRW8	1789	2802	3824
		CHVI8	0	284	720
Height (in)	Shrub	ARTRW8	15	21	26
	Herbaceous	Grass	5	7	9
		Forb	2	3	4
Fuel Loading (tons/acre)	Shrub	ARTRW8	0.63	2.21	4.47
	Herbaceous	Live	0.06	0.08	0.11
		Dead	0.02	0.04	0.05
	Down Woody Debris	10-hr	0.28	0.42	0.59
		100-hr	0.37	0.61	1.00
		1000-hr sound	0	0.16	0.59
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.07	0.21	0.45
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0175	0.0303	0.0498
	Herbaceous	Live + Dead	0.0066	0.0102	0.0157

Sagebrush Steppe: Prescribed Fire, Group 1

Gray Butte 1494 m | 4902 ft 6/30/2018	
Cover (%)	
Shrubs	5
Perennial Grass	2
Annual Grass	64
Bare Ground	12



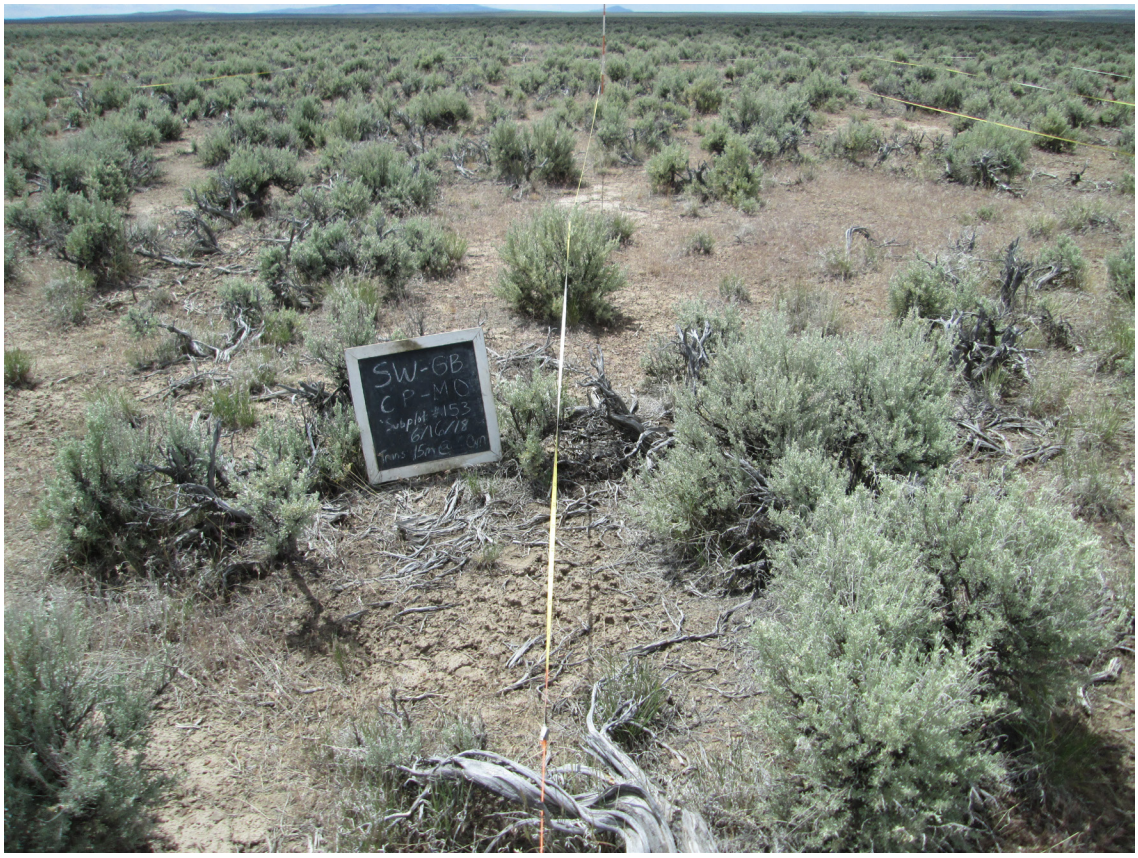
Rock Creek 1510 m | 4954 ft 6/2/2017	
Cover (%)	
Shrubs	<1
Perennial Grass	41
Annual Grass	28
Bare Ground	14

Sagebrush Steppe: Prescribed Fire, Group 1

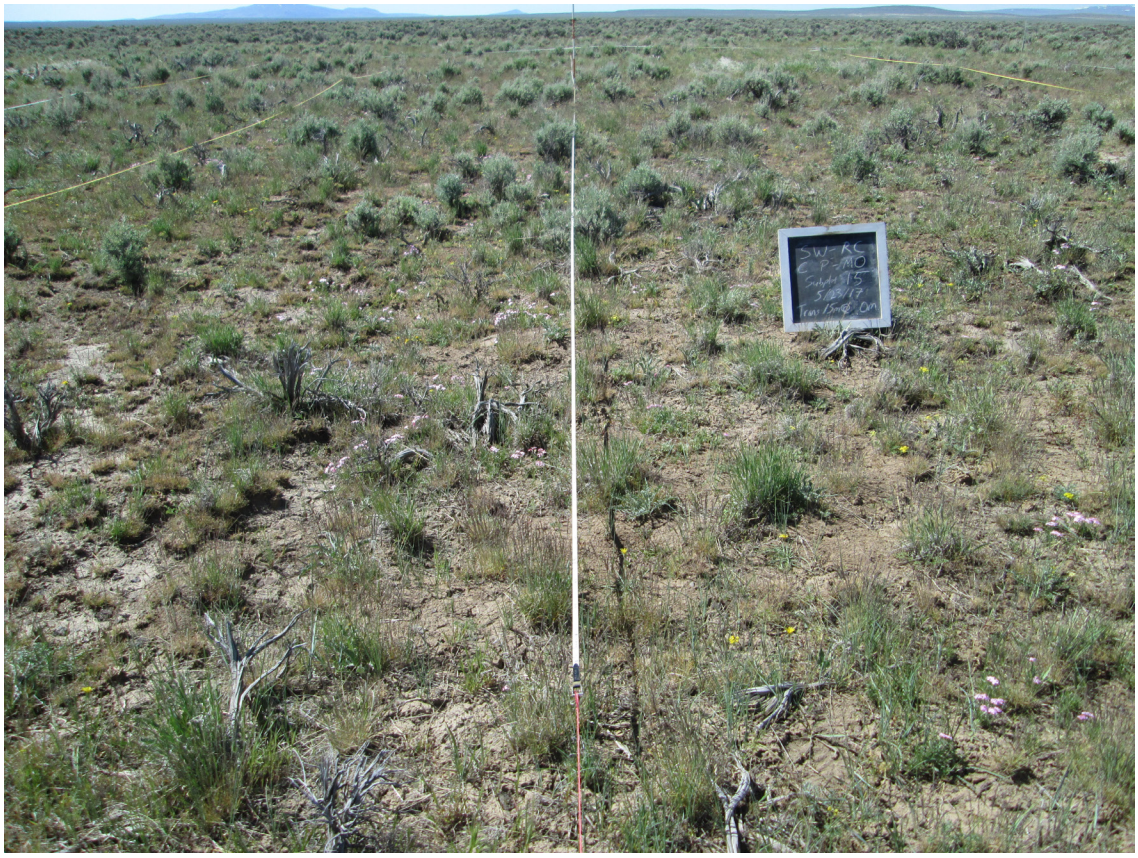
Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	0	2	4
		CHVI8	0	2	4
	Herbaceous	Perennial Grass	2	16	33
		Annual Grass	29	47	61
		Forb	3	8	16
	Litter & Duff	Interspace Litter	9	13	16
	Bare Ground	Bare Ground	12	17	23
Density (#/acre)	Shrub	ARTRW8	0	264	802
		CHVI8	0	315	611
Height (in)	Shrub	ARTRW8	17	23	30
	Herbaceous	Grass	9	10	11
		Forb	3	7	11
Fuel Loading (tons/acre)	Shrub	ARTRW8	0	0.07	0.15
	Herbaceous	Live	0.17	0.23	0.29
		Dead	0.05	0.10	0.22
	Down Woody Debris	10-hr	0.06	0.19	0.33
		100-hr	0.10	0.22	0.41
		1000-hr sound	0		
		1000-hr rotten			
	Litter & Duff	Interspace Litter	0.08	0.13	0.19
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0	0.0016	0.0039
	Herbaceous	Live + Dead	0.0134	0.0187	0.0269

Sagebrush Steppe: Mow, Group 1

Gray Butte 1498 m | 4915 ft 6/16/2018	
Cover (%)	
Shrubs	15
Perennial Grass	13
Annual Grass	16
Bare Ground	39



Rock Creek 1509 m | 4951 ft 5/23/2017	
Cover (%)	
Shrubs	7
Perennial Grass	40
Annual Grass	3
Bare Ground	26

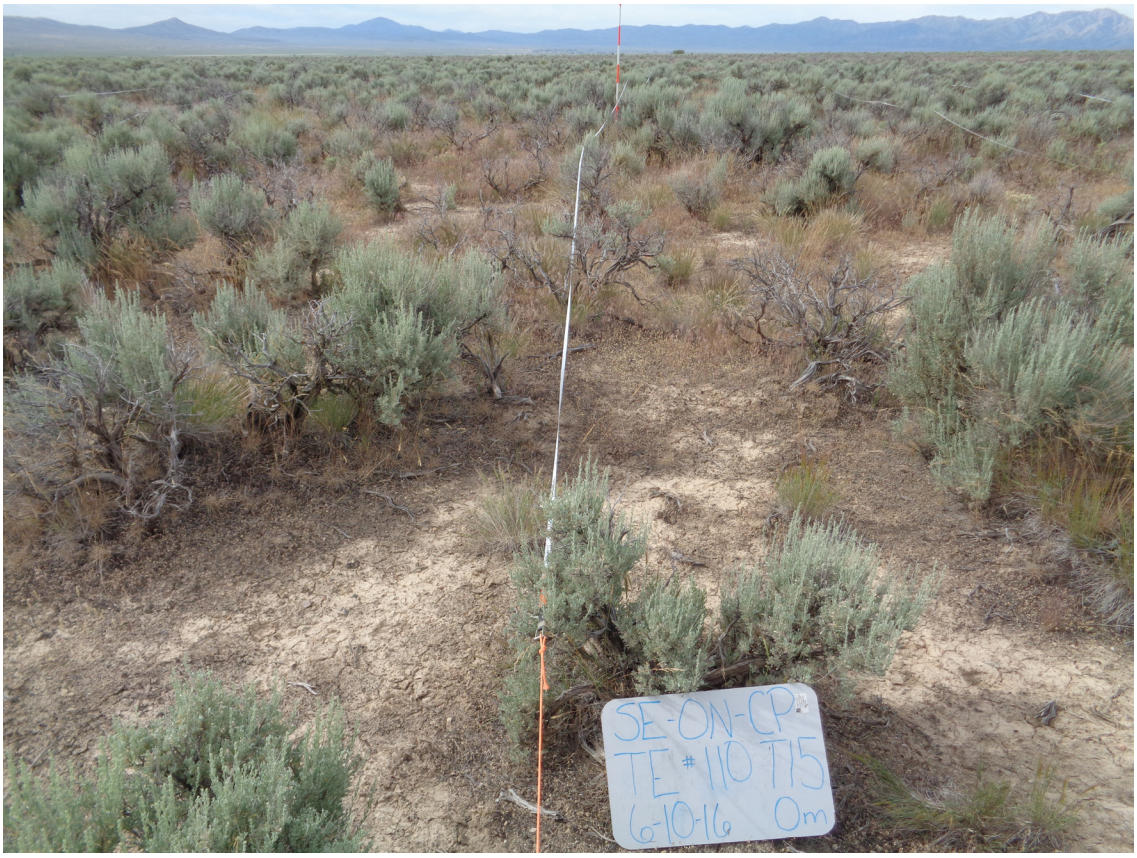


Sagebrush Steppe: Mow, Group 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	9	13	17
		CHVI8	0	<1	<1
	Herbaceous	Perennial Grass	8	18	34
		Annual Grass	3	17	31
		Forb	1	5	12
	Litter & Duff	Interspace Litter	12	15	18
	Bare Ground	Bare Ground	26	34	45
Density (#/acre)	Shrub	ARTRW8	1903	2352	2825
		CHVI8	0	39	113
Height (in)	Shrub	ARTRW8	13	18	23
	Herbaceous	Grass	7	7	9
		Forb	3	3	4
Fuel Loading (tons/acre)	Shrub	ARTRW8	0.35	1.04	2.20
	Herbaceous	Live	0.08	0.13	0.18
		Dead	0.02	0.04	0.06
	Down Woody Debris	10-hr	0.45	0.66	0.84
		100-hr	0.35	0.73	1.17
		1000-hr sound	0	0.30	0.59
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.13	0.22	0.32
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0118	0.0216	0.0321
	Herbaceous	Live + Dead	0.0087	0.0124	0.0164

Sagebrush Steppe: Tebuthiuron, Group 1

Onaqui	
1686 m | 5531 ft 6/10/2016	
Cover (%)	
Shrubs	25
Perennial Grass	32
Annual Grass	26
Bare Ground	13



Owyhee	
1621 m | 5318 ft 6/22/2018	
Cover (%)	
Shrubs	14
Perennial Grass	39
Annual Grass	52
Bare Ground	5

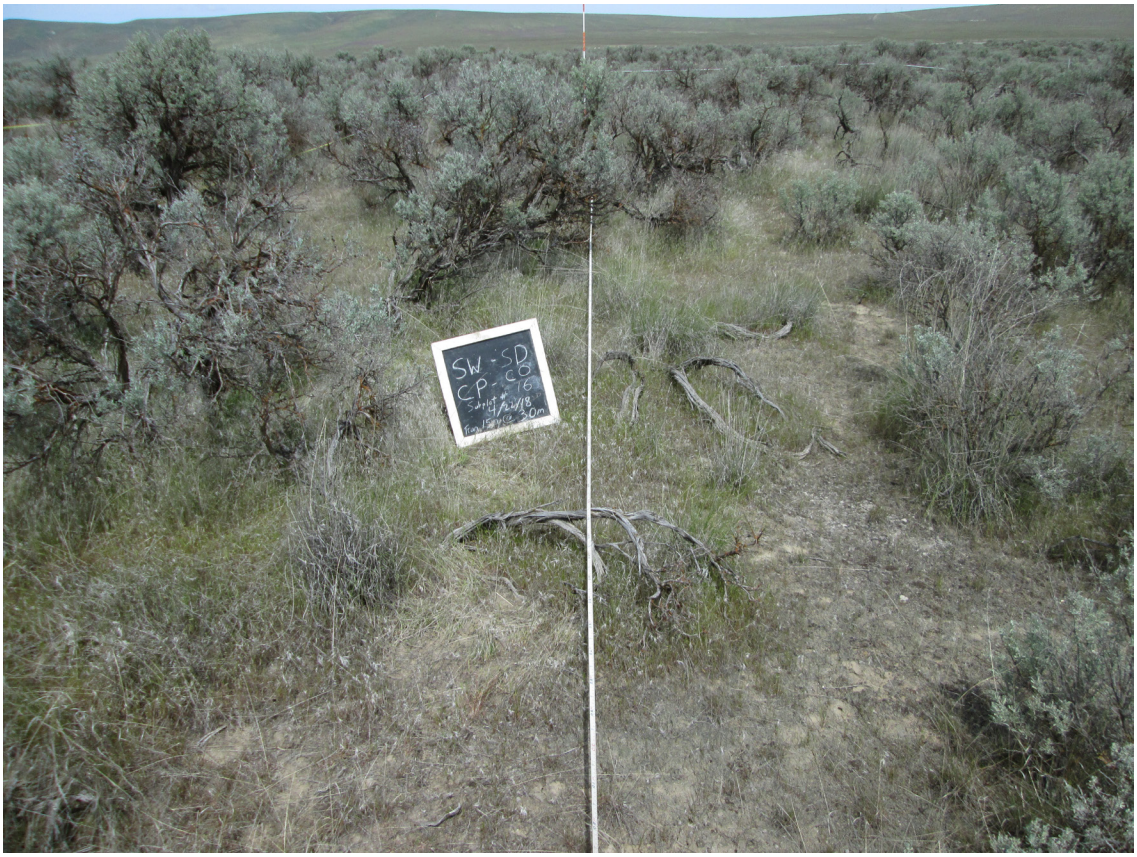
Sagebrush Steppe: Tebuthiuron, Group 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	5	14	23
		CHVI8	0		
	Herbaceous	Perennial Grass	4	19	36
		Annual Grass	18	40	64
		Forb	2	9	15
	Litter & Duff	Interspace Litter	6	9	12
	Bare Ground	Bare Ground	5	19	35
Density (#/acre)	Shrub	ARTRW8	868	1830	2498
		CHVI8	0	6	23
Height (in)	Shrub	ARTRW8	19	22	26
	Herbaceous	Grass	7	10	12
		Forb	3	5	7
Fuel Loading (tons/acre)	Shrub	ARTRW8	0.28	1.38	2.69
	Herbaceous	Live	0.11	0.20	0.28
		Dead	0.02	0.06	0.13
	Down Woody Debris	10-hr	0.42	0.57	0.74
		100-hr	0.44	0.99	1.96
		1000-hr sound	0	0.79	2.13
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.07	0.23	0.46
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0055	0.0192	0.0312
	Herbaceous	Live + Dead	0.0082	0.0145	0.0245

Sagebrush Steppe: Control, Group 2

Moses Coulee 521 m | 1709 ft 5/16/2018 Cover (%)	
Shrubs	14
Perennial Grass	29
Annual Grass	34
Bare Ground	1

Saddle Mountain 276 m | 906 ft 4/22/2018 Cover (%)	
Shrubs	24
Perennial Grass	28
Annual Grass	41
Bare Ground	6

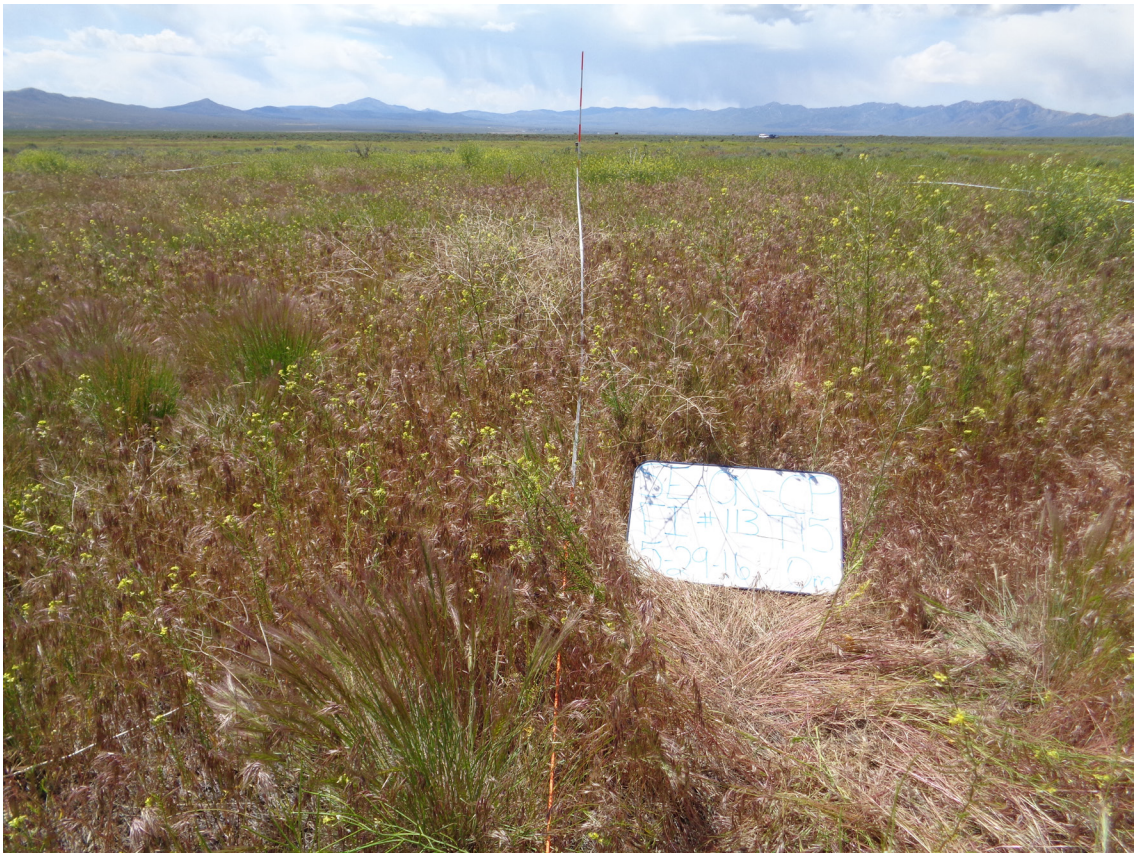


Sagebrush Steppe: Control, Group 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	12	17	26
		CHVI8	0	<1	1
	Herbaceous	Perennial Grass	17	31	42
		Annual Grass	10	26	42
		Forb	2	11	25
	Litter & Duff	Interspace Litter	5	10	15
	Bare Ground	Bare Ground	2	14	34
Density (#/acre)	Shrub	ARTRW8	1204	1873	3111
		CHVI8	0	190	409
Height (in)	Shrub	ARTRW8	19	26	34
	Herbaceous	Grass	7	9	12
		Forb	3	5	8
Fuel Loading (tons/acre)	Shrub	ARTRW8	0.77	2.00	4.31
	Herbaceous	Live	0.09	0.21	0.37
		Dead	0.03	0.16	0.27
	Down Woody Debris	10-hr	0.17	0.36	0.65
		100-hr	0.30	0.65	1.23
		1000-hr sound	0	0.30	0.62
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.09	0.19	0.37
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0091	0.0196	0.0337
	Herbaceous	Live + Dead	0.0118	0.0205	0.0272

Sagebrush Steppe: Prescribed Fire, Group 2

Onaqui 1676 m | 5499 ft 5/29/2016	
Cover (%)	
Shrubs	0
Perennial Grass	23
Annual Grass	60
Bare Ground	6



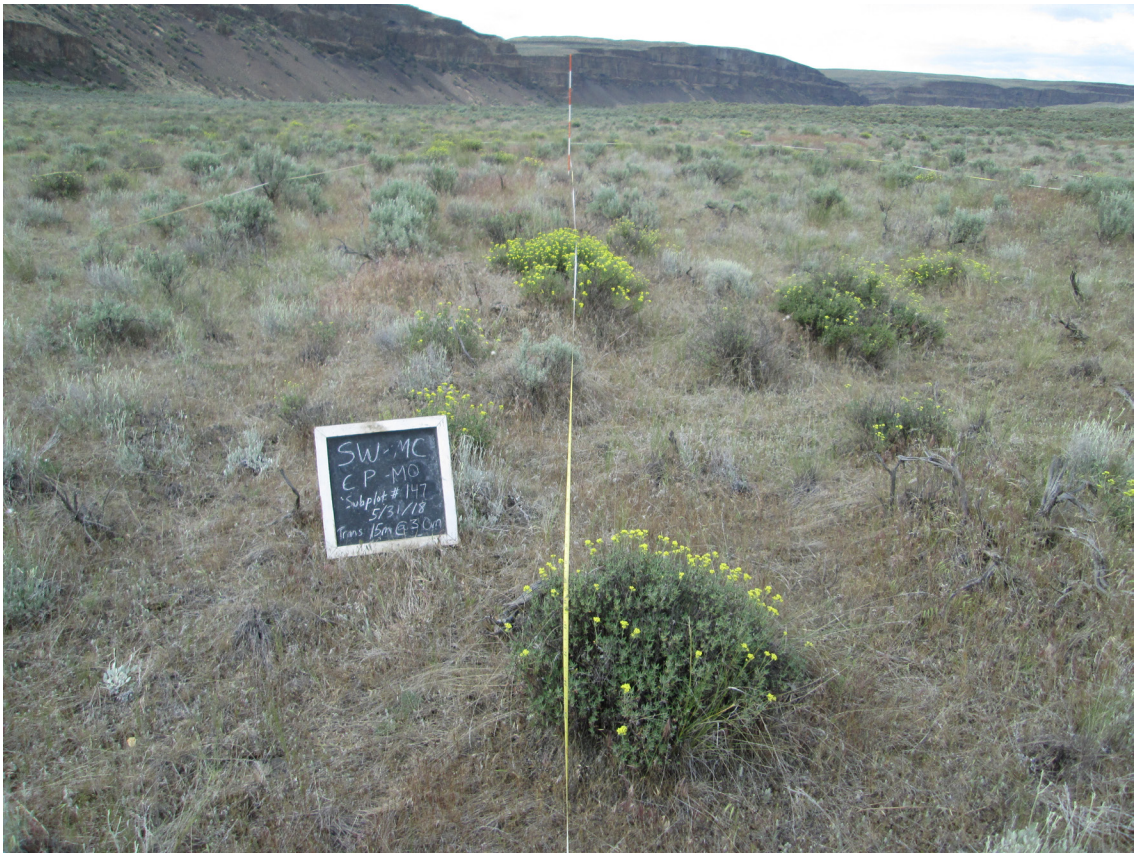
Saddle Mountain 258 m | 846 ft 4/24/2018	
Cover (%)	
Shrubs	<1
Perennial Grass	59
Annual Grass	4
Bare Ground	6

Sagebrush Steppe: Prescribed Fire, Group 2

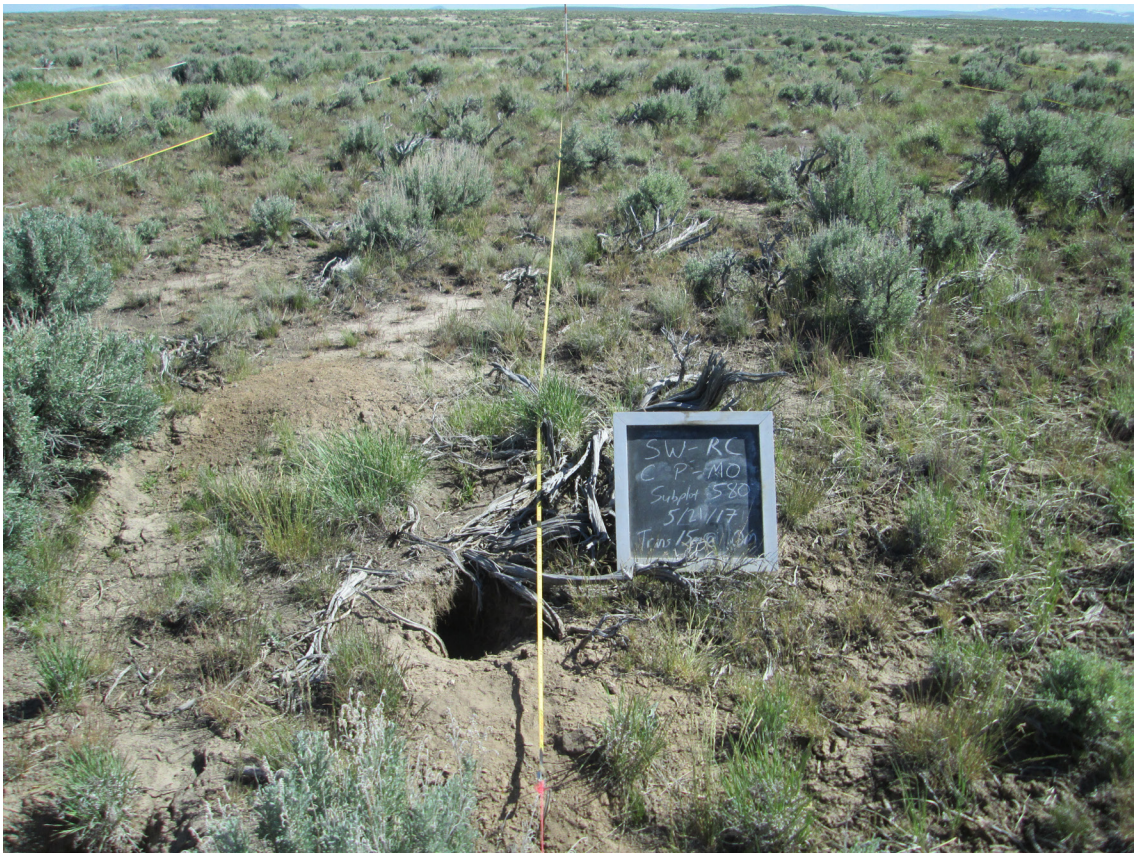
Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	0	2	5
		CHVI8	0	<1	1
	Herbaceous	Perennial Grass	23	33	49
		Annual Grass	15	39	63
		Forb	<1	9	22
	Litter & Duff	Interspace Litter	7	10	14
	Bare Ground	Bare Ground	6	14	21
Density (#/acre)	Shrub	ARTRW8	0	402	1113
		CHVI8	0	45	132
Height (in)	Shrub	ARTRW8	21	24	28
	Herbaceous	Grass	8	11	14
		Forb	2	6	13
Fuel Loading (tons/acre)	Shrub	ARTRW8	0	0.17	0.47
	Herbaceous	Live	0.18	0.35	0.60
		Dead	0.05	0.26	0.64
	Down Woody Debris	10-hr	0.10	0.25	0.43
		100-hr	0.05	0.39	1.06
		1000-hr sound	0	0.07	0.20
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.08	0.15	0.20
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0	0.0028	0.0078
	Herbaceous	Live + Dead	0.0183	0.0283	0.0432

