
Pinyon-Juniper Woodlands of the Wild Rivers Recreation Area

*Vegetation Composition, Structure, and Bird Diversity
Monitoring Report I*



Natural Heritage New Mexico and Hawks Aloft, Inc.



2011



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Esteban Muldavin,² Trevor Fetz³, Yvonne Chauvin², and Kristin Madden²
Natural Heritage New Mexico and Hawks Aloft, Inc.

September, 2011

SUMMARY

In support of effective management of ecosystems within the Wild Rivers Recreation Area, and in particular the pinyon-juniper woodlands that cloak the mountain areas, a monitoring system was installed in 2010 to track changes in vegetation composition and structure along with bird diversity. Four macro-plots 750 x 1,250 m (2,460 x 4,000 ft) in size were established on sites dominated by two-needled pinyon (*Pinus edulis*), oneseed juniper (*Juniperus monosperma*), and Rocky Mountain juniper (*J. scopulorum*). Sites were uniform in terrain and representative of the range of aspects and slopes that occur within the Guadalupe Mountains. Within each macro-plot, 15 permanent sampling points were equally spaced 250 m (820 ft) apart on a 3 x 5 grid. At each sample point, vegetation composition was measured along a transect in ten, 0.1-m² quadrats, and tree stand structure measured using the point-centered quarter method. At the same positions, bird point counts were conducted on three separate sampling campaigns from mid-May to mid-July of 2010. Tree density was significantly different across sites and ranged from 1,009 to 1,643 trees/ha, with a mean of 1,078/ha. The densest stands occurred on northerly aspects while more open stands faced either west or south. Basal area followed a similar pattern and ranged from 5.79 to 9.61 m²/ha, with a mean of 8.16 m²/ha. The two north-facing sites tended to have sparse understories dominated by cool-season grasses and, following the national classification system, belonged to the Two-needle Pinyon - Juniper species / Muttongrass Woodland Association. In contrast, the westerly and southerly sites had more grass abundance in the inter-tree spaces and were dominated by warm-season species. They were classified as part of the Two-needle Pinyon - (One-seed Juniper, Alligator Juniper) / Blue Grama Woodland Association. Overall, tree densities fell within the range of other measured stands in the Southwest, and sites represented multi-aged stand structures consistent with low-frequency fire regimes. The results suggest that further dendro-ecological work is warranted to specify the historic fire regime on these sites in support of any prescriptive treatments directed towards habitat improvement or fire hazard reduction. With respect to birds, 55 species were detected during the 2010 breeding season, but abundance and composition varied significantly among sites. Bird density ranged from 184 to 324 birds per 100 acres (40 ha) with Spotted Towhee (*Pipilo maculatus*), Mountain Chickadee (*Poecile gambeli*), and Black-throated Gray Warbler (*Dendroica nigrescens*) the most frequently recorded species, accounting for 26% of all observations. Species richness ranged from 31 to 41 species across sites, with the sites containing the highest density of trees having the fewest and the most open stands the most. Understanding the causes of these differences will require additional years of monitoring and more detailed habitat analysis. While no federal or state listed endangered or threatened species were recorded, the following species of conservation concern were detected: Juniper Titmouse (*Baeolophus ridgewayi*), Pinyon Jay (*Gymnorhinus cyanocephalus*), Brewer's Sparrow (*Spizella breweri*), Black-throated Gray Warbler, Mourning Dove (*Zenaida macroura*), and Sage Thrasher (*Oreoscoptes montanus*). While initial richness and abundance patterns were comparable to other studies in pinyon-juniper woodlands, few long-term monitoring studies have been implemented in this major ecosystem of the Southwest. Accordingly, the monitoring system installed here was designed to consistently re-measure seasonal-to-decadal dynamics of vegetation and avian communities in support of adaptive management to preserve the ecological values of the Wild Rivers Recreation Area.

Cover: A typical vegetation transect layout on macro-plot 10RW007, sampling point 7K.

¹ Final report submitted in partial fulfillment of BLM Assistance Agreement L09AC15871, effective Sept. 15, 2009.

² Natural Heritage New Mexico, Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM.

³ Hawks Aloft, Inc., Albuquerque, NM.

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Introduction

The study area lies within a proposed Special Recreation Management Area (SRMA) unit of the Bureau of Land Management (BLM) known as the the Guadalupe Mountain Zone. It is in turn, within the greater proposed Taos Plateau ACEC (Area of Critical Environmental Concern), Wild Rivers Zone. Management objectives for the Guadalupe Mountain Zone include “opportunities for visitors to engage in exercise and escape in a back country setting.” Currently, the study area is managed under the Rio Grande Corridor Final Plan (2000) as The Wild Rivers Recreation Area (WRRRA).

The WRRRA lies to the west of Questa and Cerro, New Mexico at the confluence of two gorges containing two Wild and Scenic Rivers: the Rio Grande and the Red River. It comprises a mountain and plateau complex that provide dramatic vistas of the rivers in the gorges below, and starting points for a popular trail system. The WRRRA is also home to extensive pinyon-juniper (PJ) woodlands plus cool-desert shrublands and grasslands that form a diverse mosaic of ecosystem types across the landscape. Because of the recognized importance of the WRRRA, appropriate management of these ecosystems is considered key to sustaining the recreational values of the area as a whole. In particular, the PJ woodlands, which dominate the hills, are of particular management interest with respect to recreation, wildlife, grazing, and fire. These PJ woodlands are currently being proposed for treatment to reduce stand densities for the purposes of enhancing wildlife habitat and watershed health and reducing fire threats to nearby towns and villages (BLM 2011). Accordingly, we report here on a monitoring system installed in the PJ woodlands during the summer of 2010 designed to detect changes in vegetation composition and structure, and bird diversity in the context of management actions and environmental change.

Acknowledgements

Financial support was provided by the Bureau of Land Management (Taos Field Office), the University of New Mexico, and Hawks Aloft, Inc. We wish to thank the diligent fieldwork of Erik Andersen (birds), Randy Seeley (birds), Stephanie Baker (plants), and Anthony Fettes (plants). Rebecca Keeshen provided project management and editorial assistance.

Methods

Study area

The Wild Rivers Recreation Area is located in north-central New Mexico some 5 miles (8 km) west of the town of Questa and south of the village of Cerro (Figure 1). Physiographically, it lies along the eastern edge of the Taos Plateau within the Rio Grande Rift Valley. The latter is a relatively narrow geologic zone of a series of north-to-south-trending fault-block grabens and basins between the Colorado Plateau and the Sangre de Cristo Mountains of the Southern Rocky Mountains. The rift valley is a region of volcanic activity and the WRRRA is characterized

by a Tertiary volcanic basalt lava field that caps the plateau (Pliocene Servilleta Formation basalt from ~5 Ma (Tb)) that is in turn punctuated by the volcanic cones of the Guadalupe Mountains (Pliocene dacite of Guadalupe Mountain (Tag) from ~5.1 to 5.3 Ma) in the eastern portion of the area (Kelson et al. 2008).

Elevations range from 7,480 to 8,040 ft (2,280 m to 2,450 m). The average annual precipitation as measured at nearby Cerro, NM is 12.68 in (322 mm) and temperatures peak in July with a long-term average of 82.4° F (28° C) and are coldest in January with an average minimum of 7.8° F (13.4° C).

The study focuses on the Guadalupe Mountains, which are cloaked with short-statured pinyon (*Pinus edulis*) and juniper (*Juniperus monosperma* and *J. scopulorum*) woodlands on the southerly facing slopes with scattered ponderosa pine (*Pinus ponderosa*) at higher elevations. Some north-facing slopes support ponderosa pine and Douglas-fir (*Pseudotsuga menziesii*) mixed-conifer forest. Grasslands and sagebrush shrublands are typical in the intervening valleys. While there is a proposed forest and woodland treatment plan for the Guadalupe Mountains, to date, no data on stand composition, structure, and density was publically available beyond the general descriptions provided in BLM (2011) and BLM (2010).

Sampling design

To sample simultaneously both vegetation and birds required a sampling area large enough to accommodate bird behavior patterns birds while maintaining reasonable homogeneity of habitat and vegetation composition. In addition, given limited resources, the number of samples sites would be limited while still representative of the range of variation found among the PJ woodlands of the Guadalupe Mountains. To accommodate bird sampling based on repeated sampling using point counts with sufficient separation distance (250 m; 820 ft) and sample density (15 point—see Bird Sampling Protocol below) required large macro-plots of 750 x 1,250 m (2,460 x 4,000 ft) or 93.75 ha (232 acres). Initially, nine potential sites were identified using aerial imagery in a GIS that were large enough, uniform in terrain, and representative of the range of aspects and slopes in the study area to be considered for sampling. A ground reconnaissance was then conducted and four sites selected that reflected the range of variation of the woodland composition as a whole while still homogeneous within with respect to habitat and vegetation (Figure 2).

Within each macro-plot at a site, a stratified-random 3 x 5 grid of 15 sampling points was established with 250 m (820 ft) between each sampling point starting at a point in the northwest corner (point A) and ending in the southeast corner (point O) as determined in the GIS (Figure 3). The exception was macro-plot #5 where two points were offset to the northeast to avoid placing them downslope into a different habitat type. At each point vegetation and bird sampling was conducted during the spring and summer of 2011 as outlined in the following vegetation and bird protocol sections. Point locations in UTM Zone 13 NAD83 coordinates were determined from the GIS and used to guide sampling crews to the locations using a GPS with a

± 2m (6.5 ft) resolution. Each point was monumented with a survey nail with orange markers at ground level and an identification tag indicating the plot (10WR001, 10WR 005, 10WR007, 10WR009) and point IDs (A through O). The location of all sampling points is provided in Appendix A and as file in the Digital Data Addendum.

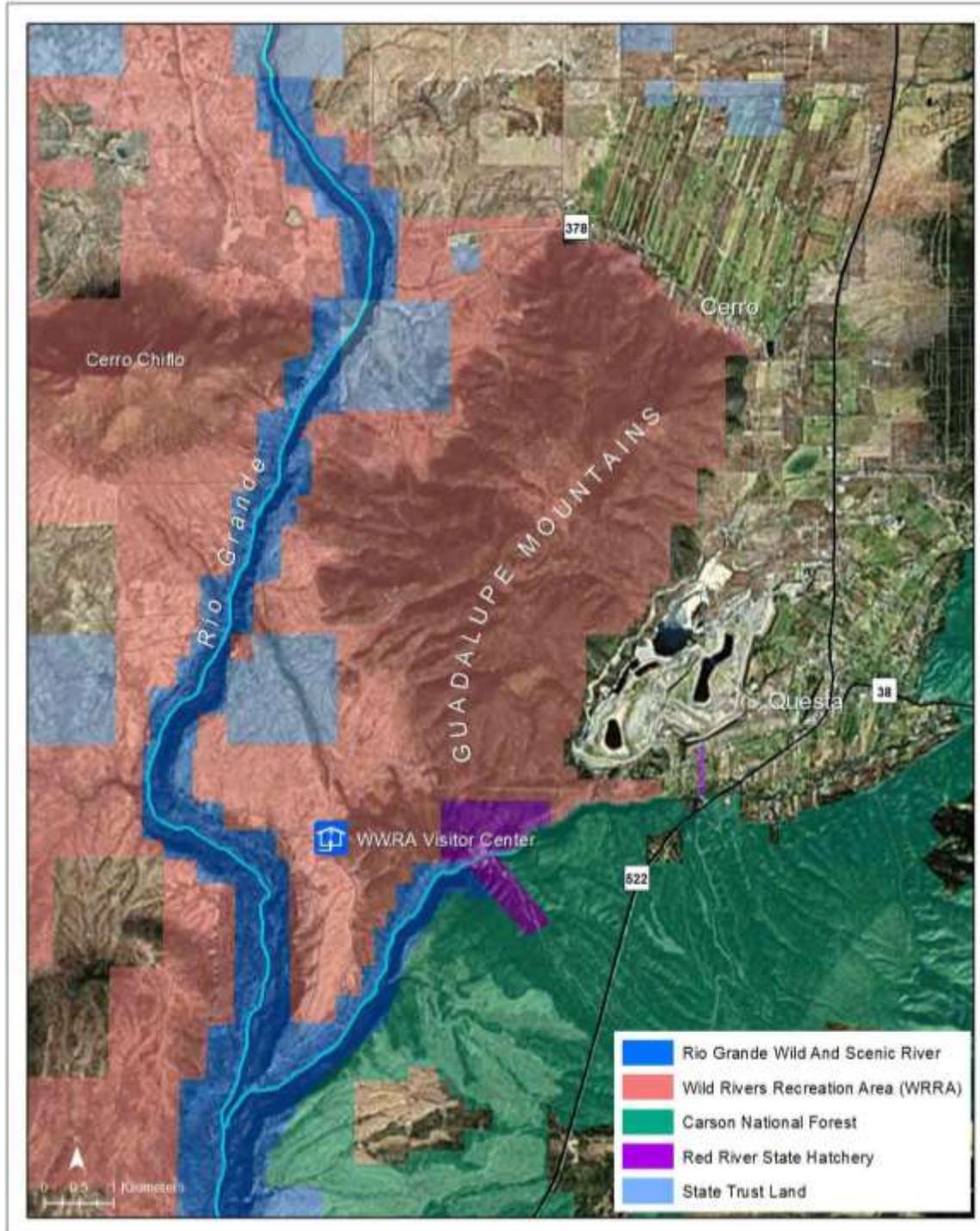


Figure 1. The Wild Rivers Recreation Area is located in north-central New Mexico, near the town of Questa.

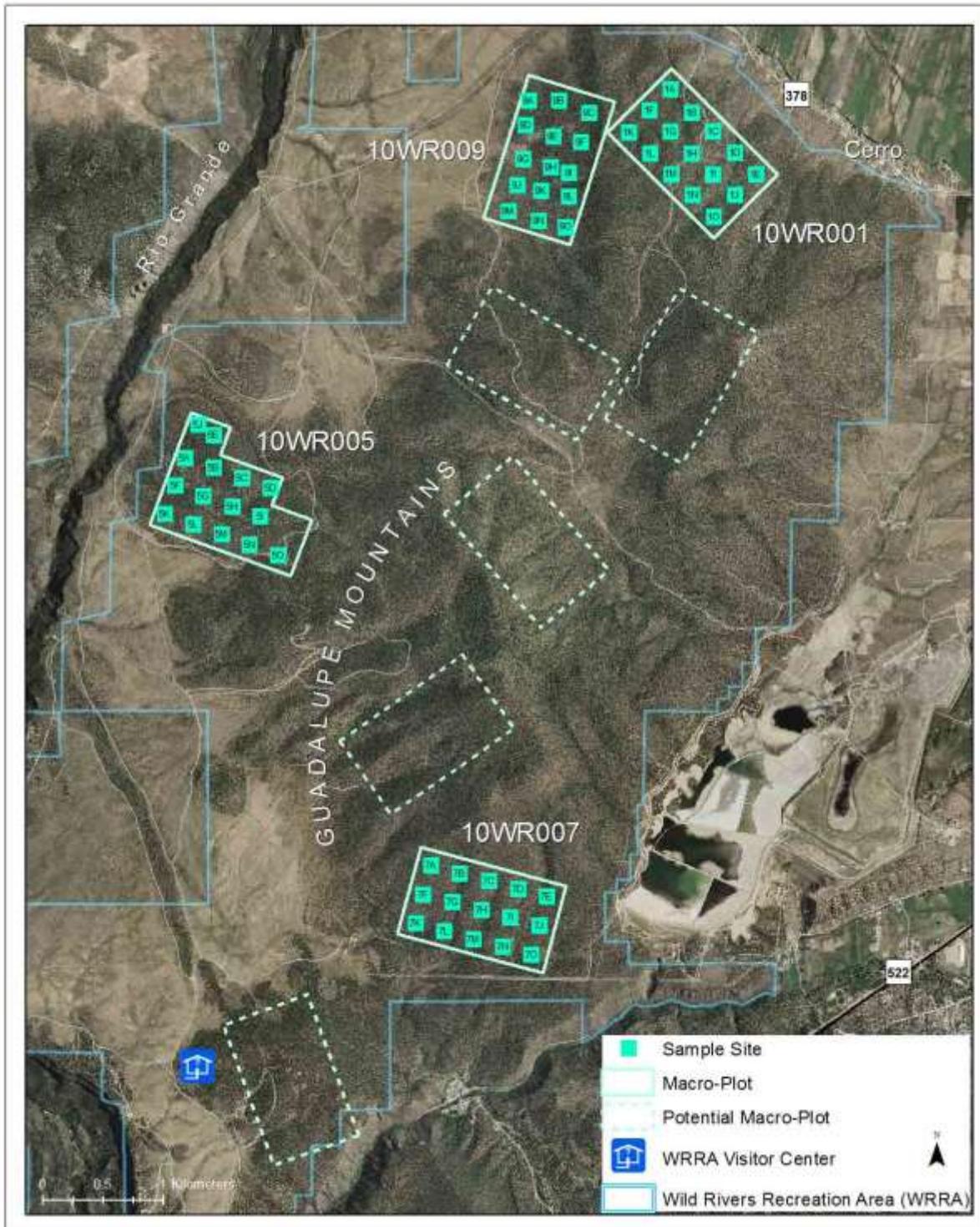


Figure 2. The four macro-plots for the Wild Rivers Recreation Area PJ woodland monitoring project were centered on the pinyon-juniper woodlands that cloak the Guadalupe Mountains. There were 15 sample points in each macro-plot used for measuring vegetation and bird diversity.

Vegetation sampling protocols and analysis

Overall, sampling was designed to ensure that re-measurement through time was capable of accurate detection of changes in plant species composition on a seasonal-to-decadal basis, as needed. At each sampling point on the grid, different sampling techniques were used to measure shrub and herbaceous vegetation versus tree. For shrubs, grasses, and forbs, percent canopy cover was visually estimated in 10 Daubenmire-style 20 x 50 cm, 0.1-m² quadrats along an 11-m transect. Transects were installed across the slope beginning at the point nail and ending with a nail at the 11-m mark. The azimuth was recorded to the nearest 2° from the zero end along the line with a Silva range compass corrected to true north, along with the overall aspect and slope (with a clinometer) for the site at the point. A cloth tape was stretched between nails and quadrats placed every meter beginning at the one-meter mark perpendicular to the transect and pointing upslope (Figure 3). Percent cover for shrubs, forbs, grasses, and seedling tree (mature trees are not counted) was recorded to the nearest 1% when cover was above 1%, and at 0.5% and 0.1% below 1%. In addition, percent ground cover was estimated for a suite of cover components (detached litter, exposed soil, gravel (>2 mm), rock (>15 cm), and herbaceous canopy (attached litter, green cover, and basal portions), wood, and microphytic crusts). Photos were taken from 0-m positions towards the 11-m end of the lines. The first reading of quadrats was conducted between 8/24/2011 and 8/31/2011.

