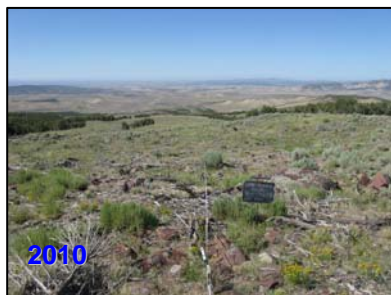
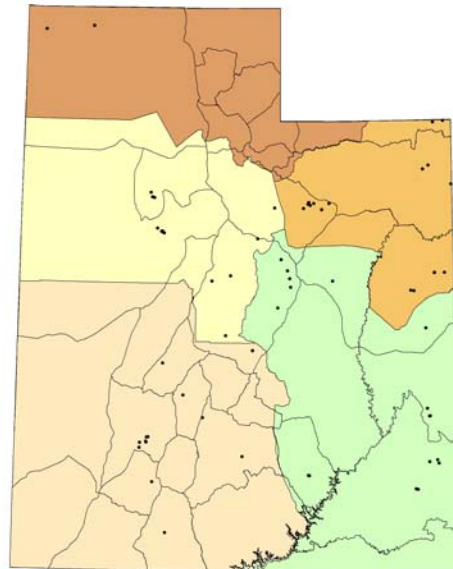


# 2010 Watershed Restoration Initiative Vegetation Monitoring Report



**PUBLICATION NUMBER 11-19  
REPORT FOR FEDERAL AID PROJECT W-82-R-55**

**STATE OF UTAH  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF WILDLIFE RESOURCES**

# **2010 Watershed Restoration Initiative Vegetation Monitoring Report**

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Performance Report for Federal Aid Project W-82-R-55

Publication No. 11-19

UTAH DEPARTMENT OF NATURAL RESOURCES  
Division of Wildlife Resources  
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Reports for all regions, with accompanying photographs, are available online at <http://wri.utah.gov/WRI/>.

## PROGRAM NARRATIVE

State: UTAH

Project Number: W-82-R-55

Grant Title: Wildlife Habitat and Monitoring

Project Title: Wildlife Habitat Monitoring/Watershed Restoration Initiative

Need: Utah's Watershed Restoration Initiative (WRI) is a partnership-driven effort to conserve, restore and manage ecosystems in priority areas across the state. The WRI focuses on enhancing Utah's water quality and yield as well as its biological diversity. To achieve these results, WRI partners fund and perform physical and mechanical habitat manipulation, negotiate administrative changes in land management, and strengthen communication and team-building among the public and stakeholders. As part of the habitat manipulation projects, range trend data is collected on selected treatment areas. Pre-treatment and post-treatment data is collected. The WRI range trend studies are used to evaluate the success and failure of land treatment projects. The health and vigor of big game populations are closely correlated to the quality and quantity of forage in key areas. Range trend data are used by DWR biologists, public land managers and private land owners for habitat improvement planning purposes.

Objective: Monitor, evaluate, and report results of habitat treatment projects conducted under the WRI throughout the state, and inform Division biologists, public land managers and private landowners of significant changes in plant community composition in these areas.

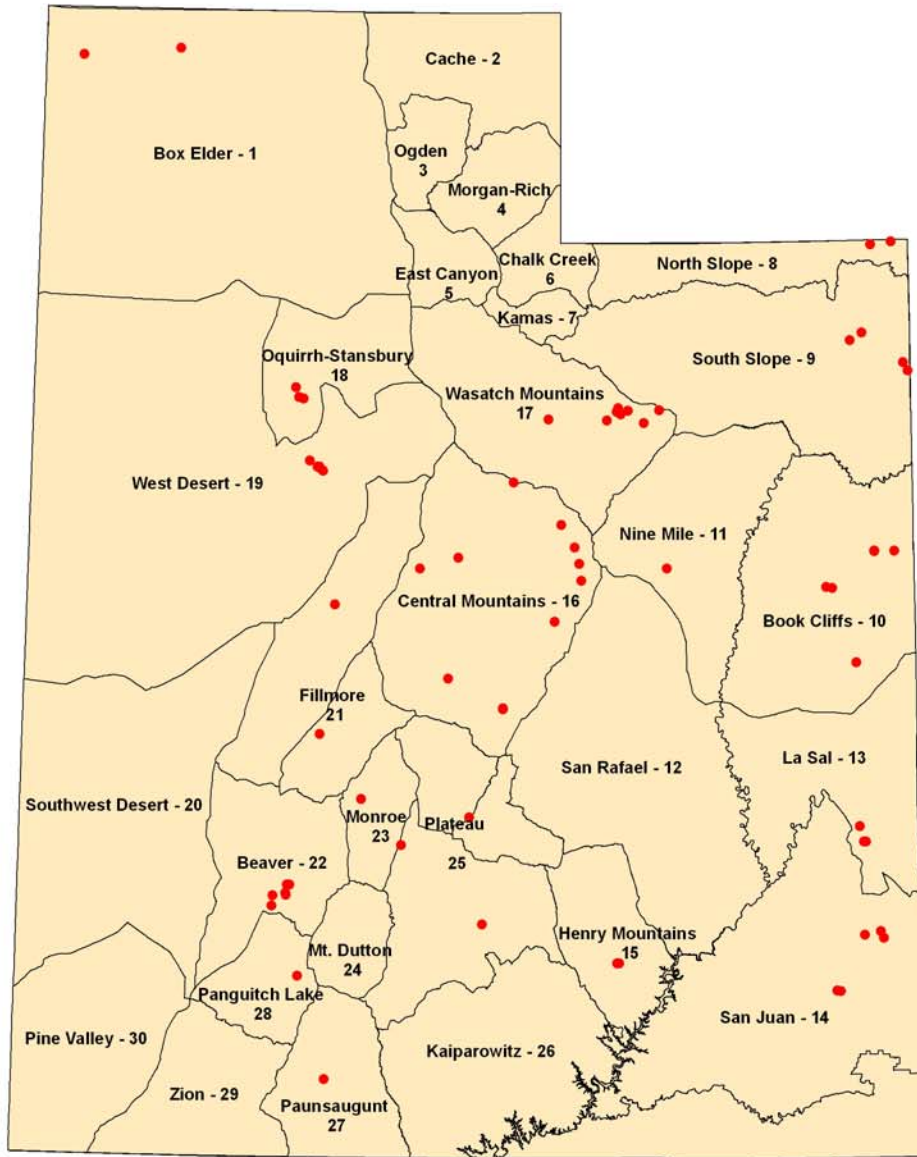
Expected Results or Benefits: WRI range trend studies in each region will be reread, and vegetation condition and trend assessments will be made for project areas. DWR biologists, land management personnel from the USFS and BLM, and private landowners will use the WRI database to evaluate the impact of land management programs on big game habitat. Annual reports will be readily available on the Division's website, on CDs, and in hard copies located in DWR regional offices, BLM and USFS offices, and public libraries.

## REMARKS

The work completed during the 2010 field season and reported in this publication involves the reading of projects initiated as part of the Watershed Restoration Initiative.

The Bureau of Land Management and U.S. Forest Service offices provided information and/or assistance in completion of the trend studies which add to the value of this interagency report. Private landowners were cooperative in allowing access to study sites located on their land.

# WRI Studies Surveyed in 2010



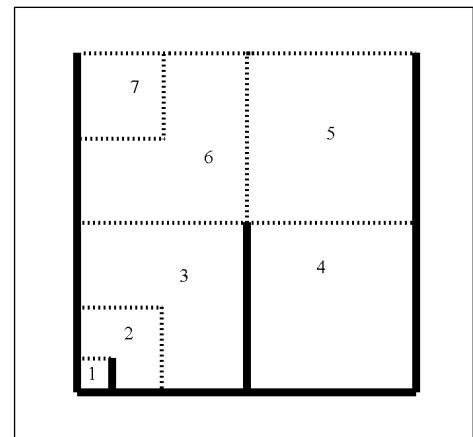
## RANGE TREND STUDY METHODS

Studies monitoring range trend depend greatly on site selection, especially when dealing with large geographic areas such as wildlife management units. Since it is impossible to intensively monitor all vegetation or habitat types within a unit, it is necessary to concentrate on specific sites and/or “key” areas within distinct plant communities on big game ranges. These “key” areas should be places where big game has demonstrated a definite pattern of use during normal climatic conditions over a long period of time. Trend studies are located within these areas of high use and/or crucial habitat as agreed upon by DWR, BLM, and USFS personnel. Often, range trend studies are established in conjunction with permanently marked pellet group transects. Once a “key” area has been selected, specific placement for sampling is determined. The sampling grid is carefully placed in order to adequately represent the surrounding area. All sampling baselines are permanently marked by half-high steel fence posts. The first, or “0 foot baseline stake”, is marked with a metal tag for proper identification of the transect.

### Vegetation Composition

Determining vegetation characteristics for each “key” area is determined by setting up 5 consecutive 100 foot baseline transects in the area of interest. This 500 foot line is the baseline and one, 100 foot belt is placed perpendicular to each 100 foot section of the baseline at random foot marks and centered on the 50 foot mark. The beginning of each belt is marked by a rebar stake to ensure a more precise alignment of the originally sampled belt. A 1/4 m<sup>2</sup> quadrat is centered every 5 feet along the same side of the belt, starting at the 5 foot mark. Cover and nested frequency values are determined for vegetation, litter, rock, pavement, cryptogams, and bare ground. Cover and nested frequency values are also estimated for all plant species occurring within a quadrat, including annual species. However, prior to 1992 no data was collected for annual species.

**Percent Cover:** Cover is determined using an ocular cover estimation procedure using 7 cover classes (Bailey and Poulton 1968, Daubenmire 1959). The seven cover classes are: 1) .01-1%, 2) 1.1-5%, 3) 5.1-25%, 4) 25.1-50%, 5) 50.1-75%, 6) 75.1-95%, and 7) 95.1-100% (Figure 1). For example, to estimate vegetation cover with this method, an observer would visualize which cover class all the vegetation would fit into if the plants were moved together until they were touching. To quantify percent cover for bare ground, litter, rock, pavement, and cryptogams, the observer would visually estimate which cover class could accommodate all of the specified cover type within the quadrat. These numbers are then recorded. To determine percent cover for each belt, the midpoint for each cover class value observed is summed and divided by the number of sampling quadrats (20). The mean for the five belts is the average for a given site.



**Figure 1.** Cover classes of the 1/4 m<sup>2</sup> sampling quadrat.

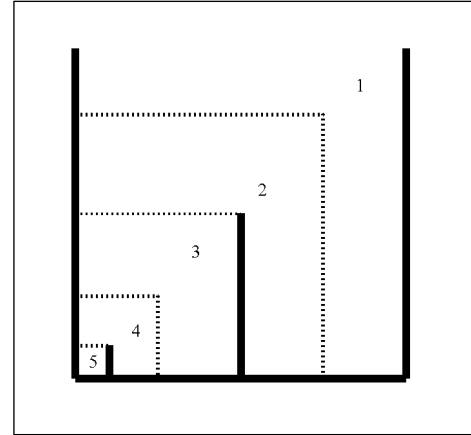
Total canopy cover of shrubs or trees is estimated using the line-intercept method (<sup>1</sup>U.S. Department of Interior Bureau of Land Management 1999). The distance along each belt covered by a particular species of tree or shrub is divided by the total length of the line to give percent canopy cover. Prior to 2002, only canopy cover above eye level was estimated. After 2002 all canopy cover both above and below eye level was estimated.

**Nested Frequency:** Nested frequency values for the quadrat range from 1-5 according to which area or sub-quadrat the plant species or cover type is rooted in. The notation for each sub-quadrat is as follows: 5 = 1% of the area, 4 = 5% of the area, 3 = 25% of the area, 2 = 50% of the area, and 1 = the remainder of the quadrat. Each time a particular plant species or cover type occurs within the quadrat, it is scored relative to which of the smallest nested quadrats it is rooted in (in the case of vegetation) or where it first occurs (for all other cover



types). The highest possible score is 5 for each quadrat occurrence and 100 per belt, for a possible score of 500 for each species or cover type at a given site (Figure 2).

Higher nested frequency scores represent a higher abundance for that plant species or cover type. These summed values are used to help determine changes in trend and composition through time. Nested frequency has been found to be a more sensitive measurement for changes taking place within plant communities than quadrat frequency (Smith et al. 1987, Smith et al. 1986, Mosley et al. 1986). Plant cover and density values are not reliable indicators of trend for herbaceous species and can fluctuate greatly with precipitation and time of season sampled. Therefore, plant cover and density values can be misleading if used independently and do not necessarily indicate changes in composition and/or distribution of key plant species.



**Figure 2.** Nested frequency sub-quadrats of the 1/4 m<sup>2</sup> sampling quadrat.

Nested frequency and average percent cover data for individual grass and forb species are summarized in the “Herbaceous Trends” table of each study discussion. Nested frequency and average cover of vegetation, rock, pavement, litter, cryptogams, and bare ground are summarized in the “Basic Cover” table of each study discussion.

**Shrub Density & Characterization:** Shrub densities are estimated using five, 1/100th acre strips centered over the length of each 100 foot belt. All shrubs rooted within each strip are counted and categorized using a modified Cole Browse Method (U.S. Department of Interior Bureau of Land Management 1999):

**Seedling:** Plants up to three years old which have become firmly established, usually less than 1/8-inch diameter.

**Young:** Larger with more complex branching. Does not show signs of maturity. Usually between 1/8 and 1/4-inch diameter.

**Mature:** Complex branching, rounded growth form, larger size, seed is produced on healthy plants. Generally larger than 1/4-inch diameter.

**Decadent:** Plant, regardless of age, that is in a state of decline, usually evidenced by 25% or more dead branches.

**Dead:** A plant which is no longer living.

Shrubs are also rated according to their availability and the amount of use they display, and placed in one of nine form classes:

1. All available, lightly hedged.
2. All available, moderately hedged.
3. All available, heavily hedged.
4. Largely available, lightly hedged.
5. Largely available, moderately hedged.
6. Largely available, heavily hedged.
7. Mostly unavailable.
8. Unavailable due to height.
9. Unavailable due to hedging.

Lightly hedged: 0 to 40 percent of twigs browsed.

Moderately hedged: 41 to 60 percent of twigs browsed.

Heavily hedged: Over 60 percent of twigs browsed. Degree of hedging is based on leader use over the past three years: current annual growth is not included.

Largely available: One-third to two-thirds of plant available to animal.

Mostly unavailable: Less than one-third of plant available to animal.

Unavailable: In classifying browse to a form class, unavailability may be the result of height, location, or density.

Shrubs are also rated on their health and placed into one of four vigor classes:

1. Normal and vigorous.
2. Insect infested or diseased.
3. Poor vigor - chlorotic or discolored leaves, smaller than normal stems or leaves, flowering restricted, partially trampled, pulled up, or otherwise damaged. Stunted growth, partial crown death.
4. Dying - substantial portion of crown dead (more than 50%), more extreme than 3 above. Probably an irreversible condition.

In addition, each mature shrub species closest to every 10 foot mark along a sampling belt is measured to determine average height and crown. This allows a maximum sample of 50 plants per species to be measured at a given site depending on their respective densities. Annual leader growth is estimated for key browse species at each study site. This is done by measuring five leaders on the closest mature shrub in each quarter (similar to point-center quarter method) from 3 stakes along the study site baseline (0', 200' and 400' stakes). These numbers are then averaged. Tree density is determined using the point-center quarter method (Cottam and Curtis 1956) at 100 foot intervals along the baseline measuring to a maximum of 15 meters. If trees are rare due to a treatment or wildfire, the sampling area is extended to 200 foot intervals measuring to a maximum of 30 meters, and 300 feet is added to the end of the transect so that five, 200 foot point-quarter centers can be read. This allows sampling trees on a much larger scale. The strip method that is used to estimate shrub density can, in most cases, effectively inventory seedling and young tree densities. However, the strip method is less effective at estimating densities of mature trees that are often widely disbursed.

Prior to 1992, shrub frequency was determined using the nested frequency method that was previously described. It was found that nested frequency of shrubs did not usually reflect accurate trends in shrub populations which had particularly low or high densities. Therefore, beginning in mid-1992, each 1/100th acre shrub strip is divided into 20, five foot segments. To give a more accurate measure of shrub frequency, presence or absence of shrub species is determined within these strip segments, and this measurement is termed strip frequency. For example, if a species was rooted in 25 of the 100 shrub strips, strip frequency for this species would be 25%. This data along with shrub cover is recorded in the "Browse Trends" table.

### **Trend Determination**

The methods described above rely on relative and absolute measurements of plant composition as determined from the frequency, cover, and density data. In addition, estimates of plant vigor, average height and crown diameter, form class, and age class are utilized to characterize shrub populations.

Browse: Particular attention is given to woody plants and their important role as indicators on crucial big game winter ranges. A variety of parameters are used to help determine trend for key browse species through time. These include:

- 1) changes in density or number of plants/acre
- 2) proportion of cover contributed by key species
- 3) recruitment or proportion of young plants in population
- 4) proportion of decadent plants
- 5) proportion of plants in poor vigor
- 6) changes in height and crown diameter measurements for mature age class
- 7) changes in browse species composition
- 8) strip frequency values

Herbaceous Understory: Trends in herbaceous plants as a group or as a single “key” species are determined by comparing the sum of nested frequency values between readings. Attention is also given to changes in species composition of grasses and forbs through time. A non-parametric statistical test, the Friedman test (analogous to analysis of variance) (Conover 1980), is conducted on nested frequencies of each species to determine significant changes at  $\alpha = 0.10$ .

Soil: Ground cover parameters are analyzed and compared in the discussions of the reread studies, but no actual trend is determined. Beginning in 2002, an erosion condition class assessment adapted from the Bureau of Land Management was also completed on each study site to provide additional qualitative information on soil condition.

## **Data Interpretation**

The following tables and partial tables are taken from study number 13A-1 to help illustrate how to read the data and some basic comparisons that can be made with the data.

Herbaceous Understory: The “Herbaceous Trends” table summarizes the average cover and nested frequency data for individual grass and forb species. The table contains all the grass and forb species that have been sampled on study 13A-1. Readings prior to mid-1992 include only nested frequency data for **perennial** species. Beginning in mid-1992, all trend studies have data for **perennial** and **annual** species, as well as cover estimates for individual species. In the following example, trend is determined using the change in the sum of nested frequency and cover of perennial grasses, and the change in composition of grasses determined by each species nested frequency and cover.

As shown in the “Herbaceous Trends” table, the undesirable species bulbous bluegrass (*Poa bulbosa*) was the most common species in nested frequency on the site in all sample years. The subscript letters indicate that the nested frequency value for *P. bulbosa* declined significantly between 1999 and 2004. Cover of *P. bulbosa* was estimated at a high of 8.01% in 1999 to a low of 2.43% in 2004. Trend for this grass species is down over the life of the study due to a significant decline in sum of nested frequency and a decrease in cover, though the decrease in this species is desirable for the grass trend of the site. The more desirable species crested wheatgrass (*A. cristatum*) has also decreased in nested frequency over the life of the study, but the decrease was only significant between the 1987 and 2009 sample years. Grasses had a combined total cover value of 11.52% in 1994, 13.89% in 1999, 11.35% in 2004 and 7.32% in 2009. These changes would indicate a slightly downward perennial grass trend over the life of the study. The forb trend can be determined in a similar manner.

HERBACEOUS TRENDS--  
Management unit 13A, Study no: 1

Type	Species	Nested Frequency					Average Cover %			
		'87	'94	'99	'04	'09	'94	'99	'04	'09
G	Agropyron cristatum	b135	ab106	ab100	ab112	a81	2.46	2.50	4.81	2.00
G	Agropyron intermedium	-	-	3	2	3	-	.03	.00	.03
G	Bouteloua gracilis	15	19	17	13	17	1.07	.14	.53	.30
G	Bromus inermis	75	67	63	68	92	.63	2.40	1.00	1.35
G	Bromus tectorum (a)	-	-	3	-	-	-	.00	-	-
G	Hilaria jamesii	-	-	-	2	-	-	-	.03	-
G	Koeleria cristata	b61	a3	a19	a3	a-	.03	.18	.01	-
G	Oryzopsis hymenoides	-	3	3	3	8	.00	.00	.03	.07
G	Poa bulbosa	b220	b256	b250	a129	a136	7.14	8.01	2.43	2.86
G	Poa fendleriana	a-	b16	d53	cd55	bc24	.06	.38	1.24	.33
G	Sitanion hystrix	6	1	-	-	-	.00	-	-	-
G	Stipa comata	b48	a14	bc24	bc30	a21	.11	.23	1.24	.36
Total for Annual Grasses		0	0	3	0	0	0	0.00	0	0
Total for Perennial Grasses		560	485	532	417	382	11.52	13.89	11.35	7.32
Total for Grasses		560	485	535	417	382	11.52	13.90	11.35	7.32
F	Astragalus convallarius	b40	bc17	ab25	b37	a9	.10	.42	.99	.10
F	Calochortus nuttallii	8	-	-	1	-	-	-	.00	-
F	Castilleja chromosa	b38	a4	a-	a-	a-	.01	-	-	-
F	Castilleja linariaefolia	-	2	1	-	-	.01	.03	-	-
F	Comandra pallida	-	-	-	3	-	-	-	.01	-
F	Cordylanthus sp. (a)	-	-	-	5	5	-	-	.16	.01
F	Crepis acuminata	b14	a6	a-	a-	a-	.03	-	-	-
F	Erigeron flagellaris	-	-	3	-	1	-	.15	-	.00
F	Erigeron pumilus	b111	a21	a43	a20	a12	.07	.51	.53	.08
F	Eriogonum racemosum	b63	a30	a34	a25	a28	.14	.30	.35	.21
F	Hymenoxys acaulis	3	-	3	1	-	-	.00	.03	-
F	Lomatium triternatum	b31	a-	a-	a-	a-	-	-	-	-
F	Lupinus argenteus	d162	c57	b20	a-	a-	3.64	.14	-	-
F	Machaeranthera canescens	1	-	2	-	-	-	.01	-	-
F	Penstemon caespitosus	85	2	6	6	5	.01	.03	.07	.02
F	Petradoria pumila	-	-	5	-	-	-	.06	-	-
F	Phlox longifolia	c67	bc53	ab31	a7	a17	.14	.06	.05	.10
F	Polygonum douglasii (a)	-	-	-	-	6	-	-	-	.01
F	Senecio multilobatus	-	1	1	-	-	.00	.00	-	-
F	Sphaeralcea coccinea	58	55	52	49	48	1.24	.38	.60	.59
F	Tragopogon dubius	6	-	-	-	-	-	-	-	-
F	Trifolium gymnocarpon	-	3	3	2	-	.00	.00	.00	-
F	Zigadenus paniculatus	-	-	3	-	1	-	.00	.00	.03
Total for Annual Forbs		0	0	0	5	11	0	0	0.15	0.01
Total for Perennial Forbs		693	251	232	151	121	5.43	2.15	2.66	1.15
Total for Forbs		693	251	232	156	132	5.43	2.15	2.82	1.17

Values with different subscript letters are significantly different at alpha = 0.10

**Browse:** The following “Browse Trends” table summarizes strip frequency and cover for all shrub species occurring on this site. All of the shrubs encountered at study number 13A-1 are listed. For example, mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) had a strip frequency of 86 out of a possible 100 in 1994, 82 in 1999 and 85 in 2004 and 2009. Average cover is determined using cover classes in conjunction with the 1/4m<sup>2</sup> quadrat and estimating the percent of the quadrat covered. In this case, mountain big sagebrush cover was estimated to be 16.28% in 1994, 9.40% in 1999, 10.65% in 2004 and 9.94% in 2009.

**BROWSE TRENDS--**

Management unit 13A, Study no: 1

Type	Species	Strip Frequency				Average Cover %			
		'94	'99	'04	'09	'94	'99	'04	'09
B	<i>Amelanchier utahensis</i>	18	18	16	20	2.25	3.74	6.50	5.30
B	<i>Artemisia tridentata vaseyana</i>	86	82	85	85	16.28	9.40	10.65	9.94
B	<i>Chrysothamnus depressus</i>	12	26	23	23	.66	.72	1.46	.87
B	<i>Chrysothamnus viscidiflorus viscidiflorus</i>	86	81	72	72	3.62	4.96	5.00	6.14
B	<i>Coryphantha vivipara arizonica</i>	0	2	5	5	-	.00	.00	.00
B	<i>Eriogonum microthecum</i>	10	16	10	9	.01	.53	.12	.12
B	<i>Gutierrezia sarothrae</i>	0	4	8	4	.01	.04	.15	.03
B	<i>Juniperus osteosperma</i>	0	0	0	0	-	-	-	.15
B	<i>Opuntia</i> sp.	36	35	41	45	.32	.56	1.12	1.33
B	<i>Pinus edulis</i>	0	16	14	10	2.92	3.53	7.21	8.53
B	<i>Purshia tridentata</i>	0	1	1	1	-	.00	.00	.00
B	<i>Quercus gambelii</i>	0	3	3	2	.76	.63	1.48	.76
B	<i>Symphoricarpos oreophilus</i>	3	2	4	2	.00	.00	.00	.00
Total for Browse		251	286	282	278	26.86	24.13	33.72	33.20

To more accurately estimate canopy cover of trees and shrubs, the line-intercept method is used along each 100 foot belt. This data is reported in the “Canopy Cover, Line Intercept” table. For example, mountain big sagebrush had a cover of 13.21% in 2004 and 13.93% in 2009. Compare this to the cover determined using the 1/4m<sup>2</sup> quadrat cover class method. Prior to 2002, only trees species were sampled in the line-intercept transect above eye level. Beginning in 2002, all woody species were included in the line-intercept transect and a total canopy cover (above and below eye level) value for each was determined.

**CANOPY COVER, LINE INTERCEPT--**

Management unit 13A, Study no: 1

Species	Percent Cover		
	'99	'04	'09
<i>Amelanchier utahensis</i>	.80	7.25	9.48
<i>Artemisia tridentata vaseyana</i>	-	13.21	13.93
<i>Chrysothamnus depressus</i>	-	1.04	.58
<i>Chrysothamnus viscidiflorus viscidiflorus</i>	-	4.73	7.25
<i>Eriogonum microthecum</i>	-	.11	.06
<i>Opuntia</i> sp.	-	.65	.71
<i>Pinus edulis</i>	3.59	11.86	13.43
<i>Quercus gambelii</i>	-	1.23	1.43
<i>Symphoricarpos oreophilus</i>	-	-	.08

Beginning in 2002, annual leader growth of the key browse species is measured to get an idea of shrub production and vigor. This data is displayed in the “Key Browse Annual Leader Growth” table. For example, annual leaders on serviceberry (*Amelanchier utahensis*) averaged 1.8 inches and 1.7 inches in length in 2004 and 2009, respectively, while mountain big sagebrush leaders averaged 1.3 inches in both sample years.

**KEY BROWSE ANNUAL LEADER GROWTH--**

Management unit 13A, Study no: 1

Species	Average leader growth (in)	
	'04	'09
<i>Amelanchier utahensis</i>	1.8	1.7
<i>Artemisia tridentata vaseyana</i>	1.3	1.3

The following “Point-Quarter Tree Data” table displays tree density estimates using the point-center quarter method which better estimates density of widely disbursed trees than the shrub density strips. Average basal diameter is also listed in inches. Point-quarter tree data for pinyon estimated 201 trees/acre in 1999, 175 tree/acre in 2004 and 213 trees/acre in 2009, with average basal diameters of 2.1 inches, 2.8 inches and 3.2 inches, respectively.

**POINT-QUARTER TREE DATA--**

Management unit 13A, Study no: 1

Species	Trees per Acre			Average diameter (in)		
	'99	'04	'09	'99	'04	'09
<i>Pinus edulis</i>	201	175	213	2.1	2.8	3.2

The “Browse Characteristics” table summarizes characteristics of the shrub community. Only mountain big sagebrush is included in this example. The sagebrush population is characterized by age class, vigor, utilization, and average height and crown for mature plants. Total density in plants/acre for mountain big sagebrush, excluding seedlings, was 3,198 plants/acre in 1987, 4,800 plants/acre in 1994, 4080 plants/acre in 1999, 3,800 plants/acre in 2004 and 3,820 plants/acre in 2009. Seedlings are excluded from the population estimate because with summer drought, many will die by late fall causing great fluctuations in population estimates between sampling dates. Since mid-1992, a larger shrub sample area (more than three times larger) was used to better characterize the shrub populations. Therefore, changes in density (before and after 1992) may not necessarily indicate changes in trend, especially shrub populations that characteristically are clumped and/or have discontinuous distributions. The earlier smaller sample could easily either overestimate or underestimate shrub populations. Other characteristics like percent decadence, percent of the population displaying poor vigor, percent heavy hedging, young recruitment, etc., are given more weight in determining shrub trend when comparing survey years where sample sizes are different.

**BROWSE CHARACTERISTICS--**

Management unit 13A, Study no: 1

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata vaseyana</i>									
87	<b>3198</b>	8	79	12	-	42	8	2	13/17
94	<b>4800</b>	4	54	42	940	13	2	10	18/32
99	<b>4080</b>	13	63	24	360	41	3	3	21/31
04	<b>3800</b>	5	73	22	-	33	10	9	15/24
09	<b>3820</b>	6	68	26	60	34	17	22	17/25

The data for mountain big sagebrush from study 13A-1 shows the proportion of decadent shrubs in the population was highest in 1994 at 42%, but has been more moderate at an average of 24% since 1999. More seedlings were also encountered in 1994, but recruitment of young plants has been low (< 10%) in all sample years except for 1999. The percentage of plants displaying poor vigor was low in most sample years, but increased to 22% in 2009. Considering all these factors, trend for sagebrush over the life of the study is stable.

Soil: The “Basic Cover” table summarizes average cover of vegetation, rock, pavement, litter, cryptogams, and bare ground. Average cover prior to mid-1992 adds up to only 100%, while cover with the current method (post mid-1992) estimates several layers of plant and ground cover and will usually exceed 100%. For vegetation cover, the previous method only determined basal vegetation cover (15.25% in 1987), while the new method estimates the vertical projection of the crown, or aerial cover (33.38% in 1994, 39.61% in 1999, 42.08% in 2004 and 42.20% in 2009). Therefore, comparisons can be made for all cover measurements except for general vegetation cover.

**BASIC COVER--**

Management unit 13A, Study no: 1

Cover Type	Average Cover %				
	'87	'94	'99	'04	'09
Vegetation	15.25	33.38	39.61	42.08	42.20
Rock	0	.02	.00	.00	.00
Pavement	0	.03	.04	.05	.03
Litter	61.00	46.05	40.37	45.25	50.69
Cryptogams	3.50	1.50	8.07	2.74	2.00
Bare Ground	20.25	32.20	29.56	34.09	22.93

A summary of the soil data is found in the “Soil Analysis Data” table. Effective rooting depth is an average of 25 soil penetrometer readings, 5 of the deepest probes possible near each of the 5 baseline starting stakes. The effective rooting depth is a relative index that can be used for site comparisons with regard to individual species differences, site preferences, and abundance. Chemical and textural characteristics are also listed and were determined by laboratory analysis of a composite soil sample taken near each of the 5 baseline starting stakes.

**SOIL ANALYSIS DATA --**

Management unit 13A, Study no: 1, Study Name: Two Mile Chaining

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
11	6.5	48.2	30.6	21.3	2	8	105.6	0.4

The descriptive terms used for ranges in pH are as follows:

- Ultra acidic < 3.5
- Extremely Acidic 3.5-4.4
- Very Strong Acidic 4.5-5.0
- Strongly Acidic 5.1-5.5
- Moderately Acidic 5.6-6.0
- Slightly Acidic 6.1-6.5
- Neutral 6.6-7.3
- Slightly Alkaline 7.4-7.8
- Moderately Alkaline 7.9-8.4
- Strongly Alkaline 8.5-9.0
- Very Strongly Alkaline > 9.1

Percent organic matter (% OM) refers to the amount of organic matter in the top 12 inches of the soil profile. Parts per million (ppm) of phosphorus (P) and potassium (K) are also included. Values for phosphorus and potassium less than 6 ppm and 60 ppm, respectively, are considered to have low availability for plant growth and development (Tiedemann and Lopez 2004).

The electrical conductivity of the soil is reported in decisiemens per meter (dS/m). Electrical conductivity is related to the amount of salts more soluble than gypsum in the soil. The following classes can be used as a reference.

Non saline	0-2
Very slightly saline	2-4
Slightly saline	4-8
Moderately saline	8-16
Strongly saline	>16

Utilization: The “Pellet Group Data” table summarizes the frequency of animal pellets sampled within the 100 quadrats placed along the sampling belts as well as data from a pellet group transect read parallel to the study site baseline. Quadrat frequency of wildlife and livestock droppings is included in reports done prior to mid-1992. For example in 1994, rabbit pellets were found in 44% of the quadrats placed on study 13A-1, decreasing to just 6% in 1999 and 2004, then increasing again to 34% in 2009. Quadrat frequency of rabbit or big game pellets indicates a relative amount of use by that particular animal. This data can help characterize changes in wildlife use patterns on the site.

It was determined that additional information on pellet groups was necessary. Therefore, a pellet group transect is now sampled in conjunction with the vegetation transects. The pellet group transect utilizes 50, 100ft<sup>2</sup> circular plots which are placed through the study area. These are usually two parallel transects of 25 plots on each side of the vegetation transect which runs 400 feet to 500 feet in length. The number of recent pellet groups for wildlife (usually deer and elk) and pats for cattle are recorded. That number is then converted to days use per acre (hectare). Rabbit pellet groups are not included in this sample. In the example, elk days use/acre was estimated at 70 in 1999 and decreased steadily to 4 elk days use/acre in 2009.

PELLET GROUP DATA--

Management unit 13A, Study no: 1

Type	Quadrat Frequency				Days use per acre (ha)		
	'94	'99	'04	'09	'99	'04	'09
Rabbit	44	6	6	34	-	-	-
Elk	28	26	11	3	70 (173)	27 (68)	4 (10)
Deer	14	28	15	9	32 (79)	16 (40)	25 (63)
Cattle	-	2	-	1	6 (14)	4 (11)	4 (9)

Other Information: Management background information, photographs, and knowledgeable plant identification add to the database for each site. Management and background information for each site is obtained from the administering agency. Permanently located photographs are taken including a general view down and back up the baseline. A close-up of each half-high baseline post further characterizes individual sites. Correct plant identification is critical for a complete and accurate site analysis. Species identification mostly follows "A Utah Flora" (Welsh et al. 2003). In some cases, most notably *Agropyron spp.* and *Purshia spp.*, the species names used by the Range Trend Study Plant Species List (Giunta 1983), Intermountain Flora (Cronquist et al. 1977) and the Intermountain Range Plant Names and Symbols (Plummer et al. 1977) are retained to maintain continuity and alleviate confusion with earlier published reports.



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- <sup>2</sup>U.S. Department of Interior Bureau of Land Management. 1999. *Utilization Studies and Residual Measurements*, Interagency Technical Reference, BLM/RS/ST-96/004+1730.
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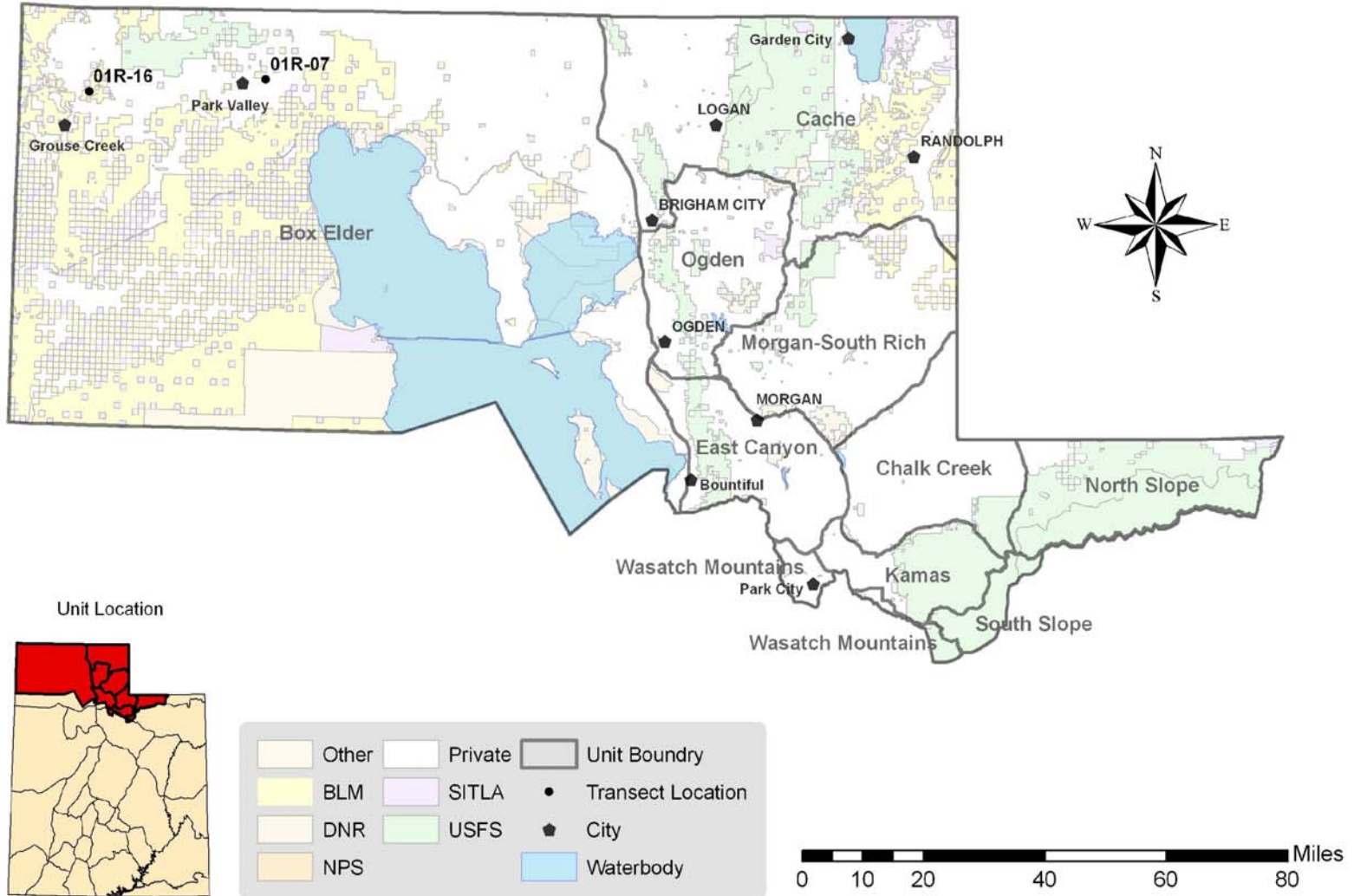
## REPORT FORMAT

The name and directions for locating the site are given on the location page. Also included on this page are the vegetation type, range type, NRCS ecological site description, land ownership, elevation, aspect, slope, arrangement and diagrammatic sketch of the baseline, and the location on a topographical map. The 7.5 minute topographical map name and public land survey description are located below the map. In addition, UTM coordinates follow the public land survey location. Compass bearings are in degrees relative to magnetic north, unless specified as true north (T).

A discussion of the study site includes descriptions of the site's historic characteristics, soil, ground cover, vegetation community, and species composition. A comparison of the pre-treatment data to post-treatment data occurs prior to the trend assessment section. The trend assessment is based upon the comparison of the recent year and the previous year's data. Additional assessment is made by comparing photographs from year to year.

Tables with the compiled data follow the study discussions. A computer-generated data summary presents the pooled data for nested frequency, quadrat frequency, basic ground cover, soil characterization, shrub density, and shrub characterization. A nonparametric statistical analysis, the Friedman test, is performed on the nested frequency values between years. This analysis indicates significance levels between species over time at  $\alpha = 0.10$ . Significant changes are indicated in the herbaceous trends table with subscript letters.

# Northern Region WRI Studies 2010



HEREFORD 2 - TREND STUDY NO. 1R-7-10

[Project #250](#)

Vegetation Type: Pinyon/Juniper, Black Sagebrush

Range Type: Crucial Deer Winter

NRCS Ecological Site Description: Not available

Land Ownership: Private

Elevation: 5,460 ft. (1,664 m)

Aspect: Southeast

Slope: 5%

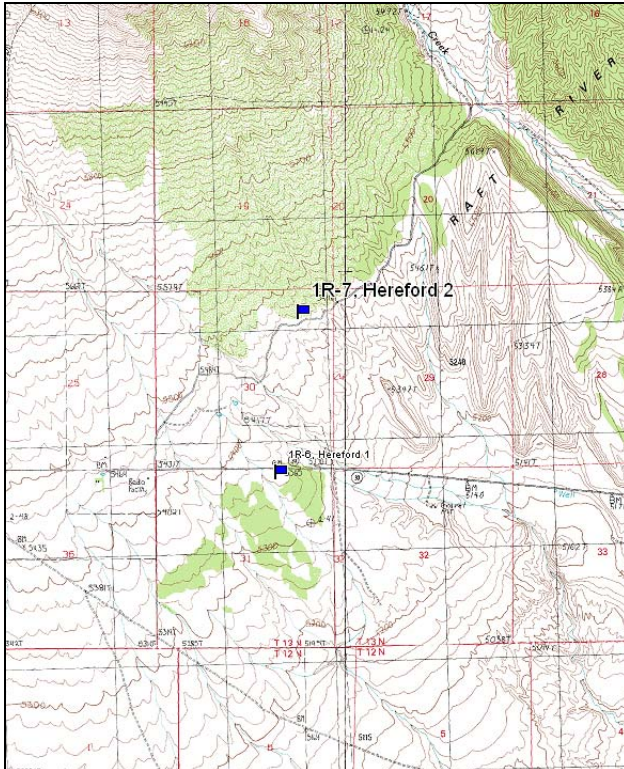
Transect bearing: 323° magnetic

Belt placement: 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

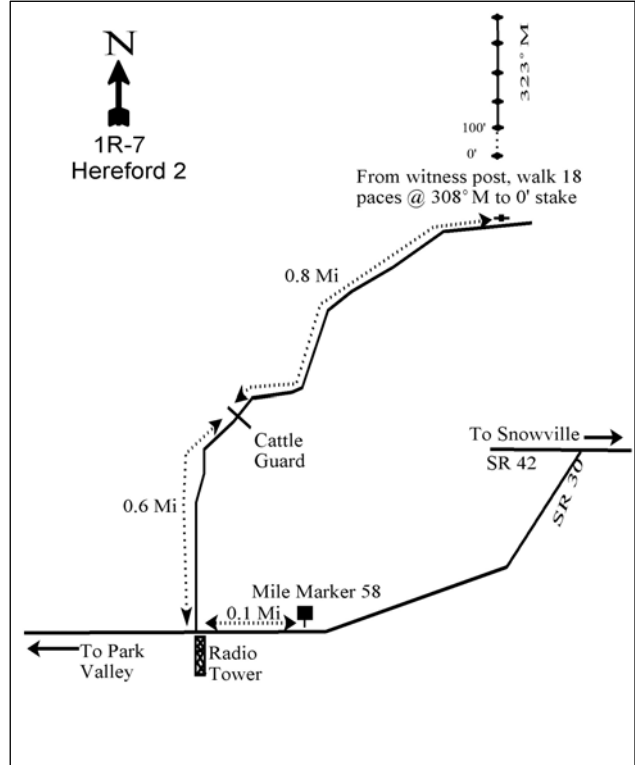
Head west on SR-42 from Snowville, UT to Curlew Junction and turn south (left) onto SR-30 and drive toward Park Valley, UT. Drive to mile marker 58 and proceed another 0.1 miles to a radio tower on the on the south (left) side of the road. Turn north (right) through a gate with a private property sign. Follow the road for 0.6 miles to a cattle guard. Continue on the road for 0.8 miles to the witness post on the left. From the witness post, walk 18 paces at 308°M to the 0' stake. The site is on the ridge. The 0' stake is marked with browse tag #59.

Map Name: Park Valley



Township: 13N Range: 12S Section: 30

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 312664 E 4633300 N

HEREFORD 2 - WRI STUDY 1R-07  
[Project #250](#)

**Site Description**

Site Information: The study was established to monitor a pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) removal project approximately four miles northeast of Park Valley. Project details included the mosaic disking of 1,200 acres of sagebrush and the chaining of 600 acres of pinyon pine and Utah juniper woodland. Slash piles were to be burned and then a diverse seed mix applied by a rangeland drill. The proposed seed mix was developed to out-compete noxious weeds and create a diverse understory. Drill seeding occurred between October and December of 2005 while aerial seeding of forage kochia (*Kochia prostrata*) occurred in January of 2006. Grazing was suspended for two years following treatment per NRCS guidelines (WRI Database 2011). Pellet group transect data has estimated light use by deer and cattle since 2005. Quadrat frequency indicated moderately high rabbit abundance in 2005 and in 2010 rabbit abundance was low (Table - Pellet Group Data).

**SEED MIX--**

Management unit 01R, Study no: 7

Project Name: Hereford Grazing Association WRI Database #: 250				Project Name: Hereford Grazing Association 2 WRI Database #: 250			
Application: Drill Seed 1*		Acres: 1200		Application: Drill Seed 2*		Acres: 340	
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Hycrest'	2970	2.48	G	Crested Wheatgrass 'Hycrest'	500	1.47
G	Russian Wildrye 'Bozoisky'	1400	1.17	G	Crested Wheatgrass 'Ephraim'	200	0.59
G	Siberian Wheatgrass 'Vavilov'	1200	484.85	G	Siberian Wheatgrass 'Vavilov'	300	0.88
G	Great Basin Wildrye 'Trailhead'	1390	561.62	G	Snake River Wheatgrass 'Secar'	350	1.03
F	Alfalfa 'Ladak+'	1400	2.89	G	Great Basin Wildrye 'Trailhead'	350	1.03
F	Sainfoin 'Eski'	2800	5.78	G	Russian Wildrye	350	1.03
F	Small Burnet	2800	969.70	F	Alfalfa 'Ladak'	50	0.15
B	Fourwing Saltbush	1375	476.19	F	Alfalfa 'Nomad'	150	0.44
B	Forage Kochia	1050	1.08	F	Alfalfa 'Spredor 4'	150	0.44
Total Pounds:		16385	13.65	F	Sainfoin 'Eski'	1020	3.00
PLS Pounds:			12.16	F	Small Burnet 'Delar'	700	2.06
Application: Aerial Seed*		Acres: 1920		B	Fourwing Saltbush	150	0.44
Seed type		lbs in mix	lbs/acre	Total Pounds:		4270	12.56
B	Forage Kochia	1920	1.00	PLS Pounds:			11.12
Total Pounds:		23530	12.26				
PLS Pounds:			0.74				

\*Three different seed mixes were applied to the site. Drill Seed 1 and Drill Seed 2 were applied by rangeland drill in late fall of 2005 and the Aerial Seed mix was applied in January of 2006.

Browse: Black sagebrush (*Artemisia nova*) was the key browse species in 2005, but had substantially decreased in cover (Table - Canopy Cover) and density after the treatment. Forage kochia and fourwing saltbush (*Atriplex canescens*) were drill seeded in 2005 and forage kochia was aerial seeded in 2006. In 2010 forage kochia was established with moderate density, but fourwing saltbush was not sampled in the density strip (Table - Browse Characteristics). Utah juniper decreased substantially in cover (Table - Canopy Cover) and density, and many live trees on the site were knocked over from the treatment (Table - Point-Quarter Data).

Herbaceous Understory: Grasses are diverse, but are not abundant and in poor condition. The annual grass species cheatgrass (*Bromus tectorum*) is the dominant grass component. The dominant perennial species include crested wheatgrass (*Agropyron cristatum*) and Indian ricegrass (*Oryzopsis hymenoides*), though they

are not abundant and are low in cover. Grasses that were drill seeded in 2005 and sampled in 2010 include crested wheatgrass and Russian wildrye (*Elymus junceus*), though crested wheatgrass was present before the treatment in 2005. Forbs are diverse and fairly abundant. The most abundant perennial forb species is small burnet (*Sanguisorba minor*) and alfalfa (*Medicago sativa*) which were seeded as part of the project (Table - Herbaceous Trends).

Soil: The soil is a loam texture with a slightly alkaline soil reaction (pH 7.4) (Table - Soil Analysis Data). Bare ground cover is moderate with a high amount of vegetation, pavement, and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2005 due to slight surface litter movement, slight pedestalling, slight flow patterns, and moderate gully erosion, and in 2010, the soil erosion condition was classified as stable.

### Pre vs. Five Years Post Treatment, 2005 vs. 2010

Browse: Black sagebrush canopy cover declined from 9% to 3% while the density decreased 80% from 3,220 plants/acre to 640 plants/acre. The seeded species forage kochia provided 3% cover in 2010 and had a density of 2,040 plants/acre. Utah juniper cover decreased from 15% to 3% while density decreased from 472 trees/acre with an average diameter of 4.2 inches in 2005 to 311 trees/acre with an average diameter of 2.9 inches in 2010. Thirty percent of the sampled trees were knocked over by the treatment, but were still alive.

Grasses: The sum of nested frequency of perennial grasses increased 48%, while cover remained similar at 2%. There was a significant increase in the nested frequency of crested wheatgrass and Indian ricegrass. Cheatgrass cover increased from 2% in 2005 to 12% in 2010, but nested frequency had not significantly increased.

Forbs: The sum of nested frequency of perennial forbs increased 53% while cover increased from 1% to 6% between 2005 and 2010. Small burnet accounted for the majority of forb cover at 3%. No other forb species provided more than 1% cover.

#### HERBACEOUS TRENDS--

Management unit 01R, Study no: 7

Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
G	Agropyron cristatum	a28	b59	.28	.93
G	Agropyron spicatum	13	17	.40	.20
G	Bromus tectorum (a)	240	304	1.45	12.17
G	Elymus junceus	-	6	-	.04
G	Oryzopsis hymenoides	a13	b26	.40	.73
G	Poa fendleriana	-	11	-	.18
G	Poa secunda	b23	a1	.45	.15
G	Sitanion hystrix	7	4	.07	.09
G	Vulpia octoflora (a)	13	-	.08	-
Total for Annual Grasses		253	304	1.53	12.17
Total for Perennial Grasses		84	124	1.62	2.34
Total for Grasses		337	428	3.15	14.51
F	Antennaria rosea	-	6	-	.06
F	Arabis sp.	4	-	.04	-
F	Arenaria sp.	1	3	.00	.03
F	Astragalus sp.	6	12	.04	.17

Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
F	<i>Astragalus utahensis</i>	3	1	.03	.03
F	<i>Calochortus nuttallii</i>	8	3	.01	.00
F	<i>Chaenactis douglasii</i>	<sub>a</sub> 5	<sub>b</sub> 21	.04	.13
F	<i>Cordylanthus sp. (a)</i>	<sub>b</sub> 37	<sub>a</sub> 4	.29	.19
F	<i>Cryptantha sp.</i>	11	7	.05	.09
F	<i>Descurainia pinnata (a)</i>	<sub>b</sub> 100	<sub>a</sub> 14	.87	1.01
F	<i>Draba sp. (a)</i>	10	-	.01	-
F	<i>Erigeron pumilus</i>	1	-	.00	-
F	<i>Eriogonum ovalifolium</i>	<sub>b</sub> 31	<sub>a</sub> 7	.18	.18
F	<i>Eriogonum sp.</i>	7	-	.07	-
F	<i>Eriogonum umbellatum</i>	16	12	.33	.06
F	<i>Gayophytum ramosissimum(a)</i>	7	-	.01	-
F	<i>Gilia sp. (a)</i>	<sub>b</sub> 108	<sub>a</sub> 26	.91	.12
F	<i>Halogeton glomeratus (a)</i>	<sub>a</sub> -	<sub>b</sub> 66	-	.74
F	<i>Lactuca serriola (a)</i>	<sub>a</sub> 7	<sub>b</sub> 75	.03	.63
F	<i>Lappula occidentalis (a)</i>	14	-	.02	-
F	<i>Medicago sativa</i>	<sub>a</sub> -	<sub>b</sub> 36	-	.68
F	<i>Penstemon sp.</i>	2	7	.01	.33
F	<i>Phlox austromontana</i>	14	9	.16	.21
F	<i>Phlox longifolia</i>	4	6	.03	.03
F	<i>Ranunculus testiculatus (a)</i>	<sub>b</sub> 65	<sub>a</sub> -	.33	-
F	<i>Salsola iberica (a)</i>	<sub>a</sub> -	<sub>b</sub> 55	-	.64
F	<i>Sanguisorba minor</i>	-	67	-	3.05
F	<i>Senecio multilobatus</i>	-	1	-	.03
F	<i>Sisymbrium altissimum (a)</i>	<sub>a</sub> -	<sub>b</sub> 15	-	.06
F	<i>Sphaeralcea coccinea</i>	-	7	-	.33
F	<i>Streptanthus cordatus</i>	<sub>b</sub> 26	<sub>a</sub> 7	.12	.04
Total for Annual Forbs		348	255	2.50	3.41
Total for Perennial Forbs		139	212	1.16	5.48
Total for Forbs		487	467	3.66	8.89

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 01R, Study no: 7

Type	Species	Strip Frequency		Average Cover %	
		'05	'10	'05	'10
B	Artemisia nova	67	26	7.55	2.34
B	Chrysothamnus viscidiflorus	6	5	.01	.24
B	Eriogonum microthecum	3	0	.03	-
B	Gutierrezia sarothrae	7	13	.01	.14
B	Juniperus osteosperma	20	9	5.97	3.26
B	Kochia prostrata	0	52	-	1.84
B	Leptodactylon pungens	13	1	.24	-
B	Opuntia sp.	3	3	-	.15
Total for Browse		119	109	13.81	8.00

CANOPY COVER, LINE INTERCEPT--

Management unit 01R, Study no: 7

Species	Percent Cover	
	'05	'10
Artemisia nova	9.21	2.88
Chrysothamnus viscidiflorus	.10	.25
Gutierrezia sarothrae	.10	.20
Juniperus osteosperma	14.98	2.98
Kochia prostrata	-	3.34
Leptodactylon pungens	.08	-
Opuntia sp.	-	.05

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 01R, Study no: 7

Species	Average leader growth (in)	
	'05	'10
Artemisia nova	1.2	0.8
Kochia prostrata	-	5.1



POINT-QUARTER TREE DATA--

Management unit 01R, Study no: 7

Species	Trees per Acre		Average diameter (in)	
	'05	'10	'05	'10
Juniperus osteosperma	472	311	4.2	2.9

BASIC COVER--

Management unit 01R, Study no: 7

Cover Type	Average Cover %	
	'05	'10
Vegetation	19.14	32.89
Rock	2.54	1.20
Pavement	32.43	24.26
Litter	23.65	31.57
Cryptogams	2.41	0
Bare Ground	33.67	30.02

SOIL ANALYSIS DATA --

Management unit 1R, Study no: 7, Study Name: Hereford 2

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
13.7	7.4	37.2	40.0	22.8	1.9	6.9	243.2	0.5

PELLET GROUP DATA--

Management unit 01R, Study no: 7

Type	Quadrat Frequency		Days use per acre (ha)	
	'05	'10	'05	'10
Rabbit	64	1	-	-
Deer	6	-	-	1 (2)
Cattle	1	-	3 (7)	3 (7)

BROWSE CHARACTERISTICS--  
Management unit 01R, Study no: 7

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia nova</i>									
05	<b>3220</b>	10	49	41	14100	0	0	17	11/24
10	<b>640</b>	6	91	3	220	0	0	3	14/18
<i>Chrysothamnus nauseosus</i>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	13/15
<i>Chrysothamnus viscidiflorus</i>									
05	<b>140</b>	29	71	-	-	29	29	0	6/9
10	<b>100</b>	20	80	-	-	20	0	0	10/11
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
05	<b>0</b>	0	0	-	-	0	0	0	8/15
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Eriogonum microthecum</i>									
05	<b>80</b>	0	75	25	-	50	50	25	4/7
10	<b>0</b>	0	0	0	-	0	0	0	-/-
<i>Gutierrezia sarothrae</i>									
05	<b>140</b>	14	86	-	200	0	0	0	6/8
10	<b>380</b>	21	79	-	-	0	0	0	10/16
<i>Juniperus osteosperma</i>									
05	<b>440</b>	50	27	23	40	0	0	9	-/-
10	<b>200</b>	40	60	0	40	0	0	0	-/-
<i>Kochia prostrata</i>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>2040</b>	14	86	-	-	6	3	0	12/13
<i>Leptodactylon pungens</i>									
05	<b>500</b>	0	88	12	-	0	0	0	5/9
10	<b>20</b>	0	100	0	-	0	0	0	6/11
<i>Opuntia sp.</i>									
05	<b>60</b>	33	67	-	-	0	0	0	4/10
10	<b>80</b>	0	100	-	-	0	0	0	4/9
<i>Tetradymia canescens</i>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	17/11

KIMBELL CREEK - TREND STUDY NO. 1R-16-10  
[Project #1739](#)

Vegetation Type: Wyoming Big Sagebrush, Pinyon/Juniper

Range Type: Substantial Deer Winter

NRCS Ecological Site Description: [Upland Loam \(Basin Big Sagebrush\), R025XY310UT](#)

Land Ownership: BLM

Elevation: 5,930 ft. (1,805 m)

Aspect: Southeast

Slope: 3-7%

Transect bearing: 272° magnetic

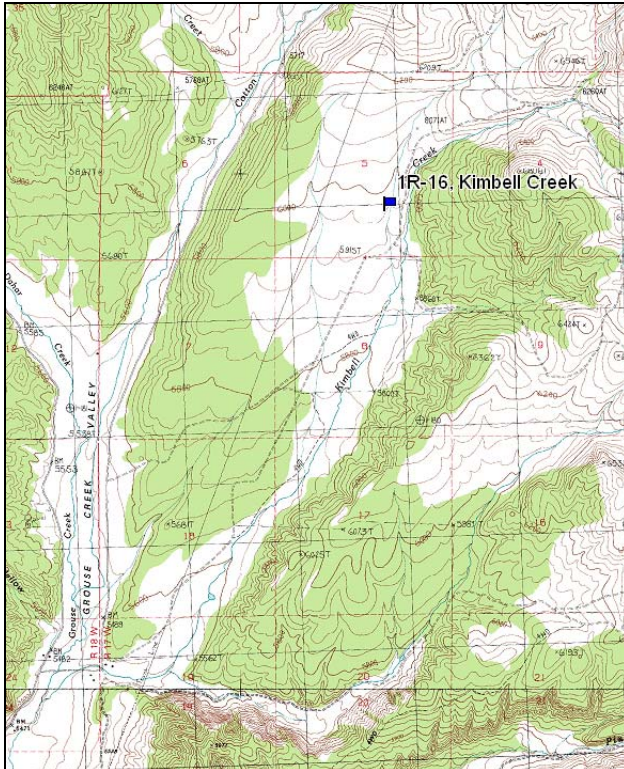
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

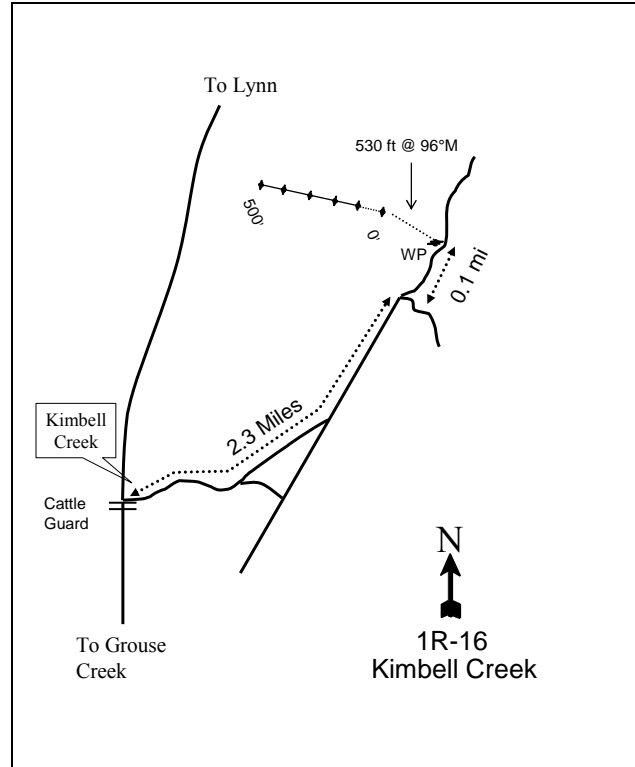
Head north from Grouse Creek to the Kimbell Creek sign and a cattleguard. Turn and continue for 2.3 miles and turn left. Continue 0.1 miles to a witness post on the left. From the witness post continue 530 feet, over a ridge and up a drainage, at 96°M to the 0' stake.