Sagebrush Steppe: Mow, Group 2

Moses Coulee 524 m | 1719 ft 5/31/2018 Cover (%)	
Shrubs	13
Perennial Grass	30
Annual Grass	29
Bare Ground	3



Rock Creek 1509 m | 4951 ft 5/21/2017 Cover (%)	
Shrubs	9
Perennial Grass	40
Annual Grass	10
Bare Ground	24



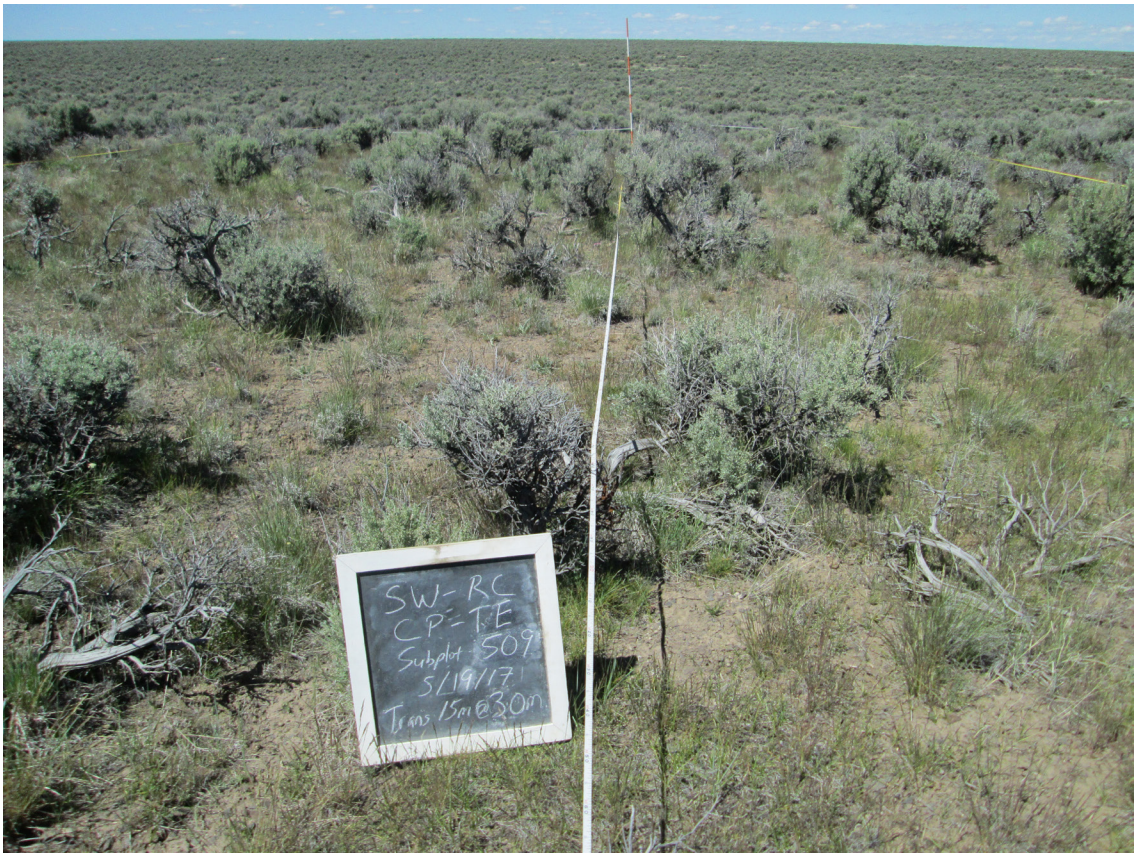
Sagebrush Steppe: Mow, Group 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	4	8	13
		CHVI8	0	<1	1
	Herbaceous	Perennial Grass	16	30	43
		Annual Grass	7	34	55
		Forb	2	9	20
	Litter & Duff	Interspace Litter	4	11	17
	Bare Ground	Bare Ground	3	10	26
Density (#/acre)	Shrub	ARTRW8	636	1503	2725
		CHVI8	0	101	431
Height (in)	Shrub	ARTRW8	16	20	25
	Herbaceous	Grass	7	10	14
		Forb	2	4	8
Fuel Loading (tons/acre)	Shrub	ARTRW8	0.13	0.65	1.48
	Herbaceous	Live	0.14	0.26	0.39
		Dead	0.04	0.17	0.25
	Down Woody Debris	10-hr	0.25	0.56	0.90
		100-hr	0.25	0.93	1.77
		1000-hr sound	0	0.17	0.37
		1000-hr rotten	0	0.01	0
	Litter & Duff	Interspace Litter	0.06	0.30	0.56
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0026	0.0112	0.0181
	Herbaceous	Live + Dead	0.0125	0.0240	0.0375

Sagebrush Steppe: Tebuthiuron, Group 2

Moses Coulee 524 m | 1719 ft 5/18/2018 Cover (%)	
Shrubs	2
Perennial Grass	24
Annual Grass	55
Bare Ground	2

Rock Creek 1516 m | 4974 ft 5/19/2017 Cover (%)	
Shrubs	10
Perennial Grass	46
Annual Grass	9
Bare Ground	22



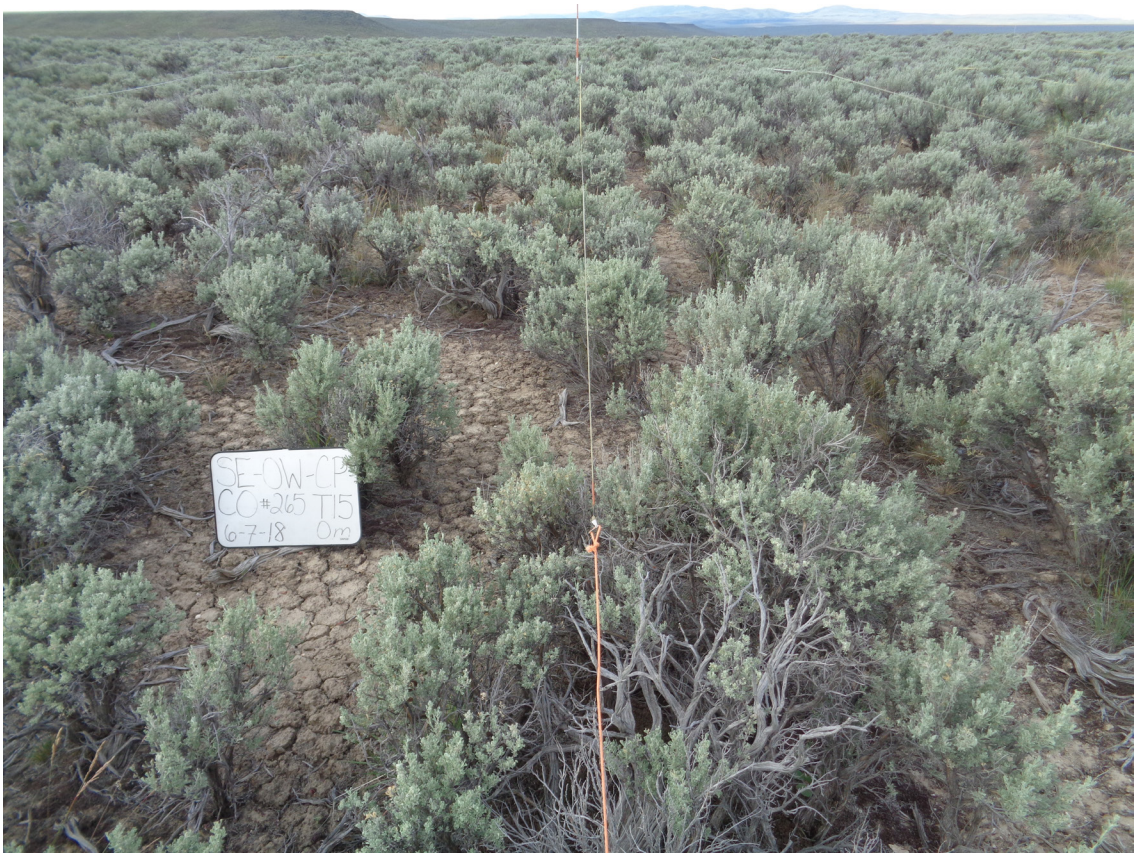
Sagebrush Steppe: Tebuthiuron, Group 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	<1	6	16
		CHVI8	0	<1	<1
	Herbaceous	Perennial Grass	7	21	34
		Annual Grass	8	44	79
		Forb	3	12	22
	Litter & Duff	Interspace Litter	5	9	14
	Bare Ground	Bare Ground	2	11	31
Density (#/acre)	Shrub	ARTRW8	82	755	1926
		CHVI8	0	68	191
Height (in)	Shrub	ARTRW8	17	24	32
	Herbaceous	Grass	7	11	14
		Forb	2	5	9
Fuel Loading (tons/acre)	Shrub	ARTRW8	0	0.62	1.86
	Herbaceous	Live	0.15	0.28	0.42
		Dead	0.03	0.13	0.26
	Down Woody Debris	10-hr	0.32	0.62	1.13
		100-hr	0.29	1.15	2.13
		1000-hr sound	0	0.46	1.02
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.06	0.15	0.23
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	<0.0001	0.0077	0.0195
	Herbaceous	Live + Dead	0.0143	0.0214	0.0290

Sagebrush Steppe: Control, Group 3

Gray Butte 1501 m | 4925 ft 6/14/2018	
Cover (%)	
Shrubs	19
Perennial Grass	8
Annual Grass	15
Bare Ground	43

Owyhee 1628 m | 5341 ft 6/7/2018	
Cover (%)	
Shrubs	50
Perennial Grass	22
Annual Grass	0
Bare Ground	24



Sagebrush Steppe: Control, Group 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	21	42	50
		CHVI8	0		
	Herbaceous	Perennial Grass	8	16	24
		Annual Grass	0	4	15
		Forb	<1	2	3
	Litter & Duff	Interspace Litter	7	11	15
	Bare Ground	Bare Ground	20	27	39
Density (#/acre)	Shrub	ARTRW8	1812	7579	12229
		CHVI8	0	6	14
Height (in)	Shrub	ARTRW8	16	19	21
	Herbaceous	Grass	5	6	7
		Forb	<1	2	3
Fuel Loading (tons/acre)	Shrub	ARTRW8	1.26	3.74	6.68
	Herbaceous	Live	0.03	0.06	0.09
		Dead	<0.01	0.02	0.03
	Down Woody Debris	10-hr	0.51	0.75	1.04
		100-hr	0.79	1.05	1.44
		1000-hr sound	0.10	0.35	0.59
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.09	0.13	0.17
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0207	0.0508	0.0833
	Herbaceous	Live + Dead	0.0031	0.0070	0.0108

Sagebrush Steppe: Prescribed Fire, Group 3

Gray Butte 1494 m | 4902 ft 6/30/2018	
Cover (%)	
Shrubs	1
Perennial Grass	15
Annual Grass	32
Bare Ground	27

Owyhee 1639 m | 5377 ft 6/11/2018	
Cover (%)	
Shrubs	3
Perennial Grass	36
Annual Grass	65
Bare Ground	1

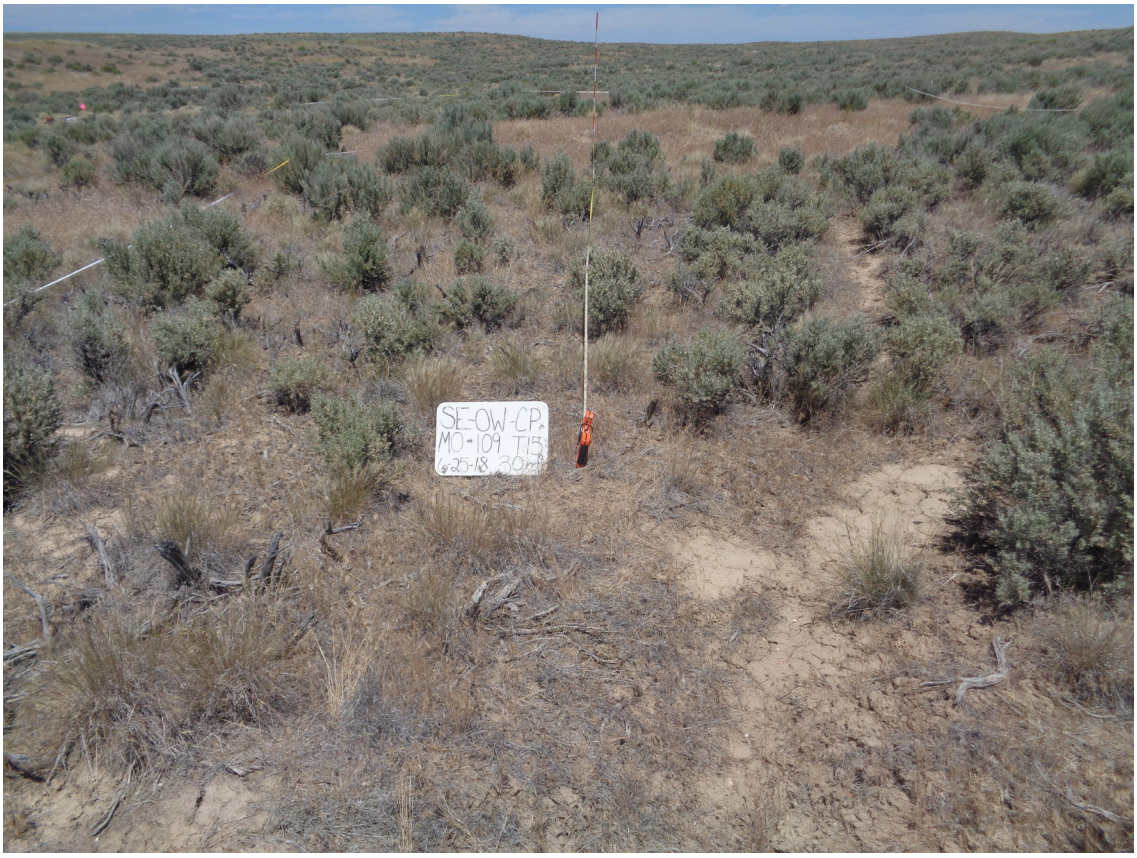
Sagebrush Steppe: Prescribed Fire, Group 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	0	13	37
		CHVI8	0	<1	2
	Herbaceous	Perennial Grass	10	20	33
		Annual Grass	13	48	71
		Forb	<1	5	8
	Litter & Duff	Interspace Litter	4	8	12
	Bare Ground	Bare Ground	1	12	21
Density (#/acre)	Shrub	ARTRW8	0	2209	6563
		CHVI8	0	123	493
Height (in)	Shrub	ARTRW8	13	19	25
	Herbaceous	Grass	7	10	13
		Forb	3	6	10
Fuel Loading (tons/acre)	Shrub	ARTRW8	0	1.59	4.46
	Herbaceous	Live	0.11	0.30	0.63
		Dead	0.03	0.11	0.28
	Down Woody Debris	10-hr	0.04	0.20	0.47
		100-hr	0	0.35	0.82
		1000-hr sound	0	0.27	0.57
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.14	0.34	0.52
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0	0.0190	0.0567
	Herbaceous	Live + Dead	0.0106	0.0210	0.0354

Sagebrush Steppe: Mow, Group 3

Onaqui 1678 m | 5505 ft 6/8/2016	
Cover (%)	
Shrubs	24
Perennial Grass	8
Annual Grass	31
Bare Ground	20

Owyhee 1637 m | 5371 ft 6/25/2018	
Cover (%)	
Shrubs	21
Perennial Grass	15
Annual Grass	59
Bare Ground	2



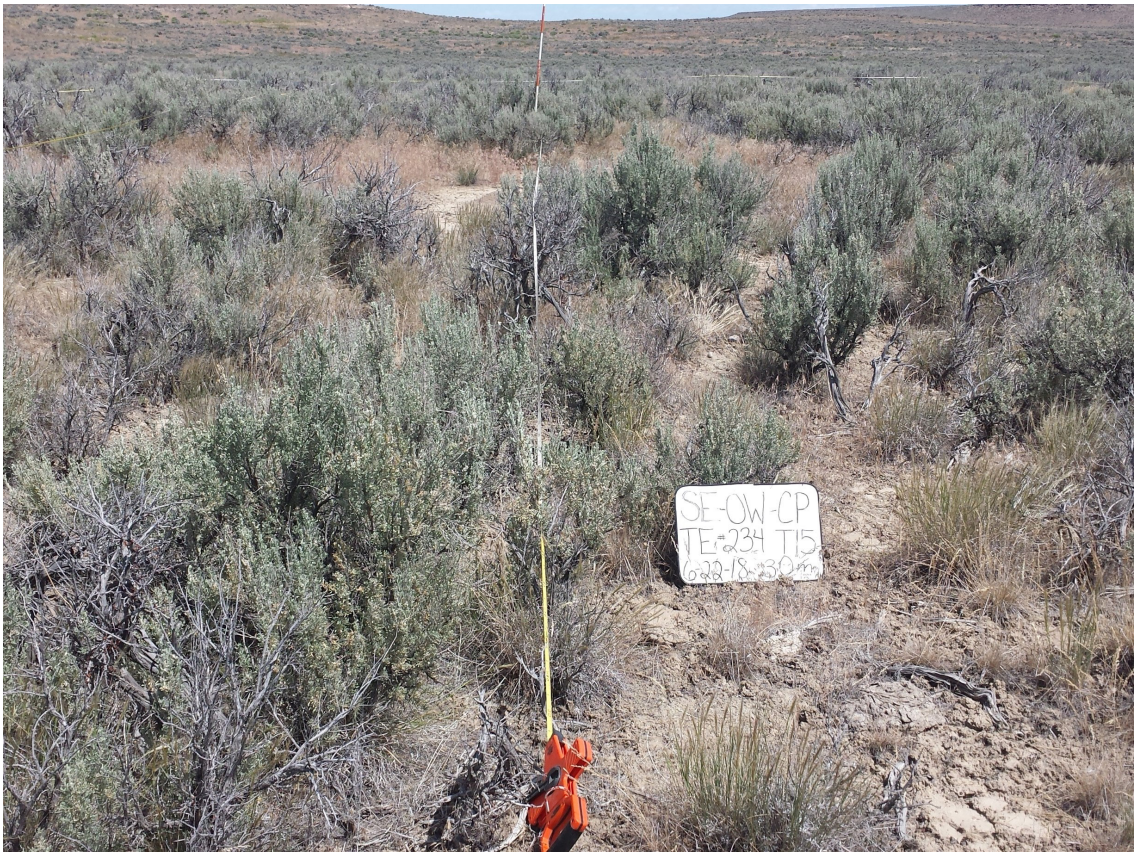
Sagebrush Steppe: Mow, Group 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	17	19	22
		CHVI8	0	4	8
	Herbaceous	Perennial Grass	8	14	23
		Annual Grass	6	30	63
		Forb	1	13	27
	Litter & Duff	Interspace Litter	10	13	17
	Bare Ground	Bare Ground	3	17	28
Density (#/acre)	Shrub	ARTRW8	2316	3581	5064
		CHVI8	91	1007	2544
Height (in)	Shrub	ARTRW8	16	19	22
	Herbaceous	Grass	7	9	10
		Forb	1	3	4
Fuel Loading (tons/acre)	Shrub	ARTRW8	1.44	2.08	2.78
	Herbaceous	Live	0.10	0.14	0.18
		Dead	0.01	0.03	0.07
	Down Woody Debris	10-hr	0.50	0.88	1.21
		100-hr	0.57	1.94	3.62
		1000-hr sound	0.05	0.86	2.27
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.21	0.43	0.61
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0188	0.0309	0.0473
	Herbaceous	Live + Dead	0.0070	0.0116	0.0168

Sagebrush Steppe: Tebuthiuron, Group 3

Gray Butte 1495 m | 4905 ft 6/27/2018	
Cover (%)	
Shrubs	7
Perennial Grass	6
Annual Grass	64
Bare Ground	14

Owyhee 1621 m | 5318 ft 6/22/2018	
Cover (%)	
Shrubs	27
Perennial Grass	32
Annual Grass	18
Bare Ground	12



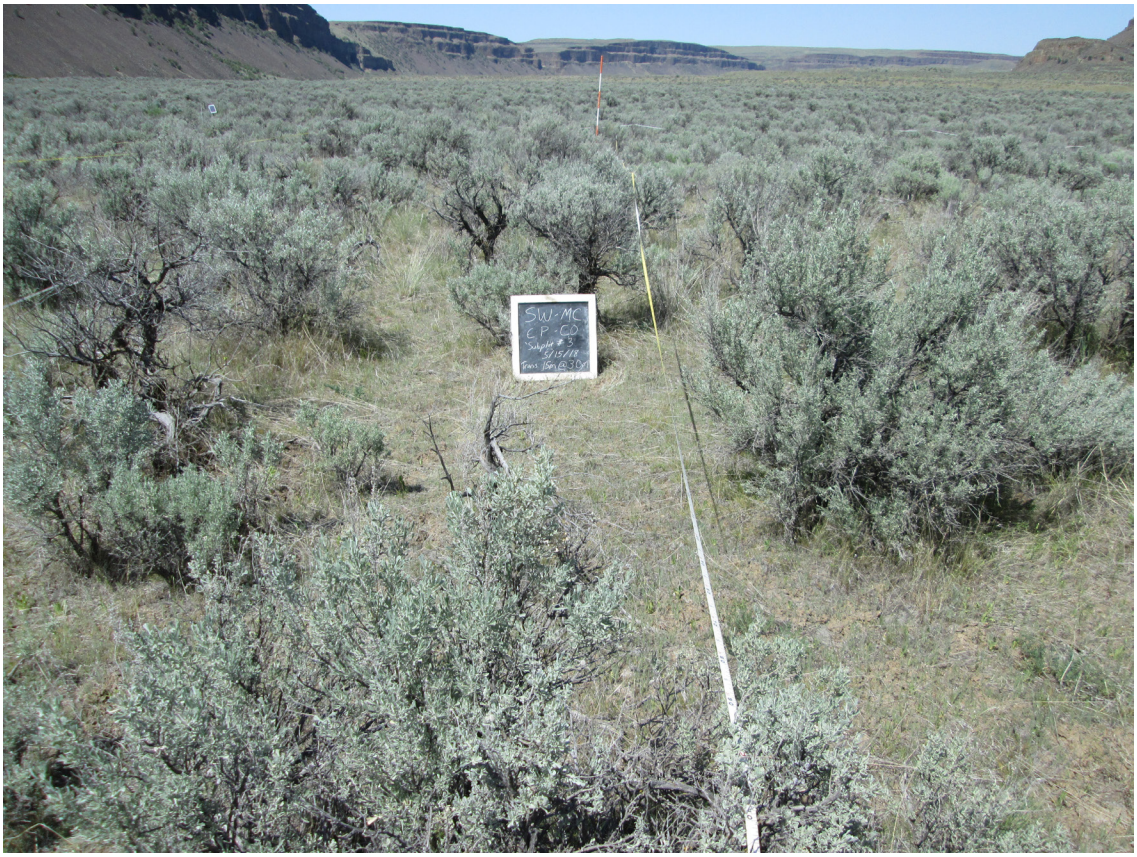
Sagebrush Steppe: Tebuthiuron, Group 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	12	21	28
		CHVI8	0	<1	<1
	Herbaceous	Perennial Grass	5	19	33
		Annual Grass	9	38	68
		Forb	1	3	7
	Litter & Duff	Interspace Litter	7	11	15
	Bare Ground	Bare Ground	4	16	32
Density (#/acre)	Shrub	ARTRW8	1585	3515	6631
		CHVI8	0	25	68
Height (in)	Shrub	ARTRW8	19	24	29
	Herbaceous	Grass	7	10	13
		Forb	1	5	9
Fuel Loading (tons/acre)	Shrub	ARTRW8	0.51	1.76	3.93
	Herbaceous	Live	0.04	0.19	0.33
		Dead	<0.01	0.08	0.13
	Down Woody Debris	10-hr	0.20	0.55	0.85
		100-hr	0.23	1.13	3.18
		1000-hr sound	0	0.86	1.83
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.05	0.22	0.46
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0074	0.0256	0.0470
	Herbaceous	Live + Dead	0.0064	0.0132	0.0199

Sagebrush Steppe: Control, Group 4

Onaqui 1671 m | 5482 ft 6/23/2016 Cover (%)	
Shrubs	25
Perennial Grass	11
Annual Grass	38
Bare Ground	24

Moses Coulee 521 m | 1709 ft 5/15/2018 Cover (%)	
Shrubs	23
Perennial Grass	35
Annual Grass	17
Bare Ground	3



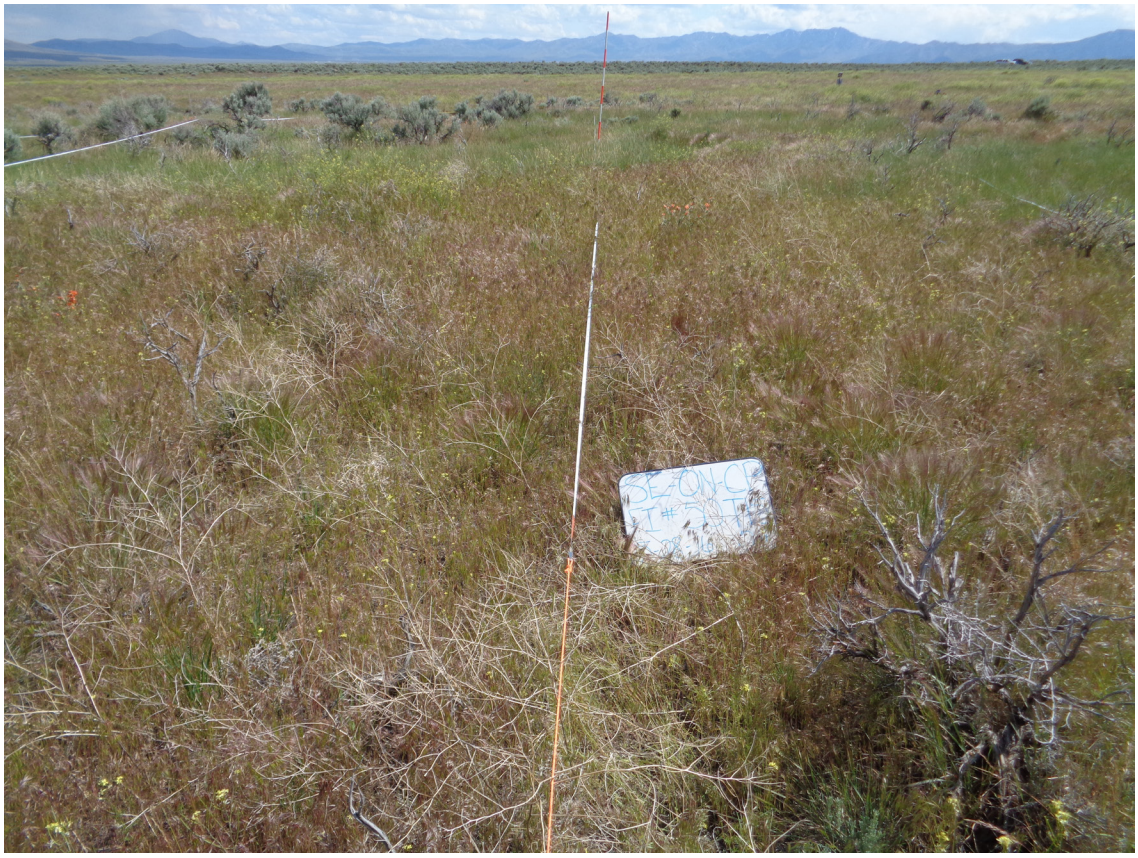
Sagebrush Steppe: Control, Group 4

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	21	25	30
		CHVI8	0	<1	<1
	Herbaceous	Perennial Grass	9	24	41
		Annual Grass	18	42	64
		Forb	5	13	24
	Litter & Duff	Interspace Litter	4	7	10
	Bare Ground	Bare Ground	3	8	15
Density (#/acre)	Shrub	ARTRW8	1522	2856	4583
		CHVI8	0	151*	91*
Height (in)	Shrub	ARTRW8	18	26	38
	Herbaceous	Grass	7	10	13
		Forb	3	5	7
Fuel Loading (tons/acre)	Shrub	ARTRW8	1.11	2.67	4.80
	Herbaceous	Live	0.10	0.16	0.25
		Dead	<0.01	0.09	0.20
	Down Woody Debris	10-hr	0.22	0.69	1.42
		100-hr	0.46	1.11	2.13
		1000-hr sound	0	0.40	0.96
		1000-hr rotten	0	0.04	0.17
	Litter & Duff	Interspace Litter	0.07	0.15	0.24
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0098	0.0363	0.0721
	Herbaceous	Live + Dead	0.0053	0.0156	0.0307