Tree density, structure, and basal area were sampled using the point-centered quadrat method (Bonham 1989). From the 0-m nail, the slope was divided into four quadrants (NE, NW, SE, SW). Within each quadrant, the distance to the nearest tree for each species (*P. edulis*, *J. monosperma*, *J. scopulorum*, and *P. ponderosa*) was measured to the nearest decimeter at the center of a tree, and the diameter just above the root crown (DRC) measured with a diameter tape. Any trees greater than 0.5 cm (0.2 in) DRC (i.e., clearly established trees) were counted. In the interest of time, a limit of 20 m (65 ft) was set as the maximum distance out from the point where a tree search was conducted in a given quadrant. Distances and DRC values for all trees are provided in Appendix A.

Vouchers of all plant species were taken and identified. Based on the vouchers, field identifications were corrected and specimens deposited at the Museum of Southwestern Biology herbarium at the University of New Mexico. All raw vegetation data were entered into a Microsoft Access database with tables specifically designed for this project by NHHM. Data was quality controlled using NHHM protocols including independently proofreading the data for accuracy. The MS Excel raw data files, scanned copies of all paper data sheets, digital transect photo point files (JPG format), and PDF and Word versions of this report are provided as an Electronic Addendum on compact disk.

WRRRA PJ Woodland Transect Monitoring Design

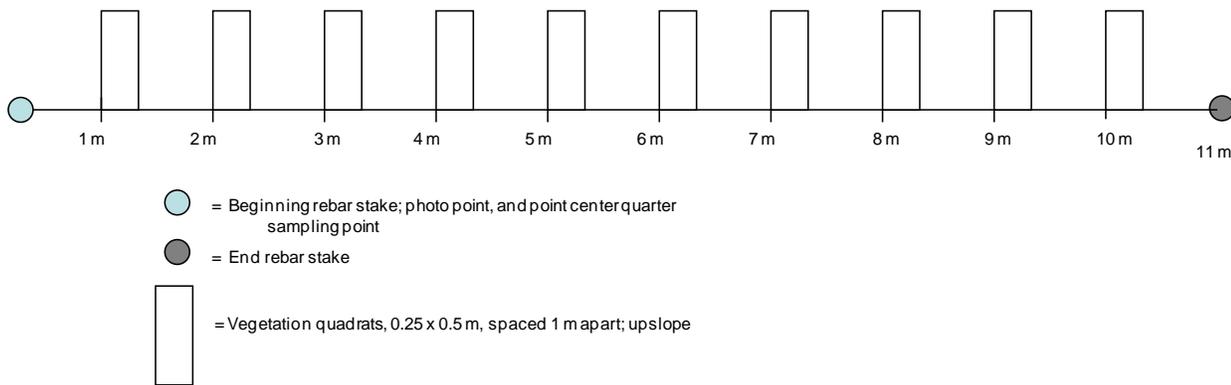


Figure 3. WRRRA PJ woodland transect monitoring design implemented at each of the 15 points within a macro-plot.

For the vegetation analysis, the absolute percent canopy cover of each species per transect at a point was calculated, i.e., the sum of individual quadrat values divided by 10 quadrats per line. The mean cover and standard deviation was then computed for each plot, based on the 15 transects. The differences in composition by major lifeform groups (shrubs, subshrubs, graminoids, and forbs) among sites was tested with one-way ANOVA using SAS 9.2 (SAS Institute 2008).

Tree density, basal area, and stand structure by species was derived from the point-centered quarter data using techniques outlined by Mitchell (2007). Total tree density per hectare was calculated from the average minimum tree distances per plot and then allocated to species by frequency of occurrence (percent of quarters occupied at the minimum distances by a given species). The average tree basal area by species was computed from the DRC values and multiplied by the density to arrive at basal area per hectare by species. Where a tree had multiple stems, the basal area was summed for the entire individual. Mean values by plot of basal area and density were computed and presented along with the distribution of species by DRC size classes as a measure of stand structure.

Bird sampling protocols and analysis

At each of the 15 points on a plot grid, we conducted point count surveys (see Bibby et al. 2000) for a total of 60 points. The surveys were conducted three times during the 2010 breeding season: 21-22 May, 10-11 June, and 12-14 July. Three observers (Erik Andersen, Kristin Madden, and Randy Seeley), each experienced with avian identification by sight and sound, conducted the 2010 surveys. At each survey point, the observer recorded all birds seen or heard during a ten-minute period. The distance of birds from the survey point was recorded using Leupold RX-600 laser rangefinders whenever possible; in many instances, distance to the bird's location was estimated. Flyovers were noted separately without measuring a distance. Surveys began in the morning within 30 minutes after sunrise and attempted to finish within four hours. Consecutive surveys at a given plot were separated by at least two weeks.

The analysis focuses on avian community species composition, and the most frequently detected species during the 2010 breeding season. Avian density estimates were calculated and expressed as the mean number of birds per 100 acres (40.5 ha). The number of birds per 100 acres was calculated based on our observations within a 50-m radius of each point. Detections beyond a 50-m (165-ft) radius were truncated from the density calculations to provide a more accurate assessment of avian density; our detection rates rapidly decreased beyond that distance. Species richness was defined as the total number of species detected per plot, within a 125-m (410-ft) radius of the point of detection. All detections beyond 125 m were truncated from the species-richness calculations to best ensure that observations at one point would be independent of observations from a neighboring point. Species recorded only as flyovers were not included in species-richness calculations.

Statistical analysis comparing avian density between plots was conducted using a Tukey-Kramer test. Statistical significance for all comparisons was set at $\alpha < 0.05$. Statistical analysis was conducted using JMP 5.0 statistical software (SAS Institute 2002).

In addition, the presence of any federal or state listed species and U.S. Fish and Wildlife Service (2008) species of conservation concern were reported.

Results and Discussion

Vegetation

Composition and structure

With respect to overall tree composition, all four sites were clearly dominated by pinyon pine (Figure 4). Only on site 5 (10WR005) did the combined densities and basal area of oneseed and Rocky Mountain juniper approach that of pinyon. Site 5 also had the lowest overall density and basal area of trees (Table 1), but our reconnaissance suggested that this site had been subject to intensive pinyon fuel-wood harvesting in the past, creating a more open stand compared to the others. In contrast, pinyon densities were highest at site 1 (10WR001), a site that faces northeast along the upper slopes of the Guadalupe Mountains, and hence represents the coolest and most mesic conditions monitored. It is also the site with the greatest abundance of Rocky Mountain Juniper, which is in keeping with its more mesic and cooler conditions. Rocky Mountain juniper tends to be more prevalent on all sites except 7 (10WR007). The slope of site 7 is predominantly south-facing and the warmest and driest of the sites, and oneseed juniper prevails.

The stand structures for each site also reflect suggest subtle differences in size class distributions (Figure 5). On the south-facing site 7 there is a greater number of small (<5 cm) and presumably younger trees, suggesting increased recruitment on this warmer site than at others. For the others, pinyon densities peak at between 5 and 10 cm. Based on Huffman (2006), these are likely to range from 10 to 75 years in age, but small trees can be upwards of 150 years old, depending on the microsite. While Rocky Mountain juniper tends to have similar stand structures to pinyon, for oneseed juniper, the numbers in small-size classes are low or absent. During the sampling, numerous juniper stumps left behind during fuelwood harvesting were observed on all sites (usually harvested preferentially to pinyon). Hence, current stand-structure densities may underrepresent the larger tree classes.

Table 1. Total tree density and basal area at root crown per site (plot) among PJ woodlands at WRRRA in 2010. Values are based on 15 point center quarter sampling points per plot (60 samples total per plot).

Plots	Density (trees/ha ²)	Basal Area (m ² /ha)
10WR001	1,643	9.40
10WR005	637	5.79
10WR007	1,024	7.93
10WR009	1,009	9.61
Average	1,078	8.18

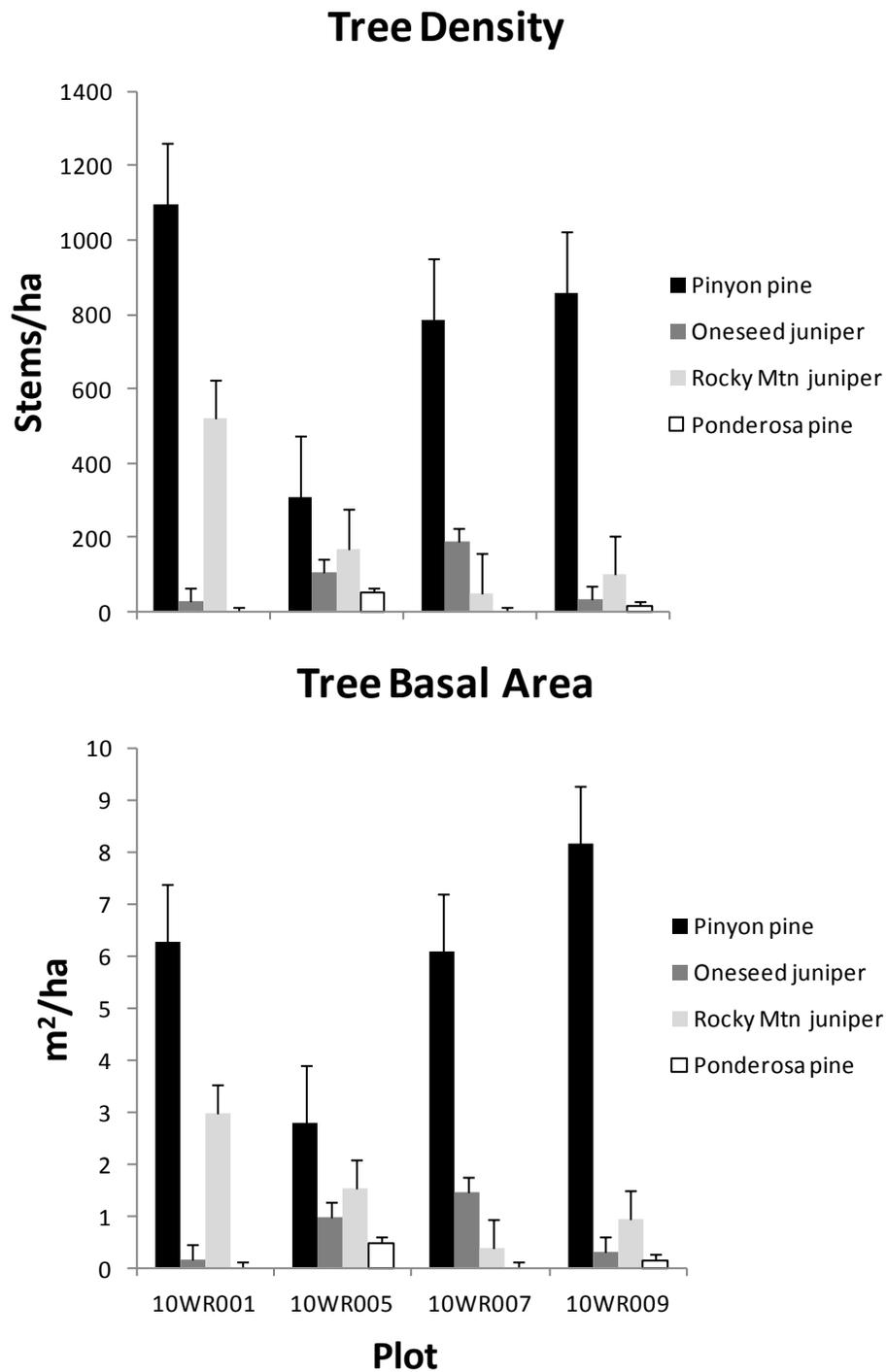
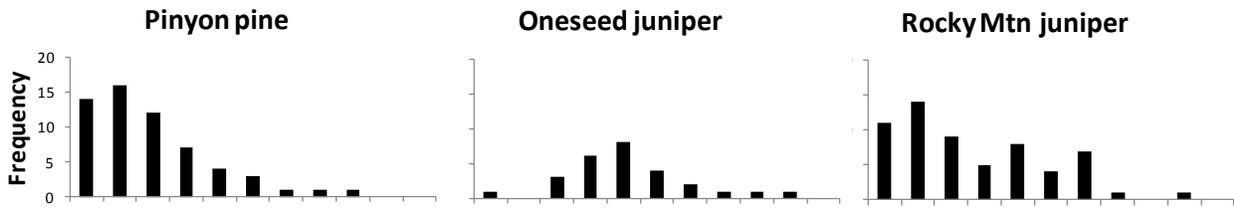
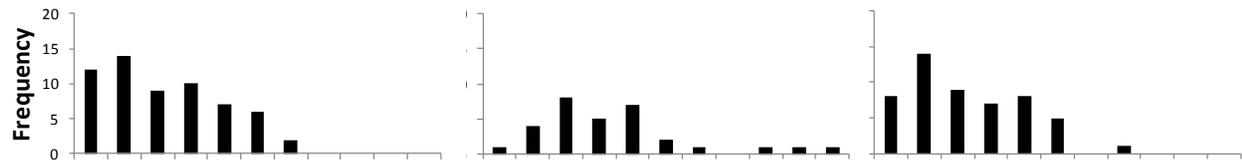


Figure 4. Tree density and basal area mean and standard error by species among the four WRRRA PJ woodland monitoring sites in 2010.

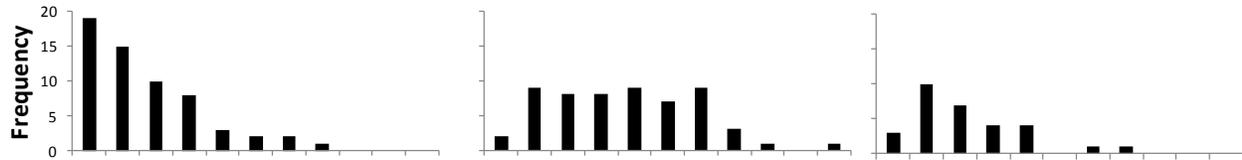
10WR001



10WR005



10WR007



10WR009

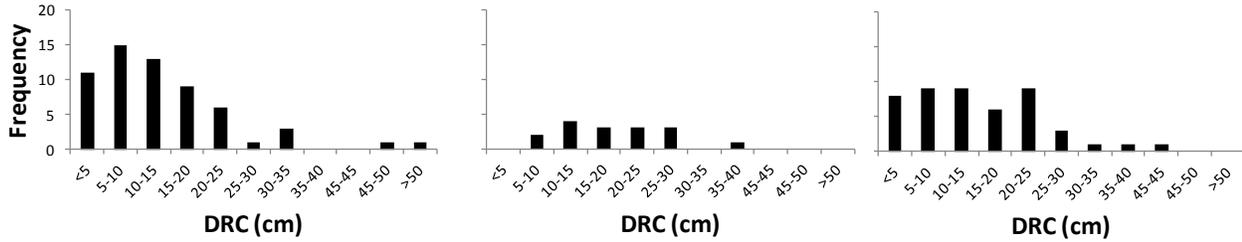


Figure 5. Stand structures based on diameter root crown (DRC) size classes for all trees sampled on the WRRRA PJ woodland monitoring plots in 2010.

Sites varied with respect to understory composition and abundance (Tables 2 and 3). Shrubs were never abundant, but big sagebrush (*Artemisia tridentata*) was present on all sites and well represented on site 9 (10WR009), and mountain mahogany (*Cercocarpus montanus*), a common post-disturbance species in PJ woodlands, was common on site 5. There were significant differences in grass cover and composition among sites. Blue grama (*Bouteloua gracilis*), a warm-season C4 species, was a common element across all sites but it was dominant only on plots 5 and 7, the westerly and southerly facing sites, respectively. Bottlebrush squirreltail (*Elymus elymoides*) and western wheatgrass (*Pascopyrum smithii*) were also common and sometimes codominants on these sites. Accordingly, following the National Vegetation Classification system (FGDC 2008), both sites would be classified as part of the Two-needle Pinyon - (One-seed Juniper, Alligator Juniper) / Blue Grama Woodland Association (*Pinus edulis* - (*Juniperus monosperma*, *Juniperus deppeana*) / *Bouteloua gracilis* Woodland) within the Southern Rocky Mountain Pinyon - Juniper Woodlands Group⁴. In contrast, muttongrass (*Poa fendleriana*), a cool-season C3 species, was the dominant on the northerly facing sites 1 and 9, along with scattered mountain muhly (*Muhlenbergia montana*). These sites would be classified as the Two-needle Pinyon - Juniper species / Muttongrass Woodland Association (*Pinus edulis* - *Juniperus* spp. / *Poa fendleriana* Woodland) of the Colorado Plateau Pinyon - Juniper Woodland Group.

On site 5, there were several species that were indicative of the more open canopy and the disturbance following more recent entry for fuelwood harvesting. These include smallleaf pussytoes (*Antennaria parvifolia*), sagewort (*Artemisia* spp.), Missouri milkvetch (*Astragalus missouriensis*), rose heath (*Chaetopappa ericoides*), redroot buckwheat (*Eriogonum racemosum*), collegethyme (*Hymenopappus flavescens* var. *canotomentosus*), pingue Hymenoxys (*Hymenoxys richardsonii*), skyrocket gilia (*Ipomopsis aggregata*), and rock goldenrod (*Petradoria pumila*).

Table 2. Mean percent canopy cover by life form per plot with ANOVA *F* ratio and probability of a significant difference across PJ woodland sites at WRRRA in 2010. Means are based on based on 10 quadrats per sampling point and 15 sampling points per plot for 150 total quadrats.

Life form	10WR001	10WR005	10WR007	10WR009	<i>F</i>	<i>P-value</i>
Tall shrubs	1.36	4.81	0.48	5.06	1.99	0.124
Dwarf shrubs	0.46	0.50	0.91	0.14	1.04	0.380
Graminoids	2.08	8.86	5.55	3.73	7.23	<0.001
Forbs	0.24	1.11	0.81	0.12	1.93	0.135
Total cover	4.14	15.28	7.75	9.05	3.54	0.020

⁴ See <http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol>

Table 3. Mean quadrat species absolute percent canopy cover by plot and overall average among PJ woodland sites at WRRRA in 2010. Means are based on based on 10 quadrats per sampling point and 15 sampling points per plot for 150 total quadrats. The average (Avg.) is the percent canopy cover average of those plots where the species was present.