Map Name: Kimbell Creek



Township: 12N Range: 17W Section: 5

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 265795 E 4630153 N

KIMBELL CREEK - WRI STUDY 1R-16

[Project #1739](#)

**Site Description**

Site Information: The study is located on the west side of Kimbell Creek in a pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*) and sagebrush (*Artemisia spp.*) mixed flat. The Kimbell Creek study was established in 2010 prior to the Kimbell Creek Sage Grouse Habitat Enhancement Project. The purpose of this project is to treat 450 acres of pinyon pine, Utah juniper and sagebrush to improve greater sage-grouse brood habitat by bullhog, harrow, mowing and seeding forb species. Most of the area has been fenced to prevent cattle use. The goals are to decrease sagebrush cover to 15-20%, provide diverse age classes of sagebrush, and increase the understory herbaceous cover to minimum of 15% (WRI Database 2011). Pellet group data estimated light use by elk, deer, and cattle in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 01R, Study no: 16

Project Name: Kimble Creek Sage Grouse Habitat Enhancement			
WRI Database #: 1739			
Application: Broadcast Seeder		Acres:	144
Seed type		lbs in mix	lbs/acre
G	Bluebunch Wheatgrass 'Anatone	300	2.08
G	Western Wheatgrass 'Arriba'	300	2.08
F	Alfalfa 'Ladak'	150	1.04
F	Arrowleaf Balsamroot	152	1.06
F	Blue Flax 'Appar'	75	0.52
F	Cicer Milkvetch 'Lutana'	300	2.08
F	Palmer Penstemon	75	0.52
F	Rocky Mountain Beeplant	150	1.04
F	Sainfoin 'Eski'	450	3.13
F	Small Burnet 'Delar'	450	3.13
F	Western Yarrow 'Eagle Mountain'	20	0.14
Total Pounds:		2422	16.82
PLS Pounds:			15.29

Browse: Three species of sagebrush are found on this site; low sagebrush (*Artemisia arbuscula*), Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) and basin big sagebrush (*A. tridentata* ssp. *tridentata*). The low sagebrush population is a relatively young with low decadences and good vigor. Wyoming big sagebrush is comprised of a moderately used, mature population with excellent recruitment of young sagebrush to the population. Basin big sagebrush is a mostly mature population with light use. Poor vigor was low in both the low sagebrush and Wyoming big sagebrush populations, whereas in the basin big sagebrush population poor vigor was high (Table - Browse Characteristics). Sagebrush accounted for the majority of the canopy cover, though Utah juniper cover was moderate (Table - Canopy Cover). The density of Utah juniper was moderate and was found in higher densities closer to the road (Table - Point-Quarter Tree Data).

Herbaceous Understory: Perennial grasses are scarce, with the exception of Sandberg bluegrass (*Poa secunda*), which is common and provides the majority of the grass cover. Cheatgrass (*Bromus tectorum*) is sparse with low frequency and cover. Forbs are fairly diverse, but not overly abundant with a mixture of annual and perennial forbs sampled. The dominant forb is longleaf phlox (*Phlox longifolia*) (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a gravelly loam. Bare ground cover is moderate with a high amount of vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

HERBACEOUS TRENDS--

Management unit 01R, Study no: 16

Type	Species	Nested	Average
		Frequency	Cover %
		'10	'10
G	Agropyron intermedium	61	.38
G	Agropyron spicatum	3	.00
G	Bromus tectorum (a)	69	.62
G	Poa bulbosa	2	.03
G	Poa secunda	334	12.23
G	Sitanion hystrix	26	.45
Total for Annual Grasses		69	0.62
Total for Perennial Grasses		426	13.11
Total for Grasses		495	13.73
F	Agoseris glauca	22	.04
F	Allium sp.	52	.15
F	Alyssum alyssoides (a)	29	.20
F	Arabis sp.	11	.05
F	Astragalus sp.	12	.17
F	Balsamorhiza sagittata	8	.27
F	Chaenactis douglasii	1	.00
F	Comandra pallida	39	.26
F	Cordylanthus sp. (a)	6	.03
F	Cryptantha sp.	8	.06
F	Gilia sp. (a)	20	.05
F	Hedysarum boreale	1	.00
F	Lappula occidentalis (a)	4	.01
F	Lesquerella sp.	3	.03
F	Lupinus argenteus	5	.03
F	Microsteris gracilis (a)	112	.70
F	Penstemon sp.	4	.18
F	Phlox longifolia	131	1.58
F	Polygonum douglasii (a)	6	.01
Total for Annual Forbs		177	1.00
Total for Perennial Forbs		297	2.85
Total for Forbs		474	3.86

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 01R, Study no: 16

Type	Species	Strip Frequency	Average Cover %
		'10	'10
B	Artemisia arbuscula	18	2.79
B	Artemisia tridentata tridentata	20	1.79
B	Artemisia tridentata wyomingensis	72	16.65
B	Chrysothamnus nauseosus	3	.41
B	Chrysothamnus viscidiflorus	62	5.52
B	Juniperus osteosperma	5	5.22
B	Opuntia sp.	13	.45
Total for Browse		193	32.85

CANOPY COVER, LINE INTERCEPT--

Management unit 01R, Study no: 16

Species	Percent Cover
	'10
Artemisia arbuscula	14.64
Artemisia tridentata tridentata	3.04
Artemisia tridentata wyomingensis	10.31
Chrysothamnus viscidiflorus	8.28
Juniperus osteosperma	6.84
Opuntia sp.	.60

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 01R, Study no: 16

Species	Average leader growth (in)
	'10
Artemisia tridentata wyomingensis	1.1

POINT-QUARTER TREE DATA--

Management unit 01R, Study no: 16

Species	Trees per Acre	Average diameter (in)
	'10	'10
Juniperus osteosperma	17	3.8

BASIC COVER--

Management unit 01R, Study no: 16

Cover Type	Average Cover % '10
Vegetation	47.97
Rock	1.29
Pavement	9.83
Litter	39.39
Bare Ground	30.46

PELLET GROUP DATA--

Management unit 01R, Study no: 16

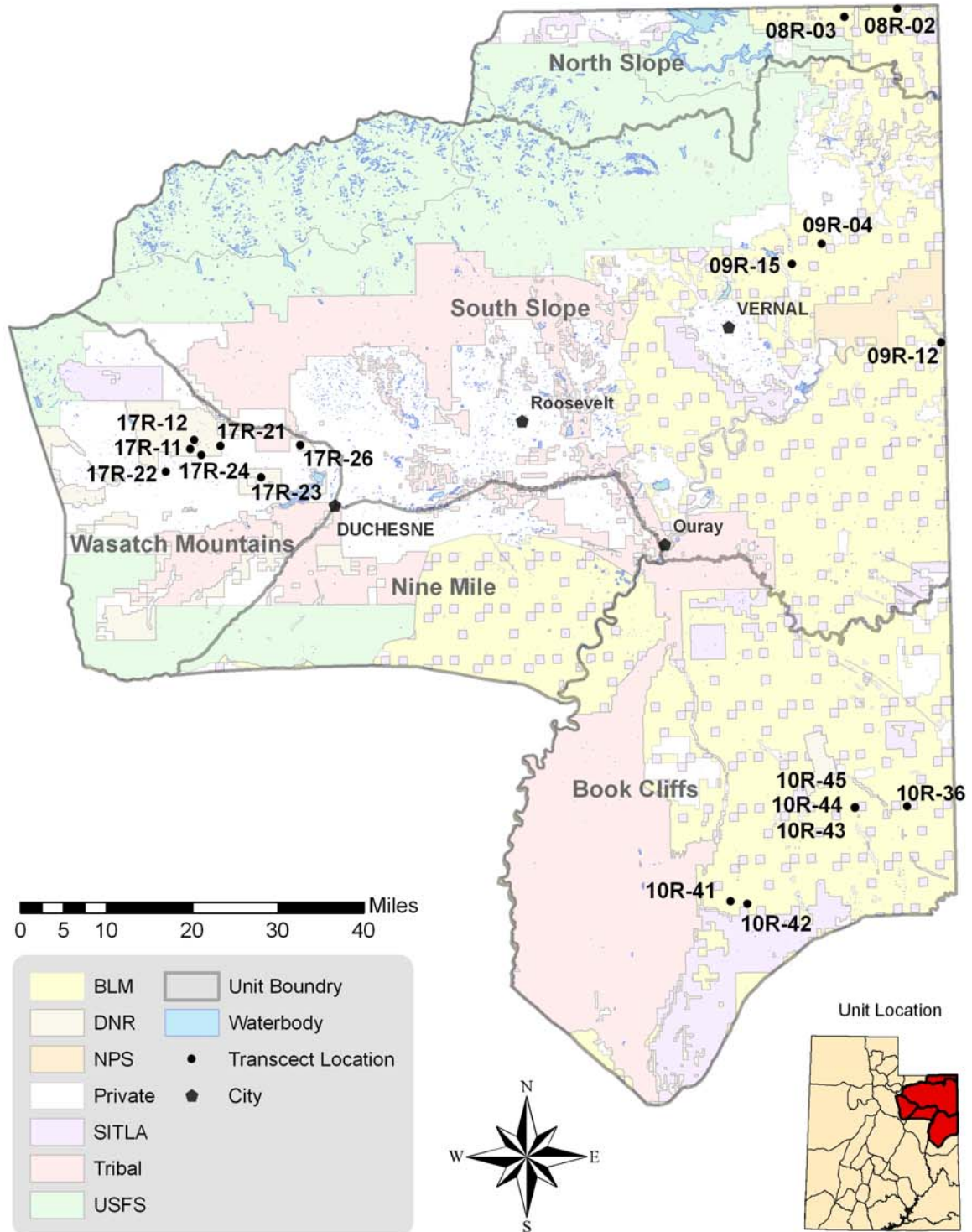
Type	Quadrat Frequency '10	Days use per acre (ha) '10
Elk	-	1 (2)
Deer	-	1 (2)
Cattle	1	6 (14)

BROWSE CHARACTERISTICS--

Management unit 01R, Study no: 16

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<i>Amelanchier utahensis</i>									
10	<b>0</b>	0	0	-	20	0	0	0	34/46
<i>Artemisia arbuscula</i>									
10	<b>2320</b>	59	41	-	300	4	0	9	14/22
<i>Artemisia tridentata tridentata</i>									
10	<b>500</b>	16	72	12	-	8	0	44	35/45
<i>Artemisia tridentata wyomingensis</i>									
10	<b>6160</b>	39	60	1	100	35	0	20	26/32
<i>Chrysothamnus nauseosus</i>									
10	<b>80</b>	0	75	25	-	0	0	25	17/20
<i>Chrysothamnus viscidiflorus</i>									
10	<b>2860</b>	3	94	3	20	0	0	17	12/19
<i>Juniperus osteosperma</i>									
10	<b>100</b>	40	60	-	20	0	0	0	-/-
<i>Opuntia sp.</i>									
10	<b>360</b>	0	100	-	-	0	0	6	5/14
<i>Purshia tridentata</i>									
10	<b>0</b>	0	0	-	-	0	0	0	25/49

# Northeastern Region WRI Studies 2010





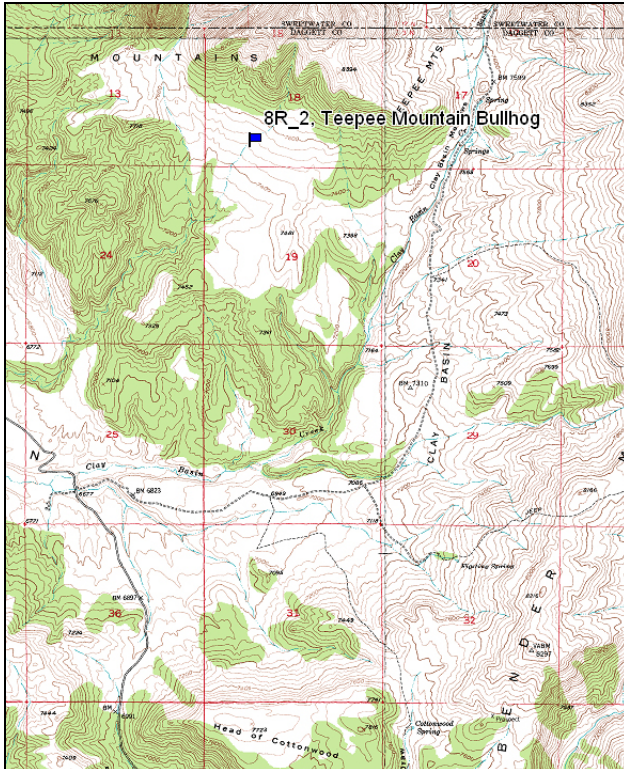
TEEPEE MOUNTAIN BULLHOG - TREND STUDY NO. 8R-2-10  
[Project #692](#)

Vegetation Type: Utah Juniper, Wyoming Big Sagebrush  
Range Type: Crucial Deer Summer, Crucial Elk Winter  
NRCS Ecological Site Description: Shallow Sandy (10-14W), R034XY266WY  
Land Ownership: BLM  
Elevation: 7,500 ft. (2,286 m)  
Aspect: Southwest  
Slope: 10-13%  
Transect bearing: 341° magnetic  
Belt placement: line 1 (11ft & 95 ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)  
Notes: No rebar

Directions:

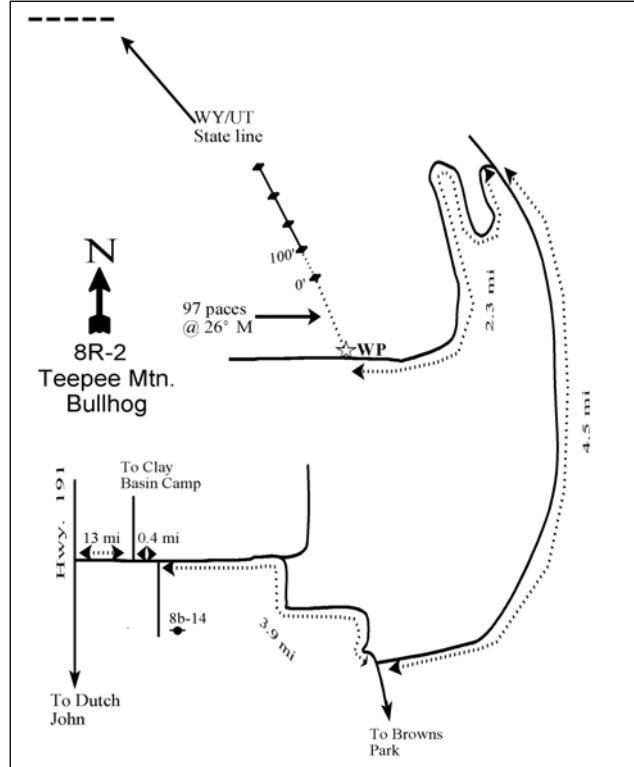
From Dutch John, proceed north toward Antelope Flat on highway U.S. 191. Continue over the state line into Wyoming and turn right just after Minnies Gap onto the Clay Basin road. Drive approximately 13 miles towards Clay Basin to the turn off to Clay Basin Camp. Turn right again and proceed 0.4 miles to the intersection to Clay Basin Bench Site (8B-14). Continue east for 3.9 miles to a road coming in from the left. Turn left here and go 4.5 miles to another road that comes in from the left. Turn left here also and go 2.3 miles to the witness post on the right side of the road. The 0-foot stake is 97 paces at 26 degrees magnetic marked with browse tag #194.

Map Name: Clay Basin



Township: 3N Range: 25E Section: 18

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 656437 E 4539448 N

TEEPEE MOUNTAIN BULLHOG - WRI STUDY 8R-2  
[Project #692](#)

## Site Description

Site Information: The study was established in 2007 to monitor the effects of a habitat improvement project on 535 acres at the base of Teepee Mountain. Encroaching pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) was treated using a bullhog in the summer of 2007. Due to the good herbaceous understory, no seed mix was applied to the treatment. The area serves as wintering habitat for deer and elk, as well as nesting, brood-rearing and wintering habitat for sage-grouse. The treatment occurred within two miles of an active sage-grouse lek (WRI Database 2011). Pellet group data estimated use to be light for elk and cattle in both 2007 and 2010, while deer use was light in 2007 and moderate in 2010 (Table - Pellet Group Data).

Browse: Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) is the dominant preferred browse species. Other preferred species include low sagebrush (*Artemisia arbuscula*) and slenderbush eriogonum (*Eriogonum microthecum*). Poor vigor and decadence of Wyoming big sagebrush has been moderately high over the sample years. At the outset of the study, utilization was moderate to heavy for Wyoming big sagebrush and light for low sagebrush, but has been mostly moderate for both species since then. Utah juniper (*Juniperus osteosperma*) density was greatly decreased following treatment in 2007 (Table - Browse Characteristics).

Herbaceous Understory: The herbaceous understory is well developed and the grasses are diverse. Eight perennial grass species were sampled in 2007, while nine were sampled in 2010. Cheatgrass (*Bromus tectorum*) was the only annual grass sampled, but has increased in prevalence on the site. Dominant species include bluebunch wheatgrass (*Agropyron spicatum*), prairie junegrass (*Koeleria cristata*) and Sandberg bluegrass (*Poa secunda*). Forbs are dominated by arrowleaf balsamroot (*Balsamorhiza sagittata*) and timber poisonvetch (*Astragalus convallarius*), but the composition of forbs is very diverse with at several species sampled each year (Table - Herbaceous Trends).

Soil: The soil texture is a sandy loam with a neutral soil reaction (pH 6.9) (Table - Soil Analysis Data). Bare ground cover is low with a high amount of vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2007 due to slight surface soil movement with the presence of rills and gullies, and in 2010 it was classified as stable.

## Pre vs. Three Years Post Treatment, 2007 vs. 2010

Browse: Wyoming big sagebrush cover changed very little, while sagebrush density declined 29% from 1,640 plants/acre to 1,160 plants/acre. The recruitment of young plants increased from 5% to 12%. Mature plants comprised 69% of the population and decadence decreased from 46% to 19%. Low sagebrush density decreased 65% from 1,620 plants/acre to 560 plants/acre. Slenderbush eriogonum density decreased 56% to 2,040 plants/acre. Utah juniper density was effectively reduced from 132 trees/acre with an average diameter of 4.7 inches to 38 trees/acre with a diameter of 1.6 inches. Of the live trees sampled, 50% of them had been shredded during the treatment or otherwise affected by the treatment but still had green growth.

Grasses: Bluebunch wheatgrass had a significant decrease in nested frequency, while cover decreased slightly from 7% to 6%. Prairie junegrass cover increased from 1% in 2007 to 5% in 2010, while the nested frequency doubled. Sandberg bluegrass had a significant decrease in nested frequency and cover decreased from 8% to 4% over the same period. Overall, the sum of nested frequency of perennial grasses decreased 13% pre-treatment to post-treatment, but cover increased from 19% to 22%.

Forbs: Arrowleaf balsamroot increased in cover from 8% to 10%, while the nested frequency decreased significantly. Timber poisonvetch nested frequency remained similar, though cover decreased from 4% to 3%.

Overall, forb cover remained constant at 14%, but the sum of nested frequency of perennial forbs decreased 35%.

HERBACEOUS TRENDS--

Management unit 08R, Study no: 2

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron intermedium	a <sup>3</sup>	b <sup>40</sup>	.03	1.71
G	Agropyron smithii	a <sup>-</sup>	b <sup>26</sup>	-	1.15
G	Agropyron spicatum	b <sup>213</sup>	a <sup>117</sup>	6.96	6.29
G	Bromus tectorum (a)	a <sup>36</sup>	b <sup>69</sup>	.42	2.24
G	Carex sp.	-	5	.00	.04
G	Koeleria cristata	a <sup>61</sup>	b <sup>124</sup>	1.03	4.73
G	Oryzopsis hymenoides	b <sup>16</sup>	a <sup>3</sup>	.42	.03
G	Poa fendleriana	b <sup>53</sup>	a <sup>31</sup>	1.24	.87
G	Poa secunda	b <sup>252</sup>	a <sup>159</sup>	7.61	4.07
G	Sitanion hystrix	2	-	.01	-
G	Stipa comata	74	81	1.65	3.22
Total for Annual Grasses		36	69	0.42	2.24
Total for Perennial Grasses		674	586	18.98	22.14
Total for Grasses		710	655	19.41	24.38
F	Agoseris glauca	b <sup>12</sup>	a <sup>-</sup>	.06	-
F	Antennaria rosea	3	-	.00	-
F	Arabis sp.	b <sup>14</sup>	a <sup>-</sup>	.07	-
F	Aster sp.	-	2	-	.03
F	Astragalus convallarius	62	69	3.48	2.53
F	Astragalus sp.	-	3	-	.03
F	Balsamorhiza sagittata	b <sup>93</sup>	a <sup>70</sup>	7.87	9.57
F	Calochortus nuttallii	b <sup>18</sup>	a <sup>6</sup>	.04	.03
F	Castilleja flava	3	3	.00	.01
F	Chenopodium album (a)	4	-	.03	-
F	Collinsia parviflora (a)	b <sup>37</sup>	a <sup>-</sup>	.07	-
F	Comandra pallida	23	32	.48	.81
F	Crepis acuminata	5	-	.06	.00
F	Cryptantha sp.	17	8	.12	.10
F	Cymopterus sp.	b <sup>16</sup>	a <sup>-</sup>	.11	-
F	Delphinium nuttallianum	1	-	.00	-
F	Descurainia pinnata (a)	8	-	.02	-
F	Draba sp. (a)	7	-	.01	-
F	Erigeron pumilus	-	5	-	.06
F	Erigeron sp.	5	11	.04	.33
F	Gayophytum ramosissimum(a)	3	-	.00	-
F	Haplopappus acaulis	b <sup>17</sup>	a <sup>-</sup>	.22	-
F	Ipomopsis aggregata	12	4	.10	.04
F	Lactuca serriola (a)	-	1	-	.00
F	Lappula occidentalis (a)	3	-	.01	-
F	Lesquerella sp.	1	-	.00	-
F	Lomatium triternatum	6	1	.04	.00

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
F	<i>Machaeranthera grindelioides</i>	-	3	.00	.06
F	<i>Mertensia</i> sp.	-	5	-	.18
F	<i>Microsteris gracilis</i> (a)	<sub>b</sub> 120	<sub>a</sub> 3	.37	.00
F	<i>Penstemon humilis</i>	5	4	.03	.03
F	<i>Penstemon</i> sp.	6	-	.21	-
F	<i>Petradoria pumila</i>	4	6	.30	.03
F	<i>Phlox hoodii</i>	<sub>b</sub> 46	<sub>a</sub> 17	.35	.22
F	<i>Phlox longifolia</i>	<sub>b</sub> 22	<sub>a</sub> 6	.05	.07
F	<i>Tragopogon dubius</i> (a)	2	-	.00	.03
Total for Annual Forbs		184	4	0.52	0.03
Total for Perennial Forbs		391	255	13.69	14.17
Total for Forbs		575	259	14.22	14.21

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 08R, Study no: 2

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	<i>Artemisia arbuscula</i>	24	16	1.41	1.33
B	<i>Artemisia tridentata wyomingensis</i>	59	43	4.72	4.88
B	<i>Ceratoides lanata</i>	2	2	.03	.03
B	<i>Cercocarpus montanus</i>	0	1	.03	.15
B	<i>Chrysothamnus nauseosus</i>	3	3	.15	.38
B	<i>Chrysothamnus viscidiflorus viscidiflorus</i>	40	35	2.23	2.07
B	<i>Eriogonum microthecum</i>	56	44	2.12	1.50
B	<i>Gutierrezia sarothrae</i>	1	0	.03	-
B	<i>Juniperus osteosperma</i>	5	1	5.55	-
B	<i>Leptodactylon pungens</i>	8	8	.45	.16
B	<i>Opuntia</i> sp.	2	1	.00	.03
B	<i>Pediocactus simpsonii</i>	5	4	.12	.03
B	<i>Tetradymia canescens</i>	0	1	-	.03
B	<i>Tetradymia canescens</i>	2	3	-	-
Total for Browse		207	162	16.85	10.62

CANOPY COVER, LINE INTERCEPT--

Management unit 08R, Study no: 2

Species	Percent Cover	
	'07	'10
Artemisia arbuscula	2.68	2.54
Artemisia tridentata wyomingensis	8.86	7.61
Ceratoides lanata	.25	-
Chrysothamnus nauseosus	.26	.70
Chrysothamnus viscidiflorus viscidiflorus	.45	1.79
Eriogonum microthecum	2.13	2.25
Juniperus osteosperma	10.89	-
Leptodactylon pungens	.08	.05
Tetradymia canescens	-	.13

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 08R, Study no: 2

Species	Average leader growth (in)	
	'07	'10
Artemisia arbuscula	0.6	0.4
Artemisia tridentata wyomingensis	1.1	1.4

POINT-QUARTER TREE DATA--

Management unit 08R, Study no: 2

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	132	38	4.7	1.6

BASIC COVER--

Management unit 08R, Study no: 2

Cover Type	Average Cover %	
	'07	'10
Vegetation	45.26	50.90
Rock	3.47	2.54
Pavement	3.39	1.80
Litter	29.85	59.55
Cryptogams	5.68	2.90
Bare Ground	26.84	12.30

SOIL ANALYSIS DATA --

Management unit 8R, Study no: 2, Study Name: Teepee Mountain Bullhog

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	6.9	63.2	23.4	13.4	1.9	35.3	140.8	0.6

PELLET GROUP DATA--

Management unit 08R, Study no: 2

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	34	-	-	-
Horse	-	-	1 (3)	-
Elk	4	-	10 (25)	3 (7)
Deer	7	2	17 (41)	11 (26)
Cattle	15	2	17 (41)	4 (9)

BROWSE CHARACTERISTICS--

Management unit 08R, Study no: 2

Y e a r	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Amelanchier alnifolia</i>									
07	<b>0</b>	0	0	-	-	0	0	0	31/44
10	<b>0</b>	0	0	-	-	0	0	0	16/30
<i>Artemisia arbuscula</i>									
07	<b>1620</b>	5	73	22	160	10	2	2	11/19
10	<b>560</b>	4	96	0	20	61	0	0	7/15
<i>Artemisia tridentata wyomingensis</i>									
07	<b>1640</b>	5	49	46	60	24	33	35	24/37
10	<b>1160</b>	12	69	19	160	52	9	22	24/36
<i>Ceratoides lanata</i>									
07	<b>40</b>	0	100	-	-	0	50	0	5/10
10	<b>40</b>	0	100	-	-	50	0	0	6/8
<i>Cercocarpus montanus</i>									
07	<b>0</b>	0	0	-	-	0	0	0	26/34
10	<b>20</b>	0	100	-	-	100	0	0	32/35
<i>Chrysothamnus nauseosus</i>									
07	<b>60</b>	0	100	-	-	0	0	0	25/28
10	<b>60</b>	0	100	-	-	0	0	0	24/27
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
07	<b>1460</b>	4	92	4	-	3	0	4	9/14
10	<b>1180</b>	10	88	2	-	5	0	2	13/17

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Eriogonum microthecum</i>									
07	<b>4680</b>	6	92	2	60	15	.85	2	7/10
10	<b>2040</b>	5	90	5	-	29	5	0	8/10
<i>Gutierrezia sarothrae</i>									
07	<b>20</b>	0	100	-	-	0	0	0	8/8
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Juniperus osteosperma</i>									
07	<b>120</b>	50	50	-	60	0	0	0	-/-
10	<b>20</b>	100	0	-	20	0	0	0	-/-
<i>Leptodactylon pungens</i>									
07	<b>200</b>	0	80	20	-	0	0	20	6/13
10	<b>200</b>	0	100	0	-	0	0	40	9/14
<i>Opuntia sp.</i>									
07	<b>80</b>	0	25	75	-	0	0	0	3/6
10	<b>20</b>	0	100	0	-	0	0	0	3/14
<i>Pediocactus simpsonii</i>									
07	<b>160</b>	0	100	-	-	0	0	0	1/3
10	<b>100</b>	0	100	-	-	0	0	0	2/3
<i>Purshia tridentata</i>									
07	<b>0</b>	0	0	-	-	0	0	0	6/11
10	<b>20</b>	0	100	-	-	0	0	0	17/38
<i>Tetradymia canescens</i>									
07	<b>40</b>	50	50	-	-	100	0	0	9/15
10	<b>60</b>	0	100	-	-	0	0	0	10/13

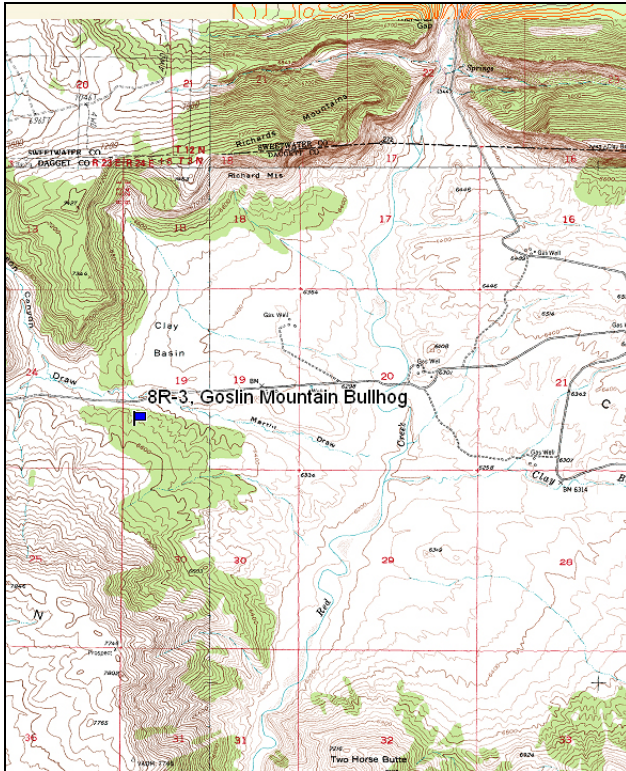
GOSLIN MOUNTAIN BULLHOG - TREND STUDY NO. 8R-3-10  
[Project #1090](#)

Vegetation Type: Pinyon/Juniper, Black Sagebrush  
Range Type: Crucial Deer Winter, Crucial Elk Winter  
NRCS Ecological Site Description: [Upland Shallow Loam \(Pinyon-Utah Juniper\), R047XB326UT](#)  
Land Ownership: BLM  
Elevation: 6,490 ft. (1,978 m)  
Aspect: North  
Slope: 8-10%  
Transect bearing: 165° magnetic  
Belt placement: line 1 (11ft & 95 ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)  
Notes: No rebar

Directions:

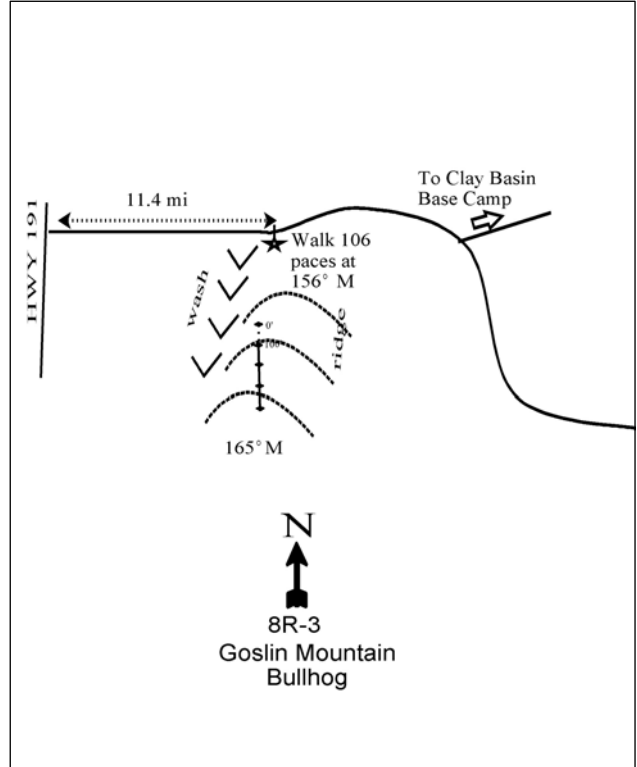
From Dutch John, proceed north towards Antelope Flat on Highway U.S. 191 for approximately 8 miles. Before the Wyoming border, turn east on the Antelope Flat Road. Drive on this road for 11.4 miles. There is a half high witness post on the right side of the road. The 0' stake is 106 paces from the half-high witness post at 156° M.

Map Name: Goslin Mountain



Township: 3N Range: 24E Section: 19

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 646493 E 4537899 N



GOSLIN MOUNTAIN BULLHOG - WRI STUDY 8R-3

[Project #1090](#)

**Site Description**

Site Information: The study was established in 2008 prior to a bullhog treatment to remove encroaching pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands from 300 acres of sagebrush flats at the base of Goslin Mountain. The project area was aerial seeded in the fall of 2008 prior to the bullhog treatment. The project was completed in the spring of 2009. The project objectives were designed to improve winter range for deer and elk and brood rearing grounds for sage-grouse (WRI Database 2011). Pellet group data estimated light use by elk, cattle and deer in 2008 and 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 08R, Study no: 3

Project Name: Goslin Bullhog Phase 2			
WRI Database #: 1090			
Application: Aerial Seed		Acres:	300
Seed type		lbs in mix	lbs/acre
G	Big Bluegrass 'Sherman'	75	0.25
G	Bluebunch WG 'Anatone'	150	0.50
G	Bottlebrush Squirreltail 'Toe Jam'	150	0.50
G	Indian Ricegrass 'Rimrock'	300	1.00
G	Orchardgrass 'Paiute'	150	0.50
G	Sandberg Bluegrass--Toole MT	75	0.25
G	Snake River Wheatgrass 'Secar'	300	1.00
G	Thickspike Wheatgrass 'Critana'	150	0.50
F	Alfalfa 'Ladak'	300	1.00
F	Alfalfa 'Ranger'	300	1.00
F	Sainfoin 'Eski'	1190	3.97
F	Small Burnet 'Delar'	1200	4.00
B	Sagebrush, Wyoming	150	0.50
Total Pounds:		4490	14.97
PLS Pounds:			12.80

Browse: Prior to treatment, Utah juniper was the dominant woody species. Following treatment, black sagebrush (*Artemisia nova*), mountain big sagebrush (*A. tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*) are the dominant species and provide the majority of the canopy cover (Table - Canopy Cover). Black sagebrush is a mature population with light utilization, good vigor and low decadence. The recruitment of young black sagebrush has been good since 2008, while recruitment of young Wyoming big sagebrush and antelope bitterbrush was poor prior to treatment but was good in 2010. Utilization of antelope bitterbrush and Wyoming big sagebrush was moderate to heavy in 2008 but was light in 2010 (Table - Browse Characteristics).

Herbaceous Understory: Perennial grasses are diverse and abundant. The dominant species are prairie junegrass (*Koeleria cristata*), Indian ricegrass (*Oryzopsis hymenoides*), bottlebrush squirreltail (*Sitanion hystrix*) and western wheatgrass (*Agropyron smithii*). Mutton bluegrass (*Poa fendleriana*) and Sandberg bluegrass (*P. secunda*) were the dominant grasses at the outset of the study, but have since decreased in nested frequency and cover. At least ten grass species were sampled in each year, and no annual species have been sampled. Forbs are diverse, but only one species, rock goldenrod (*Petradoria pumila*), in each sample year provided 1% cover or more (Table - Herbaceous Trends).

Soil: The soil texture is a sandy loam with a slightly acidic reaction (pH 6.1). Phosphorus may have limited availability for plant growth and development at 4.4 ppm (Tiedemann and Lopez 2004) (Table - Soil Analysis Data). Bare ground cover was moderate before the treatment, but since the treatment bare ground cover is low with a high amount of vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2008 and 2010.

**Pre vs. Two Years Post Treatment, 2008 vs. 2010**

Browse: Black sagebrush density decreased 15% from 1,880 plants/acre to 1,600 plants/acre while the recruitment of young plants increased from 12% to 15%. The decadence of plants decreased from 43% to 8%. Cover remained similar at 3%. Mountain big sagebrush density increased three-fold from 300 plants/acre to 880 plants/acre. The recruitment of young plants increased from 0% to 48% of the population, while decadence decreased from 80% to 2%. Cover increased from 1% to 2%. Antelope bitterbrush density increased 16% from 380 plants/acre to 440 plants/acre, while the recruitment of young increased from 5% to 18% and decadence decreased from 37% to 5%. Bitterbrush cover increased from 1% to 3%.

Grasses: The sum of nested frequency of perennial grasses has changed little since the treatment, though cover increased from 10% to 17%. Prairie junegrass, western wheatgrass, Indian ricegrass and bottlebrush squirreltail have increased greatly in cover. Mutton bluegrass and Sandberg bluegrass cover each decreased from 3% to less than 1%.

Forbs: The sum of nested frequency of perennial forbs remained similar between the two sample years. Only two species have provided over 1% cover in each sample, but the diversity of species is good and annual species are rare. Small burnet (*Sanguisorba minor*) was the only seeded forb that was sampled in 2010, though cover was less than 1% and frequency was low. Perennial forb cover increased from 3% to 5%.

HERBACEOUS TRENDS--  
Management unit 08R, Study no: 3

Type	Species	Nested Frequency		Average Cover %	
		'08	'10	'08	'10
G	Agropyron intermedium	-	3	-	.18
G	Agropyron smithii	22	48	.10	2.04
G	Agropyron spicatum	20	17	.66	.57
G	Carex sp.	43	30	.88	1.02
G	Dactylis glomerata	-	5	-	.18
G	Koeleria cristata	<sub>a</sub> 32	<sub>b</sub> 107	.88	5.21
G	Oryzopsis hymenoides	33	29	1.01	2.70
G	Poa fendleriana	<sub>b</sub> 74	<sub>a</sub> 21	2.58	.84
G	Poa secunda	<sub>b</sub> 98	<sub>a</sub> 14	2.77	.51
G	Sitanion hystrix	<sub>a</sub> 26	<sub>b</sub> 52	.39	2.14
G	Stipa comata	3	15	.16	.81
G	Stipa lettermani	23	11	.51	.27
Total for Annual Grasses		0	0	0	0
Total for Perennial Grasses		374	352	9.98	16.52
Total for Grasses		374	352	9.98	16.52
F	Agoseris glauca	5	-	.01	-
F	Antennaria rosea	12	22	.05	.48
F	Arabis sp.	5	-	.01	-
F	Astragalus convallarius	<sub>b</sub> 16	<sub>a</sub> 6	.06	.03

Type	Species	Nested Frequency		Average Cover %	
		'08	'10	'08	'10
F	Astragalus sp.	4	2	.03	.00
F	Astragalus sp.	2	3	.00	.09
F	Chenopodium fremontii (a)	-	5	-	.01
F	Collinsia parviflora (a)	2	-	.00	-
F	Cryptantha sp.	26	28	.21	.73
F	Cymopterus sp.	7	-	.02	-
F	Descurainia pinnata (a)	8	1	.17	.01
F	Epilobium sp.	3	-	.00	-
F	Erigeron sp.	8	10	.04	.25
F	Gayophytum ramosissimum(a)	-	2	-	.03
F	Heterotheca villosa	-	1	-	.03
F	Ipomopsis aggregata	19	31	.12	1.07
F	Machaeranthera canescens	<sub>a</sub> 2	<sub>b</sub> 19	.15	.24
F	Penstemon sp.	6	2	.30	.06
F	Petradoria pumila	43	38	1.38	.94
F	Phlox austromontana	<sub>b</sub> 13	<sub>a</sub> 5	.11	.00
F	Phlox longifolia	2	10	.00	.01
F	Polygonum douglasii (a)	4	4	.00	.01
F	Sanguisorba minor	<sub>a</sub> -	<sub>b</sub> 13	-	.51
F	Senecio multilobatus	6	12	.18	.09
F	Trifolium sp.	7	1	.02	.03
Total for Annual Forbs		14	12	0.17	0.06
Total for Perennial Forbs		186	203	2.74	4.63
Total for Forbs		200	215	2.92	4.69

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 08R, Study no: 3

Type	Species	Strip Frequency		Average Cover %	
		'08	'10	'08	'10
B	Amelanchier utahensis	1	0	-	-
B	Artemisia nova	46	42	2.95	2.12
B	Artemisia tridentata vaseyana	13	29	.33	2.09
B	Chrysothamnus viscidiflorus viscidiflorus	1	2	-	-
B	Eriogonum microthecum	17	7	.37	.36
B	Juniperus osteosperma	24	5	6.30	.30
B	Leptodactylon pungens	2	2	-	.15
B	Opuntia sp.	8	9	.45	.33
B	Purshia tridentata	14	18	.75	2.01
B	Symphoricarpos oreophilus	2	1	-	.15
Total for Browse		128	115	11.16	7.53

CANOPY COVER, LINE INTERCEPT--

Management unit 08R, Study no: 3

Species	Percent Cover	
	'08	'10
Artemisia nova	2.45	2.93
Artemisia tridentata vaseyana	.48	2.09
Chrysothamnus viscidiflorus viscidiflorus	-	.30
Eriogonum microthecum	.28	.33
Juniperus osteosperma	18.14	.35
Opuntia sp.	.05	.01
Purshia tridentata	1.08	2.78

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 08R, Study no: 3

Species	Average leader growth (in)	
	'08	'10
Artemisia nova	0.7	-
Artemisia tridentata vaseyana	0.9	3.9
Purshia tridentata	0.7	6.9

POINT-QUARTER TREE DATA--

Management unit 08R, Study no: 3

Species	Trees per Acre		Average diameter (in)	
	'08	'10	'08	'10
Juniperus osteosperma	431	110	17.5	2.2
Pinus edulis	20	20	0.4	0.8

BASIC COVER--

Management unit 08R, Study no: 3

Cover Type	Average Cover %	
	'08	'10
Vegetation	23.11	29.91
Rock	.78	.03
Pavement	8.16	1.10
Litter	49.88	68.13
Cryptogams	7.00	.23
Bare Ground	26.85	16.19

SOIL ANALYSIS DATA --

Management unit 8R, Study no: 3, Study Name: Goslin Mountain Bullhog

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
6.1		69.0	11.4	19.6	1.3	4.4	64.0	1.1

PELLET GROUP DATA--

Management unit 08R, Study no: 3

Type	Quadrat Frequency		Days use per acre (ha)	
	'08	'10	'08	'10
Rabbit	56	1	-	-
Elk	4	3	6 (15)	-
Deer	18	3	23 (56)	14 (35)
Cattle	-	-	7 (18)	2 (5)

BROWSE CHARACTERISTICS--

Management unit 08R, Study no: 3

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Amelanchier utahensis</i>									
08	<b>20</b>	100	0	-	-	0	100	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Artemisia nova</i>									
08	<b>1880</b>	12	46	43	160	12	1	28	11/18
10	<b>1600</b>	35	58	8	2320	1	0	4	10/19
<i>Artemisia tridentata vaseyana</i>									
08	<b>300</b>	0	20	80	20	13	67	60	17/24
10	<b>880</b>	48	50	2	1180	0	0	2	21/30
<i>Cercocarpus montanus</i>									
08	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	26/38
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
08	<b>20</b>	0	100	-	-	0	0	0	8/7
10	<b>40</b>	100	0	-	-	0	0	0	11/15
<i>Eriogonum microthecum</i>									
08	<b>660</b>	6	91	3	20	21	18	3	6/7
10	<b>180</b>	11	89	0	-	0	0	0	8/15
<i>Juniperus osteosperma</i>									
08	<b>540</b>	30	56	15	20	0	0	7	-/-
10	<b>120</b>	100	0	0	80	0	0	33	-/-
<i>Leptodactylon pungens</i>									
08	<b>60</b>	0	0	100	-	0	0	33	4/6
10	<b>40</b>	0	100	0	-	0	0	0	8/14
<i>Opuntia sp.</i>									
08	<b>340</b>	6	47	47	-	0	0	41	4/15
10	<b>320</b>	0	100	0	-	0	0	0	4/13
<i>Pediocactus simpsonii</i>									
08	<b>0</b>	0	0	-	-	0	0	0	2/3
10	<b>0</b>	0	0	-	-	0	0	0	2/2

		Age class distribution						Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)		
Purshia tridentata											
08	<b>380</b>	5	58	37	-	47	11	16	12/32		
10	<b>440</b>	18	77	5	20	36	0	0	18/40		
Symphoricarpos oreophilus											
08	<b>40</b>	0	100	-	-	50	0	0	11/17		
10	<b>20</b>	0	100	-	-	0	0	0	15/40		

DIAMOND MOUNTAIN BULLHOG - TREND STUDY NO. 9R-4-10

Vegetation Type: Utah Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Semidesert Stony Loam (Utah Juniper-Pinyon), R034XY247UT

Land Ownership: BLM

Elevation: 6,945 ft. (2,117 m)

Aspect: South

Slope: 12-14%

Transect bearing: 209° magnetic

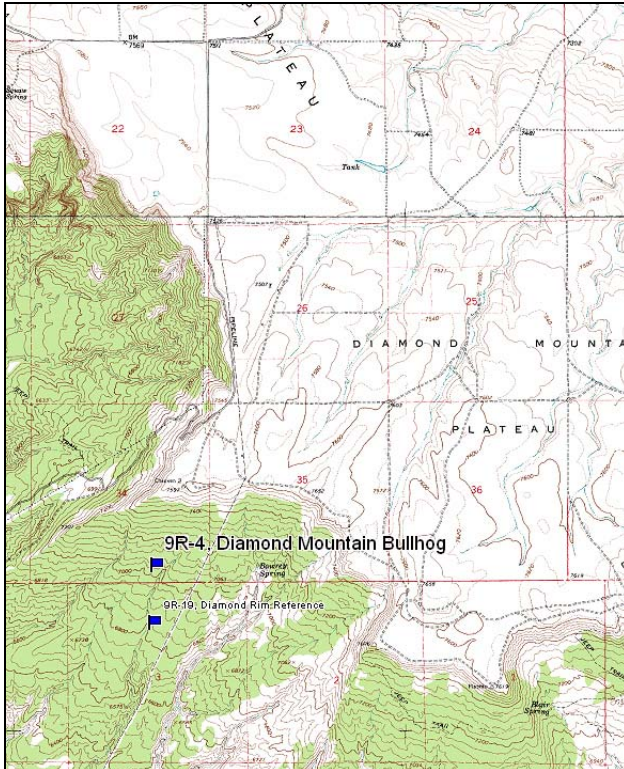
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95ft)

Notes: No rebar

Directions:

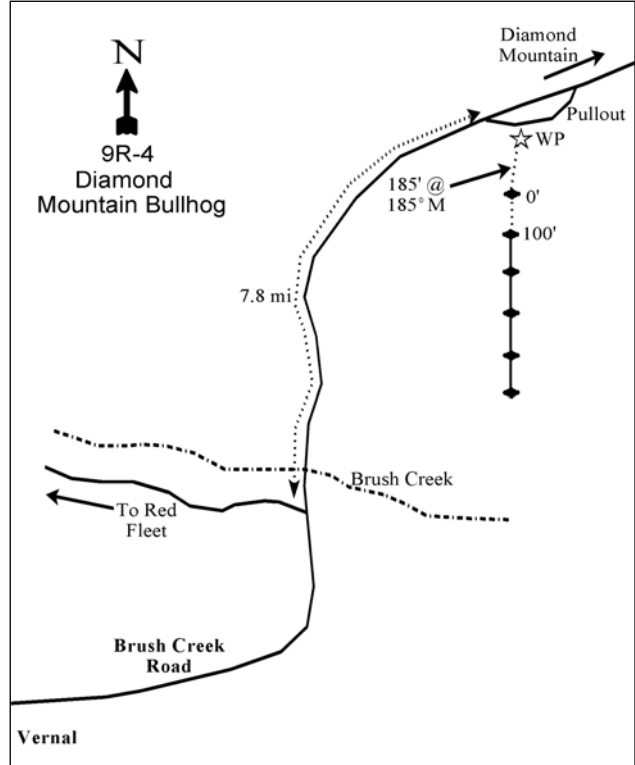
From Vernal travel northeast on Brush Creek Road heading toward Diamond Mountain for 7.8 miles to a pull off on the right. Turn here. There is a witness post on the south side of the pull off. The 0-foot stake is 185 feet from the witness post at 185°M and is marked with browse tag # 133.

Map Name: Jensen Ridge



Township: 23E Range: 2S Section: 34

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 642204 E 4495283 N

DIAMOND MOUNTAIN BULLHOG - WRI STUDY 9R-4

**Site Description**

Site Information: The Diamond Mountain Bullhog study was established in June of 2004 prior to treatment later that September. The BLM treated 320 acres of mature Utah juniper (*Juniperus osteosperma*) woodland in a fuels reduction project near the Diamond Mountain rim northeast of Vernal. The DWR provided a seed mix of grasses, forbs and shrubs for the project. Grasses, forbs and fourwing saltbush (*Atriplex canescens*) seed was flown on prior to the bullhog treatment. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) seed was applied following treatment (late November). Pellet group data estimated light deer and cow use in all sample years. Elk use was light in 2004 and 2010, and moderate in 2007 and 2009 (Table - Pellet Group Data).

SEED MIX--

Management unit 09R, Study no: 4

Project Name: Diamond Rim Bullhog					
WRI Database #: 1090					
Application: Aerial Seed		Acres: 320		Application: Aerial Seed	
Seed type		lbs in mix	lbs/acre	Seed type	
G	Orchardgrass 'Paiute'	650	2.03	B	Sagebrush, Wyoming
G	Western Wheatgrass 'Arriba'	650	2.03	Total Pounds:	
G	Sandberg Bluegrass	150	0.47	320	
F	Yellow Sweetclover	300	0.94	1.00	
F	Alfalfa 'Ladak+'	650	2.03	PLS Pounds:	
F	Sainfoin	350	1.09	0.28	
F	Blue Flax 'Appar'	300	0.94		
F	Small Burnet 'Delar'	650	2.03		
B	Fourwing Saltbush	150	0.47		
Total Pounds:		3850	12.03		
PLS Pounds:			10.74		

Browse: Wyoming big sagebrush and black sagebrush (*Artemisia nova*) are the dominant preferred browse species. Prior to the bullhog treatment, Utah juniper dominated the site providing the majority of the cover and other browse species were rare. Wyoming big sagebrush and fourwing saltbush were established on the site with the seed mix applied in 2004. The Wyoming big sagebrush population has responded well to the treatment and provided the majority of the canopy cover in 2010 (Table - Canopy Cover). Utilization of browse species has been light since the outset of the study, though use of antelope bitterbrush (*Purshia tridentata*) has been heavy in all sample years. Poor vigor and decadence of sagebrush have been mainly good over the sample years, and recruitment of young to the population has been excellent through out the sample years. However, recruitment of black sagebrush was low in 2007 (Table - Browse Characteristics).

Herbaceous Understory: Prior to treatment in 2004, the herbaceous understory was sparse. Cheatgrass (*Bromus tectorum*) was the most common grass species and provided the most cover. In 2007, following the treatment, cheatgrass cover increased significantly, but since then has decreased to near pretreatment levels. Perennial grasses increased in cover and frequency following the treatment. Bottlebrush squirreltail (*Sitanion hystrix*) is the dominant perennial species increasing substantially in frequency and cover following the treatment. The seeded species western wheatgrass (*Agropyron smithii*), orchardgrass (*Dactylis glomerata*), and Sandberg bluegrass (*Poa secunda*) were sampled following the treatment, but are not abundant on the site. Forb cover has increased overall since 2004, although seeded forbs have provided little cover in each sample year (Table - Herbaceous Trends).



Soil: The soil texture is a sandy loam with a neutral soil reaction (pH 6.6) (Table - Soil Analysis Data). Bare ground cover is low with a moderate amount of vegetation and high amount litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### **Pre vs. Three Years Post Treatment, 2004 vs. 2007**

Browse: Following treatment, the preferred browse component improved with the introduction and establishment of Wyoming big sagebrush and the removal of Utah juniper. Utah juniper dominated the site in 2004, prior to treatment, with canopy cover at 39%. Juniper density was also very high at 444 trees/acre. Juniper cover was reduced to 0% after the treatment and density decreased to less than 18 trees/acre. Wyoming big sagebrush provided 2% canopy cover, and black sagebrush canopy cover increased from 2% to 3%.

Grass: The sum of nested frequency of perennial grasses increased 89%, while cover increased to 9% from less than 1%. Western wheatgrass and orchardgrass were seeded species that were sampled following the seeding at low frequency and cover. Crested wheatgrass (*Agropyron cristatum*) was not sampled prior to the treatment and was not seeded with the treatment, but was sampled at low frequency and cover following the treatment. Bottlebrush squirreltail increased significantly in nested frequency and increased from less than 1% cover prior to treatment to 7% cover afterwards. Cheatgrass followed a similar pattern with a significant increase in nested frequency and increased from 1% cover to 14%.

Forb: The sum of nested frequency of perennial forbs increased 64% and cover increased from 1% to 6%. Seeded species sampled included Lewis flax (*Linum lewisii*), alfalfa (*Medicago sativa*), sainfoin (*Onobrychis viciaefolia*) and small burnet (*Sanguisorba minor*). Only Lewis flax provided close to 1% cover.

### **Trend Assessments**

#### Browse

- **2007 to 2009 - up (+2)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Preferred browse species, black sagebrush and Wyoming big sagebrush, continued to increase in canopy cover from 3% to 6% and from 2% to 4%, respectively.
- **2009 to 2010 - stable (0)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Black sagebrush canopy cover decreased from 6% to 4% while Wyoming big sagebrush cover increased slightly to 5%. The recruitment of young black sagebrush increased from 6% in 2007 to 49% in 2010 and Wyoming big sagebrush recruitment increased from 36% in 2007 to 57% of the population in 2010. Decadent plants comprise 1% or less of each population.

#### Grass

- **2007 to 2009 - up (+2)**: The nested frequency of perennial grasses increased 29%, though cover decreased slightly from 9% to 7%. Cheatgrass declined significantly in nested frequency and decreased from 14% to 5% cover. Western wheatgrass and crested wheatgrass increased significantly in nested frequency. None of the seeded species provide more than 1% cover, and bottlebrush squirreltail decreased from 7% to 4% cover.
- **2009 to 2010 - slightly up (+1)**: The sum of nested frequency of perennial grasses increased 14% while cover remained similar at 8%. No single perennial grass species had a significant increase in nested frequency, and only bottlebrush squirreltail provided notable cover at 5%. Cheatgrass had a significant decrease in nested frequency and cover decreased from 5% to 2%.

#### Forb

- **2007 to 2009 - down (-2)**: The sum of nested frequency of perennial forbs decreased 26% and cover decreased to 4%. Lewis flax continued to be the most predominant seeded species with 1% cover.

- **2009 to 2010 - up (+2):** The sum of nested frequency of perennial forbs increased 67% and cover increased from 4% to 7%. Timber poisonvetch (*Astragalus convallarius*) was the most common forb and provides nearly 3% cover. No seeded species provided more than 1% cover.