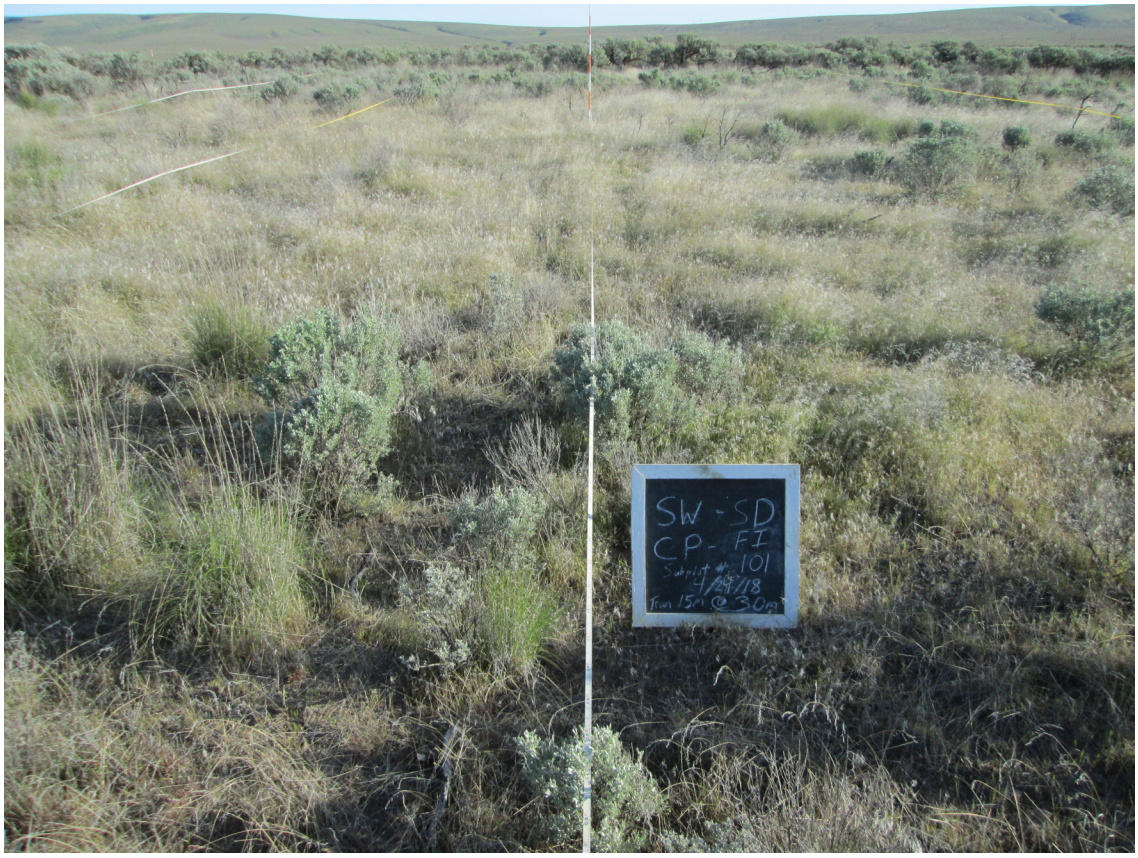
*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Sagebrush Steppe: Prescribed Fire, Group 4

Onaqui 1676 m | 5499 ft 5/28/2016 Cover (%)	
Shrubs	1
Perennial Grass	46
Annual Grass	37
Bare Ground	5



Saddle Mountain 248 m | 846 ft 4/24/2018 Cover (%)	
Shrubs	13
Perennial Grass	14
Annual Grass	59
Bare Ground	2

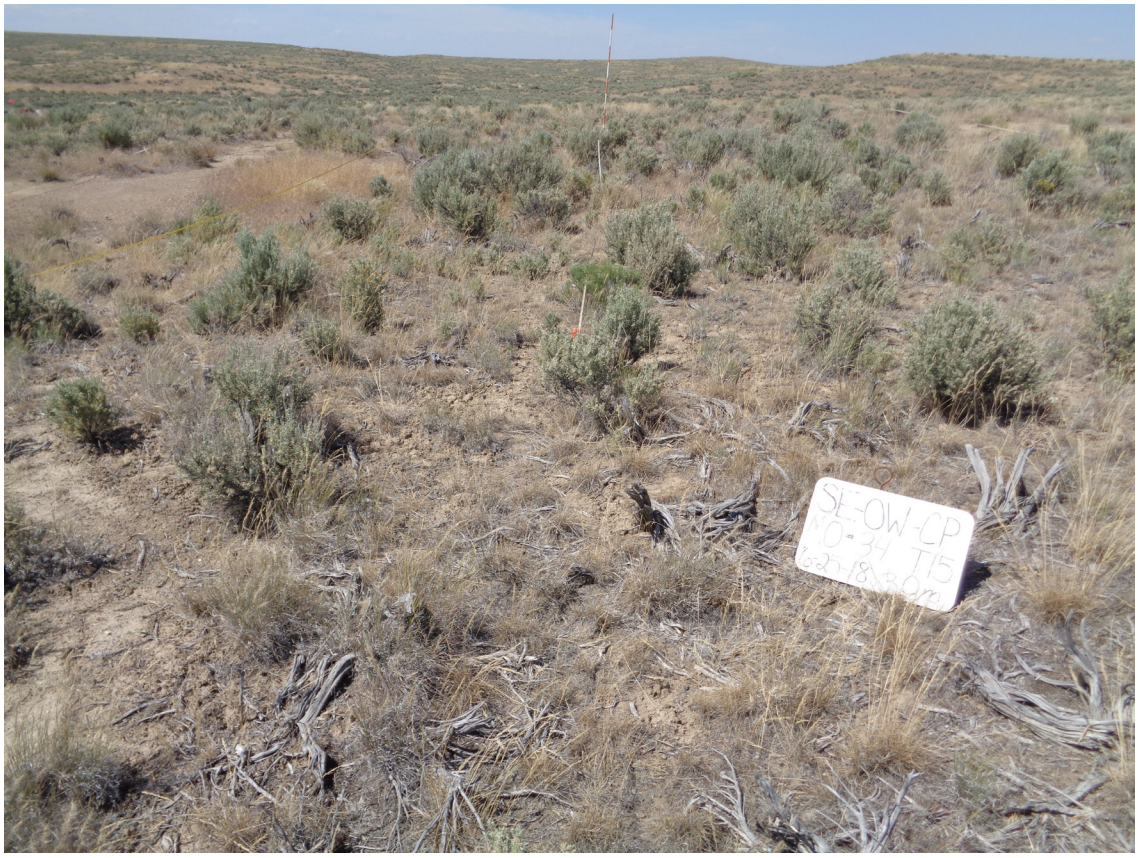


Sagebrush Steppe: Prescribed Fire, Group 4

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	0	9	20
		CHVI8	0	<1	2
	Herbaceous	Perennial Grass	10	26	46
		Annual Grass	15	42	60
		Forb	0	13	30
	Litter & Duff	Interspace Litter	5	8	13
	Bare Ground	Bare Ground	3	10	23
Density (#/acre)	Shrub	ARTRW8	0	2510	6927
		CHVI8	0	114	341
Height (in)	Shrub	ARTRW8	13	17	20
	Herbaceous	Grass	6	10	13
		Forb	2	6	11
Fuel Loading (tons/acre)	Shrub	ARTRW8	0	0.76	1.74
	Herbaceous	Live	0.13	0.24	0.32
		Dead	0.03	0.11	0.19
	Down Woody Debris	10-hr	0.07	0.30	0.72
		100-hr	0.05	0.48	1.18
		1000-hr sound	0	0.05	0.28
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.06	0.12	0.19
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0	0.0146	0.0343
	Herbaceous	Live + Dead	0.0125	0.0207	0.0296

Sagebrush Steppe: Mow, Group 4

Owyhee 1637 m | 5371 ft 6/25/2018	
Cover (%)	
Shrubs	15
Perennial Grass	44
Annual Grass	25
Bare Ground	12



Saddle Mountain 274 m | 899 ft 4/9/2018	
Cover (%)	
Shrubs	1
Perennial Grass	52
Annual Grass	31
Bare Ground	<1

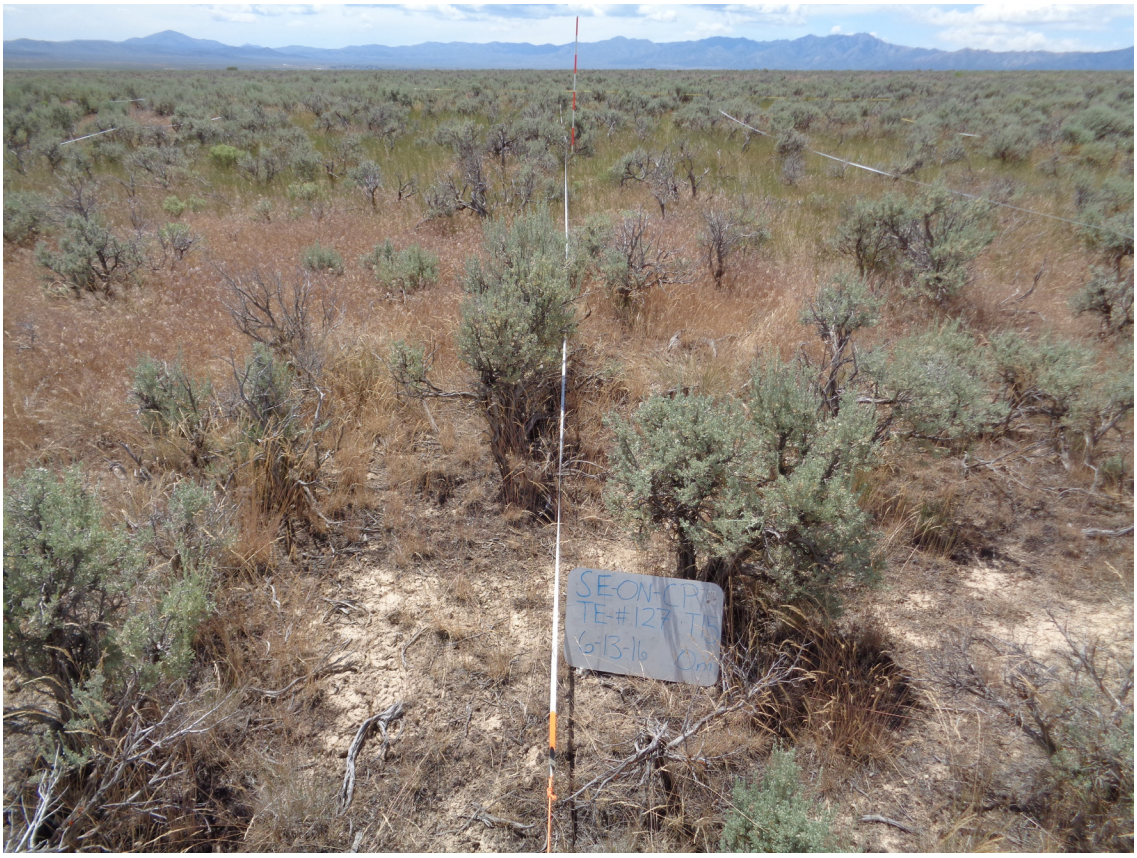
Sagebrush Steppe: Mow, Group 4

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	5	16	24
		CHVI8	0	<1	2
	Herbaceous	Perennial Grass	16	32	43
		Annual Grass	6	26	38
		Forb	<1	9	21
	Litter & Duff	Interspace Litter	6	11	17
	Bare Ground	Bare Ground	2	12	23
Density (#/acre)	Shrub	ARTRW8	1260	2842	4247
		CHVI8	0	169	500
Height (in)	Shrub	ARTRW8	14	18	22
	Herbaceous	Grass	8	10	14
		Forb	2	4	5
Fuel Loading (tons/acre)	Shrub	ARTRW8	0.21	1.23	2.17
	Herbaceous	Live	0.07	0.19	0.26
		Dead	0.02	0.12	0.33
	Down Woody Debris	10-hr	0.37	0.82	1.34
		100-hr	0.66	1.89	3.69
		1000-hr sound	0	0.72	1.24
		1000-hr rotten	0	0.16*	0*
	Litter & Duff	Interspace Litter	0.09	0.20	0.33
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0049	0.0249	0.0450
	Herbaceous	Live + Dead	0.0053	0.0175	0.0305

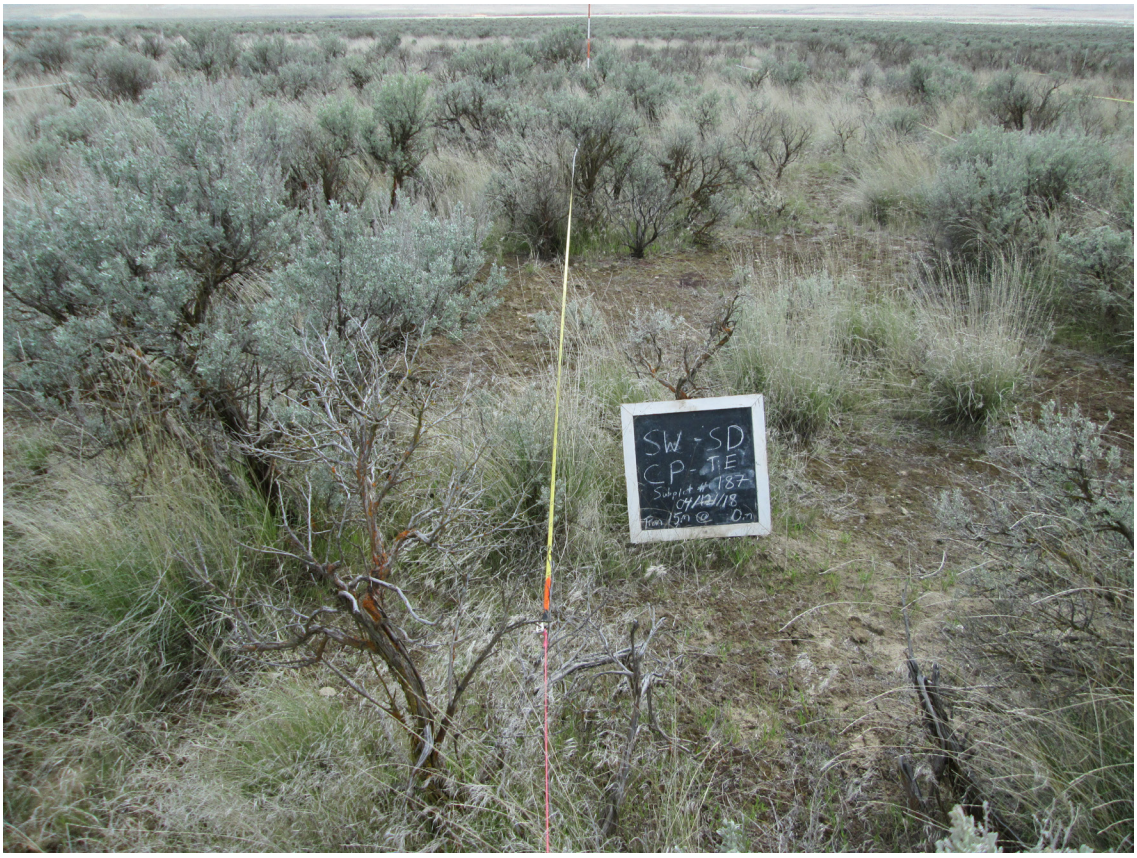
*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Sagebrush Steppe: Tebuthiuron, Group 4

Onaqui 1686 m | 5531 ft 6/13/2016	
Cover (%)	
Shrubs	20
Perennial Grass	44
Annual Grass	20
Bare Ground	6



Saddle Mountain 268 m | 879 ft 4/12/2018	
Cover (%)	
Shrubs	18
Perennial Grass	31
Annual Grass	33
Bare Ground	3



Sagebrush Steppe: Tebuthiuron, Group 4

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Shrub	ARTRW8	4	25	46
		CHVI8	0	<1	2
	Herbaceous	Perennial Grass	18	34	46
		Annual Grass	7	36	74
		Forb	1	9	25
	Litter & Duff	Interspace Litter	2	5	9
	Bare Ground	Bare Ground	2	5	10
Density (#/acre)	Shrub	ARTRW8	1011	2951	5098
		CHVI8	0	219	636
Height (in)	Shrub	ARTRW8	18	27	34
	Herbaceous	Grass	5	10	15
		Forb	2	4	6
Fuel Loading (tons/acre)	Shrub	ARTRW8	0.20	1.91	4.46
	Herbaceous	Live	0.08	0.23	0.42
		Dead	0.01	0.14	0.33
	Down Woody Debris	10-hr	0.20	0.68	1.39
		100-hr	0.15	1.25	2.68
		1000-hr sound	0	0.29	0.80
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.05	0.14	0.22
Bulk Density (lbs/ft^3)	Shrub	ARTRW8	0.0037	0.0218	0.0441
	Herbaceous	Live + Dead	0.0113	0.0218	0.0307

Wyoming big sagebrush (ARTRW8)
Fuel Loads by Size Class

Group	Treatment	1-hr + Foliar Fuel Load			10-hr Fuel Load		
		10th	Mean	90th	10th	Mean	90th
1	Control	0.36	0.78	1.42	0.39	0.93	1.71
	Prescribed Fire	0	0.04	0.08	0	0.04	0.08
	Mow	0.24	0.46	0.79	0.22	0.53	0.99
	Tebuthiuron	0.11	0.50	0.93	0.13	0.61	1.06
2	Control	0.31	0.59	1.10	0.17	0.63	1.40
	Prescribed Fire	0	0.07	0.20	0	0.08	0.22
	Mow	0.06	0.25	0.39	0.05	0.26	0.55
	Tebuthiuron	0	0.22	0.62	<0.01	0.25	0.78
3	Control	0.46	1.07	1.79	0.56	1.37	2.31
	Prescribed Fire	0	0.39	0.89	0	0.51	1.12
	Mow	0.34	0.73	1.19	0.43	0.77	1.13
	Tebuthiuron	0.24	0.69	1.31	0.32	0.87	1.70
4	Control	0.46	1.00	1.79	0.41	1.07	1.87
	Prescribed Fire	0	0.31	0.74	0	0.30	0.86
	Mow	0.10	0.53	0.99	0.09	0.51	0.84
	Tebuthiuron	0.09	0.72	1.41	0.07	0.79	1.65

Pinyon-Juniper Fuels Guide User Notes

Site Notes

- All sites are characterized by the Loamy 12-14" ecological type (Caudle et al. 2013).
- General site information:
    - During the course of the study (2006-2018), the average annual precipitation across the sites was 11.6 in. (29.4 cm), and ranged 6.9-16.5 in. (17.4-41.8 cm; PRISM Climate Group)
    - Slopes ranged 6-30%, and the sites occurred on all aspects;
    - Loamy soil surface texture, with soil depths >20 in. (50.8 cm) and minimal stoniness.
- Three treatments were implemented at every site: untreated control, prescribed fire, and mechanical cutting.
- The three sites were located in Nevada.
- All sites are located in active grazing allotments, and all subplots may have been grazed prior to construction of exclosures at the beginning of the SageSTEP.
- Site names, number of subplots, and elevation ranges for data used are available in Table 6. Site locations are shown in Figure 5.

Guide Notes

- This guide is organized by three treatments (untreated control, prescribed fire, and cutting) and three woodland development phases defined by pre-treatment tree stand cover and understory characteristics (Miller et al. 2005):
    - Phase I: Trees are present on the site, but the understory shrub and herbaceous components are the dominant influence on ecological processes (hydrology, nutrient and energy cycling).
    - Phase II: Trees are co-dominant with the understory shrub and herbaceous components. All three layers influence ecological processes.
    - Phase III: Trees are the dominant vegetation and the primary layer influencing ecological processes.
- The caption to the left of each photo denotes the canopy cover (%) by functional group for subplot depicted in the photo.
- Sampling took place between July and August in 2016, 2017, and 2018.
- Bare ground cover (%) is the only measure of fuel continuity.
- Dominant graminoids include: ACHY, ACTH7, BRTE, ELEL5, HECO26, LECI4, KOMA, PASM, POBU, POSE, PSSP6 (see Table 7 for common and scientific names)
- Annual grasses include: BRTE (see Table 5 for common and scientific names)
- Each statistic includes a mean, 10th percentile, and 90th percentile. The 10th percentile column indicates that 10% of the data was less than the 10th percentile statistic, and the 90th percentile indicates that 90% of the data were less than the 90th percentile statistic. The 10th and 90th percentiles were used instead of minimum and maximum because there were extreme values in the dataset.
- The designation of "NA" indicates data were not collected or available.
- A table of species codes can be found in Table 7.

Table 6. Summary of subplot information for the Pinyon-Juniper Subguide. All sites within the Pinyon-Juniper region (Marking Corral, Seven Mile, and South Ruby) are represented in each phase/treatment combination except for the South Ruby Control treatment, which was accidentally cut by an agency contractor at 9 years post-treatment.

Phase	Treatment	# of Sampling Plots	Elevation Range (ft)	Elevation Range (m)
1	Control	6	7054-7464	2150-2275
	Prescribed Fire	13	6575-7336	2004-2236
	Cutting	12	6677-7766	2035-2367
2	Control	13	7054-7464	2150-2275
	Prescribed Fire	26	6575-7336	2004-2236
	Cutting	26	6677-7766	2035-2367
3	Control	13	7054-7464	2150-2275
	Prescribed Fire	16	6575-7336	2004-2236
	Cutting	12	6677-7766	2035-2367

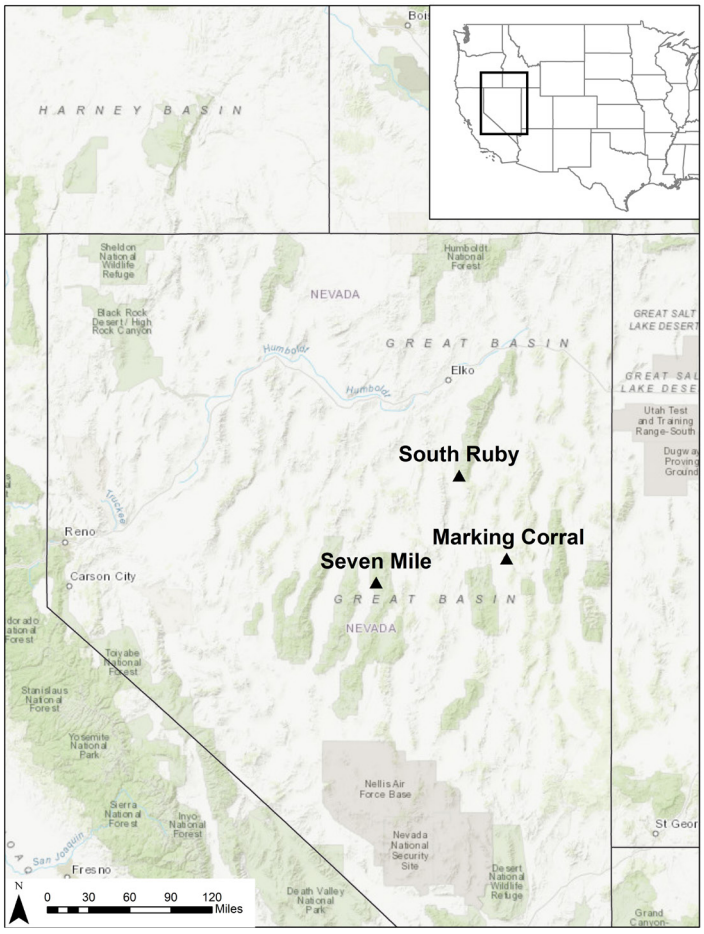


Figure 5. Location of study sites in Pinyon-Juniper Subguide.

Table 7. USDA Plant codes used in the Pinyon-Juniper Subguide.

	USDA Code	Scientific Name	Common Name
Trees	CELE3	*Cercocarpus ledifolius*	curl-leaf mountain mahogany
	JUOS	*Juniper osteosperma*	Utah juniper
	PIMO	*Pinus monophylla*	singleleaf pinyon pine
Shrubs	ARAR8	*Artemisia arbuscula*	low sagebrush
	ARNO4	*Artemisia nova*	black sagebrush
	ARTRW8	*Artemisia tridentata* ssp. *wyomingensis*	Wyoming big sagebrush
	CHVI8	*Chrysothamnus viscidiflorus*	yellow rabbitbrush
	PUTR2	*Purshia tridentata*	antelope bitterbrush
Grasses	ACHY	*Achnatherum hymenoides*	Indian ricegrass
	ACTH7	*Achnatherum thurberianum*	Thurber's needlegrass
	BRTE	*Bromus tectorum*	cheatgrass
	ELEL5	*Elymus elymoides*	bottlebrush squirreltail
	HECO26	*Hesperostipa comata*	needle-and-thread
	LECI4	*Leymus cinereus*	basin wildrye
	KOMA	*Koeleria macrantha*	prairie junegrass
	PASM	*Pascopyron smithii*	western wheatgrass
	POBU	*Poa bulbosa*	bulbous bluegrass
	POSE	*Poa secunda*	Sandberg bluegrass
	PSSP6	*Pseudoroegneria spicata*	bluebunch wheatgrass

Pinyon-Juniper: Control, Phase 1

Marking Corral 2150 m | 7054 ft 8/17/2016	
Cover (%)	
Trees	13
Shrubs	21
Perennial Grass	28
Annual Grass	<1
Bare Ground	24

Seven Mile 2275 m | 7464 ft 8/19/2017	
Cover (%)	
Trees	12
Shrubs	21
Perennial Grass	8
Annual Grass	0
Bare Ground	35

Pinyon-Juniper: Control, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	3	8	13
	Shrub	Total	11	19	25
	Herbaceous	Perennial Grass	6	17	29
		Annual Grass	0	<1	<1
		Forb	5	11	16
	Litter & Duff	Interspace Litter	9	11	14
	Bare Ground	Bare Ground	22	30	38
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	23	41	68
		JUOS & PIMO > 1.6 ft tall	59	95	125
	Shrub	Total	1990	5235	7655
Height (ft)	Tree	JUOS & PIMO	2	7	13
		JUOS & PIMO Canopy Base	<1	<1	1
Height (in)	Shrub	Total	13	15	17
	Herbaceous	Grass	5	10	16
		Forb	2	3	5
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	0.81	3.02	5.06
	Shrub	Total	0.81	2.26	4.05
	Herbaceous	Live	0.03	0.05	0.08
		Dead	<0.01	<0.01	0.02
	Down Woody Debris	10-hr	0.08	0.44	0.93
		100-hr	0.12	1.27	2.80
		1000-hr sound	0	0.06	0.19
		1000-hr rotten	0	0.25	0.76
	Litter & Duff	Interspace Litter	0.12	0.19	0.27
		Tree Litter + Duff	0.58	1.37	2.55
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	0.0025	0.0059	0.0094
	Shrub	Total	0.0166	0.0372	0.0589
	Herbaceous	Live + Dead	0.0030	0.0088	0.0141

Pinyon-Juniper: Prescribed Fire, Phase 1

Marking Corral 2183 m | 7162 ft 7/29/2016 Cover (%)	
Trees	1
Shrubs	12
Perennial Grass	35
Annual Grass	41
Bare Ground	9

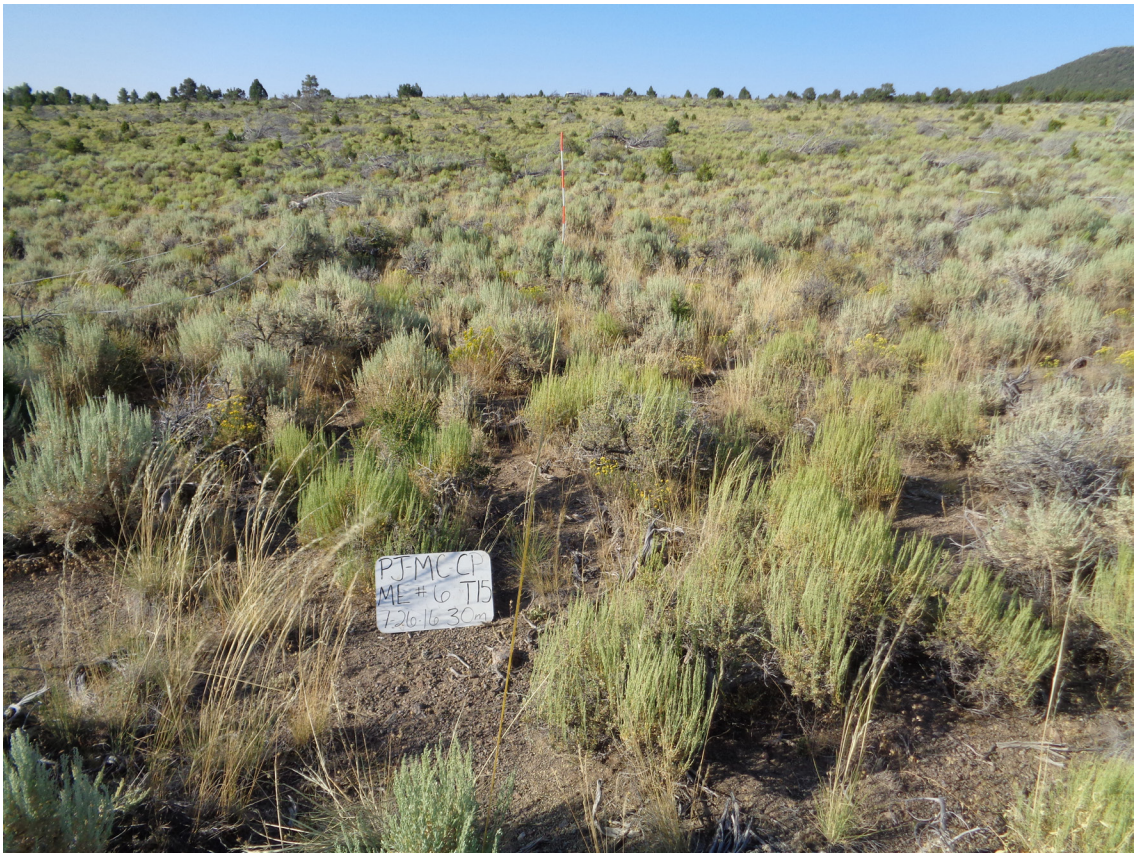
South Ruby 2004 m | 6575 ft 7/31/2018 Cover (%)	
Trees	4
Shrubs	28
Perennial Grass	28
Annual Grass	37
Bare Ground	2