Life form	PLANTS symbol	Scientific name	Common name	10WR 001	10WR 005	10WR 007	10WR 009	Avg.	
Tree (seedlings)	PIED	<i>Pinus edulis</i>	pinyon pine	0.147	0.067	0.068	0.074	0.089	
	PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir	0.003				0.003	
Tall Shrubs	ARTR2	<i>Artemisia tridentata</i>	big sagebrush	1.347	2.864	0.467	5.060	2.434	
	CEMO2	<i>Cercocarpus montanus</i>	mountain mahogany	0.013	1.941			0.977	
	ERMIS2	<i>Eriogonum microthecum</i> var. <i>simpsonii</i>	Simpson's buckwheat		0.014			0.014	
	RILE	<i>Ribes leptanthum</i>	trumpet gooseberry	0.013				0.013	
	YUBA	<i>Yucca baccata</i>	banana yucca			0.023		0.023	
	YUBAI	<i>Yucca baileyi</i> var. <i>intermedia</i>	intermediate yucca		0.001			0.001	
Dwarf shrubs	ARFR4	<i>Artemisia frigida</i>	fringed sagewort		0.001			0.001	
	CHGR6	<i>Chrysothamnus greenei</i>	Greene's rabbitbrush	0.453				0.453	
	CHVA2	<i>Chrysothamnus vaseyi</i>	Vasey's rabbitbrush				0.147	0.147	
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed		0.294	0.411	0.001	0.236	
Graminoids	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	0.014	0.213	0.503		0.244	
	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass		0.053	0.067		0.060	
	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama	0.011	0.833	0.141		0.329	
	BOGR2	<i>Bouteloua gracilis</i>	blue grama	0.350	2.098	3.625	1.429	1.875	
	CARO5	<i>Carex rossii</i>	Ross' sedge	0.275	1.707	0.122	0.421	0.631	
	ELEL5	<i>Elymus elymoides</i>	bottlebrush squirreltail	0.067	1.113	1.175	0.327	0.671	
	MUMO	<i>Muhlenbergia montana</i>	mountain muhly	0.040	0.007		0.120	0.056	
	MUWR	<i>Muhlenbergia wrightii</i>	spike muhly				0.133	0.133	
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass		1.947		0.120	1.033	
	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass	0.060		0.003	0.007	0.023	
	POFE	<i>Poa fendleriana</i>	muttongrass	1.295	1.143	0.441	1.189	1.017	
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed			0.007	0.021	0.014	
	Forbs	ALCE2	<i>Allium cernuum</i>	nodding onion		0.020			0.020
		ALFI3	<i>Aletes filifolius</i>	TransPecos Indian parsley	0.097	0.007		0.007	0.037
ANPA4		<i>Antennaria parvifolia</i>	smallleaf pussytoes		0.030		0.007	0.018	
ARTEM		<i>Artemisia</i> spp.	sagewort		0.007			0.007	
ASMI10		<i>Astragalus missouriensis</i>	Missouri milkvetch		0.003			0.003	
BADI		<i>Bahia dissecta</i>	ragleaf bahia			0.040		0.040	
BOFE	<i>Boechera fendleri</i>	Fendler's rockcress	0.010	0.013	0.020	0.007	0.013		

Life form	PLANTS symbol	Scientific name	Common name	10WR 001	10WR 005	10WR 007	10WR 009	Avg.
	CHER2	Chaetopappa ericoides	rose heath		0.001			0.001
	CHFR3	Chenopodium fremontii	Fremont's goosefoot			0.004	0.003	0.004
	CHGR2	Chenopodium graveolens	fetid goosefoot			0.014	0.027	0.021
	CHRE4	Chamaesyce revoluta	threadstem sandmat			0.007		0.007
	CHSE6	Chamaesyce serpyllifolia	thymeleaf sandmat		0.010	0.003	0.002	0.005
	ERAL4	Eriogonum alatum	winged buckwheat			0.027	0.020	0.023
	ERFL	Erigeron flagellaris	trailing fleabane		0.003	0.434		0.219
	ERFO3	Erigeron formosissimus	beautiful fleabane	0.127			0.017	0.072
	ERJA	Eriogonum jamesii	James' buckwheat	0.001	0.030	0.070		0.034
	ERRA3	Eriogonum racemosum	redroot buckwheat		0.017			0.017
	ERVE2	Erigeron vetensis	early bluetop fleabane	0.007	0.040		0.048	0.032
	HEVI4	Heterotheca villosa	hairy goldenaster			0.033		0.033
	HYFLC	Hymenopappus flavescens var. canotomentosus	collegeflower		0.020			0.020
	HYRI	Hymenoxys richardsonii	pingue hymenoxys		0.253			0.253
	IPAG	Ipomopsis aggregata	skyrocket gilia		0.020			0.020
	LERE3	Physaria rectipes	straight bladderpod	0.010	0.087	0.052		0.050
	LUARA5	Lupinus argenteus ssp. argenteus	silvery lupine		0.040			0.040
	MEOF	Melilotus officinalis	yellow sweetclover	0.007				0.007
	MIOX	Mirabilis oxybaphoides	smooth spreading four o'clock			0.067		0.067
	ORPU2	Orthocarpus purpureoalbus	purplewhite owlclover		0.013			0.013
	PECRT2	Penstemon crandallii ssp. taosensis	Taos penstemon	0.014	0.118	0.073		0.068
	PEPUP	Petrorhiza pumila ssp. pumila	rock goldenrod		0.387			0.387
	POOL	Portulaca oleracea	common purslane		0.014	0.001		0.008
	PUPAM	Pulsatilla patens ssp. multifida	cutleaf anemone		0.040		0.007	0.023
	SCLI12	Schoenocrambe linearifolia	slimleaf plainsmustard				0.001	0.001
	TOEX2	Townsendia exscapa	stemless townsendia		0.007	0.015		0.011

Vegetation Discussion

A key question when evaluating the status of PJ woodlands is to consider if the current stand structure and vegetation composition lie within the natural range of variability and the implications for fire and wildlife management. Romme et al. (2009) outline three basic PJ types in the context of fire regimes: persistent woodlands, pinyon–juniper savannas, and wooded shrublands. “Persistent woodlands” are stands where pinyons are strong dominants, understories tend to be sparse, and fire frequencies are low (>400 years) and typically stand replacing; spreading, low-intensity, surface fires had a very limited role, if any, in molding stand structure and dynamics. Our north-facing Two-needle Pinyon - Juniper species / Muttongrass Woodlands sites (1 and 9) would fit into this category. In contrast, “pinyon–juniper savannas” have more open canopies with grassy inter-tree areas and characterized by higher-frequency, low-intensity fires similar to that of grasslands. The two-needle Pinyon - (One-seed Juniper, Alligator Juniper) / Blue Grama Woodland sites (5 and 7) would fit here, although grass cover is still relatively sparse and the role of surface fires may be in question (wooded shrublands are present in the valleys and flats at WRRR, but were not sampled here).

In persistent woodlands, we would expect stands to be uneven in age, with cohorts of young trees as well as a several very large and older individuals reflecting the long intervals between fires, and this is what is reflected in the stand structures for sites 1 and 9. In pinyon–juniper savannas, more frequent surface fires would be expected to remove a significant portion of the younger, more fire-sensitive cohort and also reduce overall densities, particularly among pinyons, which are thought to be somewhat less fire-tolerant than junipers. On sites 5 and 7, smaller pinyons, and to lesser degree junipers, are common. Yet, it is not clear that current stand densities have significantly lowered grass cover and, hence, fire frequencies as a function of historical infill, or whether densities simply reflect site potential where grass cover is inherently low.

For pinyon-juniper ecosystems, few high-quality data sets are available that describe historical ranges of variability of overstory structure or fire regime (West 1999, Baker and Shinneman 2004), but recently Huffman et al. (2006, 2008) described the stand structure and understory composition of a PJ woodland at Canjilon, NM, some 45 miles (70 km) west of WRRR. Their site was at similar elevation (7,700 ft; 2,347 m) but precipitation was 2.6 in (66 mm) more and the underlying parent material was shale rather than extrusive volcanics (dacite). Their sites also had significant Gambel’s oak (*Quercus gambelii*) and big sagebrush in the understory. Their range of current stand densities was similar to ours, with patches ranging from 500 trees/ha to over 1,000, and an average of 770/ha versus 637 to 1,643 and an average of 1,078/ha at WRRR. Kennedy and Stahlecker (1986), working ring within WRRR on a peregrine falcon prey-base study, reported 2,264 /ha of pinyons and junipers in their “Pinyon/Juniper Woodland” habitat site. This a27% more than our densest site of 1,643/ha (t10WR001), yet they considered the woodland to be stable and not expanding either downslope into sagebrush shrublands or nor being invaded by tall conifers..

Using tree-ring age/DRC relationships, Huffman et al. (2006) developed a model of the 1890s stand structure reconstructed from the distribution of living and dead standing trees, logs, and stumps. Their model generated reconstructed tree densities that ranged from 0 to 1,125/ha, per patch, and overall stand densities that may have been 40% lower in the 1890s. The caveat is they likely could not account for all trees that might have been present in 1890 and died through a self-thinning process and left no trace, or those removed over the previous centuries for fuelwood. Regardless, they suggest that fire-return intervals were likely quite long and that large increases in pinyon density since 1890 in some areas may represent recovery after historically severe fire, and they remain equivocal about whether these modern densities are beyond the norm.

Overall, it remains plausible that current stand densities at WRRRA are within the natural range of variability. With the exception of site 1, stands from the middle range of densities show little small tree encroachment (Figure 6). Even on site 1, with its relatively dense stands, it is unlikely that any infilling process is related to fire exclusion because there is little evidence in these persistent woodlands for pre-settlement, low-severity fires prior to any fire exclusion. To confirm this one way another will require more in-depth stand-structure analysis that includes tree ages as well as sizes along with sampling for direct fire evidence, particularly in stands with a modicum of grass cover, to ascertain if low-intensity surface fires were ever part of these woodlands.



a) Plot 10WR001, point 1E on a northeast-facing slope



b) Plot 10WR009, point 9D on a northwest-facing slope



c) Plot 10WR005, point 5E on a west-facing slope



d) Plot 10WR007, point 7E on a south-facing slope

Figure 6. Examples of stands with moderate tree densities at or near the mean value for each site at WRRRA in 2010.

Birds

Community composition

Avian abundance and species richness varied significantly across the four sampling plots (Tables 4 and 5). We observed 55 avian species during breeding season point-count surveys in the Wild Rivers Recreation Area in 2010 (Table 4). Spotted Towhee (*Pipilo maculatus*), Mountain Chickadee (*Poecile gambeli*), and Black-throated Gray Warbler (*Dendroica nigrescens*) were the most frequently recorded species, accounting for 26% of all observations. Spotted Towhee was the most frequently recorded species in both plots 9 and 5, where it was substantially more prevalent by about 60% than on either plot 1 or 7. Black-throated Gray Warbler was the most frequently recorded species on plots 1 and 5, where it occurred about 50% more often than on either plot 7 or 9. Juniper Titmouse (*Baeolophus ridgewayi*) was also abundant, particularly on plot 7, where it occurred twice as often as elsewhere.

We observed no federal or state listed endangered or threatened species; we recorded three species on the U.S. Fish and Wildlife Service (2008) National and Southwest Region lists of birds of conservation concern: Juniper Titmouse, Pinyon Jay (*Gymnorhinus cyanocephalus*), and Brewer's Sparrow (*Spizella breweri*). Juniper Titmouse and Pinyon Jay are also New Mexico Department of Game and Fish (NMGF) Species of Greatest Conservation Need (BISON-M 2010). We recorded three additional NMGF Species of Greatest Conservation Need: Black-throated Gray Warbler, Mourning Dove (*Zenaida macroura*), and Sage Thrasher (*Oreoscoptes montanus*).

Avian density was significantly higher in both plots 5 and 9 than in plot 1, but not plot 7 (Table 8). Species richness was highest in plot 7, followed by plots 9 and 5 (N=38 for each). Although species richness was substantially lower in plot 1 than the other plots, the difference was not statistically significant.

Table 4. Comparison of breeding season avian density and species richness at four plots in the Wild Rivers Recreation Area, Taos County, New Mexico in 2010. Avian density comparisons were conducted using the Tukey-Kramer test. Plots not connected by the same letter had significantly different densities.

Plot		Mean # birds/100 acres	Species richness	
5	A	324.2	38	
9	A	293.2	38	
7	A	B	248.6	41
1		B	184.4	31

Table 5. Alphabetical list of 55 avian species observed during breeding season point-count surveys in the Wild Rivers Recreation Area, Taos County, New Mexico in 2010. We have included the NHHM State Endangerment Ranks where S3B = vulnerable and breeding and S4B = apparently secure but possible long-term concern. Abundance per plot is reported as the total number of individuals recorded at any distance from survey points. Species marked with an asterisk (*) were observed only as flyovers; we do not include flyover numbers in total observation numbers, but do include them in the total number of species detected. KS refers to those species recorded by Kennedy and Stahlecker (1986) as either breeding (B), partial breeding (P), or visitors (V). D is the estimated number of birds/km² in pinyon-juniper woodland habitat by Kennedy and Stahlecker (1986).

Common Name	Scientific Name	Rank	Plot				Total	KS	D
			1	5	7	9			
American Robin	<i>Turdus migratorius</i>		1	4	0	0	5	P	0
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>		3	9	7	9	28	B	6
Bewick's Wren	<i>Thryomanes bewickii</i>		0	1	12	7	20		
Black-billed Magpie	<i>Pica hudsonia</i>		0	0	1	4	5		
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>		1	6	3	0	10		
Black-throated Gray	<i>Dendroica nigrescens</i>	S3B	27	29	14	16	86	B	7
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>		7	0	3	38	48		
Brewer's Sparrow	<i>Spizella breweri</i>		0	1	4	8	13		
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>		1	5	7	6	19	B	1
Brown-headed Cowbird	<i>Molothrus ater</i>		6	14	5	3	28	B	3
Bushtit	<i>Psaltiriparus minimus</i>		0	0	7	42	49	V	0
Canyon Towhee	<i>Pipilo fuscus</i>		0	0	9	1	10		
Chipping Sparrow	<i>Spizella passerina</i>		1	21	27	19	68	B	2
Clark's Nutcracker	<i>Nucifraga columbiana</i>		3	4	0	0	7	P	0
Cliff Swallow*	<i>Petrochelidon pyrrhonota</i>		0	0	0	0	0		
Common Raven	<i>Corvus corax</i>		5	7	1	8	21		
Dark-eyed Junco	<i>Junco hyemalis</i>		2	4	6	15	27	B	2
Downy Woodpecker	<i>Picoides pubescens</i>		0	0	3	0	3		
Empidonax flycatcher	<i>Empidonax spp.</i>		0	0	0	3	3		
Gray Flycatcher	<i>Empidonax wrightii</i>		7	27	13	5	52	B	6
Great Horned Owl	<i>Bubo virginianus</i>		0	0	0	1	1		
Green-tailed Towhee	<i>Pipilo chlorurus</i>		0	1	3	3	7		
Hairy Woodpecker	<i>Picoides villosus</i>		0	1	4	1	6	B	6
Hermit Thrush	<i>Catharus guttatus</i>		9	7	1	0	17		
Juniper Titmouse	<i>Baeolophus ridgwayi</i>	S4B	11	13	28	14	66	B	6

Common Name	Scientific Name	Rank	Plot				Total	KS	D
			1	5	7	9			
Lesser Goldfinch	<i>Carduelis psaltria</i>		0	2	0	0	2		
Mountain Bluebird	<i>Sialia currucoides</i>		0	3	3	4	10		
Mountain Chickadee	<i>Poecile gambeli</i>		25	15	18	34	92	B	3
Mourning Dove	<i>Zenaida macroura</i>		26	16	7	5	54	B	1
Northern Flicker	<i>Colaptes auratus</i>		8	9	3	2	22	B	6
Northern Mockingbird	<i>Mimus polyglottis</i>		0	0	1	10	11		
Pine Siskin	<i>Carduelis pinus</i>		6	5	12	15	38	V	0
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	S3B	24	4	15	22	65	P	0
Plumbeous Vireo	<i>Vireo plumbeus</i>		18	39	6	9	72	B	6
Pygmy Nuthatch	<i>Sitta pygmaea</i>		1	0	0	0	1	B	1
Rock Wren	<i>Salpinctes obsoletus</i>		0	0	2	2	4		
Sage Thrasher	<i>Oreoscoptes montanus</i>		0	0	2	4	6		
Spotted Towhee	<i>Pipilo maculatus</i>		25	59	24	68	176	B	6
Steller's Jay	<i>Cyanocitta stelleri</i>		0	3	10	0	13	V	0
Townsend's Solitaire	<i>Myadestes townsendi</i>		2	5	1	2	10	V	0
Turkey Vulture	<i>Aura cathartes</i>		0	0	1	0	1		
Vesper Sparrow	<i>Pooecetes gramineus</i>		0	2	0	0	2		
Violet-green Swallow	<i>Tachycineta thalassina</i>		4	17	0	0	21	B	1
Virginia's Warbler	<i>Vermivora virginiae</i>	S3B	0	1	0	0	1		
Warbling Vireo	<i>Vireo gilvus</i>		0	1	2	1	4		
Western Bluebird	<i>Sialia mexicana</i>		1	0	0	0	1	B	1
Western Kingbird	<i>Tyrannus verticalis</i>		0	0	2	0	2		
Western Meadowlark	<i>Sturnella neglecta</i>		18	0	0	0	18		
Western Scrub-Jay	<i>Aphelocoma californica</i>		19	11	11	10	51	P	0
Western Tanager	<i>Piranga ludoviciana</i>		7	2	4	1	14		
Western Wood-Pewee	<i>Contopus sordidulus</i>		1	2	9	1	13		
White-breasted Nuthatch	<i>Sitta carolinensis</i>		3	8	6	7	24	B	1
White-throated Swift*	<i>Aeronautes saxatalis</i>		0	0	0	0	0	V	0
White-winged Dove	<i>Zenaida asiatica</i>		0	1	0	2	3		
Yellow-rumped Warbler	<i>Dendroica coronata</i>		4	18	12	7	41	V	0
Total Observations			27	37	30	40	1371		
Percent of Observations			20	27	23	30	-		
Number of Species			31	38	41	38	55		

Avian community discussion

The significantly lower avian density in plot 1 compared to the other plots was primarily a result of proportionally lower densities of several bird species relative to the other plots, and a lower overall avian species richness than the other plots. Although the reduced avian species richness in plot 1 was partially responsible for the lower avian density, among the species absent from plot 1, only Bushtit (*Psaltriparus minimus*) in plot 9 was documented in large numbers elsewhere. Chipping Sparrow (*Spizella passerina*) was the only species common on all plots except for plot 1, where only a single bird was detected. Chipping Sparrows prefer open woodlands with smaller shrubs and dense ground cover (Sedgwick 1987, Middleton 1998), characteristics that were present on plots 5, 7, and 9. These characteristics were generally lacking on plot 1, however, which was characterized as a north-facing, predominantly dense woodland. Human disturbance may also have contributed to the lower bird numbers on plot 1, which was more easily accessed and showed evidence of being more heavily frequented by people than the other plots (K. Madden pers. obs.). Close evaluation of avian point-count data did not indicate any evidence of observer bias between plots.