HERBACEOUS TRENDS--  
Management unit 09R, Study no: 4

Type	Species	Nested Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
G	<i>Agropyron cristatum</i>	a-	a3	b23	ab17	-	.22	.42	.37
G	<i>Agropyron smithii</i>	a-	a10	b37	ab26	-	.18	.95	.62
G	<i>Agropyron spicatum</i>	-	-	3	2	-	-	.03	.03
G	<i>Bromus tectorum</i> (a)	a132	b344	b302	a164	.81	14.07	5.41	1.49
G	<i>Carex</i> sp.	-	4	-	2	-	.06	-	.00
G	<i>Dactylis glomerata</i>	-	17	23	19	-	.45	.73	.56
G	<i>Oryzopsis hymenoides</i>	b50	a9	a17	a10	.22	.52	.58	.13
G	<i>Poa secunda</i>	27	35	27	44	.14	.44	.28	.35
G	<i>Sitanion hystrix</i>	a22	ab133	ab144	b184	.16	6.75	4.25	5.27
G	<i>Stipa lettermani</i>	b14	a2	a-	a7	.10	.03	.03	.21
Total for Annual Grasses		132	344	302	164	0.81	14.07	5.41	1.49
Total for Perennial Grasses		113	213	274	311	0.63	8.66	7.27	7.56
Total for Grasses		245	557	576	475	1.44	22.73	12.69	9.05
F	<i>Alyssum alyssoides</i> (a)	-	-	1	-	-	-	.00	-
F	<i>Arabis</i> sp.	b27	a2	a-	a-	.06	.00	-	-
F	<i>Arenaria</i> sp.	-	6	7	13	-	.03	.04	.08
F	<i>Astragalus convallarius</i>	b5	a45	a18	c85	.01	2.05	.67	2.74
F	<i>Chaenactis douglasii</i>	-	-	-	1	-	-	-	.00
F	<i>Chenopodium fremontii</i> (a)	-	-	-	4	-	-	-	.00
F	<i>Cirsium</i> sp.	-	-	-	1	-	-	-	.15
F	<i>Cryptantha</i> sp.	9	2	-	-	.02	.00	-	-
F	<i>Cymopterus</i> sp.	a1	b35	a2	b21	.00	.19	.00	.13
F	<i>Descurainia pinnata</i> (a)	-	3	-	-	-	.07	-	-
F	<i>Draba</i> sp. (a)	-	-	-	1	-	-	-	.00
F	<i>Gilia</i> sp. (a)	a-	b16	a-	a3	-	.03	-	.00
F	<i>Ipomopsis aggregata</i>	-	1	-	1	-	.15	-	.00
F	<i>Lactuca serriola</i> (a)	a-	a-	b38	c83	-	-	.43	1.02
F	<i>Lappula occidentalis</i> (a)	-	-	-	2	-	-	-	.00
F	<i>Lesquerella</i> sp.	-	-	-	3	-	-	-	.00
F	<i>Linum lewisii</i>	-	20	23	12	-	.95	1.18	.43
F	<i>Medicago sativa</i>	-	14	16	17	-	.43	.27	.89
F	<i>Melilotus officinalis</i>	-	-	-	1	-	-	-	.15
F	<i>Onobrychis viciaefolia</i>	-	1	-	1	-	.03	.03	.03
F	<i>Penstemon humilis</i>	3	4	-	4	.00	.04	-	.06
F	<i>Petroradia pumila</i>	56	33	42	47	1.01	1.66	1.49	1.42
F	<i>Phlox austromontana</i>	1	6	10	2	.00	.01	.19	.00
F	<i>Phlox longifolia</i>	2	-	10	3	.01	-	.05	.00
F	<i>Polygonum douglasii</i> (a)	-	-	-	1	-	-	-	.00
F	<i>Salsola iberica</i> (a)	a3	ab11	b27	b20	.00	.08	.91	.48
F	<i>Sanguisorba minor</i>	-	6	1	-	-	.18	.03	.01

Type	Species	Nested Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
F	Sphaeralcea coccinea	-	-	-	3	-	-	-	.00
F	Townsendia sp.	-	5	-	1	-	.03	-	.00
F	Tragopogon dubius (a)	-	-	2	4	-	-	.03	.21
F	Trifolium sp.	6	-	5	8	.02	-	.00	.01
F	Unknown forb-annual (a)	-	-	-	-	-	-	.03	-
Total for Annual Forbs		3	30	68	118	0.00	0.18	1.42	1.74
Total for Perennial Forbs		110	180	134	224	1.15	5.79	3.97	6.17
Total for Forbs		113	210	202	342	1.15	5.97	5.39	7.91

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 09R, Study no: 4

Type	Species	Strip Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
B	Artemisia nova	42	34	0	40	2.98	1.83	3.57	3.26
B	Artemisia tridentata wyomingensis	0	27	0	29	-	1.45	2.37	3.84
B	Atriplex canescens	0	1	0	1	-	.00	.03	.15
B	Chrysothamnus nauseosus	0	1	0	0	-	-	-	-
B	Chrysothamnus nauseosus albicaulis	0	1	0	3	-	.06	.38	1.00
B	Eriogonum microthecum	2	1	0	0	.00	-	-	-
B	Gutierrezia sarothrae	1	0	0	0	-	-	.00	-
B	Juniperus osteosperma	23	0	0	0	16.80	-	-	-
B	Opuntia sp.	2	0	0	0	.00	-	-	-
B	Purshia tridentata	2	2	0	1	-	-	.00	.03
Total for Browse		72	67	0	74	19.79	3.34	6.37	8.30

#### CANOPY COVER, LINE INTERCEPT--

Management unit 09R, Study no: 4

Species	Percent Cover			
	'04	'07	'09	'10
Artemisia nova	2.29	2.59	6.28	4.43
Artemisia tridentata wyomingensis	-	1.61	4.26	4.63
Atriplex canescens	-	.36	.61	.81
Chrysothamnus nauseosus	-	-	-	.91
Chrysothamnus nauseosus albicaulis	-	-	.53	.13
Juniperus osteosperma	39.00	-	-	-
Purshia tridentata	.03	-	.15	.10

KEY BROWSE ANNUAL LEADER GROWTH--  
Management unit 09R, Study no: 4

Species	Average leader growth (in)
	'10
Artemisia tridentata wyomingensis	1.8
Purshia tridentata	2.0

POINT-QUARTER TREE DATA--  
Management unit 09R, Study no: 4

Species	Trees per Acre				Average diameter (in)			
	'04	'07	'09	'10	'04	'07	'09	'10
Juniperus osteosperma	444	23	<18	<18	13.3	5.1	2.2	-
Pinus edulis	-	-	-	<18	-	-	-	-

BASIC COVER--  
Management unit 09R, Study no: 4

Cover Type	Average Cover %			
	'04	'07	'09	'10
Vegetation	21.13	32.40	26.40	27.36
Rock	23.10	8.66	11.42	10.17
Pavement	9.55	2.20	2.63	2.78
Litter	46.48	62.60	65.34	65.90
Cryptogams	2.37	.00	.03	.04
Bare Ground	15.22	3.80	2.54	3.27

SOIL ANALYSIS DATA --

Management unit 9R, Study no: 4, Study Name: Diamond Mountain Bullhog

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
8.0	6.6	61.4	19.1	19.5	2.0	7.0	153.6	0.6

PELLET GROUP DATA--

Management unit 09R, Study no: 4

Type	Quadrat Frequency				Days use per acre (ha)			
	'04	'07	'09	'10	'04	'07	'09	'10
Rabbit	65	23	3	-	-	-	-	-
Elk	7	19	10	3	9 (21)	25 (63)	20 (50)	13 (31)
Deer	1	1	12	9	5 (13)	7 (18)	6 (15)	6 (15)
Cattle	-	-	6	2	-	2 (5)	11 (27)	6 (14)

BROWSE CHARACTERISTICS--  
Management unit 09R, Study no: 4

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia nova</i>									
04	2560	26	53	21	180	21	44	7	9/16
07	1700	6	91	4	860	6	0	1	10/18
09	0	0	0	0	-	0	0	0	11/19
10	4340	49	51	0	2520	11	12	0	10/21
<i>Artemisia tridentata wyomingensis</i>									
04	0	0	0	0	-	0	0	0	-/-
07	2020	36	64	0	1460	.99	0	0	18/21
09	0	0	0	0	-	0	0	0	20/25
10	2900	57	43	1	4980	12	11	4	20/28
<i>Atriplex canescens</i>									
04	0	0	0	-	-	0	0	0	-/-
07	20	0	100	-	-	0	0	0	30/49
09	0	0	0	-	-	0	0	0	21/26
10	20	0	100	-	-	0	0	0	24/33
<i>Chrysothamnus nauseosus</i>									
04	0	0	0	-	-	0	0	0	-/-
07	20	0	100	-	-	0	0	0	24/43
09	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	35/58
<i>Chrysothamnus nauseosus albicaulis</i>									
04	0	0	0	-	-	0	0	0	-/-
07	20	0	100	-	-	0	0	0	17/17
09	0	0	0	-	-	0	0	0	24/33
10	60	0	100	-	-	0	0	0	26/40
<i>Chrysothamnus viscidiflorus</i>									
04	0	0	0	-	-	0	0	0	-/-
07	0	0	0	-	-	0	0	0	-/-
09	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	13/22
<i>Eriogonum microthecum</i>									
04	60	33	33	33	-	0	100	0	1/1
07	20	0	100	0	-	0	0	0	7/6
09	0	0	0	0	-	0	0	0	-/-
10	0	0	0	0	-	0	0	0	-/-
<i>Gutierrezia sarothrae</i>									
04	20	100	0	-	-	0	0	0	-/-
07	0	0	0	-	-	0	0	0	11/15
09	0	0	0	-	-	0	0	0	10/15
10	0	0	0	-	-	0	0	0	9/12

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Juniperus osteosperma</i>									
04	<b>500</b>	12	76	12	20	4	0	0	-/-
07	<b>0</b>	0	0	0	-	0	0	0	-/-
09	<b>0</b>	0	0	0	-	0	0	0	-/-
10	<b>0</b>	0	0	0	20	0	0	0	-/-
<i>Opuntia sp.</i>									
04	<b>40</b>	0	100	-	-	0	0	0	3/16
07	<b>0</b>	0	0	-	-	0	0	0	-/-
09	<b>0</b>	0	0	-	-	0	0	0	4/11
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Purshia tridentata</i>									
04	<b>60</b>	0	67	33	-	0	100	33	7/46
07	<b>40</b>	0	100	0	-	0	100	0	8/55
09	<b>0</b>	0	0	0	-	0	0	0	11/45
10	<b>40</b>	0	100	0	-	0	100	0	9/38

WEST STUNTZ - TREND STUDY NO. 9R-12-10

[Project #357](#)

Vegetation Type: Mountain Big Sagebrush

Range Type: Crucial Deer Summer, Substantial Elk Summer

NRCS Ecological Site Description: [Mountain Loam \(Mountain Big Sagebrush\), R047XC430UT](#)

Land Ownership: SITLA

Elevation: 7,800 ft. (2,377 m)

Aspect: Northwest

Slope: 3-4%

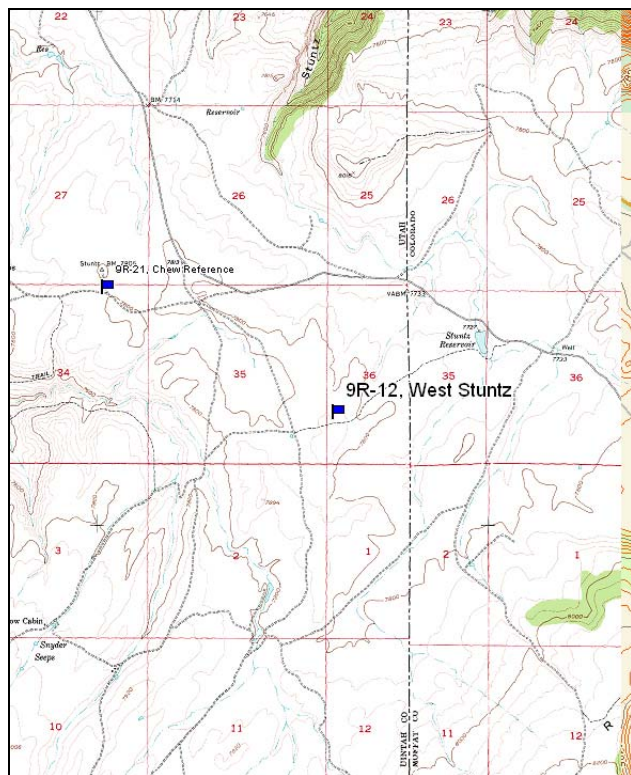
Transect bearing: 340° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

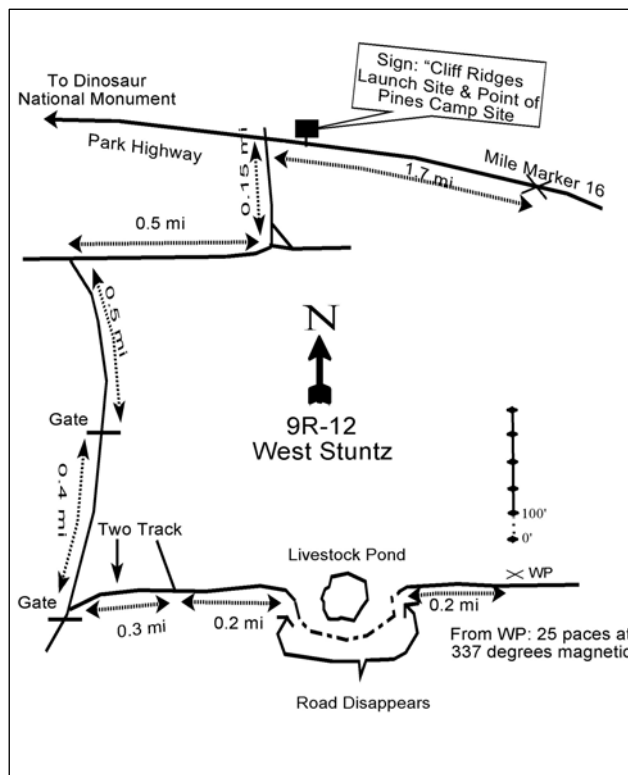
On Park Highway in Dinosaur National Monument drive to mile marker 16. From mile marker 16 drive 1.7 miles west to a turn off to the left (south). From there go 0.15 miles to a fork and turn right. Go 0.5 miles to another fork and turn left. Drive 0.5 miles to a gate. Go through the gate and drive 0.4 miles to a gate and a two track road to the left (east). Take the two track for 0.3 miles to a fork, stay straight for another 0.2 miles to a livestock pond where the road disappears. Drive around the pond to the two track on the east side. From where the two track starts again drive another 0.2 miles to a witness post on the left (north) side of the road. Walk 25 paces at 337 degrees magnetic to the 0 stake with browse tag #152.

Map Name: Stuntz Reservoir



Township: 4S Range: 25E Section: 36

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 664664 E 4476766 N

WEST STUNTZ - WRI STUDY 9R-12

[Project #357](#)

**Site Description**

Site Information: The study is located approximately fifteen miles northeast of Jensen and less than a mile west of the Utah/Colorado border. The study was established in 2006 in a dense mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) community to monitor a sagebrush thinning project in greater sage-grouse habitat. The project initially was planned to be treated with Spike (Tebuthiuron), but was changed to a two-way Dixie harrow project. The project was seeded using a broadcast seeder during the second pass of the harrow (WRI Database 2011). Pellet group data estimated light use by deer, cattle and elk in all sample years (Table - Pellet Group Data).

SEED MIX--

Management unit 09R, Study no: 12

Project Name: West Stuntz Blue Mountain		
WRI Database #: 357		
Application:	Acres:	210
Seed type	lbs in mix	lbs/acre
G Big Bluegrass 'Sherman'	100	0.48
G Bluebunch WG 'Goldar'	250	1.19
G Canby Bluegrass 'Canbar'	100	0.48
G Green Needlegrass 'Lodorm'	200	0.95
G Orchardgrass 'Paiute'	50	0.24
G Sandberg Bluegrass 'Toole MT'	100	0.48
G Thickspike Wheatgrass 'Bannock'	200	0.95
F Alfalfa 'Ladak'	300	1.43
F Blue Flax	50	0.24
F Sainfoin 'Eski'	800	3.81
F Small Burnet 'Delar'	400	1.90
F Western Yarrow 'SID Columbia'	10	0.05
B Bitterbrush	20	0.10
Total Pounds:	2580	12.29
PLS Pounds:		11.04

Browse: Mountain big sagebrush was the dominant browse on this site prior to treatment in 2006. Following treatment cover and density was greatly reduced allowing for an increase in Wyeth eriogonum (*Eriogonum heracleoides*) cover (Table - Canopy Cover). The mountain big sagebrush consists of a mature population with moderate decadence over the sample years. Utilization of sagebrush has been mostly moderate and use of Wyeth eriogonum has been light over the sample years. Poor vigor of sagebrush and Wyeth eriogonum has been low. The recruitment of young plants to the population was good for sagebrush and Wyeth eriogonum at the outset of the study, but was poor in 2010 (Table - Browse Characteristics).

Herbaceous Understory: A good herbaceous understory was present prior to treatment in 2006. After the treatment, perennial grasses remained at similar cover and nested frequency levels. However, many perennial forb species decreased significantly in nested frequency with a substantial decrease in the sum of nested frequency of perennial forbs and a two-thirds decrease in cover. Perennial grasses are abundant and diverse. Letterman needlegrass (*Stipa lettermani*), western wheatgrass (*Agropyron smithii*), Sandberg bluegrass (*Poa secunda*), and sedge (*Carex sp.*) are the dominant perennial grass species on the site. The annual grass cheatgrass (*Bromus tectorum*) was sampled in 2010 at very low frequency and cover. Silvery lupine (*Lupinus argenteus*) is the dominant perennial forb, though cover decreased significantly after treatment.



Soil: The soil texture is a clay loam with a slightly acidic soil reaction (pH 6.5) (Table - Soil Analysis Data). Bare ground cover is low with a high amount of vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### Pre vs. Four Years Post Treatment, 2006 vs. 2010

Browse: Mountain big sagebrush cover decreased from 33% to 16% following the harrow project, while the density decreased 53% from 8,840 plants/acre in 2006 to 4,120 plants/acre in 2010. Over the same period the recruitment of young decreased from 19% to 7% and the decadence of plants decreased slightly from 22% to 17%. Meanwhile, Wyeth eriogonum cover increased from 5% to 7% and the density remained similar, though recruitment of young plants decreased from 19% to 6%.

Grasses: The sum of nested frequency of perennial grasses remained similar between sample years. Western wheatgrass and sedge increased significantly in nested frequency and each provided 2% cover in 2010. Sandberg bluegrass decreased in cover from 5% to 3%, but there was no significant change in nested frequency. Letterman needlegrass cover and nested frequency values remained similar to 2006 and has been the most common grass species in each sample year accounting for 69% and 59% of grass cover in 2006 and 2010, respectively.

Forbs: The sum of nested frequency of perennial forbs decreased 44% due mostly to the decrease of pale agoseris (*Agoseris glauca*), longleaf phlox (*Phlox longifolia*) and ballhead sandwort (*Arenaria congesta*). Silvery lupine cover decreased from 16% to 6%, but there was no significant decrease in nested frequency. Silvery lupine provided approximately 69% of total forb cover in 2006 and 57% in 2010.

### HERBACEOUS TRENDS--

Management unit 09R, Study no: 12

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	<i>Agropyron smithii</i>	a13	b87	.04	1.79
G	<i>Bromus tectorum</i> (a)	a-	b11	-	.07
G	<i>Carex</i> sp.	a2	b46	.03	1.72
G	<i>Koeleria cristata</i>	b38	a6	.32	.03
G	<i>Poa fendleriana</i>	7	10	.15	.22
G	<i>Poa secunda</i>	155	126	4.61	2.70
G	<i>Sitanion hystrix</i>	a4	b14	.04	.33
G	<i>Stipa comata</i>	3	-	.03	-
G	<i>Stipa lettermani</i>	315	268	11.51	10.51
G	<i>Stipa pinetorum</i>	a-	b24	-	.46
Total for Annual Grasses		0	11	0	0.07
Total for Perennial Grasses		537	581	16.75	17.79
Total for Grasses		537	592	16.75	17.87
F	<i>Achillea millefolium</i>	a12	b47	.25	.65
F	<i>Agoseris glauca</i>	b132	a-	1.40	-
F	<i>Alyssum alyssoides</i> (a)	4	-	.00	-
F	<i>Antennaria rosea</i>	53	38	1.38	.76
F	<i>Arabis</i> sp.	2	-	.01	-
F	<i>Arenaria congesta</i>	b101	a-	.89	-
F	<i>Arenaria</i> sp.	a-	b75	-	.42
F	<i>Aster</i> sp.	b15	a-	.13	-

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	Chenopodium leptophyllum(a)	-	3	-	.00
F	Collinsia parviflora (a)	<sub>b</sub> 59	<sub>a</sub> 3	.10	.01
F	Collomia linearis (a)	<sub>b</sub> 19	<sub>a</sub> -	.05	-
F	Delphinium nuttallianum	3	-	.00	-
F	Draba sp. (a)	3	-	.00	-
F	Erigeron eatonii	<sub>b</sub> 44	<sub>a</sub> 32	.37	.14
F	Linum lewisii	<sub>a</sub> 3	<sub>b</sub> 25	.01	.33
F	Lomatium sp.	2	-	.00	-
F	Lupinus argenteus	217	196	16.31	5.78
F	Melilotus officinalis	-	4	-	.00
F	Microsteris gracilis (a)	<sub>b</sub> 32	<sub>a</sub> 9	.08	.02
F	Onobrychis viciaefolia	-	11	-	.07
F	Orthocarpus luteus (a)	4	-	.03	-
F	Penstemon comarrhenus	5	-	.03	-
F	Penstemon humilis	3	-	.00	-
F	Phlox austromontana	1	-	.00	-
F	Phlox longifolia	<sub>b</sub> 190	<sub>a</sub> 21	1.81	.09
F	Polygonum douglasii (a)	<sub>a</sub> 5	<sub>b</sub> 126	.01	1.54
F	Ranunculus testiculatus (a)	3	-	.00	-
F	Sanguisorba minor	-	7	-	.19
F	Senecio integerrimus	<sub>b</sub> 33	<sub>a</sub> -	.45	-
F	Taraxacum officinale	-	10	-	.02
F	Trifolium sp.	11	2	.19	.03
F	Zigadenus paniculatus	4	-	.09	-
Total for Annual Forbs		129	141	0.30	1.58
Total for Perennial Forbs		831	468	23.40	8.50
Total for Forbs		960	609	23.70	10.09

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 09R, Study no: 12

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata vaseyana	93	74	28.52	12.23
B	Cercocarpus montanus	-	-	.15	.85
B	Eriogonum heracleoides	86	92	5.57	7.75
B	Gutierrezia sarothrae	5	3	.33	.15
B	Purshia tridentata	1	0	-	-
Total for Browse		185	169	34.57	20.98

CANOPY COVER, LINE INTERCEPT--

Management unit 09R, Study no: 12

Species	Percent Cover	
	'06	'10
Artemisia tridentata vaseyana	33.28	16.18
Eriogonum heracleoides	4.88	6.81
Gutierrezia sarothrae	.80	.35

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 09R, Study no: 12

Species	Average leader growth (in)	
	'06	'10
Artemisia tridentata vaseyana	1.2	1.5

BASIC COVER--

Management unit 09R, Study no: 12

Cover Type	Average Cover %	
	'06	'10
Vegetation	58.41	50.40
Rock	.30	.24
Pavement	.50	.22
Litter	44.31	48.21
Cryptogams	.19	0
Bare Ground	15.15	17.64

SOIL ANALYSIS DATA --

Management unit 9R, Study no: 12, Study Name: West Stuntz

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
12.4	6.5	30.3	40.4	29.3	1.9	36.8	444.8	0.8

PELLET GROUP DATA--

Management unit 09R, Study no: 12

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	30	-	-	-
Grouse	5	-	-	-
Elk	-	-	9 (23)	5 (12)
Deer	19	3	15 (38)	11 (28)
Cattle	11	8	19 (47)	11 (27)

BROWSE CHARACTERISTICS--  
 Management unit 09R, Study no: 12

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata vaseyana</i>									
06	<b>8840</b>	19	59	22	-	.67	0	2	27/31
10	<b>4120</b>	7	75	17	700	8	25	7	21/29
<i>Eriogonum heracleoides</i>									
06	<b>9400</b>	19	79	1	380	7	0	.42	3/9
10	<b>9180</b>	6	94	0	20	0	0	0	4/13
<i>Gutierrezia sarothrae</i>									
06	<b>340</b>	6	94	-	160	0	0	0	6/11
10	<b>200</b>	0	100	-	-	0	0	0	7/12
<i>Purshia tridentata</i>									
06	<b>20</b>	0	100	-	-	0	100	0	7/17
10	<b>0</b>	0	0	-	-	0	0	0	-/-

BRUSH CREEK DIXIE WRI - TREND STUDY NO. 9R-15-10

[Project #315](#) and [Project #1659](#)

Vegetation Type: Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Semidesert Loam (Wyoming Big Sagebrush), R034XY212UT

Land Ownership: BLM

Elevation: 5,708 ft. (1,740 m)

Aspect: North

Slope: 2%

Transect bearing: 22° magnetic

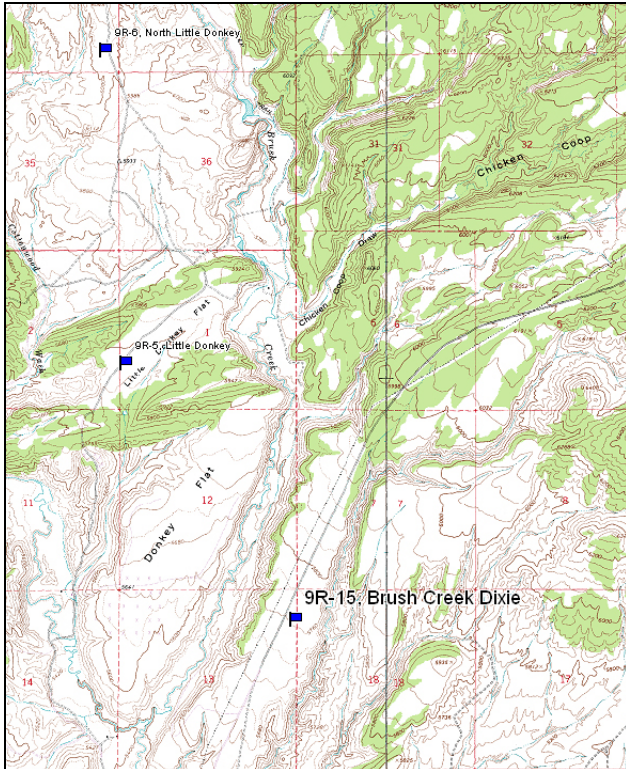
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95ft)

Notes: No rebar

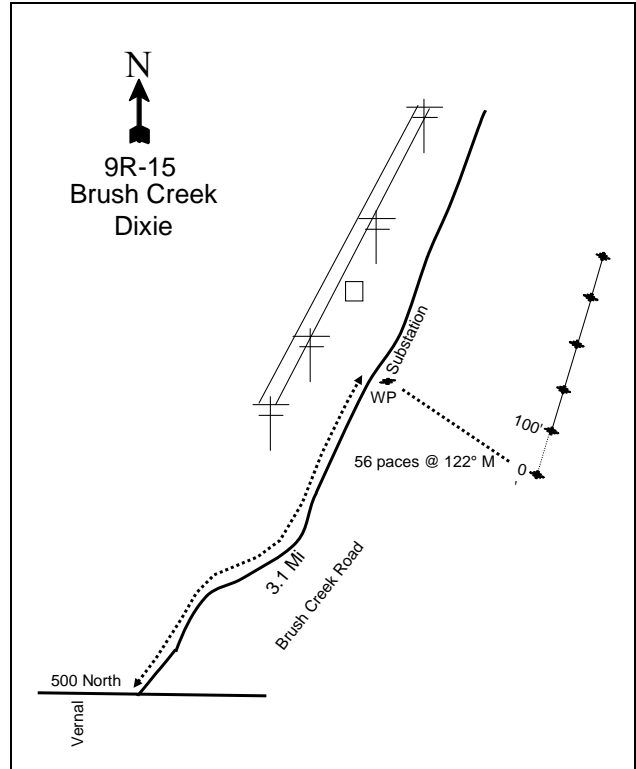
Directions:

From 500 north in Vernal, travel north on Brush Creek Road 3.1 miles to the witness post on the right side of the road. From the witness post the 0-foot stake is 56 paces at 122 degrees magnetic and is marked with browse tag # 134.

Map Name: Donkey Flat



Diagrammatic Sketch:



Township: 3S Range: 22E Section: 13

GPS: NAD 83, UTM 12S 636649 E 4491525 N

BRUSH CREEK DIXIE - WRI STUDY 9R-15  
[Project #315](#) and [Project #1659](#)

**Site Description**

Site Information: The study was established in 2007 on Brush Creek Bench to monitor a Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*) restoration project north of Vernal. The treatment sprayed 300 acres with Plateau (Imazapic) herbicide to control cheatgrass in the fall of 2008, and then was one-way Dixie harrowed while being seeded using a broadcast seeder. Wyoming big sagebrush seed was then aerially applied in March of 2009. In the fall of 2010 the treatment area was reseeded with a rangeland drill due to the lack of response from the first seeding attempt. The objectives of this treatment were to improve crucial deer, elk, and sage-grouse winter range by establishing new sagebrush and forage kochia (*Kochia prostrata*) in an area with heavy sagebrush die-off (WRI Database 2011). Pellet group data estimated heavy to very heavy deer use in 2007, 2009 and 2010. Elk and cattle use was light in all sample years (Table - Pellet Group Data).

**SEED MIX--**

Management unit 09R, Study no: 15

Project Name: Brush Creek Bench Sage Restoration WRI Database #: 315				Project Name: Brush Creek Bench Seeding WRI Database #: 1659			
Application: Broadcast Seeder		Acres: 300		Application: Rangeland Drill		Acres: 410	
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Douglas'	450	1.50	G	Crested Wheatgrass 'Ephraim'	400	0.98
G	Crested Wheatgrass 'Hycrest'	300	1.00	G	Crested Wheatgrass 'Nordan'	400	0.98
G	Russian Wildrye 'Bozoisky'	300	1.00	G	Russian Wildrye 'Bozoisky'	400	0.98
G	Sandberg Bluegrass	150	0.50	G	Sandberg Bluegrass	200	0.49
G	Snake River Wheatgrass 'Secar'	300	1.00	G	Siberian Wheatgrass 'Vavilov'	200	0.49
G	Thickspike Wheatgrass 'Critana'	300	1.00	G	Snake River Wheatgrass 'Secar'	450	1.10
F	Alfalfa 'Ladak'	600	2.00	G	Western Wheatgrass 'Arriba'	450	1.10
Total Pounds:		2400	8.00	F	Alfalfa 'Ladak Plus'	200	0.49
PLS Pounds:			6.86	F	Alfalfa 'Ranger'	200	0.49
Application: Aerial Seed		Acres: 300		F	Alfalfa 'Spreador 4'	200	0.49
Seed type		lbs in mix	lbs/acre	F	Blue Flax 'Appar'	400	0.98
B	Forage Kochia	300	1.00	F	Small Burnet 'Delar'	400	0.98
B	Sagebrush, Wyoming	300	1.00	B	Fourwing Saltbush	417	1.02
Total Pounds:		600	2.00	Total Pounds:		4317	10.53
PLS Pounds:			0.85	PLS Pounds:			8.70

Browse: Wyoming big sagebrush is the dominant preferred browse, providing the majority of browse cover in all sample years and has increased in cover since being seeded on the site. Forage kochia (*Kochia prostrata*) was seeded in the spring of 2009, but has not established well (Table - Canopy Cover). The Wyoming big sagebrush population was mostly decadent at the outset of the study, but decadence has since declined substantially. Poor vigor of sagebrush was extremely high in 2007, but since then has been low. The recruitment of young sagebrush has mostly been poor throughout the sample years (Table - Browse Characteristics).

Herbaceous Understory: Perennial grasses are diverse, but are not abundant and are in poor condition. The annual grass cheatgrass (*Bromus tectorum*) is the dominant species. Prior to treatment, cheatgrass cover was extremely high and accounted for the majority of grass cover. Following the Plateau application, cheatgrass cover was substantially lower, but still provided the majority of grass cover. Sixweeks fescue (*Vulpia*

*octoflora*) was common in 2007, but has become rare after the treatment. Perennial forbs are not abundant with scarlet globemallow (*Sphaeralcea coccinea*) being the dominant species and providing the majority of the perennial forb cover. In 2010, annual kochia (*Kochia scoparia*) was sampled for the first time in moderate frequency and cover. Perennial forb cover and nested frequency decreased following treatment, but rebounded between 2009 and 2010 (Table - Herbaceous Trends).

Soil: The soil texture is a sandy clay loam with a neutral soil reaction (pH 6.7) (Table - Soil Analysis Data). Bare ground cover is high with a moderate amount of vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### **Pre vs. Two Years Post Treatment, 2007 vs. 2009**

Browse: One year after treatment, the canopy cover of Wyoming big sagebrush declined slightly from 7% to 6%. Forage kochia, broom snakeweed (*Gutierrezia sarothrae*) and pricklypear cactus (*Opuntia sp.*) were rare. Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover.

Grass: The sum of nested frequency of perennial grasses remained similar to pretreatment. Perennial grasses are rare and provided 1% cover. Sandberg bluegrass (*Poa secunda*) was the only seeded species sampled in 2009, but was present prior to treatment. Cheatgrass decreased substantially in nested frequency and cover decreased from 32% to 9%.

Forb: The sum of nested frequency of perennial forbs declined 81% and cover declined from 2% to less than 1%. There was a significant decrease in the nested frequency of scarlet globemallow and cover decreased from 2% to less than 1%. No seeded species were established within the sample.

### **Trend Assessments**

#### Browse

- **2009 to 2010 - up (+2)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush canopy cover increased from 6% to 13%. A visual comparison of photos from 2009 to 2010 shows sagebrush to be much more vigorous with a high amount of growth in 2010.

#### Grasses

- **2009 to 2010 - slightly up (+1)**: Perennial grasses are very rare on this site, barely providing 1% cover in 2009 and less than 1% in 2010. The sum of nested frequency for perennial grasses has increased each year since treatment, but due to their scarcity provide no true difference. Cheatgrass cover decreased from 9% to 6% while there was a significant decrease in nested frequency. The spraying treatment has reduced cheatgrass abundance, but it was still sampled in nearly every quadrat.

#### Forbs

- **2009 to 2010 - slightly up (+1)**: The sum of nested frequency of perennial forbs increased nearly four-fold and cover returned to pretreatment levels at 2%. Scarlet globemallow provided the majority of the perennial forb cover at 1%. Annual kochia appeared on the site in 2010 and provided 5% cover. Annual forb cover increased from almost no cover to 6% cover.

HERBACEOUS TRENDS--

Management unit 09R, Study no: 15

Type	Species	Nested Frequency			Average Cover %		
		'07	'09	'10	'07	'09	'10
G	Agropyron cristatum	-	-	4	-	-	.01
G	Agropyron intermedium	-	6	3	-	.41	.00
G	Agropyron smithii	10	-	-	.09	-	-
G	Bromus tectorum (a)	c480	b360	a299	30.54	9.37	6.29
G	Oryzopsis hymenoides	5	-	-	.04	-	-
G	Poa bulbosa	-	-	1	-	.03	.00
G	Poa secunda	4	8	8	.04	.06	.05
G	Sitanion hystrix	13	18	16	.25	.16	.05
G	Stipa columbiana	a-	a2	b13	-	.15	.25
G	Stipa comata	19	24	30	.43	.49	.32
G	Vulpia octoflora (a)	b108	a-	a3	1.24	-	.00
Total for Annual Grasses		588	360	302	31.78	9.37	6.29
Total for Perennial Grasses		51	58	75	0.86	1.31	0.69
Total for Grasses		639	418	377	32.64	10.69	6.99
F	Allium sp.	7	-	4	.02	-	.00
F	Astragalus convallarius	1	-	8	.03	.03	.07
F	Chenopodium leptophyllum(a)	a-	a-	b10	-	-	.06
F	Descurainia pinnata (a)	b44	a-	a1	.09	-	.00
F	Grindelia squarrosa	-	2	-	-	.03	-
F	Kochia scoparia (a)	a-	a-	b173	-	-	4.86
F	Lappula occidentalis (a)	b36	a2	a11	.12	.03	.02
F	Lygodesmia sp.	-	-	7	-	-	.03
F	Machaeranthera canescens	a1	a1	b25	.00	.00	.20
F	Penstemon sp.	9	-	-	.01	-	-
F	Phlox longifolia	1	-	13	.00	-	.02
F	Plantago patagonica (a)	c178	a3	b42	1.02	.00	.59
F	Salsola iberica (a)	a4	a-	b22	.00	-	.65
F	Sphaeralcea coccinea	c159	a31	b74	2.25	.59	1.29
F	Townsendia sp.	2	-	4	.00	-	.15
Total for Annual Forbs		262	5	259	1.25	0.03	6.20
Total for Perennial Forbs		180	34	135	2.34	0.65	1.78
Total for Forbs		442	39	394	3.59	0.69	7.98

Values with different subscript letters are significantly different at alpha = 0.10



BROWSE TRENDS--

Management unit 09R, Study no: 15

Type	Species	Strip Frequency			Average Cover %		
		'07	'09	'10	'07	'09	'10
B	Artemisia tridentata wyomingensis	95	0	90	5.96	7.72	7.44
B	Ceratoides lanata	1	0	0	-	-	-
B	Gutierrezia sarothrae	4	0	3	.15	.06	.03
B	Kochia prostrata	0	0	1	-	-	.01
B	Opuntia sp.	7	0	10	.15	.15	.15
Total for Browse		107	0	104	6.26	7.93	7.63

CANOPY COVER, LINE INTERCEPT--

Management unit 09R, Study no: 15

Species	Percent Cover		
	'07	'09	'10
Artemisia tridentata wyomingensis	6.69	6.09	12.50
Gutierrezia sarothrae	.11	.03	.21
Opuntia sp.	.21	.21	.15

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 09R, Study no: 15

Species	Average leader growth (in) '10
Artemisia tridentata wyomingensis	1.2

BASIC COVER--

Management unit 09R, Study no: 15

Cover Type	Average Cover %		
	'07	'09	'10
Vegetation	41.43	22.67	23.38
Rock	.03	.02	0
Pavement	.15	.10	.11
Litter	46.23	48.15	46.02
Cryptogams	1.02	.24	.15
Bare Ground	23.17	28.59	40.22

SOIL ANALYSIS DATA --

Management unit 9R, Study no: 15, Study Name: Brush Creek Dixie

Effective rooting depth (in)	pH	sandy clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	6.7	52.2	26.4	21.4	1.1	19.6	176.0	0.5

PELLET GROUP DATA--

Management unit 09R, Study no: 15

Type	Quadrat Frequency			Days use per acre (ha)		
	'07	'09	'10	'07	'09	'10
Rabbit	49	5	10	-	-	-
Grouse	1	-	-	-	-	-
Elk	4	5	4	2 (5)	24 (60)	1 (2)
Deer	48	44	52	64 (159)	116 (288)	62 (154)
Cattle	1	1	1	6 (14)	17 (43)	5 (13)

BROWSE CHARACTERISTICS--

Management unit 09R, Study no: 15

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata wyomingensis</i>										
07	<b>4420</b>	0	10	90	2640	64	28	62	13/19	
09	No density data collected									14/20
10	<b>5100</b>	8	71	21	100	8	41	11	15/21	
<i>Ceratoides lanata</i>										
07	<b>20</b>	0	100	-	-	0	100	0	9/10	
09	No density data collected									-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-	
<i>Gutierrezia sarothrae</i>										
07	<b>220</b>	9	91	-	-	0	0	0	8/10	
09	No density data collected									9/13
10	<b>160</b>	0	100	-	-	0	0	0	11/16	
<i>Kochia prostrata</i>										
07	<b>0</b>	0	0	-	-	0	0	0	-/-	
09	No density data collected									-/-
10	<b>20</b>	100	0	-	100	0	0	0	-/-	
<i>Opuntia sp.</i>										
07	<b>140</b>	0	57	43	-	0	0	43	4/12	
09	No density data collected									4/13
10	<b>240</b>	0	92	8	-	17	0	8	4/14	

INDIAN SPRING BULLHOG - TREND STUDY NO. 10R-36-10

[Project #362](#)

Vegetation Type: Pinyon/Juniper, Black Sagebrush

Range Type: Substantial Deer Summer, Crucial Elk Winter

NRCS Ecological Site Description: Upland Shallow Loam (Pinyon-Utah juniper), R034XY322UT

Land Ownership: BLM

Elevation: 7,299 ft. (2,224 m)

Aspect: North

Slope: 1%

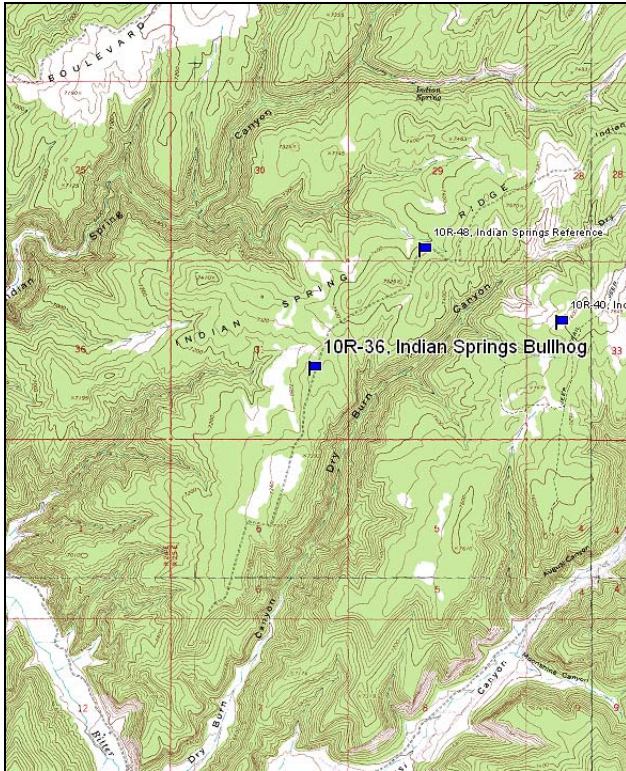
Transect bearing: 2° magnetic (Baseline was moved slightly so these readings maybe somewhat off)

Belt placement: line 1 (11ft & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

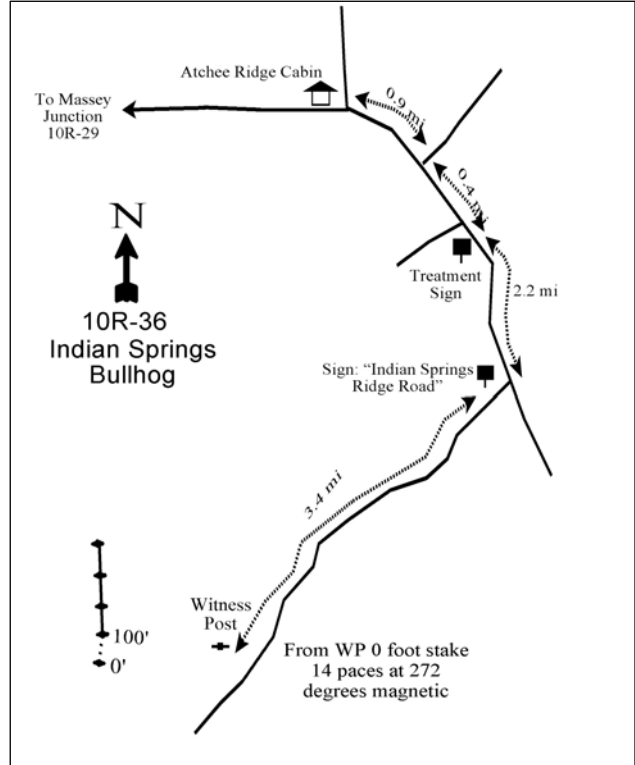
From the Seep Ridge Road, about 10 miles north of Pine Spring, turn onto the Bitter Creek Road near McCoy Reservoir. Drive easterly on this road for 10.9 miles to where the road tops out; turn right off the main road. Go 7.65 miles staying on the main road to a fork. Turn left (west) at the fork and drive 0.9 miles to another junction staying right for another 0.4 miles to a fork and a treatment sign. From there go right for 2.2 miles to a junction with a sign reading "Indian Springs Ridge Road". Go right for 3.4 miles to a witness post on the right. The 0' stake with browse tag #156, is 14 paces from the witness post at 272°M.

Map Name: Burnt Timber Canyon



Township: 13S Range: 25E Section: 31

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 658300 E 4389574 N

INDIAN SPRINGS BULLHOG - WRI STUDY 10R-36  
[Project #362](#)

**Site Description**

Site Information: The study was established in 2006 within a dense pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodland on Indian Springs Ridge to monitor the effects of a bullhog treatment. The treatment was completed in early spring of 2007 with the objectives of releasing mountain browse remaining in the understory and allowing the Bureau of Land management (BLM) and Utah Division of Natural Resources (UDWR) to establish grasses, forbs and additional browse on the site. The seed mix was applied aerially by a fixed-winged aircraft prior to the bullhog work. The treatment area receives heavy use by wintering elk and is important early fall/late spring mule deer transition range/migration corridor (WRI Database 2011). The baseline for this study was moved slightly south and east of the original location to keep the study within the treatment area in 2009, following the treatment. Pellet group data estimated light deer and moderate elk use in 2006 and 2009. Cattle use was light in 2009 and in 2010 use was light for cattle, elk and deer (Table - Pellet Group).

**SEED MIX--**

Management unit 10R, Study no: 36

Project Name: Indian Springs P-J Removal			
WRI Database #: 362			
Application: Aerial Seed		Acres:	350
Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Douglas'	200	0.57
G	Canby Bluegrass 'Canbar'	100	0.29
G	Thickspike Wheatgrass 'Bannock'	250	0.71
G	Western Wheatgrass 'Arriba'	250	0.71
G	Sandberg Bluegrass 'Toole MT'	175	0.50
G	Bluebunch WG 'Anatone'	175	0.50
G	Orchardgrass 'Paiute'	70	0.20
G	Slender Wheatgrass 'San Luis'	175	0.50
G	Blue Grama	90	0.26
F	Western Yarrow	20	0.06
F	Blue Flax 'Appar'	100	0.29
F	Small Burnet 'Delar'	700	2.00
F	Alfalfa 'Ladak'	350	1.00
F	Sainfoin 'Eski'	1050	3.00
B	Fourwing Saltbush	350	1.00
B	Sagebrush, Wyoming	350	1.00
B	Forage Kochia	100	0.29
Total Pounds:		4505	12.87
PLS Pounds:			10.23

Browse: Preferred browse species on the site include Utah serviceberry (*Amelanchier utahensis*), black sagebrush (*Artemisia nova*), Wyoming big sagebrush (*A. tridentata* spp. *Wyomingensis*), true mountain mahogany (*Cercocarpus montanus* ssp. *montanus*), dwarf rabbitbrush (*Chrysothamnus depressus*) and antelope bitterbrush (*Purshia tridentata*). Black sagebrush, low rabbitbrush and antelope bitterbrush are the key browse species on the site as the other preferred browse species are relatively few in number. Wyoming sagebrush was seeded on the site in 2006 and has since established a small, moderately young population. Decadence and poor vigor of black sagebrush was high in 2006, but has been low since then. Utilization of black sagebrush and Wyoming big sagebrush has been light, while use of other browse species has been

moderate to heavy (Table - Browse Characteristics). Pinyon pine and Utah juniper are still present on the site after the bullhog treatment, but density is relatively low (Table - Point-Quarter Tree Data).

Herbaceous Understory: Perennial grasses are diverse and fairly abundant. Prior to the treatment sedge (*Carex sp.*) was the dominant species, but has since decreased in abundance and was not sampled in 2010. Following the treatment, the most dominant perennial grass species are prairie junegrass (*Koeleria cristata*) and mutton bluegrass (*Poa fendleriana*), which provides the majority of grass cover. Slender wheatgrass (*Agropyron trachycaulum*), bluebunch wheatgrass (*A. spicatum*) and Sandberg bluegrass (*Poa secunda*) are the most common seeded grass species and other less common seeded grass species include crested wheatgrass (*Agropyron cristatum*), thickspike wheatgrass (*A. dasystachyum*), western wheatgrass (*A. smithii*), and blue grama (*Bouteloua gracilis*). Cheatgrass (*Bromus tectorum*) was sampled for the first time in 2009 at low cover and frequency. Perennial forbs are diverse and abundant and have increased in cover and frequency since the area was treated, though seeded species are less common. Desert phlox (*Phlox austromontana*) and tufted milkvetch (*Astragalus spatulatus*) are the dominant perennial forbs. Annual species were not sampled in 2009 or 2010 (Table - Herbaceous Trends).

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 6.7) (Table - Soil Analysis Data). Bare ground cover is moderate with a moderate amount of vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2006 and 2009 due to pedestalling, flow patterns, rills, and surface litter movement, but was stable in 2010.

### **Pre vs. Three Years Post Treatment, 2006 vs. 2009**

Browse: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. After the treatment black sagebrush, dwarf rabbitbrush and antelope bitterbrush canopy cover increased substantially. Black sagebrush canopy cover increased from 3% to 5%, dwarf rabbitbrush increased from 1% to 3% and antelope bitterbrush increased from 1% to 4%. Other preferred species declined in cover. Utah serviceberry decreased from 3% to less than 1%, Gambel oak (*Quercus gambelii*) decreased from 2% to 0% and true mountain mahogany decreased slightly. Pinyon pine and Utah juniper canopy cover and density declined due to the treatment. Pinyon pine density decreased from 608 trees/acre to 120 trees/acre and canopy cover decreased from 49% to 0%. Juniper density was reduced from 212 trees/acre to 47 trees/acre and canopy cover declined from 4% to 1%.

Grass: The sum of nested frequency of perennial grasses increased more than two-fold and cover increased from 2% to 14%. Cheatgrass (*Bromus tectorum*) was first sampled in 2009, but is rare. Slender wheatgrass was the most common seeded species and provided 4% cover in 2009. Mutton bluegrass was the most frequent species in 2009 and increased in cover from less than 1% to 3%. Other seeded species that provided 1% cover or more include Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass. Other less common seeded species sampled include crested wheatgrass (*Agropyron cristatum*), thickspike wheatgrass (*A. dasystachyum*), western wheatgrass (*A. smithii*) and blue grama (*Bouteloua gracilis*).

Forb: The sum of nested frequency of perennial forbs increased more than two-fold and cover increased from 4% to 11%. Desert phlox was the most common forb, it increased slightly in nested frequency and cover increased from 2% to 4%. Seeded forb species alfalfa (*Medicago sativa*), Lewis flax (*Linum lewisii*), sainfoin (*Onobrychis viciaefolia*) and small burnet (*Sanguisorba minor*) were sampled at low frequency and provided a combined 1% cover.

### **Trend Assessments**

#### Browse

- **2009 to 2010 - stable (0):** Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Preferred browse cover remained similar at 11%. Black sagebrush and dwarf rabbitbrush decreased slightly in cover from 5% to 4% and 3% to 2%,

respectively; while antelope bitterbrush increased in cover from 4% to 5%. Pinyon pine density was estimated at 103 trees/acre with an average diameter of 0.7 inches, a decrease from 120 trees/acre in 2009. Utah juniper density was estimated at 84 trees/acre with an average diameter of 0.9 inches, an increase from 47 trees/acre in 2009.

Grasses

- **2009 to 2010 - stable (0):** The sum of nested frequency of perennial grasses remained similar, although cover decreased from 14% to 10%. Prairie junegrass increased in cover from 2% to 4% and mutton bluegrass remained similar at 3%.

Forbs

- **2009 to 2010 - slightly up (+1):** The sum of nested frequency of perennial forbs increased 20% while cover was similar at 10%. Desert phlox remained the dominant species and provided 3.5% cover.

HERBACEOUS TRENDS--

Management unit 10R, Study no: 36

Type	Species	Nested Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
G	Agropyron cristatum	-	8	2	-	.06	.03
G	Agropyron dasystachyum	-	6	9	-	.30	.19
G	Agropyron smithii	a-	a2	b25	-	.03	.23
G	Agropyron spicatum	11	27	23	.13	1.30	.88
G	Agropyron trachycaulum	a-	c48	b16	-	3.88	.57
G	Bouteloua gracilis	-	4	6	-	.00	.01
G	Bromus tectorum (a)	-	4	12	-	.03	.21
G	Carex sp.	b57	a34	-	1.18	1.30	-
G	Koeleria cristata	a38	a58	b113	.50	1.46	3.62
G	Oryzopsis hymenoides	a2	ab14	b20	.01	.79	.66
G	Poa fendleriana	a15	b77	b91	.39	3.34	2.74
G	Poa secunda	9	29	16	.05	.97	.38
G	Sitanion hystrix	-	4	3	-	.21	.03
G	Stipa comata	a-	b23	ab11	-	.72	.21
Total for Annual Grasses		0	4	12	0	0.03	0.21
Total for Perennial Grasses		132	334	335	2.27	14.41	9.58
Total for Grasses		132	338	347	2.27	14.44	9.80
F	Agoseris glauca	a-	a2	b33	-	.03	.21
F	Antennaria rosea	a-	b15	b25	-	.20	.44
F	Arabis sp.	7	-	1	.04	-	.00
F	Aster sp.	a-	b18	a-	-	.64	-
F	Astragalus spatulatus	b19	a-	c99	.09	-	1.69
F	Astragalus utahensis	-	2	1	-	.00	.03
F	Castilleja linariaefolia	a-	b25	c54	-	.75	.82
F	Collinsia parviflora (a)	2	-	-	.00	-	-
F	Comandra pallida	a15	b37	b44	.06	.33	.26
F	Cordylanthus sp. (a)	9	-	-	.24	-	-
F	Crepis acuminata	-	14	2	-	.13	.06
F	Delphinium nuttallianum	-	-	3	-	-	.03
F	Erigeron eatonii	-	-	5	-	-	.06

T y p e	Species	Nested Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
F	<i>Erigeron pumilus</i>	8	9	24	.07	.07	.14
F	<i>Erigeron sp.</i>	a <sup>-</sup>	b <sup>73</sup>	a <sup>-</sup>	-	.95	-
F	<i>Eriogonum alatum</i>	11	7	3	.15	.06	.03
F	<i>Haplopappus acaulis</i>	-	2	7	-	.03	.68
F	<i>Hymenoxys acaulis</i>	a <sup>-</sup>	b <sup>12</sup>	ab <sup>7</sup>	-	.25	.10
F	<i>Ipomopsis aggregata</i>	1	-	-	.00	-	-
F	<i>Lesquerella sp.</i>	a <sup>19</sup>	ab <sup>48</sup>	b <sup>64</sup>	.10	.50	.55
F	<i>Linum lewisii</i>	-	-	10	-	.30	.04
F	<i>Machaeranthera grindelioides</i>	1	-	4	.00	-	.09
F	<i>Medicago sativa</i>	-	6	13	-	.04	.21
F	<i>Onobrychis viciaefolia</i>	a <sup>-</sup>	b <sup>15</sup>	a <sup>-</sup>	-	.19	-
F	<i>Penstemon sp.</i>	6	10	5	.02	.21	.06
F	<i>Penstemon watsonii</i>	a <sup>-</sup>	ab <sup>9</sup>	b <sup>14</sup>	-	.10	.28
F	<i>Petradoria pumila</i>	41	36	30	1.35	1.52	.67
F	<i>Phlox austromontana</i>	77	88	92	2.28	3.45	3.56
F	<i>Phlox longifolia</i>	a <sup>-</sup>	b <sup>18</sup>	b <sup>11</sup>	-	.05	.02
F	<i>Potentilla gracilis</i>	-	1	-	-	.00	-
F	<i>Sanguisorba minor</i>	a <sup>-</sup>	b <sup>14</sup>	b <sup>11</sup>	-	.49	.03
F	<i>Senecio multilobatus</i>	a <sup>1</sup>	b <sup>32</sup>	b <sup>29</sup>	.00	.34	.14
F	<i>Taraxacum officinale</i>	-	-	1	-	-	.00
F	<i>Tragopogon dubius (a)</i>	-	-	3	-	-	.00
F	<i>Zigadenus paniculatus</i>	-	3	8	-	.00	.06
Total for Annual Forbs		11	0	3	0.24	0	0.00
Total for Perennial Forbs		206	496	600	4.20	10.71	10.35
Total for Forbs		217	496	603	4.44	10.71	10.35

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 10R, Study no: 36

Type	Species	Strip Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
B	Amelanchier utahensis	19	0	2	3.38	.30	.06
B	Artemisia nova	39	0	48	4.00	4.23	2.84
B	Artemisia tridentata vaseyana	0	0	17	-	.03	1.05
B	Atriplex canescens	0	0	1	-	-	-
B	Cercocarpus montanus	10	0	7	1.49	.38	-
B	Chrysothamnus depressus	21	0	51	.35	2.95	2.63
B	Chrysothamnus viscidiflorus stenophyllus	0	0	1	-	-	-
B	Chrysothamnus viscidiflorus viscidiflorus	0	0	5	-	.51	.18
B	Juniperus osteosperma	9	0	5	1.16	.15	.53
B	Leptodactylon pungens	1	0	0	.00	-	-
B	Pediocactus simpsonii	1	0	1	-	.00	.03
B	Pinus edulis	31	0	4	13.64	.19	.09
B	Pseudotsuga menziesii	4	0	0	.15	-	-
B	Purshia tridentata	14	0	13	.88	2.83	2.55
B	Quercus gambelii	6	0	0	.98	-	-
B	Symphoricarpos oreophilus	2	0	2	.15	-	.15
B	Tetradymia canescens	0	0	1	-	-	-
Total for Browse		157	0	158	26.21	11.61	10.14

CANOPY COVER, LINE INTERCEPT--

Management unit 10R, Study no: 36

Species	Percent Cover		
	'06	'09	'10
Amelanchier utahensis	4.91	.16	.45
Artemisia nova	2.75	4.61	4.44
Artemisia tridentata vaseyana	-	.05	.13
Cercocarpus montanus	1.10	-	.16
Chrysothamnus depressus	.93	2.83	1.83
Chrysothamnus viscidiflorus stenophyllus	-	-	.06
Chrysothamnus viscidiflorus viscidiflorus	-	.63	.91
Juniperus osteosperma	4.13	.81	.65
Pinus edulis	48.75	-	.03
Pseudotsuga menziesii	.06	-	-
Purshia tridentata	.96	4.30	4.71
Quercus gambelii	1.96	-	-
Symphoricarpos oreophilus	.25	-	-



KEY BROWSE ANNUAL LEADER GROWTH--  
Management unit 10R, Study no: 36

Species	Average leader growth (in) '10
Amelanchier utahensis	2.7
Purshia tridentata	1.4

POINT-QUARTER TREE DATA--  
Management unit 10R, Study no: 36

Species	Trees per Acre			Average diameter (in)		
	'06	'09	'10	'06	'09	'10
Juniperus osteosperma	212	47	84	1.1	0.8	0.9
Pinus edulis	608	120	103	3.2	0.8	0.7

BASIC COVER--  
Management unit 10R, Study no: 36

Cover Type	Average Cover %		
	'06	'09	'10
Vegetation	28.15	37.67	35.74
Rock	11.41	1.83	1.82
Pavement	14.43	12.55	5.87
Litter	50.68	43.13	39.34
Cryptogams	2.67	.46	.05
Bare Ground	16.11	19.71	24.06

SOIL ANALYSIS DATA --  
Management unit 10R, Study no: 36, Study Name: Indian Springs

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
9.0	7.0	27.3	38.4	34.3	6.3	12.6	115.2	1.2

PELLET GROUP DATA--  
Management unit 10R, Study no: 36

Type	Quadrat Frequency			Days use per acre (ha)		
	'06	'09	'10	'06	'09	'10
Rabbit	27	9	2	-	-	-
Elk	11	10	4	17 (41)	21 (51)	12 (30)
Deer	1	2	3	10 (25)	9 (22)	14 (35)
Cattle	-	1	-	-	1 (2)	2 (5)

BROWSE CHARACTERISTICS--  
Management unit 10R, Study no: 36

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Amelanchier utahensis</i>									
06	860	26	70	5	220	21	0	0	58/50
09	No density data collected								15/29
10	40	50	50	0	40	50	0	0	23/33
<i>Artemisia nova</i>									
06	1720	3	49	48	80	3	1	29	12/19
09	No density data collected								13/19
10	2460	25	68	7	520	11	2	6	9/20
<i>Artemisia tridentata vaseyana</i>									
06	0	0	0	0	-	0	0	0	-/-
09	No density data collected								6/4
10	1340	48	49	3	320	7	15	0	7/10
<i>Atriplex canescens</i>									
06	0	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	20	0	100	-	-	0	100	0	18/19
<i>Ceratoides lanata</i>									
06	0	0	0	-	-	0	0	0	-/-
09	No density data collected								7/12
10	0	0	0	-	-	0	0	0	-/-
<i>Cercocarpus montanus</i>									
06	280	7	64	29	-	50	14	14	37/31
09	No density data collected								11/11
10	180	78	22	0	-	44	11	0	12/14
<i>Chrysothamnus depressus</i>									
06	1260	0	86	14	-	16	62	10	4/8
09	No density data collected								6/12
10	3900	4	96	0	-	0	0	0	4/10
<i>Chrysothamnus viscidiflorus stenophyllus</i>									
06	0	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	40	0	100	-	-	0	0	0	9/11
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
06	0	0	0	-	-	0	0	0	-/-
09	No density data collected								10/12
10	400	0	100	-	-	0	0	0	11/18
<i>Eriogonum microthecum</i>									
06	0	0	0	-	-	0	0	0	-/-
09	No density data collected								1/4
10	0	0	0	-	-	0	0	0	-/-

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<b>Gutierrezia sarothrae</b>									
06	0	0	0	-	-	0	0	0	-/-
09	No density data collected								8/10
10	0	0	0	-	-	0	0	0	-/-
<b>Juniperus osteosperma</b>									
06	180	67	33	-	80	0	0	11	-/-
09	No density data collected								-/-
10	100	100	0	-	20	0	0	0	-/-
<b>Kochia prostrata</b>									
06	0	0	0	-	-	0	0	0	-/-
09	No density data collected								8/14
10	0	0	0	-	-	0	0	0	-/-
<b>Leptodactylon pungens</b>									
06	20	0	100	-	-	0	0	0	-/-
09	No density data collected								-/-
10	0	0	0	-	-	0	0	0	-/-
<b>Pediocactus simpsonii</b>									
06	40	0	100	-	-	0	0	0	1/2
09	No density data collected								-/-
10	20	0	100	-	-	0	0	0	1/2
<b>Pinus edulis</b>									
06	1200	65	32	3	980	0	3	2	-/-
09	No density data collected								-/-
10	80	100	0	0	60	0	0	0	-/-
<b>Pseudotsuga menziesii</b>									
06	80	100	0	-	20	0	0	0	-/-
09	No density data collected								-/-
10	0	0	0	-	-	0	0	0	-/-
<b>Purshia tridentata</b>									
06	340	24	47	29	-	47	0	18	16/31
09	No density data collected								15/39
10	460	0	100	0	-	57	22	0	17/48

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Quercus gambelii</i>									
06	<b>780</b>	49	46	5	420	0	0	5	27/29
09	No density data collected								-/-
10	<b>0</b>	0	0	0	-	0	0	0	-/-
<i>Symphoricarpos oreophilus</i>									
06	<b>40</b>	0	100	-	-	0	0	0	11/17
09	No density data collected								30/50
10	<b>80</b>	25	75	-	-	0	0	0	26/50
<i>Tetradymia canescens</i>									
06	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	<b>20</b>	0	100	-	-	0	0	0	6/14

WINTER RIDGE BULLHOG - TREND STUDY NO. 10R-41-10

[Project #685](#)

Vegetation Type: Pinyon/Juniper, Mountain Big Sagebrush

Range Type: Substantial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Upland Loam (Wyoming Big Sagebrush), R034XY306UT

Land Ownership: BLM

Elevation: 7,380 ft. (2,249 m)

Aspect: Southeast

Slope: 4%

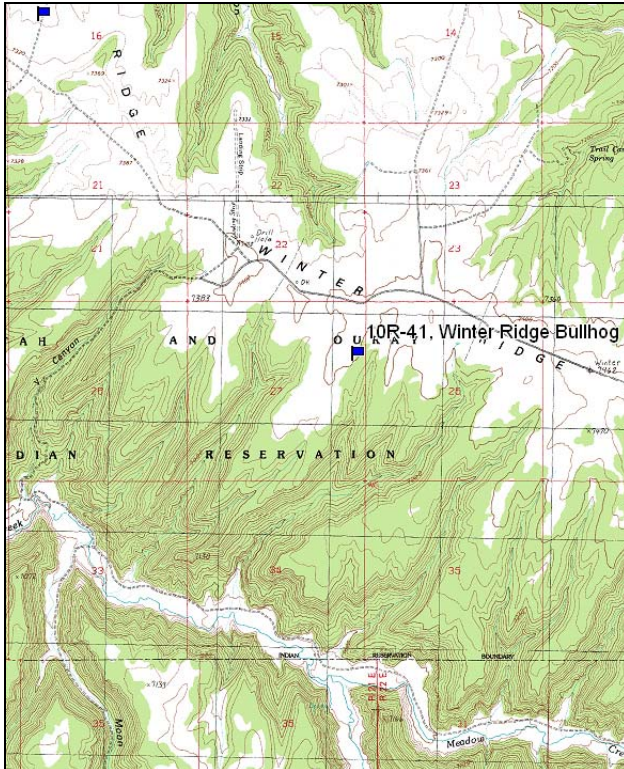
Transect bearing: 185° magnetic

Belt placement: line 1 (11ft & 95 ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

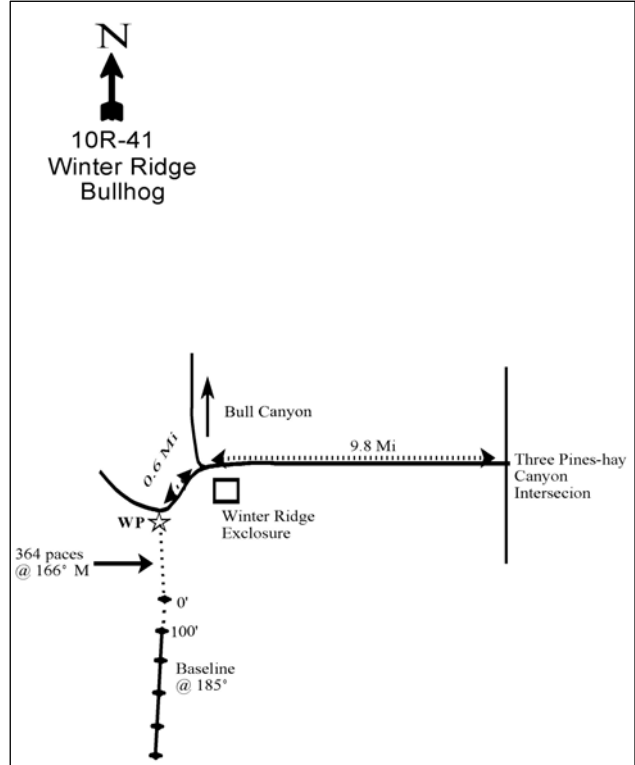
From the intersection of the Seep Ridge and Book Cliff Divide road, proceed west along the divide for 9.4 miles to the major Three Pines-Hay Canyon intersection. Drive west along the Winter Ride Rd for 9.8 miles to a fork. Stay left continuing to the west for 0.6 miles to a witness post on the left side of the road. The 0-foot stake is 364 paces from the witness post at 166 degrees magnetic. The 0-foot stake is marked by browse tag #141.