Pinyon-Juniper: Prescribed Fire, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	0	1	4
	Shrub	Total	10	17	27
	Herbaceous	Perennial Grass	13	27	38
		Annual Grass	0	21	42
		Forb	12	17	20
	Litter & Duff	Interspace Litter	6	12	19
	Bare Ground	Bare Ground	2	19	44
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	0	10	41
		JUOS & PIMO > 1.6 ft tall	0	9	21
	Shrub	Total	2311	3573	5400
Height (ft)	Tree	JUOS & PIMO	3	8	14
		JUOS & PIMO Canopy Base	<1	<1	1
Height (in)	Shrub	Total	12	16	20
	Herbaceous	Grass	4	10	16
		Forb	2	5	9
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	0	0.51	1.19
	Shrub	Total	0.18	0.70	1.17
	Herbaceous	Live	0.13	0.25	0.34
		Dead	<0.01	0.06	0.14
	Down Woody Debris	10-hr	0.27	0.35	0.48
		100-hr	0.31	1.12	2.40
		1000-hr sound	0.11	0.87	2.62
		1000-hr rotten	0	0.03	0.06
	Litter & Duff	Interspace Litter	0.06	0.17	0.39
		Tree Litter + Duff	0	0.23	0.70
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	0	0.0009	0.0028
	Shrub	Total	0.0062	0.0155	0.0262
	Herbaceous	Live + Dead	0.0136	0.0301	0.0361

Pinyon-Juniper: Cutting, Phase 1

Marking Corral 2209 m | 7247 ft 7/26/2016 Cover (%)	
Trees	<1
Shrubs	33
Perennial Grass	27
Annual Grass	3
Bare Ground	10



Seven Mile 2367 m | 7766 ft 8/19/2017 Cover (%)	
Trees	<1
Shrubs	26
Perennial Grass	24
Annual Grass	0
Bare Ground	34

Pinyon-Juniper: Cutting, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	<1	<1	<1
	Shrub	Total	22	28	37
	Herbaceous	Perennial Grass	23	29	35
		Annual Grass	0	7	21
		Forb	10	16	24
	Litter & Duff	Interspace Litter	4	10	15
	Bare Ground	Bare Ground	6	16	33
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	2	69	176
		JUOS & PIMO > 1.6 ft tall	12	38	60
	Shrub	Total	3226	5021	6138
Height (ft)	Tree	JUOS & PIMO	2	3	5
		JUOS & PIMO Canopy Base	<1	<1	<1
Height (in)	Shrub	Total	13	19	28
	Herbaceous	Grass	8	10	12
		Forb	2	6	9
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	0.01	0.04	0.10
	Shrub	Total	1.27	2.96	5.03
	Herbaceous	Live	0.12	0.24	0.35
		Dead	0.02	0.05	0.13
	Down Woody Debris	10-hr	0.12	0.50	1.24
		100-hr	0.64	1.38	2.79
		1000-hr sound	0.31	1.78	2.45
		1000-hr rotten	0	0.29	0.62
	Litter & Duff	Interspace Litter	0.10	0.25	0.38
		Tree Litter + Duff	<0.01	0.10	0.24
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	<0.0001	0.0003	0.0008
	Shrub	Total	0.0112	0.0401	0.0745
	Herbaceous	Live + Dead	0.0059	0.0218	0.0368

Pinyon-Juniper: Control, Phase 2

Marking Corral 2150 m | 7054 ft 8/19/2016 Cover (%)	
Trees	28
Shrubs	10
Perennial Grass	5
Annual Grass	0
Bare Ground	47

Marking Corral 2150 m | 7054 ft 8/17/2017 Cover (%)	
Trees	63
Shrubs	8
Perennial Grass	21
Annual Grass	0
Bare Ground	80

Pinyon-Juniper: Control, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	12	35	62
	Shrub	Total	4	10	18
	Herbaceous	Perennial Grass	3	7	11
		Annual Grass	0		
		Forb	2	7	11
	Litter & Duff	Interspace Litter	5	11	14
	Bare Ground	Bare Ground	24	32	43
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	0	78	180
		JUOS & PIMO > 1.6 ft tall	107	220	330
	Shrub	Total	679	3253	6178
Height (ft)	Tree	JUOS & PIMO	3	10	16
		JUOS & PIMO Canopy Base	<1	<1	2
Height (in)	Shrub	Total	10	13	18
	Herbaceous	Grass	4	6	8
		Forb	2	3	5
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	5.08	15.87	29.36
	Shrub	Total	0.33	0.76	1.12
	Herbaceous	Live	0.01	0.05	0.08
		Dead	0	<0.01	0.02
	Down Woody Debris	10-hr	0.22	0.41	0.60
		100-hr	0.24	0.87	1.72
		1000-hr sound	0	0.51	1.37
		1000-hr rotten	0	0.08	0.27
	Litter & Duff	Interspace Litter	0.09	0.21	0.39
		Tree Litter + Duff	2.76	10.19	19.25
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	0.0087	0.0206	0.0365
	Shrub	Total	0.0060	0.0169	0.0297
	Herbaceous	Live + Dead	0.0030	0.0105	0.0166

Pinyon-Juniper: Prescribed Fire, Phase 2

Marking Corral 2183 m | 7162 ft 7/29/2016 Cover (%)	
Trees	0
Shrubs	2
Perennial Grass	37
Annual Grass	71
Bare Ground	2

Seven Mile 2236 m | 7336 ft 8/16/2017 Cover (%)	
Trees	0
Shrubs	10
Perennial Grass	25
Annual Grass	0
Bare Ground	31

Pinyon-Juniper: Prescribed Fire, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	0	3	7
	Shrub	Total	6	12	22
	Herbaceous	Perennial Grass	16	31	47
		Annual Grass	0	26	53
		Forb	6	13	24
	Litter & Duff	Interspace Litter	7	11	17
	Bare Ground	Bare Ground	5	18	40
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	0	21	56
		JUOS & PIMO > 1.6 ft tall	0	36	64
	Shrub	Total	832	2703	4935
Height (ft)	Tree	JUOS & PIMO	2	7	15
		JUOS & PIMO Canopy Base	<1	<1	2
Height (in)	Shrub	Total	11	15	20
	Herbaceous	Grass	4	10	17
		Forb	2	3	7
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	0	1.27	3.25
	Shrub	Total	0.10	0.63	1.13
	Herbaceous	Live	0.11	0.21	0.32
		Dead	<0.01	0.04	0.08
	Down Woody Debris	10-hr	0.16	0.44	0.82
		100-hr	0.27	0.87	1.71
		1000-hr sound	0	1.42	3.71
		1000-hr rotten	0	0.06	0.14
	Litter & Duff	Interspace Litter	0.05	0.25	0.61
		Tree Litter + Duff	0	0.64	0.61
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	0	0.0021	0.0052
	Shrub	Total	0.0021	0.0151	0.0469
	Herbaceous	Live + Dead	0.0145	0.0241	0.0393

Pinyon-Juniper: Cutting, Phase 2

South Ruby	
2035 m | 6677 ft 7/26/2018	
Cover (%)	
Trees	0
Shrubs	12
Perennial Grass	29
Annual Grass	8
Bare Ground	9

Seven Mile	
2367 m | 7766 ft 8/18/2017	
Cover (%)	
Trees	3
Shrubs	18
Perennial Grass	17
Annual Grass	0
Bare Ground	26

Pinyon-Juniper: Cutting, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	0	<1	1
	Shrub	Total	15	22	29
	Herbaceous	Perennial Grass	15	25	36
		Annual Grass	0	13	28
		Forb	6	12	21
	Litter & Duff	Interspace Litter	8	12	16
	Bare Ground	Bare Ground	6	18	31
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	0	87	203
		JUOS & PIMO > 1.6 ft tall	16	67	115
	Shrub	Total	2327	4422	7948
Height (ft)	Tree	JUOS & PIMO	2	3	5
		JUOS & PIMO Canopy Base	<1	<1	1
Height (in)	Shrub	Total	14	18	23
	Herbaceous	Grass	6	11	17
		Forb	2	4	7
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	<0.01	0.08	0.21
	Shrub	Total	0.82	2.23	3.82
	Herbaceous	Live	0.07	0.17	0.38
		Dead	<0.01	0.03	0.07
	Down Woody Debris	10-hr	0.21	0.68	1.48
		100-hr	0.57	2.12	4.82
		1000-hr sound	1.15	3.20	5.84
		1000-hr rotten	0	0.20	0.60
	Litter & Duff	Interspace Litter	0.07	0.30	0.64
		Tree Litter + Duff	<0.01	0.41	0.88
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	<0.0001	0.0006	0.0013
	Shrub	Total	0.0105	0.0336	0.0517
	Herbaceous	Live + Dead	0.0064	0.0191	0.0356

Pinyon-Juniper: Control, Phase 3

Marking Corral 2150 m | 7054 ft 8/17/2016	
Cover (%)	
Trees	30
Shrubs	<1
Perennial Grass	3
Annual Grass	0
Bare Ground	15

Seven Mile 2275 m | 7464 ft 8/20/2017	
Cover (%)	
Trees	39
Shrubs	4
Perennial Grass	<1
Annual Grass	0
Bare Ground	55

Pinyon-Juniper: Control, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	32	47	64
	Shrub	Total	<1	5	11
	Herbaceous	Perennial Grass	<1	6	10
		Annual Grass	0	<1*	0*
		Forb	<1	2	4
	Litter & Duff	Interspace Litter	7	9	13
	Bare Ground	Bare Ground	24	32	43
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	68	183	414
		JUOS & PIMO > 1.6 ft tall	173	275	357
	Shrub	Total	522	1776	3997
Height (ft)	Tree	JUOS & PIMO	4	12	19
		JUOS & PIMO Canopy Base	<1	1	2
Height (in)	Shrub	Total	12	15	18
	Herbaceous	Grass	<1	6	13
		Forb	1	3	4
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	14.74	24.14	31.93
	Shrub	Total	0.07	0.41	1.25
	Herbaceous	Live	<0.01	0.03	0.08
		Dead	0	<0.01	0.01
	Down Woody Debris	10-hr	0.30	0.68	1.12
		100-hr	0.10	0.88	1.48
		1000-hr sound	0	0.67	2.21
		1000-hr rotten	0	0.49	1.45
	Litter & Duff	Interspace Litter	0.12	0.28	0.44
		Tree Litter + Duff	10.16	17.53	29.37
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	0.0166	0.0253	0.0344
	Shrub	Total	0.0010	0.0085	0.0295
	Herbaceous	Live + Dead	0.0013	0.0168	0.0597

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Pinyon-Juniper: Prescribed Fire, Phase 3

Marking Corral 2183 m | 7162 ft 8/2/2016	
Cover (%)	
Trees	5
Shrubs	7
Perennial Grass	33
Annual Grass	67
Bare Ground	4

South Ruby 2004 m | 6575 ft 8/16/2018	
Cover (%)	
Trees	3
Shrubs	1
Perennial Grass	6
Annual Grass	66
Bare Ground	4

Pinyon-Juniper: Prescribed Fire, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	5	12	20
	Shrub	Total	1	6	9
	Herbaceous	Perennial Grass	5	16	29
		Annual Grass	0	28	64
		Forb	1	11	18
	Litter & Duff	Interspace Litter	7	18	29
	Bare Ground	Bare Ground	4	17	31
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	0	32	90
		JUOS & PIMO > 1.6 ft tall	18	63	96
	Shrub	Total	113	1723	3563
Height (ft)	Tree	JUOS & PIMO	4	12	20
		JUOS & PIMO Canopy Base	<1	2	4
Height (in)	Shrub	Total	11	18	29
	Herbaceous	Grass	6	10	15
		Forb	1	5	7
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	2.41	6.10	10.12
	Shrub	Total	<0.01	0.39	0.78
	Herbaceous	Live	0.07	0.18	0.36
		Dead	<0.01	0.08	0.18
	Down Woody Debris	10-hr	0.24	0.51	0.80
		100-hr	0.64	1.37	2.29
		1000-hr sound	0.59	6.21	14.16
		1000-hr rotten	0	0.53	0.07
	Litter & Duff	Interspace Litter	0.12	0.35	0.66
		Tree Litter + Duff	0.60	3.03	5.68
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	0.0025	0.0065	0.0109
	Shrub	Total	<0.0001	0.0076	0.0196
	Herbaceous	Live + Dead	0.0100	0.0215	0.0335

Pinyon-Juniper: Cutting, Phase 3

Marking Corral 2209 m | 7247 ft 7/28/2016	
Cover (%)	
Trees	<1
Shrubs	17
Perennial Grass	24
Annual Grass	30
Bare Ground	12

Seven Mile 2367 m | 7766 ft 8/18/2017	
Cover (%)	
Trees	2
Shrubs	20
Perennial Grass	11
Annual Grass	0
Bare Ground	45

Pinyon-Juniper: Cutting, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIMO	0	2	6
	Shrub	Total	8	16	25
	Herbaceous	Perennial Grass	15	24	38
		Annual Grass	0	22	43
		Forb	3	9	15
	Litter & Duff	Interspace Litter	7	12	16
	Bare Ground	Bare Ground	2	11	27
Density (#/acre)	Tree	JUOS & PIMO < 1.6 ft tall	0	69	189
		JUOS & PIMO > 1.6 ft tall	17	58	118
	Shrub	Total	654	2645	4766
Height (ft)	Tree	JUOS & PIMO	2	4	7
		JUOS & PIMO Canopy Base	<1	<1	<1
Height (in)	Shrub	Total	12	21	34
	Herbaceous	Grass	6	11	14
		Forb	2	5	9
Fuel Loading (tons/acre)	Tree	JUOS & PIMO	<0.01	0.78	2.93
	Shrub	Total	0.30	1.51	3.60
	Herbaceous	Live	0.05	0.29	0.54
		Dead	0.02	0.14	0.32
	Down Woody Debris	10-hr	0.37	1.03	1.43
		100-hr	1.39	4.35	5.10
		1000-hr sound	3.67	11.44	22.55
		1000-hr rotten	0	0.03	0.14
	Litter & Duff	Interspace Litter	0.37	0.57	0.94
		Tree Litter + Duff	<0.01	2.25	6.82
Bulk Density (lbs/ft^3)	Tree	JUOS & PIMO Canopy	<0.0001	0.0019	0.0069
	Shrub	Total	0.0072	0.0222	0.0540
	Herbaceous	Live + Dead	0.0132	0.0295	0.0457

Pinyon-Juniper: Control

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOS	Cover (%)	2	5	8	4	18	31	13	19	23
	Density < 1.6 ft tall (#/ac)	0	23	45	0	5	23	0	24	45
	Density > 1.6 ft tall (#/ac)	35	49	61	34	94	184	38	82	142
	Height (ft)	8	10	11	10	12	15	13	15	19
	Canopy Base Height (ft)	<1	<1	1	<1	<1	2	<1	1	2
	Foliar Load (tons/ac)	0.24	0.52	0.85	0.55	1.89	3.28	1.33	2.11	2.62
	1-hr load (tons/ac)	0.04	0.09	0.15	0.10	0.33	0.57	0.23	0.37	0.46
	10-hr load (tons/ac)	0.09	0.21	0.35	0.23	0.79	1.35	0.55	0.89	1.08
	100-hr load (tons/ac)	0.12	0.34	0.60	0.37	1.44	2.92	0.94	1.75	2.50
	1000-hr load (tons/ac)	0.13	0.60	1.17	0.65	2.97	6.42	2.18	3.90	5.69
	1-hr Dead load (tons/ac)	0.01	0.05	0.10	0.06	0.27	0.57	0.19	0.35	0.50
	10-hr Dead load (tons/ac)	<0.01	0.03	0.06	0.03	0.15	0.33	0.11	0.20	0.29
	Total load (tons/ac)	0.66	1.86	3.24	1.98	7.83	16.07	5.11	9.57	13.77
	Bulk Density (lbs/ft^3)	0.0019	0.0036	0.0058	0.0030	0.0104	0.0185	0.0070	0.0101	0.0139
PIMO	Cover (%)	<1	3	6	4	17	35	19	28	37
	Density < 1.6 ft tall (#/ac)	0	15	34	0	73	175	23	159	409
	Density > 1.6 ft tall (#/ac)	8	46	74	30	126	190	119	193	262
	Height (ft)	6	7	9	7	11	13	12	15	18
	Canopy Base Height (ft)	<1	<1	1	<1	<1	2	<1	1	2
	Foliar Load (tons/ac)	0.03	0.23	0.47	0.25	1.39	2.83	1.79	2.63	3.45
	1-hr load (tons/ac)	0.01	0.12	0.25	0.14	0.80	1.62	0.98	1.49	2.01
	10-hr load (tons/ac)	0.02	0.15	0.30	0.16	0.90	1.83	1.14	1.70	2.25
	100-hr load (tons/ac)	0.02	0.24	0.50	0.28	1.63	3.26	1.94	3.00	4.06
	1000-hr load (tons/ac)	0.03	0.33	0.72	0.37	2.67	5.43	3.01	4.76	6.73
	1-hr Dead load (tons/ac)	<0.01	0.02	0.05	0.02	0.22	0.49	0.20	0.37	0.61
	10-hr Dead load (tons/ac)	<0.01	0.03	0.06	0.03	0.29	0.64	0.25	0.48	0.80
	Total load (tons/ac)	0.11	1.12	2.33	1.29	7.91	15.76	9.32	14.43	19.88
	Bulk Density (lbs/ft^3)	0.0003	0.0023	0.0041	0.0022	0.0101	0.0191	0.0115	0.0152	0.0217
CELE3	Cover (%)							0	<1	<1
	Density < 1.6 ft tall (#/ac)								0	
	Density > 1.6 ft tall (#/ac)		0			0		0	2	8
	Height (ft)							0	2	8
	Canopy Base Height (ft)							<1	2	4

Pinyon-Juniper: Control
Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARAR8	Cover (%)	0	<1	<1	0	1	3	0	<1*	0*
	Density (#/ac)	0			0			0	10*	0*
	Height (in)				0	3	11	0		
	1-hr + fol. load (tons/ac)				0	0.05	0.09			
	10-hr load (tons/ac)				0	0.04	0.06			
	Bulk Density (lbs/ft^3)				0	0.0040	0.0070			
ARNO4	Cover (%)	0			0	<1*	0*	0	<1*	0*
	Density (#/ac)				0			0		
	Height (in)									
	1-hr + fol. load (tons/ac)									
	10-hr load (tons/ac)									
	Bulk Density (lbs/ft^3)									
ARTRW8	Cover (%)	8	13	17	2	6	11	<1	3	6
	Density (#/ac)	1192	2767	4258	409	1633	3384	368	977	2017
	Height (in)	16	18	20	11	15	19	13	15	18
	1-hr + fol. load (tons/ac)	0.24	0.80	1.46	0.02	0.23	0.45	0.02	0.14	0.44
	10-hr load (tons/ac)	0.21	0.44	0.64	<0.01	0.16	0.28	<0.01	0.10	0.41
	Bulk Density (lbs/ft^3)	0.0135	0.0315	0.0514	0.0012	0.0107	0.0193	0.0010	0.0072	0.0234
CHVI8	Cover (%)	3	6	9	<1	2	4	0	1	5
	Density (#/ac)	670	2385	3781	45	1125	2144	0	566	2148
	Height (in)	10	11	12	0	7	11	0	5	10
	1-hr + fol. load (tons/ac)	0.04	0.11	0.18	0	0.03	0.07	0	0.02	0.05
	10-hr load (tons/ac)	0	0.02	0.04	0	<0.01	0.02	0	<0.01	<0.01
	Bulk Density (lbs/ft^3)	0.0023	0.0057	0.0089	0	0.0017	0.0042	0	0.0011	0.0035
PUTR2	Cover (%)	0	<1	<1	0	<1	2	0	<1	2
	Density (#/ac)	0	15	45	0	35	127	0	24	63
	Height (in)	0	7	20	0	6	24	0	4	19
	1-hr + fol. load (tons/ac)	0	<0.01	<0.01	0	0.01	0.05	0	<0.01	0.03
	10-hr load (tons/ac)	0	<0.01	<0.01	0	0.01	0.05	0	<0.01	0.03
	Bulk Density (lbs/ft^3)	0	<0.0001	0.0002	0	0.0004	0.0020	0	0.0002	0.0011

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Pinyon-Juniper: Prescribed Fire

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOS	Cover (%)	0	<1	2	0	2	7	3	7	12
	Density < 1.6 ft tall (#/ac)	0	5	23	0	7	23	0	14	34
	Density > 1.6 ft tall (#/ac)	0	7	21	0	25	57	10	37	61
	Height (ft)	0	6	14	0	7	13	9	14	17
	Canopy Base Height (ft)	<1	<1	2	<1	<1	1	<1	2	3
	Foliar Load (tons/ac)	0	0.10	0.28	0	0.22	0.70	0.40	0.80	1.50
	1-hr load (tons/ac)	0	0.02	0.05	0	0.04	0.12	0.07	0.14	0.26
	10-hr load (tons/ac)	0	0.04	0.11	0	0.09	0.29	0.17	0.33	0.61
	100-hr load (tons/ac)	0	0.08	0.17	0	0.16	0.58	0.33	0.63	1.14
	1000-hr load (tons/ac)	0	0.17	0.26	0	0.30	1.09	0.61	1.35	2.43
	1-hr Dead load (tons/ac)	0	0.02	0.02	0	0.03	0.10	0.06	0.12	0.22
	10-hr Dead load (tons/ac)	0	0.01	0.01	0	0.02	0.06	0.03	0.07	0.12
	Total load (tons/ac)	0	0.44	0.92	0	0.84	3.16	1.81	3.44	6.20
	Bulk Density (lbs/ft^3)	0	0.0007	0.0020	0	0.0015	0.0048	0.0020	0.0041	0.0069
PIMO	Cover (%)	0	<1	<1	0	<1	2	<1	5	11
	Density < 1.6 ft tall (#/ac)	0	5	23	0	14	23	0	18	45
	Density > 1.6 ft tall (#/ac)	0	3	3	0	11	29	6	26	47
	Height (ft)	0	1	4	0	6	15	4	14	28
	Canopy Base Height (ft)	<1	<1	1	<1	<1	2	<1	2	7
	Foliar Load (tons/ac)	0	0.02	0.07	0	0.09	0.15	0.01	0.44	1.04
	1-hr load (tons/ac)	0	0.01	0.04	0	0.05	0.07	<0.01	0.26	0.62
	10-hr load (tons/ac)	0	0.01	0.05	0	0.06	0.09	<0.01	0.29	0.69
	100-hr load (tons/ac)	0	0.02	0.08	0	0.10	0.15	0.01	0.53	1.27
	1000-hr load (tons/ac)	0	0.04	0.11	0	0.15	0.23	0.01	0.90	2.26
	1-hr Dead load (tons/ac)	0	<0.01	<0.01	0	0.01	0.02	<0.01	0.08	0.25
	10-hr Dead load (tons/ac)	0	<0.01	<0.01	0	0.01	0.02	<0.01	0.11	0.32
	Total load (tons/ac)	0	0.12	0.37	0	0.49	0.67	0.05	2.60	6.28
	Bulk Density (lbs/ft^3)	0	0.0002	0.0003	0	0.0006	0.0012	0.0002	0.0024	0.0051
CELE3	Cover (%)	0			0			0		
	Density < 1.6 ft tall (#/ac)									
	Density > 1.6 ft tall (#/ac)									
	Height (ft)									
	Canopy Base Height (ft)									

Pinyon-Juniper: Prescribed Fire

Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARAR8	Cover (%)	0			0			0		
	Density (#/ac)									
	Height (in)									
	1-hr + fol. load (tons/ac)									
	10-hr load (tons/ac)									
	Bulk Density (lbs/ft^3)									
ARNO4	Cover (%)	0	<1	2	0	<1	3	0	<1	<1
	Density (#/ac)	0	114	163	0	98	420	0	204	57
	Height (in)	0	2	9	0	2	9	0	2	4
	1-hr + fol. load (tons/ac)	0	<0.01	0.0039	0	0.02	0.05	0	0.01	0.01
	10-hr load (tons/ac)	0	<0.01	<0.01	0	0.03	0.07	0	0.01	0.01
	Bulk Density (lbs/ft^3)	0	0.0006	0.0003	0	0.0024	0.0054	0	0.0011	0.0003
ARTRW8	Cover (%)	1	5	9	<1	4	9	0	3	4
	Density (#/ac)	286	1469	3933	23	1339	2964	0	1154	1771
	Height (in)	13	19	27	0	12	19	0	8	17
	1-hr + fol. load (tons/ac)	<0.01	0.13	0.42	0	0.16	0.35	0	0.09	0.18
	10-hr load (tons/ac)	<0.01	0.08	0.14	0	0.11	0.21	0	0.05	0.13
	Bulk Density (lbs/ft^3)	0.0003	0.0057	0.0167	0	0.0079	0.0199	0	0.0044	0.0087
CHVI8	Cover (%)	3	11	20	<1	5	15	0	1	3
	Density (#/ac)	509	1743	2884	57	1133	2521	0	197	647
	Height (in)	10	13	17	9	11	15	0	9	18
	1-hr + fol. load (tons/ac)	0.03	0.23	0.57	<0.01	0.09	0.20	0	0.01	0.05
	10-hr load (tons/ac)	0	<0.01	<0.01	0	<0.01	0.01	0	<0.01*	0*
	Bulk Density (lbs/ft^3)	0.0015	0.0086	0.0199	0.0002	0.0039	0.0081	0	0.0007	0.0024
PUTR2	Cover (%)	0	1	3	0	2	4	0	2	4
	Density (#/ac)	0	84	245	0	84	216	0	87	250
	Height (in)	0	21	45	0	14	33	0	16	36
	1-hr + fol. load (tons/ac)	0	0.02	0.05	0	0.03	0.09	0	0.04	0.14
	10-hr load (tons/ac)	0	0.02	0.05	0	0.03	0.09	0	0.04	0.14
	Bulk Density (lbs/ft^3)	0	0.0006	0.0013	0	0.0008	0.0022	0	0.0014	0.0045

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Pinyon-Juniper: Cutting

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOS	Cover (%)	0	<1	<1	0	<1	<1	0	1	3
	Density < 1.6 ft tall (#/ac)	0	47	137	0	27	68	0	30	65
	Density > 1.6 ft tall (#/ac)	4	25	53	10	36	72	13	35	73
	Height (ft)	2	3	4	3	4	5	3	5	8
	Canopy Base Height (ft)	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Foliar Load (tons/ac)	<0.01	0.02	0.04	<0.01	0.02	0.05	<0.01	0.13	0.22
	1-hr load (tons/ac)	<0.01	<0.01	0.01	<0.01	<0.01	0.01	<0.01	0.02	0.04
	10-hr load (tons/ac)	<0.01	0.01	0.01	<0.01	0.01	0.02	<0.01	0.05	0.09
	100-hr load (tons/ac)	<0.01	0.01	0.02	<0.01	0.01	0.02	<0.01	0.08	0.13
	1000-hr load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	0	0.15	0.19
	1-hr Dead load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	0	0.01	0.02
	10-hr Dead load (tons/ac)	0	<0.01	<0.01	0	<0.01*	0*	0	0.01	0.01
	Total load (tons/ac)	<0.01	0.03	0.09	<0.01	0.05	0.10	<0.01	0.45	0.69
	Bulk Density (lbs/ft^3)	<0.0001	0.0003	0.0008	<0.0001	0.0004	0.0009	<0.0001	0.0011	0.0030
PIMO	Cover (%)	0	<1	<1	0	<1	<1	0	<1	2.13
	Density < 1.6 ft tall (#/ac)	0	5	23	0	54	135	0	34	65
	Density > 1.6 ft tall (#/ac)	0	12	30	4	31	55	4	22	45
	Height (ft)	0	2	4	3	3	4	2	3	5
	Canopy Base Height (ft)	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Foliar Load (tons/ac)	<0.01	<0.01	0.01	<0.01	0.01	0.03	0	0.05	0.15
	1-hr load (tons/ac)	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0	0.03	0.09
	10-hr load (tons/ac)	<0.01	<0.01	0.01	<0.01	0.01	0.02	0	0.03	0.10
	100-hr load (tons/ac)	<0.01	<0.01	0.01	<0.01	0.01	0.02	0	0.06	0.18
	1000-hr load (tons/ac)	<0.01	<0.01	0.01	<0.01	0.01	0.02	0	0.11	0.28
	1-hr Dead load (tons/ac)	0			0			0	0.01	0.02
	10-hr Dead load (tons/ac)				0	0.00	0	0	0.01	0.03
	Total load (tons/ac)	<0.01	0.02	0.04	<0.01	0.03	0.10	0	0.31	0.84
	Bulk Density (lbs/ft^3)	0	<0.0001	0.0001	<0.0001	0.0002	0.0005	0	0.0008	0.0019
CELE3	Cover (%)	0			0	<1	<1	0	2	7
	Density < 1.6 ft tall (#/ac)				0	3*	0*	0	7*	0*
	Density > 1.6 ft tall (#/ac)				0	6	6	0	24	77
	Height (ft)				0	<1	<1	0	1	5
	Canopy Base Height (ft)				<1	<1	<1	<1	<1	3