Avian species composition in the Wild Rivers Recreation Area during the 2010 breeding season was similar to that reported by Kennedy and Stahlecker (1986) for WRRRA (see Table 5) Kennedy and Stahlecker (1986) reported 133 species from WRRRA but only 35 in their Pinyon/Juniper Woodland compared to the 55 we observed, of which 28 were held in common (sampling intensities and seasons were similar and comparable). The seven that we did not see were Common Nighthawk, American Crow, Red-breasted Nuthatch, Ruby-crowned Kinglet, Townsend's Warbler, Cassin's Finch, and Red Crossbill. Of these, only Red-breasted Nuthatch was considered a breeder. While species richness and diversity were somewhat different, the most abundant species were more or less the same (e.g., Black-throated Gray Warbler and Juniper Titmouse). There is an indication that we observed more Pinyon Jay, Gray Flycatcher, Spotted Towhee, Mountain Chickadee, and Bushtit individuals than they did, at least in the pinyon-juniper woodlands.

Avian species richness in this study was also similar to that documented in PJ habitat at Ute Mountain in northern New Mexico (N=51; Hawks Aloft, Inc. 2011), and was higher than that documented in PJ habitat near Raton in northeastern New Mexico (N=41; Goguen and Matthews 1998), and on the Zuni Pueblo in western New Mexico (N=42; Albert et al. 2004). The methods used at Ute Mountain were consistent with those used in this study, and the species composition was nearly identical. The close proximity of Ute Mountain to the Wild Rivers study area and the strong similarity in species composition between the two locations suggest that our results provide a reliable inventory of regularly occurring avian species during the breeding season in north-central New Mexico PJ woodlands. Although Goguen and Matthews (1998) followed similar methods to those used in this study, they did not report detections of

raptors or aerial foragers (e.g., swallows, swifts, and nighthawks), so their actual species richness may have been closer to our findings. Albert et al. (2004) followed a less rigorous survey protocol that may have influenced their species richness. Additionally, they did not report any specifics regarding species composition on the Zuni Pueblo. As a result, their findings are less directly comparable to this study.

Avian studies in PJ habitat throughout the western United States generally report similar species compositions to that found in this study, at least in terms of common species (e.g., Goguen and Matthews 1998, Paulin et al. 1999, Pavlacky and Anderson 2001, Fleishman and Dobkin 2009). But, most studies in PJ woodlands have focused on nesting ecology (e.g., Laudenslayer and Balda 1976) or the habitat selection of specific species (e.g., DeMarco et al. 2000, Goguen et al. 2005), and do not provide comprehensive species lists that would allow for direct comparisons of avian species richness and composition. In total, more than 70 bird species are known to breed in PJ woodland (Gillihan 2006), although specific sites likely support closer to 20 to 30 species (Balda and Masters 1980, Paulin et al. 1999). We did not specifically search for evidence of breeding, but based on the timing of surveys, the abundance and presence of individual species across survey periods, and their preferred breeding micro-habitats, the richness of breeding birds in our study was likely somewhere near 30 species.

Among the 70+ species known to breed in PJ woodland across the western United States, a handful are considered to be PJ obligates. There is no formal list of PJ obligates, and different researchers consider different species to be obligates relative to their study areas. For example, Paulin et al. (1999) considered Bullock's Oriole (*Icterus bullockii*) to be a PJ obligate in their Utah study area. In New Mexico, Bullock's Orioles are generally associated with lowlands and riparian areas (Parmeter et al. 2002), and we did not record the species in the higher-elevation PJ habitat surveyed during this study. There are, however, a suite of species consistently considered to be PJ obligates throughout the west. These species include Gray Flycatcher (*Empidonax wrightii*), Juniper Titmouse, Black-throated Gray Warbler, Blue-gray Gnatcatcher (*Polioptila caerulea*), and Pinyon Jay (see Balda and Masters 1980, Goguen and Matthews 1998, Paulin et al. 1999, Pavlacky and Anderson 2001, Fleishman and Dobkin 2009). All five of these species were common in our study area, and all but Blue-gray Gnatcatcher were documented in all four study plots; Blue-gray Gnatcatcher was not detected in plot 5.

Other species frequently considered PJ obligates include Bewick's Wren (*Thryomanes bewickii*), Western Scrub-Jay (*Aphelocoma californica*), Ash-throated Flycatcher (*Myarchus cinerascens*), Chipping Sparrow, and Bushtit (Goguen and Matthews 1998, Paulin et al. 1999, Pavlacky and Anderson 2001, Gillihan 2006, Fleishman and Dobkin 2009). Although we regularly recorded each of these species, only Western Scrub-Jay, Ash-throated Flycatcher, and Chipping Sparrow were documented in all four plots. Bushtit was common in plot 9, but was not recorded in plots 1 or 5. Bewick's Wren was regular in plots 7 and 9, but was not recorded in plot 1.

Among the six species of conservation concern documented in 2010, three (Juniper Titmouse, Pinyon Jay, and Black-throated Gray Warbler) are considered PJ obligates. Juniper Titmouse detections in plot 7 were twice that of the other three plots, but the species was regularly recorded in all four plots. Juniper Titmouse prefers more open woodland and is most common where juniper is dominant and where large, mature junipers are present to provide natural cavities for nesting (Cicero 2000). The primary threat to Juniper Titmouse is the removal of mature junipers, such as for rangeland conversion or for fuelwood (Schmidt 1994). Because the availability of nesting cavities may be limiting in PJ woodland, the retention of older juniper trees with large, twisted trunks is important for this species (Cicero 2000).

Pinyon Jay was recorded in all four plots, but was less common in plot 5, where pinyon density was the lowest of the other plots. Pinyon Jay co-evolved with pinyon pine and is highly reliant on pinyon seeds for forage (Balda 2002). The species prefers mature pinyon stands, which produce larger seed crops (Short and McCulloch 1977). Breeding is closely tied to pinyon cone crop size, and may be delayed if cone crops are small (Balda 2002). However, Ligon (1978) found that nesting may also be stimulated by insect abundance. The greatest threat to this species is habitat destruction. For example, efforts to eradicate PJ woodlands throughout the western United States during the 1940s-1960s may have led to the deaths of millions of Pinyon Jays during that time (Balda 2002).

Black-throated Gray Warbler was regularly recorded in all four plots, but was detected nearly twice as often in plots 1 and 5. This warbler prefers PJ stands with brushy undergrowth (Guzy and Lowther 1997), and mature PJ woodlands with high canopy cover (Sedgwick 1987, Gillihan 2006). The greatest threat to this species may be habitat fragmentation. In addition, Brown-headed Cowbirds regularly parasitize Black-throated Gray Warbler nests, and increased habitat fragmentation may increase the likelihood of cowbird parasitism (Guzy and Lowther 1997). Data from Breeding Bird Survey routes indicate a significant negative population trend in Black-throated Gray Warbler in New Mexico (Sauer et al. 2008).

Two other species of conservation concern documented during this study, Brewer's Sparrow and Sage Thrasher, are both considered sage obligates (Braun et al. 1976, Reynolds et al. 1999, Rotenberry et al. 1999). Both bird species were recorded in plots 7 and 9, plots that incorporated a sagebrush component. Brewer's Sparrows are most closely associated with landscapes dominated by big sagebrush (*Artemisia tridentata*), but may also occur in large openings in PJ woodlands (Sedgwick 1987). Sage Thrashers are also most closely associated with big sagebrush, but also occur in open PJ woodland, especially during migration (Reynolds et al. 1999). The greatest threat to both Brewer's Sparrow and Sage Thrasher is the widespread fragmentation and reduction in native sagebrush shrublands (Reynolds et al. 1999, Rotenberry et al. 1999).

The final species of conservation concern documented in 2010 was Mourning Dove. The species was recorded on all four plots, but was most prevalent in plot 1, where it was the second-most abundant species. Although Mourning Dove is a common species that can be found in a variety of habitats, it has shown declining population trends in New Mexico and nationally over the last several decades (Robbins et al. 1986, Sauer et al. 2008), and it therefore considered a New Mexico Species of Greatest Conservation Need (BISON-M 2010). The specific reasons for the decline of Mourning Doves are poorly understood, but hunting and lead poisoning from the ingestion of lead pellets are among the significant causes of mortality (Otis et al. 2008). In New Mexico, the recent range expansions of White-winged Doves (*Zenaida asiatica*) and Eurasian Collared Doves (*Streptopelia decaocto*) also may be negatively impacting Mourning Doves.

PJ woodlands occupy about 26 percent of the land surface in New Mexico (Piper 1977) and approximately 55 million acres throughout the western United States (Gillihan 2006). Despite this expansiveness, breeding bird communities in this habitat have been poorly studied (Segwick 1987, Goguen and Matthews 1998) and limited information is available regarding management practices that benefit PJ bird communities (Gillihan 2006).

Summary

This study has provided fundamental baseline information regarding vegetation composition and structure along with avian use in the pinyon-juniper woodlands of the Wild Rivers Recreation Area. Sampled stands represented a range of stand structures and understory compositions that are common across the Guadalupe Mountains. While stand densities varied from open to closed canopies, these were not considered out of the range of natural variability with respect to potential fire regimes for a given site. As with pinyon-juniper woodlands elsewhere, the habitat in the Wild Rivers Recreation Area supports a rich and distinctive avian community, including several species of conservation concern and pinyon-juniper obligates. We urge land managers to consider carefully the habitat and avian diversity values of this woodland when making future management decisions.

References

- Albert, S., N. Luna, R. Jensen, and L. Livingston. 2004. Restoring biodiversity to pinyon-juniper woodlands. *Ecological Restoration* 22:18-23.
- Baker, W.L., and D.J. Shinneman. 2004. Fire and restoration of pinyon-juniper woodlands in the western United States: a review. *Forest Ecology and Management* 189:1-21.
- Balda, R. P. 2002. Pinyon Jay (*Gymnorhinus*

- cyanocephalus). In *The Birds of North America*, No. 605 (A. Poole and F. Gill eds.). The Birds of North America, Inc., Philadelphia, PA.
- Balda, R. P. and N. L. Masters. 1980. Avian communities in the pinyon-juniper woodlands: a descriptive analysis. Pp. 146-169 in R. M. DeGraaf, technical coordinator. *Workshop proceedings: managing western forests and grasslands for nongame birds*. USDA Forest Service INT-GTR-86.
- Bibby, C. J., N. D. Burgess, D. A. Hill, and S. H. Hustoe. 2000. Point counts and point transects. Pages 91-112 in *Bird Census Techniques*. Academic Press, London, United Kingdom.
- [BISON-M] Biota Information System of New Mexico. June 5, 2010. BISON-M home page. <http://www.bison-m.org>. Accessed 3 January, 2010.
- Braun, C. E., M. F. Baker, R. L. Eng, J. S. Gashwiler, and M. H. Schroeder. 1976. Conservation committee report on effects of alteration of sagebrush communities on the associated avifauna. *Wilson Bulletin* 88:165-171.
- Bureau of Land Management (BLM). 2010. Guadalupe Mountain Vegetation Treatment Plan. DOI-BLM-NM-F020-2011-0011-EA U.S. Department of the Interior, Bureau of Land Management, Farmington District.
- Bureau of Land Management (BLM). 2011. Farmington District Fire Management Plan. Department of the Interior, Bureau of Land Management, Farmington District.
- Cicero, C. 2000. Oak Titmouse (*Baeolophus inornatus*) and Juniper Titmouse (*Baeolophus ridgwayi*). In *The Birds of North America*, No. 485 (A. Poole and F. Gill eds.). The Birds of North America, Inc., Philadelphia, PA.
- DeMarco, T. E., C. B. Goguen, D. R. Curson, and N. E. Mathews. 2000. Breeding behavior of the Plumbeous Vireo in New Mexico. *Western North American Naturalist* 60:394-402.
- Federal Geographic Data Committee (FGDC). 2008. Vegetation Classification Standard, version 2 FGDC-STD-005, v2. Washington, D.C.
- Fleishman, E. and D. S. Dobkin. 2009. Current and potential future elevational distributions of birds associated with pinyon-juniper woodlands in the central Great Basin, U.S.A. *Restoration Ecology* 17:731-739.
- Gillihan, S. W. 2006. Sharing the land with pinyon-juniper birds. *Partners in Flight Western Working Group*. Salt Lake City, UT.

- Goguen, C. B., D. R. Curson, and N. E. Mathews. 2005. Breeding ecology of the Gray Flycatcher in pinyon-juniper woodlands in New Mexico. *Western Birds* 36:286-295.
- Goguen, C. B. and N. E. Matthews. 1998. Songbird community composition and nesting success in grazed and ungrazed pinyon-juniper woodlands. *Journal of Wildlife Management* 62:474-484.
- Guzy, M. J. and P. E. Lowther. 1997. Black-throated Gray Warbler (*Dendroica nigrescens*). In *The Birds of North America*, No. 319 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologist's Union, Washington, D.C.
- Hawks Aloft. 2011. 2010 avian inventory of Ute Mountain, Bureau of Land Management, Taos Resource area. Hawks Aloft, Inc., Albuquerque, NM.
- Huffman, D. W. , P. Z. Fulé, K. M. Pearson, J. E. Crouse, and W. W. Covington. 2006. Pinyon-Juniper Fire regime: Natural Range of Variability. Final Report to Rocky Mountain Research Station for 04-JV-11221615-271 Ecological Restoration Institute, Northern Arizona University, Flagstaff, AZ.
- Huffman, D.W., P.Z. Fulé, K.M. Pearson, and J.E. Crouse. 2008. Fire history of pinyon-juniper woodlands at upper ecotones with ponderosa forests in Arizona and New Mexico. *Canadian Journal of Forest Research* 38:2097-2108.
- Kelson, K, R. Thompson, and P. Bauer. 2008. Preliminary geologic map of the Guadalupe Mountain quadrangle, Taos County, New Mexico. Open-file Map Series OF-GM 169, New Mexico Bureau of Geology and Mineral Resources.
- Kennedy, P. and D. Stahlecker. 1986. Prey base analysis by habitat site, Taos Resource Area near Questa in Taos County, New Mexico (Peregrine Falcon prey). Report to the Bureau of Land Management, Taos Field Office, Taos, New Mexico. Eagle Environmental, Inc, Albuquerque, NM.
- Laudenslayer, W. F. and R. P. Balda. 1976. Breeding bird use of a pinyon-juniper-ponderosa pine ecotone. *Auk* 93:571-586.
- Ligon, J. D. 1978. Reproductive interdependence of Pinyon Jays and pinyon pines. *Ecological Monographs* 48:111-126.
- Middleton, A. L. 1998. Chipping Sparrow (*Spizella passerian*). *The Birds of North America Online* (A Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/334>.

- Mitchell, K, 2007. Quantitative Analysis by the Point-Centered Quarter Method. Kevin Department of Mathematics and Computer Science. Electronic submission to: <http://arxiv.org/abs/1010.3303v1>. Cornell University Library, Ithaca NY.
- Otis, D. L., J. H. Schulz, D. Miller, R. E. Mirarchi and T. S. Baskett. 2008. Mourning Dove (*Zenaida macroura*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/117>.
- Parmeter, J., B. Neville, and D. Emkalns. 2002. New Mexico bird finding guide. New Mexico Ornithological Society, Albuquerque, NM.
- Paulin, K. M., J. J. Cook, and S. R. Dewey. 1999. Pinyon-juniper woodlands as sources of avian diversity. Pp. 240-243 in S. B. Monsen and R. Stevens, compilers. Proceedings: ecology and management of pinyon-juniper communities within the Interior West. USDA Forest Service RMRS-P-9.
- Pavlacky, D. C. and S. H. Anderson. 2001. Habitat preferences of pinyon-juniper specialists near the limit of their geographic range. *Condor* 103:322-331.
- Piper, R.D. 1977. The southwest pinyon-juniper ecosystem. Pages 1-6 in Ecology, uses and management of pinyon-juniper woodlands: proceedings of the workshop (E.F. Aldon and T.J. Loring tech. coords.). USFS Gen. Tech. Rep. RM-39, Fort Collins, CO.
- Reynolds, T. D., T. D. Rich, and D. A. Stephens. 1999. Sage Thrasher (*Oreoscoptes montanus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/463>.
- Robbins, C. S., D. Bystrack, and P. H. Geissler. 1986. The Breeding Bird Survey: its first fifteen years, 1965-1979. Resource Publication 157, U.S. Fish and Wildlife Service, Washington, D.C.
- Romme, W., C. Allen, J. Bailey, W. Baker, B. Bestelmeyer, P. Brown, K. Eisenhart, L. Floyd-Hanna, D. Huffman, B. Jacobs, R. Miller, E. Muldavin, T. Swetnam, R. Tausch, and P. Weisberg. 2009. Historical and modern disturbance regimes, stand structures, and landscape dynamics in piñon-juniper vegetation of the western U.S. *Rangeland Ecology and Management* 62:203-222
- Rotenberry, J. T., M. A. Patten and K. L. Preston. 1999. Brewer's Sparrow (*Spizella breweri*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/390>.