Map Name: Tenmile Canyon North



Township: 15S Range: 21E Section: 27

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 625125 E 4371785 N

WINTER RIDGE BULLHOG - WRI STUDY 10R-41  
[Project #685](#)

## Site Description

Site Information: The study was established in 2007 to monitor a pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) bullhog on Winter Ridge within the Book Cliffs. Initially, the project was part of lop and scatter treatment over 7,000 acres. The transect lies within the [WRI project 358](#) polygon boundary, which was a lop and scatter. However, this area was too thick for lop and scatter to be effective and it was decided to use a bullhog instead. This project was designed to enhance sage-grouse and big game habitat and preserve sagebrush communities (WRI Database 2011). In 2010, the study transect belt five was moved to line one and line five was eliminated because it fell outside of the treatment area. Pellet group data estimated light use by elk, deer, cattle and horses in 2007 and light use by cattle and horses in 2010 (Table - Pellet Group Data).

Browse: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the most common preferred browse. Dwarf rabbitbrush (*Chrysothamnus depressus*) and broom snakeweed (*Gutierrezia sarothrae*) are also found on the site. The mountain big sagebrush is a lightly used, mature population with high decadence. Poor vigor of sagebrush has been mostly high over the sample years. Recruitment of young sagebrush plants has been fairly poor. The dwarf rabbitbrush population is a lightly used, mature population with low decadence. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) were effectively removed from this site by the treatment to allow the understory to expand (Table - Browse Characteristics).

Herbaceous Understory: Grasses are diverse but are not particularly abundant. Needle-and-thread (*Stipa comata*), Sandberg bluegrass (*Poa secunda*) and prairie junegrass (*Koeleria cristata*) are the most common perennial grass species, though not abundant on the site. Forb species are diverse, but not overly abundant. There was more diversity of forbs after the treatment, though the frequency and cover remained low. Bladderpod (*Lesquerella* sp.) and desert phlox (*Phlox austromontana*) are the dominant forb species (Table - Herbaceous Trends).

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 7.3) (Table - Soil Analysis Data). Bare ground cover is moderate with a high amount of litter from the debris left after the bullhog project providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as critical in 2007 due to pedestalling around most of the shrubs, evidence of surface litter, rock, and soil movement, and the formation of flow patterns and rills, but had improved to stable in 2010.

## Pre vs. Three Years Post Treatment, 2007 vs. 2010

Browse: The bullhog reduced the density of pinyon pine from 837 trees/acre to 157 trees/acre and Utah juniper from 103 trees/acre to 58 trees/acre. Mountain big sagebrush cover decreased slightly from 3% to 2% and density declined 31% from 1,560 plants/acre to 1,080 plants/acre. Recruitment of young remained low at 7%, but decadence decreased from 65% to 33% with an attendant increase in the percentage of mature plants (29% to 59%). Low rabbitbrush density increased 51% from 500 plants/acre to 760 plants/acre, while decadence declined from 28% to 5% of the population.

Grasses: The sum of nested frequency of perennial grasses increased 11%, but the overall cover remained similar at 3%. Needle-and-thread was the only species to provide at least 1% cover.

Forbs: The nested frequency of perennial forbs increased 9%, but cover nearly doubled from 3 to 5%. Bladderpod, tufted milkvetch (*Astragalus spatulatus*) and desert phlox provided the majority of the cover with each species providing 1% cover. After the treatment, diversity of forb species increased with nine new species being sampled, though frequency was low.

HERBACEOUS TRENDS--

Management unit 10R, Study no: 41

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron dasystachyum	5	17	.01	.14
G	Agropyron spicatum	26	19	.54	.23
G	Bouteloua gracilis	6	14	.06	.10
G	Carex sp.	25	31	.10	.30
G	Koeleria cristata	51	40	.31	.38
G	Oryzopsis hymenoides	<sub>b</sub> 34	<sub>a</sub> -	.35	-
G	Poa fendleriana	<sub>a</sub> -	<sub>b</sub> 13	-	.05
G	Poa secunda	46	42	.44	.29
G	Sitanion hystrix	12	13	.02	.20
G	Stipa comata	<sub>a</sub> 51	<sub>b</sub> 95	.52	1.03
Total for Annual Grasses		0	0	0	0
Total for Perennial Grasses		256	284	2.37	2.75
Total for Grasses		256	284	2.37	2.75
F	Antennaria rosea	-	7	-	.04
F	Arabis sp.	9	6	.09	.03
F	Arenaria sp.	24	22	.12	.03
F	Astragalus convallarius	2	1	.00	.00
F	Astragalus sp.	4	-	.01	-
F	Astragalus spatulatus	<sub>a</sub> 12	<sub>b</sub> 30	.03	.94
F	Castilleja linariaefolia	-	4	-	.03
F	Cryptantha sp.	-	5	-	.03
F	Erigeron pumilus	-	9	-	.10
F	Erigeron sp.	<sub>b</sub> 22	<sub>a</sub> 3	.16	.06
F	Eriogonum alatum	1	-	.03	.00
F	Eriogonum sp.	-	4	-	.03
F	Haplopappus acaulis	<sub>b</sub> 34	<sub>a</sub> 2	.58	.00
F	Hymenoxys acaulis	<sub>a</sub> 12	<sub>b</sub> 35	.05	.48
F	Lactuca serriola (a)	-	3	-	.00
F	Lappula occidentalis (a)	-	2	-	.15
F	Lesquerella sp.	68	81	.31	1.17
F	Machaeranthera grindelioides	15	22	.13	.39
F	Penstemon caespitosus	31	46	.45	.57
F	Penstemon sp.	5	-	.03	-
F	Phlox austromontana	74	61	.62	.95
F	Phlox longifolia	-	1	-	.00
F	Senecio multilobatus	-	3	-	.03
F	Tragopogon dubius (a)	4	8	.01	.03
Total for Annual Forbs		4	13	0.00	0.18
Total for Perennial Forbs		313	342	2.64	4.97
Total for Forbs		317	355	2.65	5.15

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 10R, Study no: 41

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia tridentata vaseyana	47	38	3.21	1.60
B	Ceratoides lanata	0	1	-	-
B	Chrysothamnus depressus	12	20	-	.24
B	Gutierrezia sarothrae	40	39	.88	.67
B	Juniperus osteosperma	5	1	1.78	1.19
B	Opuntia sp.	3	2	.00	.00
B	Pinus edulis	24	11	4.81	1.72
Total for Browse		131	112	10.71	5.45

CANOPY COVER, LINE INTERCEPT--

Management unit 10R, Study no: 41

Species	Percent Cover	
	'07	'10
Artemisia tridentata vaseyana	3.04	2.15
Chrysothamnus depressus	.13	.13
Gutierrezia sarothrae	1.03	.43
Juniperus osteosperma	11.86	2.68
Opuntia sp.	.01	-
Pinus edulis	18.36	.88

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 10R, Study no: 41

Species	Average leader growth (in)
	'10
Artemisia tridentata vaseyana	1.5

POINT-QUARTER TREE DATA--

Management unit 10R, Study no: 41

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	103	58	5.5	4.7
Pinus edulis	837	157	2.4	1.3



BASIC COVER--

Management unit 10R, Study no: 41

Cover Type	Average Cover %	
	'07	'10
Vegetation	16.72	15.20
Rock	5.05	1.28
Pavement	2.32	.01
Litter	45.18	59.97
Cryptogams	4.11	1.06
Bare Ground	40.31	25.59

SOIL ANALYSIS DATA --

Management unit 10R, Study no: 41, Study Name: Winter Ridge Bullhog

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.3	28.2	40.4	31.4	3.8	9.2	51.2	0.6

PELLET GROUP DATA--

Management unit 10R, Study no: 41

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	51	3	-	-
Horse	3	1	-	5 (13)
Elk	10	-	-	-
Deer	1	-	-	-
Cattle	-	-	-	1 (2)

BROWSE CHARACTERISTICS--  
Management unit 10R, Study no: 41

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata vaseyana</i>										
07	<b>1560</b>	5	29	65	20	19	5	44	19/23	
10	<b>1080</b>	7	59	33	20	19	2	20	17/19	
<i>Ceratoides lanata</i>										
07	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>20</b>	0	100	-	-	0	0	0	9/6	
<i>Chrysothamnus depressus</i>										
07	<b>500</b>	0	72	28	-	4	12	12	4/6	
10	<b>760</b>	8	87	5	-	26	0	0	5/7	
<i>Gutierrezia sarothrae</i>										
07	<b>3600</b>	5	94	1	360	0	0	1	8/6	
10	<b>2260</b>	48	52	0	140	0	0	0	6/6	
<i>Juniperus osteosperma</i>										
07	<b>120</b>	50	50	-	-	0	0	0	-/-	
10	<b>20</b>	100	0	-	60	0	0	0	-/-	
<i>Opuntia sp.</i>										
07	<b>60</b>	0	100	-	20	0	0	0	2/7	
10	<b>40</b>	0	100	-	-	0	0	50	3/11	
<i>Pinus edulis</i>										
07	<b>660</b>	67	33	-	240	3	0	0	-/-	
10	<b>280</b>	100	0	-	220	0	0	0	-/-	

WINTER RIDGE BULLHOG - TREND STUDY NO. 10R-42-10

[Project #685](#)

Vegetation Type: Pinyon/Juniper, Mountain Big Sagebrush

Range Type: Substantial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Upland Loam (Wyoming Big Sagebrush), R034XY306UT

Land Ownership: BLM

Elevation: 7,400 ft. (2,256 m)

Aspect: Southeast

Slope: 7%

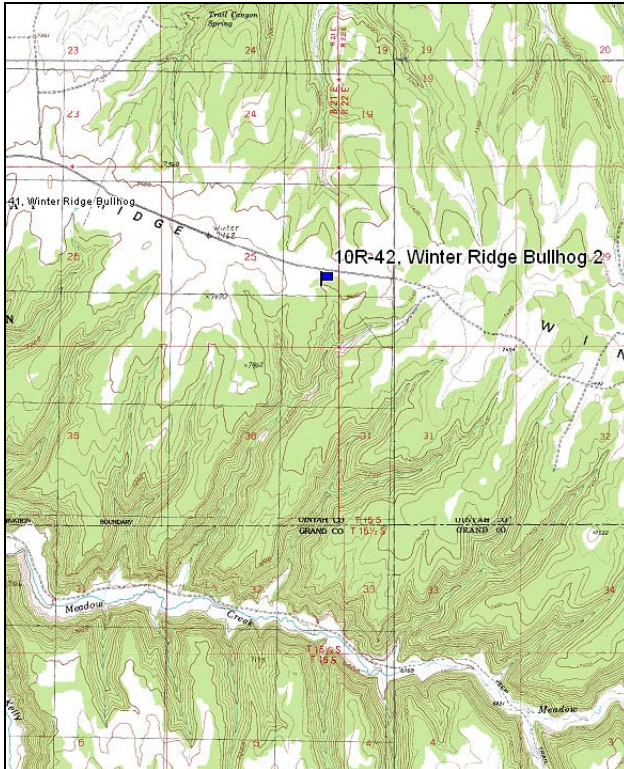
Transect bearing: 240° magnetic

Belt placement: line 1 (59ft), line 2 (71ft), line 3 (95ft), 220°M, line 4 (34ft), line 5 (11 ft)

Directions:

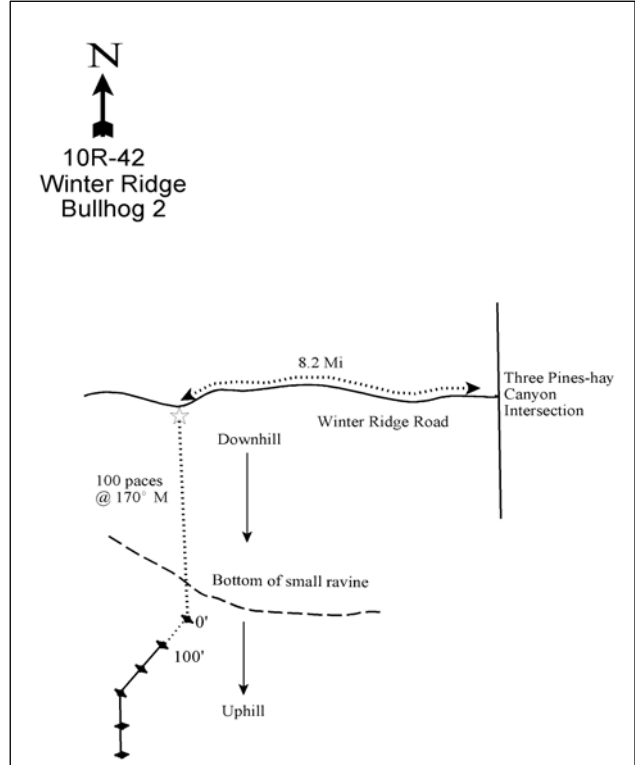
From the intersection of the Seep Ridge and Book Cliff Divide Roads, proceed west along the divide for 9.4 miles to the major Three Pines-Hay Canyon intersection. Drive west along Winter Ridge Road for 8.2 miles to a witness post on the left side of the road. From the witness post, the 0-foot stake is 100 paces at 170 degrees magnetic, near the bottom of a small gully. The 0-foot stake is marked with browse tag #140.

Map Name: Tenmile Canyon North



Township: 15S Range: 21E Section: 25

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 628293 E 4371299 N

WINTER RIDGE BULLHOG 2 - WRI STUDY 10R-42  
[Project #685](#)

## Site Description

Site Information: The study was established in 2007 to monitor a pinyon pine (*Pinus edulis*), Rocky Mountain juniper (*Juniperus scopulorum*), and Utah juniper (*J. osteosperma*) bullhog treatment on Winter Ridge within the Book Cliffs. Initially, the project was part of a lop and scatter over 7,000 acres. However, the area was too thick for lop and scatter to be effective. This project was designed to enhance sage-grouse and big game habitat, and preserve sagebrush communities (WRI Database 2011). In 2010, the study transect lines one and two were moved and placed at the end of line five because line one and line two fell outside of the treatment area. Pellet group data estimated light use by elk, deer, cattle and horses in 2007, and light use by deer, cattle and horses in 2010 (Table - Pellet Group Data).

Browse: The preferred browse species are mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), dwarf rabbitbrush (*Chrysothamnus depressus*) and antelope bitterbrush (*Purshia tridentata*). The decadence of mountain big sagebrush has been high since the outset of the study. Vigor of sagebrush has improved since the treatment, but poor vigor still remains moderately high. Recruitment of young sagebrush was poor in 2007, but was excellent in 2010. Utilization of sagebrush has been mostly moderate since the outset of the study. The dwarf rabbitbrush population is moderately used, mature population with good vigor and low decadence over the sample years (Table - Browse Characteristics). Utah juniper (*Juniperus osteosperma*), Rocky Mountain juniper (*Juniperus scopulorum*) and pinyon pine (*Pinus edulis*) provided the majority of line intercept cover prior to treatment, but cover was greatly reduced following the treatment (Table - Canopy Cover).

Herbaceous Understory: Perennial grasses are diverse and fairly abundant. Blue grama (*Bouteloa gracilis*), prairie junegrass (*Koeleria cristata*) and needle-and-thread (*Stipa comata*) are the dominant grass species. No annual grass species have been sampled on this site. Perennial forb species are diverse and common. Rose pussytoes (*Antennaria rosea*) and mat penstemon (*Penstemon caespitosus*) are the most common forb species (Table - Herbaceous Trends).

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover was low in 2010, but was moderately high in 2007. Litter and vegetation provided a high amount of protective ground cover (Table - Basic Cover). The soil erosion condition was classified as critical in 2007 due to pedestalling, evidence of surface litter, rock and soil movement, the formation of flow patterns and rills, but had improved to stable in 2010.

## Pre vs. Three Years Post Treatment Assessment, 2007 vs. 2010

Browse: Juniper and pinyon pine cover were reduced from 27% to 2%. Pinyon density decreased from 297 trees/acre with an average diameter of 3.6 inches to 130 trees/acre with an average diameter of 0.8 inches. Utah juniper density followed a similar pattern decreasing from a density of 69 trees/acre with an average diameter of 8.6 inches to 27 trees/acre with an average diameter of 1 inch. Mountain big sagebrush cover decreased from 4% to 2% while density decreased 16% from 1,800 plants/acre to 1,520 plants/acre. The recruitment of young sagebrush increased from 3% to 29% of the population. The density of dwarf rabbitbrush decreased 50% from 9,300 plant/acre to 4,640 plants/acre.

Grasses: The sum of nested frequency of perennial grasses decreased slightly by 11%, though cover remained similar at 10%. Blue grama increased significantly in nested frequency and cover increased from 3% to 6%. The nested frequency of prairie junegrass and Sandberg bluegrass (*Poa secunda*) both decreased significantly.

Forbs: The perennial forb sum of nested frequency changed little and cover remained similar at 6%. Rose pussytoes significantly decreased in nested frequency and cover declined from 3% to 2%.

HERBACEOUS TRENDS--

Management unit 10R, Study no: 42

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron dasystachyum	a46	b84	.36	.86
G	Agropyron spicatum	b30	a3	.25	.03
G	Bouteloua gracilis	a92	b152	3.23	5.65
G	Carex sp.	b38	a4	.22	.01
G	Elymus junceus	3	12	.03	.07
G	Koeleria cristata	a120	72	2.60	1.08
G	Oryzopsis hymenoides	11	7	.36	.07
G	Poa fendleriana	b50	a35	.62	.45
G	Poa secunda	b133	a88	.97	.80
G	Stipa comata	76	76	1.11	1.22
Total for Annual Grasses		0	0	0	0
Total for Perennial Grasses		599	533	9.77	10.25
Total for Grasses		599	533	9.77	10.25
F	Agoseris glauca	-	2	-	.00
F	Androsace septentrionalis (a)	-	3	-	.00
F	Antennaria rosea	b146	a107	2.76	2.12
F	Arabis sp.	4	-	.01	.00
F	Arenaria sp.	-	4	-	.00
F	Astragalus convallarius	8	8	.04	.06
F	Astragalus spatulatus	a5	b14	.04	.21
F	Calochortus nuttallii	a-	b31	-	.14
F	Castilleja flava	a-	b40	-	.17
F	Crepis acuminata	8	6	.03	.06
F	Cryptantha sp.	5	12	.00	.09
F	Cymopterus sp.	a-	b16	-	.04
F	Draba sp. (a)	-	10	.00	.02
F	Erigeron pumilus	a5	b13	.01	.14
F	Erigeron sp.	b51	a14	.27	.11
F	Eriogonum alatum	12	2	.11	.15
F	Euphorbia brachycera	1	2	.03	.03
F	Gayophytum ramosissimum(a)	-	4	-	.03
F	Haplopappus acaulis	11	-	.04	-
F	Hymenoxys acaulis	2	11	.00	.19
F	Hymenoxys richardsonii	-	2	-	.03
F	Ipomopsis aggregata	-	-	.00	-
F	Lesquerella sp.	28	34	.18	.61
F	Lupinus argenteus	4	-	.01	-
F	Machaeranthera grindelioides	b16	a3	.07	.06
F	Orthocarpus sp. (a)	b91	a7	1.20	.01
F	Penstemon caespitosus	54	60	.52	1.22
F	Penstemon sp.	2	4	.15	.06
F	Phlox austromontana	b44	a12	.88	.10
F	Phlox longifolia	38	53	.19	.16

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
F	Senecio multilobatus	-	1	.00	.00
F	Sphaeralcea grossulariifolia	11	6	.08	.16
F	Unknown forb-annual (a)	1	-	.00	-
Total for Annual Forbs		92	24	1.21	0.07
Total for Perennial Forbs		455	457	5.49	5.97
Total for Forbs		547	481	6.70	6.04

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 10R, Study no: 42

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Abies sp.	1	0	.38	-
B	Artemisia tridentata vaseyana	46	38	2.58	.99
B	Cercocarpus montanus	2	0	-	-
B	Chrysothamnus depressus	69	56	2.40	2.09
B	Chrysothamnus viscidiflorus viscidiflorus	4	7	.03	.04
B	Gutierrezia sarothrae	58	77	1.57	1.83
B	Juniperus osteosperma	6	3	1.99	.38
B	Juniperus scopulorum	5	0	1.46	-
B	Pinus edulis	16	6	3.59	1.38
B	Pinus ponderosa	4	0	.86	-
B	Purshia tridentata	11	1	.86	.00
B	Tetradymia canescens	0	2	-	-
Total for Browse		222	190	15.74	6.74

#### CANOPY COVER, LINE INTERCEPT--

Management unit 10R, Study no: 42

Species	Percent Cover	
	'07	'10
Abies sp.	.01	-
Artemisia tridentata vaseyana	4.03	2.21
Cercocarpus montanus	.30	-
Chrysothamnus depressus	3.00	1.75
Chrysothamnus viscidiflorus viscidiflorus	-	.05
Gutierrezia sarothrae	1.68	2.23
Juniperus osteosperma	7.75	1.13
Juniperus scopulorum	4.40	-
Pinus edulis	14.46	1.10
Pinus ponderosa	.96	-
Purshia tridentata	1.10	.26

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 10R, Study no: 42

Species	Average leader growth (in)	
	'07	'10
Artemisia tridentata vaseyana	1.6	2.7
Purshia tridentata	4.2	2.3

POINT-QUARTER TREE DATA--

Management unit 10R, Study no: 42

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	69	69	8.6	8.6
Pinus edulis	297	297	3.6	0.8

BASIC COVER--

Management unit 10R, Study no: 42

Cover Type	Average Cover %	
	'07	'10
Vegetation	33.20	29.00
Rock	.94	1.77
Pavement	2.65	2.24
Litter	37.62	55.47
Cryptogams	6.46	1.30
Bare Ground	33.34	19.55

SOIL ANALYSIS DATA --

Management unit 10R, Study no: 42, Study Name: Winter Bridge Bullhog 2

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.2	30.2	42.4	27.4	1.9	10.9	83.2	0.5

PELLET GROUP DATA--

Management unit 10R, Study no: 42

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	32	7	-	-
Horse	-	1	7 (17)	5 (12)
Elk	3	2	7 (17)	-
Deer	4	3	3 (7)	17 (42)
Cattle	-	3	6 (14)	3 (7)

BROWSE CHARACTERISTICS--  
Management unit 10R, Study no: 42

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Abies sp.</i>									
07	20	100	0	-	40	0	0	0	-/-
10	0	0	0	-	-	0	0	0	-/-
<i>Artemisia tridentata vaseyana</i>									
07	1800	3	27	70	20	36	6	32	26/26
10	1520	29	32	39	200	28	13	16	19/18
<i>Cercocarpus montanus</i>									
07	60	67	33	-	-	33	33	0	22/19
10	0	0	0	-	-	0	0	0	-/-
<i>Chrysothamnus depressus</i>									
07	9300	6	92	3	20	7	13	.43	5/8
10	4640	10	88	2	-	12	40	.86	5/9
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
07	100	0	100	-	-	0	0	0	8/7
10	200	10	90	-	40	0	0	0	8/9
<i>Gutierrezia sarothrae</i>									
07	5020	3	94	2	280	0	0	2	7/7
10	5160	50	50	0	320	.38	0	.38	7/7
<i>Juniperus osteosperma</i>									
07	140	43	43	14	40	0	0	0	-/-
10	60	67	0	33	-	0	0	33	-/-
<i>Juniperus scopulorum</i>									
07	100	60	40	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	-/-
<i>Pinus edulis</i>									
07	340	53	41	6	580	0	0	0	-/-
10	120	83	17	0	180	0	0	17	-/-
<i>Pinus ponderosa</i>									
07	80	75	25	-	-	0	0	50	-/-
10	0	0	0	-	-	0	0	0	-/-
<i>Purshia tridentata</i>									
07	280	7	79	14	-	14	14	7	20/36
10	20	0	100	0	20	0	0	0	11/22
<i>Tetradymia canescens</i>									
07	0	0	0	-	-	0	0	0	7/7
10	40	100	0	-	-	50	0	0	7/9



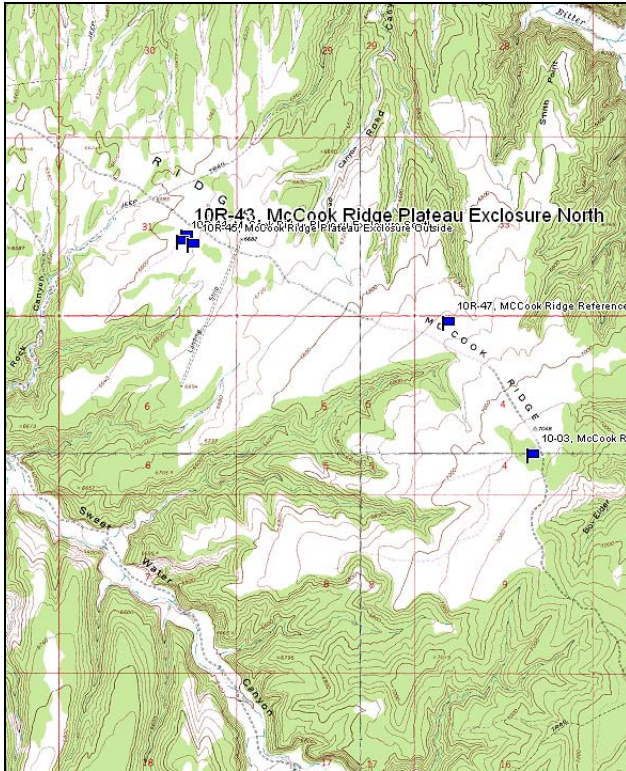
McCOOK PLATEAU ENCLOSURE NORTH - TREND STUDY NO. 10R-43-10  
[Project #1109](#)

Vegetation Type: Winterfat, Perennial Grass  
Range Type: Crucial Deer Winter, Crucial Elk Winter  
NRCS Ecological Site Description: Upland Stony Loam (Wyoming Big Sagebrush), R034XY334UT  
Land Ownership: BLM  
Elevation: 6,550 ft. (1,996 m)  
Aspect: West  
Slope: 4%  
Transect bearing: 120° magnetic  
Belt placement: line 1 (11ft, 59 ft, & 95 ft), line 2 (34ft & 71)  
Notes: No rebar

Directions:

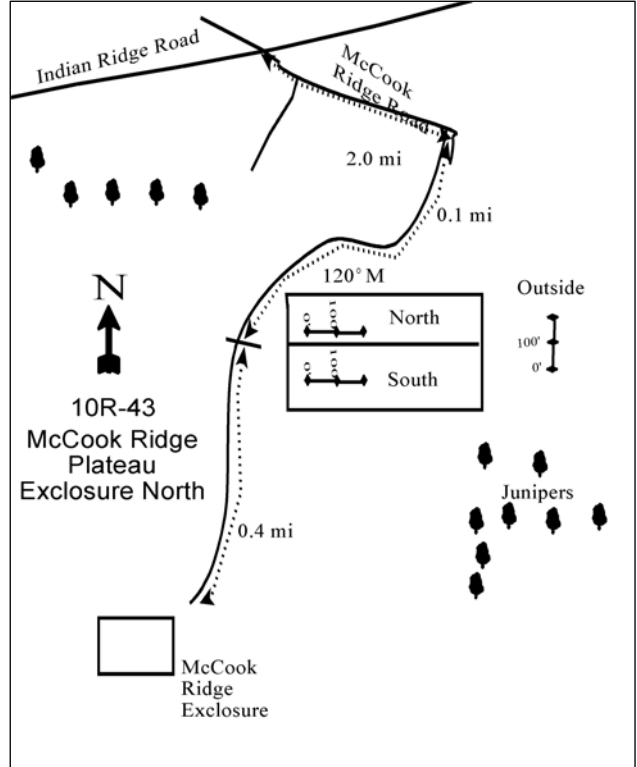
From Ouray, go 38 miles south to the McCook Ridge-Indian Ridge turnoff. Turn left (east) and travel on the Indian Ridge road towards Sweetwater Canyon and McCook Ridge 9.1 miles to the intersection of Cooper Canyon, Indian Ridge and McCook Ridge. From Indian Ridge road, turn southeast and proceed up McCook Ridge approximately 2 miles to road on the right. Turn right and drive 0.1 miles to the enclosure on the left side of the road. The 0' stake is marked with browse tag # 253.

Map Name: Cooper Canyon



Township: 13S Range: 24E Section: 31

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 648497 E 4389446 N

McCOOK RIDGE PLATEAU EXCLOSURE NORTH - WRI STUDY 10R-43  
[Project #1109](#)

**Site Description**

Site Information: The study is located on McCook Ridge at the head of Slick Rock Canyon and Road Canyon. The study was established prior to the construction of a total enclosure in 2008 to monitor the effects of a Plateau herbicide (Imazapic) application on a cheatgrass dominated area of the Book Cliffs. The site is referenced by the McCook Plateau Enclosure South (10R-44) and McCook Plateau Outside (10R-45) studies which were treated with Plateau and seeded, and is also referenced by the McCook Ridge Enclosure (10-2), McCook Ridge Livestock Enclosure (10R-13) and McCook Ridge Total Enclosure (10R-14) which was not treated with Plateau or seeded. This area has seen a decrease in perennial grasses and shrubs and an increase in invasive cheatgrass (*Bromus tectorum*). In order to restore perennial grasses, forbs, and shrubs, 400 acres were sprayed with Plateau and drill seeded. An enclosure complex was constructed to evaluate the effects of wildlife and livestock use on the treatment area. The enclosure was treated one year before the rest of the area (WRI Database 2011). Pellet group data estimated light use by cattle, deer, and elk in 2008, but no pellet groups were sampled in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 10R, Study no: 43

Project Name: McCook Ridge Cheatgrass					
WRI Database #: 1109					
Application: Drill Seed		Acres: 400		Application: Drill (fluffy seed box)	
Acres: 400		Acres: 400			
Seed type		lbs in mix	lbs/acre	Seed type	
G	Snake River Wheatgrass 'Secar'	400	1.00	B	Sagebrush, Wyoming
G	Thickspike Wheatgrass 'Critana'	400	1.00	B	Forage Kochia 'Immigrant'
G	Indian Ricegrass 'Rimrock'	400	1.00	Total Pounds:	
G	Russian Wildrye 'Bozoisky'	400	1.00	600	
G	Bottlebrush Squirreltail 'Toe Jam'	200	0.50	PLS Pounds:	
G	Canby Bluegrass 'Canbar'	100	0.25	0.78	
G	Crested Wheatgrass 'Douglas'	400	1.00		
G	Crested Wheatgrass 'Hycrest'	400	1.00		
F	Scarlet Globemallow	20	0.05		
F	Alfalfa 'Ladak'	600	1.50		
F	Blue Flax 'Appar'	100	0.25		
B	Fourwing Saltbush	400	1.00		
Total Pounds:		3820	9.55		
PLS Pounds:			7.78		

Browse: The dominant browse species sampled within the total enclosure are fringed sagebrush (*Artemisia frigida*) and winterfat (*Ceratoides lanata*). Fourwing saltbush (*Atriplex canescens*) and broom snakeweed (*Gutierrezia sarothrae*) also occur in low abundance. The recruitment of young winterfat plants was poor at the outset of the study, but since then has been good. Utilization of winterfat was mostly heavy in 2008, but since the construction of the enclosure there has been light utilization reported. Use of fringed sagebrush and fourwing saltbush was light to moderate in 2008 prior to the construction of the enclosure. (Table - Browse Characteristics).

Herbaceous Understory: When the study was established, cheatgrass (*Bromus tectorum*) was the dominant grass species, although thickspike wheatgrass (*Agropyron dasystachyum*) was also common. The Plateau treatment significantly decreased the frequency and cover of cheatgrass, and thickspike wheatgrass increased

substantially in cover and is now the dominant grass species on the site. Other less common perennial grass species include Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass (*Poa secunda*) and bottlebrush squirreltail (*Sitanion hystrix*). Perennial forbs are rare on the site. Forb species are dominated by the annual species annual stickseed (*Lappula occidentalis*) (Table - Herbaceous Trends).

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is moderately high with a high amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### Pre vs. Two Years Post Treatment Assessment, 2008 vs. 2010

Browse: Canopy cover of preferred browse species increased from 16% to 19%. Winterfat cover decreased substantially from 12% to 9%, and density decreased slightly by 9% from 23,000 plants/acre to 20,820 plants/acre. Fringed sagebrush increased in cover from 3% to 9% and substantially increased in density by 86% from 5,360 plants/acre to 9,980 plants/acre.

Grasses: Cheatgrass decreased significantly in nested frequency and cover decreased from 14% to 4%. This was coupled with a significant increase in the nested frequency of thickspike wheatgrass and an increase in cover from 5% to 19%. The seeded species Indian ricegrass and bottlebrush squirreltail were sampled in low frequency and cover, though both species were present prior to seeding.

Forbs: Perennial forbs are rare and not diverse. The annual species annual stickseed is the dominant forb species on the site. Annual stickseed increased significantly in nested frequency and cover increased from 1% to 4%, accounting for the majority of forb cover.

#### HERBACEOUS TRENDS--

Management unit 10R, Study no: 43

Type	Species	Nested Frequency		Average Cover %	
		'08	'10	'08	'10
G	<i>Agropyron dasystachyum</i>	<sub>a</sub> 182	<sub>b</sub> 232	5.42	19.06
G	<i>Bromus tectorum</i> (a)	<sub>b</sub> 416	<sub>a</sub> 260	13.73	3.77
G	<i>Oryzopsis hymenoides</i>	15	8	.24	.19
G	<i>Poa secunda</i>	<sub>a</sub> 18	<sub>b</sub> 37	.09	.47
G	<i>Sitanion hystrix</i>	6	2	.01	.01
G	Unknown grass - perennial	<sub>a</sub> -	<sub>b</sub> 18	-	.39
Total for Annual Grasses		416	260	13.73	3.77
Total for Perennial Grasses		221	297	5.77	20.13
Total for Grasses		637	557	19.50	23.91
F	<i>Chenopodium fremontii</i> (a)	-	1	-	.00
F	<i>Descurainia pinnata</i> (a)	-	2	-	.03
F	<i>Lappula occidentalis</i> (a)	<sub>a</sub> 113	<sub>b</sub> 312	.56	3.57
F	<i>Ranunculus testiculatus</i> (a)	37	38	.05	.23
F	<i>Sphaeralcea coccinea</i>	33	30	.36	.38
F	<i>Townsendia</i> sp.	2	-	.00	-
F	<i>Trifolium</i> sp.	-	1	-	.00
Total for Annual Forbs		150	353	0.61	3.84
Total for Perennial Forbs		35	31	0.36	0.38
Total for Forbs		185	384	0.98	4.22

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 10R, Study no: 43

Type	Species	Strip Frequency		Average Cover %	
		'08	'10	'08	'10
B	Artemisia frigida	61	74	4.01	6.71
B	Atriplex canescens	9	18	.68	1.12
B	Ceratoides lanata	99	97	9.99	9.47
B	Gutierrezia sarothrae	3	4	.18	.15
Total for Browse		172	193	14.86	17.46

CANOPY COVER, LINE INTERCEPT--

Management unit 10R, Study no: 43

Species	Percent Cover	
	'08	'10
Artemisia frigida	3.26	9.26
Atriplex canescens	.31	1.06
Ceratoides lanata	12.26	8.66
Gutierrezia sarothrae	.01	.06

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 10R, Study no: 43

Species	Average leader growth (in) '10
Ceratoides lanata	2.3

BASIC COVER--

Management unit 10R, Study no: 43

Cover Type	Average Cover %	
	'08	'10
Vegetation	46.46	47.31
Rock	.05	.01
Pavement	5.47	1.61
Litter	33.90	35.91
Cryptogams	.01	.03
Bare Ground	28.45	30.31

SOIL ANALYSIS DATA --

Management unit 10R, Study no: 43,44,45, Study Name: McCook Plateau

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.2	34.0	39.4	26.6	1.7	5.5	201.6	0.6

PELLET GROUP DATA--

Management unit 10R, Study no: 43

Type	Quadrat Frequency		Days use per acre (ha)	
	'08	'10	'08	'10
Rabbit	74	5	-	-
Elk	3	-	2 (5)	-
Deer	52	1	15 (36)	-
Cattle	2	-	2 (5)	-

BROWSE CHARACTERISTICS--

Management unit 10R, Study no: 43

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia frigida</i>									
08	<b>5360</b>	3	85	12	80	16	0	.74	11/12
10	<b>9980</b>	8	92	0	1440	0	0	.20	9/12
<i>Atriplex canescens</i>									
08	<b>300</b>	7	60	33	-	27	0	7	34/37
10	<b>400</b>	30	55	15	-	0	0	0	20/29
<i>Ceratoides lanata</i>									
08	<b>23000</b>	4	87	10	240	37	51	1	11/11
10	<b>20820</b>	17	83	0	360	0	0	.09	8/10
<i>Gutierrezia sarothrae</i>									
08	<b>100</b>	0	100	-	-	0	0	0	8/8
10	<b>180</b>	0	100	-	-	0	0	0	8/12

McCOOK PLATEAU ENCLOSURE SOUTH - TREND STUDY NO. 10R-44-10

[Project #1109](#)

Vegetation Type: Winterfat, Perennial Grass

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Upland Stony Loam (Wyoming Big Sagebrush), R034XY334UT

Land Ownership: BLM

Elevation: 6,550 ft. (1,996 m)

Aspect: West

Slope: 4%

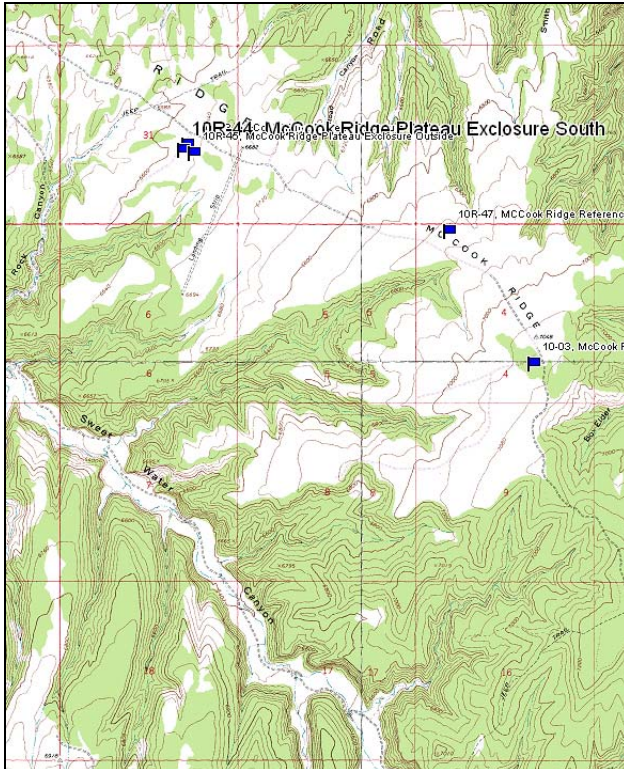
Transect bearing: 120° magnetic

Belt placement: line 1 (11ft, 59ft & 95ft), line 2 (34ft & 71 ft)

Directions:

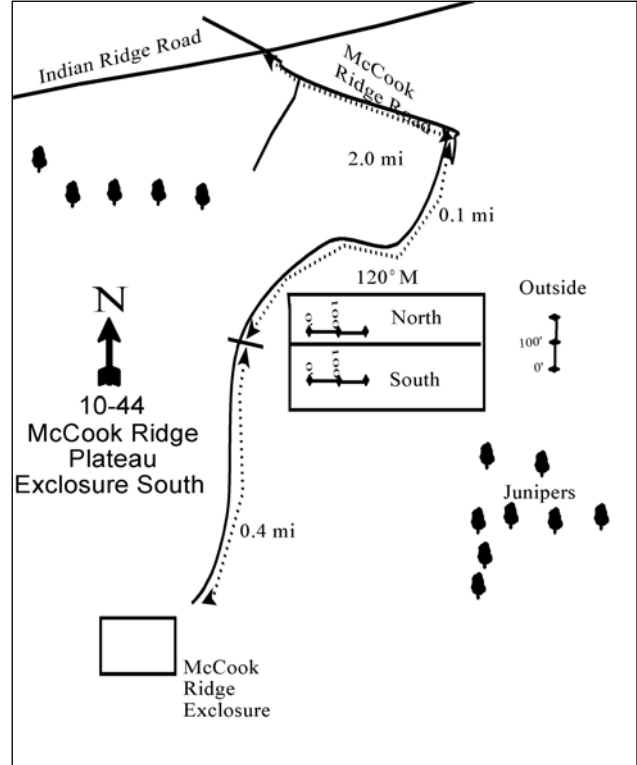
From Ouray, go 38 miles south to the McCook Ridge-Indian Ridge turnoff. Turn left (east) and travel on the Indian Ridge road towards Sweetwater Canyon and McCook Ridge 9.1 miles to the intersection of Cooper Canyon, Indian Ridge and McCook Ridge. From Indian Ridge road, turn southeast and proceed up McCook Ridge approximately 2 miles to road on the right. Turn right and drive 0.1 miles to the enclosure on the left side of the road. The 0' stake is marked with browse tag # 239.

Map Name: Cooper Canyon



Township: 13S Range: 24E Section: 31

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 648460 E 4389399 N

McCOOK RIDGE PLATEAU EXCLOSURE SOUTH - WRI STUDY 10R-44  
[Project #1109](#)

**Site Description**

Site Information: The study is located on McCook Ridge at the head of Slick Rock Canyon and Road Canyon. The study was established prior to the construction of a livestock enclosure in 2008 to monitor the effects of a Plateau herbicide (Imazapic) application on a cheatgrass dominated area of the Book Cliffs. The site is referenced by the McCook Plateau Enclosure North (10R-4) and McCook Plateau Outside (10R-45) studies which were treated with Plateau and seeded, and is also referenced by the McCook Ridge Enclosure (10-2), McCook Ridge Livestock Enclosure (10R-13) and McCook Ridge Total Enclosure (10R-14) which was not treated with Plateau or seeded. This area has seen a decrease in perennial grasses and shrubs and an increase in invasive cheatgrass (*Bromus tectorum*). In order to restore perennial grasses, forbs and shrubs, 400 acres were sprayed with Plateau and drill seeded. An enclosure complex was constructed to evaluate the effects of wildlife and livestock use on the treatment area. The enclosure was treated one year before the rest of the area (WRI Database 2011). Pellet group data estimated light use by cattle, deer, and elk in 2008, and no pellet groups were found in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 10R, Study no: 44

Project Name: McCook Ridge Cheatgrass					
WRI Database #: 1109					
Application: Drill Seed		Acres: 400		Application: Drill (fluffy seed box)	
				Acres: 400	
Seed type		lbs in mix	lbs/acre	Seed type	
G	Snake River Wheatgrass 'Secar'	400	1.00	B	Sagebrush, Wyoming
G	Thickspike Wheatgrass 'Critana'	400	1.00	B	Forage Kochia 'Immigrant'
G	Indian Ricegrass 'Rimrock'	400	1.00	Total Pounds:	
G	Russian Wildrye 'Bozoisky'	400	1.00	600	
G	Bottlebrush Squirreltail 'Toe Jam'	200	0.50	PLS Pounds:	
G	Canby Bluegrass 'Canbar'	100	0.25	0.78	
G	Crested Wheatgrass 'Douglas'	400	1.00		
G	Crested Wheatgrass 'Hycrest'	400	1.00		
F	Scarlet Globemallow	20	0.05		
F	Alfalfa 'Ladak'	600	1.50		
F	Blue Flax 'Appar'	100	0.25		
B	Fourwing Saltbush	400	1.00		
Total Pounds:		3820	9.55		
PLS Pounds:			7.78		

Browse: Preferred browse species on the site include fringed sagebrush (*Artemisia frigida*), fourwing saltbush (*Atriplex canescens*) and winterfat (*Ceratoides lanata*). Fringed sagebrush and winterfat are dominant browse providing the majority of the canopy cover (Table - Canopy Cover). The fringed sagebrush population is mostly mature with low decadence and good vigor. The recruitment of young fringed sagebrush plants has been low since the outset of the study. The winterfat population is relatively mature with low decadence over the sample years. The recruitment of young winterfat to the population was poor in 2008, but since then recruitment has been good. Utilization of winterfat has been moderate to heavy while the use of fringed sagebrush has been mostly light (Table - Browse Characteristics).

Herbaceous Understory: The herbaceous understory was dominated by annual forb and grass species in all sample years. Cheatgrass is the most dominant grass species, but has decreased following the Plateau treatment. The most common perennial grass species are thickspike wheatgrass (*Agropyron dasystachyum*)

and Sandberg bluegrass (*Poa secunda*). The seeded species bottlebrush squirreltail was sampled in 2010 in low abundance. Perennial forbs are very rare on the site. The forb composition is made up of mostly annual species. The dominant forb species is annual stickseed (*Lappula occidentalis*), which increased significantly in nested frequency and cover following the treatment (Table- Herbaceous Trends).

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is moderately high with a high amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### Pre vs. Two Years Post Treatment Assessment, 2008 vs. 2010

Browse: The density of fringed sagebrush increased 81% from 7,300 plants/acre to 13,200 plants/acre, while cover increased substantially from 3% to 14%. The recruitment of young fringed sagebrush plants remained poor at 5% of the population. The density of winterfat decreased by 17% from 22,620 plants/acre to 18,780 plants/acre and cover decreased from 14% to 11%. The recruitment of young winterfat plants increased from 3% to 14% of the population.

Grasses: The sum of nested frequency of perennial grasses increased by 28% and cover increased from 3% to 8%. Following the application of Plateau, the nested frequency of cheatgrass declined significantly and cover decreased from 17% to 6%. There was little change in the nested frequency of thickspike wheatgrass, but cover increased from 2% to 5%. Sandberg bluegrass increased significantly in nested frequency and slightly increase in cover from 1% to 2%.

Forbs: Perennial forbs are very rare on this site and no seeded species were sampled. The dominant forb, annual stickseed, increased in cover from 1% to 5% and accounted for nearly all of the forb cover in each sample year.

#### HERBACEOUS TRENDS--

Management unit 10R, Study no: 44

Type	Species	Nested Frequency		Average Cover %	
		'08	'10	'08	'10
G	Agropyron dasystachyum	95	72	2.09	5.30
G	Bromus tectorum (a)	<sub>b</sub> 429	<sub>a</sub> 311	16.57	5.48
G	Poa secunda	<sub>a</sub> 52	<sub>b</sub> 115	.71	1.95
G	Sitanion hystrix	-	3	-	.03
G	Unknown grass - perennial	<sub>a</sub> -	<sub>b</sub> 25	-	1.09
Total for Annual Grasses		429	311	16.57	5.48
Total for Perennial Grasses		147	215	2.80	8.39
Total for Grasses		576	526	19.37	13.88
F	Alyssum alyssoides (a)	29	53	.05	.39
F	Chenopodium fremontii (a)	-	3	-	.00
F	Descurainia pinnata (a)	-	10	-	.02
F	Lactuca serriola (a)	-	1	-	.03
F	Lappula occidentalis (a)	<sub>a</sub> 184	<sub>b</sub> 331	1.43	5.14
F	Ranunculus testiculatus (a)	18	20	.03	.08
F	Schoenrambe linifolia	-	6	-	.06
F	Townsendia sp.	4	-	.01	-
Total for Annual Forbs		231	418	1.50	5.67
Total for Perennial Forbs		4	6	0.00	0.06



Type	Species	Nested Frequency		Average Cover %	
		'08	'10	'08	'10
Total for Forbs		235	424	1.51	5.73

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 10R, Study no: 44

Type	Species	Strip Frequency		Average Cover %	
		'08	'10	'08	'10
B	Artemisia frigida	79	90	4.72	9.75
B	Atriplex canescens	14	14	1.67	2.03
B	Ceratoides lanata	99	96	10.63	9.24
B	Gutierrezia sarothrae	2	1	.00	-
Total for Browse		194	201	17.04	21.03

#### CANOPY COVER, LINE INTERCEPT--

Management unit 10R, Study no: 44

Species	Percent Cover	
	'08	'10
Artemisia frigida	2.63	14.10
Atriplex canescens	1.81	1.60
Ceratoides lanata	14.11	10.66

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 10R, Study no: 44

Species	Average leader growth (in)
	'10
Ceratoides lanata	3.1

#### BASIC COVER--

Management unit 10R, Study no: 44

Cover Type	Average Cover %	
	'08	'10
Vegetation	43.76	42.40
Rock	.09	.18
Pavement	12.24	4.07
Litter	40.32	35.14
Cryptogams	.02	0
Bare Ground	19.46	33.21

SOIL ANALYSIS DATA --

Management unit 10R, Study no: 43,44,45, Study Name: McCook Plateau

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.2	34.0	39.4	26.6	1.7	5.5	201.6	0.6

PELLET GROUP DATA--

Management unit 10R, Study no: 44

Type	Quadrat Frequency		Days use per acre (ha)	
	'08	'10	'08	'10
Rabbit	77	10	-	-
Elk	3	3	4 (10)	-
Deer	35	8	24 (60)	-
Cattle	1	-	4 (11)	-

BROWSE CHARACTERISTICS--

Management unit 10R, Study no: 44

		Age class distribution					Utilization		
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia frigida</i>									
08	<b>7300</b>	4	91	5	200	21	0	0	11/11
10	<b>13200</b>	5	95	0	4580	19	6	0	9/12
<i>Atriplex canescens</i>									
08	<b>320</b>	0	31	69	-	31	19	44	27/27
10	<b>460</b>	30	70	0	-	26	22	0	16/33
<i>Ceratoides lanata</i>									
08	<b>22620</b>	3	86	10	20	31	49	.17	11/11
10	<b>18780</b>	14	86	0	160	28	37	0	8/10
<i>Cercocarpus ledifolius</i>									
08	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	6/8
<i>Gutierrezia sarothrae</i>									
08	<b>80</b>	0	75	25	20	0	0	0	11/12
10	<b>60</b>	0	100	0	-	0	0	0	5/7

McCOOK PLATEAU ENCLOSURE OUTSIDE - TREND STUDY NO. 10R-45-10  
[Project #1109](#)

Vegetation Type: Winterfat, Perennial Grass

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Upland Stony Loam (Wyoming Big Sagebrush), R034XY334UT

Land Ownership: BLM

Elevation: 6,550 ft. (1,996 m)

Aspect: West

Slope: 4%

Transect bearing: 120° magnetic

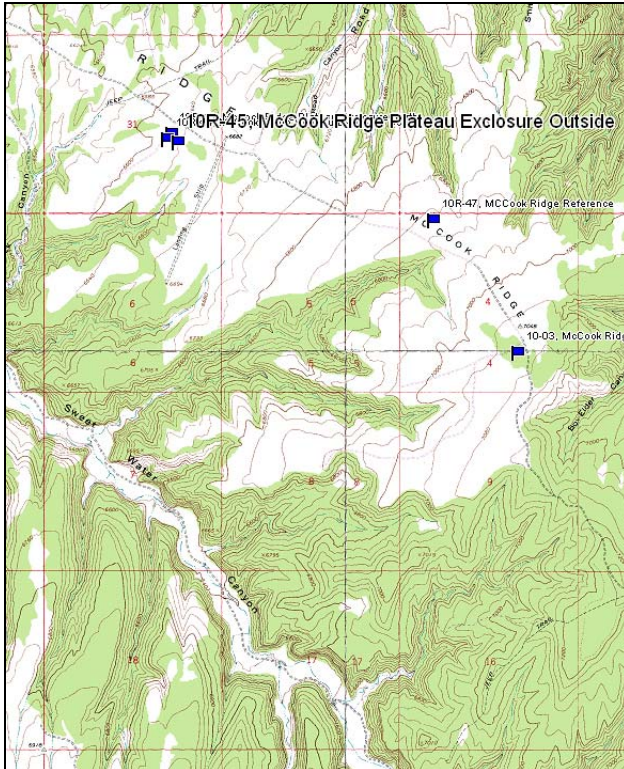
Belt placement: line 1 (11ft, 59ft & 95ft), line 2 (34ft & 71 ft)

Notes: No rebar

Directions:

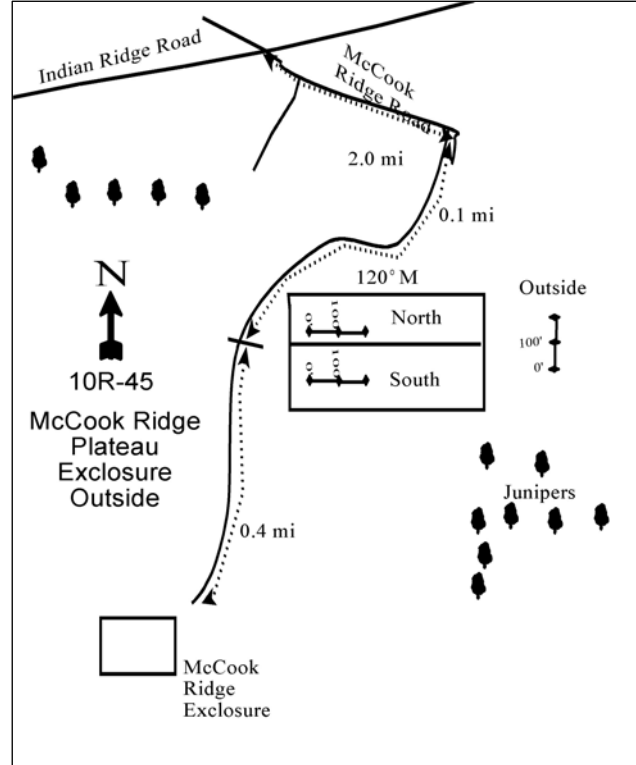
From Ouray, go 38 miles south to the McCook Ridge-Indian Ridge turnoff. Turn left (east) and travel on the Indian Ridge road towards Sweetwater Canyon and McCook Ridge 9.1 miles to the intersection of Cooper Canyon, Indian Ridge and McCook Ridge. From Indian Ridge road, turn southeast and proceed up McCook Ridge approximately 2 miles to road on the right. Turn right and drive 0.1 miles to the enclosure on the right side of the road. The 0' stake is marked with browse tag # 276.

Map Name: Cooper Canyon



Township: 13S Range: 24E Section: 31

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 648564 E 4389372 N

McCOOK RIDGE PLATEAU EXCLOSURE OUTSIDE - WRI STUDY 10R-45

[Project #1109](#)

**Site Description**

Site Information: The study is located on McCook Ridge at the head of Slick Rock Canyon and Road Canyon. This study was established outside of an enclosure complex in 2008 to monitor the effects of a Plateau herbicide (Imazapic) application on a cheatgrass dominated area of the Book Cliffs. The site is referenced by the McCook Plateau Enclosure South (10R-44) and McCook Plateau Enclosure North (10R-43) studies which were treated with plateau and seeded, and is also referenced by the McCook Ridge Enclosure (10-2), McCook Ridge Livestock Enclosure (10R-13) and McCook Ridge Total Enclosure (10R-14) which was not treated with plateau or seeded. This area has seen a decrease in perennial grasses and shrubs and an increase in invasive cheatgrass (*Bromus tectorum*) In order to restore perennial grasses, forbs, and shrubs, 400 acres were sprayed with Plateau and then drill seeded. The enclosure studies were treated one year before the rest of the area (WRI Database 2011). Pellet group data estimated light use by cattle, deer, and elk in 2008, and no pellet groups were found in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 10R, Study no: 45

Project Name: McCook Ridge Cheatgrass					
WRI Database #: 1109					
Application: Drill Seed		Acres: 400		Application: Drill (fluffy seed box)	
Seed type		lbs in mix	lbs/acre	Seed type	
G	Snake River Wheatgrass 'Secar'	400	1.00	B	Sagebrush, Wyoming
G	Thickspike Wheatgrass 'Critana'	400	1.00	B	Forage Kochia 'Immigrant'
G	Indian Ricegrass 'Rimrock'	400	1.00	Total Pounds:	
G	Russian Wildrye 'Bozoisky'	400	1.00	600	
G	Bottlebrush Squirreltail 'Toe Jam'	200	0.50	PLS Pounds:	
G	Canby Bluegrass 'Canbar'	100	0.25	0.78	
G	Crested Wheatgrass 'Douglas'	400	1.00		
G	Crested Wheatgrass 'Hycrest'	400	1.00		
F	Scarlet Globemallow	20	0.05		
F	Alfalfa 'Ladak'	600	1.50		
F	Blue Flax 'Appar'	100	0.25		
B	Fourwing Saltbush	400	1.00		
Total Pounds:		3820	9.55		
PLS Pounds:			7.78		

Browse: Winterfat (*Ceratoides lanata*) and fringed sagebrush (*Artemisia frigida*) are the dominant browse species and are considered the key browse species on the site. Utilization of winterfat has been mostly moderate with heavier use in 2008, while use of fringed sagebrush has been light over the sample years. The recruitment of young winterfat was poor in 2008, but has improved significantly with excellent recruitment in 2010. Fringed sagebrush and winterfat have had low decadence and good vigor since the outset of the study. Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*) was seeded in 2008 and sampled in 2010, though it occurred in low abundance. Other less common browse species sampled include mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), fourwing saltbush (*Atriplex canescens*) and broom snakeweed (*Gutierrezia sarothrae*) (Table - Browse Trends).

Herbaceous Understory: Perennial grass cover and nested frequency improved following the Plateau treatment. Cheatgrass (*Bromus tectorum*) decreased significantly in nested frequency and in cover after the treatment.

Thickspike wheatgrass (*Agropyron dasystachyum*), Sandberg bluegrass (*Poa secunda*), and an unknown perennial grass species are the dominant perennial grass species. The unknown perennial species and crested wheatgrass were sampled for the first time in 2010, though crested wheatgrass was seeded as part of the treatment. Perennial forbs are very rare. Annuals dominate the forb composition with annual stickseed (*Lappula occidentalis*) being the dominant species (Table - Browse Characteristics).