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Pinyon-Juniper: Cutting
Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARAR8	Cover (%)	0			0	<1	<1	0	1	7
	Density (#/ac)				0			0	208	715
	Height (in)				0	<1*	0*	0	4	12
	1-hr + fol. load (tons/ac)				0	<0.01*	0*	0	0.01	0.05
	10-hr load (tons/ac)				0	<0.01*	0*	0	0.01	0.04
	Bulk Density (lbs/ft^3)				0	<0.0001*	0*	0	0.0010	0.0034
ARNO4	Cover (%)	0	<1	1	0	<1	<1	0	<1	<1
	Density (#/ac)	0			0	51	91	0		
	Height (in)				0			0	1*	0*
	1-hr + fol. load (tons/ac)							0	0.02*	0*
	10-hr load (tons/ac)							0	0.02*	0*
	Bulk Density (lbs/ft^3)							0	0.0011*	0*
ARTRW8	Cover (%)	3	17	25	0	15	24	0	7	17
	Density (#/ac)	286	3159	5132	0	3042	5939	2	1699	4333
	Height (in)	14	20	31	0	16	22	0	16	34
	1-hr + fol. load (tons/ac)	0.03	0.72	1.24	0	0.64	1.12	0	0.34	1.05
	10-hr load (tons/ac)	0.03	0.59	1.25	0	0.55	1.10	0	0.23	0.88
	Bulk Density (lbs/ft^3)	0.0007	0.0301	0.0631	0	0.0290	0.0487	0	0.0160	0.0527
CHVI8	Cover (%)	2	6	10	<1	3	5	<1	1	2
	Density (#/ac)	779	1433	1958	159	914	1885	5	199	314
	Height (in)	10	13	17	10	13	15	1	13	22
	1-hr + fol. load (tons/ac)	0.03	0.10	0.19	0.0060	0.06	0.12	0	0.01	0.03
	10-hr load (tons/ac)	0	<0.01	<0.01	0	<0.01	0.01	0	<0.01	<0.01
	Bulk Density (lbs/ft^3)	0.0012	0.0040	0.0070	0.0003	0.0025	0.0043	0	0.0005	0.0008
PUTR2	Cover (%)	0	4	9	0	4	9	0	5	15
	Density (#/ac)	0	195	532	0	194	477	0	307	663
	Height (in)	0	20	48	0	16	36	0	18	45
	1-hr + fol. load (tons/ac)	0	0.14	0.43	0	0.09	0.28	0	0.16	0.40
	10-hr load (tons/ac)	0	0.15	0.47	0	0.09	0.28	0	0.16	0.42
	Bulk Density (lbs/ft^3)	0	0.0024	0.0076	0	0.0022	0.0064	0	0.0036	0.0094

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Utah-Juniper Fuels Guide User Notes

Site Notes

- All sites are characterized by the Loamy 12-14" ecological type (Caudle et al. 2013).
- General site information:
  - During the course of the study (2006-2018), the average annual precipitation across the sites was 12.3 in. (32.2 cm), and ranged 8.5-17.7 in. (21.6-45.0 cm; PRISM Climate Group)
  - Slopes ranged 3-33%, and the sites occurred on all aspects;
  - Loamy soil surface texture, with soil depths >20 in. (50.8 cm) and minimal stoniness.
- Four treatments were implemented at each site: untreated control, prescribed fire, mechanical cutting, and mechanical mastication.
- The three sites are located in western Utah. In prior fuels guides, an additional study site, Stansbury, was included. This site burned in a wildfire after two years post-treatment, and is therefore not included in this guide. The Stansbury site had higher precipitation than the other sites and was the only Utah Juniper site with Antelope Bitterbrush (PUTR2; Purshia tridentata) or mountain big sagebrush (ARTRV; Artemisia tridentata ssp. vaseyana). Therefore, prior fuels guides may have higher shrub fuel loads that include antelope bitterbrush and mountain big sagebrush.
- Onaqui is the only site with an active grazing allotment; all subplots at Onaqui may have been grazed prior to construction of exclosures at the beginning of the SageSTEP.
- Site names, number of subplots, and elevation ranges for data used are available in Table 4. Site locations are shown in Figure 4.

Guide Notes

- This guide is organized by four treatments (untreated control, prescribed fire, cutting, and mastication) and three woodland development phases defined by pre-treatment tree stand cover and understory characteristics (Miller et al. 2005):
  - Phase I: Trees are present on the site, but the understory shrub and herbaceous components are the dominant influence on ecological processes (hydrology, nutrient and energy cycling).
  - Phase II: Trees are co-dominant with the understory shrub and herbaceous components. All three layers influence ecological processes.
  - Phase III: Trees are the dominant vegetation and the primary layer influencing ecological processes.
- The caption to the left of each photo denotes the canopy cover (%) by functional group for subplot depicted in the photo.
- Sampling took place between June and early September in 2016, 2017, and 2018.
- Dominant graminoids include: ACHY, BRTE, ELEL5, HECO26, POSE, PSSP6, PLJA (see Table 5 for common and scientific names)
- Annual grasses include: BRTE (see Table 5 for common and scientific names)
- For each variable, the following descriptive statistics are reported: mean, 10th percentile, and 90th percentile. The 10th percentile column indicates that 10% of the data were less than the 10th percentile statistic, and the 90th percentile indicates that 90% of the data were less than the 90th percentile statistic. The 10th and 90th percentiles were used instead of minimum and maximum because there were extreme values in the dataset.
- The designation of "NA" indicates data were not collected or available.
- A table of species codes can be found in Table 5.

Table 4. Summary of subplot information for the Utah Juniper Subguide. All sites within the Utah Juniper region (Onaqui, Scipio, and Greenville Bench) are represented in each phase/treatment combination.

Phase	Treatment	# of Sampling Plots	Elevation Range (ft)	Elevation Range (m)
1	Control	14	5617-5919	1712-1804
	Prescribed Fire	12	5617-6024	1712-1836
	Cutting	11	5696-5856	1736-1785
	Mastication	14	5558-5801	1694-1768
2	Control	18	5617-5919	1712-1804
	Prescribed Fire	21	5617-6024	1712-1836
	Cutting	18	5696-5856	1736-1785
	Mastication	18	5558-5801	1694-1768
3	Control	15	5617-5919	1712-1804
	Prescribed Fire	13	5617-6024	1712-1836
	Cutting	17	5696-5856	1736-1785
	Mastication	13	5558-5801	1694-1768

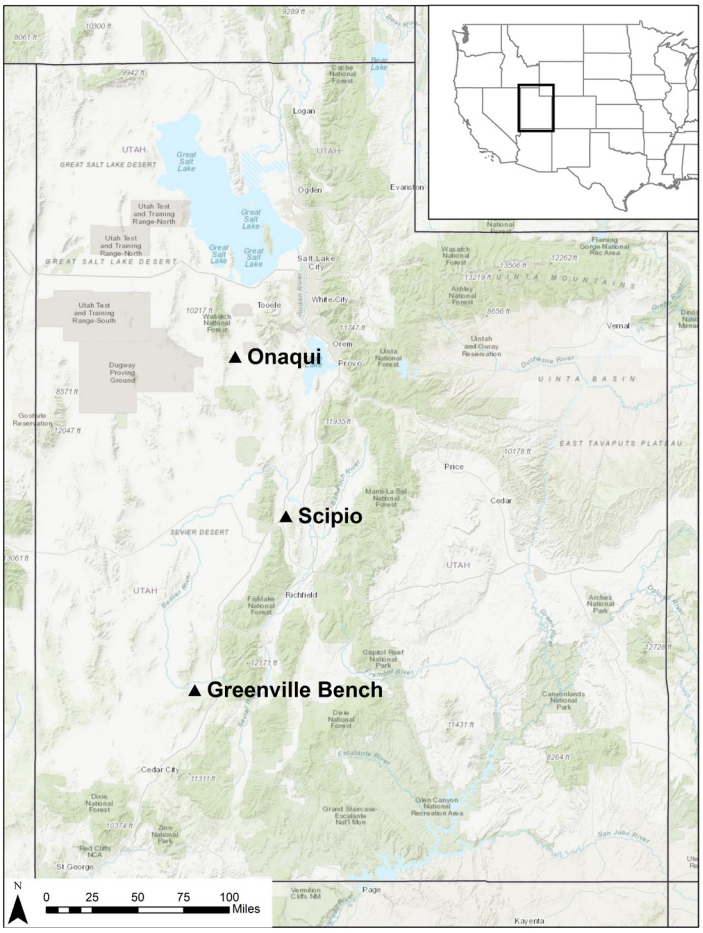


Figure 4. Location of study sites in Utah Juniper Subguide.

Table 5. USDA Plant codes used in the Utah Juniper Subguide.

	USDA Code	Scientific Name	Common Name
Trees	JUOS	*Juniper osteosperma*	Utah juniper
	PIED	*Pinus edulis*	two-needle pinyon pine
Shrubs	ARTRW8	*Artemisia tridentata* ssp. *wyomingensis*	Wyoming big sagebrush
	CHVI8	*Chrysothamnus viscidiflorus*	yellow rabbitbrush
Grasses	ACHY	*Achnatherum hymenoides*	Indian ricegrass
	BRTE	*Bromus tectorum*	cheatgrass
	ELEL5	*Elymus elymoides*	bottlebrush squirreltail
	HECO26	*Hesperostipa comata*	needle-and-thread
	PLJA	*Pleuraphis jamesii*	James' galleta
	POSE	*Poa secunda*	Sandberg bluegrass
	PSSP6	*Pseudoroegneria spicata*	bluebunch wheatgrass

Utah Juniper: Control, Phase 1

Greenville Bench 1804 m | 5919 ft 6/13/2017 Cover (%)	
Tree	15
Shrub	19
Perennial Grass	9
Annual Grass	2
Bare Ground	47

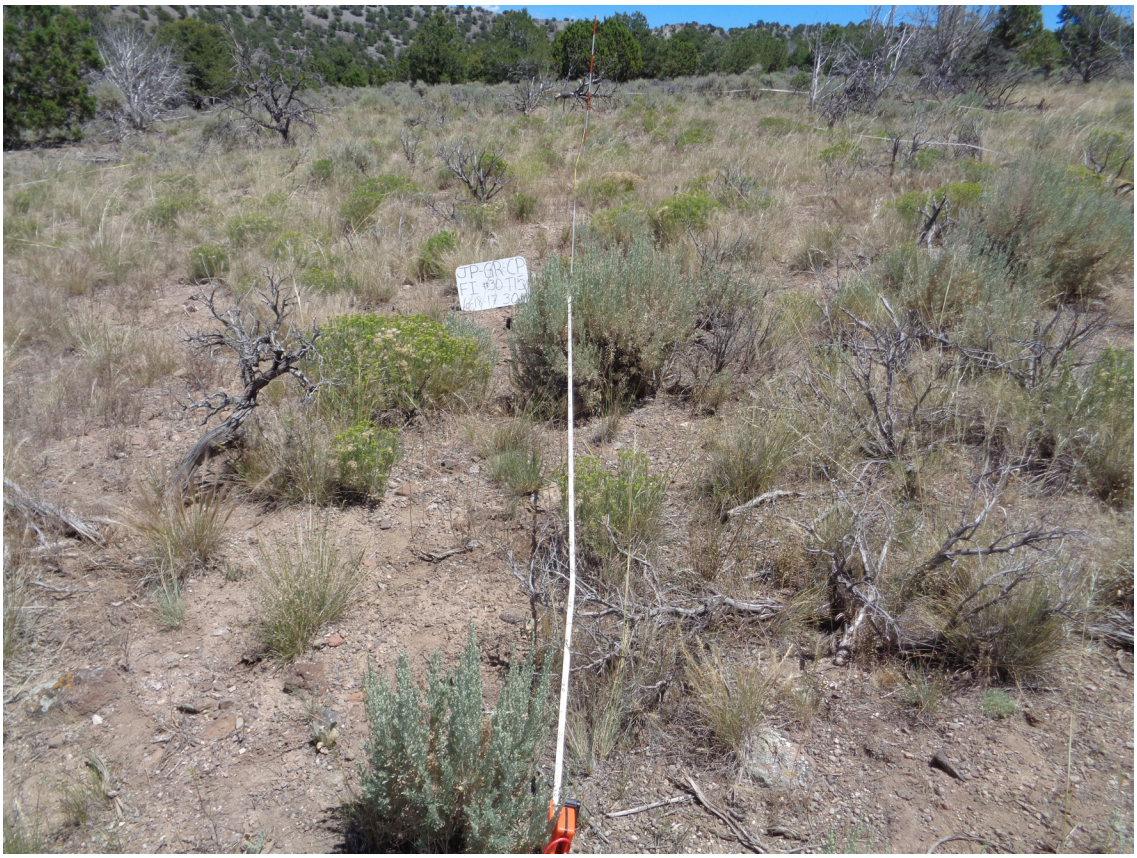
Onaqui 1712 m | 5617 ft 6/28/2016 Cover (%)	
Tree	3
Shrub	14
Perennial Grass	8
Annual Grass	<1
Bare Ground	36

Utah Juniper: Control, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	6	10	16
	Shrub	Total	11	18	26
	Herbaceous	Perennial Grass	10	18	26
		Annual Grass	<1	9	21
		Forb	1	23	40
	Litter & Duff	Interspace Litter	5	10	15
	Bare Ground	Bare Ground	12	22	33
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	29	90
		JUOS & PIED > 1.6 ft tall	35	83	121
	Shrub	Total	2156	4856	7941
Height (ft)	Tree	JUOS & PIED	2	7	13
		JUOS & PIED Canopy Base	<1	<1	1
Height (in)	Shrub	Total	13	16	20
	Herbaceous	Grass	5	9	14
		Forb	3	4	5
Fuel Loading (tons/acre)	Tree	JUOS & PIED	1.73	4.04	6.91
	Shrub	Total	1.01	1.99	3.78
	Herbaceous	Live	0.06	0.13	0.25
		Dead	0	0.02	0.04
	Down Woody Debris	10-hr	0.16	0.52	0.85
		100-hr	0.30	1.15	2.22
		1000-hr sound	0	0.46	2.02
		1000-hr rotten	0	0.20	0.48
	Litter & Duff	Interspace Litter	0.05	0.17	0.30
		Tree Litter + Duff	1.32	3.08	5.13
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	0.0038	0.0072	0.0127
	Shrub	Total	0.0230	0.0348	0.0439
	Herbaceous	Live + Dead	0.0071	0.0153	0.0287

Utah Juniper: Prescribed Fire, Phase 1

Greenville Bench 1836 m | 6024 ft 6/18/2017 Cover (%)	
Tree	2
Shrub	17
Perennial Grass	36
Annual Grass	15
Bare Ground	27



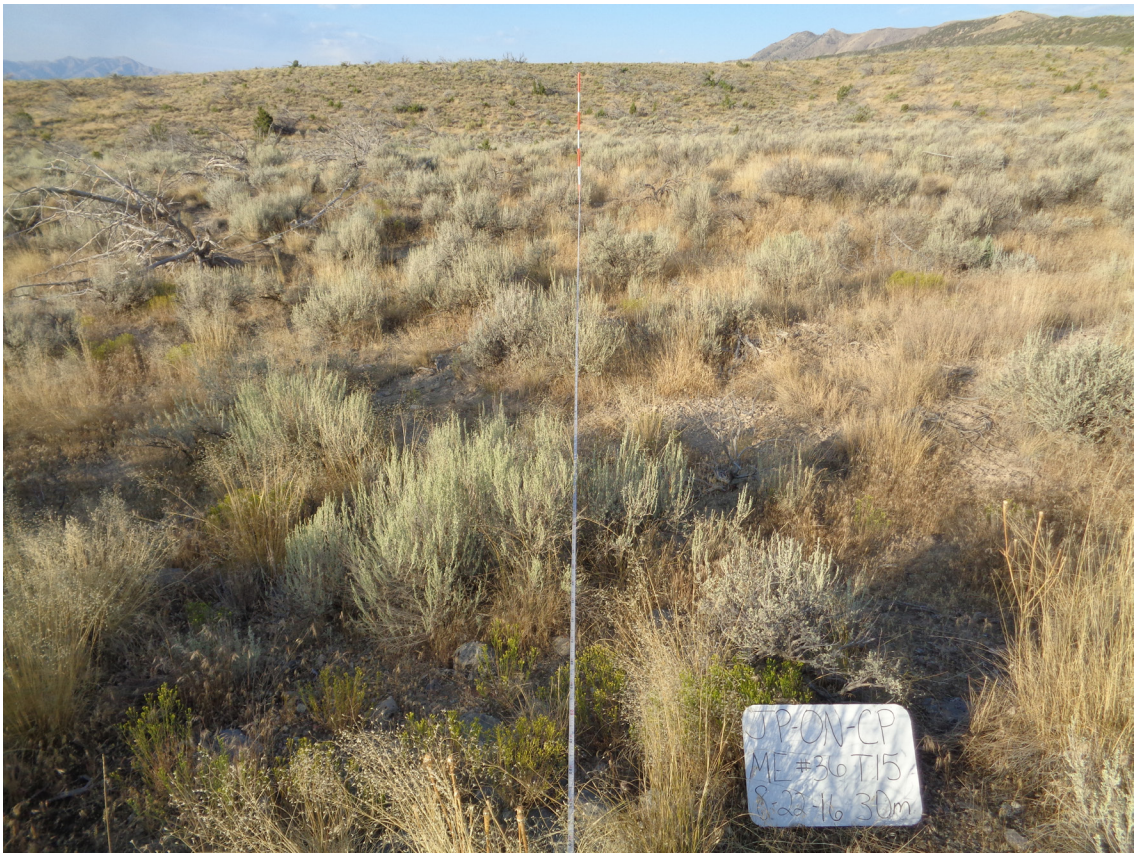
Onaqui 1712 m | 5617 ft 7/14/2016 Cover (%)	
Tree	0
Shrub	10
Perennial Grass	35
Annual Grass	30
Bare Ground	9

Utah Juniper: Prescribed Fire, Phase 1

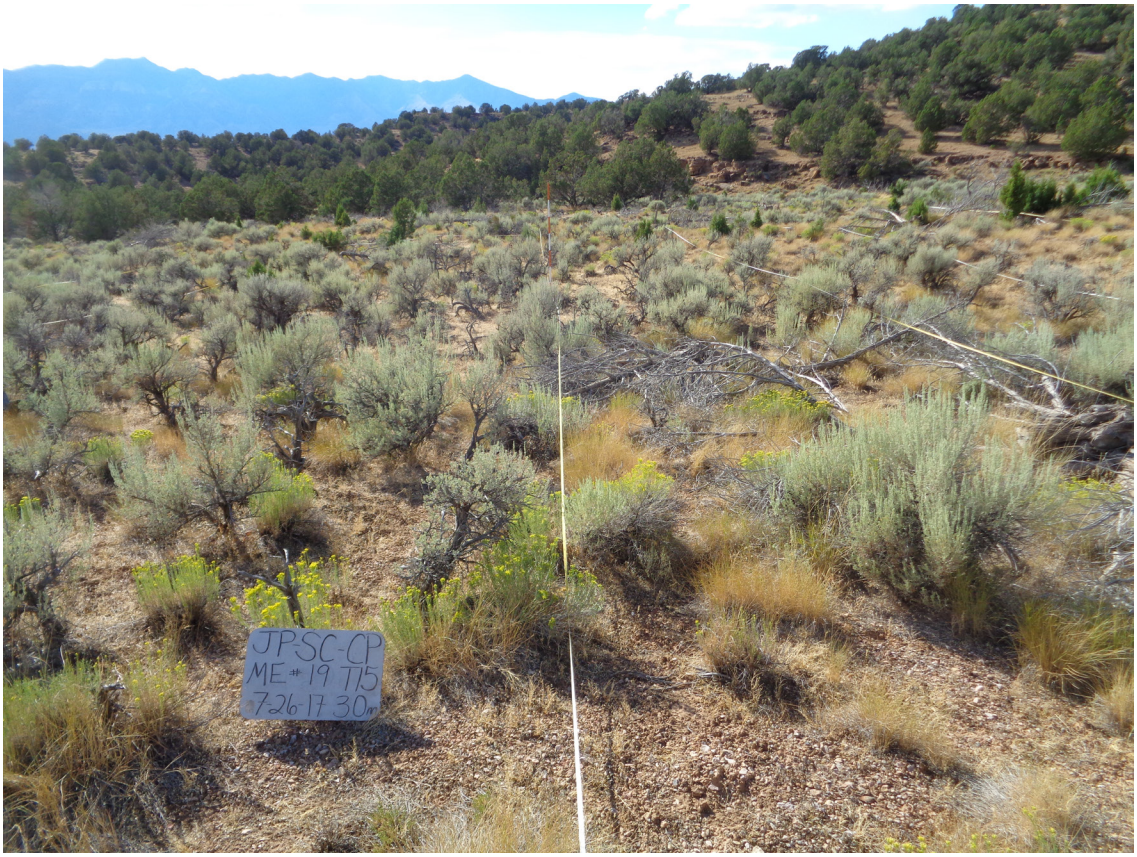
Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	0	<1	2
	Shrub	Total	2	12	22
	Herbaceous	Perennial Grass	12	34	48
		Annual Grass	8	19	33
		Forb	6	26	53
	Litter & Duff	Interspace Litter	7	10	17
	Bare Ground	Bare Ground	8	15	24
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	4	20
		JUOS & PIED > 1.6 ft tall	0	3	8
	Shrub	Total	755	5911	13020
Height (ft)	Tree	JUOS & PIED	3	8	14
		JUOS & PIED Canopy Base	<1	<1	2
Height (in)	Shrub	Total	11	14	15
	Herbaceous	Grass	7	9	11
		Forb	1	5	10
Fuel Loading (tons/acre)	Tree	JUOS & PIED	0	0.26	0.91
	Shrub	Total	0.07	0.64	1.77
	Herbaceous	Live	0.20	0.34	0.52
		Dead	<0.01	0.04	0.07
	Down Woody Debris	10-hr	0.18	0.36	0.51
		100-hr	0.10	0.57	0.93
		1000-hr sound	0	0.21	0.46
		1000-hr rotten	0	0.08	0.23
	Litter & Duff	Interspace Litter	0.08	0.17	0.27
		Tree Litter + Duff	0	0.07	0.27
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	0	0.0003	0.0012
	Shrub	Total	0.0007	0.0134	0.0270
	Herbaceous	Live + Dead	0.0178	0.0320	0.0525

Utah Juniper: Cutting, Phase 1

Onaqui	
1736 m | 5696 ft 8/22/2016	
Cover (%)	
Tree	0
Shrub	24
Perennial Grass	19
Annual Grass	36
Bare Ground	21



Scipio	
1750 m | 5741 ft 7/26/2017	
Cover (%)	
Tree	1
Shrub	26
Perennial Grass	39
Annual Grass	3
Bare Ground	9

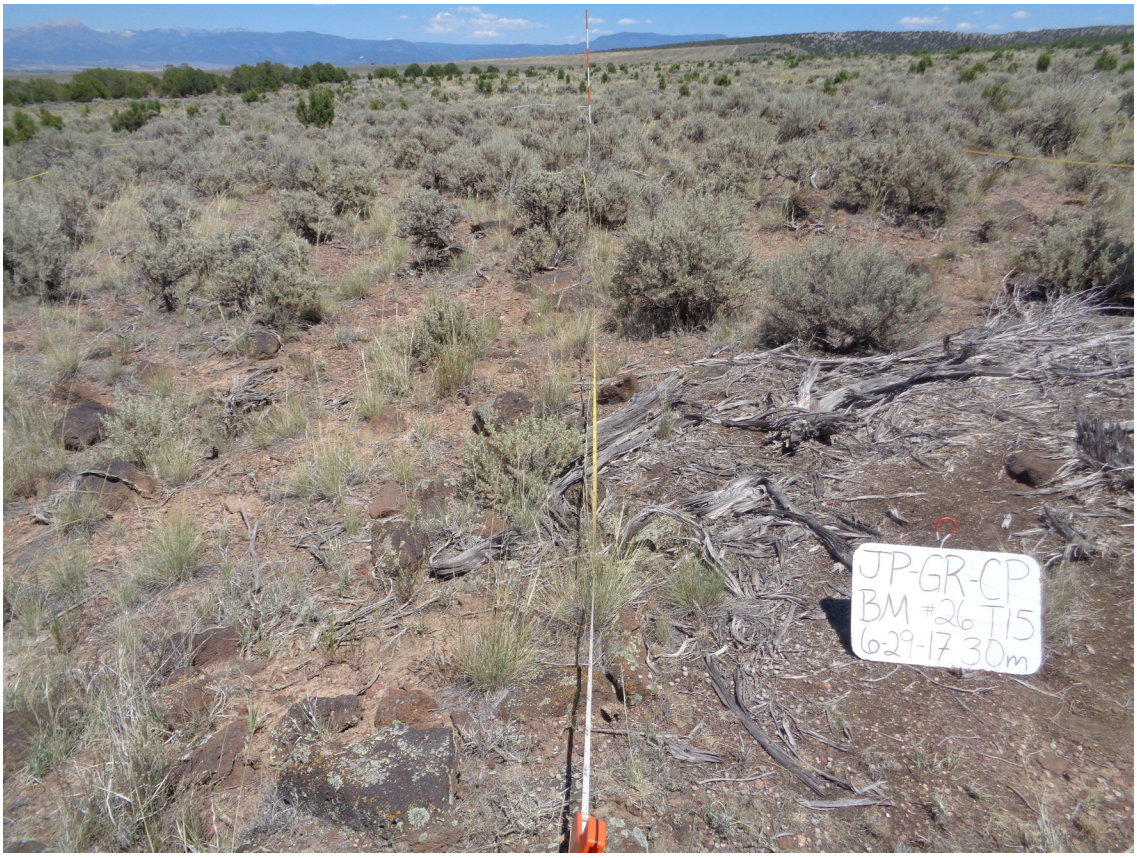


Utah Juniper: Cutting, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	0	<1	1
	Shrub	Total	19	24	31
	Herbaceous	Perennial Grass	19	26	39
		Annual Grass	2	16	36
		Forb	2	19	47
	Litter & Duff	Interspace Litter	8	10	14
	Bare Ground	Bare Ground	7	17	28
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	33	90
		JUOS & PIED > 1.6 ft tall	4	26	74
	Shrub	Total	3058	7252	12073
Height (ft)	Tree	JUOS & PIED	2	4	6
		JUOS & PIED Canopy Base	<1	<1	<1
Height (in)	Shrub	Total	12	16	23
	Herbaceous	Grass	8	10	15
		Forb	3	4	5
Fuel Loading (tons/acre)	Tree	JUOS & PIED	<0.01	0.06	0.14
	Shrub	Total	0.86	2.46	4.31
	Herbaceous	Live	0.08	0.16	0.35
		Dead	0.00	0.04	0.10
	Down Woody Debris	10-hr	0.12	0.60	1.37
		100-hr	0.39	1.12	2.07
		1000-hr sound	0	0.73	1.56
		1000-hr rotten	0	0.08	0.22
	Litter & Duff	Interspace Litter	0.09	0.20	0.33
		Tree Litter + Duff	<0.01	0.04	0.08
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	<0.0001	0.0004	0.0011
	Shrub	Total	0.0178	0.0434	0.0746
	Herbaceous	Live + Dead	0.0106	0.0174	0.0301

Utah Juniper: Mastication, Phase 1

Greenville Bench 1768 m | 5801 ft 6/29/2017 Cover (%)	
Tree	<1
Shrub	16
Perennial Grass	28
Annual Grass	5
Bare Ground	30



Scipio 1694 m | 5558 ft 7/28/2017 Cover (%)	
Tree	0
Shrub	13
Perennial Grass	46
Annual Grass	<1
Bare Ground	21

Utah Juniper: Mastication, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	<1	<1	1
	Shrub	Total	11	14	18
	Herbaceous	Perennial Grass	28	36	48
		Annual Grass	0	9	23
		Forb	3	10	19
	Litter & Duff	Interspace Litter	7	11	15
	Bare Ground	Bare Ground	12	22	31
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	32	83
		JUOS & PIED > 1.6 ft tall	5	32	69
	Shrub	Total	2817	4374	6587
Height (ft)	Tree	JUOS & PIED	2	3	5
		JUOS & PIED Canopy Base	<1	<1	1
Height (in)	Shrub	Total	11	14	16
	Herbaceous	Grass	6	10	12
		Forb	3	3	4
Fuel Loading (tons/acre)	Tree	JUOS & PIED	<0.01	0.04	0.12
	Shrub	Total	0.47	1.01	1.77
	Herbaceous	Live	0.12	0.27	0.47
		Dead	0.02	0.07	0.16
	Down Woody Debris	*1-hr	0.01	0.44	0.83
		*10-hr	0.14	1.12	2.47
		100-hr	0.14	1.10	1.95
		1000-hr sound	0	0.26	0.70
		1000-hr rotten	0	0.10	0.32
	Litter & Duff	Interspace Litter	0.07	0.19	0.35
		Tree Litter + Duff	<0.01	0.06	0.21
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	<0.0001	0.0004	0.0011
	Shrub	Total	0.0121	0.0238	0.0395
	Herbaceous	Live + Dead	0.0159	0.0323	0.0422

*1-hr and 10-hr masticated down woody debris were sampled using different methods than the 100-hr or 1000-hr fuels in the mastication treatments, or 10-hr fuels in the other treatments; see Methods section.