- SAS Institute. 2002. JMP user's guide. 5th ed. SAS Institute, Cary, NC.
- SAS 2008. Statistical Analysis System (SAS) 2002-2008 by SAS Institute Inc., Cary, NC.
- Sauer, J. R., J. E. Hines, and J. Fallon. 2008. The North American Breeding Bird Survey, Results and Analysis 1966 - 2007. Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, MD.
- Schmidt, L. A. 1994. Pinyon-juniper fuelwood markets in the Southwest. U.S. Forest Service Gen. Tech. Report GTR-RM-258: 214-218.
- Sedgwick, J. A. 1987. Avian habitat relationships in pinyon-juniper woodland. Wilson Bulletin 99:413-431.
- Short, H. L., and C. Y. McCulloch. 1977. Managing pinyon-juniper ranges for wildlife. USDA Forest Service GTR-RM-47.
- U.S. Fish and Wildlife Service. 2008. Birds of conservation concern 2008. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp.
- West, N.E. 1999. Juniper and pinyon savannas and woodlands of western North America. Pp. 288-308 in Anderson, R.C., J.S. Fralish, and J.M. Baskin (eds.), Savannas, barrens, and rock outcrop plant communities of North America. Cambridge University Press, Cambridge, UK.

Appendix A

Plot and line transect locations for WRRRA PJ woodland monitoring project in 2010. There are 15 transect lines (A-O) per plot (Plot) with UTM coordinates for the string 1-m mark and ending at 11 m on each line with associated GPS precision, UTM zone, and datum. Line AZM refers to azimuth bearing of the lines. In addition, the overall plot slope in percent and aspect in azimuth are provided as measured on the ground in August 2010.

PLOT	Tran	Easting Start	Northing Start	Prec M	Easting End	Northing End	Prec M	Zone	Datum	Line AZM	Plot Slope %	Plot AZM	Date
10WR001	1A	443478	4068394	2.4	443469	4068399	2.5	13	NAD83	310	26	40	8/26/2010
10WR001	1B	443652	4068202	2.5	443649	4068195	2.6	13	NAD83	215	13	306	8/26/2010
10WR001	1C	443831	4068041	2.5	443831	4068055	2.7	13	NAD83	360	15	90	8/26/2010
10WR001	1D	444009	4067866	2.6	443997	4067868	2.9	13	NAD83	278	18	8	8/26/2010
10WR001	1E	444186	4067687	2.4	444178	4067691	3.1	13	NAD83	310	10	40	8/26/2010
10WR001	1F	443302	4068218	1.9	443291	4068223	2.8	13	NAD83	300	20	40	8/26/2010
10WR001	1G	443479	4068042	1.4	443475	4068056	2.6	13	NAD83	346	18	70	8/26/2010
10WR001	1H	443655	4067864	2.5	443644	4067866	2.8	13	NAD83	270	18	360	8/26/2010
10WR001	1I	443831	4067688	2.7	443820	4067688	2.8	13	NAD83	280	10	10	8/26/2010
10WR001	1J	444010	4067512	3.2	444003	4067502	2.9	13	NAD83	230	28	320	8/26/2010
10WR001	1K	443128	4068040	2	443117	4068043	3.2	13	NAD83	290	22	20	8/26/2010
10WR001	1L	443304	4067862	2.8	443294	4067870	3.2	13	NAD83	300	15	30	8/26/2010
10WR001	1M	443483	4067688	2.5	443472	4067687	2.5	13	NAD83	280	11	10	8/26/2010
10WR001	1N	443660	4067512	2.5	443648	4067518	2.8	13	NAD83	300	28	40	8/26/2010
10WR001	1O	443834	4067334	2.7	443822	4067339	3.2	13	NAD83	290	22	20	8/26/2010
10WR005	5A	439439	4065322	2.8	439444	4065316	2.8	13	NAD83	150	10	250	8/24/2010
10WR005	5B	439675	4065240	2.8	439679	4065228	2.9	13	NAD83	162	20	240	8/24/2010
10WR005	5C	439912	4065150	2.5	439904	4065160	2.5	13	NAD83	144	10	60	8/24/2010
10WR005	5D	440147	4065068	2.3	440136	4065060	2.7	13	NAD83	56	10	320	8/24/2010
10WR005	5E	439676	4065509	2.9	439664	4065506	2.9	13	NAD83	250	7	330	8/24/2010

PLOT	Tran	Easting Start	Northing Start	Prec M	Easting End	Northing End	Prec M	Zone	Datum	Line AZM	Plot Slope %	Plot AZM	Date
10WR005	5F	439355	4065088	2.6	439362	4065080	2.9	13	NAD83	150	10	235	8/24/2010
10WR005	5G	439591	4065004	2.1	439586	4064994	2.6	13	NAD83	220	6	330	8/24/2010
10WR005	5H	439829	4064917	2.9	439818	4064913	2.7	13	NAD83	250	25	344	8/24/2010
10WR005	5I	440060	4064833	2.6	440070	4064828	3.7	13	NAD83	110	22	220	8/24/2010
10WR005	5J	439548	4065598	1.9	439543	4065591	2.3	13	NAD83	220	8	310	8/24/2010
10WR005	5K	439269	4064852	2.7	439266	4064841	2.7	13	NAD83	200	15	280	8/24/2010
10WR005	5L	439505	4064768	2.4	439512	4064768	2.7	13	NAD83	90	5	180	8/24/2010
10WR005	5M	439742	4064684	3.1	439737	4064675	2.7	13	NAD83	214	9	324	8/24/2010
10WR005	5N	439974	4064598	2.7	439984	4064599	2.6	13	NAD83	82	12	180	8/24/2010
10WR005	5O	440211	4064510	2.4	440204	4064504	2.7	13	NAD83	226	6	308	8/24/2010
10WR007	7A	441483	4061920	2.7	441492	4061920	2.4	13	NAD83	82	25	172	8/30/2010
10WR007	7B	441724	4061855	3.2	441734	4061849	2.9	13	NAD83	126	40	216	8/30/2010
10WR007	7C	441964	4061791	2.7	441973	4061797	2.6	13	NAD83	46	35	136	8/30/2010
10WR007	7D	442208	4061727	2.7	442217	4061729	2.6	13	NAD83	75	20	165	8/30/2010
10WR007	7E	442449	4061661	2.7	442453	4061650	2.4	13	NAD83	170	20	260	8/30/2010
10WR007	7F	441417	4061676	2.9	441430	4061676	2.8	13	NAD83	106	20	196	8/30/2010
10WR007	7G	441661	4061615	2.3	441672	4061615	2.9	13	NAD83	70	16	160	8/31/2010
10WR007	7H	441902	4061548	2.7	441908	4061555	2.7	13	NAD83	48	17	138	8/31/2010
10WR007	7I	442143	4061485	2.7	442153	4061490	2.4	13	NAD83	65	12	155	8/31/2010
10WR007	7J	442383	4061418	2.7	442393	4061414	2.8	13	NAD83	115	10	205	8/31/2010
10WR007	7K	441355	4061441	2.6	441363	4061442	3.3	13	NAD83	78	19	172	8/23/2010
10WR007	7L	441595	4061373	3	441603	4061382	2.7	13	NAD83	44	25	134	8/31/2010
10WR007	7M	441838	4061307	3.2	441842	4061318	2.8	13	NAD83	20	27	110	8/31/2010
10WR007	7N	442078	4061241	2.8	442083	4061232	2.9	13	NAD83	150	5	240	8/31/2010
10WR007	7O	442321	4061177	3	442329	4061175	3	13	NAD83	110	10	200	8/31/2010
10WR009	9A	442300	4068299	2.7	442293	4068292	2.7	13	NAD83	220	23	315	8/25/2010
10WR009	9B	442549	4068301	2.8	442551	4068292	3	13	NAD83	180	27	270	8/25/2010

PLOT	Tran	Easting Start	Northing Start	Prec M	Easting End	Northing End	Prec M	Zone	Datum	Line AZM	Plot Slope %	Plot AZM	Date
10WR009	9C	442800	4068200	2.6	442801	4068190	2.7	13	NAD83	170	20	260	8/25/2010
10WR009	9D	442273	4068097	2.2	442270	4068087	2.8	13	NAD83	200	18	278	8/25/2010
10WR009	9E	442498	4068000	3.3	442509	4067999	2.8	13	NAD83	110	32	200	8/25/2010
10WR009	9F	442731	4067953	2.3	442727	4067941	2.6	13	NAD83	200	30	310	8/25/2010
10WR009	9G	442251	4067811	2.5	442253	4067799	2.4	13	NAD83	170	11	270	8/25/2010
10WR009	9H	442481	4067748	4.5	442477	4067739	4.6	13	NAD83	210	30	300	8/25/2010
10WR009	9I	442629	4067700	2.8	442633	4067688	2.8	13	NAD83	150	22	260	8/25/2010
10WR009	9J	442203	4067599	1.9	442195	4067590	2.5	13	NAD83	210	16	300	8/25/2010
10WR009	9K	442401	4067550	2.6	442389	4067548	3.1	13	NAD83	270	28	360	8/25/2010
10WR009	9L	442631	4067501	2.8	442624	4067490	2.5	13	NAD83	210	36	300	8/25/2010
10WR009	9M	442126	4067377	2.2	442134	4067372	2.8	13	NAD83	140	8	230	8/25/2010
10WR009	9N	442381	4067299	2.3	442369	4067297	3.2	13	NAD83	264	20	354	8/25/2010
10WR009	9O	442600	4067248	2.9	442592	4067241	2.7	13	NAD83	221	20	320	8/25/2010

Appendix B. Quadrat species canopy cover data for WRRRA PJ woodland 2010. Ten quadrats (Q) per transect (T), 15 transects per plot (PlotID); Quadrat size was 20 x 50 cm at 1-meter intervals along a transect beginning at the 1-m mark and end at 11 m. Sampled in August 2010.

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR001	1A	2	CARO5	Carex rossii	1
10WR001	1A	2	PIED	Pinus edulis	0.1
10WR001	1A	3	CARO5	Carex rossii	4
10WR001	1A	3	ELEL5	Elymus elymoides	0.1
10WR001	1A	3	OPPO	Opuntia polyacantha	1
10WR001	1A	4	PIED	Pinus edulis	2
10WR001	1A	5	CARO5	Carex rossii	1
10WR001	1A	7	CARO5	Carex rossii	1
10WR001	1A	9	OPPO	Opuntia polyacantha	0.1
10WR001	1A	10	OPPO	Opuntia polyacantha	1
10WR001	1B	3	PIED	Pinus edulis	1
10WR001	1C	1	BOGR2	Bouteloua gracilis	0.5
10WR001	1C	1	MEOF	Melilotus officinalis	1
10WR001	1C	1	PIED	Pinus edulis	0.5
10WR001	1C	2	ARTR2	Artemisia tridentata	30
10WR001	1C	2	ELEL5	Elymus elymoides	2
10WR001	1C	2	PIED	Pinus edulis	1
10WR001	1C	3	ARTR2	Artemisia tridentata	25
10WR001	1C	3	BOGR2	Bouteloua gracilis	1.5
10WR001	1C	3	CHGR6	Chrysothamnus Greenei	45
10WR001	1C	4	CHGR6	Chrysothamnus Greenei	8
10WR001	1C	6	ARTR2	Artemisia tridentata	1
10WR001	1C	6	BOGR2	Bouteloua gracilis	4
10WR001	1C	9	ARTR2	Artemisia tridentata	10
10WR001	1C	9	ELEL5	Elymus elymoides	0.5
10WR001	1C	10	ARTR2	Artemisia tridentata	100
10WR001	1D	1	CARO5	Carex rossii	1
10WR001	1D	2	BOCU	Bouteloua curtipendula	1.5
10WR001	1D	2	CARO5	Carex rossii	2
10WR001	1D	3	BOCU	Bouteloua curtipendula	0.1
10WR001	1D	3	CARO5	Carex rossii	5
10WR001	1D	4	BOCU	Bouteloua curtipendula	0.1
10WR001	1D	4	POFE	Poa fendleriana	1
10WR001	1D	5	CARO5	Carex rossii	0.1
10WR001	1D	6	POFE	Poa fendleriana	0.1
10WR001	1D	8	POFE	Poa fendleriana	0.1
10WR001	1D	9	CARO5	Carex rossii	0.1
10WR001	1D	9	PSME	Pseudotsuga menziesii	0.5
10WR001	1D	10	CARO5	Carex rossii	0.5
10WR001	1E	2	ARTR2	Artemisia tridentata	30
10WR001	1E	3	PIED	Pinus edulis	0.5
10WR001	1E	4	PIED	Pinus edulis	1
10WR001	1E	7	POFE	Poa fendleriana	0.1
10WR001	1E	9	BOFE	Boechera fendleri	0.1
10WR001	1F	4	POFE	Poa fendleriana	6
10WR001	1F	8	PIED	Pinus edulis	0.5
10WR001	1F	9	BOFE	Boechera fendleri	0.1

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR001	1F	10	BOFE	Boechera fendleri	0.1
10WR001	1F	10	CARO5	Carex rossii	2
10WR001	1G	1	CARO5	Carex rossii	1
10WR001	1G	1	PECRT2	Penstemon crandallii ssp. taosensis	2
10WR001	1G	2	CARO5	Carex rossii	1.5
10WR001	1G	3	CARO5	Carex rossii	2
10WR001	1G	3	POFE	Poa fendleriana	2
10WR001	1G	4	CARO5	Carex rossii	1
10WR001	1G	4	CEMO2	Cercocarpus montanus	2
10WR001	1G	4	POFE	Poa fendleriana	4
10WR001	1G	5	BOGR2	Bouteloua gracilis	0.5
10WR001	1G	5	CARO5	Carex rossii	2
10WR001	1G	5	POFE	Poa fendleriana	2
10WR001	1G	6	PIED	Pinus edulis	1.5
10WR001	1G	7	PIED	Pinus edulis	0.5
10WR001	1H	1	ERFO3	Erigeron formosissimus	10
10WR001	1H	2	ERFO3	Erigeron formosissimus	5
10WR001	1H	5	ALFI3	Aletes filifolius	1.5
10WR001	1H	5	BOFE	Boechera fendleri	0.1
10WR001	1H	5	ELEL5	Elymus elymoides	1
10WR001	1H	6	MEOF	Melilotus officinalis	0.1
10WR001	1H	6	PIED	Pinus edulis	1
10WR001	1H	7	BOFE	Boechera fendleri	0.1
10WR001	1H	9	BOFE	Boechera fendleri	0.5
10WR001	1H	10	BOFE	Boechera fendleri	0.5
10WR001	1I	1	BOGR2	Bouteloua gracilis	19
10WR001	1I	2	LERE3	Physaria rectipes	1
10WR001	1I	3	PIMI7	Piptatherum micranthum	
10WR001	1I	4	ELEL5	Elymus elymoides	3
10WR001	1I	4	PIMI7	Piptatherum micranthum	5
10WR001	1I	5	PIMI7	Piptatherum micranthum	1
10WR001	1I	5	RILE	Ribes leptanthum	2
10WR001	1I	7	PIMI7	Piptatherum micranthum	2
10WR001	1I	8	PIED	Pinus edulis	1
10WR001	1I	8	PIMI7	Piptatherum micranthum	1
10WR001	1I	9	BOGR2	Bouteloua gracilis	13
10WR001	1I	10	BOGR2	Bouteloua gracilis	14
10WR001	1J	1	CARO5	Carex rossii	3
10WR001	1J	1	ELEL5	Elymus elymoides	0.5
10WR001	1J	1	MUMO	Muhlenbergia montana	5
10WR001	1J	2	CARO5	Carex rossii	2
10WR001	1J	2	PIED	Pinus edulis	1
10WR001	1J	2	POFE	Poa fendleriana	1
10WR001	1J	3	PIED	Pinus edulis	0.5
10WR001	1J	3	POFE	Poa fendleriana	3
10WR001	1J	5	ERFO3	Erigeron formosissimus	2
10WR001	1J	6	PIED	Pinus edulis	1
10WR001	1J	7	PIED	Pinus edulis	1
10WR001	1J	8	PIED	Pinus edulis	0.5
10WR001	1J	8	POFE	Poa fendleriana	4
10WR001	1K	1	ERFO3	Erigeron formosissimus	2

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR001	1K	1	POFE	<i>Poa fendleriana</i>	1
10WR001	1K	2	POFE	<i>Poa fendleriana</i>	5
10WR001	1K	3	POFE	<i>Poa fendleriana</i>	8
10WR001	1K	4	PIED	<i>Pinus edulis</i>	1
10WR001	1L	1	POFE	<i>Poa fendleriana</i>	5
10WR001	1L	2	PIED	<i>Pinus edulis</i>	0.5
10WR001	1L	3	PIED	<i>Pinus edulis</i>	0.5
10WR001	1L	3	POFE	<i>Poa fendleriana</i>	35
10WR001	1L	7	PIED	<i>Pinus edulis</i>	0.5
10WR001	1L	10	ERJA	<i>Eriogonum jamesii</i>	0.1
10WR001	1L	10	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	0.1
10WR001	1M	3	POFE	<i>Poa fendleriana</i>	13
10WR001	1M	4	PIED	<i>Pinus edulis</i>	1
10WR001	1M	6	POFE	<i>Poa fendleriana</i>	15
10WR001	1M	7	POFE	<i>Poa fendleriana</i>	12
10WR001	1M	9	ARTR2	<i>Artemisia tridentata</i>	6
10WR001	1M	10	LERE3	<i>Physaria rectipes</i>	0.5
10WR001	1M	10	POFE	<i>Poa fendleriana</i>	3
10WR001	1N	2	ALFI3	<i>Aletes filifolius</i>	0.5
10WR001	1N	2	ELEL5	<i>Elymus elymoides</i>	3
10WR001	1N	2	PIED	<i>Pinus edulis</i>	2
10WR001	1N	2	POFE	<i>Poa fendleriana</i>	9
10WR001	1N	3	ALFI3	<i>Aletes filifolius</i>	0.5
10WR001	1N	3	POFE	<i>Poa fendleriana</i>	9
10WR001	1N	4	ALFI3	<i>Aletes filifolius</i>	7
10WR001	1N	4	CARO5	<i>Carex rossii</i>	4
10WR001	1N	4	POFE	<i>Poa fendleriana</i>	4
10WR001	1N	5	POFE	<i>Poa fendleriana</i>	6
10WR001	1N	6	CARO5	<i>Carex rossii</i>	1
10WR001	1N	6	CHGR6	<i>Chrysothamnus greenei</i>	15
10WR001	1N	6	POFE	<i>Poa fendleriana</i>	7
10WR001	1N	7	CARO5	<i>Carex rossii</i>	3
10WR001	1N	7	MUMO	<i>Muhlenbergia montana</i>	1
10WR001	1N	7	POFE	<i>Poa fendleriana</i>	6
10WR001	1N	8	PIED	<i>Pinus edulis</i>	2
10WR001	1N	9	POFE	<i>Poa fendleriana</i>	1
10WR001	1O	5	POFE	<i>Poa fendleriana</i>	4
10WR001	1O	7	ALFI3	<i>Aletes filifolius</i>	5
10WR001	1O	7	POFE	<i>Poa fendleriana</i>	1
10WR001	1O	8	POFE	<i>Poa fendleriana</i>	9
10WR001	1O	9	CARO5	<i>Carex rossii</i>	1
10WR001	1O	9	POFE	<i>Poa fendleriana</i>	8
10WR001	1O	10	CARO5	<i>Carex rossii</i>	2
10WR001	1O	10	ERVE2	<i>Erigeron vetensis</i>	1
10WR001	1O	10	POFE	<i>Poa fendleriana</i>	10
10WR005	5A	2	ELEL5	<i>Elymus elymoides</i>	9
10WR005	5A	2	LERE3	<i>Physaria rectipes</i>	0.5
10WR005	5A	3	ELEL5	<i>Elymus elymoides</i>	3
10WR005	5A	3	ERJA	<i>Eriogonum jamesii</i>	1
10WR005	5A	3	HYFLC	<i>Hymenopappus flavescens</i> var. <i>canotomentosus</i>	3