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and high amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

**Pre vs. Two Years Post Treatment Assessment, 2008 vs. 2010**

Browse: Winterfat cover decreased from 17% to 11% while density declined 11% from 26,380 plants/acre to 23,420 plants/acre. Fringed sagebrush cover decreased slightly from 5% to 4% while density increased 29% from 5,540 plants/acre to 7,160 plants/acre. There was an increase in the recruitment of young fringed sagebrush plants from 3% to 10%, while recruitment of young winterfat plants increase from 3% to 36%. Wyoming big sagebrush was sampled after the treatment with a density of 140 plants/acre.

Grasses: The nested frequency of cheatgrass declined significantly and cover decreased from 6% to 2%. The sum of nested frequency of perennial grasses increased 32% and cover increased from 12% to 18%. An unknown grass species was sampled for the first time in 2010 and provided 7% cover. Thickspike wheatgrass saw a significant decrease in nested frequency and cover decreased slightly from 8% to 7%. Sandberg bluegrass increased significantly in nested frequency and cover remained similar at 4%.

Forbs: Perennial forbs are rare on this site, having been sampled in only one quadrat each sample year. Annual forbs provided the majority of the total forb cover in 2008 and all of the cover in 2010. Stickseed provided 1% cover in 2008 and 2% cover in 2010.

HERBACEOUS TRENDS--  
Management unit 10R, Study no: 45

Type	Species	Nested Frequency		Average Cover %	
		'08	'10	'08	'10
G	<i>Agropyron cristatum</i>	-	5	-	.00
G	<i>Agropyron dasystachyum</i>	<sub>b</sub> 186	<sub>a</sub> 128	7.76	6.99
G	<i>Bromus tectorum</i> (a)	<sub>b</sub> 340	<sub>a</sub> 218	5.87	2.03
G	<i>Oryzopsis hymenoides</i>	2	5	.38	.03
G	<i>Poa secunda</i>	<sub>a</sub> 138	<sub>b</sub> 199	3.45	4.14
G	<i>Sitanion hystrix</i>	4	2	.00	.03
G	Unknown grass - perennial	<sub>a</sub> -	<sub>b</sub> 98	-	7.01
Total for Annual Grasses		340	218	5.87	2.03
Total for Perennial Grasses		330	437	11.60	18.22
Total for Grasses		670	655	17.47	20.25
F	<i>Collomia linearis</i> (a)	-	4	-	.00
F	<i>Descurainia pinnata</i> (a)	-	7	-	.04
F	<i>Lappula occidentalis</i> (a)	<sub>a</sub> 196	<sub>b</sub> 264	1.13	1.84
F	<i>Ranunculus testiculatus</i> (a)	19	5	.03	.01
F	<i>Sphaeralcea coccinea</i>	3	2	.15	.00
Total for Annual Forbs		215	280	1.17	1.90
Total for Perennial Forbs		3	2	0.14	0.00

Type	Species	Nested Frequency		Average Cover %	
		'08	'10	'08	'10
	Total for Forbs	218	282	1.32	1.91

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 10R, Study no: 45

Type	Species	Strip Frequency		Average Cover %	
		'08	'10	'08	'10
B	Artemisia frigida	66	86	3.62	5.26
B	Artemisia nova	-	-	.03	-
B	Artemisia tridentata vaseyana	2	2	-	.03
B	Atriplex canescens	9	11	.06	.18
B	Ceratoides lanata	100	94	13.26	10.04
B	Gutierrezia sarothrae	8	7	.19	.21
	Total for Browse	185	200	17.17	15.74

#### CANOPY COVER, LINE INTERCEPT--

Management unit 10R, Study no: 45

Species	Percent Cover	
	'08	'10
Artemisia frigida	5.08	4.38
Artemisia tridentata vaseyana	.11	.06
Ceratoides lanata	17.23	10.63
Gutierrezia sarothrae	.30	.65

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 10R, Study no: 45

Species	Average leader growth (in)
	'10
Ceratoides lanata	1.8

#### BASIC COVER--

Management unit 10R, Study no: 45

Cover Type	Average Cover %	
	'08	'10
Vegetation	43.78	38.50
Rock	.11	.07
Pavement	9.78	3.84
Litter	33.60	26.84
Cryptogams	.12	.22
Bare Ground	25.89	42.11

SOIL ANALYSIS DATA --

Management unit 10R, Study no: 43,44,45, Study Name: McCook Plateau

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.2	34.0	39.4	26.6	1.7	5.5	201.6	0.6

PELLET GROUP DATA--

Management unit 10R, Study no: 45

Type	Quadrat Frequency		Days use per acre (ha)	
	'08	'10	'08	'10
Rabbit	65	13	-	-
Elk	10	11	8 (13)	-
Deer	30	8	15 (36)	-
Cattle	5	1	2 (5)	-

BROWSE CHARACTERISTICS--

Management unit 10R, Study no: 45

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia frigida</i>										
08	<b>5540</b>	3	95	2	-	12	0	0	11/13	
10	<b>7160</b>	10	90	0	260	9	7	0	7/10	
<i>Artemisia tridentata vaseyana</i>										
08	<b>100</b>	0	40	60	-	40	60	60	11/15	
10	<b>140</b>	57	29	14	-	14	14	14	12/14	
<i>Atriplex canescens</i>										
08	<b>180</b>	0	67	33	-	44	0	22	28/31	
10	<b>400</b>	35	55	10	20	10	10	0	13/14	
<i>Ceratoides lanata</i>										
08	<b>26380</b>	3	86	11	-	24	55	.22	10/11	
10	<b>23420</b>	36	64	1	840	28	14	0	7/10	
<i>Gutierrezia sarothrae</i>										
08	<b>1260</b>	0	89	11	-	0	0	0	7/7	
10	<b>1040</b>	2	98	0	-	0	0	0	7/8	

SANTAQUIN GREASEWOOD - TREND STUDY NO. 17R-11-10

Vegetation Type: Black Greasewood, Basin Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Not available

Land Ownership: UDWR

Elevation: 6,810 ft. (2,076 m)

Aspect: South

Slope: 2%

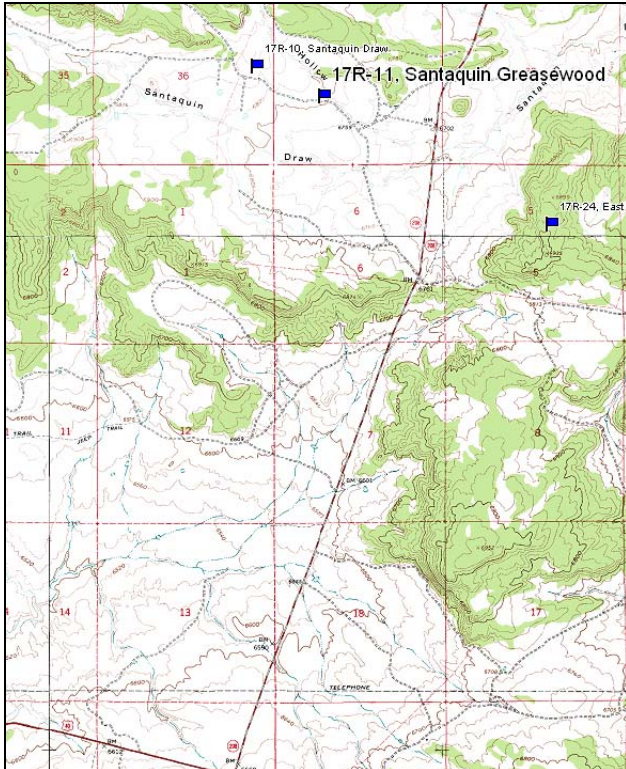
Transect bearing: 180° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

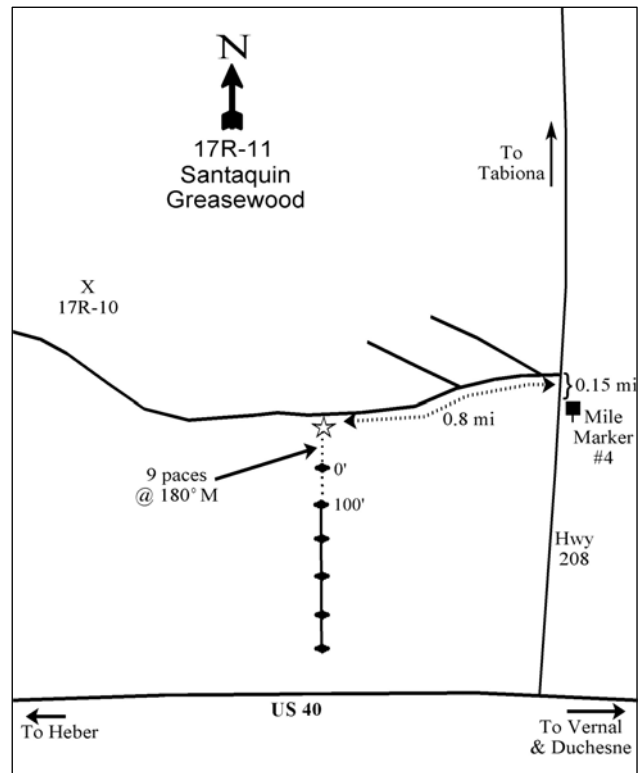
From US 40 turn north on Highway 208. Travel 0.15 miles north of mile marker 4 to a road that comes in from the left (west). Turn here and drive 0.8 miles to a witness post on the left side of the road. The 0-foot stake is 9 paces from the witness post at 180°M, and is marked with browse tag #40.

Map Name: Tabiona



Township: 2S Range: 7W Section: 31

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 523637 E 4456729 N



SANTAQUIN GREASEWOOD - WRI STUDY 17R-11

**Site Description**

Site Information: The study monitors a chaining treatment of a greasewood (*Sarcobatus vermiculatus*) and big sagebrush (*Artemisia tridentata*) flat on the Tabby Mountain Wildlife Management Area (WMA). Areas within the WMA dominated by sagebrush, greasewood, pinyon pine (*Pinus edulis*), and Utah juniper (*Juniperus osteosperma*) were chained with a smooth chain in 2004. Sagebrush stands within Santaquin draw experienced a vegetation die off in 2002 and 2003 attributed to drought conditions. The goal of the chaining treatment was to remove greasewood and to open up the site to establish grasses, forbs, and preferred browse for wildlife winter range. The study site was established in July of 2004 and was chained later that fall. The treatment area was first seeded, chained then another seed mix including Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and forage kochia (*Kochia prostrata*) was flown onto the treatment. Pellet group data estimated deer use to be very heavy in 2004, moderate in 2007 and 2010, and heavy in 2009. Elk use was moderate in 2004, 2007, 2010 and light in 2009. Cattle use was light in all sample years (Table - Pellet Group Data).

SEED MIX--  
Management unit 17R, Study no: 11

Project Name: Santaquin Greasewood				Project Name: Santaquin Sagebrush Browse							
WRI Database #: None				WRI Database #: None							
Application:		Acres:		380		Application: Aerial Seed		Acres:		1755	
Seed type		lbs in mix		lbs/acre		Seed type		lbs in mix		lbs/acre	
G	Great Basin Wildrye 'Trailhead'	750	1.97	F	Alfalfa 'Ladak+'	1000	0.57	F	Sainfoin 'Eski'	1000	0.57
G	Russian Wildrye 'Bozoisky'	750	1.97	B	Forage Kochia 'Immigrant'	800	0.46	B	Sagebrush, Wyoming	1465	0.83
G	Siberian Wheatgrass 'Vavilov'	400	1.05	B	Winterfat	300	0.17	Total Pounds:		4565	2.60
G	Thickspike Wheatgrass 'Critana'	750	1.97	PLS Pounds:						1.65	
F	Alfalfa 'Ladak+'	200	0.53								
F	Sainfoin	400	1.05								
B	Fourwing Saltbush	300	0.79								
Total Pounds:		3550		9.34							
PLS Pounds:				8.39							
Application:		Acres:		40							
Seed type		lbs in mix		lbs/acre							
F	Sainfoin	40	1.00								
F	Alfalfa 'Ladak+'	20	0.50								
B	Sagebrush, Wyoming	40	1.00								
Total Pounds:		100		2.50							
PLS Pounds:				1.71							

Browse: Black greasewood is the dominant shrub on the site. Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and Wyoming big sagebrush are the dominant preferred browse species. Decadence and poor vigor of basin big sagebrush has steadily decreased over the study years. The recruitment of young basin big sagebrush has been excellent after 2004. Wyoming big sagebrush has gradually increased in abundance since being seeded to the site after the treatment. The Wyoming big sagebrush is a relatively young population with low decadence and good vigor. Utilization of sagebrush populations has been light since the outset of the study. Seeded species sampled on the site include Wyoming big sagebrush, winterfat (*Ceratoides lanata*), and forage kochia, though winterfat was only sampled in 2007. Forage kochia was abundant on the site in 2010. Other species found on site include shadscale (*Atriplex confertifolia*) and pricklypear cactus (*Opuntia* sp.) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are moderately abundant and fairly diverse. The dominant species on the site include Siberian wheatgrass (*Agropyron fragile*), Indian ricegrass (*Oryzopsis hymenoides*), and Sandberg bluegrass (*Poa secunda*). Cheatgrass (*Bromus tectorum*) has been sampled over the sample years, but is rare on the site. Western wheatgrass (*Agropyron smithii*) was the dominant grass species at the outset of the study, but has become rare on the site. Seeded species sampled on the site include thickspike wheatgrass (*Agropyron dasystachyum*), Siberian wheatgrass (*A. sibiricum*), Great Basin wildrye (*Elymus cinereus*), and Russian wildrye (*E. junceus*). Forbs are not diverse or abundant. Annuals were common at the outset of the study, but have become rare on the site. Fleabane (*Erigeron sp.*) is the dominant forb and accounts for the majority of the cover on the site. At the outset of the study pinnate tansymustard (*Descurainia pinnata*) and slimleaf goosefoot (*Chenopodium leptophyllum*) were the dominant species, but have become rare on the site (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is moderately high with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2004 due to pedestalling. The soil erosion condition improved to stable in 2007, 2009 and 2010.

### **Pre vs. Three Years Post Treatment, 2004 vs. 2007**

Browse: Basin big sagebrush density increased 42% from 2,640 plants/acre to 3,760 plants/acre and cover increased from 4% to 6%. Decadence of sagebrush decreased from 85% to 29% and plants displaying poor vigor decreased from 64% to 27%. The recruitment of young sagebrush plants increased from 4% to 60% of the population. Greasewood seem to be unaffected by the treatment. The density of greasewood remained similar at 1,280 plants/acre and cover increased from 14% to 19%. The average size of greasewood remained similar with an average height of 34 inches and crown of 50 inches.

Grass: The sum of nested frequency of perennial grasses increased nearly three fold and perennial grass cover increased from 2% to 6%. Siberian wheatgrass and Russian wildrye were seeded species sampled following the treatment. Siberian wheatgrass was sampled in low frequency and cover and Russian wildrye was the dominant grass species with 2% cover. Sandberg bluegrass and western wheatgrass provided 1% cover and increased in frequency.

Forb: The sum of nested frequency for perennial forbs increased substantially and cover increased from nearly 0% to 2%. Fleabane was the dominant perennial forb and provided 2% cover. Weedy annual forb species had dominated the site prior to treatment but decreased 13% in sum of nested frequency and cover decreased from 3% to 2%.

### **Trend Assessments**

#### Browse

- **2007 to 2009 - stable (0):** Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Basin big sagebrush canopy cover increased 6% to 7% and greasewood canopy cover remained similar at 19%. Forage kochia and Wyoming big sagebrush were sampled in low cover.
- **2009 to 2010 - up (+2):** Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Basin big sagebrush canopy cover increased to 11% while Wyoming big sagebrush canopy cover increased from 1% to 5%. Young plants accounted for 44% of the basin big sagebrush population and decadence was low at 4% while the Wyoming big sagebrush population consisted of 72% young and 27% mature. All populations exhibited good vigor. Greasewood canopy cover decreased slightly to 18%.

Grass

- **2007 to 2009 - stable (0):** The sum of nested frequency of perennial grasses remained similar and cover changed little at 6%. There was a slight change in composition as there was a significant decrease in the nested frequency of Russian wildrye and a significant increase in Siberian wheatgrass. Siberian wheatgrass may have been misidentified as bluebunch wheatgrass. No cheatgrass was sampled this year.
- **2009 to 2010 - up (+2):** The sum of nested frequency of perennial grasses increased 30% while cover remained similar. Siberian wheatgrass cover decreased from 3% to 2% while Sandberg bluegrass cover decreased from 2% to 1% and neither has significantly changed in nested frequency. Indian ricegrass significantly increased in nested frequency and provided 1% cover.

Forb

- **2007 to 2009 - up (+2):** The sum of nested frequency of perennial forbs increased 26%, but cover decreased from 2% to 1%. The sum of nested frequency of annual forbs decreased 85% and became rare on the site.
- **2009 to 2010 - slightly down (-1):** The nested frequency of perennial forbs decreased 29%, though cover increased slightly to 2%. Forbs are rare.

HERBACEOUS TRENDS--

Management unit 17R, Study no: 11

Type	Species	Nested Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
G	Agropyron fragile	a-	a7	b49	b39	-	.30	2.74	1.85
G	Agropyron dasystachyum	a-	a-	a-	b25	-	-	-	.65
G	Agropyron smithii	b31	b36	a19	a7	1.12	1.27	.28	.16
G	Agropyron spicatum	a-	a-	b20	b14	-	-	.40	.24
G	Bromus tectorum (a)	2	7	-	8	.00	.01	-	.01
G	Elymus cinereus	-	-	1	-	-	-	.03	-
G	Elymus junceus	a-	b35	a10	a11	-	1.56	.47	.22
G	Muhlenbergia sp.	-	-	-	1	-	-	-	.00
G	Oryzopsis hymenoides	a-	a12	a7	b37	-	.71	.10	1.26
G	Poa secunda	a35	b78	ab65	b89	.46	1.41	2.03	1.20
G	Sitanion hystrix	a1	b16	ab13	a5	.03	.34	.20	.00
G	Stipa comata	-	5	-	12	-	.01	-	.06
Total for Annual Grasses		2	7	0	8	0.00	0.01	0	0.01
Total for Perennial Grasses		67	189	184	240	1.63	5.62	6.26	5.68
Total for Grasses		69	196	184	248	1.63	5.63	6.26	5.70
F	Alyssum alyssoides (a)	a-	ab1	ab1	b20	-	.01	.03	.02
F	Arabis sp.	a-	b10	a-	a-	-	.03	-	-
F	Chenopodium album (a)	b27	a-	a4	a3	.17	-	.01	.03
F	Chenopodium leptophyllum(a)	b111	a18	a39	a26	1.00	.04	.18	.38
F	Collinsia parviflora (a)	5	-	-	-	.03	-	-	-
F	Descurainia pinnata (a)	b199	c242	a-	a7	1.87	1.23	-	.03
F	Erigeron sp.	a8	b78	b102	b74	.04	2.00	.98	1.85
F	Gilia sp. (a)	3	-	-	-	.01	-	-	-
F	Lappula occidentalis (a)	a13	b48	a-	a9	.08	.22	-	.01
F	Linum lewisii	-	3	4	2	-	.16	.09	.03
F	Phlox longifolia	1	6	2	4	.00	.01	.03	.00

Type	Species	Nested Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
F	Schoenocrambe linifolia	a-	ab11	b27	b19	-	.07	.11	.16
F	Sphaeralcea coccinea	-	2	4	-	-	.00	.01	-
Total for Annual Forbs		358	309	44	65	3.18	1.50	0.22	0.49
Total for Perennial Forbs		9	110	139	99	0.05	2.29	1.22	2.05
Total for Forbs		367	419	183	164	3.23	3.80	1.45	2.54

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 17R, Study no: 11

Type	Species	Strip Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
B	Artemisia tridentata tridentata	56	57	0	56	6.69	4.87	5.85	5.63
B	Artemisia tridentata wyomingensis	0	0	0	61	.33	-	1.53	5.88
B	Atriplex confertifolia	7	17	0	13	.51	.25	.40	.10
B	Ceratoides lanata	0	1	0	0	-	.00	-	-
B	Kochia prostrata	0	3	0	38	-	.03	.76	3.01
B	Opuntia sp.	34	29	0	21	.46	.52	.19	.06
B	Sarcobatus vermiculatus	41	40	0	43	11.46	10.67	12.32	8.79
Total for Browse		138	147	0	232	19.47	16.35	21.07	23.49

#### CANOPY COVER, LINE INTERCEPT--

Management unit 17R, Study no: 11

Species	Percent Cover			
	'04	'07	'09	'10
Artemisia tridentata tridentata	4.41	5.66	6.50	10.89
Artemisia tridentata wyomingensis	-	-	.50	5.23
Atriplex confertifolia	.30	.30	.23	1.13
Kochia prostrata	-	-	.06	1.75
Opuntia sp.	.38	.65	1.18	.30
Sarcobatus vermiculatus	13.98	18.64	18.61	17.88

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 17R, Study no: 11

Species	Average leader growth (in)			
	'04	'07	'09	'10
Artemisia tridentata tridentata	2.2	1.3	-	1.7

BASIC COVER--

Management unit 17R, Study no: 11

Cover Type	Average Cover %			
	'04	'07	'09	'10
Vegetation	25.38	25.39	32.08	31.85
Rock	.38	.00	.00	.06
Pavement	.16	.08	.00	0
Litter	44.01	50.01	55.73	49.94
Cryptogams	10.02	3.75	.98	1.29
Bare Ground	35.42	34.75	27.12	31.70

SOIL ANALYSIS DATA --

Management unit 17R, Study no: 11, Study Name: Santaquin Greasewood

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
12.1	7.2	49.6	32.9	17.5	1.1	4.5	137.6	1.0

PELLET GROUP DATA--

Management unit 17R, Study no: 11

Type	Quadrat Frequency				Days use per acre (ha)			
	'04	'07	'09	'10	'04	'07	'09	'10
Rabbit	13	42	35	14	-	-	-	-
Grouse	-	2	-	-	-	-	-	-
Elk	7	17	12	11	27 (68)	29 (71)	48 (117)	28 (69)
Deer	49	33	27	10	236 (584)	27 (68)	11 (26)	23 (58)
Cattle	-	-	2	2	1 (2)	1 (2)	7 (16)	12 (30)

BROWSE CHARACTERISTICS--

Management unit 17R, Study no: 11

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<b>Artemisia tridentata tridentata</b>									
04	<b>2640</b>	4	11	85	2260	25	7	66	27/29
07	<b>3760</b>	60	12	29	9860	5	.53	27	17/22
09	<b>0</b>	0	0	0	-	0	0	0	15/16
10	<b>7000</b>	44	53	4	640	15	.28	1	19/21
<b>Artemisia tridentata wyomingensis</b>									
04	<b>0</b>	0	0	0	-	0	0	0	18/37
07	<b>0</b>	0	0	0	-	0	0	0	-/-
09	<b>0</b>	0	0	0	-	0	0	0	11/13
10	<b>5480</b>	72	27	1	2840	0	0	.72	14/17
<b>Atriplex confertifolia</b>									
04	<b>160</b>	13	75	13	200	0	13	0	13/19
07	<b>1040</b>	75	25	0	440	0	0	0	10/16
09	<b>0</b>	0	0	0	-	0	0	0	11/17
10	<b>780</b>	44	56	0	260	0	0	0	11/16

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Ceratoides lanata</i>									
04	0	0	0	-	-	0	0	0	-/-
07	20	100	0	-	-	0	0	0	-/-
09	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	-/-
<i>Echinocactus sp.</i>									
04	0	0	0	-	-	0	0	0	-/-
07	0	0	0	-	-	0	0	0	-/-
09	0	0	0	-	-	0	0	0	1/3
10	0	0	0	-	-	0	0	0	-/-
<i>Kochia prostrata</i>									
04	0	0	0	-	-	0	0	0	-/-
07	60	33	67	-	140	0	0	0	5/6
09	0	0	0	-	-	0	0	0	4/6
10	8880	50	50	-	200	.22	0	0	6/7
<i>Opuntia sp.</i>									
04	1120	7	59	34	-	0	0	16	5/12
07	920	0	74	26	-	2	0	13	4/10
09	0	0	0	0	-	0	0	0	5/9
10	560	0	93	7	-	7	0	7	4/10
<i>Sarcobatus vermiculatus</i>									
04	1340	16	79	4	2140	3	0	1	32/50
07	1280	16	75	9	3060	0	0	16	34/50
09	0	0	0	0	-	0	0	0	33/45
10	1380	23	77	0	20	4	0	0	33/45

SANTAQUIN CHAINING - TREND STUDY NO. 17R-12-10

Vegetation Type: Pinyon/Juniper, Black sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Not available

Land Ownership: UDWR

Elevation: 6,870 ft. (2,094 m)

Aspect: East

Slope: 2-3%

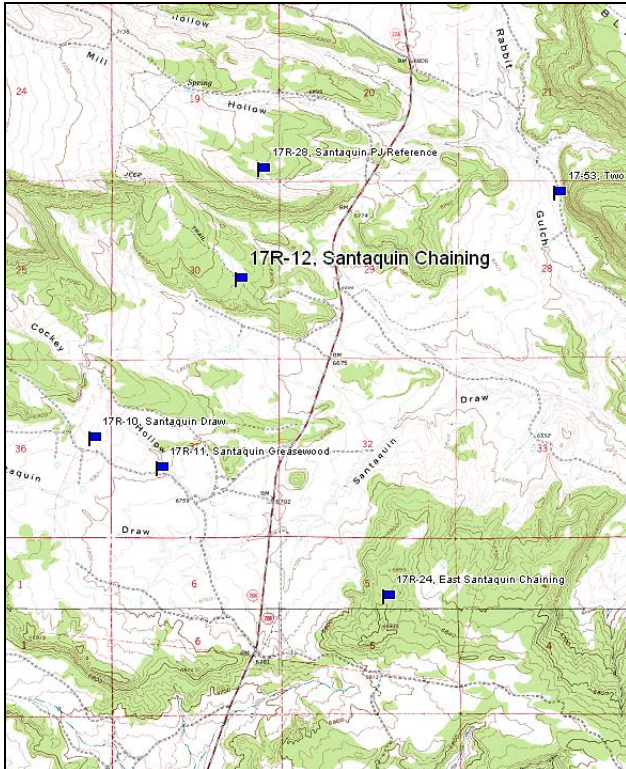
Transect bearing: 294° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

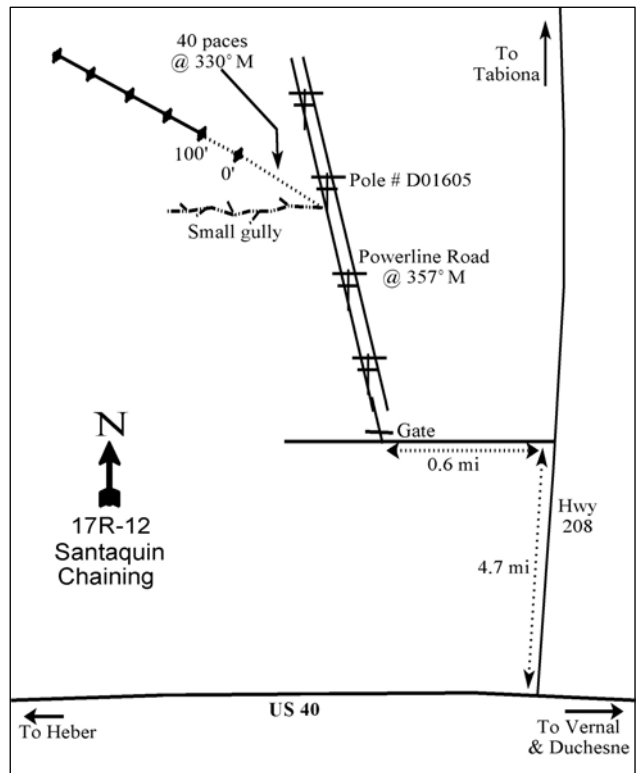
From US 40 turn north on Highway 208. Travel 4.7 miles north to a road that comes in from the left (west). Turn here and drive 0.6 miles to the power line road that comes in from the right. Turn here, pass through the gate and travel on this road at 357°M to pole #D01605. The 0-foot stake is 40 paces from this pole at 330°M, and is marked with browse tag #136.

Map Name: Tabiona



Township: 2S Range: 7W Section: 30

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 524346 E 4458437 N

SANTAQUIN CHAINING - WRI STUDY 17R-12

**Site Description**

Site Information: The study was established in 2004 to monitor the effects of a pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) chaining north of Santaquin Draw on the Tabby Mountain Wildlife Management Area (WMA). Prior to treatment this area was dominated by pinyon pine and Utah juniper with limited herbaceous understory. The chaining treated about 300 acres of a pinyon pine and Utah juniper covered ridge. The treatment area was first seeded with grasses, then 2-way chained with a 60 lb. link Ely chain. Following the chaining another seed mix including Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and forage kochia (*Kochia prostrata*) was flown onto the treatment. Pellet group data estimated moderate deer use in 2004, 2007, and 2009, and heavy in 2010. Elk use was moderate in 2004 and 2007, and heavy in 2009 and 2010 (Table - Pellet Group Data). The soil erosion condition was classified as stable in all sample years.

SEED MIX--

Management unit 17R, Study no: 12

Project name: Santaquin Sagebrush Browse WRI Database #: None				Project name: Santaquin Pinyon/Juniper			
Application: Aerial		Acres: 1755		Application:		Acres: 305	
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix	lbs/acre
F	Alfalfa 'Ladak+'	1000	0.57	G	Crested Wheatgrass 'Ephraim'	300	0.98
F	Sainfoin 'Eski'	1000	0.57	G	Orchardgrass 'Paiute'	300	0.98
B	Forage Kochia 'Immigrant'	800	0.46	G	Russian Wildrye 'Bozoisky'	300	0.98
B	Sagebrush, Wyoming	1465	0.83	G	Thickspike Wheatgrass 'Critana'	350	1.15
B	Winterfat	300	0.17	F	Alfalfa 'Ladak+'	250	0.82
Total Pounds:		4565	2.60	F	Alfalfa 'Nomad'	100	0.33
PLS Pounds:			1.65	F	Blue Flax 'Appar'	150	0.49
Project name: Santaquin Sagebrush Shrub				F	Sainfoin	300	0.98
Application:		Acres: 40		F	Small Burnet 'Delar'	600	1.97
Seed type		lbs in mix	lbs/acre	B	Fourwing Saltbush	300	0.98
F	Alfalfa 'Ladak+'	20	0.50	Total Pounds:		2950	9.67
F	Sainfoin	40	1.00	PLS Pounds:			8.58
B	Sagebrush, Wyoming	40	1.00				
B	Winterfat	20	0.50				
Total Pounds:		120	3.00				
PLS Pounds:			1.94				

Browse: Pinyon pine and Utah juniper canopy cover was effectively reduced from the chaining treatment and canopy cover has been minimal over the sample years following the treatment (Table - Canopy Cover). Wyoming big sagebrush and black sagebrush (*Artemisia nova*) are the preferred browse species on the site. Black sagebrush has been present in all sample years. The black sagebrush is a lightly used mature population with good vigor and low decadence over the sample years, though decadence and poor vigor were high before the treatment. Wyoming big sagebrush, which was seeded, has established and appears to be increasing in each sample year. Decadence and poor vigor of Wyoming big sagebrush has been low since the outset of the study. The recruitment of young plants for both sagebrush populations has been good over the sample years.

Herbaceous Understory: Perennial grasses have responded well to this treatment and have steadily increased in frequency since 2004. The most prevalent species have been crested wheatgrass (*Agropyron cristatum*), which



was seeded, and Indian ricegrass (*Oryzopsis hymenoides*) and western wheatgrass (*A. smithii*) which were present before treatment. Cheatgrass (*Bromus tectorum*) and rattail fescue (*Festuca myuros*) were the only annual grass species sampled but were found in small quantities. Seeded species sampled after the treatment include crested wheatgrass, thickspike wheatgrass (*Agropyron cristatum*), orchard grass (*Dactylis glomerata*), and Russian wildrye (*Elymus junceus*). Other common grass species include needle-and-tread (*Stipa comata*) and bottlebrush squirreltail (*Sitanion hystrix*). Forbs are fairly diverse and moderately abundant. Perennial forbs initially responded well to this treatment but have fluctuated in frequency and cover in each sample year. Lewis flax (*Linum lewisii*), a seeded species, has consistently been the most common forb (Table - Herbaceous Trends).

Soil: The soil texture is a sandy loam with a neutral soil reaction (pH 7.0) (Table - Soil Analysis Data). Bare ground cover is low with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### **Pre vs. Three Years Post Treatment, 2004 vs. 2007**

Browse: Black sagebrush had similar cover to the pretreatment condition at 2%, though density of black sagebrush decreased 63% from 3,440 plants/acre to 1,260 plants/acre. Decadence of black sagebrush decreased from 48% to 0% and poor vigor decreased from 25% to 5%. The seeded species, Wyoming big sagebrush, increased substantially in density and cover increased to 1% with most of the sampled plants being young plants. Canopy cover decreased from 19% for Utah juniper and 27% for pinyon pine to less than 1% for each species. Utah juniper density decreased from 235 trees/acre to 37 trees/ acre and pinyon pine density decreased from 208 trees/acre to 57 trees/acre.

Grass: The sum of nested frequency of perennial grasses increased 88% and cover increased from 2% to 10%. Following the treatment the dominant species were crested wheatgrass, bluebunch wheatgrass, Indian ricegrass, and bottlebrush which significantly increased in frequency and each provided 2% cover. Seeded species sampled following to treatment include crested wheatgrass, orchardgrass, and Russian wildrye.

Forb: The sum of nested frequency of perennial forbs increased 33% while cover increased from 2% to 6%. Annual forbs continued to be a minor part of the system. Two seeded species, Lewis flax and small burnet (*Sanguisorba minor*), were established in moderate frequency and cover. Sainfoin (*Onobrychis viciaefolia*) was also sampled, but at low frequency and cover.

### **Trend Assessments**

#### Browse

- **2007 to 2009 - stable (0)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Black sagebrush canopy cover slightly increased from 2% to 3% and Wyoming big sagebrush remained similar at 1%
- **2009 to 2010 - stable (0)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Black sagebrush canopy cover increased slightly to 4% and Wyoming big sagebrush remained similar. Young plants represented 44% of the Wyoming big sagebrush population with no decadent plants. The density of pinyon pine and Utah juniper increased from 20 trees/acre to 32 trees/acre and 16 trees/acre to 35 trees/acre, respectively.

#### Grass

- **2007 to 2009 - up (+2)**: The sum of nested frequency of perennial grasses increased 24% and cover increased from 10% to 20%. Crested wheatgrass increased substantially in cover from 2% to 6% and Indian ricegrass increased from 2% to 4%. The seeded species, thickspike wheatgrass, was sampled for the first time in 2009.

- **2009 to 2010 - slightly up (+1):** The sum of nested frequency of perennial grasses increased 14% while cover decreased slightly to 19%. Crested wheatgrass, western wheatgrass, and Indian ricegrass combined to provide 72% of grass cover.

Forb

- **2007 to 2009 - down (-2):** The sum of nested frequency of perennial forbs decreased 45%, though cover increased slightly from 5% to 6%. Much of the increase in cover came from a significant increase in the nested frequency of blue flax and a large increase in cover. Annual forbs are still a minor part of the system.
- **2009 to 2010 - slightly up (+1):** The sum of nested frequency of perennial forbs increased 16% but cover decreased from 6% to 3%. No species provided 1% or more cover.

HERBACEOUS TRENDS--

Management unit 17R, Study no: 12

Type	Species	Nested Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
G	Agropyron cristatum	a-	b93	b110	b130	-	2.36	6.22	4.61
G	Agropyron dasystachyum	a-	a-	b48	b30	-	-	1.77	.33
G	Agropyron smithii	b45	a24	ab40	b61	.21	.48	2.15	4.31
G	Agropyron spicatum	a-	b56	a13	a-	-	1.99	.65	-
G	Bouteloua gracilis	7	6	6	11	.03	.03	.18	.23
G	Bromus tectorum (a)	1 <sub>a</sub>	b62	b40	b47	.00	.53	.93	1.14
G	Carex sp.	9	19	11	16	.08	.22	.39	.27
G	Dactylis glomerata	-	6	10	-	-	.28	.25	-
G	Elymus cinereus	-	-	-	1	-	-	-	.03
G	Elymus junceus	a-	a3	a9	b27	-	.15	.59	1.37
G	Festuca myuros (a)	-	1	-	-	-	.00	-	-
G	Oryzopsis hymenoides	a52	a43	ab60	b93	.66	2.15	4.15	5.33
G	Poa secunda	19	17	24	18	.39	.14	.55	.13
G	Sitanion hystrix	a33	ab55	b66	ab58	.24	1.79	2.97	1.20
G	Stipa comata	9	5	8	17	.48	.22	.18	.83
G	Stipa lettermani	-	-	-	-	-	-	-	.00
Total for Annual Grasses		1	63	40	47	0.00	0.54	0.93	1.14
Total for Perennial Grasses		174	327	405	462	2.11	9.84	20.06	18.69
Total for Grasses		175	390	445	509	2.12	10.38	21.00	19.84
F	Arabis sp.	b21	a6	a-	a-	.06	.01	-	-
F	Astragalus convallarius	10	-	-	-	.04	-	-	-
F	Astragalus sp.	-	-	2	-	-	-	.03	-
F	Astragalus utahensis	a-	a5	b19	b27	-	.06	.75	.96
F	Chaenactis douglasii	a-	ab3	ab6	b16	-	.00	.03	.03
F	Chenopodium album (a)	a-	a2	b20	a10	-	.00	.65	.02
F	Chenopodium leptophyllum(a)	-	-	2	-	-	-	.00	-
F	Chenopodium sp. (a)	2	1	-	-	.00	.03	-	-
F	Cryptantha sp.	ab1	b12	a-	a-	.00	.07	-	-
F	Cymopterus sp.	11	7	1	-	.02	.04	.00	-
F	Descurainia pinnata (a)	a4	b17	a6	a-	.00	.03	.06	-
F	Erigeron eatonii	1	-	-	2	.00	-	-	.03
F	Gayophytum ramosissimum(a)	-	-	-	4	-	-	-	.01

Type	Species	Nested Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
F	<i>Ipomopsis aggregata</i>	4	4	-	-	.01	.00	-	-
F	<i>Ipomopsis congesta</i>	-	11	-	10	-	.19	-	.06
F	<i>Lactuca serriola</i>	a-	b10	a-	a-	-	.08	-	-
F	<i>Lappula occidentalis</i> (a)	a-	b29	a5	a7	-	.61	.18	.03
F	<i>Linum lewisii</i>	a-	b37	b59	b45	-	1.64	3.99	.86
F	<i>Machaeranthera canescens</i>	3	-	3	9	.00	-	.00	.21
F	<i>Onobrychis viciaefolia</i>	-	2	-	-	-	.03	-	-
F	<i>Penstemon humilis</i>	b20	ab5	a-	ab4	.48	.45	-	.18
F	<i>Penstemon</i> sp.	-	-	5	1	-	-	.33	.00
F	<i>Phlox hoodii</i>	19	17	11	19	.57	.31	.25	.45
F	<i>Polygonum douglasii</i> (a)	5	-	-	-	.01	-	-	-
F	<i>Sanguisorba minor</i>	a-	b22	ab14	ab8	-	.50	.40	.16
F	<i>Schoenocrambe linifolia</i>	a4	b17	ab13	ab12	.00	.06	.20	.45
F	<i>Senecio multilobatus</i>	b87	b89	a3	a4	.53	1.75	.01	.01
F	<i>Streptanthus cordatus</i>	-	5	-	5	-	.03	-	.01
F	<i>Tragopogon dubius</i>	-	-	1	-	-	-	.00	-
F	<i>Trifolium</i> sp.	11	3	4	2	.04	.01	.00	.00
Total for Annual Forbs		11	49	33	21	0.02	0.68	0.90	0.06
Total for Perennial Forbs		192	255	141	164	1.79	5.27	6.03	3.44
Total for Forbs		203	304	174	185	1.81	5.95	6.93	3.50

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 17R, Study no: 12

Type	Species	Strip Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
B	<i>Artemisia nova</i>	66	34	0	46	1.89	1.72	2.85	2.91
B	<i>Artemisia tridentata</i> <i>wyomingensis</i>	1	16	0	18	-	.51	.72	1.49
B	<i>Chrysothamnus nauseosus</i>	0	0	0	1	-	-	-	-
B	<i>Gutierrezia sarothrae</i>	6	4	0	2	.03	.00	.00	-
B	<i>Juniperus osteosperma</i>	12	3	0	3	1.06	.38	.53	.63
B	<i>Kochia prostrata</i>	0	3	0	0	-	.03	.15	-
B	<i>Leptodactylon pungens</i>	12	9	0	9	.25	.25	.36	.22
B	<i>Opuntia fragilis</i>	0	7	0	6	-	.03	-	.39
B	<i>Opuntia</i> sp.	12	4	0	5	.06	.03	.06	-
B	<i>Pediocactus simpsonii</i>	1	0	0	0	-	-	-	-
B	<i>Pinus edulis</i>	16	1	0	1	6.82	.53	.53	.03
Total for Browse		126	81	0	91	10.12	3.50	5.23	5.67

CANOPY COVER, LINE INTERCEPT--

Management unit 17R, Study no: 12

Species	Percent Cover			
	'04	'07	'09	'10
Artemisia nova	2.98	2.16	3.33	3.46
Artemisia tridentata wyomingensis	-	.63	1.06	1.29
Gutierrezia sarothrae	-	.11	.10	-
Juniperus osteosperma	18.50	.01	.13	.05
Kochia prostrata	-	.01	-	-
Leptodactylon pungens	.23	-	.28	.11
Opuntia fragilis	-	.13	-	.06
Opuntia sp.	.13	.05	-	-
Pinus edulis	27.33	.40	.40	.30

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 17R, Study no: 12

Species	Average leader growth (in)		
	'07	'09	'10
Artemisia nova	1.1	-	1.0
Artemisia tridentata wyomingensis	2.2	-	1.9

POINT-QUARTER TREE DATA--

Management unit 17R, Study no: 12

Species	Trees per Acre				Average diameter (in)			
	'04	'07	'09	'10	'04	'07	'09	'10
Juniperus osteosperma	235	37	16	35	9.6	3.7	2.4	3.9
Pinus edulis	208	57	20	32	4.7	1.3	1.5	1.1

BASIC COVER--

Management unit 17R, Study no: 12

Cover Type	Average Cover %			
	'04	'07	'09	'10
Vegetation	13.21	22.37	33.31	32.20
Rock	2.91	4.47	4.05	3.48
Pavement	6.34	2.59	2.28	1.85
Litter	61.73	55.81	55.32	50.52
Cryptogams	7.78	.43	.15	.00
Bare Ground	17.40	24.82	19.75	19.27

SOIL ANALYSIS DATA --

Management unit 17R, Study no: 12, Study Name: Santaquin PJ Chaining

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
6.9	7.0	65.4	15.1	19.5	3.5	16.3	128.0	0.9

PELLET GROUP DATA--

Management unit 17R, Study no: 12

Type	Quadrat Frequency				Days use per acre (ha)			
	'04	'07	'09	'10	'04	'07	'09	'10
Rabbit	19	26	18	8	-	-	-	-
Elk	11	19	31	29	17 (41)	36 (89)	108 (266)	77 (190)
Deer	33	25	31	19	26 (64)	40 (98)	47 (116)	29 (71)
Cattle	-	1	-	-	-	-	-	-

BROWSE CHARACTERISTICS--

Management unit 17R, Study no: 12

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<i>Artemisia nova</i>									
04	<b>3440</b>	20	33	48	80	4	0	25	8/15
07	<b>1260</b>	10	90	0	380	30	2	5	8/15
09	No density data collected								10/14
10	<b>2720</b>	24	75	1	780	.73	17	0	8/15
<i>Artemisia tridentata wyomingensis</i>									
04	<b>20</b>	0	100	0	-	0	0	0	-/-
07	<b>740</b>	62	35	3	360	8	5	3	14/14
09	No density data collected								13/12
10	<b>820</b>	44	56	0	200	5	5	0	17/18
<i>Atriplex canescens</i>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	21/16
09	No density data collected								17/16
10	<b>0</b>	0	0	-	-	0	0	0	25/22
<i>Atriplex confertifolia</i>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								15/13
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Ceratoides lanata</i>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	8/9
09	No density data collected								6/8
10	<b>0</b>	0	0	-	-	0	0	0	8/7
<i>Chrysothamnus depressus</i>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	3/6
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<b>Chrysothamnus nauseosus</b>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	<b>20</b>	0	100	-	-	100	0	0	14/15
<b>Chrysothamnus viscidiflorus stenophyllus</b>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	13/22
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<b>Echinocactus sp.</b>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	1/3
<b>Gutierrezia sarothrae</b>									
04	<b>200</b>	0	100	-	-	0	0	30	7/7
07	<b>160</b>	0	100	-	-	0	0	0	6/8
09	No density data collected								7/10
10	<b>60</b>	33	67	-	-	0	0	0	8/8
<b>Juniperus osteosperma</b>									
04	<b>260</b>	31	54	15	-	8	0	23	-/-
07	<b>60</b>	67	33	0	-	0	0	0	-/-
09	No density data collected								-/-
10	<b>60</b>	100	0	0	-	0	0	0	-/-
<b>Kochia prostrata</b>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>60</b>	0	100	-	-	0	0	0	7/8
09	No density data collected								8/8
10	<b>0</b>	0	0	-	-	0	0	0	9/10
<b>Leptodactylon pungens</b>									
04	<b>440</b>	0	68	32	-	0	0	14	5/7
07	<b>360</b>	0	100	0	-	11	0	0	4/7
09	No density data collected								4/8
10	<b>240</b>	0	100	0	100	0	0	0	5/10

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Opuntia fragilis</i>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>220</b>	18	82	-	-	0	0	0	2/9
09	No density data collected								3/7
10	<b>180</b>	56	44	-	40	0	0	0	2/4
<i>Opuntia sp.</i>									
04	<b>640</b>	9	63	28	-	0	0	9	3/12
07	<b>140</b>	0	100	0	-	0	0	0	4/9
09	No density data collected								3/9
10	<b>120</b>	33	67	0	-	17	0	0	3/8
<i>Pediocactus simpsonii</i>									
04	<b>20</b>	0	100	-	-	0	0	0	1/3
07	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Pinus edulis</i>									
04	<b>400</b>	65	35	-	80	0	0	0	-/-
07	<b>20</b>	100	0	-	60	0	0	0	-/-
09	No density data collected								-/-
10	<b>20</b>	100	0	-	60	0	0	0	-/-

BLACKTAIL CHAINING - TREND STUDY NO. 17R-21-10

[Project #367](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Not available

Land Ownership: UDWR

Elevation: 6,653 ft. (2,028 m)

Aspect: Northeast

Slope: 3%

Transect bearing: 143° magnetic

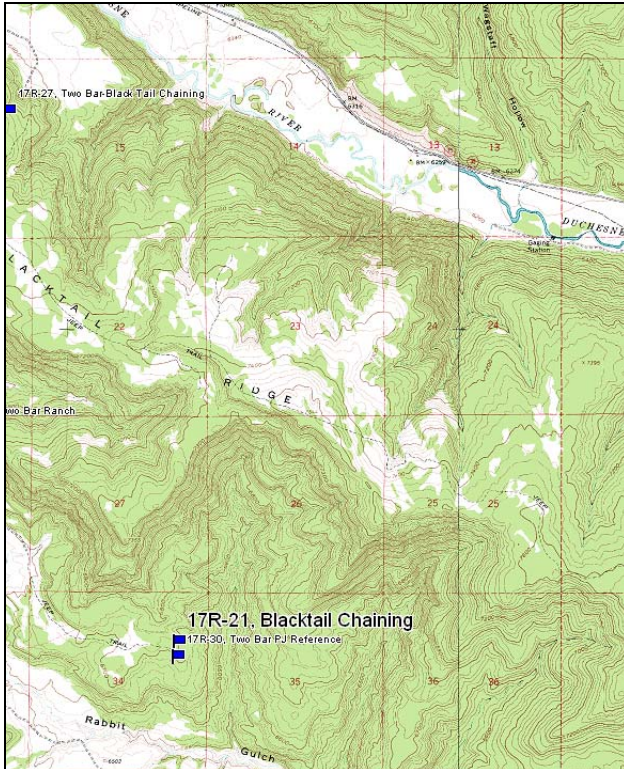
Belt placement: line 1 (11ft and 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Notes: No rebar

Directions:

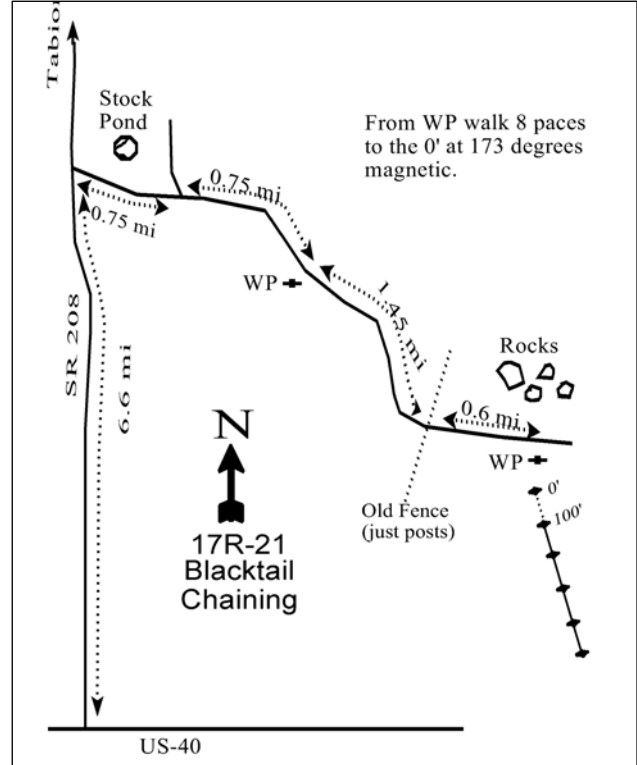
From US 40 drive north on SR 208 for 6.6 miles to a road on the right. Turn here and drive 0.75 miles to a junction. Stay straight on this road following it around a bend for 0.75 miles to a witness post on the right. From there drive 1.45 miles to an old fence (just posts remain) following the road as it curves back to the east. Proceed 0.6 miles to a witness post on the right and a rock pile on the left. From the witness post walk 18 paces at 173 degrees magnetic to the 0' stake marked with browse tag #148.

Map Name: Tabiona



Township: 6S Range: 11E Section: 25

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 529257 E 4457303 N



BLACKTAIL CHAINING - WRI STUDY 17R-21

[Project #367](#)

**Site Description**

Site Information: The study was established in 2006 in the Tabby Mountain Wildlife Management Area (WMA), ten miles northeast of Fruitland to monitor a 500 acre pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) chaining and reseeding in the fall of 2006. The treatment was part of a conservation easement and a larger habitat improvement project on Tabby Mountain and in Rabbit Gulch following an extensive sagebrush die-off (WRI Database 2011). Pellet group data from 2006 estimated heavy deer and elk use. In 2009, deer use was heavy while elk and cattle use was light. Elk and deer use was moderate in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 17R, Study no: 21

Project Name: Santaquin East P-J Chaining						
WRI Database #:367						
Application: Aerial Seed 1*		Acres:	500	Application: Seed Dribbler*		Acres: 500
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix lbs/acre
G	Canby Bluegrass 'Canbar'	125	0.25	F	Small Burnet 'Delar'	50 0.10
G	Crested Wheatgrass 'Ephraim'	16	0.03	B	Bitterbrush	25 0.05
G	Crested Wheatgrass 'Hycrest'	500	1.00	B	Green Ephedra	50 0.10
G	Orchardgrass 'Paiute'	100	0.20	B	True Mountain Mahogany	25 0.05
G	Russian Wildrye	514	1.03	Total Pounds:		150 0.30
G	Snake River Wheatgrass 'Secar'	250	0.50	PLS Pounds:		0.26
G	Thickspike Wheatgrass 'Bannock'	500	1.00	Application: Aerial Seed 2*		Acres: 500
F	Alfalfa 'Ladak'	150	0.30	Seed type		lbs in mix lbs/acre
F	Alfalfa 'Nomad'	150	0.30	B	Forage Kochia	500 1.00
F	Alfalfa 'Ranger'	200	0.40	B	Sagebrush, Wyoming	500 1.00
F	Blue Flax	125	0.25	Total Pounds:		1000 2.00
F	Sainfoin 'Eski'	1000	2.00	PLS Pounds:		0.26
F	Small Burnet 'Delar'	1000	2.00			
B	Fourwing Saltbush	500	1.00			
Total Pounds:		5130	10.26			
PLS Pounds:			8.85			

\*Three different seed mixes were applied to the site. Aerial Seed 1 mix was applied in fall of 2006 prior to the chaining treatment and Aerial Seed 2 mix was applied in January of 2007 following the chaining treatment. Seed Dribbler mix was applied in the fall of 2006 during the chaining treatment.

Browse: Prior to the seeding and chaining treatment, the key browse species consisted of scattered Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), which occurred primarily in clearings within the pinyon pine and Utah juniper. The preferred browse species on the site are forage kochia (*Kochia prostrata*) and Wyoming big sagebrush. Decadence and poor vigor of sagebrush plants were high prior to the treatment but following the treatment decadence and poor vigor have been low. The recruitment of young sagebrush plants has been exceptionally good since the treatment. Forage kochia has established on the site following the treatment and is the only seeded browse species to be measurable sampled. Other common browse species on the site are pricklypear cactus (*Opuntia* sp.), Utah juniper and pinyon pine (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant and diverse. Perennial grass frequency and cover increased following treatment. Perennial grasses are a mixture of native and seeded species with the native species needle-and-thread (*Stipa comata*) being the dominant species. Other common grasses include thickspike

wheatgrass (*Agropyron dasystachyum*), western wheatgrass (*A. smithii*), and crested wheatgrass (*A. cristatum*). Several seeded perennial species were sampled following treatment which include crested wheatgrass, thickspike wheatgrass, orchardgrass (*Dactylis glomerata*), and Russian wildrye (*Elymus junceus*). Two annual species, cheatgrass (*Bromus tectorum*) and sixweeks fescue (*Vulpia octoflora*), are present, and cheatgrass became fairly abundant in 2009 and 2010, after the treatment. Forbs were really rare prior to the treatment and have also responded well to the treatment. Perennial forb frequency has increased each year. Flaxleaf plainsmustard (*Schoenrambe linifolia*) is the dominant forb species and provides the majority of the forb cover. Seeded forb species include Lewis flax (*Linum lewisii*), Sainfoin (*Onobrychis viciaefolia*), and small burnet (*Sanguisorba minor*). No seeded forbs provided substantial cover (Table - Herbaceous Trends).

Soil: The soil texture is a sandy loam with a neutral soil reaction (pH 6.9) (Table - Soil Analysis Data). Bare ground cover is low to moderate with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years

### **Pre vs. Three Years Post Treatment, 2006 vs. 2009**

Browse: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush slightly decreased in canopy cover to less than 1%, however, forage kochia was introduced and provided 2% canopy cover. Pinyon pine and Utah juniper cover was reduced from 21% canopy cover to 2%. The density of pinyon trees decreased from 56 trees/acre to 32 trees/acre and juniper trees decreased from 37 trees/acre to 22 trees/acre. The trees were substantially smaller with decreases in the average diameter of both species.

Grass: The sum of nested frequency of perennial grasses increased slightly and cover increased from 3% to 19%. The sum of nested frequency of annual grasses declined 23% and cover increased from 1% to 2%. Needle-and-thread significantly increased in frequency and cover increased from 2% to 8%. Many of the seeded species were sampled at moderate frequency which includes crested wheatgrass, thickspike wheatgrass, and orchardgrass. Cheatgrass increased significantly in frequency and cover increased from less than 1% to 2%.

Forb: Forbs were extremely rare on the site prior to treatment. The sum of nested frequency of perennial forbs increased greatly, primarily due to a very low frequency in 2006. Cover of perennial forbs increased from 0% to 4%.

### **Trend Assessments**

#### Browse

- **2009 to 2010 - slightly up (+1)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big Sagebrush canopy cover remained near 1% while recruitment was high at 40% and decadence low at 6%. Forage kochia became more common, density was 2,100 plants/acre in 2010. Pinyon pine density decreased from 32 trees/acre to 21 trees/acre. Utah juniper density remained at 20 trees/acre.

#### Grass

- **2009 to 2010 - up (+2)**: The sum of nested frequency of perennial grasses increased 31% while cover remained between 18% and 19%. Needle-and-thread was remained the most common grass and cover remained near 8%. Thickspike wheatgrass and western wheatgrass provided a combined 6% cover. Cheatgrass slightly increased in frequency, though cover remained similar at 2%.

Forb

- **2009 to 2010 - slightly up (+1):** The nested frequency of perennial forbs increased 15% while cover decreased slightly from 4% to 3%. No seeded species provided significant cover. Slimleaf plainsmustard provided 2% cover in both samples.