Utah Juniper: Control, Phase 2

Onaqui	
1712 m | 5617 ft 6/26/2016	
Cover (%)	
Tree	18
Shrub	7
Perennial Grass	15
Annual Grass	<1
Bare Ground	33

Scipio	
1753 m | 5751 ft 7/2/2017	
Cover (%)	
Tree	34
Shrub	10
Perennial Grass	10
Annual Grass	15
Bare Ground	23

Utah Juniper: Control, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	16	22	32
	Shrub	Total	4	10	20
	Herbaceous	Perennial Grass	7	14	23
		Annual Grass	<1	5	13
		Forb	3	20	35
	Litter & Duff	Interspace Litter	5	10	17
	Bare Ground	Bare Ground	12	26	40
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	70	146
		JUOS & PIED > 1.6 ft tall	55	118	189
	Shrub	Total	1439	3251	5805
Height (ft)	Tree	JUOS & PIED	3	9	15
		JUOS & PIED Canopy Base	<1	<1	2
Height (in)	Shrub	Total	10	15	20
	Herbaceous	Grass	4	7	11
		Forb	2	3	5
Fuel Loading (tons/acre)	Tree	JUOS & PIED	6.28	9.83	14.44
	Shrub	Total	0.08	0.73	1.79
	Herbaceous	Live	0.02	0.07	0.15
		Dead	0	0.02	0.04
	Down Woody Debris	10-hr	0.15	0.41	0.96
		100-hr	0.18	0.78	1.92
		1000-hr sound	0	0.18	0.42
		1000-hr rotten	0	0.07	0.22
	Litter & Duff	Interspace Litter	0.07	0.25	0.48
		Tree Litter + Duff	3.90	7.90	11.71
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	0.0089	0.0131	0.0186
	Shrub	Total	0.0021	0.0144	0.0318
	Herbaceous	Live + Dead	0.0050	0.0108	0.0178

Utah Juniper: Prescribed Fire, Phase 2

Onaqui 1712 m | 5617 ft 7/14/2016	
Cover (%)	
Tree	0
Shrub	12
Perennial Grass	26
Annual Grass	17
Bare Ground	21

Scipio 1742 m | 5715 ft 7/2/2017	
Cover (%)	
Tree	<1
Shrub	5
Perennial Grass	24
Annual Grass	14
Bare Ground	5

Utah Juniper: Prescribed Fire, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	0	1	3
	Shrub	Total	3	11	18
	Herbaceous	Perennial Grass	20	33	47
		Annual Grass	11	21	29
		Forb	4	29	56
	Litter & Duff	Interspace Litter	4	9	14
	Bare Ground	Bare Ground	8	15	25
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	18	45
		JUOS & PIED > 1.6 ft tall	0	9	21
	Shrub	Total	1259	4419	8836
Height (ft)	Tree	JUOS & PIED	2	8	14
		JUOS & PIED Canopy Base	<1	1	2
Height (in)	Shrub	Total	10	14	20
	Herbaceous	Grass	8	11	15
		Forb	2	5	5
Fuel Loading (tons/acre)	Tree	JUOS & PIED	0	0.57	1.41
	Shrub	Total	<0.01	0.46	1.63
	Herbaceous	Live	0.15	0.30	0.45
		Dead	0.01	0.06	0.09
	Down Woody Debris	10-hr	0.27	0.62	1.31
		100-hr	0.39	1.19	2.02
		1000-hr sound	0	0.61	1.48
		1000-hr rotten	0	0.06	0.22
	Litter & Duff	Interspace Litter	0.07	0.18	0.35
		Tree Litter + Duff	0	0.17	0.55
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	0	0.0009	0.0019
	Shrub	Total	0.0004	0.0107	0.0294
	Herbaceous	Live + Dead	0.0145	0.0278	0.0380

Utah Juniper: Cutting, Phase 2

Greenville Bench 1785 m | 5856 ft 6/20/2017	
Cover (%)	
Tree	<1
Shrub	27
Perennial Grass	26
Annual Grass	11
Bare Ground	18

Scipio 1750 m | 5741 ft 7/25/2017	
Cover (%)	
Tree	<1
Shrub	29
Perennial Grass	16
Annual Grass	7
Bare Ground	9

Utah Juniper: Cutting, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	<1	<1	1
	Shrub	Total	14	22	29
	Herbaceous	Perennial Grass	16	27	34
		Annual Grass	2	11	23
		Forb	2	19	39
	Litter & Duff	Interspace Litter	4	10	15
	Bare Ground	Bare Ground	9	18	29
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	59	142
		JUOS & PIED > 1.6 ft tall	15	42	71
	Shrub	Total	2289	5758	11540
Height (ft)	Tree	JUOS & PIED	2	4	5
		JUOS & PIED Canopy Base	<1	<1	<1
Height (in)	Shrub	Total	13	16	21
	Herbaceous	Grass	7	9	14
		Forb	2	5	8
Fuel Loading (tons/acre)	Tree	JUOS & PIED	0.03	0.10	0.27
	Shrub	Total	0.51	1.97	3.87
	Herbaceous	Live	0.12	0.21	0.31
		Dead	<0.01	0.04	0.07
	Down Woody Debris	10-hr	0.34	0.70	1.06
		100-hr	0.76	1.55	2.74
		1000-hr sound	0.13	1.81	3.62
		1000-hr rotten	0	0.10	0.21
	Litter & Duff	Interspace Litter	0.05	0.20	0.35
		Tree Litter + Duff	0.02	0.14	0.23
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	0.0003	0.0007	0.0017
	Shrub	Total	0.0153	0.0371	0.0599
	Herbaceous	Live + Dead	0.0108	0.0223	0.0365

Utah Juniper: Mastication, Phase 2

Greenville Bench 1768 m | 5801 ft 6/29/2017 Cover (%)	
Tree	2
Shrub	7
Perennial Grass	42
Annual Grass	22
Bare Ground	14

Onaqui 1704 m | 5591 ft 8/23/2016 Cover (%)	
Tree	<1
Shrub	20
Perennial Grass	22
Annual Grass	2
Bare Ground	33

Utah Juniper: Mastication, Phase 2

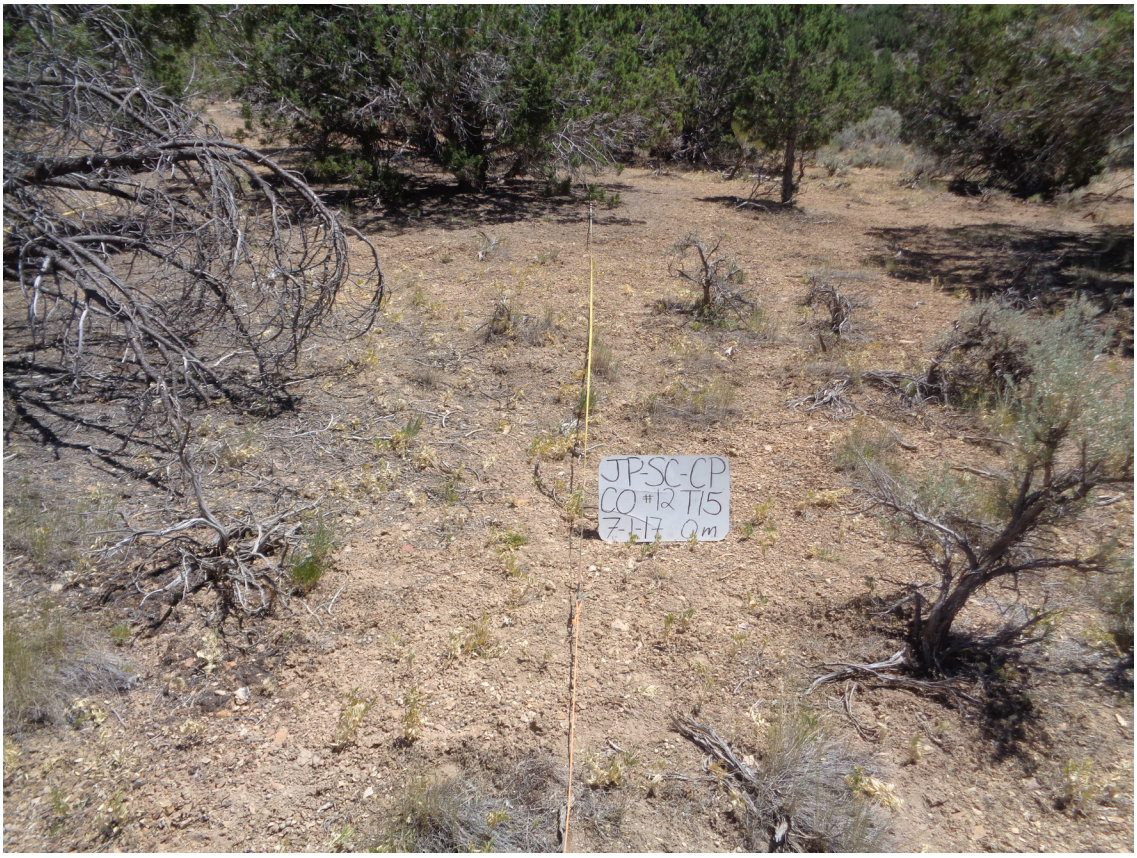
Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	<1	<1	2
	Shrub	Total	8	15	20
	Herbaceous	Perennial Grass	22	30	38
		Annual Grass	<1	10	21
		Forb	2	14	26
	Litter & Duff	Interspace Litter	7	12	18
	Bare Ground	Bare Ground	14	21	29
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	31	68
		JUOS & PIED > 1.6 ft tall	8	49	82
	Shrub	Total	2754	4882	7673
Height (ft)	Tree	JUOS & PIED	2	3	5
		JUOS & PIED Canopy Base	<1	<1	<1
Height (in)	Shrub	Total	11	13	15
	Herbaceous	Grass	6	9	11
		Forb	2	3	5
Fuel Loading (tons/acre)	Tree	JUOS & PIED	<0.01	0.10	0.17
	Shrub	Total	0.17	0.92	1.78
	Herbaceous	Live	0.09	0.19	0.36
		Dead	0.01	0.03	0.07
	Down Woody Debris	*1-hr	0.26	0.76	1.51
		*10-hr	0.60	1.70	3.01
		100-hr	0.22	1.12	2.15
		1000-hr sound	0	0.51	1.24
		1000-hr rotten	0	0.57	0.84
	Litter & Duff	Interspace Litter	0.10	0.25	0.40
		Tree Litter + Duff	<0.01	0.17	0.37
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	<0.0001	0.0007	0.0013
	Shrub	Total	0.0073	0.0238	0.0421
	Herbaceous	Live + Dead	0.0105	0.0221	0.0367

*1-hr and 10-hr masticated down woody debris were sampled using different methods than the 100-hr or 1000-hr fuels in the mastication treatments, or 10-hr fuels in the other treatments; see Methods section.

Utah Juniper: Control, Phase 3

Greenville Bench 1804 m | 5919 ft 6/15/2017	
Cover (%)	
Tree	42
Shrub	<1
Perennial Grass	0
Annual Grass	0
Bare Ground	39

Scipio 1753 m | 5751 ft 7/1/2017	
Cover (%)	
Tree	29
Shrub	1
Perennial Grass	2
Annual Grass	2
Bare Ground	34



Utah Juniper: Control, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	28	39	53
	Shrub	Total	1	3	5
	Herbaceous	Perennial Grass	2	9	19
		Annual Grass	0	2	4
		Forb	1	13	22
	Litter & Duff	Interspace Litter	5	9	15
	Bare Ground	Bare Ground	23	31	38
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	9	84	171
		JUOS & PIED > 1.6 ft tall	106	189	310
	Shrub	Total	620	1746	3265
Height (ft)	Tree	JUOS & PIED	4	10	15
		JUOS & PIED Canopy Base	<1	1	2
Height (in)	Shrub	Total	12	15	19
	Herbaceous	Grass	4	5	6
		Forb	1	3	4
Fuel Loading (tons/acre)	Tree	JUOS & PIED	10.50	16.91	23.26
	Shrub	Total	0.03	0.24	0.48
	Herbaceous	Live	<0.01	0.08	0.08
		Dead	0	<0.01	0.02
	Down Woody Debris	10-hr	0.11	0.39	0.69
		100-hr	0.02	0.60	1.24
		1000-hr sound	0	0.14	0.42
		1000-hr rotten	0	0.28	0.84
	Litter & Duff	Interspace Litter	0.04	0.27	0.50
		Tree Litter + Duff	7.71	10.20	13.48
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	0.0155	0.0206	0.0262
	Shrub	Total	0.0011	0.0062	0.0105
	Herbaceous	Live + Dead	0.0009	0.0132	0.0185

Utah Juniper: Prescribed Fire, Phase 3

Onaqui 1712 m | 5617 ft 7/17/2016	
Cover (%)	
Tree	2
Shrub	7
Perennial Grass	31
Annual Grass	15
Bare Ground	31

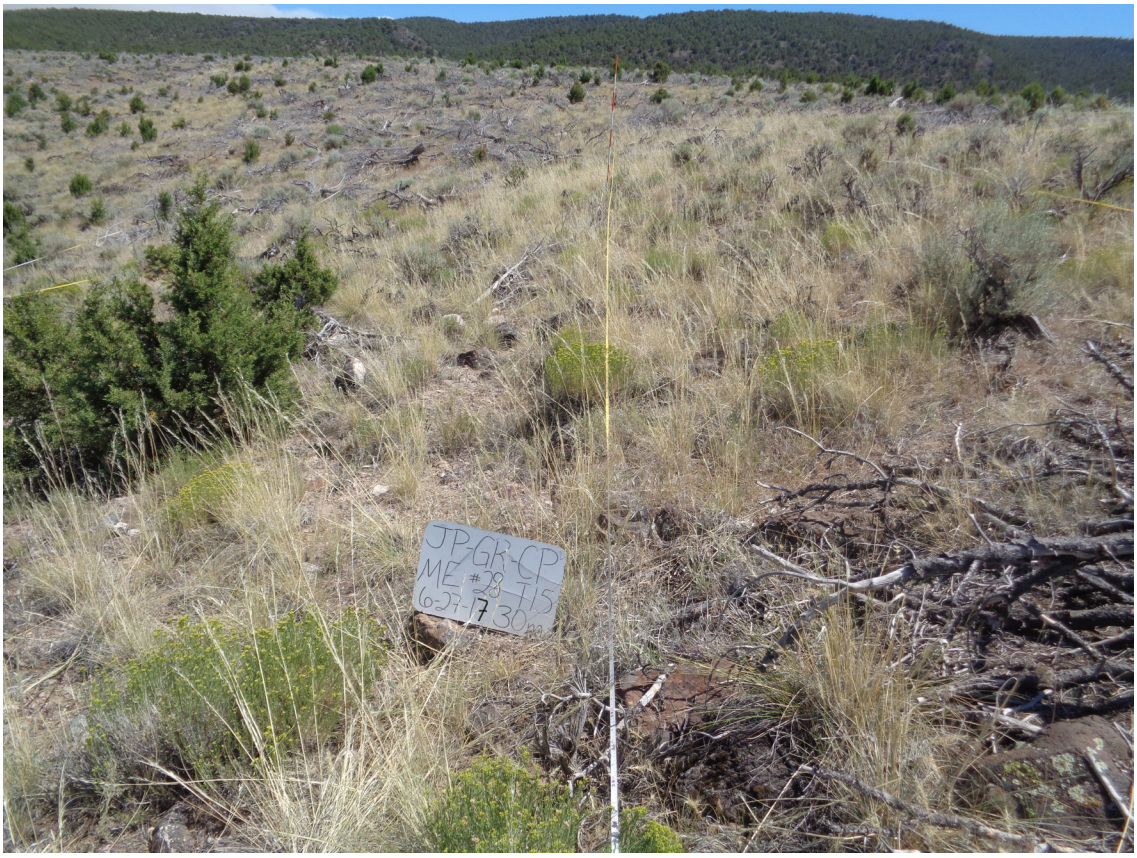
Scipio 1742 m | 5715 ft 7/3/2017	
Cover (%)	
Tree	1
Shrub	1
Perennial Grass	2
Annual Grass	33
Bare Ground	8

Utah Juniper: Prescribed Fire, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	1	9	17
	Shrub	Total	2	6	9
	Herbaceous	Perennial Grass	10	25	36
		Annual Grass	9	25	46
		Forb	6	25	46
	Litter & Duff	Interspace Litter	6	10	14
	Bare Ground	Bare Ground	7	15	28
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	38	86
		JUOS & PIED > 1.6 ft tall	12	48	97
	Shrub	Total	994	3409	6345
Height (ft)	Tree	JUOS & PIED	4	11	16
		JUOS & PIED Canopy Base	<1	2	3
Height (in)	Shrub	Total	9	12	13
	Herbaceous	Grass	9	12	17
		Forb	3	5	8
Fuel Loading (tons/acre)	Tree	JUOS & PIED	0.64	3.79	7.01
	Shrub	Total	0	0.29	0.74
	Herbaceous	Live	0.08	0.22	0.36
		Dead	<0.01	0.05	0.11
	Down Woody Debris	10-hr	0.36	0.72	1.26
		100-hr	0.63	2.07	4.68
		1000-hr sound	0.27	0.94	1.97
		1000-hr rotten	0	0.05	0.16
	Litter & Duff	Interspace Litter	0.05	0.20	0.44
		Tree Litter + Duff	0.13	1.42	3.70
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	0.0007	0.0052	0.0091
	Shrub	Total	0	0.0046	0.0103
	Herbaceous	Live + Dead	0.0091	0.0186	0.0308

Utah Juniper: Cutting, Phase 3

Greenville Bench 1785 m | 5856 ft 6/27/2017 Cover (%)	
Tree	<1
Shrub	17
Perennial Grass	44
Annual Grass	26
Bare Ground	6



Onaqui 1736 m | 5696 ft 8/20/2016 Cover (%)	
Tree	<1
Shrub	15
Perennial Grass	29
Annual Grass	1
Bare Ground	33

Utah Juniper: Cutting, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	<1	1	2
	Shrub	Total	5	11	18
	Herbaceous	Perennial Grass	26	33	42
		Annual Grass	1	15	29
		Forb	5	18	39
	Litter & Duff	Interspace Litter	4	9	14
	Bare Ground	Bare Ground	11	17	23
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	81	175
		JUOS & PIED > 1.6 ft tall	37	74	115
	Shrub	Total	1709	4265	8026
Height (ft)	Tree	JUOS & PIED	2	4	5
		JUOS & PIED Canopy Base	<1	<1	1
Height (in)	Shrub	Total	9	14	20
	Herbaceous	Grass	7	10	12
		Forb	4	5	6
Fuel Loading (tons/acre)	Tree	JUOS & PIED	0.07	0.19	0.38
	Shrub	Total	0	0.46	0.81
	Herbaceous	Live	0.13	0.34	0.63
		Dead	0.03	0.10	0.18
	Down Woody Debris	10-hr	0.42	0.95	1.40
		100-hr	1.29	2.34	3.71
		1000-hr sound	2.24	5.79	10.95
		1000-hr rotten	0	0.20	0.32
	Litter & Duff	Interspace Litter	0.09	0.18	0.28
		Tree Litter + Duff	0.02	0.22	0.67
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	0.0005	0.0013	0.0021
	Shrub	Total	0	0.0098	0.0210
	Herbaceous	Live + Dead	0.0162	0.0370	0.0610

Utah Juniper: Mastication, Phase 3

Onaqui	
1704 m | 5591 ft 9/18/2016	
Cover (%)	
Tree	<1
Shrub	11
Perennial Grass	34
Annual Grass	7
Bare Ground	22

Scipio	
1694 m | 5558 ft 7/27/2017	
Cover (%)	
Tree	<1
Shrub	16
Perennial Grass	21
Annual Grass	1
Bare Ground	28

Utah Juniper: Mastication, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOS & PIED	<1	<1	2
	Shrub	Total	4	11	18
	Herbaceous	Perennial Grass	17	25	34
		Annual Grass	2	16	31
		Forb	3	14	33
	Litter & Duff	Interspace Litter	4	10	16
	Bare Ground	Bare Ground	12	19	27
Density (#/acre)	Tree	JUOS & PIED < 1.6 ft tall	0	38	135
		JUOS & PIED > 1.6 ft tall	6	58	105
	Shrub	Total	1192	3448	5976
Height (ft)	Tree	JUOS & PIED	2	3	6
		JUOS & PIED Canopy Base	0	<1	<1
Height (in)	Shrub	Total	9	13	17
	Herbaceous	Grass	8	10	12
		Forb	2	4	6
Fuel Loading (tons/acre)	Tree	JUOS & PIED	0.01	0.14	0.37
	Shrub	Total	<0.01	0.60	1.47
	Herbaceous	Live	0.12	0.23	0.38
		Dead	0.01	0.04	0.07
	Down Woody Debris	*1-hr	0.16	1.31	2.45
		*10-hr	0.20	2.12	3.37
		100-hr	0.84	1.79	3.09
		1000-hr sound	0.15	1.74	5.10
		1000-hr rotten	0	0.48	1.94
	Litter & Duff	Interspace Litter	0.13	0.35	0.66
		Tree Litter + Duff	<0.01	0.28	0.94
Bulk Density (lbs/ft^3)	Tree	JUOS & PIED Canopy	<0.0001	0.0009	0.0023
	Shrub	Total	0.0006	0.0171	0.0342
	Herbaceous	Live + Dead	0.0124	0.0249	0.0410

*1-hr and 10-hr masticated down woody debris were sampled using different methods than the 100-hr or 1000-hr fuels in the mastication treatments, or 10-hr fuels in the other treatments; see Methods section.

Utah Juniper: Control

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOS	Cover (%)	2	8	16	12	18	23	13	26	40
	Density < 1.6 ft tall (#/ac)	0	29	90	0	45	97	0	57	130
	Density > 1.6 ft tall (#/ac)	22	67	121	45	81	120	48	103	146
	Height (ft)	7	10	15	9	12	15	12	13	16
	Canopy Base Height (ft)	<1	<1	1	<1	<1	2	<1	1	2
	Foliar Load (tons/ac)	0.24	0.80	1.51	1.14	1.75	2.36	1.29	2.64	4.07
	1-hr load (tons/ac)	0.04	0.14	0.27	0.20	0.31	0.41	0.23	0.46	0.71
	10-hr load (tons/ac)	0.10	0.33	0.63	0.48	0.74	0.99	0.54	1.11	1.74
	100-hr load (tons/ac)	0.16	0.61	1.24	0.84	1.45	2.19	0.93	2.20	3.74
	1000-hr load (tons/ac)	0.28	1.26	2.81	1.64	3.21	5.48	1.64	4.89	9.08
	1-hr Dead load (tons/ac)	0.02	0.11	0.25	0.15	0.29	0.49	0.15	0.44	0.81
	10-hr Dead load (tons/ac)	0.01	0.06	0.14	0.08	0.16	0.28	0.08	0.25	0.46
	Total load (tons/ac)	0.85	3.32	6.75	4.53	7.90	12.02	5.04	11.99	20.53
	Bulk Density (lbs/ft^3)	0.0023	0.0061	0.0127	0.0067	0.0102	0.0133	0.0069	0.0141	0.0206
PIED	Cover (%)	0	2	6	0	5	17	0	13	35
	Density < 1.6 ft tall (#/ac)	0			0	23	90	0	27	68
	Density > 1.6 ft tall (#/ac)	0	15	44	0	37	124	0	86	226
	Height (ft)	0	6	11	0	4	10	0	6	13
	Canopy Base Height (ft)	<1	1	2	<1	1	2	<1	1	2
	Foliar Load (tons/ac)	0.04	0.22	0.43	0.07	0.76	1.38	0.07	1.54	3.07
	1-hr load (tons/ac)	0.02	0.12	0.24	0.03	0.42	0.79	0.04	0.84	1.69
	10-hr load (tons/ac)	0.02	0.14	0.27	0.04	0.49	0.89	0.05	0.98	1.96
	100-hr load (tons/ac)	0.04	0.24	0.48	0.07	0.85	1.58	0.08	1.67	3.35
	1000-hr load (tons/ac)	0.04	0.36	0.77	0.08	1.33	2.51	0.12	2.47	4.99
	1-hr Dead load (tons/ac)	<0.01	0.02	0.06	<0.01	0.10	0.18	<0.01	0.17	0.34
	10-hr Dead load (tons/ac)	<0.01	0.03	0.07	<0.01	0.13	0.24	0.01	0.22	0.44
	Total load (tons/ac)	0.16	1.13	2.32	0.30	4.07	7.63	0.38	7.89	15.83
	Bulk Density (lbs/ft^3)	0	0.0011	0.0034	0	0.0029	0.0101	0	0.0065	0.0173

Utah Juniper: Control

Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARTRW8	Cover (%)	7	15	24	2	8	16	<1	3	4
	Density (#/ac)	1269	2943	5039	545	1373	2298	195	881	1435
	Height (in)	15	20	26	12	20	27	5	15	22
	1-hr + fol. load (tons/ac)	0.56	0.80	1.17	0.03	0.39	0.90	0.02	0.13	0.23
	10-hr load (tons/ac)	0.65	0.91	1.31	0.03	0.42	1.06	0.02	0.13	0.24
	Bulk Density (lbs/ft^3)	0.0230	0.0348	0.0439	0.0021	0.0143	0.0318	0.0011	0.0062	0.0105
CHVI8	Cover (%)	0	1	5	0	<1	3	0	<1	1
	Density (#/ac)	0	840	2902	0	670	2418	0	450	1481
	Height (in)	0	4	12	0	4	10	0	4	8
	1-hr + fol. load (tons/ac)	0			0	<0.01	<0.01	0	<0.01	<0.01
	10-hr load (tons/ac)				0			0		
	Bulk Density (lbs/ft^3)				0	0.0001	0.0002	0	<0.0001	<0.0001

Utah Juniper: Prescribed Fire

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOS	Cover (%)	0	<1	2	0	<1	3	1	5	8
	Density < 1.6 ft tall (#/ac)	0			0	10	23	0	31	63
	Density > 1.6 ft tall (#/ac)	0	1	4	0	7	21	5	20	37
	Height (ft)	0	3	15	0	3	11	9	13	18
	Canopy Base Height (ft)	<1	<1	1	<1	<1	2	<1	1	3
	Foliar Load (tons/ac)	0	0.04	0.17	0	0.09	0.31	0.14	0.45	0.75
	1-hr load (tons/ac)	0	<0.01	0.03	0	0.02	0.05	0.02	0.08	0.13
	10-hr load (tons/ac)	0	0.02	0.07	0	0.04	0.13	0.06	0.19	0.31
	100-hr load (tons/ac)	0	0.04	0.14	0	0.07	0.25	0.10	0.36	0.64
	1000-hr load (tons/ac)	0	0.09	0.33	0	0.14	0.53	0.20	0.79	1.54
	1-hr Dead load (tons/ac)	0	<0.01	0.03	0	0.01	0.05	0.02	0.07	0.14
	10-hr Dead load (tons/ac)	0	<0.01	0.02	0	<0.01	0.03	0.01	0.04	0.08
	Total load (tons/ac)	0	0.20	0.79	0	0.37	1.35	0.56	1.99	3.51
	Bulk Density (lbs/ft^3)	0	0.0002	0.0010	0	0.0006	0.0019	0.0006	0.0028	0.0051
PIED	Cover (%)	0	<1	<1	0	<1	2	0	5	15
	Density < 1.6 ft tall (#/ac)	0	4	20	0	9	23	0	7	18
	Density > 1.6 ft tall (#/ac)	0	2	8	0	2	8	0	28	92
	Height (ft)	0	2	7	0	3	14	0	4	13
	Canopy Base Height (ft)	<1	1	2	1	2	3	<1	2	3
	Foliar Load (tons/ac)	<0.01	0.04	0.10	0.03	0.12	0.22	0.91	1.12	1.30
	1-hr load (tons/ac)	0	0.02	0.05	0.01	0.07	0.13	0.49	0.62	0.72
	10-hr load (tons/ac)	<0.01	0.02	0.06	0.02	0.08	0.15	0.57	0.71	0.83
	100-hr load (tons/ac)	<0.01	0.04	0.11	0.02	0.14	0.27	0.97	1.22	1.43
	1000-hr load (tons/ac)	<0.01	0.06	0.16	0.03	0.23	0.47	1.40	1.82	2.15
	1-hr Dead load (tons/ac)	0	<0.01	0.01	<0.01	0.02	0.04	0.09	0.12	0.15
	10-hr Dead load (tons/ac)	0	<0.01	0.01	<0.01	0.02	0.05	0.12	0.16	0.19
	Total load (tons/ac)	<0.01	0.19	0.51	0.11	0.68	1.35	4.54	5.77	6.77
	Bulk Density (lbs/ft^3)	0	0.0001	0.0001	0	0.0003	0.0013	0	0.0024	0.0083