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR005	5A	4	BOGR2	<i>Bouteloua gracilis</i>	6
10WR005	5A	7	POFE	<i>Poa fendleriana</i>	2
10WR005	5A	8	CARO5	<i>Carex rossii</i>	21
10WR005	5A	8	ERJA	<i>Eriogonum jamesii</i>	0.5
10WR005	5A	10	ELEL5	<i>Elymus elymoides</i>	7
10WR005	5A	10	ERJA	<i>Eriogonum jamesii</i>	0.5
10WR005	5B	1	ELEL5	<i>Elymus elymoides</i>	1
10WR005	5B	1	OPPO	<i>Opuntia polyacantha</i>	4
10WR005	5B	1	POFE	<i>Poa fendleriana</i>	2
10WR005	5B	4	ELEL5	<i>Elymus elymoides</i>	8
10WR005	5B	4	POFE	<i>Poa fendleriana</i>	5
10WR005	5B	5	POFE	<i>Poa fendleriana</i>	0.5
10WR005	5B	6	ELEL5	<i>Elymus elymoides</i>	3
10WR005	5C	1	BOCU	<i>Bouteloua curtipendula</i>	9
10WR005	5C	1	ELEL5	<i>Elymus elymoides</i>	0.5
10WR005	5C	1	TOEX2	<i>Townsendia exscapa</i>	0.5
10WR005	5C	3	POFE	<i>Poa fendleriana</i>	7
10WR005	5C	3	TOEX2	<i>Townsendia exscapa</i>	0.5
10WR005	5C	4	CARO5	<i>Carex rossii</i>	8
10WR005	5C	4	LUARA5	<i>Lupinus argenteus ssp. argenteus</i>	3
10WR005	5C	4	POFE	<i>Poa fendleriana</i>	18
10WR005	5C	5	BOFE	<i>Boechera fendleri</i>	0.5
10WR005	5C	5	BOCU	<i>Bouteloua curtipendula</i>	11
10WR005	5C	5	CARO5	<i>Carex rossii</i>	6
10WR005	5C	5	POFE	<i>Poa fendleriana</i>	8
10WR005	5C	6	BOFE	<i>Boechera fendleri</i>	1.5
10WR005	5C	6	CARO5	<i>Carex rossii</i>	9
10WR005	5C	7	BOCU	<i>Bouteloua curtipendula</i>	1
10WR005	5C	7	CARO5	<i>Carex rossii</i>	1
10WR005	5C	8	BOCU	<i>Bouteloua curtipendula</i>	1
10WR005	5C	8	CARO5	<i>Carex rossii</i>	8
10WR005	5C	8	ELEL5	<i>Elymus elymoides</i>	2
10WR005	5C	8	LUARA5	<i>Lupinus argenteus ssp. argenteus</i>	3
10WR005	5C	8	PEPUP	<i>Petradoria pumila ssp. pumila</i>	6
10WR005	5C	9	BOCU	<i>Bouteloua curtipendula</i>	1
10WR005	5C	9	CARO5	<i>Carex rossii</i>	4
10WR005	5C	9	PEPUP	<i>Petradoria pumila ssp. pumila</i>	4
10WR005	5C	10	CARO5	<i>Carex rossii</i>	3
10WR005	5D	4	BOCU	<i>Bouteloua curtipendula</i>	26
10WR005	5D	4	CEMO2	<i>Cercocarpus montanus</i>	29
10WR005	5D	4	ERJA	<i>Eriogonum jamesii</i>	0.5
10WR005	5D	4	POFE	<i>Poa fendleriana</i>	3
10WR005	5D	5	CEMO2	<i>Cercocarpus montanus</i>	22
10WR005	5D	5	POFE	<i>Poa fendleriana</i>	2
10WR005	5D	6	ERJA	<i>Eriogonum jamesii</i>	2
10WR005	5D	9	POFE	<i>Poa fendleriana</i>	10
10WR005	5D	10	MUMO	<i>Muhlenbergia montana</i>	1
10WR005	5D	10	PECRT2	<i>Penstemon crandallii ssp. taosensis</i>	1.5
10WR005	5D	10	LERE3	<i>Physaria rectipes</i>	0.5
10WR005	5D	10	PUPAM	<i>Pulsatilla patens ssp. multifida</i>	6
10WR005	5E	1	ARTR2	<i>Artemisia tridentata</i>	45

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR005	5E	1	BOCU	<i>Bouteloua curtipendula</i>	12
10WR005	5E	1	CARO5	<i>Carex rossii</i>	2
10WR005	5E	1	PEPUP	<i>Petradoria pumila</i> ssp. <i>pumila</i>	1
10WR005	5E	2	BOCU	<i>Bouteloua curtipendula</i>	20
10WR005	5E	2	ELEL5	<i>Elymus elymoides</i>	7
10WR005	5E	2	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	9
10WR005	5E	3	BOCU	<i>Bouteloua curtipendula</i>	19
10WR005	5E	4	BOGR2	<i>Bouteloua gracilis</i>	41
10WR005	5E	5	BOCU	<i>Bouteloua curtipendula</i>	7
10WR005	5E	5	CARO5	<i>Carex rossii</i>	3
10WR005	5E	5	PEPUP	<i>Petradoria pumila</i> ssp. <i>pumila</i>	21
10WR005	5E	5	LERE3	<i>Physaria rectipes</i>	0.5
10WR005	5E	5	POFE	<i>Poa fendleriana</i>	7
10WR005	5E	6	BOGR2	<i>Bouteloua gracilis</i>	2
10WR005	5E	6	CARO5	<i>Carex rossii</i>	3
10WR005	5E	6	PEPUP	<i>Petradoria pumila</i> ssp. <i>pumila</i>	4
10WR005	5E	6	LERE3	<i>Physaria rectipes</i>	0.5
10WR005	5E	6	POFE	<i>Poa fendleriana</i>	8
10WR005	5E	7	BOCU	<i>Bouteloua curtipendula</i>	1
10WR005	5E	7	CARO5	<i>Carex rossii</i>	9
10WR005	5E	7	POFE	<i>Poa fendleriana</i>	2
10WR005	5E	8	ALCE2	<i>Allium cernuum</i>	3
10WR005	5E	8	BOGR2	<i>Bouteloua gracilis</i>	4
10WR005	5E	8	CARO5	<i>Carex rossii</i>	14
10WR005	5E	8	OPPO	<i>Opuntia polyacantha</i>	0.5
10WR005	5E	8	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	6
10WR005	5E	9	BOCU	<i>Bouteloua curtipendula</i>	9
10WR005	5E	9	CARO5	<i>Carex rossii</i>	10
10WR005	5E	9	HYRI	<i>Hymenoxys richardsonii</i>	11
10WR005	5E	9	PEPUP	<i>Petradoria pumila</i> ssp. <i>pumila</i>	2
10WR005	5E	10	BOCU	<i>Bouteloua curtipendula</i>	8
10WR005	5E	10	BOGR2	<i>Bouteloua gracilis</i>	8
10WR005	5E	10	CARO5	<i>Carex rossii</i>	13
10WR005	5E	10	CHER2	<i>Chaetopappa ericoides</i>	0.1
10WR005	5E	10	HYRI	<i>Hymenoxys richardsonii</i>	17
10WR005	5F	2	ELEL5	<i>Elymus elymoides</i>	2
10WR005	5F	2	POFE	<i>Poa fendleriana</i>	2
10WR005	5F	4	ASMI10	<i>Astragalus missouriensis</i>	0.5
10WR005	5F	6	CARO5	<i>Carex rossii</i>	2
10WR005	5F	6	POFE	<i>Poa fendleriana</i>	10
10WR005	5F	10	ELEL5	<i>Elymus elymoides</i>	2
10WR005	5F	10	POFE	<i>Poa fendleriana</i>	1
10WR005	5G	1	BOGR2	<i>Bouteloua gracilis</i>	12
10WR005	5G	1	CARO5	<i>Carex rossii</i>	3
10WR005	5G	1	YUBAI	<i>Yucca baileyi</i> var. <i>intermedia</i>	0.1
10WR005	5G	2	ARTR2	<i>Artemisia tridentata</i>	0.1
10WR005	5G	2	BOGR2	<i>Bouteloua gracilis</i>	20
10WR005	5G	2	GUSA2	<i>Gutierrezia sarothrae</i>	0.1
10WR005	5G	3	BOGR2	<i>Bouteloua gracilis</i>	8
10WR005	5G	3	ERMIS2	<i>Eriogonum microthecum</i> var.	2

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
				simpsonii	
10WR005	5G	3	GUSA2	Gutierrezia sarothrae	2
10WR005	5G	3	HYRI	Hymenoxys richardsonii	10
10WR005	5G	3	PEPUP	Petradoria pumila ssp. pumila	10
10WR005	5G	4	BOGR2	Bouteloua gracilis	5
10WR005	5G	4	ORPU2	Orthocarpus purpureoalbus	2
10WR005	5G	4	LERE3	Physaria rectipes	1
10WR005	5G	4	POFE	Poa fendleriana	0.1
10WR005	5G	5	ACHY	Achnatherum hymenoides	8
10WR005	5G	5	CARO5	Carex rossii	2
10WR005	5G	5	ELEL5	Elymus elymoides	1
10WR005	5G	5	PEPUP	Petradoria pumila ssp. pumila	10
10WR005	5G	5	LERE3	Physaria rectipes	2
10WR005	5G	6	ARTR2	Artemisia tridentata	10
10WR005	5G	6	CARO5	Carex rossii	25
10WR005	5G	7	CARO5	Carex rossii	0.1
10WR005	5G	8	BOGR2	Bouteloua gracilis	0.1
10WR005	5G	8	CARO5	Carex rossii	1
10WR005	5G	8	ERMIS2	Eriogonum microthecum var. simpsonii	0.1
10WR005	5G	8	ERRA3	Eriogonum racemosum	1
10WR005	5G	8	LERE3	Physaria rectipes	1
10WR005	5G	9	ARFR4	Artemisia frigida	0.1
10WR005	5G	9	BOGR2	Bouteloua gracilis	1
10WR005	5G	9	ERRA3	Eriogonum racemosum	0.1
10WR005	5G	9	PECRT2	Penstemon crandallii ssp. taosensis	0.1
10WR005	5G	9	POFE	Poa fendleriana	10
10WR005	5G	10	CARO5	Carex rossii	1.5
10WR005	5G	10	ERRA3	Eriogonum racemosum	1.5
10WR005	5G	10	PECRT2	Penstemon crandallii ssp. taosensis	0.1
10WR005	5G	10	POFE	Poa fendleriana	0.1
10WR005	5H	1	CEMO2	Cercocarpus montanus	0.1
10WR005	5H	1	POFE	Poa fendleriana	0.1
10WR005	5H	2	CEMO2	Cercocarpus montanus	30
10WR005	5H	3	CEMO2	Cercocarpus montanus	20
10WR005	5H	4	ANPA4	Antennaria parvifolia	0.5
10WR005	5H	4	CEMO2	Cercocarpus montanus	10
10WR005	5H	5	CARO5	Carex rossii	1
10WR005	5H	5	POFE	Poa fendleriana	2
10WR005	5H	6	CEMO2	Cercocarpus montanus	30
10WR005	5H	6	POFE	Poa fendleriana	0.5
10WR005	5H	7	POFE	Poa fendleriana	3
10WR005	5H	10	POFE	Poa fendleriana	0.5
10WR005	5I	1	ELEL5	Elymus elymoides	2
10WR005	5I	1	POFE	Poa fendleriana	1
10WR005	5I	2	POFE	Poa fendleriana	3
10WR005	5I	7	CEMO2	Cercocarpus montanus	70
10WR005	5I	8	CEMO2	Cercocarpus montanus	80
10WR005	5I	9	CARO5	Carex rossii	0.1
10WR005	5J	1	CARO5	Carex rossii	35

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR005	5J	1	IPAG	<i>Ipomopsis aggregata</i>	1
10WR005	5J	1	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	0.5
10WR005	5J	1	LERE3	<i>Physaria rectipes</i>	0.5
10WR005	5J	2	CARO5	<i>Carex rossii</i>	2
10WR005	5J	2	GUSA2	<i>Gutierrezia sarothrae</i>	1
10WR005	5J	2	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	0.5
10WR005	5J	3	CARO5	<i>Carex rossii</i>	5
10WR005	5J	3	IPAG	<i>Ipomopsis aggregata</i>	2
10WR005	5J	3	LERE3	<i>Physaria rectipes</i>	0.5
10WR005	5J	4	CARO5	<i>Carex rossii</i>	13
10WR005	5J	4	ERVE2	<i>Erigeron vetensis</i>	4
10WR005	5J	5	CARO5	<i>Carex rossii</i>	1
10WR005	5J	6	ARTEM	<i>Artemisia</i> spp.	1
10WR005	5J	6	BOGR2	<i>Bouteloua gracilis</i>	16
10WR005	5J	6	CARO5	<i>Carex rossii</i>	14
10WR005	5J	6	LERE3	<i>Physaria rectipes</i>	1
10WR005	5J	7	BOGR2	<i>Bouteloua gracilis</i>	0.5
10WR005	5J	7	CARO5	<i>Carex rossii</i>	12
10WR005	5J	7	ERVE2	<i>Erigeron vetensis</i>	2
10WR005	5J	10	CARO5	<i>Carex rossii</i>	0.5
10WR005	5J	10	ERFL	<i>Erigeron flagellaris</i>	0.5
10WR005	5J	10	POFE	<i>Poa fendleriana</i>	10
10WR005	5K	1	BOGR2	<i>Bouteloua gracilis</i>	21
10WR005	5K	2	ELEL5	<i>Elymus elymoides</i>	13
10WR005	5K	2	OPPO	<i>Opuntia polyacantha</i>	5
10WR005	5K	2	PASM	<i>Pascopyrum smithii</i>	5
10WR005	5K	2	LERE3	<i>Physaria rectipes</i>	2
10WR005	5K	3	ELEL5	<i>Elymus elymoides</i>	30
10WR005	5K	3	PASM	<i>Pascopyrum smithii</i>	27
10WR005	5K	4	ARTR2	<i>Artemisia tridentata</i>	0.5
10WR005	5K	4	CARO5	<i>Carex rossii</i>	4
10WR005	5K	4	ELEL5	<i>Elymus elymoides</i>	10
10WR005	5K	4	GUSA2	<i>Gutierrezia sarothrae</i>	14
10WR005	5K	4	PASM	<i>Pascopyrum smithii</i>	18
10WR005	5K	5	ARTR2	<i>Artemisia tridentata</i>	5
10WR005	5K	5	OPPO	<i>Opuntia polyacantha</i>	0.5
10WR005	5K	5	PASM	<i>Pascopyrum smithii</i>	16
10WR005	5K	6	ARTR2	<i>Artemisia tridentata</i>	30
10WR005	5K	6	ELEL5	<i>Elymus elymoides</i>	3
10WR005	5K	6	PASM	<i>Pascopyrum smithii</i>	3
10WR005	5K	7	ARTR2	<i>Artemisia tridentata</i>	80
10WR005	5K	7	PASM	<i>Pascopyrum smithii</i>	2
10WR005	5K	8	BOGR2	<i>Bouteloua gracilis</i>	4
10WR005	5K	8	ELEL5	<i>Elymus elymoides</i>	7
10WR005	5K	8	GUSA2	<i>Gutierrezia sarothrae</i>	2
10WR005	5K	8	PASM	<i>Pascopyrum smithii</i>	5
10WR005	5K	8	LERE3	<i>Physaria rectipes</i>	1
10WR005	5K	9	BOGR2	<i>Bouteloua gracilis</i>	30
10WR005	5K	9	CHSE6	<i>Chamaesyce serpyllifolia</i>	1
10WR005	5K	9	PASM	<i>Pascopyrum smithii</i>	4