HERBACEOUS TRENDS--

Management unit 17R, Study no: 21

Type	Species	Nested Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
G	Agropyron cristatum	a <sup>-</sup>	b <sup>33</sup>	c <sup>55</sup>	-	1.78	1.75
G	Agropyron dasystachyum	a <sup>-</sup>	b <sup>62</sup>	b <sup>68</sup>	-	2.75	2.90
G	Agropyron smithii	97	70	103	.69	3.67	2.88
G	Agropyron spicatum	-	7	4	-	.45	.79
G	Bouteloua gracilis	16	7	21	.07	.21	.87
G	Bromus tectorum (a)	a <sup>27</sup>	b <sup>69</sup>	b <sup>83</sup>	.07	1.78	1.93
G	Carex sp.	ab <sup>17</sup>	a <sup>-</sup>	b <sup>22</sup>	.03	-	.46
G	Dactylis glomerata	a <sup>-</sup>	b <sup>21</sup>	a <sup>2</sup>	-	.74	.03
G	Elymus junceus	-	3	7	-	.21	.30
G	Oryzopsis hymenoides	b <sup>57</sup>	a <sup>16</sup>	a <sup>25</sup>	.79	.48	.49
G	Poa secunda	26	15	10	.10	.40	.28
G	Sitanion hystrix	-	12	5	-	.24	.16
G	Stipa comata	88	101	131	1.53	7.93	7.53
G	Stipa lettermani	b <sup>19</sup>	a <sup>2</sup>	a <sup>3</sup>	.24	.06	.00
G	Vulpia octoflora (a)	c <sup>121</sup>	b <sup>45</sup>	a <sup>20</sup>	.64	.39	.06
<b>Total for Annual Grasses</b>		<b>148</b>	<b>114</b>	<b>103</b>	<b>0.70</b>	<b>2.18</b>	<b>1.99</b>
<b>Total for Perennial Grasses</b>		<b>320</b>	<b>349</b>	<b>456</b>	<b>3.46</b>	<b>18.97</b>	<b>18.48</b>
<b>Total for Grasses</b>		<b>468</b>	<b>463</b>	<b>559</b>	<b>4.17</b>	<b>21.15</b>	<b>20.47</b>
F	Astragalus convallarius	-	6	9	-	.03	.07
F	Astragalus sp.	-	3	-	-	.03	-
F	Chenopodium fremontii (a)	a <sup>-</sup>	b <sup>44</sup>	b <sup>28</sup>	-	.52	.48
F	Chenopodium leptophyllum(a)	-	3	7	-	.00	.02
F	Collinsia parviflora (a)	-	-	1	-	-	.00
F	Cryptantha sp.	2	9	10	.01	.33	.44
F	Descurainia pinnata (a)	3	-	-	.01	-	-
F	Draba sp. (a)	ab <sup>3</sup>	a <sup>-</sup>	b <sup>17</sup>	.00	-	.22
F	Gayophytum ramosissimum(a)	a <sup>-</sup>	b <sup>14</sup>	ab <sup>8</sup>	-	.39	.01
F	Ipomopsis aggregata	2	-	-	.00	-	-
F	Lactuca serriola (a)	-	-	7	-	.00	.01
F	Lappula occidentalis (a)	b <sup>62</sup>	a <sup>24</sup>	a <sup>24</sup>	.21	.64	.09
F	Linum lewisii	-	-	2	-	.00	.04
F	Medicago sativa	-	5	4	-	.67	.19
F	Mentzelia albicaulis (a)	a <sup>-</sup>	b <sup>13</sup>	ab <sup>5</sup>	-	.39	.06
F	Onobrychis viciaefolia	-	-	2	-	-	.00
F	Penstemon sp.	1	-	3	.00	-	.00
F	Polygonum douglasii (a)	20	9	9	.04	.10	.02
F	Salsola iberica (a)	-	1	8	-	.30	.82
F	Sanguisorba minor	-	-	5	-	.00	.15
F	Schoenrambe linifolia	a <sup>-</sup>	b <sup>38</sup>	b <sup>39</sup>	-	2.21	1.61

Type	Species	Nested Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
F	Senecio multilobatus	-	6	3	-	.69	.00
F	Tragopogon dubius (a)	-	-	1	-	.00	.03
Total for Annual Forbs		88	108	115	0.27	2.39	1.79
Total for Perennial Forbs		5	67	77	0.02	3.99	2.52
Total for Forbs		93	175	192	0.29	6.38	4.31

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 17R, Study no: 21

Type	Species	Strip Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
B	Artemisia tridentata wyomingensis	13	0	25	1.14	.33	.33
B	Chrysothamnus nauseosus	0	0	1	-	-	-
B	Juniperus osteosperma	2	0	0	.56	.75	.24
B	Kochia prostrata	0	0	47	-	1.83	1.45
B	Opuntia sp.	34	0	43	1.70	2.27	2.60
B	Pinus edulis	6	0	0	2.40	.98	.98
Total for Browse		55	0	116	5.82	6.17	5.61

#### CANOPY COVER, LINE INTERCEPT--

Management unit 17R, Study no: 21

Species	Percent Cover		
	'06	'09	'10
Artemisia tridentata wyomingensis	1.16	.43	1.01
Juniperus osteosperma	7.50	.85	.26
Kochia prostrata	-	1.60	1.36
Opuntia sp.	1.79	2.09	1.35
Pinus edulis	13.64	.91	.80

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 17R, Study no: 21

Species	Average leader growth (in) '10
Artemisia tridentata wyomingensis	1.9
Kochia prostrate	3.5
Purshia tridentata	2.4

POINT-QUARTER TREE DATA--  
Management unit 17R, Study no: 21

Species	Trees per Acre			Average diameter (in)		
	'06	'09	'10	'06	'09	'10
Juniperus osteosperma	37	22	19	24	9.4	5.3
Pinus edulis	56	32	21	6.3	1.8	1.5

BASIC COVER--  
Management unit 17R, Study no: 21

Cover Type	Average Cover %		
	'06	'09	'10
Vegetation	10.14	37.38	33.64
Rock	1.12	.15	.15
Pavement	0	.01	0
Litter	50.79	57.48	51.63
Cryptogams	5.64	.79	.38
Bare Ground	40.21	22.59	20.82

SOIL ANALYSIS DATA --  
Management unit 17R, Study no: 21, Study Name: Blacktail Chaining

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
11.3	6.9	71.3	14.4	14.3	4.5	20.7	131.2	0.9

PELLET GROUP DATA--  
Management unit 17R, Study no: 21

Type	Quadrat Frequency			Days use per acre (ha)		
	'06	'09	'10	'06	'09	'10
Rabbit	69	63	25	-	-	-
Elk	23	22	13	43 (106)	15 (36)	33 (81)
Deer	20	31	20	52 (129)	40 (98)	25 (61)
Cattle	-	-	-	-	1 (2)	-

BROWSE CHARACTERISTICS--  
Management unit 17R, Study no: 21

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Artemisia nova									
06	0	0	0	-	-	0	0	0	11/30
09	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	-/-
Artemisia tridentata wyomingensis									
06	340	6	18	76	2140	29	0	65	15/28
09	0	0	0	0	-	0	0	0	14/17
10	1040	40	54	6	-	25	42	2	16/21

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<b>Cercocarpus montanus</b>									
06	0	0	0	-	-	0	0	0	64/55
09	0	0	0	-	-	0	0	0	44/54
10	0	0	0	-	-	0	0	0	27/49
<b>Chrysothamnus nauseosus</b>									
06	0	0	0	-	-	0	0	0	-/-
09	0	0	0	-	-	0	0	0	28/31
10	60	100	0	-	-	0	0	0	31/35
<b>Juniperus osteosperma</b>									
06	40	0	50	50	-	0	0	0	-/-
09	0	0	0	0	-	0	0	0	-/-
10	0	0	0	0	-	0	0	0	-/-
<b>Kochia prostrata</b>									
06	0	0	0	-	-	0	0	0	-/-
09	0	0	0	-	-	0	0	0	12/14
10	2100	29	71	-	200	9	2	0	11/16
<b>Leptodactylon pungens</b>									
06	0	0	0	-	-	0	0	0	2/6
09	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	-/-
<b>Opuntia sp.</b>									
06	1800	0	83	17	-	0	0	9	6/20
09	0	0	0	0	-	0	0	0	5/15
10	1900	8	91	1	-	0	0	1	5/18
<b>Pinus edulis</b>									
06	120	33	67	-	20	0	0	0	-/-
09	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	-/-
<b>Purshia tridentata</b>									
06	0	0	0	-	-	0	0	0	12/54
09	0	0	0	-	-	0	0	0	24/71
10	0	0	0	-	-	0	0	0	20/54

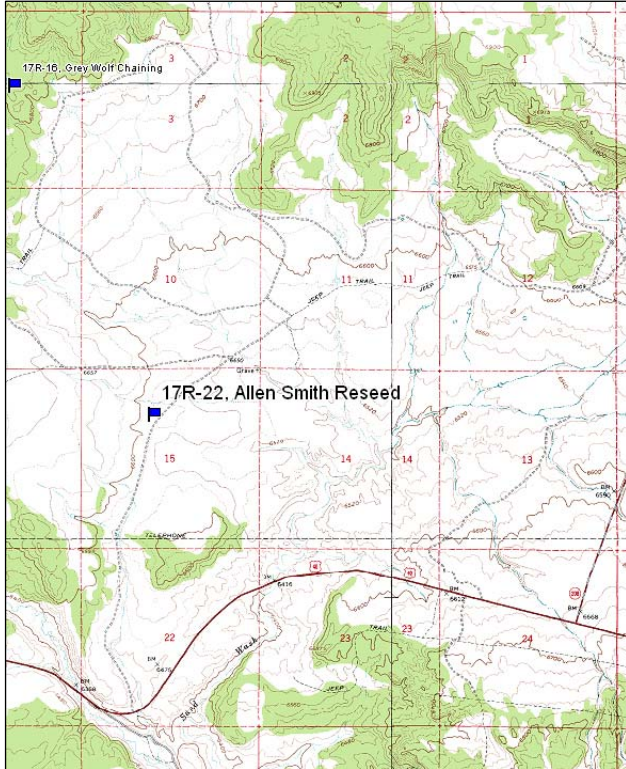
ALLEN SMITH RESEED - TREND STUDY NO. 17R-22-10  
[Project #417](#)

Vegetation Type: Wyoming Big Sagebrush  
Range Type: Crucial Deer Winter, Crucial Elk Winter  
NRCS Ecological Site Description: Not available  
Land Ownership: Private  
Elevation: 6,600 ft. (2,012 m)  
Aspect: Southeast  
Slope: 2%  
Transect bearing: 356° magnetic  
Belt placement: line 1 (11ft & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)  
Notes: No rebar

Directions:

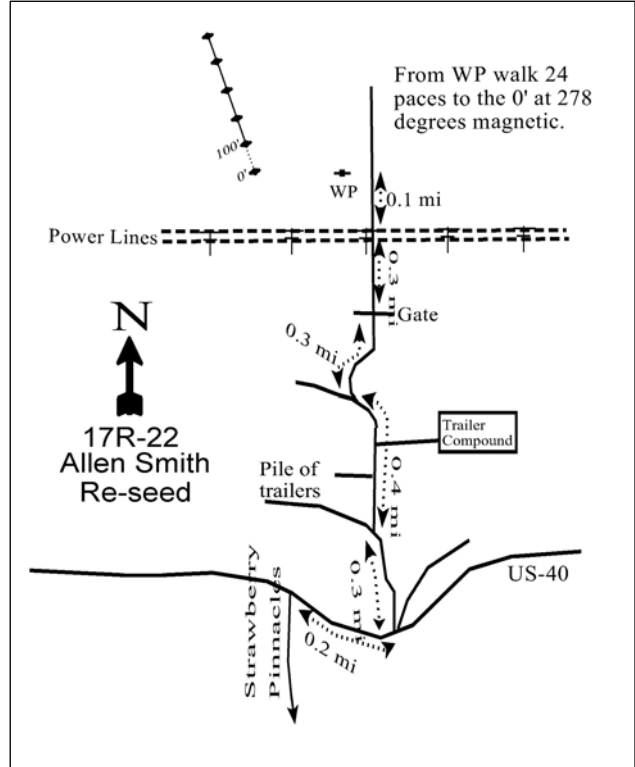
Driving east on US-40 drive to the farthest west turn off to the Strawberry Pinnacles. From there drive east 0.2 miles to a road on the left (north) side of the road. Turn here and drive north for 0.3 miles to a fork that leads to a pile of trailers. Stay to the right and drive 0.4 miles passing a trailer compound and coming to another fork. Stay to the right and drive 0.3 miles to a gate. Go through the gate and drive 0.5 miles to power lines crossing the road. From there drive 0.1 miles to a witness post on the left. From the witness post walk 24 paces at 278 degrees to the 0' stake marked with browse tag #147.

Map Name: Fruitland



Township: 3S Range: 8W Section: 15

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 519024 E 4452480 N

ALLEN SMITH RESEED - WRI STUDY 17R-22  
[#Project 417](#)

**Site Description**

Site Information: The study is located in the Sand Wash area three and a half miles east of Fruitland on private land. The study was established to monitor an aerial seeding to promote forb and browse production in a crested wheatgrass (*Agropyron cristatum*) and Russian wildrye (*Elymus junceus*) dominated flat. The Alan Smith property was disked and seeded in the early 1990's. The site was heavily seeded to crested wheatgrass and Russian wildrye. In the early 2000's, the sagebrush left on the site was treated with Spike (Tebuthiuron). Initially, the project planned to spray the area with Roundup (glyphosate) herbicide and use a rangeland drill to distribute the seed mix, but the project was later changed to an aerial seeding and was not sprayed with Roundup herbicide. The seeding occurred in November 2006 and shortly afterward, 300 head of Livestock were used to incorporate the seed mix into the soil for the span of two weeks. The objectives of the project were to incorporate forb and browse species and establish cover for sage-grouse on the site and enhance winter range for mule deer and elk (WRI Database 2011). Pellet group data estimated light deer and cattle use and heavy elk use in each year (Table - Pellet Group Data).

SEED MIX--  
 Management unit 17R, Study no: 22

Project Name: Sink Draw Interseeding			
WRI Database #: 417			
Application: Aerial Seed		Acres: 600	
Seed type		lbs in mix	lbs/acre
G	Blue Grama	150	0.25
G	Orchardgrass 'Paiute'	60	0.10
G	Sandberg Bluegrass 'Toole MT'	150	0.25
G	Western Wheatgrass 'Arriba'	300	0.50
F	Alfalfa 'Ladak'	250	0.42
F	Alfalfa 'Ranger'	250	0.42
F	Alfalfa 'Spredor 4'	250	0.42
F	Blue Flax ' Appar	150	0.25
F	Cicer Milkvetch 'Lutana'	600	1.00
F	Sainfoin 'Eski'	1200	2.00
F	Small Burnet 'Delar'	1200	2.00
B	Forage Kochia	600	1.00
B	Fourwing Saltbush	300	0.50
B	Sagebrush, Wyoming	600	1.00
B	Winterfat	150	0.25
Total Pounds:		6210	10.35
PLS Pounds:			8.00

Browse: The key browse species was Wyoming big sagebrush at one time, but nearly the whole population was dead in 2006. A few live sagebrush plants have established since treatment. It was likely the high density of crested wheatgrass prevented seedling establishment prior to treatment. Forage kochia (*Kochia prostrata*) has established on the site after being seeded as part of the treatment. Patches of black greasewood (*Sarcobatus vermiculatus*) occurred in nearby depressions but were not sampled within the study. Other species sampled included: broom snakeweed (*Gutierrezia sarothrae*), pricklypear cactus (*Opuntia sp.*), and slenderbush eriogonum (*Eriogonum microthecum*) (Table - Browse Characteristics).



**Herbaceous Understory:** Grasses are abundant and fairly diverse. The grass component is dominated by the seeded species crested wheatgrass which accounts for the majority of the herbaceous understory cover. Seeded species sampled after the treatment include western wheatgrass (*Agropyron smithii*) and Sandberg bluegrass (*Poa secunda*), though Sandberg bluegrass was sampled prior to the treatment. Cheat grass (*Bromus tectorum*) has been sampled on the site but has been rare on the site. Perennial forbs were rare in all sample years, but decreased significantly following treatment (Table - Herbaceous Trends).

**Soil:** The soil texture is a sandy clay loam with a slightly alkaline soil reaction (pH 7.5) (Table - Soil Analysis Data). Bare ground cover is moderate with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). Soil erosion condition was classified as stable in all sample years.

### Pre vs. Four Years Post Treatment, 2006 vs. 2010

**Browse:** all of the Wyoming big sagebrush plants sampled prior to the treatment were dead at a density of 2,320 plants/acre. Following the treatment Wyoming big sagebrush density was 40 plants/acre, all of which were mature. Forage kochia was sampled in 2010, at a density of 140 plants/acre.

**Grasses:** The sum of nested frequency of perennial grasses remained similar and cover increased from 22% to 24%. Crested wheatgrass cover remained at 21% cover.

**Forbs:** Forbs are rare on the site. The nested frequency of perennial forbs decreased 42% while cover remained low between 1% and 2%. Alfalfa (*Medicago sativa*) was the most common forb.

#### HERBACEOUS TRENDS--

Management unit 17R, Study no: 22

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	403	376	20.61	21.00
G	Agropyron intermedium	21	20	.13	.31
G	Agropyron smithii	a-	b13	-	.48
G	Agropyron spicatum	4	-	.03	-
G	Bromus tectorum (a)	3	-	.03	-
G	Carex sp.	14	27	.10	.53
G	Elymus junceus	b34	a19	1.31	1.06
G	Oryzopsis hymenoides	b37	a5	.21	.15
G	Poa secunda	1	9	.00	.33
G	Stipa comata	-	3	-	.03
Total for Annual Grasses		3	0	0.03	0
Total for Perennial Grasses		514	472	22.41	23.93
Total for Grasses		517	472	22.45	23.93
F	Arabis sp.	1	-	.00	-
F	Astragalus convallarius	-	4	-	.30
F	Chenopodium leptophyllum(a)	-	4	-	.00
F	Cryptantha sp.	2	-	.00	-
F	Descurainia pinnata (a)	b24	a-	.08	-
F	Draba sp. (a)	2	1	.00	.00
F	Eriogonum cernuum (a)	5	-	.01	-
F	Lappula occidentalis (a)	1	-	.00	-

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	Leucelene ericoides	3	3	.00	.03
F	Machaeranthera canescens	<sub>b</sub> 35	<sub>a</sub> -	.37	-
F	Medicago sativa	<sub>b</sub> 42	<sub>a</sub> 26	1.39	.53
F	Melilotus officinalis	2	-	.00	-
F	Phlox austromontana	3	2	.03	.03
F	Salsola iberica (a)	<sub>b</sub> 141	<sub>a</sub> -	.46	-
F	Schoenrambe linifolia	4	1	.01	.01
F	Senecio multilobatus	3	-	.00	-
F	Sphaeralcea coccinea	24	21	.30	.29
F	Trifolium sp.	6	15	.01	.08
Total for Annual Forbs		173	5	0.57	0.00
Total for Perennial Forbs		125	72	2.16	1.27
Total for Forbs		298	77	2.73	1.28

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 17R, Study no: 22

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata wyomingensis	0	2	-	.03
B	Chrysothamnus viscidiflorus viscidiflorus	0	1	-	-
B	Gutierrezia sarothrae	5	10	.03	.21
B	Kochia prostrata	0	4	-	.01
B	Opuntia sp.	9	5	.15	.03
Total for Browse		14	22	0.18	0.28

#### CANOPY COVER, LINE INTERCEPT--

Management unit 17R, Study no: 22

Species	Percent Cover	
	'06	'10
Gutierrezia sarothrae	-	.50
Kochia prostrata	-	.11
Opuntia sp.	.10	.15

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 17R, Study no: 22

Species	Average leader growth (in)
	'10
Artemisia tridentata wyomingensis	1.5

BASIC COVER--

Management unit 17R, Study no: 22

Cover Type	Average Cover %	
	'06	'10
Vegetation	25.70	25.87
Rock	.77	.31
Pavement	1.70	1.67
Litter	52.02	49.02
Cryptogams	.13	.15
Bare Ground	39.75	32.19

SOIL ANALYSIS DATA --

Management unit 17R, Study no: 22, Study Name: Allen Smith Reseed

Effective rooting depth (in)	pH	sandy clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
10.1	7.5	49.6	27.1	23.3	1.9	12.1	160.0	0.7

PELLET GROUP DATA--

Management unit 17R, Study no: 22

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	25	1	-	-
Grouse	1	-	-	-
Elk	42	33	62 (152)	50 (122)
Deer	13	15	7 (17)	3 (7)
Cattle	9	14	21 (52)	10 (25)

BROWSE CHARACTERISTICS--

Management unit 17R, Study no: 22

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata wyomingensis</i>										
06	0	0	0	-	-	0	0	0	7/8	
10	40	0	100	-	-	0	0	0	12/13	
<i>Ceratoides lanata</i>										
06	0	0	0	-	-	0	0	0	14/23	
10	0	0	0	-	-	0	0	0	11/14	
<i>Chrysothamnus nauseosus</i>										
06	0	0	0	-	-	0	0	0	-/-	
10	0	0	0	-	-	0	0	0	16/23	
<i>Chrysothamnus viscidiflorus viscidiflorus</i>										
06	0	0	0	-	-	0	0	0	-/-	
10	20	0	100	-	-	0	0	0	-/-	

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Eriogonum corymbosum</i>									
06	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	11/15
<i>Eriogonum microthecum</i>									
06	0	0	0	-	-	0	0	0	11/15
10	0	0	0	-	-	0	0	0	-/-
<i>Gutierrezia sarothrae</i>									
06	140	0	100	-	-	0	0	0	5/11
10	400	0	100	-	-	0	0	0	7/12
<i>Kochia prostrata</i>									
06	0	0	0	-	-	0	0	0	-/-
10	140	14	86	-	-	14	0	0	6/9
<i>Opuntia sp.</i>									
06	180	11	56	33	-	0	0	22	4/16
10	100	0	100	0	-	0	0	0	4/17

RABBIT GULCH INTERSEEDING - TREND STUDY NO. 17R-23-10

[Project #420](#)

Vegetation Type: Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Not available

Land Ownership: Private

Elevation: 6,100 ft. (1,859 m)

Aspect: South

Slope: 1%

Transect bearing: 71° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

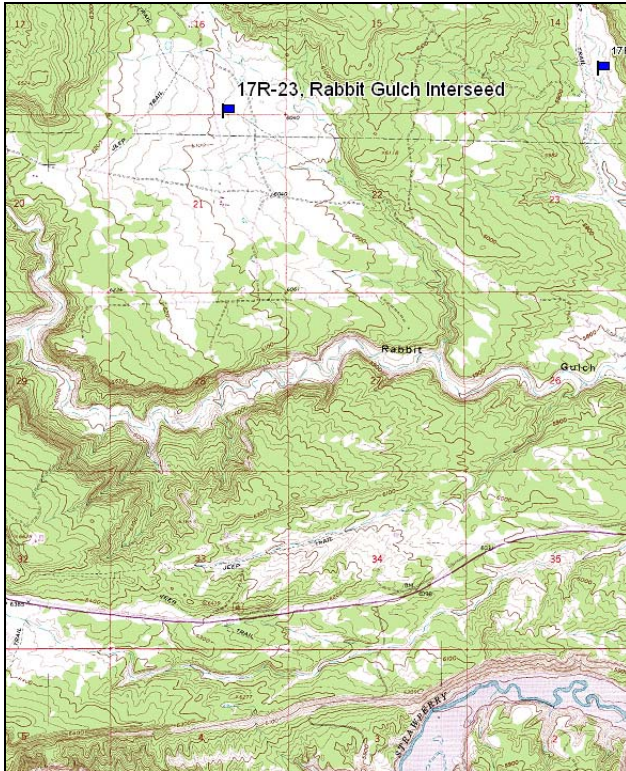
Notes: No rebar

Directions:

From the Starvation Bridge on U.S. 40 travel west 1.5 miles to a turnoff on the north side of the road (28000 W.). Follow this road 0.25 miles to a fork. Continue left 0.9 miles and staying left. Continue 0.2 miles to a cattleguard and fence. After the cattleguard proceed 1.0 mile to a witness post on the left side of the road.

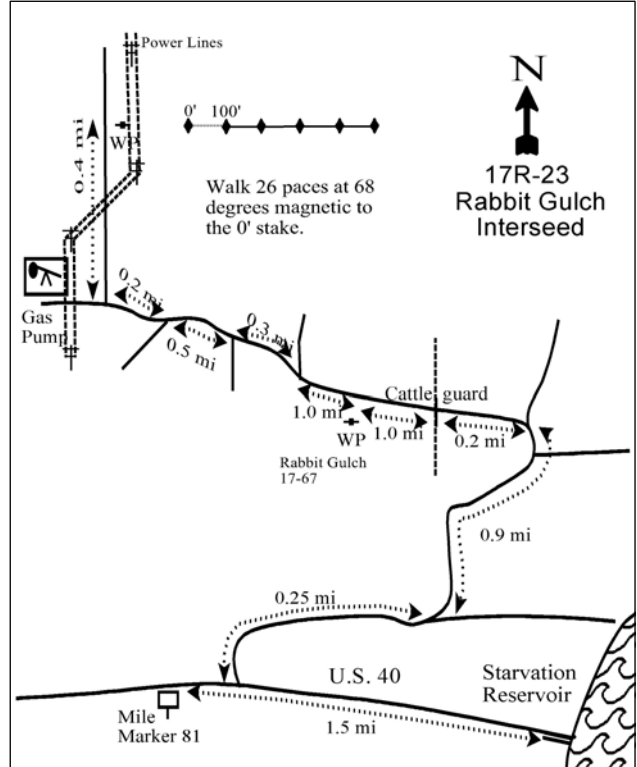
From the witness post drive 0.1 miles to a fork and stay left for 0.4 miles to another intersection again staying left. Continue 0.3 miles to an intersection staying right for 0.5 miles to a fork continuing right for 0.2 miles to another intersection. From here turn right (north) and drive 0.4 miles to a witness post on the right. From the witness post walk 26 paces at 68 degrees magnetic to the 0' stake marked with browse tag #145.

Map Name: Rabbit Gulch



Township: 3S Range: 6W Section: 21

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 536969 E 4451389 N

RABBIT GULCH INTERSEEDING - WRI STUDY 17R-23  
[Project #420](#)

**Site Description**

Site Information: The study is located on a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) bench northeast of Rabbit Gulch and approximately nine miles northwest of Duchesne in the Tabby Mountain Wildlife Management Area (WMA). The study was established in 2006 to monitor the effects of an interseeding project in decadent Wyoming big sagebrush population. Rabbit Gulch suffered sagebrush mortality during the summer of 2002. Grass, forb, and browse seed mix was drilled into 130 acres of the proposed 475 acre area in the spring of 2007. Sagebrush seed was applied on the surface to maximize germination. The objective of the project was to improve critical winter habitat for mule deer and elk (WRI Database 2011). Pellet group data estimated light deer, elk and cattle use in all sample years (Table - Pellet Group Data).

SEED MIX--

Management unit 17R, Study no: 23

Project Name: Rabbit Gulch Interseeding							
WRI Database #:420							
Application: Drill Seed		Acres: 250		Application: Drill Seed		Acres: 250	
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix	lbs/acre
G	Blue Grama	20	0.08	B	Forage Kochia 'Immigrant'	250	1.00
G	Crested Wheatgrass 'Douglas'	60	0.24	B	Fourwing Saltbush	250	1.00
G	Russian Wildrye 'Bozoisky'	60	0.24	B	Sagebrush, Wyoming	250	1.00
G	Sandberg Bluegrass 'Toole MT'	60	0.24	B	Winterfat	125	0.50
G	Snake River Wheatgrass 'Secar'	60	0.24	Total Pounds:		875	3.50
G	Western Wheatgrass 'Arriba'	60	0.24	PLS Pounds:			1.43
F	Alfalfa 'Ranger'	250	1.00				
F	Blue Flax 'Appar'	60	0.24				
F	Sainfoin 'Eski'	500	2.00				
F	Small Burnet 'Delar'	500	2.00				
Total Pounds:		1630	6.52				
PLS Pounds:			5.84				

Browse: The preferred browse species on the site is Wyoming big sagebrush. Prior to the treatment, the Wyoming big sagebrush population were mostly decadent and dead with the majority of the population exhibiting poor vigor. Following the treatment the health of the sagebrush population improved. Dead and decadent sagebrush plants substantially decreased and plants exhibiting poor vigor were low. The recruitment of young sagebrush plants has been excellent, but sagebrush cover has remained low. Utilization of sagebrush has been mostly light over the sample years. Other browse species sampled on the site include shadscale (*Atriplex confertifolia*), winterfat (*Ceratoides lanata*), broom snakeweed (*Gutierrezia sarothrae*), and pricklypear cactus (*Opuntia* sp.). Utilization of shadscale and winterfat has been mostly light, though winterfat has exhibited heavier use following treatment (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant and diverse on the site. Indian ricegrass (*Oryzopsis hymenoides*) and needle-and-thread (*Stipa comata*) are the dominant grass species and provide the majority of the grass cover on the site. No other perennial species were very abundant. Cheatgrass (*Bromus tectorum*) is rare on the site. Seeded grass species sampled on the site following the treatment include blue grama (*Bouteloua gracilis*), Russian wildrye (*Elymus junceus*), and Sandberg bluegrass (*Poa secunda*). Perennial forbs are very rare on the site. Scarlet globemallow (*Sphaeralcea coccinea*) was the most common perennial species, but has provided very little cover on the site (Table - Herbaceous Trends).

Soil: The soil texture is a sandy loam with a slightly alkaline soil reaction (pH 7.7) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2006 due to infrequent rills, flow patterns, and gully activity, along with some surface litter and soil movement. Soil was rated as stable in 2010.

**Pre vs. Three Years Post Treatment, 2006 vs. 2010**

Browse: Wyoming big sagebrush density increased three fold from 220 plants/acre to 840 plants/acre and provided 1% cover. The sagebrush population improved from having no recruitment of young to the population and extremely high decadence to 50% recruitment and low decadence (14%). Shadscale density remained similar at 440 plants/acre with the population in good condition. Recruitment of young shadscale to the population was moderate at 14% while mature plants accounted for the remaining 86% of the population. Winterfat density increased 54% from 260 plants/acre to 400 plants/acre. Eighty five% of winterfat plants showed moderate or heavy use.

Grasses: The sum of nested frequency of perennial grasses increased 20% and cover increased from 13% to 18%. Indian ricegrass decreased significantly in nested frequency and cover decreased from 9% to 3%. Needle-and-thread significant increased in nested frequency and cover increased from 4% to 14%. All other species provided little cover.

Forbs: Perennial forbs are very scarce. Scarlet globemallow provided more than half of perennial forb cover in 2010 at 1%.

HERBACEOUS TRENDS--

Management unit 17R, Study no: 23

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron spicatum	-	2	-	.00
G	Bouteloua gracilis	-	1	-	.15
G	Bromus tectorum (a)	2	9	.01	.12
G	Elymus junceus	-	2	-	.03
G	Hilaria jamesii	-	3	-	.06
G	Oryzopsis hymenoides	<sub>b</sub> 244	<sub>a</sub> 104	9.10	2.67
G	Poa fendleriana	1	8	.03	.06
G	Poa secunda	5	9	.04	.09
G	Sitanion hystrix	<sub>a</sub> 4	<sub>b</sub> 16	.04	.80
G	Stipa comata	<sub>a</sub> 124	<sub>b</sub> 309	4.09	13.93
G	Vulpia octoflora (a)	<sub>b</sub> 35	<sub>a</sub> 10	.18	.05
Total for Annual Grasses		37	19	0.19	0.17
Total for Perennial Grasses		378	454	13.31	17.81
Total for Grasses		415	473	13.51	17.98
F	Alyssum alyssoides (a)	-	2	-	.01
F	Calochortus nuttallii	-	5	-	.02
F	Chenopodium leptophyllum(a)	-	3	-	.01
F	Descurainia pinnata (a)	14	5	.08	.01
F	Draba sp. (a)	2	10	.00	.02
F	Eriogonum cernuum (a)	<sub>b</sub> 15	<sub>a</sub> -	.08	-

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	Halogeton glomeratus (a)	<sub>b</sub> 56	<sub>a</sub> 22	.45	.44
F	Lappula occidentalis (a)	31	41	.08	.45
F	Leucelene ericoides	6	9	.06	.19
F	Machaeranthera canescens	4	-	.01	-
F	Oenothera sp.	-	1	-	.03
F	Plantago patagonica (a)	<sub>a</sub> 6	<sub>b</sub> 30	.03	.72
F	Salsola iberica (a)	1	-	.00	-
F	Schoenrambe linifolia	4	8	.01	.06
F	Sphaeralcea coccinea	35	38	.24	.98
F	Townsendia sp.	-	4	-	.00
Total for Annual Forbs		125	113	0.75	1.67
Total for Perennial Forbs		49	65	0.32	1.29
Total for Forbs		174	178	1.07	2.97

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 17R, Study no: 23

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata wyomingensis	10	23	.98	.44
B	Atriplex confertifolia	16	17	.55	.78
B	Ceratoides lanata	7	11	.19	.27
B	Gutierrezia sarothrae	20	8	.63	.06
B	Kochia prostrata	0	1	-	-
B	Opuntia sp.	37	39	1.26	2.01
Total for Browse		90	99	3.63	3.57

#### CANOPY COVER, LINE INTERCEPT--

Management unit 17R, Study no: 23

Species	Percent Cover	
	'06	'10
Artemisia tridentata wyomingensis	.83	.43
Atriplex confertifolia	1.46	2.13
Ceratoides lanata	.13	.16
Gutierrezia sarothrae	.13	-
Opuntia sp.	1.78	2.46



KEY BROWSE ANNUAL LEADER GROWTH--  
Management unit 17R, Study no: 23

Species	Average leader growth (in) '10
Artemisia tridentata wyomingensis	1.6
Ceratoides lanata	2.1

BASIC COVER--  
Management unit 17R, Study no: 23

Cover Type	Average Cover %	
	'06	'10
Vegetation	19.73	26.62
Pavement	.02	0
Litter	33.06	29.79
Cryptogams	8.35	1.92
Bare Ground	53.54	51.37

SOIL ANALYSIS DATA --

Management unit 17R, Study no: 23, Study Name: Rabbit Gulch Interseeding

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
8.9	7.7	64.7	18.9	16.4	0.7	7.4	176.0	0.4

PELLET GROUP DATA--

Management unit 17R, Study no: 23

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	58	7	-	-
Elk	13	13	21 (53)	17 (41)
Deer	26	16	22 (55)	10 (25)
Cattle	3	6	12 (30)	12 (29)

BROWSE CHARACTERISTICS--  
Management unit 17R, Study no: 23

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata wyomingensis</i>										
06	<b>220</b>	0	9	91	1120	27	9	82	15/22	
10	<b>840</b>	50	36	14	-	14	17	5	18/28	
<i>Atriplex confertifolia</i>										
06	<b>420</b>	19	62	19	740	0	10	10	12/24	
10	<b>440</b>	14	86	0	-	5	0	0	13/28	
<i>Ceratoides lanata</i>										
06	<b>260</b>	62	38	-	160	8	8	23	4/9	
10	<b>400</b>	0	100	-	20	60	25	0	7/9	
<i>Gutierrezia sarothrae</i>										
06	<b>520</b>	8	85	8	20	19	4	96	5/10	
10	<b>220</b>	9	91	0	-	0	0	0	8/11	
<i>Kochia prostrata</i>										
06	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>20</b>	0	100	-	-	0	0	0	9/13	
<i>Opuntia sp.</i>										
06	<b>1220</b>	2	85	13	-	0	0	7	5/17	
10	<b>1520</b>	0	99	1	-	0	0	1	5/21	

EAST SANTAQUIN CHAINING - TREND STUDY NO. 17R-24-10

[Project #367](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Not available

Land Ownership: UDWR

Elevation: 6,700 ft. (2,042 m)

Aspect: Southeast

Slope: 3%

Transect bearing: 0'-300' 358° magnetic, 300'-500' 331° magnetic

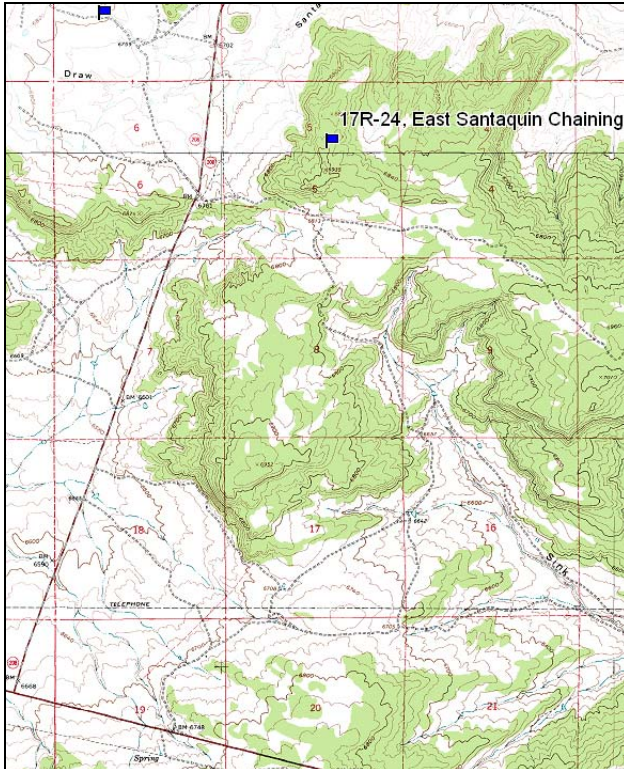
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

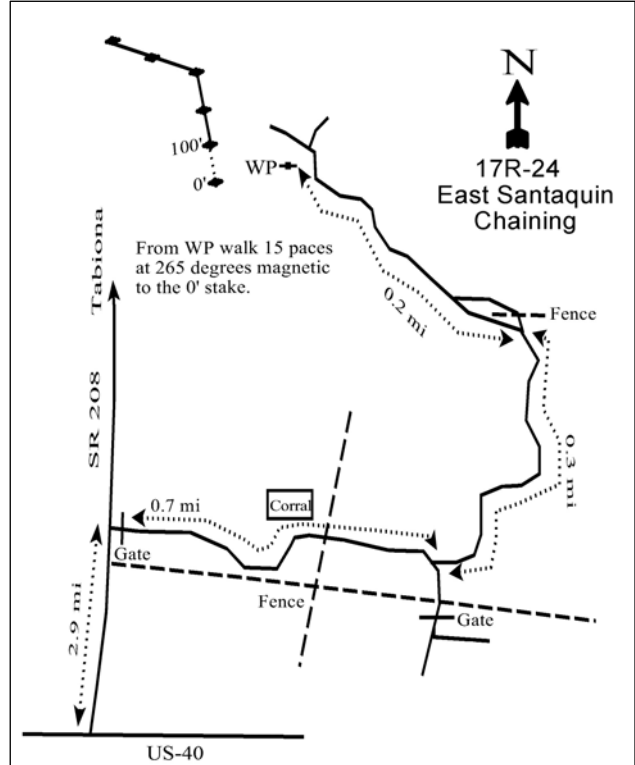
From US-40 drive north on SR 208 2.9 miles to a gated road on the right. Turn here and proceed through the gate for 0.7 miles to a fork. Turn left and follow the road for 0.3 road to a fence then veer left and drive 0.2 miles to a witness post on the left. Walk 15 paces at 265 degrees magnetic to the 0' stake marked with browse tag #146.

Map Name: Tabiona



Township: 7S Range: 11E Section: 5

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 525694 E 4455581 N

EAST SANTAQUIN CHAINING - WRI STUDY 17R-24  
[Project #367](#)

**Site Description**

Site Information: This study was established in 2006 to monitor the effects of a chaining and seeding eight miles northeast of Fruitland, within the Tabby Mountain Wildlife Management Area (WMA). Following a six year drought, over 217,000 acres of the Uintah Basin/Northeastern Region suffered a sagebrush (*Artemisia spp.*) die-off. In order to improve winter ranges several projects were implemented. As a result the Tabby Mountain WMA had many large habitat improvement projects conducted to reinvigorate decadent sagebrush stands and to remove pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) encroachments. The objective of the project was to rehabilitate sagebrush steppe habitat in an effort to conserve mule deer populations in the East Santaquin area (WRI Database 2011). Pellet group data estimated heavy deer and elk use in 2006 and light elk, deer, cow and sheep use in 2010 (Table - Pellet Group Data).

**SEED MIX--**

Management unit 17R, Study no: 24

Project Name: Santaquin East P-J Chaining						
WRI Database #:367						
Application: Aerial Seed 1*		Acres:	500	Application: Seed Dribbler*		Acres: 500
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix lbs/acre
G	Canby Bluegrass 'Canbar'	125	0.25	F	Small Burnet 'Delar'	50 0.10
G	Crested Wheatgrass 'Ephraim'	16	0.03	B	Bitterbrush	25 0.05
G	Crested Wheatgrass 'Hycrest'	500	1.00	B	Green Ephedra	50 0.10
G	Orchardgrass 'Paiute'	100	0.20	B	True Mountain Mahogany	25 0.05
G	Russian Wildrye	514	1.03	Total Pounds:		150 0.30
G	Snake River Wheatgrass 'Secar'	250	0.50	PLS Pounds:		0.26
G	Thickspike Wheatgrass 'Bannock'	500	1.00	Application: Aerial Seed 2*		Acres: 500
F	Alfalfa 'Ladak'	150	0.30	Seed type		lbs in mix lbs/acre
F	Alfalfa 'Nomad'	150	0.30	B	Forage Kochia	500 1.00
F	Alfalfa 'Ranger'	200	0.40	B	Sagebrush, Wyoming	500 1.00
F	Blue Flax	125	0.25	Total Pounds:		1000 2.00
F	Sainfoin 'Eski'	1000	2.00	PLS Pounds:		0.26
F	Small Burnet 'Delar'	1000	2.00			
B	Fourwing Saltbush	500	1.00			
Total Pounds:		5130	10.26			
PLS Pounds:			8.85			

\*Three different seed mixes were applied to the site. Aerial Seed 1 mix was applied in fall of 2006 prior to the chaining treatment and Aerial Seed 2 mix was applied in January of 2007 following the chaining treatment. Seed Dribbler mix was applied in the fall of 2006 during the chaining treatment.

Browse: Palatable browse species were sparse prior to treatment. Antelope bitterbrush (*Purshia tridentata*) was the only preferred browse species sampled in density measurements in 2006. Following treatment and the removal of pinyon and juniper, palatable browse species increased. Preferred browse species sampled after the treatment included Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*) and forage kochia (*Kochia prostrata*). The recruitment of young forage kochia and sagebrush plants to the population was excellent and utilization was light. Seeded species sampled on the site following the treatment include Wyoming big sagebrush, forage kochia, antelope bitterbrush, and true mountain mahogany (*Cercocarpus montanus*) (Table - Browse Characteristics).

**Herbaceous Understory:** Grasses are abundant and diverse. Prior to treatment perennial grasses were common but did not provide much cover. Indian ricegrass (*Oryzopsis hymenoides*) provided the majority of the cover. The most common grass species on the site include crested wheatgrass (*Agropyron cristatum*), western wheatgrass (*A. smithii*), needle-and-thread (*Stipa comata*), Indian ricegrass, and cheatgrass (*Bromus tectorum*). Seeded species sampled after the treatment include crested wheatgrass and thickspike wheatgrass (*Agropyron dasystachyum*). The forb community was very limited and patchy. Lewis flax (*Linum lewisii*), alfalfa (*Medicago sativa*), sainfoin (*Onobrychis viciaefolia*) and small burnet (*Sanguisorba minor*) were seeded species sampled (Table - Herbaceous Trends).

**Soil:** The soil texture is a sandy loam with a neutral soil reaction (pH 7.0) (Table - Soil Analysis Data). Bare ground cover is moderate with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as moderate in 2006 due to soil and surface litter movement, pedestalling and flow patterns. Soil condition improved to stable in 2010.

**Pre vs. Four Years Post Treatment, 2006 vs. 2010**

**Browse:** Wyoming big sagebrush canopy cover increased from 0% to 1% and density increased from 0 plants/acre to 800 plants/acre. Forage kochia canopy cover increased from 0% to 5% and density increased from 0 plants/acre to 2,900 plants/acre. Pinyon pine (*Pinus edulis*) density decreased from 46 trees/acre to 8 trees/acre and Utah juniper (*Juniperus osteosperma*) density decreased from 44 trees/acre to 7 trees/acre. The combined canopy cover of pinyon pine and Utah juniper was reduced from 30% to 1%.

**Grasses:** The sum of nested frequency perennial grasses increased 33% and cover increased from 4% to 13%. Following the treatment, crested wheatgrass, western wheatgrass, and Indian ricegrass each provided 3% cover while needle-and-thread and thickspike wheatgrass each provided 2% cover. Cheatgrass increased significantly in frequency and provided 2% cover in 2010.

**Forbs:** Forbs are rare on the site. Perennial forbs showed no change following treatment. Lewis flax (*Linum lewisii*), alfalfa (*Medicago sativa*), sainfoin (*Onobrychis viciaefolia*) and small burnet (*Sanguisorba minor*) were seeded species that were sampled in low frequency and cover.

**HERBACEOUS TRENDS--**

Management unit 17R, Study no: 24

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	<i>Agropyron cristatum</i>	a-	b76	-	2.53
G	<i>Agropyron dasystachyum</i>	a-	b61	-	1.71
G	<i>Agropyron smithii</i>	b94	a97	.32	2.57
G	<i>Agropyron spicatum</i>	-	11	-	.30
G	<i>Bromus tectorum</i> (a)	a76	b129	.58	2.10
G	<i>Carex</i> sp.	b91	a34	.42	.48
G	<i>Oryzopsis hymenoides</i>	95	75	2.08	2.90
G	<i>Poa secunda</i>	37	41	.44	.43
G	<i>Sitanion hystrix</i>	1	3	.00	.00
G	<i>Stipa comata</i>	a29	b64	.50	2.41
Total for Annual Grasses		76	129	0.58	2.10
Total for Perennial Grasses		347	462	3.78	13.38
Total for Grasses		423	591	4.37	15.49
F	<i>Arabis</i> sp.	-	-	.00	-

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	Astragalus convallarius	-	2	-	.01
F	Chenopodium fremontii (a)	-	12	-	.01
F	Chenopodium leptophyllum(a)	-	13	-	.07
F	Cryptantha sp.	2	9	.00	.09
F	Descurainia pinnata (a)	1	3	.00	.03
F	Draba sp. (a)	1	-	.00	-
F	Eriogonum sp.	-	3	-	.00
F	Gayophytum ramosissimum(a)	2	-	.00	-
F	Gilia sp. (a)	2	-	.00	-
F	Ipomopsis aggregata	<sub>b</sub> 42	<sub>a</sub> 1	.15	.03
F	Ipomopsis congesta	-	6	-	.06
F	Lappula occidentalis (a)	<sub>b</sub> 28	<sub>a</sub> 3	.09	.00
F	Linum lewisii	<sub>a</sub> -	<sub>b</sub> 12	-	.23
F	Medicago sativa	-	7	-	.07
F	Onobrychis viciaefolia	-	3	-	.15
F	Penstemon sp.	1	2	.00	.15
F	Polygonum douglasii (a)	<sub>b</sub> 32	<sub>a</sub> 4	.07	.01
F	Sanguisorba minor	-	2	-	.15
F	Senecio multilobatus	24	33	.46	.44
Total for Annual Forbs		66	35	0.18	0.13
Total for Perennial Forbs		69	80	0.62	1.40
Total for Forbs		135	115	0.81	1.53

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 17R, Study no: 24

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata wyomingensis	0	20	-	1.13
B	Chrysothamnus viscidiflorus	0	6	-	-
B	Chrysothamnus viscidiflorus viscidiflorus	1	0	.01	-
B	Juniperus osteosperma	3	0	1.25	-
B	Kochia prostrata	0	44	-	2.84
B	Leptodactylon pungens	2	9	-	.18
B	Opuntia fragilis	56	30	2.03	.18
B	Opuntia sp.	9	4	.56	-
B	Pinus edulis	2	2	.71	.30
B	Purshia tridentata	4	4	1.04	1.63
Total for Browse		77	119	5.61	6.28

CANOPY COVER, LINE INTERCEPT--  
Management unit 17R, Study no: 24

Species	Percent Cover	
	'06	'10
Artemisia tridentata wyomingensis	-	1.33
Chrysothamnus viscidiflorus viscidiflorus	.05	-
Juniperus osteosperma	8.46	-
Kochia prostrata	-	4.63
Leptodactylon pungens	-	.31
Opuntia fragilis	2.06	.58
Opuntia sp.	.58	.05
Pinus edulis	21.53	.58
Purshia tridentata	1.31	1.60

KEY BROWSE ANNUAL LEADER GROWTH--  
Management unit 17R, Study no: 24

Species	Average leader growth (in) '10
Artemisia tridentata wyomingensis	1.6
Cercocarpus montanus	3.0
Purshia tridentata	2.2

POINT-QUARTER TREE DATA--  
Management unit 17R, Study no: 24

Species	Trees per Acre		Average diameter (in)	
	'06	'10	'06	'10
Juniperus osteosperma	44	7	21.8	9.2
Pinus edulis	46	8	17.0	1.1

BASIC COVER--  
Management unit 17R, Study no: 24

Cover Type	Average Cover %	
	'06	'10
Vegetation	10.18	25.13
Rock	2.45	.47
Pavement	.01	.00
Litter	58.43	59.43
Cryptogams	2.16	.15
Bare Ground	34.68	20.44

SOIL ANALYSIS DATA --

Management unit 17R, Study no: 24, Study Name: East Santaquin Chaining

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
11.0	7.0	72.7	14.5	12.8	1.3	9.4	83.2	0.4

PELLET GROUP DATA--

Management unit 17R, Study no: 24

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Sheep	-	1	-	3 (8)
Rabbit	70	9	-	-
Elk	22	7	48 (119)	19 (46)
Deer	27	18	42 (104)	9 (23)
Cattle	-	3	-	9 (22)

BROWSE CHARACTERISTICS--

Management unit 17R, Study no: 24

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
<b>Amelanchier utahensis</b>										
06	0	0	0	-	-	0	0	0	19/40	
10	0	0	0	-	-	0	0	0	30/55	
<b>Artemisia tridentata wyomingensis</b>										
06	0	0	0	-	-	0	0	0	14/21	
10	800	18	83	-	-	10	0	0	16/15	
<b>Atriplex canescens</b>										
06	0	0	0	-	-	0	0	0	-/-	
10	0	0	0	-	-	0	0	0	31/45	
<b>Cercocarpus montanus</b>										
06	0	0	0	-	-	0	0	0	23/41	
10	0	0	0	-	20	0	0	0	28/27	
<b>Chrysothamnus viscidiflorus</b>										
06	0	0	0	-	-	0	0	0	-/-	
10	120	33	67	-	-	0	33	17	9/22	
<b>Chrysothamnus viscidiflorus viscidiflorus</b>										
06	20	0	100	-	40	0	0	0	11/20	
10	0	0	0	-	-	0	0	0	12/30	
<b>Ephedra viridis</b>										
06	0	0	0	-	-	0	0	0	-/-	
10	0	0	0	-	-	0	0	0	11/3	



		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<b>Juniperus osteosperma</b>									
06	<b>60</b>	0	100	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	20	0	0	0	-/-
<b>Kochia prostrata</b>									
06	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>2900</b>	37	63	-	9580	5	8	0	10/19
<b>Leptodactylon pungens</b>									
06	<b>40</b>	0	100	-	-	100	0	0	4/7
10	<b>300</b>	7	93	-	-	0	0	0	4/13
<b>Opuntia fragilis</b>									
06	<b>6260</b>	27	69	4	20	0	0	2	2/10
10	<b>3640</b>	18	82	0	340	0	0	0	2/7
<b>Opuntia sp.</b>									
06	<b>440</b>	0	77	23	-	0	0	23	4/19
10	<b>140</b>	71	29	0	-	0	0	0	4/14
<b>Pinus edulis</b>									
06	<b>40</b>	0	100	-	20	0	0	0	-/-
10	<b>40</b>	50	50	-	20	0	0	0	-/-
<b>Purshia tridentata</b>									
06	<b>80</b>	0	100	-	-	25	50	0	15/63
10	<b>180</b>	22	78	-	-	0	0	0	15/34

TWO BAR-SAND WASH CHAINING- TREND STUDY NO. 17R-26-10

[Project #368](#)

Vegetation Type: Pinyon/Juniper, Black Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Not available

Land Ownership: UDWR

Elevation: 6,160 ft. (1,878 m)

Aspect: Northeast

Slope: 5%

Transect bearing: 194° magnetic

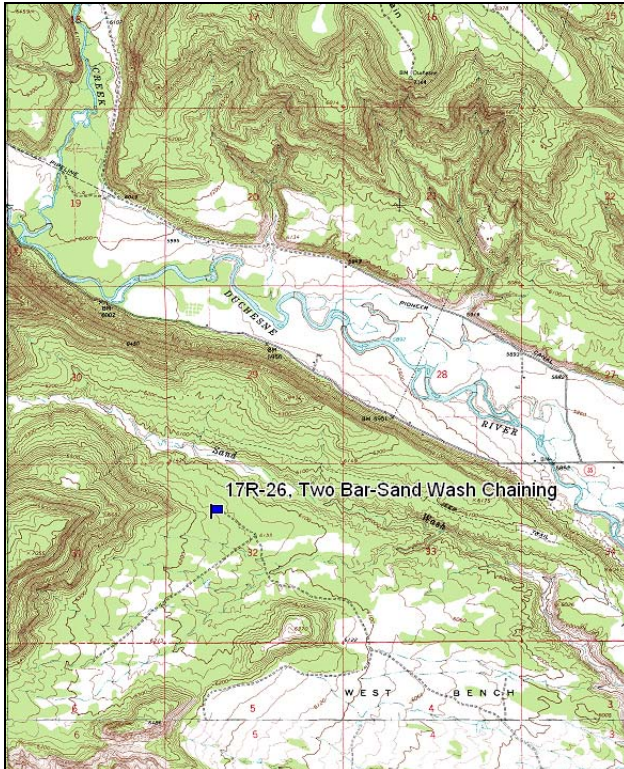
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: Belts on and two is missing. The rebar for belt three is placed at the 4ft mark.

Directions:

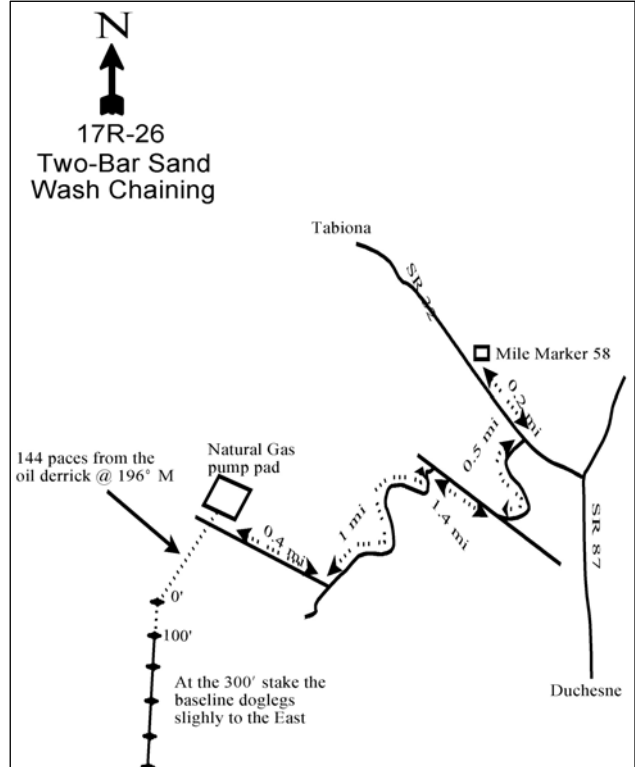
From Tabiona, travel southeast on State Road 32 to mile marker 58 continuing on 0.2 miles to road coming into the right. Turn here and go 0.5 miles to a fork, stay right and go 1.4 miles to another fork. Here turn left and travel 1 mile to fork going right for 0.4 miles to natural gas pump pad on the right side of the road. The 0-foot stake is 114 paces from the oil derrick at 196 degrees magnetic, and is marked with browse tag #195.

Map Name: Talmage



Township: 2S Range: 5W Section: 32

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 544307 E 4457435 N

TWO BAR-SAND WASH CHAINING - WRI STUDY 17R-26

[Project #368](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) thinning project on the Tabby Mountain Wildlife Management Area (WMA) approximately fourteen miles southeast of Tabiona. The area serves as critical deer and elk wintering habitat, but pinyon pine and Utah juniper encroachment has eliminated much of the sagebrush habitat. In the fall of 2007, pinyon and juniper trees were removed from approximately 1,000 acres with two passes of an anchor chain, and shrubs were seeded with a dribbler. Grass and forb seed was applied aerially after the chaining was complete in October of 2007, and in January of 2008 Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) seed was aerially applied to the treatment. The objectives of the project were to restore the sagebrush steppe and improve critical mule deer and elk winter habitat (WRI Database 2011). Pellet group data estimated moderate deer use and light elk use in each sample year (Table - Pellet Group Data).

SEED MIX--

Management unit 17R, Study no: 26

Project name: 2-Bar PJ thinning- Sand Wash					
WRI Database #: 368					
Application: Aerial Seed 1*		Acres: 400		Application: Dribbler*	
				Acres: 1000	
Seed type		lbs in mix	lbs/acre	Seed type	
G	Canby Bluegrass 'Canbar'	100	0.25	B	Bitterbrush
G	Crested Wheatgrass 'Douglas'	200	0.50	B	Fourwing Saltbush
G	Crested Wheatgrass 'Hycrest'	200	0.50	B	True Mountain Mahogany
G	Indian Ricegrass 'Rimrock'	400	1.00	Total Pounds:	
G	Pubescent Wheatgrass	200	0.50	400 0.40	
G	Russian Wildrye	300	0.75	PLS Pounds:	
G	Sand Dropseed	20	0.05	0.26	
G	Snake River Wheatgrass 'Secar'	200	0.50	Application: Aerial Seed 2*	
G	Thickspike Wheatgrass 'Critana'	400	1.00	Acres: 925	
F	Alfalfa 'Ladak'	200	0.50	Seed type	
F	Alfalfa 'Ranger'	200	0.50	B	Sagebrush, Wyoming
F	Blue Flax 'Appar'	100	0.25	960 1.04	
F	Small Burnet 'Delar'	800	2.00	Total Pounds:	
Total Pounds:		3320 8.30		1360 1.47	
PLS Pounds:		7.37		0.22	

\*Three different seed mixes were applied to the site. Aerial Seed 1 mix was applied in October of 2007 after to the chaining treatment and Aerial Seed 2 mix was applied in January of 2008. Seed Dribbler mix was applied in the fall of 2007 during the chaining treatment.

Browse: Black sagebrush (*Artemisia nova*) is the predominant preferred browse species. Since the treatment, the black sagebrush has been a relatively mature population with low decadence and good vigor. The recruitment of young sagebrush plants to the population has been good following the treatment. Utilization was moderately heavy before the chaining treatment, but following the treatment use has been light. Seeded species sampled following the treatment include true mountain mahogany (*Cercocarpus montanus*) and fourwing saltbush (*Atriplex canescens*), though occurring in very low densities. Other browse species sampled on the site include pricklypear cactus (*Opuntia* sp.) and granite prickly phlox (*Leptodactylon pungens*) (Table - Browse Characteristics). Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) cover and density were effectively reduced by the treatment (Table - Point-Quarter Tree Data).

**Herbaceous Understory:** Grasses are diverse but are not overly abundant. Prior to treatment grasses were exceedingly rare, but have become more abundant following the treatment. Indian ricegrass (*Oryzopsis hymenoides*) is the dominant grass species on the site and provides the majority of the grass cover. Some seeded grass species were sampled following the treatment which include crested wheatgrass (*Agropyron cristatum*), thickspike wheatgrass (*A. dasystachyum*), and Indian ricegrass. Forbs are abundant and diverse. Before the treatment, forbs were extremely rare, but have become abundant due to the increase in annual species. The dominant forb species sampled on the site was rockcress (*Arabis sp.*) and an annual species nodding eriogonum (*Eriogonum cernuum*) which provided the majority of the forb cover on the site. Following the treatment, seeded species blue flax (*Linum lewisii*), alfalfa (*Medicago sativa*) and small burnet (*Sanguisorba minor*) were sampled (Table - Herbaceous Trends).

**Soil:** The soil texture is a sandy clay loam with a neutral soil reaction (pH 7.0) (Table - Soil Analysis Data). Bare ground cover is high with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). Soil erosion condition was classified as critical in 2007 due to litter and soil movement, pedestalling, flow patterns, and rill and gully formation. Soil erosion condition improved to slight in 2010 due to surface rock, litter, and soil movement, slight pedestalling, flow patterns, and erosion occurring near gullies.

**Pre vs. Three Years Post Treatment, 2007 vs. 2010**

**Browse:** Black sagebrush canopy cover increased from 3% to 4% while density declined 30% from 2,420 plants/acre to 1,700 plants/acre. The dynamics of the population improved as recruitment of young sagebrush plants increased from 2% to 22% of the population and decadence decreased from 62% to 5%. Fourwing saltbush was seeded and was sampled at 20 plants/acre. Pinyon pine and Utah juniper canopy cover was reduced from 22% to 5%. Pinyon pine density was reduced from 160 plants/acre to 79 plants/acre while Utah juniper density was decreased from 137 trees/acre to 42 trees/acre.

**Grasses:** The sum of nested frequency of perennial grasses increased three fold while cover increased from less than 1% to 5%. Indian ricegrass became the dominant grass at 4% and increased significantly in nested frequency. No other species provided 1% cover

**Forbs:** The sum of nested frequency of perennial forbs increased five fold and cover increased form near 0% to 5%. The dominant perennial species was a rockcress (*Arabis sp.*) which increased significantly in nested frequency and cover increased from 0% to 2%. Nodding eriogonum increased significantly in nested frequency and cover increased substantially from less than 1% to 8%.