Utah Juniper: Prescribed Fire

Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARTRW8	Cover (%)	1	5	10	0	3	8	<1	2	6
	Density (#/ac)	125	2078	5757	45	1462	4837	32	1004	2548
	Height (in)	13	21	26	12	18	26	0	13	26
	1-hr + fol. load (tons/ac)	0.03	0.18	0.31	0.01	0.17	0.38	0	0.09	0.20
	10-hr load (tons/ac)	0.03	0.21	0.47	0.01	0.17	0.38	0	0.12	0.20
	Bulk Density (lbs/ft^3)	0.0007	0.0108	0.0243	0.0004	0.0093	0.0250	0	0.0044	0.0085
CHVI8	Cover (%)	0	3	9	0	3	7	0	<1	2
	Density (#/ac)	0	1620	4149	0	1324	3021	0	407	1617
	Height (in)	0	9	13	0	7	13	0	5	12
	1-hr + fol. load (tons/ac)	0	0.05	0.17	0	0.03	0.13	0	<0.01	<0.01
	10-hr load (tons/ac)	0			0			0		
	Bulk Density (lbs/ft^3)	0	0.0027	0.0092	0	0.0014	0.0073	0	0.0002	0.0003

Utah Juniper: Cutting

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOS	Cover (%)	0	<1	1	<1	<1	1	<1	1	2
	Density < 1.6 ft tall (#/ac)	0	20	68	0	41	103	0	60	166
	Density > 1.6 ft tall (#/ac)	4	24	74	12	39	71	34	57	86
	Height (ft)	2	4	5	3	4	5	4	4	5
	Canopy Base Height (ft)	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Foliar Load (tons/ac)	<0.01	0.03	0.07	0.01	0.04	0.10	0.03	0.07	0.11
	1-hr load (tons/ac)	0	<0.01	0.01	<0.01	<0.01	0.02	<0.01	0.01	0.02
	10-hr load (tons/ac)	0	<0.01	0.02	<0.01	0.02	0.04	<0.01	0.02	0.04
	100-hr load (tons/ac)	0	<0.01	0.03	<0.01	0.02	0.05	<0.01	0.03	0.04
	1000-hr load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	<0.01	0.01	0.02
	1-hr Dead load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01
	10-hr Dead load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01
	Total load (tons/ac)	<0.01	0.05	0.13	0.02	0.10	0.26	0.05	0.15	0.23
	Bulk Density (lbs/ft^3)	<0.0001	0.0004	0.0011	0.0002	0.0007	0.0017	0.0005	0.0011	0.0018
PIED	Cover (%)	0	<1	<1	0	<1	<1	0	<1	<1
	Density < 1.6 ft tall (#/ac)	0	12	45	0	17	29	0	21	72
	Density > 1.6 ft tall (#/ac)	0	2	12	0	2	4	0	17	52
	Height (ft)	0	<1	3	0	2	5	0	2	4
	Canopy Base Height (ft)	<1	<1	<1	<1	1	2	<1	<1	1
	Foliar Load (tons/ac)	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	0.06
	1-hr load (tons/ac)	<0.01	<0.01	<0.01	0	<0.01	<0.01	<0.01	0.01	0.03
	10-hr load (tons/ac)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.03
	100-hr load (tons/ac)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.05
	1000-hr load (tons/ac)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.05
	1-hr Dead load (tons/ac)	0			0	<0.01	<0.01	0	<0.01	0.0002
	10-hr Dead load (tons/ac)				0	<0.01	<0.01	0	<0.01	0.0002
	Total load (tons/ac)	<0.01	<0.01	0.02	<0.01	0.02	0.04	<0.01	0.08	0.22
	Bulk Density (lbs/ft^3)	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0	0.0002	0.0005

Utah Juniper: Cutting

Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARTRW8	Cover (%)	13	19	22	6	16	25	0	4	12
	Density (#/ac)	1953	3458	4678	1095	3285	5868	23	965	2026
	Height (in)	16	22	27	14	21	30	0	12	21
	1-hr + fol. load (tons/ac)	0.44	0.99	1.84	0.23	0.83	1.35	0	0.18	0.39
	10-hr load (tons/ac)	0.55	1.15	2.35	0.27	0.96	1.50	0	0.20	0.45
	Bulk Density (lbs/ft^3)	0.0152	0.0395	0.0746	0.0130	0.0350	0.0527	0	0.0087	0.0204
CHVI8	Cover (%)	0	5	13	0	4	10	0	2	6
	Density (#/ac)	0	2983	8743	0	1819	3902	0	767	2235
	Height (in)	0	6	13	0	8	13	0	5	11
	1-hr + fol. load (tons/ac)	0	0.06	0.29	0	0.04	0.15	0	0.02	0.03
	10-hr load (tons/ac)	0			0			0		
	Bulk Density (lbs/ft^3)	0	0.0039	0.0167	0	0.0021	0.0081	0	0.0011	0.0016

Utah Juniper: Mastication

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOS	Cover (%)	<1	<1	<1	<1	<1	1	<1	<1	2
	Density < 1.6 ft tall (#/ac)	0	26	61	0	23	68	0	33	117
	Density > 1.6 ft tall (#/ac)	4	29	64	8	40	67	6	53	91
	Height (ft)	2	3	4	3	4	5	2	4	5
	Canopy Base Height (ft)	<1	<1	<1	0	<1	<1	0	<1	<1
	Foliar Load (tons/ac)	<0.01	0.02	0.05	<0.01	0.04	0.07	0.02	0.06	0.17
	1-hr load (tons/ac)	<0.01	<0.01	0.01	<0.01	<0.01	0.01	<0.01	0.01	0.03
	10-hr load (tons/ac)	<0.01	<0.01	0.02	<0.01	0.01	0.02	<0.01	0.02	0.06
	100-hr load (tons/ac)	<0.01	<0.01	0.02	<0.01	0.01	0.02	<0.01	0.03	0.07
	1000-hr load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	0	0.01	0.02
	1-hr Dead load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01
	10-hr Dead load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01
	Total load (tons/ac)	<0.01	0.04	0.11	<0.01	0.08	0.13	0.05	0.13	0.36
	Bulk Density (lbs/ft^3)	0	0.0004	0.0010	0.0001	0.0006	0.0011	0.0001	0.0009	0.0023
PIED	Cover (%)	0	<1	<1	0	<1	<1	0	<1	<1
	Density < 1.6 ft tall (#/ac)	0	6	31	0	9	29	0	3	0*
	Density > 1.6 ft tall (#/ac)	0	4	14	0	8	29	0	5	21
	Height (ft)	0	1	4	0	2	5	0	2	4
	Canopy Base Height (ft)	<1	<1	1	<1	<1	1	<1	<1	<1
	Foliar Load (tons/ac)	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	0.02
	1-hr load (tons/ac)	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
	10-hr load (tons/ac)	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
	100-hr load (tons/ac)	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01
	1000-hr load (tons/ac)	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01
	1-hr Dead load (tons/ac)	0			0	<0.01	<0.01	0		
	10-hr Dead load (tons/ac)				0	<0.01	<0.01			
	Total load (tons/ac)	<0.01	<0.01	0.01	0.01	0.05	0.10	<0.01	0.02	0.06
	Bulk Density (lbs/ft^3)	0	<0.0001	<0.0001	0	0.0001	0.0003	0	0.0001	0.0002

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Utah Juniper: Mastication

Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARTRW8	Cover (%)	6	10	14	4	10	16	<1	6	11
	Density (#/ac)	1215	2148	2948	1315	2485	3833	91	1480	2534
	Height (in)	14	18	22	12	15	20	9	15	24
	1-hr + fol. load (tons/ac)	0.14	0.46	0.77	0.11	0.42	0.82	<0.01	0.29	0.57
	10-hr load (tons/ac)	0.19	0.54	0.81	0.09	0.47	1.02	<0.01	0.33	0.62
	Bulk Density (lbs/ft^3)	0.0085	0.0228	0.0384	0.0073	0.0233	0.0419	0.0006	0.0168	0.0342
CHVI8	Cover (%)	0	3	5	0	2	6	0	1	4
	Density (#/ac)	0	1161	3363	0	998	2566	0	491	1108
	Height (in)	0	6	11	0	5	11	0	5	13
	1-hr + fol. load (tons/ac)	0	0.02	0.05	0	<0.01	<0.01	0	<0.01	<0.01
	10-hr load (tons/ac)	0			0			0		
	Bulk Density (lbs/ft^3)	0	0.0011	0.0031	0	0.0005	<0.0001	0	0.0003	0.0001

Changes in Masticated 1-hr Down Woody Debris Fuel Loads Over Time

Variable	Phase	Years Since Treatment	10th	Mean	90th
1-hr Down Woody Debris Fuel Load (tons/acre)	1	1	0.62	1.51	2.41
		5-6	0.35	0.89	1.75
		10	0.01	0.44	0.83
	2	1	0.57	2.06	3.44
		5-6	0.36	1.20	2.39
		10	0.26	0.76	1.51
	3	1	3.47	5.21	7.41
		5-6	0.97	2.30	3.69
		10	0.16	1.31	2.45

Changes in fuel loads of masticated down woody debris at the Utah SageSTEP sites were analyzed statistically by Wozniak et al. (*In prep*.). Only the finest size class of masticated down woody debris (1-hr fuels) decreased significantly over time.

Western Juniper Fuels Guide User Notes

Site Notes

- All sites are characterized by the Loamy 12-14" ecological type (Caudle et al. 2013).
- General site information:
  - During the course of the study (2006-2018), the average annual precipitation across the sites was 13.1 in (33.2 cm), and ranged 6.5-21.2 in (16.5-53.7 cm; PRISM Climate Group)
  - Slopes ranged 3-33%, and the sites occurred on all aspects;
  - Loamy soil surface texture, with soil depths >20 in. (50.8 cm) and minimal stoniness.
- Three treatments were implemented at every site: untreated control, prescribed fire, and mechanical cutting.
- The four sites were located in eastern Oregon and northeastern California.
- Bridge Creek is the only site with an active grazing allotment; all subplots at Bridge Creek may have been grazed prior to construction of exclosures at the beginning of the SageSTEP.
- Site names, number of subplots, and elevation ranges for data used are available in Table 8. Site locations are shown in Figure 6.

Guide Notes

- This guide is organized by three treatments (untreated control, prescribed fire, and cutting) and three woodland development phases defined by pre-treatment tree stand cover and understory characteristics (Miller et al. 2005):
  - Phase I: Trees are present on the site, but the understory shrub and herbaceous components are the dominant influence on ecological processes (hydrology, nutrient and energy cycling).
  - Phase II: Trees are co-dominant with the understory shrub and herbaceous components. All three layers influence ecological processes.
  - Phase III: Trees are the dominant vegetation and the primary layer influencing ecological processes.
- The caption to the left of each photo denotes the canopy cover (%) by functional group for subplot depicted in the photo.
- Sampling took place between May and July in 2016, 2017, and 2018.
- Dominant graminoids include: ACTH7, BRTE, ELEL5, FEID, KOMA, POSE, PSSP6, VUOC (see Table 59for common and scientific names)
- Annual grasses include: BRTE, BRAR5, BRBR5, TACA8, VEDU, VUOC (see Table 9 for common and scientific names)
- Each statistic includes a mean, 10^{th} percentile, and 90^{th} percentile. The 10^{th} percentile column indicates that 10% of the data was less than the 10^{th} percentile statistic, and the 90^{th} percentile indicates that 90% of the data were less than the 90^{th} percentile statistic. The 10^{th} and 90^{th} percentiles were used instead of minimum and maximum because there were extreme values in the dataset.
- The designation of "NA" indicates data were not collected or available.
- A table of species codes can be found in Table 9.

Table 8. Summary of subplot information for the Western Juniper Subguide. All sites within the Western Juniper region (Blue Mountain, Bridge Creek, Devine Ridge, and Walker Butte) are represented in each phase/treatment combination except for the control and prescribed fire treatments in Phase 3. Bridge Creek did not have any Phase 3 control sampling plots, and Walker Butte did not have any Phase 3 prescribed fire sampling plots.

Phase	Treatment	# of Sampling Plots	Elevation Range (ft)	Elevation Range (m)
1	Control	22	2858-5020	871-1530
	Prescribed Fire	30	2943-4967	897-1514
	Cutting	26	2838-5180	865-1579
2	Control	28	2858-5020	871-1530
	Prescribed Fire	18	2943-4967	897-1514
	Cutting	21	2838-5180	865-1579
3	Control	12	4616-5020	1407-1530
	Prescribed Fire	12	2943-4967	897-1514
	Cutting	12	2838-5180	865-1579

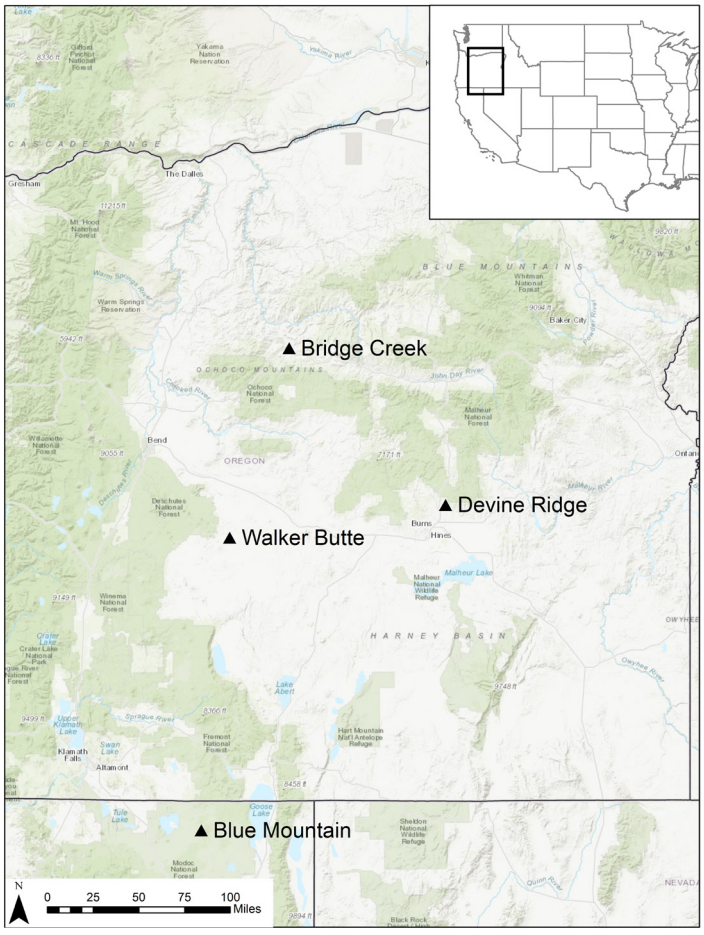


Figure 6. Location of study sites in Western Juniper Subguide.

Table 9. USDA Plant codes used in the Western Juniper Subguide.

	USDA Code	Scientific Name	Common Name
Trees	CELE3	*Cercocarpus ledifolius*	curl-leaf mountain mahogany
	JUOC	*Juniper occidentalis*	western juniper
Shrubs	ARAR8	*Artemisia arbuscula*	low sagebrush
	ARTRV	*Artemisia tridentata ssp. vaseyana*	mountain big sagebrush
	CHVI8	Chrysothamnus viscidiflorus	yellow rabbitbrush
	PUTR2	*Purshia tridentata*	antelope bitterbrush
Grasses	ACTH7	*Achnatherum thurberianum*	Thurber's needlegrass
	BRTE	*Bromus tectorum*	cheatgrass
	BRAR5	*Bromus arvensis*	field brome
	BRBR5	*Bromus briziformis*	rattlesnake brome
	ELEL5	*Elymus elymoides*	bottlebrush squirreltail
	FEID	*Festuca idahoensis*	Idaho fescue
	KOMA	*Koeleria macrantha*	prairie junegrass
	POSE	*Poa secunda*	Sandberg bluegrass
	PSSP6	*Pseudoroegneria spicata*	bluebunch wheatgrass
	VUOC	*Vulpia octoflora*	sixweeks fescue

Western Juniper: Control, Phase 1

Bridge Creek 871 m | 2858 ft 6/4/2016	
Cover (%)	
Trees	10
Shrubs	6
Perennial Grass	58
Annual Grass	8
Bare Ground	5

Devine Ridge 1518 m | 4980 ft 6/29/2017	
Cover (%)	
Trees	6
Shrubs	28
Perennial Grass	48
Annual Grass	18
Bare Ground	10

Western Juniper: Control, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	6	13	27
	Shrub	Total	2	10	20
	Herbaceous	Perennial Grass	23	42	61
		Annual Grass	0	8	20
		Forb	5	11	23
	Litter & Duff	Interspace Litter	3	8	12
	Bare Ground	Bare Ground	5	19	39
Density (#/acre)	Tree	JUOC < 1.6 ft tall	0	47	151
		JUOC > 1.6 ft tall	37	82	158
	Shrub	Total	569	1414	2658
Height (ft)	Tree	JUOC	2	10	23
		JUOC Canopy Base	0	<1	2
Height (in)	Shrub	Total	10	22	35
	Herbaceous	Grass	6	10	13
		Forb	2	4	7
Fuel Loading (tons/acre)	Tree	JUOC	2.87	6.93	12.05
	Shrub	Total	0	0.18	0.42
	Herbaceous	Live	0.07	0.16	0.33
		Dead	0.02	0.09	0.21
	Down Woody Debris	10-hr	0.29	0.68	1.20
		100-hr	0.20	0.80	1.67
		1000-hr sound	0	0.12	0.43
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.04	0.10	0.16
		Tree Litter + Duff	0.82	2.38	4.36
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	0.0029	0.0050	0.0086
	Shrub	Total	0	0.0039	0.0105
	Herbaceous	Live + Dead	0.0137	0.0189	0.0268

Western Juniper: Prescribed Fire, Phase 1

Blue Mountain 1499 m | 4918 ft 6/19/2017 Cover (%)	
Trees	0
Shrubs	34
Perennial Grass	39
Annual Grass	49
Bare Ground	2

Walker Butte 1412 m | 4633 ft 5/25/2016 Cover (%)	
Trees	0
Shrubs	11
Perennial Grass	44
Annual Grass	<1
Bare Ground	27

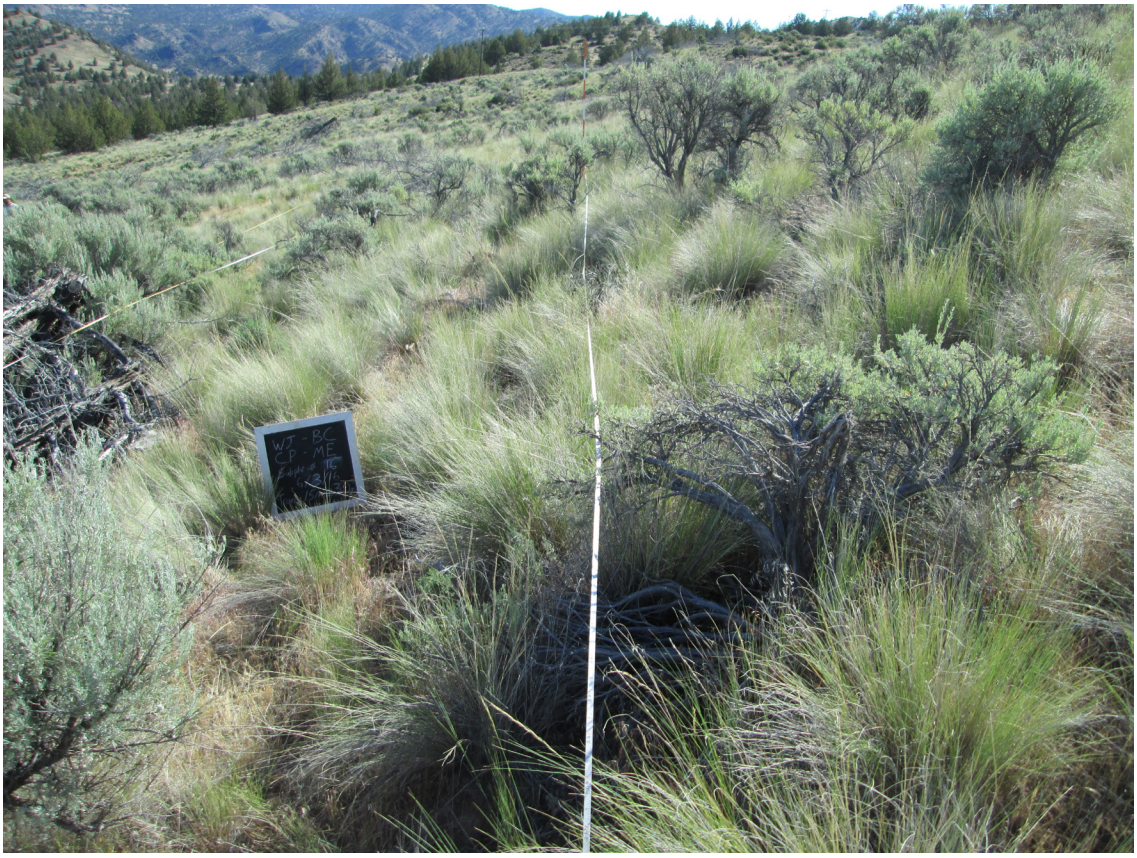
Western Juniper: Prescribed Fire, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	0	<1	<1
	Shrub	Total	3	12	24
	Herbaceous	Perennial Grass	33	43	58
		Annual Grass	<1	22	51
		Forb	2	22	40
	Litter & Duff	Interspace Litter	3	8	15
	Bare Ground	Bare Ground	2	14	32
Density (#/acre)	Tree	JUOC < 1.6 ft tall	0	4	2
		JUOC > 1.6 ft tall	0	2	8
	Shrub	Total	279	1964	3721
Height (ft)	Tree	JUOC	2	8	19
		JUOC Canopy Base	0	<1	1
Height (in)	Shrub	Total	10	20	31
	Herbaceous	Grass	7	9	11
		Forb	1	6	10
Fuel Loading (tons/acre)	Tree	JUOC	0	0.14*	0.03*
	Shrub	Total	0	0.19	0.54
	Herbaceous	Live	0.15	0.30	0.54
		Dead	0.01	0.16	0.40
	Down Woody Debris	10-hr	0.08	0.36	0.72
		100-hr	0.10	0.62	1.60
		1000-hr sound	0	3.57	6.45
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.05	0.13	0.24
		Tree Litter + Duff	0	0.02	0.04
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	0	0.0001	0.0001
	Shrub	Total	0	0.0073	0.0199
	Herbaceous	Live + Dead	0.0186	0.0338	0.0492

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Western Juniper: Cutting, Phase 1

Bridge Creek 865 m | 2838 ft 6/3/2016	
Cover (%)	
Trees	<1
Shrubs	10
Perennial Grass	59
Annual Grass	38
Bare Ground	3



Walker Butte 1419 m | 4656 ft 5/24/2016	
Cover (%)	
Trees	1
Shrubs	8
Perennial Grass	31
Annual Grass	0
Bare Ground	34

Western Juniper: Cutting, Phase 1

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	0	<1	1
	Shrub	Total	9	24	46
	Herbaceous	Perennial Grass	34	48	64
		Annual Grass	0	14	37
		Forb	1	11	31
	Litter & Duff	Interspace Litter	3	8	13
	Bare Ground	Bare Ground	2	14	30
Density (#/acre)	Tree	JUOC < 1.6 ft tall	0	45	146
		JUOC > 1.6 ft tall	0	50	100
	Shrub	Total	1000	2947	4530
Height (ft)	Tree	JUOC	2	3	4
		JUOC Canopy Base	0	<1	<1
Height (in)	Shrub	Total	15	24	36
	Herbaceous	Grass	8	11	16
		Forb	1	4	8
Fuel Loading (tons/acre)	Tree	JUOC	0.03	0.10	0.19
	Shrub	Total	0	1.20	2.96
	Herbaceous	Live	0.14	0.25	0.43
		Dead	0.07	0.15	0.29
	Down Woody Debris	10-hr	0.30	0.91	1.85
		100-hr	0.44	1.28	2.31
		1000-hr sound	0.21	3.02	6.95
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.08	0.20	0.36
		Tree Litter + Duff	0	0.04	0.06
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	0	0.0006	0.0011
	Shrub	Total	0	0.0213	0.0429
	Herbaceous	Live + Dead	0.0217	0.0320	0.0452

Western Juniper: Control, Phase 2

Blue Mountain 1530 m | 5020 ft 6/17/2017	
Cover (%)	
Trees	23
Shrubs	9
Perennial Grass	64
Annual Grass	5
Bare Ground	10

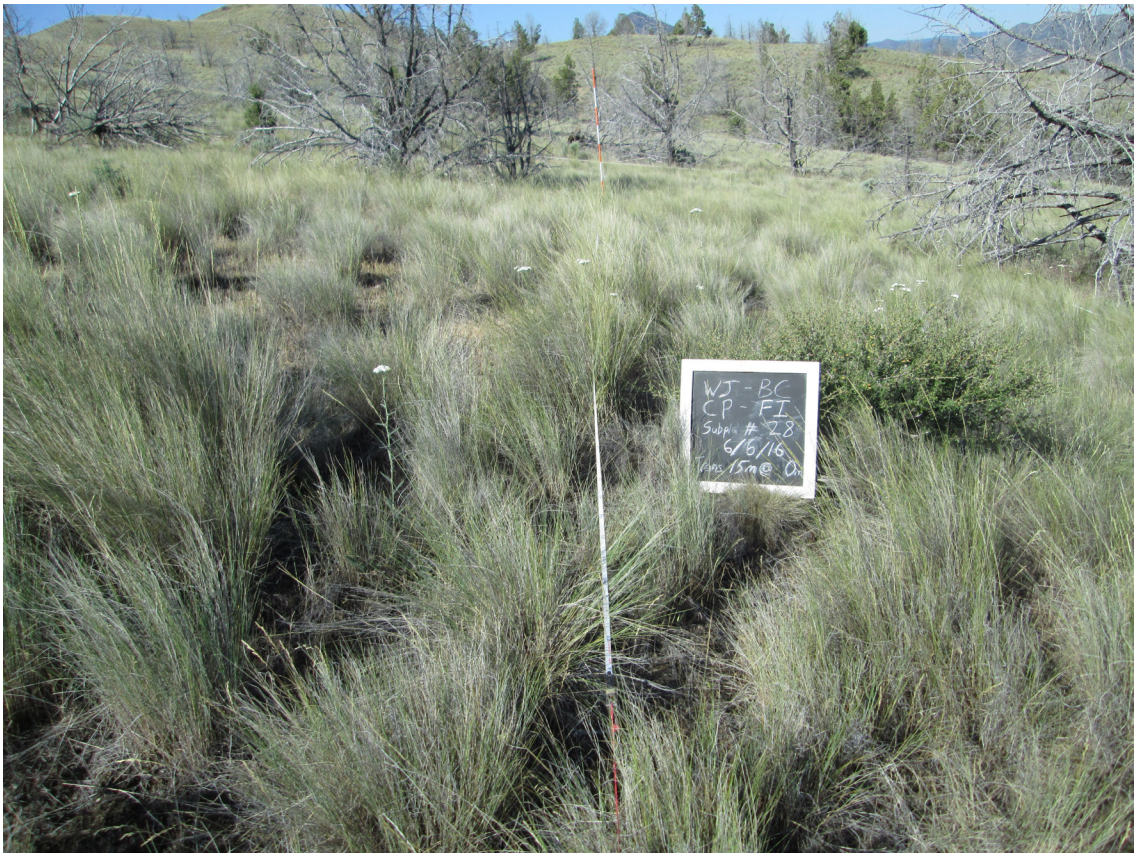
Devine Ridge 1518 m | 4980 ft 6/30/2017	
Cover (%)	
Trees	24
Shrubs	11
Perennial Grass	25
Annual Grass	5
Bare Ground	29

Western Juniper: Control, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	17	26	36
	Shrub	Total	1	9	17
	Herbaceous	Perennial Grass	18	38	65
		Annual Grass	0	4	11
		Forb	4	14	23
	Litter & Duff	Interspace Litter	3	7	11
	Bare Ground	Bare Ground	4	18	46
Density (#/acre)	Tree	JUOC < 1.6 ft tall	0	71	207
		JUOC > 1.6 ft tall	56	96	161
	Shrub	Total	488	1403	2621
Height (ft)	Tree	JUOC	2	14	30
		JUOC Canopy Base	0	2	5
Height (in)	Shrub	Total	15	24	33
	Herbaceous	Grass	6	8	12
		Forb	1	5	10
Fuel Loading (tons/acre)	Tree	JUOC	9.52	14.44	20.16
	Shrub	Total	0	0.19	0.45
	Herbaceous	Live	0.04	0.13	0.32
		Dead	0.01	0.05	0.12
	Down Woody Debris	10-hr	0.31	0.69	1.30
		100-hr	0.13	0.76	1.34
		1000-hr sound	0	0.56	1.54
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.04	0.13	0.31
		Tree Litter + Duff	1.45	3.39	5.89
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	0.0052	0.0080	0.0113
	Shrub	Total	0	0.0030	0.0066
	Herbaceous	Live + Dead	0.0058	0.0144	0.0235

Western Juniper: Prescribed Fire, Phase 2

Bridge Creek 897 m | 2943 ft 6/6/2016	
Cover (%)	
Trees	<1
Shrubs	2
Perennial Grass	59
Annual Grass	50
Bare Ground	2