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR005	5K	10	BOGR2	<i>Bouteloua gracilis</i>	15
10WR005	5K	10	ELEL5	<i>Elymus elymoides</i>	16
10WR005	5K	10	PASM	<i>Pascopyrum smithii</i>	3
10WR005	5L	1	PASM	<i>Pascopyrum smithii</i>	45
10WR005	5L	1	POOL	<i>Portulaca oleracea</i>	0.1
10WR005	5L	2	BOGR2	<i>Bouteloua gracilis</i>	13
10WR005	5L	2	CARO5	<i>Carex rossii</i>	3
10WR005	5L	2	PASM	<i>Pascopyrum smithii</i>	21
10WR005	5L	2	POOL	<i>Portulaca oleracea</i>	2
10WR005	5L	3	CARO5	<i>Carex rossii</i>	5
10WR005	5L	3	GUSA2	<i>Gutierrezia sarothrae</i>	5
10WR005	5L	3	PASM	<i>Pascopyrum smithii</i>	23
10WR005	5L	4	CARO5	<i>Carex rossii</i>	2
10WR005	5L	4	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.5
10WR005	5L	4	PASM	<i>Pascopyrum smithii</i>	55
10WR005	5L	5	BOGR2	<i>Bouteloua gracilis</i>	6
10WR005	5L	5	GUSA2	<i>Gutierrezia sarothrae</i>	3
10WR005	5L	5	PASM	<i>Pascopyrum smithii</i>	15
10WR005	5L	6	PASM	<i>Pascopyrum smithii</i>	2
10WR005	5L	7	OPPO	<i>Opuntia polyacantha</i>	16
10WR005	5L	7	PASM	<i>Pascopyrum smithii</i>	8
10WR005	5L	7	PIED	<i>Pinus edulis</i>	9
10WR005	5L	8	ELEL5	<i>Elymus elymoides</i>	1
10WR005	5L	8	OPPO	<i>Opuntia polyacantha</i>	1
10WR005	5L	8	PASM	<i>Pascopyrum smithii</i>	27
10WR005	5L	9	BOGR2	<i>Bouteloua gracilis</i>	28
10WR005	5L	9	GUSA2	<i>Gutierrezia sarothrae</i>	11
10WR005	5L	9	PASM	<i>Pascopyrum smithii</i>	10
10WR005	5L	10	BOGR2	<i>Bouteloua gracilis</i>	31
10WR005	5L	10	PASM	<i>Pascopyrum smithii</i>	3
10WR005	5M	1	BOGR2	<i>Bouteloua gracilis</i>	8
10WR005	5M	1	ELEL5	<i>Elymus elymoides</i>	3
10WR005	5M	2	POFE	<i>Poa fendleriana</i>	0.5
10WR005	5M	3	CARO5	<i>Carex rossii</i>	1.5
10WR005	5M	3	POFE	<i>Poa fendleriana</i>	0.1
10WR005	5M	4	POFE	<i>Poa fendleriana</i>	3
10WR005	5M	6	POFE	<i>Poa fendleriana</i>	3
10WR005	5M	7	CARO5	<i>Carex rossii</i>	2
10WR005	5M	7	POFE	<i>Poa fendleriana</i>	5
10WR005	5M	9	ELEL5	<i>Elymus elymoides</i>	0.5
10WR005	5M	10	POFE	<i>Poa fendleriana</i>	2
10WR005	5N	1	ARTR2	<i>Artemisia tridentata</i>	10
10WR005	5N	1	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR005	5N	1	ELEL5	<i>Elymus elymoides</i>	4
10WR005	5N	1	LERE3	<i>Physaria rectipes</i>	2
10WR005	5N	2	ARTR2	<i>Artemisia tridentata</i>	45
10WR005	5N	2	BOGR2	<i>Bouteloua gracilis</i>	1
10WR005	5N	2	ELEL5	<i>Elymus elymoides</i>	15
10WR005	5N	3	ARTR2	<i>Artemisia tridentata</i>	90
10WR005	5N	3	BOGR2	<i>Bouteloua gracilis</i>	2
10WR005	5N	3	CARO5	<i>Carex rossii</i>	2
10WR005	5N	3	ELEL5	<i>Elymus elymoides</i>	1

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR005	5N	4	ELEL5	<i>Elymus elymoides</i>	5
10WR005	5N	5	ARTR2	<i>Artemisia tridentata</i>	1
10WR005	5N	5	BOGR2	<i>Bouteloua gracilis</i>	3
10WR005	5N	5	CARO5	<i>Carex rossii</i>	0.1
10WR005	5N	6	BOGR2	<i>Bouteloua gracilis</i>	6
10WR005	5N	9	BOGR2	<i>Bouteloua gracilis</i>	4
10WR005	5N	9	ELEL5	<i>Elymus elymoides</i>	8
10WR005	5N	9	GUSA2	<i>Gutierrezia sarothrae</i>	1
10WR005	5N	9	PIED	<i>Pinus edulis</i>	1
10WR005	5N	10	ELEL5	<i>Elymus elymoides</i>	2
10WR005	5N	10	GUSA2	<i>Gutierrezia sarothrae</i>	5
10WR005	5O	1	ARTR2	<i>Artemisia tridentata</i>	11
10WR005	5O	1	ELEL5	<i>Elymus elymoides</i>	1
10WR005	5O	1	POFE	<i>Poa fendleriana</i>	6
10WR005	5O	2	POFE	<i>Poa fendleriana</i>	3
10WR005	5O	3	BOGR2	<i>Bouteloua gracilis</i>	3
10WR005	5O	3	CARO5	<i>Carex rossii</i>	1
10WR005	5O	4	BOGR2	<i>Bouteloua gracilis</i>	1
10WR005	5O	4	LERE3	<i>Physaria rectipes</i>	0.1
10WR005	5O	5	ALFI3	<i>Aletes filifolius</i>	1
10WR005	5O	5	ARTR2	<i>Artemisia tridentata</i>	90
10WR005	5O	5	POFE	<i>Poa fendleriana</i>	15
10WR005	5O	6	ARTR2	<i>Artemisia tridentata</i>	2
10WR005	5O	6	BOGR2	<i>Bouteloua gracilis</i>	5
10WR005	5O	6	CARO5	<i>Carex rossii</i>	0.5
10WR005	5O	7	ARTR2	<i>Artemisia tridentata</i>	5
10WR005	5O	7	BOGR2	<i>Bouteloua gracilis</i>	7
10WR005	5O	7	CARO5	<i>Carex rossii</i>	0.1
10WR005	5O	8	CARO5	<i>Carex rossii</i>	2
10WR005	5O	8	POFE	<i>Poa fendleriana</i>	10
10WR005	5O	9	ARTR2	<i>Artemisia tridentata</i>	5
10WR005	5O	9	BOGR2	<i>Bouteloua gracilis</i>	3
10WR005	5O	9	CARO5	<i>Carex rossii</i>	0.1
10WR005	5O	9	OPPO	<i>Opuntia polyacantha</i>	5
10WR005	5O	9	POFE	<i>Poa fendleriana</i>	2
10WR005	5O	10	ANPA4	<i>Antennaria parvifolia</i>	4
10WR005	5O	10	CARO5	<i>Carex rossii</i>	0.5
10WR005	5O	10	POFE	<i>Poa fendleriana</i>	4
10WR007	7A	1	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7A	1	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7A	1	OPPO	<i>Opuntia polyacantha</i>	15
10WR007	7A	2	BOGR2	<i>Bouteloua gracilis</i>	30
10WR007	7A	2	CARO5	<i>Carex rossii</i>	0.1
10WR007	7A	6	BOGR2	<i>Bouteloua gracilis</i>	6
10WR007	7A	6	ELEL5	<i>Elymus elymoides</i>	8
10WR007	7A	7	BADI	<i>Bahia dissecta</i>	5
10WR007	7A	7	BOGR2	<i>Bouteloua gracilis</i>	2
10WR007	7A	7	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7A	8	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR007	7A	8	ELEL5	<i>Elymus elymoides</i>	0.5
10WR007	7B	1	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7B	1	OPPO	<i>Opuntia polyacantha</i>	2

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR007	7B	2	ELEL5	<i>Elymus elymoides</i>	8
10WR007	7B	2	OPPO	<i>Opuntia polyacantha</i>	2
10WR007	7B	3	BOGR2	<i>Bouteloua gracilis</i>	2
10WR007	7B	3	ELEL5	<i>Elymus elymoides</i>	5
10WR007	7B	3	GUSA2	<i>Gutierrezia sarothrae</i>	2
10WR007	7B	3	OPPO	<i>Opuntia polyacantha</i>	10
10WR007	7B	3	POFE	<i>Poa fendleriana</i>	8
10WR007	7B	3	SPCR	<i>Sporobolus cryptandrus</i>	1
10WR007	7B	4	BOGR2	<i>Bouteloua gracilis</i>	15
10WR007	7B	4	GUSA2	<i>Gutierrezia sarothrae</i>	40
10WR007	7B	5	BOGR2	<i>Bouteloua gracilis</i>	15
10WR007	7B	5	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7B	5	OPPO	<i>Opuntia polyacantha</i>	2
10WR007	7B	6	BOGR2	<i>Bouteloua gracilis</i>	40
10WR007	7B	6	ELEL5	<i>Elymus elymoides</i>	8
10WR007	7B	7	BOGR2	<i>Bouteloua gracilis</i>	1
10WR007	7B	8	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7B	9	ELEL5	<i>Elymus elymoides</i>	10
10WR007	7B	10	ELEL5	<i>Elymus elymoides</i>	10
10WR007	7B	10	MIOX	<i>Mirabilis oxybaphoides</i>	10
10WR007	7C	1	ERFL	<i>Erigeron flagellaris</i>	10
10WR007	7C	2	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR007	7C	2	ELEL5	<i>Elymus elymoides</i>	0.5
10WR007	7C	2	ERFL	<i>Erigeron flagellaris</i>	20
10WR007	7C	3	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7C	3	ERFL	<i>Erigeron flagellaris</i>	0.1
10WR007	7C	4	ELEL5	<i>Elymus elymoides</i>	5
10WR007	7C	4	ERFL	<i>Erigeron flagellaris</i>	15
10WR007	7C	4	POFE	<i>Poa fendleriana</i>	0.1
10WR007	7C	5	CARO5	<i>Carex rossii</i>	2
10WR007	7C	5	CHGR2	<i>Chenopodium graveolens</i>	0.1
10WR007	7C	5	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7C	5	ERFL	<i>Erigeron flagellaris</i>	20
10WR007	7C	5	POFE	<i>Poa fendleriana</i>	0.1
10WR007	7C	6	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7C	6	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7C	6	YUBA	<i>Yucca baccata</i>	2
10WR007	7C	7	CHFR3	<i>Chenopodium fremontii</i>	0.5
10WR007	7C	8	ELEL5	<i>Elymus elymoides</i>	8
10WR007	7C	8	POFE	<i>Poa fendleriana</i>	2
10WR007	7C	9	BADI	<i>Bahia dissecta</i>	1
10WR007	7C	9	BOGR2	<i>Bouteloua gracilis</i>	6
10WR007	7C	9	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7C	9	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7C	9	POFE	<i>Poa fendleriana</i>	0.1
10WR007	7C	10	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7C	10	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7C	10	POFE	<i>Poa fendleriana</i>	15
10WR007	7C	10	SPCR	<i>Sporobolus cryptandrus</i>	0.1
10WR007	7D	1	BOGR2	<i>Bouteloua gracilis</i>	55
10WR007	7D	2	BOGR2	<i>Bouteloua gracilis</i>	0.5
10WR007	7D	2	PIED	<i>Pinus edulis</i>	0.5

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR007	7D	3	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7D	3	PIED	<i>Pinus edulis</i>	2
10WR007	7D	4	BOGR2	<i>Bouteloua gracilis</i>	1
10WR007	7D	5	BOGR2	<i>Bouteloua gracilis</i>	5
10WR007	7D	5	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7D	6	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7D	6	PIED	<i>Pinus edulis</i>	0.5
10WR007	7D	8	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7D	8	PIED	<i>Pinus edulis</i>	1
10WR007	7D	9	ELEL5	<i>Elymus elymoides</i>	35
10WR007	7D	10	CHGR2	<i>Chenopodium graveolens</i>	1.5
10WR007	7D	10	ELEL5	<i>Elymus elymoides</i>	1.5
10WR007	7D	10	GUSA2	<i>Gutierrezia sarothrae</i>	0.5
10WR007	7E	1	LERE3	<i>Physaria rectipes</i>	0.5
10WR007	7E	1	POFE	<i>Poa fendleriana</i>	2
10WR007	7E	2	BOCU	<i>Bouteloua curtipendula</i>	0.1
10WR007	7E	2	OPPO	<i>Opuntia polyacantha</i>	1.5
10WR007	7E	2	LERE3	<i>Physaria rectipes</i>	0.5
10WR007	7E	2	POFE	<i>Poa fendleriana</i>	1
10WR007	7E	3	PIED	<i>Pinus edulis</i>	0.1
10WR007	7E	3	POFE	<i>Poa fendleriana</i>	1
10WR007	7E	4	OPPO	<i>Opuntia polyacantha</i>	2
10WR007	7E	4	POFE	<i>Poa fendleriana</i>	0.1
10WR007	7E	6	POFE	<i>Poa fendleriana</i>	0.1
10WR007	7E	7	POFE	<i>Poa fendleriana</i>	2
10WR007	7E	8	PIMI7	<i>Piptatherum micranthum</i>	0.5
10WR007	7E	8	POFE	<i>Poa fendleriana</i>	3
10WR007	7F	2	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7F	3	PIED	<i>Pinus edulis</i>	1
10WR007	7F	3	POFE	<i>Poa fendleriana</i>	4
10WR007	7F	4	PIED	<i>Pinus edulis</i>	1.5
10WR007	7F	5	POFE	<i>Poa fendleriana</i>	5
10WR007	7F	6	CARO5	<i>Carex rossii</i>	2
10WR007	7F	6	CHGR2	<i>Chenopodium graveolens</i>	0.5
10WR007	7F	6	POFE	<i>Poa fendleriana</i>	2
10WR007	7F	7	ELEL5	<i>Elymus elymoides</i>	0.5
10WR007	7F	7	POFE	<i>Poa fendleriana</i>	2
10WR007	7F	8	ELEL5	<i>Elymus elymoides</i>	3
10WR007	7F	8	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	5
10WR007	7F	8	POFE	<i>Poa fendleriana</i>	0.1
10WR007	7F	9	POFE	<i>Poa fendleriana</i>	5
10WR007	7F	10	BOGR2	<i>Bouteloua gracilis</i>	25
10WR007	7F	10	ELEL5	<i>Elymus elymoides</i>	8
10WR007	7G	1	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR007	7G	1	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7G	2	BOGR2	<i>Bouteloua gracilis</i>	0.5
10WR007	7G	3	BOGR2	<i>Bouteloua gracilis</i>	15
10WR007	7G	3	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7G	3	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7G	3	ERJA	<i>Eriogonum jamesii</i>	3
10WR007	7G	4	BOGR2	<i>Bouteloua gracilis</i>	4

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR007	7G	4	ELEL5	<i>Elymus elymoides</i>	5
10WR007	7G	5	BOGR2	<i>Bouteloua gracilis</i>	2
10WR007	7G	5	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7G	5	GUSA2	<i>Gutierrezia sarothrae</i>	15
10WR007	7G	5	HEVI4	<i>Heterotheca villosa</i>	5
10WR007	7G	6	BOGR2	<i>Bouteloua gracilis</i>	20
10WR007	7G	6	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7G	7	BOGR2	<i>Bouteloua gracilis</i>	25
10WR007	7G	8	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR007	7G	8	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7G	9	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7H	1	ELEL5	<i>Elymus elymoides</i>	1.5
10WR007	7H	1	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	1
10WR007	7H	2	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7H	3	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7H	3	PIED	<i>Pinus edulis</i>	0.1
10WR007	7H	3	POFE	<i>Poa fendleriana</i>	1.5
10WR007	7H	4	TOEX2	<i>Townsendia exscapa</i>	1
10WR007	7H	5	ELEL5	<i>Elymus elymoides</i>	2
10WR007	7H	8	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	1
10WR007	7H	9	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7H	10	BOCU	<i>Bouteloua curtipendula</i>	15
10WR007	7I	2	PIED	<i>Pinus edulis</i>	0.5
10WR007	7I	3	ELEL5	<i>Elymus elymoides</i>	1.5
10WR007	7I	3	ERJA	<i>Eriogonum jamesii</i>	1.5
10WR007	7I	3	PIED	<i>Pinus edulis</i>	0.5
10WR007	7I	4	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR007	7I	5	BOFE	<i>Boechera fendleri</i>	3
10WR007	7I	5	BOGR2	<i>Bouteloua gracilis</i>	3
10WR007	7I	5	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7I	6	ELEL5	<i>Elymus elymoides</i>	6
10WR007	7I	7	BOGR2	<i>Bouteloua gracilis</i>	6
10WR007	7I	7	ERAL4	<i>Eriogonum alatum</i>	4
10WR007	7I	8	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR007	7I	8	CARO5	<i>Carex rossii</i>	0.5
10WR007	7I	8	ELEL5	<i>Elymus elymoides</i>	6
10WR007	7I	8	LERE3	<i>Physaria rectipes</i>	0.1
10WR007	7J	1	BOGR2	<i>Bouteloua gracilis</i>	20
10WR007	7J	4	ARTR2	<i>Artemisia tridentata</i>	35
10WR007	7J	5	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR007	7J	6	BOGR2	<i>Bouteloua gracilis</i>	12
10WR007	7J	6	CARO5	<i>Carex rossii</i>	0.5
10WR007	7J	7	ARTR2	<i>Artemisia tridentata</i>	3
10WR007	7J	7	BOGR2	<i>Bouteloua gracilis</i>	1
10WR007	7J	7	CARO5	<i>Carex rossii</i>	4
10WR007	7J	8	BOGR2	<i>Bouteloua gracilis</i>	30
10WR007	7J	8	CARO5	<i>Carex rossii</i>	0.1
10WR007	7J	9	CARO5	<i>Carex rossii</i>	0.1
10WR007	7J	10	BOGR2	<i>Bouteloua gracilis</i>	10
10WR007	7K	1	BOGR2	<i>Bouteloua gracilis</i>	5