**HERBACEOUS TRENDS--**  
Management unit 17R, Study no: 26

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron cristatum	a-	b20	-	.41
G	Agropyron dasystachyum	a-	b12	-	.08
G	Agropyron intermedium	-	6	-	.18
G	Agropyron spicatum	b15	a1	.11	.03
G	Bromus tectorum (a)	a-	b15	-	.23
G	Hilaria jamesii	4	-	.01	-
G	Oryzopsis hymenoides	a11	b44	.05	3.50
G	Sitanion hystrix	a2	b14	.00	.51
G	Stipa comata	-	3	-	.15
Total for Annual Grasses		0	15	0	0.23

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
Total for Perennial Grasses		32	100	0.17	4.88
Total for Grasses		32	115	0.17	5.11
F	Arabis sp.	<sub>a</sub> 6	<sub>b</sub> 47	.01	2.44
F	Arenaria sp.	-	3	-	.03
F	Astragalus convallarius	-	1	-	.03
F	Astragalus spatulatus	-	1	-	.00
F	Astragalus utahensis	-	1	-	.00
F	Castilleja linariaefolia	-	-	-	.03
F	Caulanthus crassicaulis	3	-	.01	-
F	Chenopodium album (a)	-	6	-	.18
F	Chenopodium fremontii (a)	<sub>a</sub> -	<sub>b</sub> 10	-	.18
F	Chenopodium leptophyllum(a)	-	6	-	.01
F	Collinsia parviflora (a)	-	1	-	.00
F	Comandra pallida	-	3	-	.03
F	Cryptantha sp.	3	3	.00	.71
F	Cymopterus sp.	3	10	.00	.10
F	Descurainia pinnata (a)	<sub>b</sub> 15	<sub>a</sub> 2	.03	.00
F	Eriogonum cernuum (a)	<sub>a</sub> 8	<sub>b</sub> 263	.03	8.05
F	Gilia sp. (a)	-	3	-	.00
F	Halogeton glomeratus (a)	-	6	-	.04
F	Hedysarum boreale	-	6	-	.04
F	Ipomopsis congesta	3	2	.00	.03
F	Lactuca serriola (a)	-	2	-	.01
F	Lappula occidentalis (a)	-	3	-	.03
F	Linum lewisii	-	8	-	.48
F	Medicago sativa	-	-	-	.03
F	Navarretia intertexta (a)	-	14	-	.23
F	Penstemon sp.	-	4	-	.33
F	Phlox longifolia	-	1	-	.00
F	Salsola iberica (a)	-	11	-	.42
F	Sanguisorba minor	-	-	-	.03
F	Streptanthus cordatus	1	-	.00	-
F	Townsendia sp.	-	3	-	.15
Total for Annual Forbs		23	327	0.06	9.18
Total for Perennial Forbs		19	93	0.03	4.50
Total for Forbs		42	420	0.10	13.69

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 17R, Study no: 26

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia nova	55	38	3.41	2.58
B	Atriplex canescens	0	1	-	-
B	Cercocarpus montanus	2	1	.41	-
B	Chrysothamnus nauseosus	0	1	-	-
B	Gutierrezia sarothrae	1	2	-	.06
B	Juniperus osteosperma	5	4	3.62	.84
B	Leptodactylon pungens	3	4	.00	.21
B	Opuntia sp.	40	48	2.29	2.93
B	Pinus edulis	10	1	2.80	.94
Total for Browse		116	100	12.55	7.59

CANOPY COVER, LINE INTERCEPT--

Management unit 17R, Study no: 26

Species	Percent Cover	
	'07	'10
Artemisia nova	2.66	1.93
Artemisia tridentata wyomingensis	-	1.95
Cercocarpus montanus	.65	-
Juniperus osteosperma	10.14	1.85
Leptodactylon pungens	-	.05
Opuntia sp.	1.61	1.86
Pinus edulis	11.88	3.16

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 17R, Study no: 26

Species	Average leader growth (in)	
	'07	'10
Artemisia nova	0.9	1.0
Cercocarpus montanus	2.7	4.9

POINT-QUARTER TREE DATA--

Management unit 17R, Study no: 26

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	160	79	15.1	3.3
Pinus edulis	137	42	6.5	1.5

BASIC COVER--

Management unit 17R, Study no: 26

Cover Type	Average Cover %	
	'07	'10
Vegetation	13.84	25.02
Rock	1.29	1.57
Pavement	.03	.24
Litter	34.72	42.48
Cryptogams	5.44	.52
Bare Ground	55.03	45.27

SOIL ANALYSIS DATA --

Management unit 17R, Study no: 26, Study Name: Two Bar-Sand Wash Chaining

Effective rooting depth (in)	pH	sandy clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.0	57.4	19.0	23.6	1.6	9.5	115.2	0.8

PELLET GROUP DATA--

Management unit 17R, Study no: 26

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	51	16	-	-
Elk	11	1	5 (13)	-
Deer	18	16	36 (89)	32 (79)
Cattle	-	-	1 (2)	1 (2)

BROWSE CHARACTERISTICS--

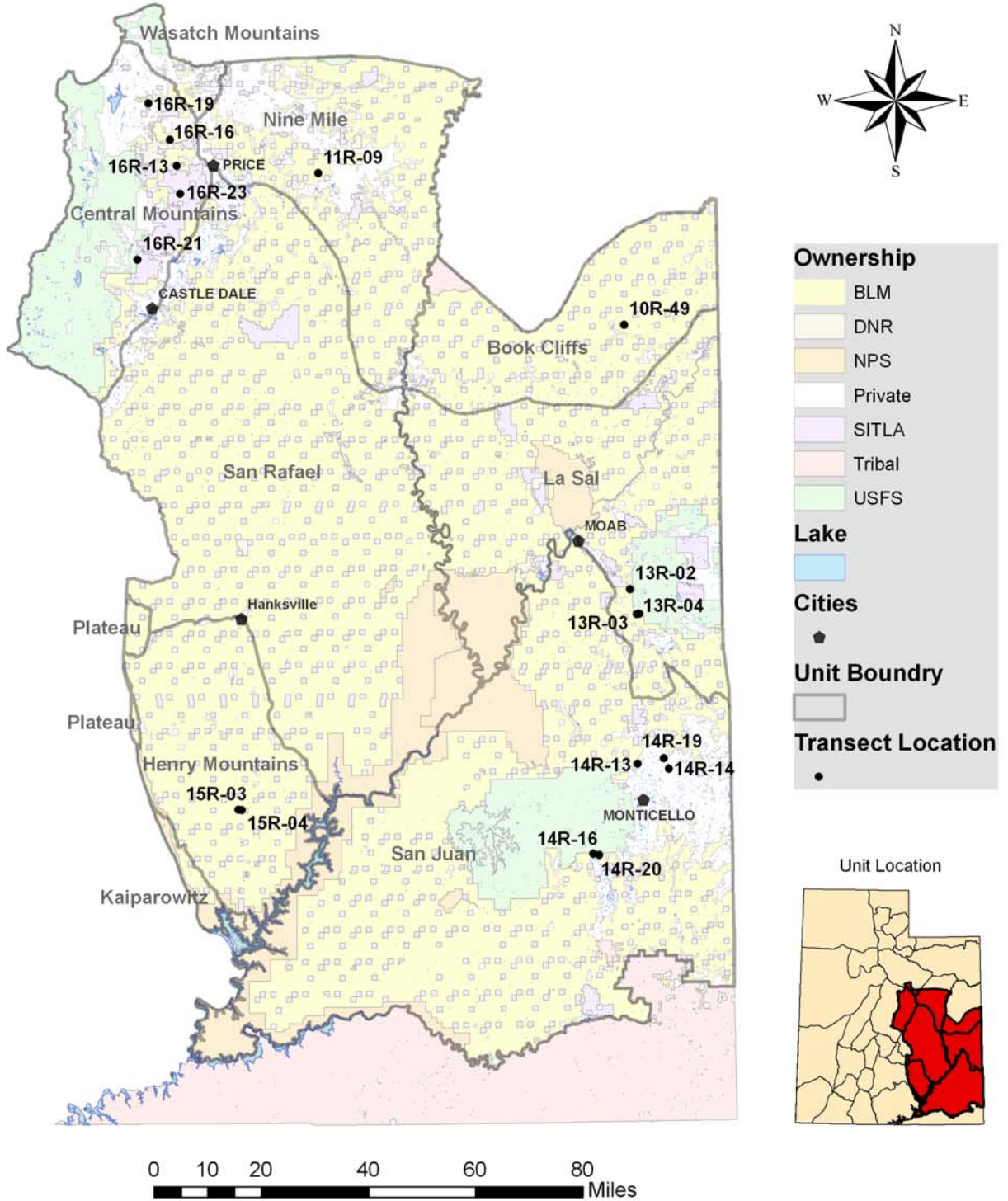
Management unit 17R, Study no: 26

		Age class distribution					Utilization		
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<b>Artemisia nova</b>									
07	<b>2420</b>	2	36	62	60	26	38	48	6/17
10	<b>1700</b>	22	73	5	100	2	2	7	10/20
<b>Atriplex canescens</b>									
07	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>20</b>	0	100	-	-	0	0	0	22/27
<b>Cercocarpus montanus</b>									
07	<b>40</b>	50	50	-	20	0	0	50	51/70
10	<b>20</b>	100	0	-	-	0	0	0	40/55
<b>Chrysothamnus nauseosus</b>									
07	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>20</b>	100	0	-	-	0	0	0	16/13
<b>Ephedra viridis</b>									
07	<b>0</b>	0	0	-	-	0	0	0	25/32
10	<b>0</b>	0	0	-	-	0	0	0	33/50

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Gutierrezia sarothrae</i>									
07	<b>20</b>	100	0	-	-	0	0	0	4/2
10	<b>60</b>	100	0	-	-	0	0	0	12/18
<i>Juniperus osteosperma</i>									
07	<b>120</b>	0	83	17	-	0	0	0	-/-
10	<b>140</b>	43	57	0	200	0	0	0	-/-
<i>Leptodactylon pungens</i>									
07	<b>140</b>	0	43	57	-	0	0	0	2/4
10	<b>240</b>	17	83	0	-	0	0	0	5/8
<i>Opuntia sp.</i>									
07	<b>3080</b>	0	94	6	-	23	0	5	3/12
10	<b>2760</b>	9	91	0	40	0	0	4	4/13
<i>Pinus edulis</i>									
07	<b>220</b>	64	36	-	-	0	0	0	-/-
10	<b>20</b>	100	0	-	80	0	0	0	-/-



# Southeastern Region WRI Studies 2010



LONG CANYON BENCH CHAINING - TREND STUDY NO. 10R-49-10

[Project #29](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Substantial Elk Winter

NRCS Ecological Site Description: Semidesert Loam (Wyoming Big Sagebrush), R034XY212UT

Land Ownership: SITLA

Elevation: 5,156 ft. (1,571 m)

Aspect: North

Slope: 5%

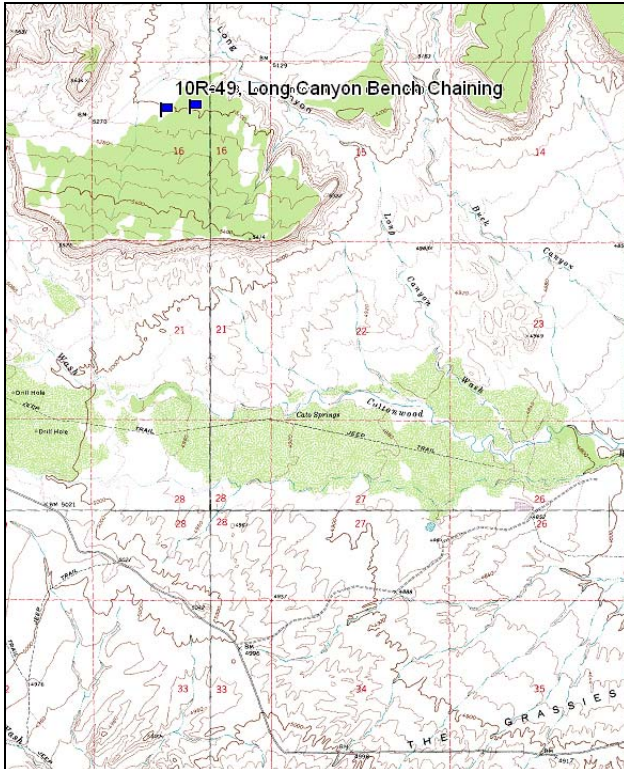
Transect bearing: 208° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft) rebar at 1ft

Directions:

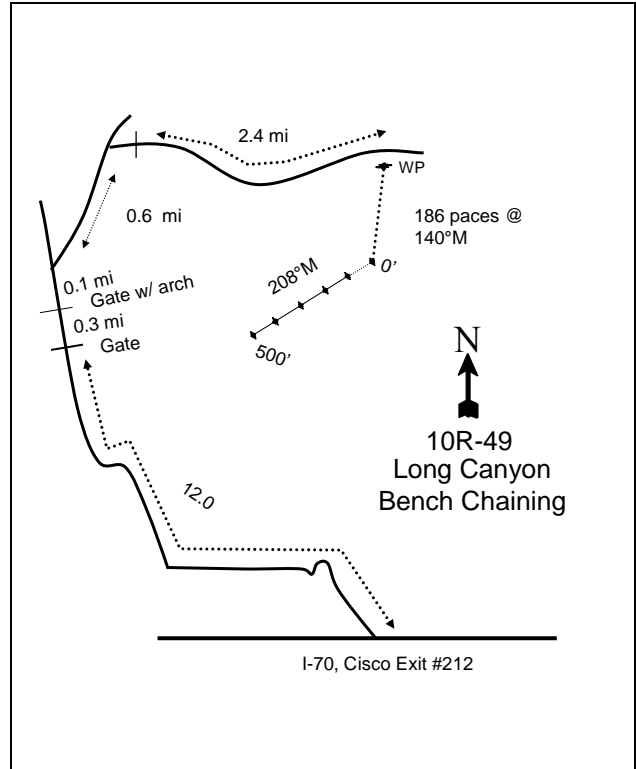
From I-70, take Exit #212 north for 12 miles to a gate, continue another 0.3 miles to another gate and then take a right after 0.1 miles. Drive another 0.6 miles and take a right and go through a gate just after the turn. Drive 2.4 miles to a witness post on the south side of the road. From the witness post continue 186 paces at 140 degrees magnets to the 0-foot post.

Map Name: Flume Canyon



Township: 19S Range: 22E Section: 16

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 639911 E 4335425 N

LONG CANYON BENCH CHAIN - WRI STUDY 10R-49

[Project #29](#)

**Site Description**

Site Information: The study is located approximately thirteen miles north of Cisco on a bench west of Long Canyon on the southern edge of the Book Cliffs. The site was established in 2010 to monitor a chaining completed in October of 2006. Study 10R-38 was established in 2006 prior to treatment, but the study area eventually wasn't included in the final treatment. This study can now be used as a pretreatment reference area. Deer in this area rely heavily on private hay meadows and a narrow sagebrush strip near the mouth of Cottonwood Canyon for winter range. 350 acres of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) was chained one-way then aerial seeded and chained a second time. Plateau herbicide (Imazapic) was applied after the chaining to help control cheatgrass (*Bromus tectorum*). The objective of the project was to increase deer winter range and fawning areas adjacent to thermal and escape cover (WRI Database 2011). Pellet group data estimated low elk use and moderate deer use in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 10R, Study no: 49

Project Name: Long Canyon Bench Pinyon-Juniper Chaining			
WRI Database #: 29			
Application: Aerial Seed		Acres: 350	
Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Douglas'	150	0.43
G	Crested Wheatgrass 'CDII'	150	0.43
G	Pubescent Wheatgrass	350	1.00
G	Crested Wheatgrass 'Hycrest'	214	0.61
G	Tall Wheatgrass 'Alkar'	350	1.00
G	Indian Ricegrass 'Rimrock'	200	0.57
G	Great Basin Wildrye 'Trailhead'	500	1.43
G	Thickspike Wheatgrass 'Bannock'	350	1.00
G	Siberian Wheatgrass 'Vavilov'	350	1.00
G	Russian Wildrye	350	1.00
F	Alfalfa 'Ranger'	350	1.00
F	Alfalfa 'Spredor 4'	350	1.00
F	Small Burnet 'Delar'	900	2.57
F	Rocky Mountain Beeplant	134	0.38
F	Blue Flax	100	0.29
B	Sagebrush, Wyoming	200	0.57
B	Fourwing Saltbush	350	1.00
B	Winterfat	291	0.83
B	Forage Kochia	100	0.29
Total Pounds:		5739	16.40
PLS Pounds:			13.45

Browse: Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) is the preferred browse species and provides the majority of the browse cover on the site. The recruitment of young sagebrush plants is extremely high with the majority of the population being young. Decadence and poor vigor of sagebrush was low and utilization was light. Other less common browse species found on the site include broom snakeweed (*Gutierrezia sarothrae*) winterfat (*Ceratoides lanata*), green ephedra (*Ephedra viridis*), pricklypear cactus (*Opuntia* sp.), and Utah juniper. In comparing to WRI study 10R-38, Utah juniper occurred more frequently

and provided more cover prior to the 2007 chaining, as evidenced by litter and dead trees scatter across the site (Table - Browse Characteristics).

Herbaceous Understory: Perennial grass species were robust with excellent seed production. The dominant perennial grass species are crested wheatgrass (*Agropyron cristatum*) and Indian ricegrass (*Oryzopsis hymenoides*) which provided the majority of the grass cover on the site. Other perennial species sampled included pubescent wheatgrass (*A. intermedium*), western wheatgrass (*A. smithii*), Great Basin wildrye (*Elymus cinereus*) and Russian wildrye (*E. junceus*). Crested wheatgrass, pubescent wheatgrass, Indian ricegrass, and Great Basin wildrye were all included in the seed mix. Cheatgrass (*Bromus tectorum*) was the most frequently encountered grass and provided 4% cover. Perennial forbs are rare on the site. Annual forbs are the abundant and provide the majority of forb cover. Seeded forbs were not sampled in 2010. Russian thistle (*Salsola iberica*), nodding eriogonum (*Eriogonum cernuum*), and annual stickseed (*Lappula occidentalis*) are the dominant forbs (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a fine sandy loam. Bare ground cover is moderately high with a high amount of litter and moderate amount vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

HERBACEOUS TRENDS--

Management unit 10R, Study no: 49

Type	Species	Nested Frequency '10	Average Cover % '10
G	<i>Agropyron cristatum</i>	83	4.85
G	<i>Agropyron intermedium</i>	17	1.37
G	<i>Agropyron smithii</i>	15	.60
G	<i>Bromus tectorum</i> (a)	288	4.05
G	<i>Elymus cinereus</i>	-	.38
G	<i>Elymus junceus</i>	7	.52
G	<i>Oryzopsis hymenoides</i>	27	2.57
G	<i>Sitanion hystrix</i>	3	.20
G	<i>Vulpia octoflora</i> (a)	12	.04
Total for Annual Grasses		300	4.09
Total for Perennial Grasses		152	10.51
Total for Grasses		452	14.60
F	<i>Arabis</i> sp.	10	.04
F	<i>Aster</i> sp.	6	.03
F	<i>Cryptantha</i> sp.	46	.13
F	<i>Descurainia pinnata</i> (a)	13	.04
F	<i>Eriogonum cernuum</i> (a)	142	.85
F	<i>Euphorbia</i> sp.	-	.00
F	<i>Gilia</i> sp. (a)	50	.17
F	<i>Lactuca serriola</i> (a)	1	.00
F	<i>Lappula occidentalis</i> (a)	147	.61
F	<i>Lupinus</i> sp.	3	.00
F	<i>Mentzelia</i> sp.	39	.44
F	<i>Phlox longifolia</i>	1	.00
F	<i>Plantago patagonica</i> (a)	3	.00
F	<i>Salsola iberica</i> (a)	121	1.14

Type	Species	Nested Frequency	Average Cover %
		'10	'10
F	Schoenocrambe linifolia	13	.91
Total for Annual Forbs		477	2.85
Total for Perennial Forbs		118	1.57
Total for Forbs		595	4.43

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 10R, Study no: 49

Type	Species	Strip Frequency	Average Cover %
		'10	'10
B	Artemisia tridentata wyomingensis	39	7.13
B	Ceratoides lanata	1	-
B	Ephedra viridis	1	-
B	Gutierrezia sarothrae	18	1.38
B	Juniperus osteosperma	1	.53
B	Opuntia sp.	6	-
Total for Browse		66	9.05

#### CANOPY COVER, LINE INTERCEPT--

Management unit 10R, Study no: 49

Species	Percent Cover
	'10
Artemisia tridentata wyomingensis	5.44
Gutierrezia sarothrae	1.81
Juniperus osteosperma	.16

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 10R, Study no: 49

Species	Average leader growth (in)
	'10
Artemisia tridentata wyomingensis	1.9

#### POINT-QUARTER TREE DATA--

Management unit 10R, Study no: 49

Species	Trees per Acre	Average diameter (in)
	'10	'10
Juniperus osteosperma	53	4.3

BASIC COVER--

Management unit 10R, Study no: 49

Cover Type	Average Cover % '10
Vegetation	29.30
Rock	3.32
Pavement	5.44
Litter	41.73
Cryptogams	.66
Bare Ground	29.47

PELLET GROUP DATA--

Management unit 10R, Study no: 49

Type	Quadrat Frequency '10	Days use per acre (ha) '10
Rabbit	13	-
Elk	7	4 (10)
Deer	16	22 (55)

BROWSE CHARACTERISTICS--

Management unit 10R, Study no: 49

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
<i>Artemisia tridentata wyomingensis</i>										
10	<b>6380</b>	79	19	1	35080	7	0	1	16/24	
<i>Ceratoides lanata</i>										
10	<b>20</b>	0	0	100	-	0	0	100	-/-	
<i>Ephedra viridis</i>										
10	<b>20</b>	0	100	-	-	0	0	0	20/19	
<i>Gutierrezia sarothrae</i>										
10	<b>700</b>	14	80	6	20	0	0	6	12/19	
<i>Juniperus osteosperma</i>										
10	<b>40</b>	100	0	-	20	0	0	0	-/-	
<i>Opuntia sp.</i>										
10	<b>120</b>	0	100	-	-	0	0	0	4/20	

EAST CARBON BULLHOG - TREND STUDY NO. 11R-9-10

[Project #510](#)

Vegetation Type: Pinyon/Juniper, Perennial Grass

Range Type: Crucial Deer Winter, Crucial Elk Year-Long

NRCS Ecological Site Description: Upland Stony Loam (Pinyon-Juniper), R034XY330UT

Land Ownership: BLM

Elevation: 6,553 ft. (1,997 m)

Aspect: South

Slope: 7%

Transect bearing: 180° magnetic

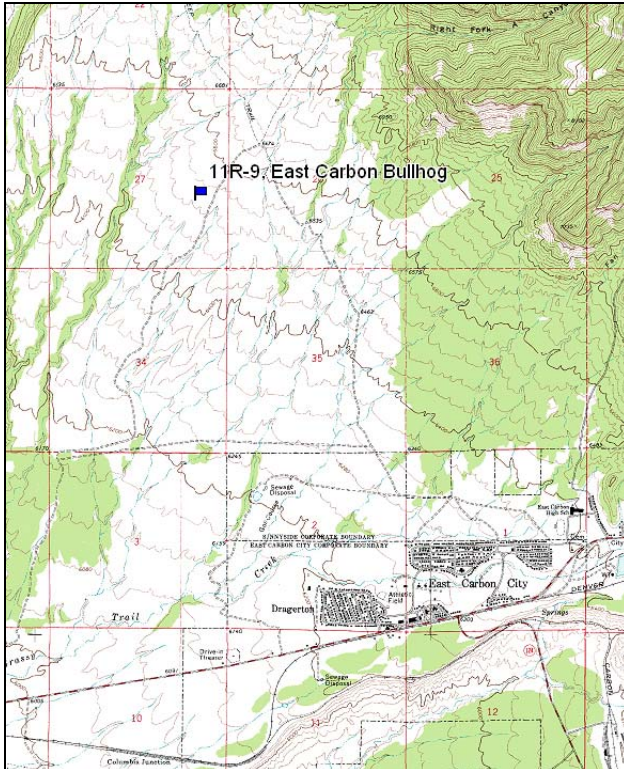
Belt placement: line 1 (11ft & 95 ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Notes: No rebar

Directions:

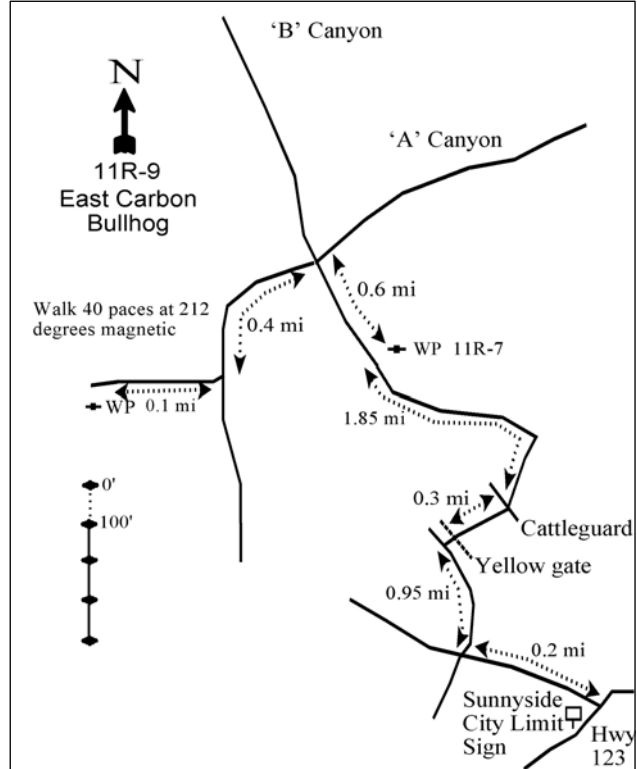
From Highway 123 turn left after passing the Sunnyside city limit sign on the west side of town. Drive for 0.2 miles to an intersection and turn right, continue 0.95 miles to a right turn through a yellow gate. Continue 0.3 miles to a cattle guard and 1.45 miles to another intersection (of A and B canyons). Turn left and continue for 0.4 miles to a right turn, continue another 0.1 miles to the witness post on the south side of the road. From the witness post walk 40 paces at 212 degrees magnetic.

Map Name: Sunnyside



Township: 14S Range: 13E Section: 27

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 547915 E 4380935 N

## EAST CARBON BULLHOG - WRI STUDY 11R-9

### [Project #510](#)

#### **Site Description**

Site Information: This study was established in 2006, three miles northwest of East Carbon City in an old chaining. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodland reestablished in the area and browse and herbaceous species became rare, big game winter habitat decreased and fire danger increased for nearby Sunnyside and East Carbon. In fall of 2006 the BLM conducted a bullhog treatment and applied a seed mix to improve habitat value. The seed mix was applied aerially to the west half of the bullhog project and as a result the study site was not part of the seeded portion. Many individual mature trees were left scattered across the landscape, not in clumps to provide escape or thermal cover (WRI Database 2011). Pellet group data estimated light elk use in the 2006 and 2010 sample years. Deer use was moderate over the same period and cattle use was light (Table - Pellet Group Data).

Browse: Browse species are rare on this site. True mountain mahogany (*Cercocarpus montanus* ssp. *montanus*) and green ephedra (*Ephedra viridis*) are the preferred browse species, though low in density and cover. Utilization of mahogany and green ephedra has been light since the treatment but was heavy prior to the treatment. The recruitment of young mahogany and green ephedra plants has been good since the treatment but was poor in 2006 (Table - Browse Characteristics). The treatment left a mosaic of scattered pinyon pine and Utah juniper throughout the site; though density and cover was significantly reduced by the bullhog project (Table - Point-Quarter Tree Data).

Herbaceous Understory: Grasses are not diverse and are dominated by the seeded species crested wheatgrass (*Agropyron cristatum*). Crested wheatgrass responded well to the removal of pinyon pine and Utah juniper and increased significantly in cover. Other less common perennial grasses found on the site and occur in very low abundance include purple three-awn (*Aristida purpurea*), Russian wildrye, (*Elymus junceus*), Indian ricegrass (*Oryzopsis hymenoides*), and bottlebrush squirreltail (*Sitanion hystrix*). Perennial forbs are very rare. Diversity of forbs increased measurably after the treatment.

Soil: The soil texture is a sandy clay loam with a slightly alkaline soil reaction (pH 7.8) (Table - Soil Analysis Data). Bare ground cover is low with moderate amount of vegetation and high amount of litter and rock providing protective ground cover. Protective ground cover increased as a result of the treatment. Prior to the treatment bare ground cover was high (Table - Basic Cover). The soil erosion condition was classified as moderate in 2006 due to pedestalling, flow patterns, two active gullies, and surface rock and litter movement. Erosion condition was classified as stable in 2010.

#### **Pre vs. Four Years Post Treatment Assessment, 2006 vs. 2010**

Browse: True mountain mahogany density decreased from 120 plants/acre to 60 plants/acre while cover increased from 2% to 3%. The overall health of the population improved following treatment as plants exhibiting poor vigor decreased from 67% to 0% and young plants accounted for 67% of the population. Green ephedra density increased from 140 plants/acre to 320 plants/acre. The population has shifted from a 100% mature population with heavy use to young plants being 88% of the population. Pinyon pine density decreased from 116 trees/acre to 29 trees/acre and Utah juniper density was reduced from 232 trees/acre to 75 trees/acre.

Grasses: The nested frequency of perennial grasses remained similar to 2006 levels. Cover increased from 8% to 19% due almost entirely to crested wheatgrass which increased from 7% cover to 18%. No annual species were sampled in either sample year.

Forbs: Perennial forbs are rare and provide less than 1% cover, but diversity of species increased from three species sampled prior to treatment to eight species after the treatment. No seeded species were sampled.



HERBACEOUS TRENDS--

Management unit 11R, Study no: 9

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	204	212	7.39	18.40
G	Aristida purpurea	3	7	.15	.18
G	Elymus junceus	-	2	-	.03
G	Oryzopsis hymenoides	1	3	.15	.03
G	Sitanion hystrix	-	2	-	.15
Total for Annual Grasses		0	0	0	0
Total for Perennial Grasses		208	226	7.70	18.80
Total for Grasses		208	226	7.70	18.80
F	Euphorbia sp.	8	16	.12	.05
F	Lesquerella sp.	-	5	-	.00
F	Lithospermum sp.	a-	b12	-	.05
F	Lomatium sp.	-	3	-	.03
F	Machaeranthera canescens	-	7	-	.21
F	Penstemon sp.	a6	b31	.02	.23
F	Phlox longifolia	1	-	.00	-
F	Physaria sp.	-	3	-	.00
F	Townsendia sp.	-	3	-	.01
Total for Annual Forbs		0	0	0	0
Total for Perennial Forbs		15	80	0.14	0.60
Total for Forbs		15	80	0.14	0.60

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 11R, Study no: 9

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Cercocarpus montanus	5	3	1.36	.78
B	Ephedra viridis	2	2	.38	.88
B	Gutierrezia sarothrae	0	4	.00	.03
B	Juniperus osteosperma	11	3	3.26	.15
B	Pinus edulis	10	2	6.14	2.50
Total for Browse		28	14	11.15	4.34

CANOPY COVER, LINE INTERCEPT--

Management unit 11R, Study no: 9

Species	Percent Cover	
	'06	'10
Cercocarpus montanus	1.75	2.83
Ephedra viridis	.85	.50
Gutierrezia sarothrae	-	.05
Juniperus osteosperma	2.45	.98
Pinus edulis	14.88	3.70

KEY BROWSE ANNUAL LEADER GROWTH--  
Management unit 11R, Study no: 9

Species	Average leader growth (in)	
	'06	'10
Cercocarpus montanus	2.2	3.5

POINT-QUARTER TREE DATA--  
Management unit 11R, Study no: 9

Species	Trees per Acre		Average diameter (in)	
	'06	'10	'06	'10
Juniperus osteosperma	232	75	3.9	2.5
Pinus edulis	116	29	4.9	3.8

BASIC COVER--  
Management unit 11R, Study no: 9

Cover Type	Average Cover %	
	'06	'10
Vegetation	18.98	23.95
Rock	13.50	12.82
Pavement	4.66	5.01
Litter	45.75	44.58
Cryptogams	1.08	.33
Bare Ground	31.97	18.61

SOIL ANALYSIS DATA --

Management unit 11R, Study no: 9, Study Name: East Carbon Bullhog

Effective rooting depth (in)	pH	sandy clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
10.4	7.8	48.2	27.3	24.5	3.5	17.1	83.2	0.6

PELLET GROUP DATA--  
Management unit 11R, Study no: 9

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	82	11	-	-
Elk	-	3	2 (5)	13 (31)
Deer	22	8	36 (89)	21 (53)
Cattle	-	1	-	7 (18)
Buffalo	-	1	-	-

BROWSE CHARACTERISTICS--  
Management unit 11R, Study no: 9

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Cercocarpus montanus</i>									
06	120	0	33	67	-	67	17	67	59/59
10	60	67	33	0	60	0	0	0	48/51
<i>Echinocactus sp.</i>									
06	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	4/9
<i>Ephedra viridis</i>									
06	140	0	100	-	-	0	100	0	39/45
10	320	88	13	-	60	0	0	0	38/39
<i>Gutierrezia sarothrae</i>									
06	0	0	0	-	20	0	0	0	2/2
10	220	36	64	-	-	0	0	0	5/9
<i>Juniperus osteosperma</i>									
06	240	25	75	-	20	0	0	0	-/-
10	60	67	33	-	20	0	0	0	-/-
<i>Opuntia sp.</i>									
06	0	0	0	-	-	0	0	0	4/9
10	0	0	0	-	-	0	0	0	4/9
<i>Pinus edulis</i>									
06	220	18	82	-	20	0	0	0	-/-
10	40	0	100	-	-	0	0	0	-/-
<i>Yucca sp.</i>									
06	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	11/22

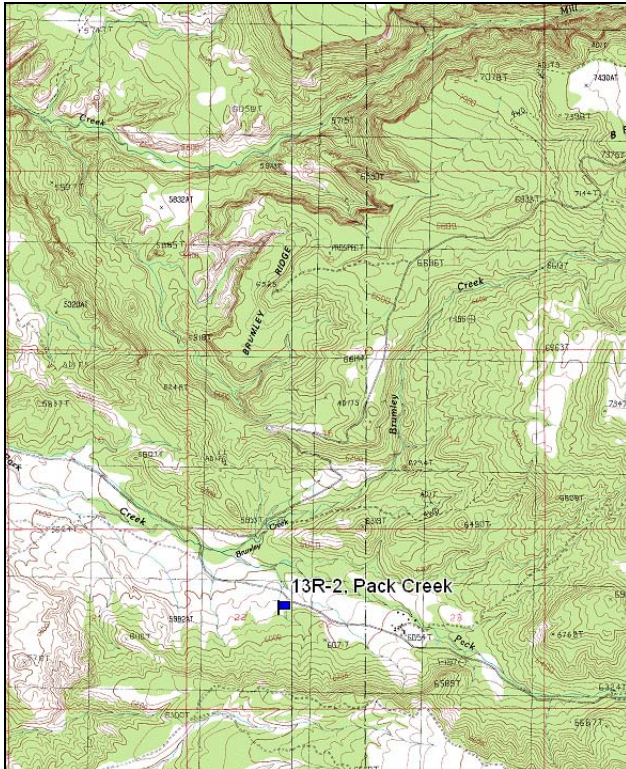
PACK CANYON - TREND STUDY NO. 13R-2-10  
[Project #907](#)

Vegetation Type: Wyoming Big Sagebrush, Blackbrush  
Range Type: Crucial Deer Winter  
NRCS Ecological Site Description: [Semidesert Stony Loam \(Blackbrush\), R035XY243UT](#)  
Land Ownership: BLM  
Elevation: 5,900 ft. (1,798 m)  
Aspect: North  
Slope: 7%  
Transect bearing: 245° magnetic  
Belt placement: line 1 (11ft & 95 ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

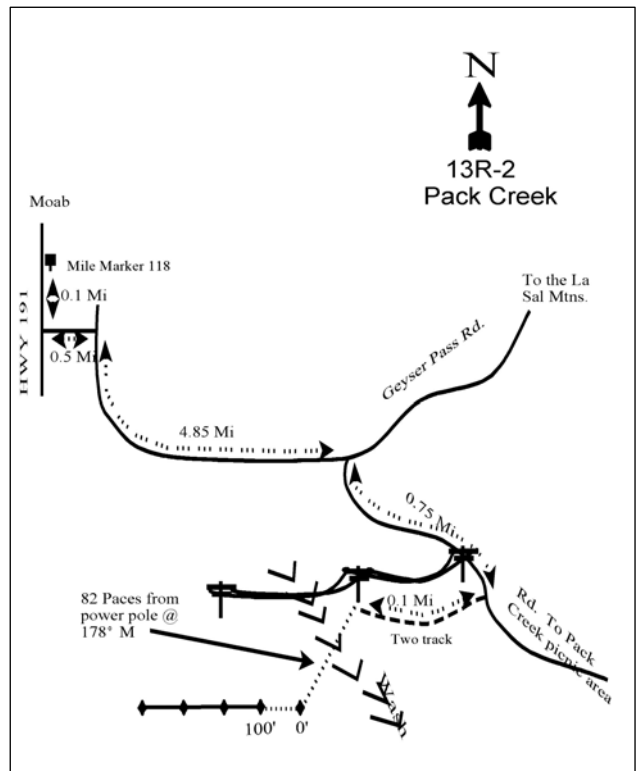
Travel south from Moab on Highway 191 to mile marker 118 from here continue 0.1. Turn left and go 0.5 miles to a T in the road. Here take a right and travel 4.85 miles to a fork. Take the right fork toward the Pack Creek picnic area. Go 0.75 miles to a faint 2 track road on the right, turn here and go 0.1 mile to where the road ends. There is a power pole at the end of the 2 track. From the pole the 0-foot stake is 82 paces at 178 degrees magnetic and is marked with browse tag #158.

Map Name: Kane Springs



Township: 27S Range: 23E Section: 22

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 641638 E 4255899 N

PACK CREEK - WRI STUDY 13R-2

[Project #907](#)

**Site Description**

Site Information: The study was established in 2007 to monitor maintenance of a project implemented in 2004 and 2005 by the BLM thirteen miles southeast of Moab. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees were thinned and the slash was piled and burned. However, many of the remaining trees continued to die as a result of bark beetle (*Ips sp.*) infestation and fire damage. Additionally cheatgrass (*Bromus tectorum*) invaded the site and has become a major component of the herbaceous understory. A secondary treatment was implemented in 2007 to decrease fire hazards and improve wildlife habitat on 300 acres. A bullhog removed standing dead trees in spring of 2007, and the understory was burned and broadcast seeded using ATV and harrow that fall (WRI Database 2011). Pellet group data estimated light elk use in all sample years and moderate to heavy use by deer over the same period. Use was estimated light for cattle in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 13R, Study no: 2

Project Name: Pack Creek			
WRI Database #: 907			
Application: Broadcast Seeder		Acres:	171
Seed type		lbs in mix	lbs/acre
G	Canby Bluegrass 'Canbar'	150	0.88
G	Indian Ricegrass 'Rimrock'	200	1.17
G	Sandberg Bluegrass	100	0.58
G	Sand Dropseed	50	0.29
G	Siberian Wheatgrass 'Vavilov'	450	2.63
G	Thickspike Wheatgrass 'Bannock'	400	2.34
G	Western Wheatgrass 'Arriba'	300	1.75
F	Palmer Penstemon	8	0.05
B	Fourwing Saltbush	100	0.58
Total Pounds:		1758	10.28
PLS Pounds:			8.74

Browse: Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and blackbrush (*Coleogyne ramosissima*) are the preferred browse species on the site. The Wyoming big sagebrush is a relatively mature population with a moderate amount of decadent plants, though in 2007 sagebrush plants had high decadence and really poor vigor. The blackbrush is a relatively healthy population with good vigor and low decadence, though decadence was moderate in 2007. Recruitment of young sagebrush and blackbrush plants has been poor and utilization has been mostly light to moderate since the outset of the study. Broom snakeweed (*Gutierrezia sarothrae*) and Utah juniper (*Juniperus osteosperma*) are the only other common browse species found on the site (Table - Browse Characteristics).

Herbaceous Understory: Perennial grasses are diverse but are not overly abundant. Cheatgrass (*Bromus tectorum*) is the most common grass species and accounted for majority of grass cover in 2007, but reduced significantly in density and cover. Bottlebrush squirreltail (*Sitanion hystrix*) was the most common perennial species. Forb species are diverse and moderately abundant. The weedy annual forb Russian thistle (*Salsola iberica*) is the dominant forb species on the site. The most common perennial forbs are gooseberryleaf globemallow (*Sphaeralcea grossulariifolia*), Cryptantha (*Cryptantha sp.*), Zion milkvetch (*Astragalus zionis*), and longleaf phlox (*Phlox longifolia*) (Table -Herbaceous Trends).

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is low with moderate amount of vegetation, litter, rock, and pavement providing protective ground cover (Table - Basic Cover). Soil erosion condition was classified as stable in all sample years.

**Pre vs. Three Years Post Treatment, 2007 vs. 2010**

Browse: The density of Wyoming big sagebrush decreased 13% from 1,100 plants/acre to 960 plants/acre while cover remained similar at 2%. Decadence declined from 56% to 19% and poor vigor declined from 44% to 13% of the population. Blackbrush density increased 12% from 1,680 plants/acre to 1,880 plants/acre while cover increased from 5% to 7%. Decadent plants decreased from 23% to 1% of the population. Utah juniper density decreased from 32 trees/acre to 18 trees/acre while cover remained similar at 3%. Pinyon pine density was 20 trees/acre in 2007 and 2 trees/acre in 2010 and cover was minimal.

Grasses: The sum of nested frequency of perennial grass slightly increased 14% and cover increased from 4% to 5%. Cheatgrass was the most common grass species in both sample years. Prior to treatment, cheatgrass cover was sampled at 26%. Following treatment cover decreased to 3%. The only perennial species to provide significant cover was bottlebrush squirreltail at 3% in each sample year.

Forbs: The sum of nested frequency of perennial forb decreased slightly by 16%, though cover increased from 4% to 5%. Annual forb cover increased from 2% to 4%. Russian thistle was the most common forb in 2010 and provided the majority of forb cover at 3%.

HERBACEOUS TRENDS--  
Management unit 13R, Study no: 2

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron fragile	-	5	-	.01
G	Aristida purpurea	-	1	-	.18
G	Bouteloua gracilis	-	3	-	.15
G	Bromus tectorum (a)	<sub>b</sub> 457	<sub>a</sub> 262	26.22	3.22
G	Hilaria jamesii	5	4	.01	.66
G	Oryzopsis hymenoides	3	1	.16	.85
G	Poa secunda	23	16	.67	.72
G	Sitanion hystrix	68	83	2.62	2.75
G	Vulpia octoflora (a)	<sub>b</sub> 35	<sub>a</sub> 10	.09	.19
Total for Annual Grasses		492	272	26.31	3.41
Total for Perennial Grasses		99	113	3.46	5.33
Total for Grasses		591	385	29.77	8.74
F	Astragalus flexuosus	3	-	.24	-
F	Astragalus sp.	<sub>a</sub> 4	<sub>b</sub> 17	.00	.87
F	Astragalus zionis	<sub>b</sub> 52	<sub>a</sub> 21	.20	.13
F	Calochortus nuttallii	2	6	.01	.02
F	Chenopodium leptophyllum(a)	-	1	-	.00
F	Collinsia parviflora (a)	-	11	-	.05
F	Cryptantha sp.	<sub>b</sub> 42	<sub>a</sub> 22	.56	.68
F	Cymopterus sp.	3	1	.01	.00
F	Delphinium nuttallianum	1	-	.00	-
F	Draba sp. (a)	<sub>b</sub> 58	<sub>a</sub> 3	.14	.00
F	Eriogonum cernuum (a)	<sub>a</sub> 4	<sub>b</sub> 40	.03	.14

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
F	Eriogonum corymbosum	2	-	.00	-
F	Eriogonum ovalifolium	3	-	.01	-
F	Eriogonum sp.	a-	b14	-	.03
F	Gilia sp. (a)	b106	a32	.74	.10
F	Helianthus annuus (a)	a1	b14	.01	.13
F	Holosteum umbellatum (a)	1	-	.00	-
F	Hymenoxys acaulis	1	4	.04	.19
F	Lactuca serriola (a)	6	7	.01	.01
F	Lesquerella sp.	4	17	.04	.18
F	Linum lewisii	1	-	.00	-
F	Lygodesmia spinosa	5	-	.01	-
F	Machaeranthera canescens	3	1	.01	.03
F	Microsteris gracilis (a)	-	1	-	.00
F	Penstemon cyanocaulis	27	17	1.28	.04
F	Penstemon sp.	a-	b22	-	.75
F	Petrorhiza pumila	4	4	.66	.63
F	Phlox longifolia	b51	a20	.21	.06
F	Ranunculus testiculatus (a)	b66	a10	.31	.09
F	Salsola iberica (a)	a100	b154	.42	3.05
F	Sphaeralcea grossulariifolia	12	25	.34	.92
F	Townsendia sp.	b31	a19	.13	.19
F	Tragopogon dubius (a)	-	1	-	.15
F	Zigadenus paniculatus	-	1	-	.00
Total for Annual Forbs		342	274	1.67	3.75
Total for Perennial Forbs		251	211	3.80	4.75
Total for Forbs		593	485	5.48	8.51

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 13R, Study no: 2

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	<i>Artemisia tridentata wyomingensis</i>	33	27	1.91	2.45
B	<i>Atriplex canescens</i>	0	0	-	.01
B	<i>Chrysothamnus nauseosus</i>	14	2	.59	-
B	<i>Coleogyne ramosissima</i>	30	35	4.85	4.88
B	<i>Echinocereus triglochidatus</i>	4	2	.03	.03
B	<i>Ephedra torreyana</i>	2	0	-	-
B	<i>Ephedra viridis</i>	0	3	-	.03
B	<i>Eriogonum corymbosum</i>	3	3	.30	.33
B	<i>Gutierrezia sarothrae</i>	54	55	4.45	3.23
B	<i>Juniperus osteosperma</i>	1	2	.85	-
B	<i>Opuntia sp.</i>	0	3	-	.03
B	<i>Pinus edulis</i>	1	0	.15	.03
B	<i>Sclerocactus sp.</i>	0	1	-	.03
Total for Browse		142	133	13.15	11.07

CANOPY COVER, LINE INTERCEPT--

Management unit 13R, Study no: 2

Species	Percent Cover	
	'07	'10
<i>Artemisia tridentata wyomingensis</i>	1.66	1.95
<i>Coleogyne ramosissima</i>	4.50	7.03
<i>Ephedra viridis</i>	-	.35
<i>Eriogonum corymbosum</i>	.03	.08
<i>Gutierrezia sarothrae</i>	4.46	1.93
<i>Juniperus osteosperma</i>	3.20	2.98
<i>Pinus edulis</i>	-	.06

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 13R, Study no: 2

Species	Average leader growth (in)	
	'07	'10
<i>Artemisia tridentata wyomingensis</i>	1.3	1.5
<i>Coleogyne ramosissima</i>	1.7	1.4



POINT-QUARTER TREE DATA--  
Management unit 13R, Study no: 2

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	32	18	13.7	6.1
Pinus edulis	20	2	0.7	3.8

BASIC COVER--  
Management unit 13R, Study no: 2

Cover Type	Average Cover %	
	'07	'10
Vegetation	49.04	28.95
Rock	13.73	13.38
Pavement	13.09	13.63
Litter	22.51	38.90
Cryptogams	1.72	.32
Bare Ground	13.86	18.81

SOIL ANALYSIS DATA --  
Management unit 13R, Study no: 2, Study Name: Pack Creek

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.2	48.2	32.0	19.8	2.6	10.4	108.8	0.6

PELLET GROUP DATA--  
Management unit 13R, Study no: 2

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	16	9	-	-
Elk	3	1	85 (210)	1 (3)
Deer	36	30	32 (79)	60 (147)
Cattle	-	-	-	1 (2)

BROWSE CHARACTERISTICS--  
Management unit 13R, Study no: 2

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
Artemisia tridentata wyomingensis										
07	<b>1100</b>	5	38	56	40	29	2	44	15/25	
10	<b>960</b>	0	81	19	-	17	4	13	16/27	
Atriplex canescens										
07	<b>0</b>	0	0	-	-	0	0	0	36/54	
10	<b>0</b>	0	0	-	-	0	0	0	-/-	

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<b>Chrysothamnus nauseosus</b>										
07	740	0	97	3	-	3	0	8	20/27	
10	180	89	11	0	-	0	0	0	35/45	
<b>Coleogyne ramosissima</b>										
07	1680	6	71	23	-	39	0	4	10/21	
10	1880	3	96	1	-	13	3	0	9/21	
<b>Echinocereus triglochidatus</b>										
07	80	0	100	-	-	0	0	0	4/3	
10	40	0	100	-	-	0	0	0	5/5	
<b>Ephedra torreyana</b>										
07	40	0	100	-	-	0	0	0	17/22	
10	0	0	0	-	-	0	0	0	-/-	
<b>Ephedra viridis</b>										
07	0	0	0	-	-	0	0	0	-/-	
10	60	0	100	-	-	0	33	0	21/29	
<b>Eriogonum corymbosum</b>										
07	160	50	50	-	20	0	0	0	12/13	
10	80	0	100	-	-	0	0	0	7/10	
<b>Gutierrezia sarothrae</b>										
07	4340	12	84	3	3180	0	0	3	10/15	
10	3140	14	86	0	20	0	0	0	8/11	
<b>Juniperus osteosperma</b>										
07	20	0	100	-	-	0	0	0	-/-	
10	40	50	50	-	-	0	0	0	-/-	
<b>Opuntia sp.</b>										
07	0	0	0	-	-	0	0	0	5/8	
10	60	100	0	-	-	0	0	0	5/15	
<b>Pinus edulis</b>										
07	20	100	0	-	-	0	0	0	-/-	
10	0	0	0	-	20	0	0	0	-/-	
<b>Rhus sp.</b>										
07	0	0	0	-	-	0	0	0	-/-	
10	0	0	0	-	-	0	0	0	27/50	
<b>Sclerocactus sp.</b>										
07	0	0	0	-	-	0	0	0	-/-	
10	20	0	100	-	-	0	0	0	4/4	
<b>Yucca sp.</b>										
07	0	0	0	-	-	0	0	0	27/53	
10	0	0	0	-	-	0	0	0	4/13	

BLACK RIDGE FUEL REDUCTION - TREND STUDY NO. 13R-3-10  
[Project #1408](#) and [Project #1730](#)

Vegetation Type: Pinyon/Juniper

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Upland Stony Sand (Utah Juniper-Pinyon), R035XY323UT

Land Ownership: BLM

Elevation: 6,635 ft. (2,021 m)

Aspect: West

Slope: 10%

Transect bearing: 187° magnetic

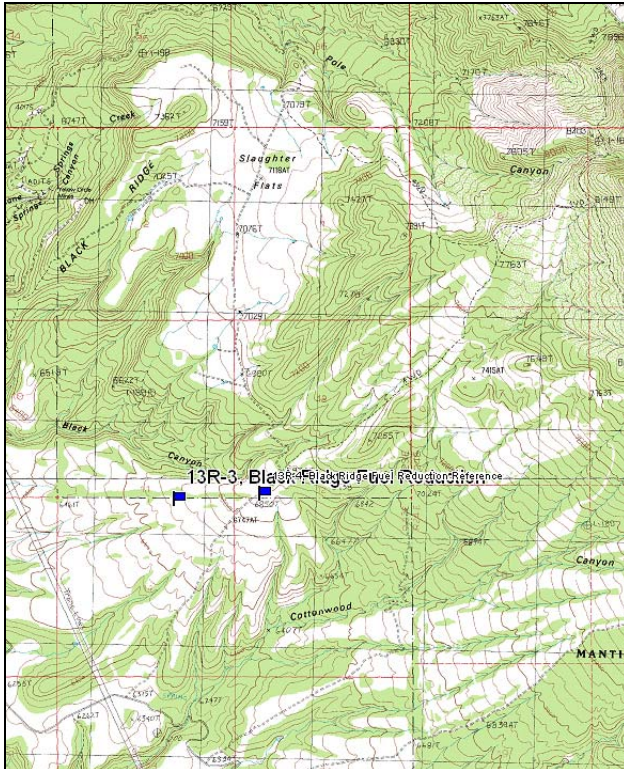
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

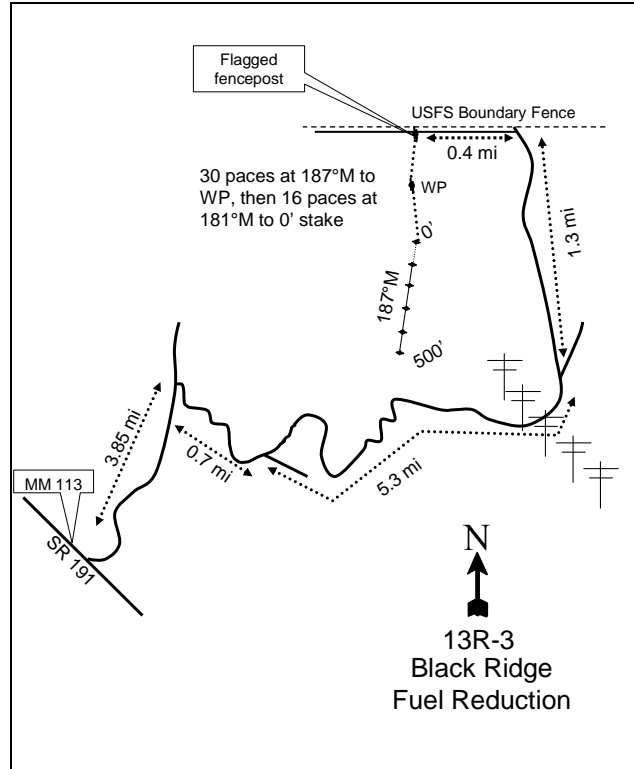
From Moab, travel south on SR 191 just past mile marker 113, where a road turns off to Black Ridge and Yellow Circle Mine. Turn left (east) and go 3.85 miles on the main road. Turn right and go 0.7 miles up the ridge to a fork. Go left and stay on the main road for 5.3 miles (passing a gate at 2.6 miles). Turn left onto a jeep trail 0.1 miles after crossing under some power lines, and continue on main trail 1.3 miles to a cattle guard at the Forest Service boundary. Turn left before the cattle guard onto a two track and continue for 0.4 miles (a fence post should be wrapped in flagging). From the marked post walk 30 paces at 187 degrees magnetic to a witness post. From the witness post walk 16 paces at 181 degrees magnetic to the 0-stake.

Map Name: La Sal West



Township: 28S Range: 23E Section: 14

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 643665 E 4248461 N

BLACK RIDGE FUEL REDUCTION - WRI STUDY 13R-3  
[Project #1408](#) and [Project #1730](#)

**Site Description**

Site Information: This study was established in 2010 to monitor a fuel reduction treatment about ten miles southeast of Moab on Black Ridge Mesa. It is located near the US Forest Service boundary fence at north end of the project. The treatment would be implemented through a combination of mechanical and hand cutting, utilizing a bullhog or mechanical shredder along with chainsaws and other hand tools. The objectives would be to create an assortment of mixed-density pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) groupings with treatment ranging from no cutting to the complete removal of pinyon pine and Utah juniper trees. The goals of this treatment are to protect the wildland/urban interface and nearby communities, reduce fuel loading, enhance wildlife habitat and restore vegetative communities. This treatment will connect with the Pack Creek project (WRI 13R-2). Grazing will be rested for a minimum of two years after project completion (WRI Database 2011). Pellet group data estimated light elk and cattle use prior to treatment in 2010, while deer use was heavy (Table - Pellet Group Data).

SEED MIX--  
 Management unit 13R, Study no: 3

Project Name: Black Ridge Phase I WRI Database #: 1408				Project Name: Black Ridge Phase II WRI Database #: 1730			
Application: Aerial Seed		Acres: 1473		Application: Aerial Seed		Acres: 160	
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Hycrest'	350	0.24	G	Western Wheatgrass 'Arriba'	450	2.81
G	Sand Dropseed	230	0.16	G	Blue Grama 'Alma'	80	0.50
G	Sterile Triticale 'Quickguard'	1000	0.68	G	Indian Ricegrass	300	1.88
G	Blue Grama 'Alma'	1000	0.68	G	Needle and Threadgrass	50	0.31
G	Indian Ricegrass	2550	1.73	G	Sand Dropseed	16	0.10
G	Needle and Threadgrass	1100	0.75	G	Sandberg Bluegrass	65	0.41
G	Sandberg Bluegrass	600	0.41	F	Blue Flax 'Appar'	80	0.50
G	Western Wheatgrass 'Arriba'	4050	2.75	F	Cicer Milkvetch 'Lutana'	250	1.56
F	Blue Flax 'Appar'	1060	0.72	F	Sainfoin 'Eski'	350	2.19
F	Cicer Milkvetch 'Lutana'	2200	1.49	F	Rocky Mountain Penstemon	32	0.20
F	Sainfoin 'Eski'	2950	2.00	B	Fourwing Saltbush	150	0.94
F	Small Burnet 'Delar'	1830	1.24	B	Sagebrush, Wyoming	65	0.41
F	Rocky Mountain Penstemon	200	0.14	Total Pounds:		65	11.80
B	Bitterbrush	1600	1.09	PLS Pounds:			9.55
B	Fourwing Saltbush	2950	2.00				
B	Stansbury Cliffrose	199	0.14				
Total Pounds:		23869	16.20				
PLS Pounds:			13.29				

Browse: Preferred browse species were somewhat limited on this site in 2010, prior to any treatment taking place. Fringed sagebrush (*Artemisia frigida*) and green ephedra (*Ephedra viridis*) were the only palatable browse species sampled in 2010, though occurring in very low abundance. The green ephedra population is lightly used mature population with good vigor and low decadence. Recruitment of young green ephedra plants was excellent in 2010 (Table - Browse Characteristics). Fringed sagebrush was very rare and provided very minimal cover (Table - Browse Trends). Other browse species included broom snakeweed (*Gutierrezia sarothrae*) and pricklypear cactus (*Opuntia sp.*) (Table - Browse Characteristics). Pinyon pine and Utah juniper provided the majority of the cover. (Table - Canopy Cover).

Herbaceous Understory: The herbaceous understory was very limited and not diverse. Crested wheatgrass (*Agropyron cristatum*) was the only perennial grass species sampled and provided the majority of the cover. Cheatgrass (*Bromus tectorum*) was the only other grass species sampled but occurred infrequently. Rock goldenrod (*Petradoria pumila*) was the most common forb species and accounted for nearly all of the forb cover (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a stony loam. Bare ground cover is moderately high with a high amount of litter and moderate amount vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2010 due to pedestalling, flow patterns, rills, and high amount of soil movement.