Devine Ridge 1514 m | 4967 ft 7/3/2017	
Cover (%)	
Trees	<1
Shrubs	19
Perennial Grass	40
Annual Grass	16
Bare Ground	19

Western Juniper: Prescribed Fire, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	0	1	3
	Shrub	Total	3	11	21
	Herbaceous	Perennial Grass	29	43	55
		Annual Grass	4	29	61
		Forb	2	21	41
	Litter & Duff	Interspace Litter	1	8	16
	Bare Ground	Bare Ground	1	12	24
Density (#/acre)	Tree	JUOC < 1.6 ft tall	0	6	23
		JUOC > 1.6 ft tall	0	10	31
	Shrub	Total	434	1374	2750
Height (ft)	Tree	JUOC	2	7	13
		JUOC Canopy Base	0	<1	2
Height (in)	Shrub	Total	11	19	26
	Herbaceous	Grass	7	10	15
		Forb	2	6	10
Fuel Loading (tons/acre)	Tree	JUOC	0	0.49	0.92
	Shrub	Total	0	0.17	0.55
	Herbaceous	Live	0.19	0.32	0.49
		Dead	0.03	0.18	0.41
	Down Woody Debris	10-hr	0.12	0.40	0.99
		100-hr	0.18	0.92	1.67
		1000-hr sound	0.64	2.48	4.97
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.04	0.13	0.22
		Tree Litter + Duff	0	0.08	0.26
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	0	0.0004	0.0012
	Shrub	Total	0	0.0038	0.0091
	Herbaceous	Live + Dead	0.0200	0.0374	0.0594

Western Juniper: Cutting, Phase 2

Blue Mountain 1557 m | 5108 ft 6/14/2017	
Cover (%)	
Trees	<1
Shrubs	25
Perennial Grass	60
Annual Grass	8
Bare Ground	1

Walker Butte 1419 m | 4656 ft 5/20/2016	
Cover (%)	
Trees	1
Shrubs	10
Perennial Grass	31
Annual Grass	<1
Bare Ground	30

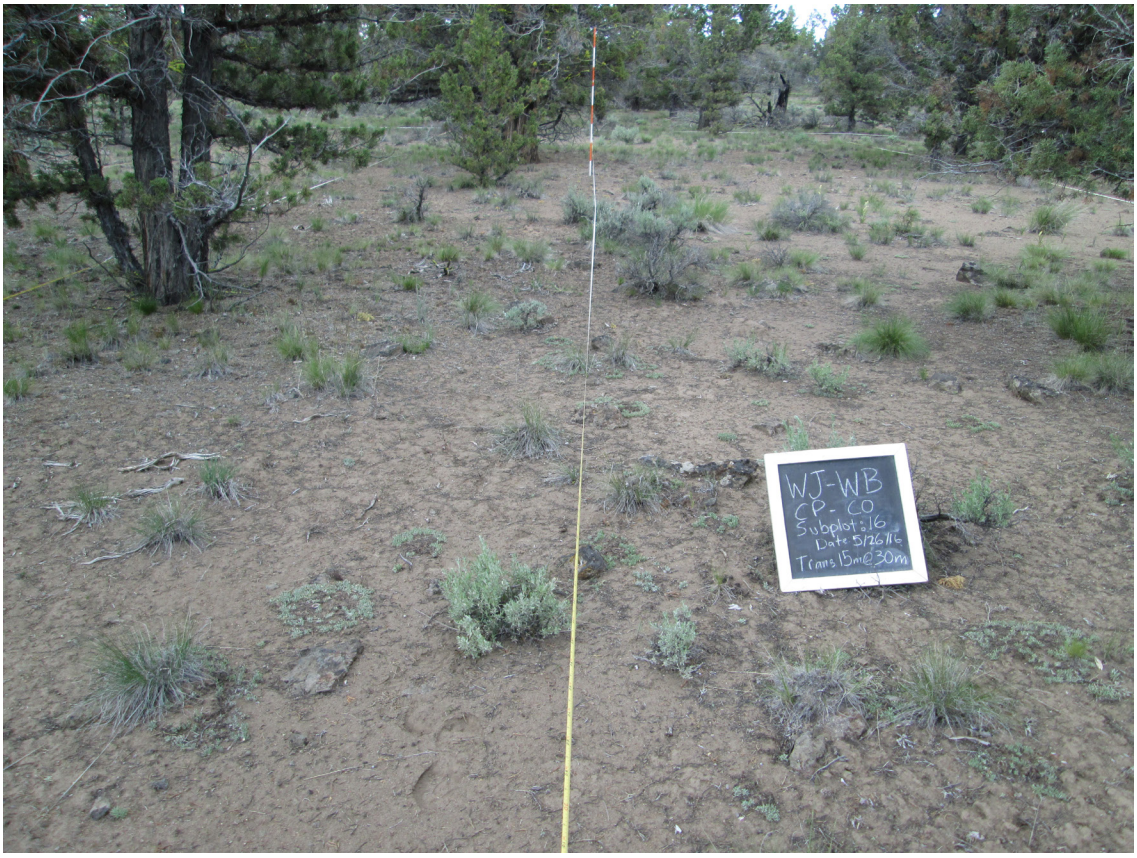
Western Juniper: Cutting, Phase 2

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	<1	<1	2
	Shrub	Total	7	24	44
	Herbaceous	Perennial Grass	41	50	62
		Annual Grass	<1	15	38
		Forb	2	18	37
	Litter & Duff	Interspace Litter	3	6	10
	Bare Ground	Bare Ground	<1	8	20
Density (#/acre)	Tree	JUOC < 1.6 ft tall	0	65	157
		JUOC > 1.6 ft tall	8	65	123
	Shrub	Total	944	2364	3867
Height (ft)	Tree	JUOC	2	3	5
		JUOC Canopy Base	0	<1	<1
Height (in)	Shrub	Total	17	27	33
	Herbaceous	Grass	8	12	15
		Forb	2	7	10
Fuel Loading (tons/acre)	Tree	JUOC	0.02	0.13	0.29
	Shrub	Total	0	1.56	3.99
	Herbaceous	Live	0.14	0.25	0.37
		Dead	0.04	0.16	0.32
	Down Woody Debris	10-hr	0.70	1.13	1.95
		100-hr	1.18	2.38	3.64
		1000-hr sound	2.30	6.96	11.25
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.08	0.25	0.41
		Tree Litter + Duff	0.02	0.25	0.84
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	0.0001	0.0008	0.0014
	Shrub	Total	0	0.0204	0.0443
	Herbaceous	Live + Dead	0.0110	0.0267	0.0447

Western Juniper: Control, Phase 3

Devine Ridge 1518 m | 4980 ft 7/1/2017	
Cover (%)	
Trees	46
Shrubs	5
Perennial Grass	35
Annual Grass	5
Bare Ground	17

Walker Butte 1407 m | 4616 ft 5/26/2016	
Cover (%)	
Trees	29
Shrubs	2
Perennial Grass	13
Annual Grass	0
Bare Ground	36

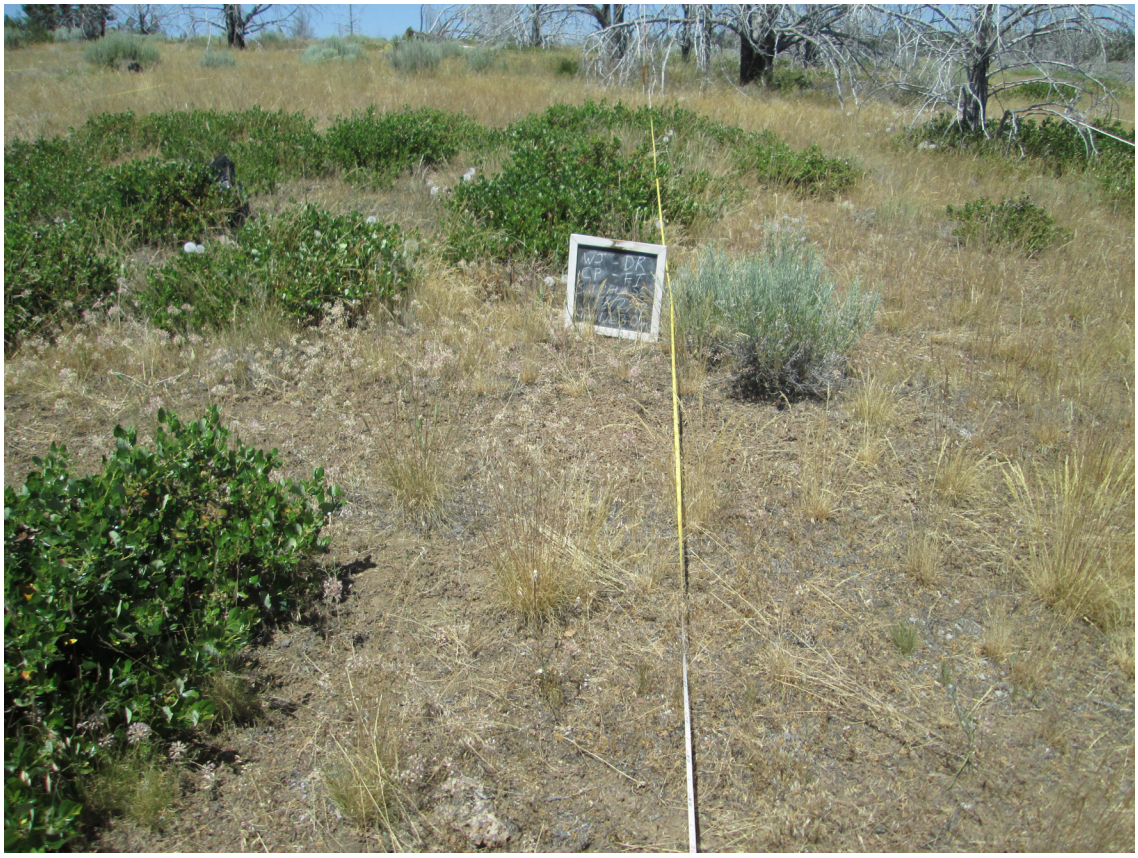


Western Juniper: Control, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	26	37	45
	Shrub	Total	<1	5	8
	Herbaceous	Perennial Grass	19	38	55
		Annual Grass	0	3	7
		Forb	3	12	20
	Litter & Duff	Interspace Litter	5	8	11
	Bare Ground	Bare Ground	6	17	34
Density (#/acre)	Tree	JUOC < 1.6 ft tall	2	47	88
		JUOC > 1.6 ft tall	83	115	149
	Shrub	Total	232	693	1155
Height (ft)	Tree	JUOC	6	22	35
		JUOC Canopy Base	<1	5	10
Height (in)	Shrub	Total	20	24	29
	Herbaceous	Grass	5	7	9
		Forb	2	5	8
Fuel Loading (tons/acre)	Tree	JUOC	15.73	21.89	28.60
	Shrub	Total	0	0.08	0.22
	Herbaceous	Live	0.04	0.10	0.14
		Dead	0.00	0.03	0.07
	Down Woody Debris	10-hr	0.23	0.41	0.56
		100-hr	0.11	0.62	1.62
		1000-hr sound	0	0.21	0.38
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.06	0.15	0.34
		Tree Litter + Duff	1.23	2.97	4.26
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	0.0069	0.0095	0.0119
	Shrub	Total	0	0.0012	0.0026
	Herbaceous	Live + Dead	0.0073	0.0125	0.0191

Blue Mountain 1499 m | 4918 ft 6/20/2017	
Cover (%)	
Trees	6
Shrubs	25
Perennial Grass	68
Annual Grass	29
Bare Ground	<1

Devine Ridge 1514 m | 4967 ft 7/2/2017	
Cover (%)	
Trees	0
Shrubs	18
Perennial Grass	49
Annual Grass	23
Bare Ground	6

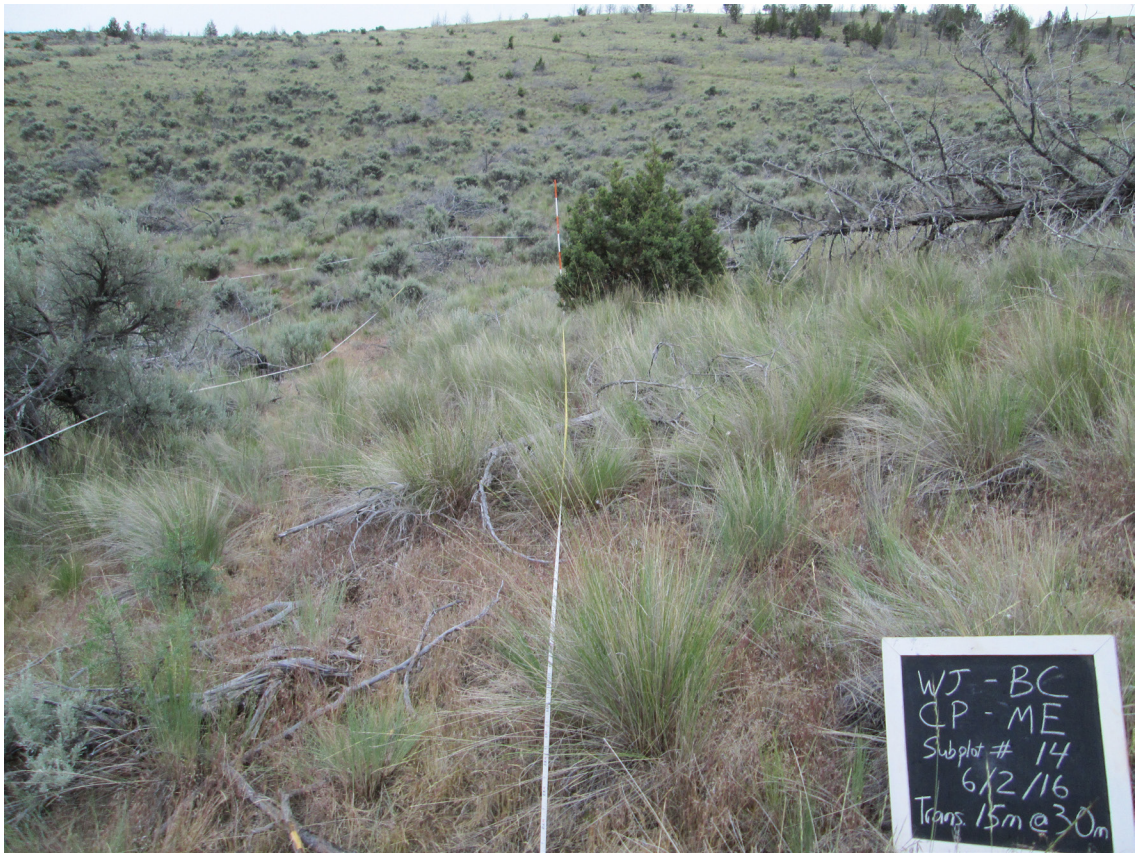


Western Juniper: Prescribed Fire, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	0	4	11
	Shrub	Total	5	13	25
	Herbaceous	Perennial Grass	33	43	54
		Annual Grass	8	21	29
		Forb	9	21	33
	Litter & Duff	Interspace Litter	3	7	14
	Bare Ground	Bare Ground	3	11	19
Density (#/acre)	Tree	JUOC < 1.6 ft tall	0	8	23
		JUOC > 1.6 ft tall	0	16	36
	Shrub	Total	519	1398	2513
Height (ft)	Tree	JUOC	2	12	26
		JUOC Canopy Base	0	2	5
Height (in)	Shrub	Total	12	23	31
	Herbaceous	Grass	6	11	15
		Forb	3	7	11
Fuel Loading (tons/acre)	Tree	JUOC	0	1.78	5.83
	Shrub	Total	0	0.51	1.98
	Herbaceous	Live	0.09	0.26	0.50
		Dead	0.01	0.14	0.25
	Down Woody Debris	10-hr	0.11	0.54	1.42
		100-hr	0.40	1.70	3.14
		1000-hr sound	1.19	8.26	16.71
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.07	0.14	0.23
		Tree Litter + Duff	0	0.23	0.53
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	0	0.0009	0.0025
	Shrub	Total	0	0.0070	0.0288
	Herbaceous	Live + Dead	0.0126	0.0248	0.0457

Western Juniper: Cutting, Phase 3

Bridge Creek 865 m | 2838 ft 6/2/2016	
Cover (%)	
Trees	1
Shrubs	10
Perennial Grass	48
Annual Grass	44
Bare Ground	2



Walker Butte 1419 m | 4656 ft 5/20/2016	
Cover (%)	
Trees	3
Shrubs	12
Perennial Grass	33
Annual Grass	0
Bare Ground	26

Western Juniper: Cutting, Phase 3

Variable	Category	Component	10th	Mean	90th
Total Cover (%)	Tree	JUOC	<1	1	2
	Shrub	Total	3	14	37
	Herbaceous	Perennial Grass	34	49	61
		Annual Grass	11	24	42
		Forb	4	11	17
	Litter & Duff	Interspace Litter	2	6	11
	Bare Ground	Bare Ground	<1	6	14
Density (#/acre)	Tree	JUOC < 1.6 ft tall	2	82	173
		JUOC > 1.6 ft tall	5	77	127
	Shrub	Total	357	2246	4600
Height (ft)	Tree	JUOC	2	3	6
		JUOC Canopy Base	0	<1	<1
Height (in)	Shrub	Total	10	26	39
	Herbaceous	Grass	9	11	14
		Forb	3	7	9
Fuel Loading (tons/acre)	Tree	JUOC	<0.01	0.23	0.42
	Shrub	Total	0	0.50	1.47
	Herbaceous	Live	0.13	0.25	0.31
		Dead	0.05	0.14	0.23
	Down Woody Debris	10-hr	1.06	2.06	3.62
		100-hr	1.79	3.35	5.27
		1000-hr sound	6.01	12.75	23.71
		1000-hr rotten	0		
	Litter & Duff	Interspace Litter	0.08	0.19	0.35
		Tree Litter + Duff	<0.01	0.75	1.39
Bulk Density (lbs/ft^3)	Tree	JUOC Canopy	<0.0001	0.0011	0.0017
	Shrub	Total	0	0.0054	0.0171
	Herbaceous	Live + Dead	0.0144	0.0255	0.0349

Western Juniper: Control

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOC	Cover (%)	6	13	27	17	26	36	26	37	45
	Density < 1.6 ft tall (#/ac)	0	47	151	0	71	207	2	47	88
	Density > 1.6 ft tall (#/ac)	37	82	158	56	96	161	83	115	149
	Height (ft)	6	14	24	11	19	29	22	26	31
	Canopy Base Height (ft)	0	<1	2	0	2	5	<1	5	10
	Foliar Load (tons/ac)	NA			NA			NA		
	1-hr load (tons/ac)	0.83	1.90	3.18	2.69	3.68	4.89	4.03	5.72	7.42
	10-hr load (tons/ac)	0.42	0.96	1.62	1.36	1.88	2.51	2.06	2.92	3.79
	100-hr load (tons/ac)	0.47	1.40	2.60	1.70	3.18	4.59	3.39	4.53	6.00
	1000-hr load (tons/ac)	0.71	1.95	3.59	2.56	3.98	5.41	4.42	6.32	8.30
	1-hr Dead load (tons/ac)	0.10	0.38	0.76	0.42	0.94	1.40	0.98	1.28	1.68
	10-hr Dead load (tons/ac)	0.05	0.22	0.43	0.24	0.54	0.80	0.56	0.73	0.96
	Total load (tons/ac)	2.81	6.81	11.84	9.34	14.19	19.83	15.46	21.51	28.11
	Bulk Density (lbs/ft^3)	0.0029	0.0050	0.0086	0.0052	0.0080	0.0113	0.0069	0.0095	0.0119
CELE3	Cover (%)	0	<1*	0*	0	<1*	0*	0	<1*	0*
	Density < 1.6 ft tall (#/ac)	0	1*	0*	0			0		
	Density > 1.6 ft tall (#/ac)	0	5*	0*	0	1*	0*	0	<1*	0*
	Height (ft)	0	1*	0*	0	<1*	0*	0	<1*	0*
	Canopy Base Height (ft)	<1	5	9	5	7	10	5	5	5

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Western Juniper: Control

Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARAR8	Cover (%)	0	<1	1	0	<1	<1	0	<1*	0*
	Density (#/ac)	0	114	132	0	75	361	0	6	20
	Height (in)	0	<1*	0*	0			0		
	1-hr + fol. load (tons/ac)	0								
	10-hr load (tons/ac)									
	Bulk Density (lbs/ft^3)									
ARTRV	Cover (%)	<1	5	13	0	4	10	0	2	4
	Density (#/ac)	48	598	1179	16	467	1008	25	288	386
	Height (in)	0	13	33	0	15	29	0	16	28
	1-hr + fol. load (tons/ac)	0	0.09	0.23	0	0.09	0.20	0	0.04	0.09
	10-hr load (tons/ac)	0	0.08	0.17	0	0.08	0.18	0	0.04	0.10
	Bulk Density (lbs/ft^3)	0	0.0030	0.0080	0	0.0026	0.0059	0	0.0012	0.0026
CHVI8	Cover (%)	0	<1	2	0	<1	2	0	<1*	0*
	Density (#/ac)	0	385	804	0	378	1099	0	42	84
	Height (in)	0	2	9	0	<1*	0*	0		
	1-hr + fol. load (tons/ac)	0	0.01	0.03	0	<0.01*	0*			
	10-hr load (tons/ac)	0	<0.01	0.01	0	<0.01*	0*			
	Bulk Density (lbs/ft^3)	0	0.0009	0.0022	0	0.0004*	0*			
PUTR2	Cover (%)	0	2	8	0	4	10	0	2	5
	Density (#/ac)	0	140	316	0	321	749	0	227	624
	Height (in)	0			0			0		
	1-hr + fol. load (tons/ac)									
	10-hr load (tons/ac)									
	Bulk Density (lbs/ft^3)									

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Western Juniper: Prescribed Fire

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOC	Cover (%)	0	<1	<1	0	1	3	0	4	11
	Density < 1.6 ft tall (#/ac)	0	4*	2*	0	6	23	0	8	23
	Density > 1.6 ft tall (#/ac)	0	2	8	0	10	31	0	16	36
	Height (ft)	0	2	6	0	4	11	0	12	26
	Canopy Base Height (ft)	0	<1	1	0	<1	2	0	2	5
	Foliar Load (tons/ac)	NA			NA			NA		
	1-hr load (tons/ac)	0	0.04*	0.02*	0	0.14	0.38	0	0.47	1.40
	10-hr load (tons/ac)	0	0.02*	<0.01*	0	0.07	0.18	0	0.24	0.72
	100-hr load (tons/ac)	0	0.02*	<0.01*	0	0.11	0.15	0	0.37	1.33
	1000-hr load (tons/ac)	0	0.04*	0*	0	0.10	0.21	0	0.50	1.63
	1-hr Dead load (tons/ac)	0	<0.01*	0*	0	0.04*	0.03*	0	0.10	0.38
	10-hr Dead load (tons/ac)	0	<0.01*	0*	0	0.02	0.02	0	0.06	0.22
	Total load (tons/ac)	0	0.13*	0.03*	0	0.48	0.90	0	1.75	5.74
	Bulk Density (lbs/ft^3)	0	0.0001	0.0001	0	0.0004	0.0012	0	0.0009	0.0025
CELE3	Cover (%)	0			0			0		
	Density < 1.6 ft tall (#/ac)									
	Density > 1.6 ft tall (#/ac)									
	Height (ft)									
	Canopy Base Height (ft)									

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Western Juniper: Prescribed Fire

Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARAR8	Cover (%)	0			0			0		
	Density (#/ac)	0	2*	0*						
	Height (in)	0								
	1-hr + fol. load (tons/ac)									
	10-hr load (tons/ac)									
	Bulk Density (lbs/ft^3)									
ARTRV	Cover (%)	0	2	6	0	3	7	<1	2	7
	Density (#/ac)	0	155	329	0	353	743	2	129	250
	Height (in)	0	19	36	0	13	28	0	12	31
	1-hr + fol. load (tons/ac)	0	0.05	0.12	0	0.06	0.21	0	0.07	0.21
	10-hr load (tons/ac)	0	0.04	0.10	0	0.06	0.18	0	0.06	0.21
	Bulk Density (lbs/ft^3)	0	0.0014	0.0031	0	0.0023	0.0059	0	0.0020	0.0069
CHVI8	Cover (%)	0	7	19	<1	5	15	0	2	4
	Density (#/ac)	0	1402	2839	23	741	1685	0	785	2398
	Height (in)	0	9	18	0	4	15	0	2	10
	1-hr + fol. load (tons/ac)	0	0.09	0.26	0	0.03	0.13	0		
	10-hr load (tons/ac)	0	0.02	0.06	0	<0.01	0.01			
	Bulk Density (lbs/ft^3)	0	0.0040	0.0096	0	0.0015	0.0056			
PUTR2	Cover (%)	0	2	7	0	1	4	<1	4	10
	Density (#/ac)	0	123	416	0	61	195	23	218	852
	Height (in)	0			0			0	6	28
	1-hr + fol. load (tons/ac)							0	0.16	0.66
	10-hr load (tons/ac)							0	0.31	1.55
	Bulk Density (lbs/ft^3)							0	0.0050	0.0219

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Western Juniper: Cutting

Live Tree Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
JUOC	Cover (%)	0	<1	1	<1	<1	2	<1	1	2
	Density < 1.6 ft tall (#/ac)	0	45	146	0	65	157	2	82	173
	Density > 1.6 ft tall (#/ac)	0	50	100	8	65	123	5	77	127
	Height (ft)	0	3	5	3	4	6	2	4	6
	Canopy Base Height (ft)	0	<1	<1	0	<1	<1	0	<1	<1
	Foliar Load (tons/ac)	NA			NA			NA		
	1-hr load (tons/ac)	0.02	0.09	0.13	0.03	0.12	0.22	0.05	0.17	0.25
	10-hr load (tons/ac)	0.01	0.04	0.06	0.01	0.05	0.10	0.02	0.08	0.12
	100-hr load (tons/ac)	<0.01	0.01	0.03	<0.01	0.02	0.04	<0.01	0.03	0.06
	1000-hr load (tons/ac)	0			0			0	0	<0.01
	1-hr Dead load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	<0.01	<0.01	<0.01
	10-hr Dead load (tons/ac)	0	<0.01	<0.01	0	<0.01	<0.01	<0.01	<0.01	<0.01
	Total load (tons/ac)	0.03	0.10	0.19	0.03	0.13	0.28	0.07	0.24	0.41
	Bulk Density (lbs/ft^3)	0	0.0006	0.0011	0.0001	0.0008	0.0014	<0.0001	0.0011	0.0017
CELE3	Cover (%)	0	<0.01*	0*	0	<0.01	2	0	4	12
	Density < 1.6 ft tall (#/ac)	0			0	13	23	0	86*	85*
	Density > 1.6 ft tall (#/ac)	0	2*	0*	0	5*	4*	0	43	77
	Height (ft)	0	<1*	0*	0	3	9	0	4	12
	Canopy Base Height (ft)	0	1*	2*	<1	2	8	0	2	7

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.

Western Juniper: Cutting

Live Shrub Statistics by Species

Species	Variable	Phase 1			Phase 2			Phase 3		
		10th	Mean	90th	10th	Mean	90th	10th	Mean	90th
ARAR8	Cover (%)	0	<1	1	0	<1*	0*	0	<1*	0*
	Density (#/ac)	0	67	136	0	6*	0*	0	23	61
	Height (in)	0	1*	0*	0			0		
	1-hr + fol. load (tons/ac)	0								
	10-hr load (tons/ac)									
	Bulk Density (lbs/ft^3)									
ARTRV	Cover (%)	3	14	35	5	13	24	<1	5	9
	Density (#/ac)	352	1350	3395	363	1210	2294	91	537	927
	Height (in)	0	18	36	0	18	29	2	24	38
	1-hr + fol. load (tons/ac)	0	0.45	1.57	0	0.48	1.35	0	0.09	0.23
	10-hr load (tons/ac)	0	0.35	1.18	0	0.39	1.04	0	0.08	0.18
	Bulk Density (lbs/ft^3)	0	0.0116	0.0400	0	0.0130	0.0333	0	0.0026	0.0060
CHVI8	Cover (%)	0	3	6	0	1	2	0	1	3
	Density (#/ac)	0	866	2033	23	423	1181	0	1117	3668
	Height (in)	0	5	14	0	2	11	0	5	11
	1-hr + fol. load (tons/ac)	0	0.06	0.17	0	0.02*	0*	0	<0.01*	0*
	10-hr load (tons/ac)	0	0.02	0.06	0	0.01*	0*	0	<0.01*	0*
	Bulk Density (lbs/ft^3)	0	0.0033	0.0086	0	0.0012*	0*	0	0.0002*	0*
PUTR2	Cover (%)	0	3	11	0	8	25	0	7	27
	Density (#/ac)	0	127	477	0	395	1136	0	288	808
	Height (in)	0	<1*	0*	0	11	44	0	8	40
	1-hr + fol. load (tons/ac)				0	0.21*	0*	0	0.13	0.38
	10-hr load (tons/ac)				0	0.37*	0*	0	0.21	0.61
	Bulk Density (lbs/ft^3)				0	0.0043*	0*	0	0.0025	0.0085

*A value above the 90th percentile resulted in a mean value greater than the 90th percentile.