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR007	7K	2	BOCU	<i>Bouteloua curtipendula</i>	0.1
10WR007	7K	2	BOGR2	<i>Bouteloua gracilis</i>	7.9
10WR007	7K	3	BOGR2	<i>Bouteloua gracilis</i>	10
10WR007	7K	3	ERJA	<i>Eriogonum jamesii</i>	0.5
10WR007	7K	4	BOCU	<i>Bouteloua curtipendula</i>	0.9
10WR007	7K	4	BOGR2	<i>Bouteloua gracilis</i>	7
10WR007	7K	4	LERE3	<i>Physaria rectipes</i>	0.1
10WR007	7K	5	BOGR2	<i>Bouteloua gracilis</i>	0.5
10WR007	7K	5	ERJA	<i>Eriogonum jamesii</i>	0.5
10WR007	7K	5	LERE3	<i>Physaria rectipes</i>	0.5
10WR007	7K	6	BOGR2	<i>Bouteloua gracilis</i>	2
10WR007	7K	6	ERJA	<i>Eriogonum jamesii</i>	3
10WR007	7K	6	GUSA2	<i>Gutierrezia sarothrae</i>	1
10WR007	7K	6	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	3
10WR007	7K	7	GUSA2	<i>Gutierrezia sarothrae</i>	1
10WR007	7K	8	BOGR2	<i>Bouteloua gracilis</i>	0.5
10WR007	7K	8	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	0.5
10WR007	7K	9	BOGR2	<i>Bouteloua gracilis</i>	15
10WR007	7K	9	PECRT2	<i>Penstemon crandallii</i> ssp. <i>taosensis</i>	0.5
10WR007	7K	10	BOCU	<i>Bouteloua curtipendula</i>	5
10WR007	7K	10	BOGR2	<i>Bouteloua gracilis</i>	1
10WR007	7L	1	BOCU	<i>Bouteloua curtipendula</i>	0.1
10WR007	7L	1	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR007	7L	1	OPPO	<i>Opuntia polyacantha</i>	12
10WR007	7L	2	BOGR2	<i>Bouteloua gracilis</i>	20
10WR007	7L	3	BOGR2	<i>Bouteloua gracilis</i>	10
10WR007	7L	3	ELEL5	<i>Elymus elymoides</i>	1.5
10WR007	7L	5	YUBA	<i>Yucca baccata</i>	1.5
10WR007	7L	6	POFE	<i>Poa fendleriana</i>	12
10WR007	7L	7	TOEX2	<i>Townsendia exscapa</i>	0.1
10WR007	7L	8	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7L	10	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7L	10	TOEX2	<i>Townsendia exscapa</i>	0.1
10WR007	7M	1	ACHY	<i>Achnatherum hymenoides</i>	10
10WR007	7M	1	LERE3	<i>Physaria rectipes</i>	0.5
10WR007	7M	2	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7M	3	ELEL5	<i>Elymus elymoides</i>	0.5
10WR007	7M	3	OPPO	<i>Opuntia polyacantha</i>	18
10WR007	7M	4	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7M	4	ELEL5	<i>Elymus elymoides</i>	0.5
10WR007	7M	5	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7M	5	CHFR3	<i>Chenopodium fremontii</i>	0.1
10WR007	7M	5	GUSA2	<i>Gutierrezia sarothrae</i>	0.1
10WR007	7M	6	PIED	<i>Pinus edulis</i>	2
10WR007	7M	8	BOGR2	<i>Bouteloua gracilis</i>	1
10WR007	7M	8	ELEL5	<i>Elymus elymoides</i>	5
10WR007	7M	8	OPPO	<i>Opuntia polyacantha</i>	6
10WR007	7M	9	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7M	10	CARO5	<i>Carex rossii</i>	1

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR007	7M	10	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7N	1	CHRE4	<i>Chamaesyce revoluta</i>	0.1
10WR007	7N	2	CARO5	<i>Carex rossii</i>	8
10WR007	7N	2	ERJA	<i>Eriogonum jamesii</i>	2
10WR007	7N	2	LERE3	<i>Physaria rectipes</i>	0.1
10WR007	7N	3	ELEL5	<i>Elymus elymoides</i>	3
10WR007	7N	3	GUSA2	<i>Gutierrezia sarothrae</i>	2
10WR007	7N	6	LERE3	<i>Physaria rectipes</i>	1.5
10WR007	7N	8	BOGR2	<i>Bouteloua gracilis</i>	3
10WR007	7N	9	BOGR2	<i>Bouteloua gracilis</i>	2
10WR007	7N	9	GUSA2	<i>Gutierrezia sarothrae</i>	0.1
10WR007	7N	9	LERE3	<i>Physaria rectipes</i>	3
10WR007	7N	10	ELEL5	<i>Elymus elymoides</i>	4
10WR007	7O	1	ARTR2	<i>Artemisia tridentata</i>	2
10WR007	7O	1	BOGR2	<i>Bouteloua gracilis</i>	7
10WR007	7O	1	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7O	1	OPPO	<i>Opuntia polyacantha</i>	5
10WR007	7O	1	LERE3	<i>Physaria rectipes</i>	1
10WR007	7O	1	PIED	<i>Pinus edulis</i>	0.5
10WR007	7O	2	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.1
10WR007	7O	2	ELEL5	<i>Elymus elymoides</i>	1
10WR007	7O	2	TOEX2	<i>Townsendia exscapa</i>	1
10WR007	7O	3	ELEL5	<i>Elymus elymoides</i>	0.5
10WR007	7O	4	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7O	5	ELEL5	<i>Elymus elymoides</i>	0.1
10WR007	7O	6	ARTR2	<i>Artemisia tridentata</i>	5
10WR007	7O	6	BOGR2	<i>Bouteloua gracilis</i>	2
10WR007	7O	7	BOGR2	<i>Bouteloua gracilis</i>	45
10WR007	7O	7	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.1
10WR007	7O	8	BOGR2	<i>Bouteloua gracilis</i>	35
10WR007	7O	8	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.1
10WR007	7O	8	POOL	<i>Portulaca oleracea</i>	0.1
10WR007	7O	9	BOGR2	<i>Bouteloua gracilis</i>	15
10WR007	7O	9	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.1
10WR007	7O	10	ARTR2	<i>Artemisia tridentata</i>	25
10WR007	7O	10	BOGR2	<i>Bouteloua gracilis</i>	2
10WR007	7O	10	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.1
10WR007	7O	10	POOL	<i>Portulaca oleracea</i>	0.1
10WR009	9A	2	BOGR2	<i>Bouteloua gracilis</i>	3
10WR009	9A	3	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR009	9A	5	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.1
10WR009	9A	6	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.1
10WR009	9A	8	ELEL5	<i>Elymus elymoides</i>	2
10WR009	9B	1	BOGR2	<i>Bouteloua gracilis</i>	1
10WR009	9B	1	CARO5	<i>Carex rossii</i>	1.5
10WR009	9B	1	ELEL5	<i>Elymus elymoides</i>	1
10WR009	9B	1	POFE	<i>Poa fendleriana</i>	1
10WR009	9B	2	BOGR2	<i>Bouteloua gracilis</i>	3
10WR009	9B	2	POFE	<i>Poa fendleriana</i>	1
10WR009	9B	3	POFE	<i>Poa fendleriana</i>	4
10WR009	9B	4	POFE	<i>Poa fendleriana</i>	2
10WR009	9B	5	POFE	<i>Poa fendleriana</i>	0.1

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR009	9B	6	POFE	<i>Poa fendleriana</i>	10
10WR009	9B	7	POFE	<i>Poa fendleriana</i>	5
10WR009	9B	8	POFE	<i>Poa fendleriana</i>	0.1
10WR009	9B	9	ELEL5	<i>Elymus elymoides</i>	1
10WR009	9B	9	POFE	<i>Poa fendleriana</i>	5
10WR009	9B	10	ALFI3	<i>Aletes filifolius</i>	1
10WR009	9B	10	POFE	<i>Poa fendleriana</i>	0.1
10WR009	9C	8	PIED	<i>Pinus edulis</i>	6
10WR009	9C	9	PIED	<i>Pinus edulis</i>	3
10WR009	9D	1	BOGR2	<i>Bouteloua gracilis</i>	7
10WR009	9D	2	BOGR2	<i>Bouteloua gracilis</i>	0.5
10WR009	9D	3	ARTR2	<i>Artemisia tridentata</i>	1
10WR009	9D	3	BOGR2	<i>Bouteloua gracilis</i>	1
10WR009	9D	3	CHSE6	<i>Chamaesyce serpyllifolia</i>	0.1
10WR009	9D	5	BOGR2	<i>Bouteloua gracilis</i>	0.5
10WR009	9D	6	BOGR2	<i>Bouteloua gracilis</i>	1
10WR009	9D	7	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR009	9D	7	PIED	<i>Pinus edulis</i>	0.5
10WR009	9D	9	BOGR2	<i>Bouteloua gracilis</i>	0.1
10WR009	9E	8	POFE	<i>Poa fendleriana</i>	1
10WR009	9E	10	PIED	<i>Pinus edulis</i>	1
10WR009	9F	1	BOGR2	<i>Bouteloua gracilis</i>	5
10WR009	9F	1	CARO5	<i>Carex rossii</i>	1.5
10WR009	9F	1	MUMO	<i>Muhlenbergia montana</i>	7
10WR009	9F	1	POFE	<i>Poa fendleriana</i>	3
10WR009	9F	2	CARO5	<i>Carex rossii</i>	2
10WR009	9F	5	POFE	<i>Poa fendleriana</i>	1
10WR009	9F	6	MUMO	<i>Muhlenbergia montana</i>	5
10WR009	9F	6	POFE	<i>Poa fendleriana</i>	1
10WR009	9F	7	ERAL4	<i>Eriogonum alatum</i>	3
10WR009	9F	7	MUMO	<i>Muhlenbergia montana</i>	1
10WR009	9F	8	MUMO	<i>Muhlenbergia montana</i>	1
10WR009	9F	8	POFE	<i>Poa fendleriana</i>	1
10WR009	9F	9	BOGR2	<i>Bouteloua gracilis</i>	15
10WR009	9F	9	MUMO	<i>Muhlenbergia montana</i>	3
10WR009	9F	10	BOGR2	<i>Bouteloua gracilis</i>	7
10WR009	9F	10	MUMO	<i>Muhlenbergia montana</i>	0.5
10WR009	9F	10	POFE	<i>Poa fendleriana</i>	10
10WR009	9G	1	PIMI7	<i>Piptatherum micranthum</i>	1
10WR009	9G	3	BOGR2	<i>Bouteloua gracilis</i>	10
10WR009	9G	3	PASM	<i>Pascopyrum smithii</i>	3
10WR009	9G	4	ELEL5	<i>Elymus elymoides</i>	2
10WR009	9G	4	PASM	<i>Pascopyrum smithii</i>	5
10WR009	9G	5	BOGR2	<i>Bouteloua gracilis</i>	25
10WR009	9G	5	PASM	<i>Pascopyrum smithii</i>	1
10WR009	9G	6	BOGR2	<i>Bouteloua gracilis</i>	30
10WR009	9G	6	CHVA2	<i>Chrysothamnus vaseyi</i>	22
10WR009	9G	7	BOGR2	<i>Bouteloua gracilis</i>	4
10WR009	9G	7	PASM	<i>Pascopyrum smithii</i>	3
10WR009	9G	7	SPCR	<i>Sporobolus cryptandrus</i>	3
10WR009	9G	8	ARTR2	<i>Artemisia tridentata</i>	55
10WR009	9G	8	CARO5	<i>Carex rossii</i>	5

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR009	9G	8	ELEL5	<i>Elymus elymoides</i>	2
10WR009	9G	8	PASM	<i>Pascopyrum smithii</i>	1
10WR009	9G	8	SPCR	<i>Sporobolus cryptandrus</i>	0.1
10WR009	9G	9	BOGR2	<i>Bouteloua gracilis</i>	12
10WR009	9G	9	CARO5	<i>Carex rossii</i>	5
10WR009	9G	9	ELEL5	<i>Elymus elymoides</i>	10
10WR009	9G	9	GUSA2	<i>Gutierrezia sarothrae</i>	0.1
10WR009	9G	9	PASM	<i>Pascopyrum smithii</i>	5
10WR009	9G	10	ARTR2	<i>Artemisia tridentata</i>	90
10WR009	9G	10	CARO5	<i>Carex rossii</i>	1
10WR009	9G	10	ELEL5	<i>Elymus elymoides</i>	2
10WR009	9G	10	GUSA2	<i>Gutierrezia sarothrae</i>	0.1
10WR009	9H	4	POFE	<i>Poa fendleriana</i>	0.1
10WR009	9H	6	ARTR2	<i>Artemisia tridentata</i>	35
10WR009	9H	9	CARO5	<i>Carex rossii</i>	0.1
10WR009	9H	9	ELEL5	<i>Elymus elymoides</i>	0.1
10WR009	9H	10	BOGR2	<i>Bouteloua gracilis</i>	1
10WR009	9H	10	SCLI12	<i>Schoenocrambe linearifolia</i>	0.1
10WR009	9I	3	CHGR2	<i>Chenopodium graveolens</i>	2
10WR009	9I	3	2FORB	unidentified forb - seedling	1
10WR009	9I	4	CHGR2	<i>Chenopodium graveolens</i>	0.1
10WR009	9I	5	CHGR2	<i>Chenopodium graveolens</i>	1
10WR009	9I	5	2FORB	unidentified forb - seedling	0.5
10WR009	9I	6	CHFR3	<i>Chenopodium fremontii</i>	0.5
10WR009	9I	6	CHGR2	<i>Chenopodium graveolens</i>	1
10WR009	9I	6	2FORB	unidentified forb - seedling	3
10WR009	9I	7	2FORB	unidentified forb - seedling	0.1
10WR009	9I	9	BOGR2	<i>Bouteloua gracilis</i>	1
10WR009	9I	9	ELEL5	<i>Elymus elymoides</i>	5
10WR009	9I	10	BOGR2	<i>Bouteloua gracilis</i>	2
10WR009	9I	10	ELEL5	<i>Elymus elymoides</i>	8
10WR009	9J	1	ARTR2	<i>Artemisia tridentata</i>	60
10WR009	9J	1	ELEL5	<i>Elymus elymoides</i>	2
10WR009	9J	2	ARTR2	<i>Artemisia tridentata</i>	50
10WR009	9J	2	ELEL5	<i>Elymus elymoides</i>	5
10WR009	9J	2	ERVE2	<i>Erigeron vetensis</i>	4
10WR009	9J	3	ARTR2	<i>Artemisia tridentata</i>	50
10WR009	9J	3	ELEL5	<i>Elymus elymoides</i>	2
10WR009	9J	3	ERVE2	<i>Erigeron vetensis</i>	1
10WR009	9J	4	BOGR2	<i>Bouteloua gracilis</i>	26
10WR009	9J	4	CARO5	<i>Carex rossii</i>	5
10WR009	9J	5	ARTR2	<i>Artemisia tridentata</i>	10
10WR009	9J	5	BOGR2	<i>Bouteloua gracilis</i>	0.5
10WR009	9J	5	CARO5	<i>Carex rossii</i>	9
10WR009	9J	5	ELEL5	<i>Elymus elymoides</i>	1.5
10WR009	9J	6	ARTR2	<i>Artemisia tridentata</i>	47
10WR009	9J	6	BOGR2	<i>Bouteloua gracilis</i>	3
10WR009	9J	6	CARO5	<i>Carex rossii</i>	4
10WR009	9J	6	ELEL5	<i>Elymus elymoides</i>	1
10WR009	9J	6	ERVE2	<i>Erigeron vetensis</i>	0.1
10WR009	9J	7	ARTR2	<i>Artemisia tridentata</i>	23
10WR009	9J	7	BOGR2	<i>Bouteloua gracilis</i>	1

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR009	9J	7	CARO5	Carex rossii	11
10WR009	9J	7	ELEL5	Elymus elymoides	2
10WR009	9J	8	BOGR2	Bouteloua gracilis	29
10WR009	9J	8	CARO5	Carex rossii	1
10WR009	9J	9	ARTR2	Artemisia tridentata	25
10WR009	9J	9	BOGR2	Bouteloua gracilis	3
10WR009	9J	10	ARTR2	Artemisia tridentata	70
10WR009	9J	10	ELEL5	Elymus elymoides	1
10WR009	9K	1	POFE	Poa fendleriana	5
10WR009	9K	3	PIED	Pinus edulis	0.1
10WR009	9K	3	POFE	Poa fendleriana	5
10WR009	9K	5	POFE	Poa fendleriana	4
10WR009	9K	6	ANPA4	Antennaria parvifolia	1
10WR009	9K	6	POFE	Poa fendleriana	5
10WR009	9K	7	ERVE2	Erigeron vetensis	0.5
10WR009	9K	8	CARO5	Carex rossii	2
10WR009	9K	8	ERVE2	Erigeron vetensis	0.5
10WR009	9K	8	MUWR	Muhlenbergia wrightii	10
10WR009	9K	9	POFE	Poa fendleriana	3
10WR009	9L	1	POFE	Poa fendleriana	9
10WR009	9L	2	POFE	Poa fendleriana	15
10WR009	9L	3	CARO5	Carex rossii	1
10WR009	9L	4	CARO5	Carex rossii	0.5
10WR009	9L	4	ERVE2	Erigeron vetensis	0.5
10WR009	9L	4	MUWR	Muhlenbergia wrightii	10
10WR009	9L	4	POFE	Poa fendleriana	1
10WR009	9L	6	CARO5	Carex rossii	0.5
10WR009	9L	6	POFE	Poa fendleriana	9
10WR009	9L	6	PUPAM	Pulsatilla patens ssp. multifida	1
10WR009	9L	7	ERVE2	Erigeron vetensis	0.5
10WR009	9L	7	POFE	Poa fendleriana	5
10WR009	9L	8	POFE	Poa fendleriana	1
10WR009	9L	10	ELEL5	Elymus elymoides	1
10WR009	9L	10	ERVE2	Erigeron vetensis	0.1
10WR009	9L	10	MUMO	Muhlenbergia montana	0.5
10WR009	9L	10	POFE	Poa fendleriana	6
10WR009	9M	1	ARTR2	Artemisia tridentata	55
10WR009	9M	1	PIED	Pinus edulis	0.5
10WR009	9M	2	POFE	Poa fendleriana	2
10WR009	9M	4	BOGR2	Bouteloua gracilis	1
10WR009	9M	5	BOGR2	Bouteloua gracilis	15
10WR009	9M	6	ARTR2	Artemisia tridentata	2
10WR009	9M	7	ARTR2	Artemisia tridentata	26
10WR009	9M	8	ARTR2	Artemisia tridentata	75
10WR009	9M	9	ARTR2	Artemisia tridentata	73
10WR009	9M	10	ARTR2	Artemisia tridentata	12
10WR009	9M	10	BOGR2	Bouteloua gracilis	2
10WR009	9N	2	BOFE	Boechera fendleri	1
10WR009	9N	4	BOGR2	Bouteloua gracilis	4
10WR009	9N	4	CARO5	Carex rossii	6
10WR009	9N	4	ERFO3	Erigeron formosissimus	2
10WR009	9N	4	POFE	Poa fendleriana	8

PlotID	T	Q	PLANTS Symbol	Scientific name	Canopy Cover %
10WR009	9N	5	CARO5	Carex rossii	1
10WR009	9N	5	POFE	Poa fendleriana	12
10WR009	9N	6	CARO5	Carex rossii	1
10WR009	9N	7	POFE	Poa fendleriana	23
10WR009	9N	8	POFE	Poa fendleriana	6
10WR009	9N	9	ERFO3	Erigeron formosissimus	0.5
10WR009	9N	9	POFE	Poa fendleriana	1
10WR009	9O	1	ELEL5	Elymus elymoides	0.5
10WR009	9O	2	POFE	Poa fendleriana	4
10WR009	9O	3	POFE	Poa fendleriana	8
10WR009	9O	7	POFE	Poa fendleriana	1
10WR009	9O	10	BOGR2	Bouteloua gracilis	0.5
10WR009	9O	10	CARO5	Carex rossii	5