HERBACEOUS TRENDS--  
Management unit 13R, Study no: 3

T y p e	Species	Nested Frequency	Average Cover %
		'10	'10
G	<i>Agropyron cristatum</i>	249	11.13
G	<i>Bromus tectorum</i> (a)	27	.27
Total for Annual Grasses		27	0.27
Total for Perennial Grasses		249	11.13
Total for Grasses		276	11.40
F	<i>Chenopodium fremontii</i> (a)	5	.04
F	<i>Collinsia parviflora</i> (a)	4	.00
F	<i>Draba</i> sp. (a)	5	.01
F	<i>Gilia</i> sp. (a)	12	.07
F	<i>Lappula occidentalis</i> (a)	3	.00
F	<i>Lesquerella</i> sp.	4	.00
F	<i>Petradoria pumila</i>	45	2.45
Total for Annual Forbs		29	0.14
Total for Perennial Forbs		49	2.46
Total for Forbs		78	2.60

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--  
Management unit 13R, Study no: 3

T y p e	Species	Strip Frequency	Average Cover %
		'10	'10
B	<i>Artemisia frigida</i>	-	.38
B	<i>Ephedra viridis</i>	10	3.83
B	<i>Gutierrezia sarothrae</i>	16	.47
B	<i>Juniperus osteosperma</i>	5	4.58
B	<i>Pinus edulis</i>	5	10.73
Total for Browse		36	20.01

CANOPY COVER, LINE INTERCEPT--  
Management unit 13R, Study no: 3

Species	Percent Cover '10
Ephedra viridis	4.71
Gutierrezia sarothrae	.15
Juniperus osteosperma	5.86
Pinus edulis	14.71

POINT-QUARTER TREE DATA--  
Management unit 13R, Study no: 3

Species	Trees per Acre '10
Juniperus osteosperma	71
Pinus edulis	178

Average diameter (in) '10
3.0
3.6

BASIC COVER--  
Management unit 13R, Study no: 3

Cover Type	Average Cover % '10
Vegetation	31.38
Rock	6.14
Pavement	7.48
Litter	54.79
Cryptogams	.17
Bare Ground	24.22

PELLET GROUP DATA--  
Management unit 13R, Study no: 3

Type	Quadrat Frequency '10	Days use per acre (ha) '10
Rabbit	4	-
Elk	1	2 (5)
Deer	26	64 (157)
Cattle	-	4 (9)

BROWSE CHARACTERISTICS--  
Management unit 13R, Study no: 3

		Age class distribution			Utilization				
Y e a r	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Atriplex canescens</i>									
10	<b>0</b>	0	0	-	-	0	0	0	15/19
<i>Ephedra viridis</i>									
10	<b>380</b>	26	74	-	-	0	11	0	43/57
<i>Gutierrezia sarothrae</i>									
10	<b>520</b>	19	81	-	40	0	0	0	6/8
<i>Juniperus osteosperma</i>									
10	<b>160</b>	0	100	-	20	0	0	0	-/-
<i>Opuntia sp.</i>									
10	<b>0</b>	0	0	-	-	0	0	0	5/39
<i>Pinus edulis</i>									
10	<b>160</b>	25	75	-	-	0	0	0	-/-

BLACK RIDGE FUEL REDUCTION REFERENCE - TREND STUDY NO. 13R-4-10  
[Project #1408](#) and [Project #1730](#)

Vegetation Type: Pinyon/Juniper

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Upland Stony Sand (Utah Juniper-Pinyon), R035XY323UT

Land Ownership: BLM

Elevation: 6,768 ft. (2,063 m)

Aspect: Southwest

Slope: 4%

Transect bearing: 145° magnetic

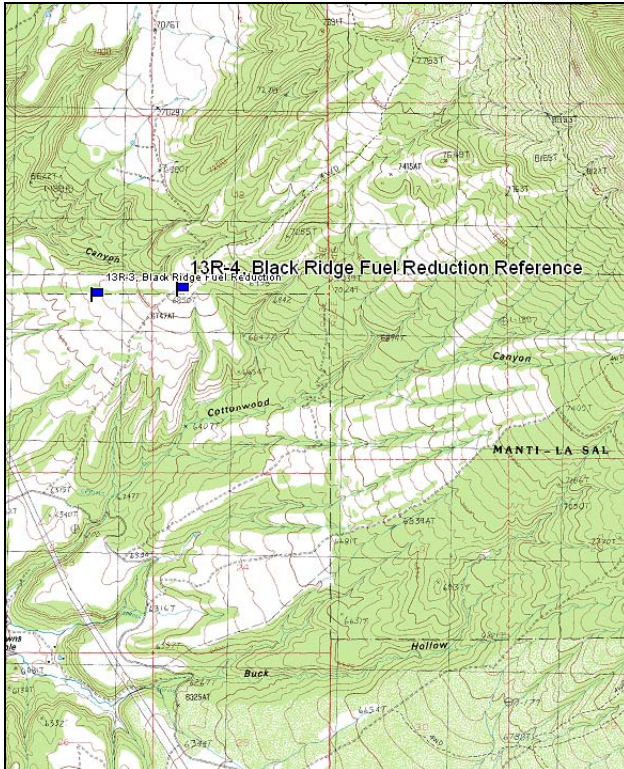
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft) (rebar), line 5 (95 ft)

Notes: No rebar

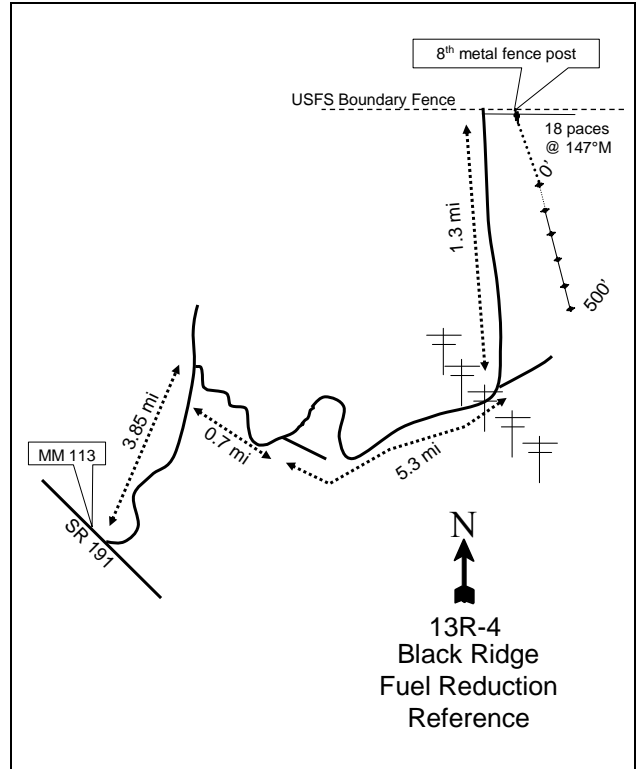
Directions:

From Moab, travel south on SR 191 just past mile marker 113, where a road turns off to Black Ridge and Yellow Circle Mine. Turn left (east) and go 3.85 miles on the main road. Turn right and go 0.7 miles up the ridge to a fork. Go left and stay on the main road for 5.3 miles (passing a gate at 2.6 miles). Turn left onto a jeep trail 0.1 miles after crossing under some power lines, and continue on main trail 1.3 miles to a cattle guard at the Forest Service boundary. Turn right onto a two track, just before the cattle guard. The witness post is the eighth metal post on the Forest Service boundary fence, it was wrapped in flagging. From the witness post continue 18 paces at 147 degrees magnetic to the 0-foot stake.

Map Name: La Sal West



Diagrammatic Sketch:



Township: 28S Range: 23E Section: 13

GPS: NAD 83, UTM 12S 644432 E 4248529 N



BLACK RIDGE FUELS REDUCTION REFERENCE - WRI STUDY 13R-4  
[Project #1408](#) and [Project #1730](#)

**Site Description**

Site Information: This study was established as an untreated reference in companion to Black Ridge Fuels Reduction (13R-03) ten miles southeast of Moab on Black Ridge Mesa. The study is located near the US Forest Service boundary fence in a dense pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodland (WRI Database 2011). Pellet group data estimated light elk and cattle use prior to treatment in 2010 while deer use was moderate (Table - Pellet Group Data).

Browse: Green ephedra was the only palatable browse species sampled in 2010, but was very rare. Pinyon pine and Utah juniper are the dominant browse species and provided nearly all the canopy cover. The production of preferred browse species is being limited by pinyon pine and Utah juniper. Other browse species sampled included broom snakeweed (*Gutierrezia sarothrae*) and yucca (*Yucca sp.*) (Table - Browse Characteristics).

Herbaceous Understory: Herbaceous understory is limited. Grasses are not diverse or abundant. Crested wheatgrass (*Agropyron cristatum*) is the dominant perennial grass species and provided the majority of the grass cover. Cheatgrass (*Bromus tectorum*) and Indian ricegrass (*Oryzopsis hymenoides*) were also sampled. Forbs are rare on the site. Rock goldenrod (*Petradoria pumila*) was the predominant forb and provided the majority of cover (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a stony loam. Bare ground cover is moderately high with a high amount of litter and moderate amount vegetation and pavement providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2010 due to pedestalling, flow patterns, rills, and soil movement.

HERBACEOUS TRENDS--  
 Management unit 13R, Study no: 4

Type	Species	Nested	Average
		Frequency	Cover %
		'10	'10
G	Agropyron cristatum	105	3.22
G	Bromus tectorum (a)	16	.34
G	Oryzopsis hymenoides	2	.03
Total for Annual Grasses		16	0.34
Total for Perennial Grasses		107	3.25
Total for Grasses		123	3.60
F	Arabis sp.	5	.06
F	Astragalus convallarius	18	.28
F	Astragalus sp.	4	.01
F	Euphorbia sp.	28	.20
F	Gilia sp. (a)	14	.04
F	Hymenoxys acaulis	7	.15
F	Lesquerella sp.	3	.01
F	Petradoria pumila	27	1.47
F	Salsola iberica (a)	2	.01
F	Schoenrambe linifolia	-	.00
F	Townsendia sp.	6	.04

Type	Species	Nested Frequency '10	Average Cover % '10
	Total for Annual Forbs	16	0.04
	Total for Perennial Forbs	98	2.24
	Total for Forbs	114	2.29

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 13R, Study no: 4

Type	Species	Strip Frequency '10	Average Cover % '10
B	Ephedra viridis	1	.41
B	Gutierrezia sarothrae	25	.58
B	Juniperus osteosperma	13	9.76
B	Pinus edulis	9	17.26
B	Sclerocactus sp.	1	-
B	Yucca sp.	0	.03
	Total for Browse	49	28.04

CANOPY COVER, LINE INTERCEPT--

Management unit 13R, Study no: 4

Species	Percent Cover '10
Ephedra viridis	.08
Gutierrezia sarothrae	.25
Juniperus osteosperma	15.03
Pinus edulis	19.38

POINT-QUARTER TREE DATA--

Management unit 13R, Study no: 4

Species	Trees per Acre '10	Average diameter (in) '10
Juniperus osteosperma	167	4.3
Pinus edulis	117	3.4

BASIC COVER--

Management unit 13R, Study no: 4

Cover Type	Average Cover % '10
Vegetation	32.18
Rock	4.73
Pavement	13.71
Litter	43.36
Cryptogams	3.14
Bare Ground	31.29

PELLET GROUP DATA--

Management unit 13R, Study no: 4

Type	Quadrat Frequency '10	Days use per acre (ha) '10
Rabbit	1	-
Elk	1	3 (7)
Deer	13	22 (55)
Cattle	-	4 (9)

BROWSE CHARACTERISTICS--

Management unit 13R, Study no: 4

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
<i>Artemisia tridentata wyomingensis</i>										
10	0	0	0	-	-	0	0	0	22/28	
<i>Chrysothamnus nauseosus</i>										
10	0	0	0	-	-	0	0	0	26/32	
<i>Ephedra viridis</i>										
10	20	0	100	-	-	0	0	0	39/58	
<i>Gutierrezia sarothrae</i>										
10	880	9	86	5	-	0	0	2	6/7	
<i>Juniperus osteosperma</i>										
10	280	29	71	-	-	7	0	0	-/-	
<i>Opuntia sp.</i>										
10	0	0	0	-	-	0	0	0	5/19	
<i>Pinus edulis</i>										
10	180	11	89	-	-	0	0	0	-/-	
<i>Sclerocactus sp.</i>										
10	20	0	100	-	-	0	0	0	9/5	
<i>Yucca sp.</i>										
10	0	0	0	-	-	0	0	0	7/12	

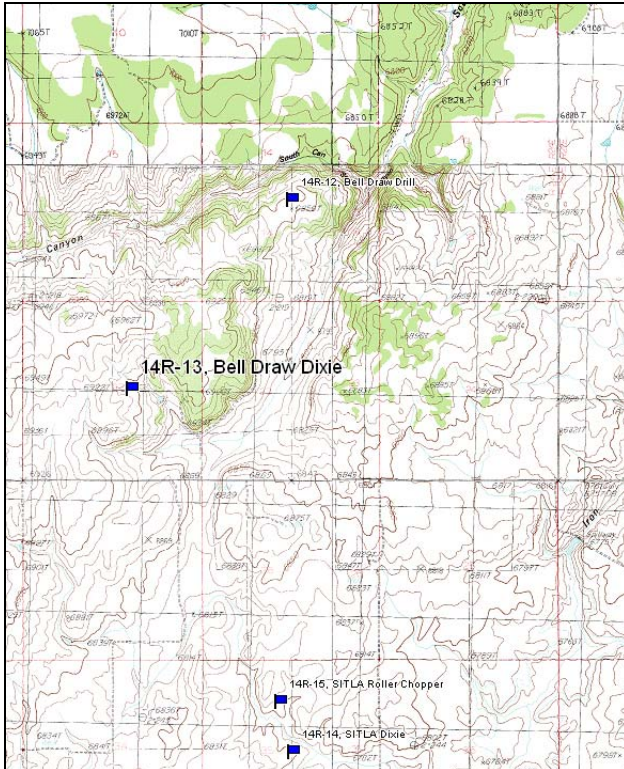
BELL DRAW DIXIE - TREND STUDY NO. 14R-13-10  
[Project #295](#)

Vegetation Type: Wyoming Big Sage  
Range Type: Crucial Deer Spring/Fall  
NRCS Ecological Site Description: [Upland Loam \(Basin Big Sagebrush\), R035XY306UT](#)  
Land Ownership: Private  
Elevation: 6,900 ft. (2,103 m)  
Aspect: Northeast  
Slope: 7%  
Transect bearing: 249° magnetic  
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95ft)

Directions:

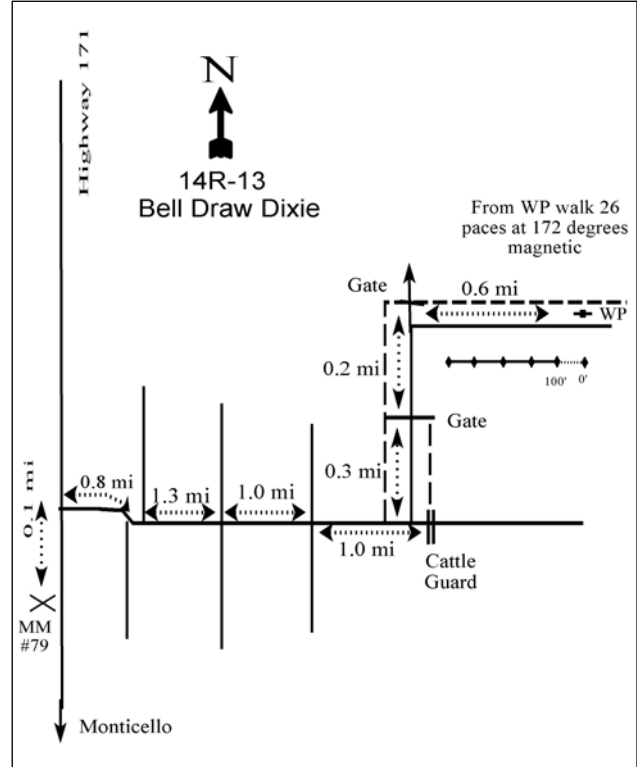
From mile marker 79 on highway 191 north of Monticello drive 0.1 miles north and turn right onto a road heading east. Drive 0.8 miles to a junction; stay straight for 1.3 miles to another junction again staying straight for 1.0 mile to another junction again staying straight for another 1.0 mile to a junction. Turn left (north) at this junction and drive 0.3 miles to a gate. Drive 0.2 miles to another gate and turn right on a road just before the gate. Proceed 0.6 miles to a witness post on the left. The witness post is right next to a fence post. The 0' stake is 26 paces from the witness post at 172 degrees magnetic. The 0' stake is marked with browse tag #165.

Map Name: Monticello North



Township: 32S Range: 24E Section: 22

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 651795 E 4205153 N

BELL DRAW DIXIE - WRI STUDY 14R-13

[Project #295](#)

**Site Description**

Site Information: The study was established in 2006 prior to a Dixie harrow treatment on 330 acres of private land within a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) community. The purpose of the project was to create a more diverse plant community. The project was seeded using a broadcast seeder in front of the Dixie harrow. The project was completed in the fall of 2006. The project area was subsequently sprayed by the landowner with an unknown herbicide to further kill sagebrush between the 2009 and 2010 readings. This study is located seven miles northeast of Monticello (WRI Database 2011). Pellet group data estimated light deer and elk use and moderate cattle use in 2006 and heavy deer and light cattle use in 2009. Cattle and deer use were light in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 14R, Study no: 13

Project Name: Bell Draw - Harrow Mix			
WRI Database #: 295			
Application: Broadcast Seeder		Acres:	50
Seed type		lbs in mix	lbs/acre
G	Orchardgrass 'Paiute'	13	0.26
G	Tall Wheatgrass 'Alkar'	49	0.98
G	Newhy Wheatgrass	50	1.00
G	Pubescent Wheatgrass	100	2.00
G	Slender Wheatgrass 'San Luis'	100	2.00
G	Great Basin Wildrye 'Trailhead'	25	0.50
G	Crested Wheatgrass 'Ephraim'	30	0.60
G	Crested Wheatgrass 'Hycrest'	30	0.60
F	Small Burnet 'Delar'	125	2.50
F	Rocky Mountain Beeplant	25	0.50
F	Blue Flax	13	0.26
F	Alfalfa 'Ladak'	50	1.00
F	Alfalfa 'Nomad'	50	1.00
B	Fourwing Saltbush	75	1.50
B	Forage Kochia	35	0.70
Total Pounds:		770	15.40
PLS Pounds:			13.01

Browse: Wyoming big sagebrush was the dominant browse species historically and provided nearly all browse cover. Following treatment in 2006, Wyoming big sagebrush cover decreased, as did all other browse cover. The decadence of sagebrush was high at the outset of the study but has been good since then. The recruitment of young sagebrush plants has been high over the sample years. Other species sampled on this site include broom snakeweed (*Gutierrezia sarothrae*), rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *hololeucus*), spiny hopsage (*Grayia spinosa*), pricklypear cactus (*Opuntia* sp.) and fishhook cactus (*Sclerocactus* sp.).

Herbaceous Understory: Grasses are not diverse and are moderately abundant with crested wheatgrass (*Agropyron cristatum*) dominating the grass component. Crested wheatgrass has provided nearly all the grass cover since the outset of the study. Cheatgrass (*Bromus tectorum*) was sampled in 2005 for the first time, but occurred infrequently. Forbs are diverse and are not overly abundant. The most common perennial forbs include scarlet globemallow (*Sphaeralcea coccinea*) and daisy (*Erigeron* sp.). Annual forbs have steadily

increased in abundance since the treatment. Bur buttercup (*Ranunculus testiculatus*) and annual stickseed (*Lappula occidentalis*) are the dominant annual forb species (Table - Herbaceous Trends)

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is low with moderate amount of vegetation, litter, rock, and pavement providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as moderate in 2006 due to surface litter movement, pedestalling, and flow patterns. The soil condition was classified as stable in 2009 and 2010.

### **Pre vs. Three Years Post Treatment, 2006 vs. 2009**

Browse: The harrow project was successful at reducing the canopy cover of Wyoming big sagebrush from 23% to 14%. Broom snakeweed canopy cover also decreased from 8% to less than 1%. Neither of the seeded browse species, forage kochia (*Kochia prostrata*) and fourwing saltbush (*Atriplex canescens*), were sampled three years after treatment. Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover.

Grasses: The sum of nested frequency of perennial grasses remained similar, but cover almost doubled from 7% to 12%. The increase in cover can be attributed solely to crested wheatgrass which was the only perennial grass sampled. No seeded species except crested wheatgrass was sampled, though crested wheatgrass was present prior to the treatment. Cheatgrass (*Bromus tectorum*) was sampled for the first time in 2009, following the treatment, at low frequency and cover. The site has not responded well to the treatment, because diversity has not been increased nor has the grass component improved remaining a mostly crested wheatgrass dominated monoculture.

Forbs: The sum of nested frequency for perennial forbs decreased by 69% and cover decreased from 2% to less than 1%. The weedy species bur buttercup (*Ranunculus testiculatus*) and annual stickseed (*Lappula occidentalis*) were sampled for the first time. Alfalfa (*Medicago sativa*) was the only seeded species that was sampled. Alfalfa was only sampled in 3% of the quadrats and provided very little cover.

### **Trend Assessments**

#### Browse

- **2009 to 2010 - down (-2)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush cover decreased from 14% to 2% after the area was sprayed with an herbicide. Recruitment was excellent at 43% and decadence was low at 8%. As a side note, sagebrush density has increased from 3,800 plants/acre in 2006 to 6,640 plants/acre in 2010, though the average size of each plant was much smaller.

#### Grasses

- **2009 to 2010 - slightly up (+1)**: The sum of nested frequency of perennial grasses increased 30% while cover remained similar at 12%. Crested wheatgrass increased in frequency but cover remained similar at 12%. Cheatgrass was still present at low frequency. Diversity improved slightly with pubescent wheatgrass (*Agropyron intermedium*), mutton bluegrass (*Poa fendleriana*) and bottlebrush squirreltail (*Sitanion hystrix*) being sampled for the first time.

#### Forbs

- **2009 to 2010 - slightly up (+1)**: The sum of nested frequency of perennial forbs increased two fold and cover increased from 1% to 3%. Of the seeded species, only alfalfa (*Medicago sativa*) was sampled but is very rare on the site.

HERBACEOUS TRENDS--  
Management unit 14R, Study no: 13

Type	Species	Nested Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
G	<i>Agropyron cristatum</i>	<sub>a</sub> 192	<sub>a</sub> 194	<sub>b</sub> 243	6.58	11.76	11.93
G	<i>Agropyron intermedium</i>	-	-	3	-	-	.00
G	<i>Bromus tectorum</i> (a)	<sub>a</sub> -	<sub>b</sub> 21	<sub>c</sub> 39	-	.06	.85
G	<i>Poa fendleriana</i>	-	-	3	-	-	.03
G	<i>Sitanion hystrix</i>	-	-	3	-	-	.15
Total for Annual Grasses		0	21	39	0	0.06	0.85
Total for Perennial Grasses		192	194	252	6.58	11.76	12.11
Total for Grasses		192	215	291	6.58	11.82	12.97
F	<i>Astragalus convallarius</i>	3	7	6	.00	.06	.94
F	<i>Calochortus nuttallii</i>	-	-	1	-	-	.01
F	<i>Castilleja linariaefolia</i>	-	-	3	-	-	.03
F	<i>Collinsia parviflora</i> (a)	-	-	5	-	-	.03
F	<i>Cordylanthus</i> sp. (a)	<sub>a</sub> -	<sub>a</sub> -	<sub>b</sub> 22	-	-	.24
F	<i>Cryptantha</i> sp.	<sub>a</sub> -	<sub>a</sub> -	<sub>b</sub> 11	-	-	.08
F	<i>Erigeron</i> sp.	13	19	27	.04	.18	1.00
F	<i>Erodium cicutarium</i> (a)	-	-	3	-	-	.15
F	<i>Euphorbia</i> sp.	<sub>b</sub> 46	<sub>a</sub> -	<sub>a</sub> -	.14	-	-
F	<i>Gayophytum ramosissimum</i> (a)	-	-	12	-	-	.22
F	<i>Lactuca serriola</i> (a)	-	-	3	-	-	.03
F	<i>Lappula occidentalis</i> (a)	<sub>a</sub> -	<sub>a</sub> 3	<sub>b</sub> 109	-	.00	1.93
F	<i>Machaeranthera grindelioides</i>	1	-	-	.00	-	.03
F	<i>Medicago sativa</i>	-	4	1	-	.09	.15
F	<i>Microsteris gracilis</i> (a)	<sub>a</sub> -	<sub>a</sub> -	<sub>b</sub> 14	-	-	.03
F	<i>Penstemon</i> sp.	4	5	6	.03	.18	.03
F	<i>Polygonum douglasii</i> (a)	<sub>a</sub> -	<sub>a</sub> -	<sub>b</sub> 20	-	-	.10
F	<i>Ranunculus testiculatus</i> (a)	<sub>a</sub> -	<sub>a</sub> 16	<sub>b</sub> 89	-	.02	1.01
F	<i>Senecio multilobatus</i>	<sub>c</sub> 128	<sub>b</sub> 3	<sub>a</sub> 41	1.72	.01	.12
F	<i>Sphaeralcea coccinea</i>	21	24	29	.13	.34	.49
F	<i>Tragopogon dubius</i> (a)	-	-	1	-	-	.03
F	<i>Trifolium</i> sp.	-	5	13	-	.01	.20
Total for Annual Forbs		0	19	278	0	0.02	3.79
Total for Perennial Forbs		216	67	138	2.08	0.87	3.10
Total for Forbs		216	86	416	2.08	0.90	6.90

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 14R, Study no: 13

Type	Species	Strip Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
B	Artemisia tridentata wyomingensis	71	0	66	18.95	15.32	3.15
B	Chrysothamnus nauseosus hololeucus	10	0	6	.53	.38	1.00
B	Gutierrezia sarothrae	76	0	44	2.18	1.65	2.40
B	Opuntia sp.	6	0	5	1.12	.53	.33
Total for Browse		163	0	121	22.79	17.90	6.89

CANOPY COVER, LINE INTERCEPT--

Management unit 14R, Study no: 13

Species	Percent Cover		
	'06	'09	'10
Artemisia tridentata wyomingensis	23.41	14.36	2.25
Chrysothamnus nauseosus hololeucus	.43	.30	.20
Gutierrezia sarothrae	8.31	.80	1.45
Opuntia sp.	.83	.26	.41

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 14R, Study no: 13

Species	Average leader growth (in) '10
Artemisia tridentata wyomingensis	1.9

BASIC COVER--

Management unit 14R, Study no: 13

Cover Type	Average Cover %		
	'06	'09	'10
Vegetation	26.28	29.39	26.53
Rock	.01	.03	0
Pavement	.05	.02	0
Litter	20.48	35.20	39.63
Cryptogams	.96	.24	.07
Bare Ground	67.24	54.65	47.70

SOIL ANALYSIS DATA --

Management unit 14R, Study no: 13, Study Name: Bell Draw Dixie

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
15.4	7.3	44.2	36.0	19.8	1.4	21.1	172.8	0.6



PELLET GROUP DATA--

Management unit 14R, Study no: 13

Type	Quadrat Frequency			Days use per acre (ha)		
	'06	'09	'10	'06	'09	'10
Rabbit	78	61	29	-	-	-
Elk	3	2	-	1 (2)	-	-
Deer	1	16	12	3 (7)	43 (106)	5 (12)
Cattle	5	2	2	27 (66)	6 (14)	4 (11)

BROWSE CHARACTERISTICS--

Management unit 14R, Study no: 13

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<i>Artemisia tridentata wyomingensis</i>									
06	<b>3800</b>	31	46	23	76220	0	0	11	27/40
09	No density data collected								18/26
10	<b>6640</b>	43	49	8	140	12	4	6	7/9
<i>Chrysothamnus nauseosus hololeucus</i>									
06	<b>200</b>	10	20	70	-	10	10	60	19/21
09	No density data collected								15/20
10	<b>120</b>	33	67	0	20	0	0	0	14/24
<i>Gutierrezia sarothrae</i>									
06	<b>7740</b>	38	62	0	3580	0	0	0	5/9
09	No density data collected								5/6
10	<b>2800</b>	21	79	0	-	0	0	0	6/8
<i>Opuntia sp.</i>									
06	<b>120</b>	17	67	17	-	0	0	17	6/30
09	No density data collected								5/17
10	<b>160</b>	25	75	0	-	0	0	13	4/17

SITLA DIXIE - TREND STUDY NO. 14R-14-10  
[Project #334](#)

Vegetation Type: Wyoming Big Sage

Range Type: Crucial Deer Winter

NRCS Ecological Site Description: [Upland Loam \(Basin Big Sagebrush\), R035XY306UT](#)

Land Ownership: SITLA

Elevation: 6,800 ft. (2,075 m)

Aspect: Southeast

Slope: 2%

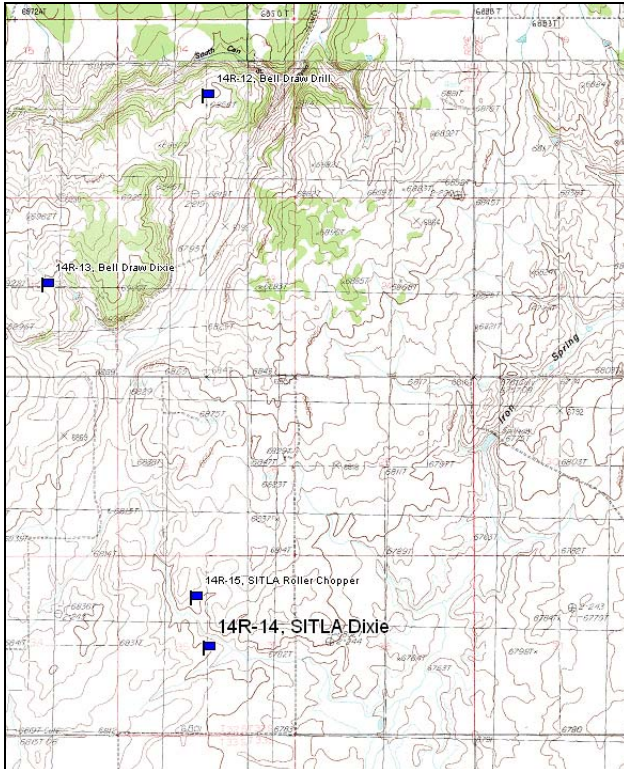
Transect bearing: 253° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95ft)

Directions:

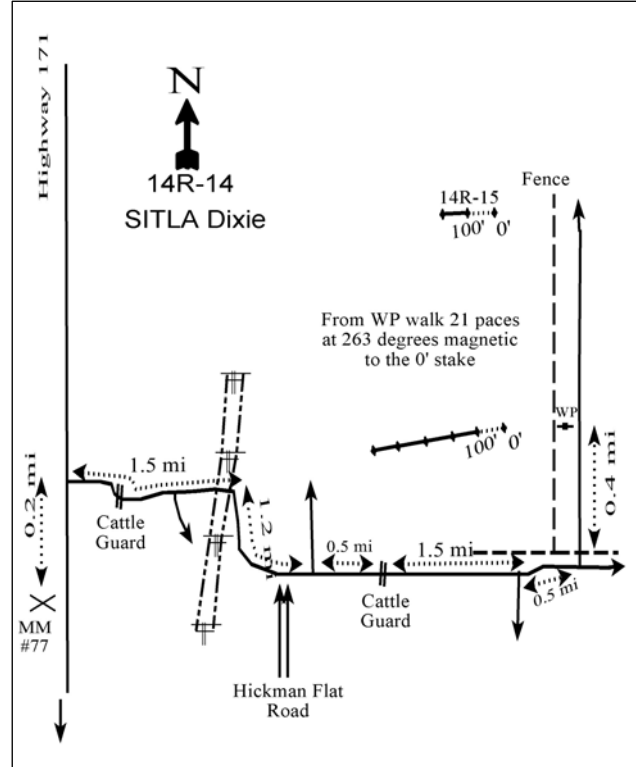
From mile marker 77 on highway 191 north of Monticello, drive 0.2 miles north and turn right onto a road heading east (Hickman Flat Road). From there drive for 1.5 miles to some power lines and a southward bend in the road. Go 1.2 miles to a junction staying straight for another 0.5 miles to a cattle guard. From the cattle guard drive 1.5 miles to another junction and continue straight for 0.5 miles. Turn left onto a two-track road and a gate. Proceed 0.4 miles through the gate to a witness post on the left. Walk 21 paces from the witness post at 263 degrees magnetic to the 0' stake marked with browse tag #164.

Map Name: Monticello North



Township: 32S Range: 24E Section: 35

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 653300 E 4201916 N

SITLA DIXIE - WRI STUDY 14R-14  
[Project #334](#)

**Site Description**

Site Information: This study was established in 2006, within a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) community approximately seven miles northeast of Monticello. The study was established to monitor the effects of a one-way Dixie harrow treatment to rejuvenate sagebrush stands currently occupied by sage-grouse. A seed mix of grass, forb, and browse species was broadcast seeded during the harrow treatment. The project was completed in the fall of 2006. The objectives of the project were to improve brood and rearing habitat for the Gunnison sage-grouse by establishing young sagebrush and a diverse herbaceous understory (WRI Database 2011). Pellet group data estimated light cattle use in 2006, 2009, and 2010 and moderate deer use in 2009 and light use in 2010 and light sheep use in 2009 (Table - Pellet Group Data).

SEED MIX--

Management unit 14R, Study no: 14

Project Name: Gunnison Sage Grouse Sagebrush Treatments			
WRI Database #: 334			
Application: Broadcast		Acres: 150	
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Goldar'	300	2.00
G	Indian Ricegrass 'Rimrock'	300	2.00
G	Sand Dropseed	10	0.07
G	Thickspike Wheatgrass 'Bannock'	300	2.00
G	Pubescent Wheatgrass	150	1.00
G	Western Wheatgrass 'Arriba'	150	1.00
F	Alfalfa 'Ladak'	150	1.00
F	Cicer Milkvetch 'Lutana'	150	1.00
F	Sainfoin 'Eski'	450	3.00
F	Small Burnet 'Delar'	300	2.00
B	Sagebrush, Wyoming	150	1.00
Total Pounds:		2410	16.07
PLS Pounds:			14.04

Browse: Wyoming big sagebrush is the primary preferred browse species, and has accounted for most of the browse cover in all sample years (Table - Canopy Cover). The Wyoming big sagebrush is a lightly used mature population with low decadence and good vigor over the sample years. The recruitment of young sagebrush plants was poor at the outset of the study but has been good since then. Other browse species sampled on the site include Dwarf rabbitbrush (*Chrysothamnus depressus*), rubber rabbitbrush (*Chrysothamnus nauseosus* spp. *hololeucus*) and broom snakeweed (*Gutierrezia sarothrae*) though occurring in low abundance (Table - Browse Characteristics).

Herbaceous Understory: The herbaceous understory improved following the treatment. Prior to the treatment perennial grass cover was lacking and was dominated by a blanket of cheatgrass. Cheatgrass (*Bromus tectorum*) is the dominant grass species on the site; though cover decreased following the treatment while perennial grass species increased in frequency of occurrence and cover. Seeded perennial grass species sampled following the treatment, included pubescent wheatgrass (*A. intermedium*) and Indian ricegrass (*Oryzopsis hymenoides*), thickspike wheatgrass (*A. dasystachyum*), and western wheatgrass (*A. smithii*). Prior to the treatment forbs were not diverse or abundant. Perennial forbs initially responded well to the treatment with increases in species diversity, cover and nested frequency. In 2010, several annual forb species were sampled for the first time and perennial forb cover decreased. The dominant perennial forbs are scarlet

globemallow (*Sphaeralcea coccinea*) and clover (*Trifolium sp.*). Annual stickseed (*Lappula occidentalis*) and bur buttercup (*Ranunculus testiculatus*) are the most common annual forbs. Alfalfa (*Medicago sativa*) was the only seeded forb that was sampled following treatment, but was sampled in low frequency and cover (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.3) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2006 due to pedestalling, flow patterns and surface litter movement. In 2009 and 2010, the soil erosion condition was classified as stable.

### **Pre vs. Three Years Post Treatment, 2006 vs. 2009**

Browse: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. The harrow project was successful at reducing the Wyoming big sagebrush canopy from 20% to 16%. Dwarf rabbitbrush, which was not sampled prior to treatment, provided 6% canopy cover in 2009 while other browse species combined to provide less than 1% canopy cover.

Grass: Perennial grass species remained rare on the study site. The sum of nested frequency of perennial grasses increased over two-fold and cover increased to 1%. Two seeded species were sampled, pubescent wheatgrass and Indian ricegrass, though cover and frequency were low. Cheatgrass decreased significantly in nested frequency and cover decreased from 6% to 4%, but cheatgrass still provided 74% of total grass cover in 2009. Establishment of seeded species was rare.

Forb: Perennial forbs responded very well to the treatment. The sum of nested frequency increased two-fold and cover increased from 1% to 5%. Alfalfa was the only seeded forb to be sampled and it was only sampled in one quadrat. Scarlet globemallow cover increased from less than 1% to nearly 2%, and clover increased significantly in nested frequency and provided 1% cover.

### **Trend Assessments**

#### Browse

- **2009 to 2010 - up (+2)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush canopy cover increased from 16% to 23%. While no comparisons can be made regarding density, an interesting note is that density increased from 5,340 plants/acre in 2006 to 11,580 plants/acre in 2010. The recruitment of young sagebrush plants represented 24% of the 2010 population while decadent plants accounted for 1%.

#### Grasses

- **2009 to 2010 - stable (0)**: Perennial grass species remained rare on the study site. The sum of nested frequency of perennial grasses decreases slightly by 12% while cover remained similar at 2%. The frequency of cheatgrass remained similar and cover decreased from 4% to 1%.

#### Forbs

- **2009 to 2010 - stable (0)**: The nested frequency of perennial forbs remained similar and cover decreased slightly from 5% to 4%. Scarlet globemallow remained similar in nested frequency and cover remained at 2%. Alfalfa was sampled in very low frequency and cover, and was the only seeded forb sampled.

HERBACEOUS TRENDS--  
Management unit 14R, Study no: 14

Type	Species	Nested Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
G	<i>Agropyron cristatum</i>	31	48	44	.19	.81	.95
G	<i>Agropyron dasystachyum</i>	-	-	3	-	-	.01
G	<i>Agropyron intermedium</i>	-	8	2	-	.04	.01
G	<i>Agropyron smithii</i>	-	-	2	-	-	.01
G	<i>Bouteloua gracilis</i>	1	-	-	.00	-	-
G	<i>Bromus tectorum</i> (a)	274	242	246	6.00	3.80	.87
G	<i>Oryzopsis hymenoides</i>	-	1	15	-	.03	.16
G	<i>Sitanion hystrix</i>	<sub>a</sub> 6	<sub>b</sub> 39	<sub>ab</sub> 19	.30	.46	.34
Total for Annual Grasses		274	242	246	6.00	3.80	0.87
Total for Perennial Grasses		38	96	85	0.50	1.34	1.50
Total for Grasses		312	338	331	6.50	5.15	2.37
F	<i>Astragalus convallarius</i>	-	2	-	-	.03	-
F	<i>Cirsium</i> sp.	-	-	-	-	.00	.00
F	<i>Collinsia parviflora</i> (a)	-	-	7	-	-	.01
F	<i>Cordylanthus</i> sp. (a)	<sub>a</sub> -	<sub>a</sub> -	<sub>b</sub> 39	-	-	.26
F	<i>Descurainia pinnata</i> (a)	-	-	3	-	-	.01
F	<i>Erigeron</i> sp.	<sub>b</sub> 15	<sub>a</sub> 5	<sub>a</sub> 2	.06	.04	.03
F	<i>Eriogonum</i> sp.	<sub>a</sub> -	<sub>b</sub> 15	<sub>ab</sub> 1	-	.05	.00
F	<i>Eriogonum umbellatum</i>	-	-	2	-	-	.03
F	<i>Erodium cicutarium</i> (a)	-	7	2	-	.30	.00
F	<i>Gayophytum ramosissimum</i> (a)	<sub>a</sub> -	<sub>a</sub> 8	<sub>b</sub> 28	-	.01	.06
F	<i>Gilia</i> sp. (a)	-	6	-	-	.01	-
F	<i>Lactuca serriola</i> (a)	-	-	3	-	-	.00
F	<i>Lappula occidentalis</i> (a)	<sub>a</sub> 16	<sub>a</sub> 23	<sub>b</sub> 104	.22	.11	.45
F	<i>Medicago sativa</i>	-	2	3	-	.03	.06
F	<i>Microsteris gracilis</i> (a)	<sub>a</sub> -	<sub>a</sub> -	<sub>b</sub> 43	-	-	.18
F	<i>Phlox hoodii</i>	-	-	3	-	-	.18
F	<i>Phlox longifolia</i>	<sub>a</sub> 6	<sub>a</sub> 27	<sub>b</sub> 45	.04	.10	.22
F	<i>Polygonum douglasii</i> (a)	<sub>a</sub> -	<sub>a</sub> 9	<sub>b</sub> 52	-	.01	.17
F	<i>Ranunculus testiculatus</i> (a)	<sub>a</sub> -	<sub>b</sub> 71	<sub>c</sub> 117	-	.57	1.43
F	<i>Salsola iberica</i> (a)	4	2	10	.03	.01	.02
F	<i>Senecio multilobatus</i>	-	5	2	-	.01	.00
F	<i>Sphaeralcea coccinea</i>	118	124	112	.56	1.87	2.03
F	<i>Trifolium</i> sp.	<sub>a</sub> 6	<sub>b</sub> 85	<sub>b</sub> 107	.01	.70	1.08
F	Unknown forb-annual (a)	3	10	-	.01	.78	-
F	Unknown forb-perennial	<sub>a</sub> -	<sub>b</sub> 30	<sub>ab</sub> 4	-	2.55	.01
F	<i>Zigadenus paniculatus</i>	-	1	-	-	.00	-
Total for Annual Forbs		23	136	408	0.26	1.81	2.60
Total for Perennial Forbs		145	296	281	0.67	5.40	3.66
Total for Forbs		168	432	689	0.94	7.22	6.27

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 14R, Study no: 14

Type	Species	Strip Frequency			Average Cover %		
		'06	'09	'10	'06	'09	'10
B	Artemisia frigida	0	0	1	-	-	-
B	Artemisia tridentata wyomingensis	89	0	93	22.17	16.00	19.34
B	Chrysothamnus depressus	0	0	2	-	-	-
B	Chrysothamnus nauseosus hololeucus	12	0	6	.71	.18	.68
B	Chrysothamnus viscidiflorus	4	0	0	-	-	-
B	Eriogonum microthecum				-	.03	-
B	Gutierrezia sarothrae	24	0	27	.15	.06	.06
B	Opuntia sp.	3	0	3	-	.03	.15
Total for Browse		132	0	132	23.04	16.31	20.23

CANOPY COVER, LINE INTERCEPT--

Management unit 14R, Study no: 14

Species	Percent Cover		
	'06	'09	'10
Artemisia tridentata wyomingensis	20.43	15.85	23.29
Chrysothamnus depressus	-	6.08	.05
Chrysothamnus nauseosus hololeucus	.36	.16	.25
Gutierrezia sarothrae	.16	.71	.48

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 14R, Study no: 14

Species	Average leader growth (in)		
	'06	'09	'10
Artemisia tridentata wyomingensis	0.9	2.1	1.2

BASIC COVER--

Management unit 14R, Study no: 14

Cover Type	Average Cover %		
	'06	'09	'10
Vegetation	27.42	24.70	29.72
Rock	.66	.55	.46
Pavement	.35	.42	.22
Litter	39.73	40.73	36.82
Cryptogams	.35	.44	.15
Bare Ground	51.45	49.08	46.59

SOIL ANALYSIS DATA --

Management unit 14R, Study no: 14, Study Name: SITLA Dixie

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
11.2	7.3	38.2	39.0	22.8	1.5	15.5	214.4	0.6

PELLET GROUP DATA--

Management unit 14R, Study no: 14

Type	Quadrat Frequency			Days use per acre (ha)		
	'06	'09	'10	'06	'09	'10
Rabbit	74	63	24	-	-	-
Elk	4	2	-	-	-	-
Deer	4	21	4	-	28 (69)	1 (2)
Cattle	1	3	1	4 (9)	16 (40)	4 (11)

BROWSE CHARACTERISTICS--

Management unit 14R, Study no: 14

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<i>Artemisia frigida</i>									
06	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	<b>20</b>	0	100	-	-	0	0	0	4/6
<i>Artemisia tridentata wyomingensis</i>									
06	<b>5340</b>	2	76	22	48740	3	.74	13	20/28
09	No density data collected								18/25
10	<b>11580</b>	24	75	1	5360	5	0	1	18/29
<i>Chrysothamnus depressus</i>									
06	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	<b>40</b>	0	100	-	-	50	50	0	5/7
<i>Chrysothamnus nauseosus hololeucus</i>									
06	<b>420</b>	76	19	5	40	0	67	5	15/19
09	No density data collected								14/19
10	<b>200</b>	10	90	0	20	10	0	0	13/21
<i>Chrysothamnus viscidiflorus</i>									
06	<b>80</b>	0	50	50	20	0	100	50	12/12
09	No density data collected								-/-
10	<b>0</b>	0	0	0	-	0	0	0	-/-
<i>Gutierrezia sarothrae</i>									
06	<b>940</b>	9	91	-	320	0	0	0	6/9
09	No density data collected								8/11
10	<b>1040</b>	8	92	-	-	0	0	0	7/9
<i>Opuntia sp.</i>									
06	<b>60</b>	33	67	-	-	0	0	0	7/15
09	No density data collected								6/20
10	<b>60</b>	67	33	-	-	0	0	0	5/12

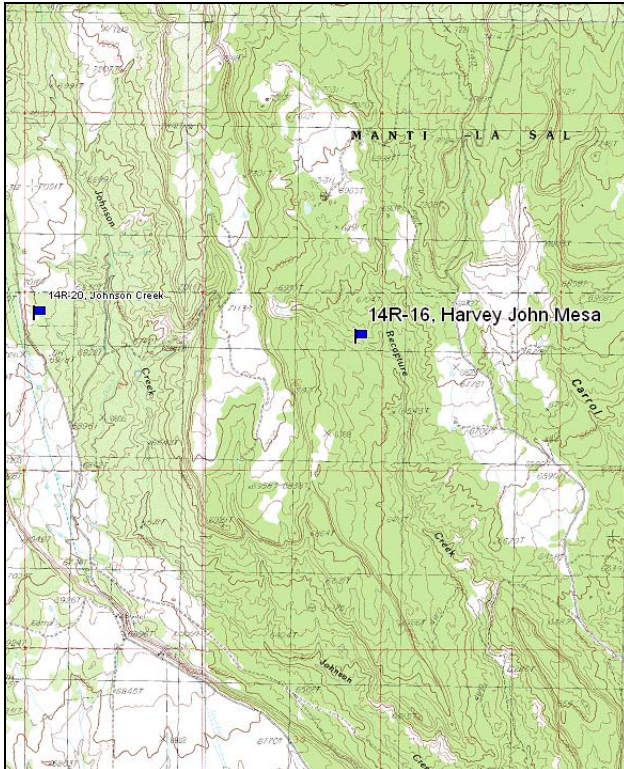
HARVEY JOHN MESA - TREND STUDY NO. 14R-16-10  
[Project #526](#)

Vegetation Type: Mountain Big Sagebrush  
Range Type: Crucial Deer Summer, Crucial Elk Winter  
NRCS Ecological Site Description: [Upland Shallow Loam \(Pinyon-Utah Juniper\), R035XY315UT](#)  
Land Ownership: Private  
Elevation: 7,050 ft. (2,149 m)  
Aspect: South  
Slope: 5%  
Transect bearing: 68° magnetic  
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)  
Notes: No Rebar

Directions:

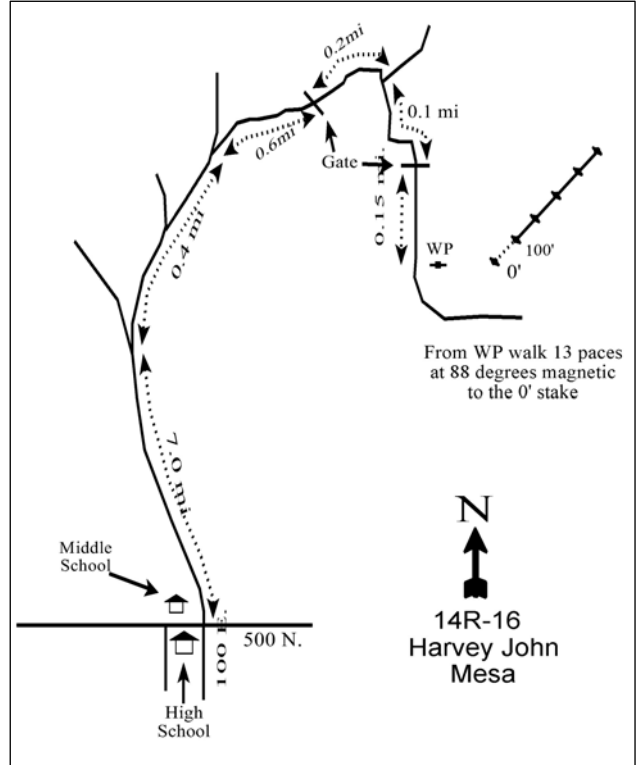
From the intersection of 500 N. and 100 E. in Blanding, drive north for 7.0 miles to a fork. Take the right fork staying right through another small fork for 0.4 miles to another fork. Go right for 0.6 miles to a locked gate that provides access to the private property. Proceed through the gate and go 0.2 miles following the road around as it bends south to another fork. Take the right fork for 0.1 miles to another gate. Drive through the gate for 0.15 miles to a witness post on the left. Walk 13 paces at 92 degrees magnetic to the 0' stake marked with browse tag #179.

Map Name: Blanding North



Township: 35S Range: 22E Section: 22

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 632384 E 4176097 N



HARVEY JOHN MESA - WRI STUDY 14R-16

[Project 526](#)

**Site Description**

Site Information: This study was established in 2006 to monitor a one-way Dixie harrow sagebrush reduction treatment on a private pasture on Harvey Kartchner Mesa. The Dixie harrow treatment was completed in mosaics and strips. A seed mix of forb and grass species were applied with a broadcast seeder. The treatment was completed in fall of 2006. The objectives of the project were to improve diversity of the herbaceous understory of 250 acres of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and remove 20 acres of encroaching pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). Horses and a few cattle grazed this area along with deer and elk (WRI Database 2011). Pellet group data estimated light deer, elk and horse use in 2006 and 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 14R, Study no: 16

Project Name: Harvey John Kartchner Mesa			
WRI Database #: 526			
Application: Broadcast Seeder		Acres:	150
Seed type		lbs in mix	lbs/acre
G	Big Bluegrass 'Sherman'	50	0.33
G	Canby Bluegrass 'Canbar'	50	0.33
G	Bluebunch WG 'Goldar'	300	2.00
G	Slender Wheatgrass 'San Luis'	150	1.00
G	Indian Ricegrass 'Rimrock'	150	1.00
G	Mountain Brome	150	1.00
G	Sheep Fescue	50	0.33
F	Alfalfa 'Ladak'	150	1.00
F	Palmer Penstemon	15	0.10
F	Sainfoin 'Eski'	300	2.00
F	Forage Kochia	50	0.33
F	Small Burnet 'Delar'	300	2.00
F	Cicer Milkvetch 'Lutana'	150	1.00
F	Blue Flax	75	0.50
F	American Vetch	30	0.20
Total Pounds:		1970	13.13
PLS Pounds:			12.04

Browse: Mountain big sagebrush is the preferred browse on the site and provided the majority of the browse cover. The mountain big sagebrush is a mature population with good vigor. Decadence of sagebrush was moderately high at the outset of the study but has since been low. Utilization of sagebrush has been mostly moderate over the sample years. Other browse species sampled on the site included rubber rabbitbrush (*Chrysothamnus nauseosus*), stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), broom snakeweed (*Gutierrezia sarothrae*) and gray horsebrush (*Tetradymia canescens*).

Herbaceous Understory: Grasses are not diverse or abundant. Crested wheatgrass (*Agropyron cristatum*) and bottlebrush squirreltail (*Sitanion hystrix*) were the only perennial grass species sampled. Cheatgrass was more abundant prior to treatment, but did not dominate the site. Seeded species were not sampled in 2010. Forbs are diverse but not abundant with annual forbs dominating the site. The annual birdbeak (*Cordylanthus* sp.) is the dominant forb species on the site. Perennial forb cover improved slightly following treatment and Lewis flax (*Linum lewisii*) was the only seeded species sampled. No one perennial species was dominant.

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.1) (Table - Soil Analysis Data). Bare ground cover is extremely high with moderate amount of vegetation and litter providing protective ground cover (Table - Basic Cover). Soil erosion condition was classified as slight in 2006 because of litter and heavy soil movement, flow patterns, pedestalling, and rills. The soil erosion condition was classified as stable in 2009 and 2010.

**Pre vs. Four Years Post Treatment, 2006 vs. 2010**

Browse: Mountain big sagebrush cover decreased from 40% to 36% and density decreased 46% from 24,060 plants/acre to 12,980 plants/acre. The recruitment of young sagebrush plants decreased from 18% to 8% of the population. Decadence of sagebrush decreased from 17% to 2% of the population.

Grasses: The sum of nested frequency of perennial grasses declined 11% and cover decreased from 4% to 3%. The biggest change was from a significant decrease in the nested frequency of crested wheatgrass, which also decreased from 2% cover to less than 1%. Bottlebrush squirreltail cover remained similar at 2%. The nested frequency of cheatgrass declined significantly and cover decreased from 6% to less than 1%.

Forbs: The sum of nested frequency of perennial forbs increased two fold and cover increased to 1%. Perennial forbs are rare on this site. Annual forbs increased substantially in nested frequency and cover increased from less than 1% to 3%. Birdbeak increased significantly in frequency and cover increased from less than 1% to 2%. Lewis flax was the only seeded species sampled, but provided less than 1% cover.

**HERBACEOUS TRENDS--**

Management unit 14R, Study no: 16

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	<sub>b</sub> 81	<sub>a</sub> 41	2.25	.85
G	Bromus tectorum (a)	<sub>b</sub> 262	<sub>a</sub> 62	6.33	.19
G	Sitanion hystrix	96	117	1.97	2.10
G	Vulpia octoflora (a)	1	-	.00	-
Total for Annual Grasses		263	62	6.33	0.19
Total for Perennial Grasses		177	158	4.23	2.95
Total for Grasses		440	220	10.57	3.15
F	Arabis sp.	1	3	.00	.00
F	Aster sp.	-	-	-	.15
F	Astragalus convallarius	-	1	-	.15
F	Calochortus nuttallii	1	5	.00	.01
F	Cordylanthus sp. (a)	<sub>a</sub> 12	<sub>b</sub> 130	.09	1.88
F	Descurainia pinnata (a)	3	-	.00	-
F	Erigeron bellidialstrm (a)	6	-	.04	-
F	Eriogonum racemosum	3	1	.03	.03
F	Grindelia squarrosa	-	4	-	.18
F	Heterotheca villosa	3	-	.03	-
F	Hymenoxys acaulis	-	1	-	.03
F	Linum lewisii	<sub>a</sub> -	<sub>b</sub> 19	-	.46
F	Machaeranthera grindelioides	-	3	-	.00
F	Microsteris gracilis (a)	-	5	-	.01
F	Penstemon sp.	16	13	.11	.18
F	Phlox longifolia	<sub>a</sub> 12	<sub>b</sub> 34	.03	.19

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	<i>Polygonum douglasii</i> (a)	<sub>a</sub> 4	<sub>b</sub> 184	.00	.66
F	<i>Ranunculus testiculatus</i> (a)	-	5	-	.01
F	<i>Senecio multilobatus</i>	1	-	.00	-
F	<i>Sphaeralcea coccinea</i>	1	5	.00	.01
F	<i>Tragopogon dubius</i> (a)	-	3	-	.03
Total for Annual Forbs		25	327	0.14	2.59
Total for Perennial Forbs		38	89	0.22	1.41
Total for Forbs		63	416	0.36	4.01

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 14R, Study no: 16

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	<i>Artemisia tridentata vaseyana</i>	100	100	30.22	31.62
B	<i>Chrysothamnus nauseosus</i>	2	3	.53	.03
B	<i>Chrysothamnus viscidiflorus stenophyllus</i>	7	9	.09	.83
B	<i>Gutierrezia sarothrae</i>	28	9	.67	.23
B	<i>Opuntia</i> sp.	2	2	-	-
B	<i>Tetradymia canescens</i>	0	2	-	.04
Total for Browse		139	125	31.52	32.77

#### CANOPY COVER, LINE INTERCEPT--

Management unit 14R, Study no: 16

Species	Percent Cover	
	'06	'10
<i>Artemisia tridentata vaseyana</i>	40.04	36.08
<i>Chrysothamnus nauseosus</i>	.68	.30
<i>Chrysothamnus viscidiflorus stenophyllus</i>	-	.11
<i>Gutierrezia sarothrae</i>	.45	.06
<i>Tetradymia canescens</i>	-	.03

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 14R, Study no: 16

Species	Average leader growth (in)	
	'06	'10
<i>Artemisia tridentata vaseyana</i>	0.6	1.4

BASIC COVER--

Management unit 14R, Study no: 16

Cover Type	Average Cover %	
	'06	'10
Vegetation	35.42	39.30
Rock	.49	.01
Pavement	.23	.01
Litter	20.50	35.26
Cryptogams	.91	.00
Bare Ground	53.70	44.54

SOIL ANALYSIS DATA --

Management unit 14R, Study no: 16, Study Name: Harvey John Mesa

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
10.9	7.1	36.2	44.0	19.8	1.3	22.7	112.0	0.5

PELLET GROUP DATA--

Management unit 14R, Study no: 16

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	50	2	-	-
Horse	5	-	7 (17)	2 (4)
Elk	1	-	11 (28)	1 (3)
Deer	6	2	11 (28)	4 (10)

BROWSE CHARACTERISTICS--

Management unit 14R, Study no: 16

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
<i>Artemisia tridentata vaseyana</i>										
06	<b>24060</b>	18	65	17	60	.74	19	6	14/27	
10	<b>12980</b>	8	91	2	640	43	20	1	14/25	
<i>Chrysothamnus nauseosus</i>										
06	<b>60</b>	0	0	100	-	0	0	100	45/53	
10	<b>60</b>	67	33	0	-	0	0	0	19/25	
<i>Chrysothamnus viscidiflorus stenophyllus</i>										
06	<b>280</b>	0	100	-	-	0	71	21	6/8	
10	<b>320</b>	0	100	-	20	0	0	0	5/12	
<i>Gutierrezia sarothrae</i>										
06	<b>880</b>	2	98	-	-	0	0	0	7/10	
10	<b>220</b>	9	91	-	-	0	0	0	7/8	
<i>Opuntia sp.</i>										
06	<b>40</b>	0	50	50	-	0	0	50	2/3	
10	<b>40</b>	0	100	0	-	0	0	0	2/3	

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Tetradymia canescens									
06	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>40</b>	100	0	-	20	0	0	0	-/-

PETER'S CANYON - TREND STUDY NO. 14R-19-10  
[Project #906](#)

Vegetation Type: Pinyon/Juniper, Perennial Grass

Range Type: Crucial Deer Spring/fall

NRCS Ecological Site Description: [Upland Loam \(Basin Big Sagebrush\), R035XY306UT](#)

Land Ownership: BLM

Elevation: 6,990 ft. (2,131 m)

Aspect: Southeast

Slope: 2%

Transect bearing: 299° magnetic

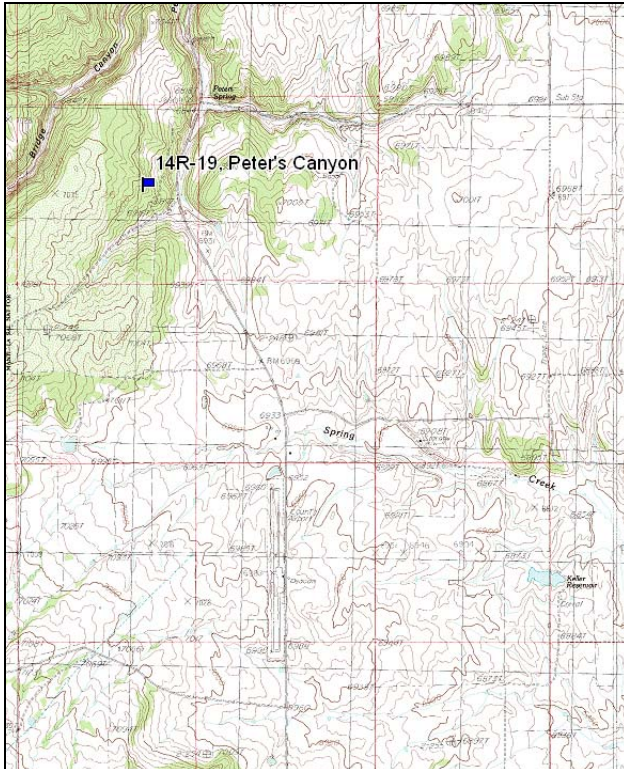
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

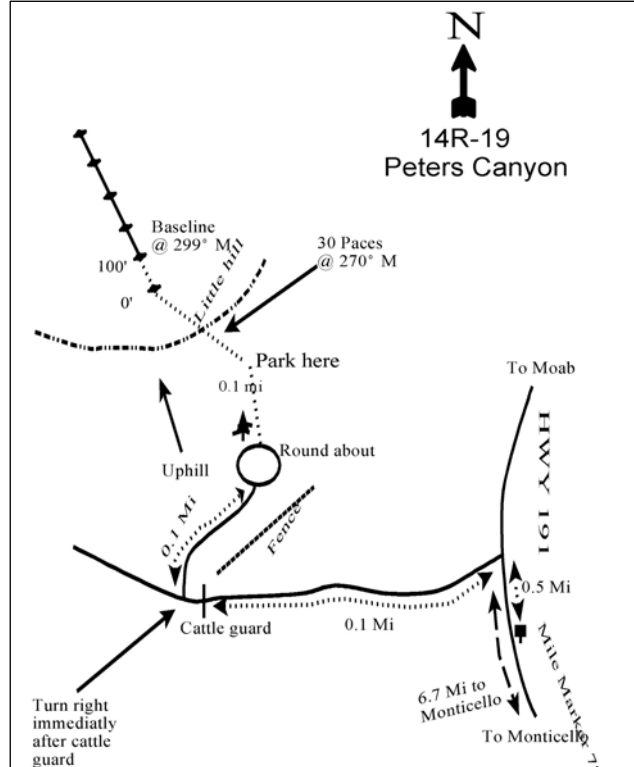
On US 191 travel north from Monticello for about 6.7 miles to mile marker 78. Continue 0.5 miles to a road that comes in from the left. Turn here and follow this road 0.1 miles to a cattle guard, immediately afterward there will be a road that comes in from the right. Turn here and travel north 0.1 miles to a round about. The 0-foot stake is 57 paces at 304 degrees magnetic from an old dead Pinion on the northwest part of the round about or 0.1 miles from the northwest corner of the roundabout from the new witness post 30 paces at 270 degrees magnetic.

Map Name: Monticello North



Township: 32S Range: 23E Section: 26

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 643989 E 4203465 N

PETER'S CANYON - WRI STUDY 14R-19  
[Project #906](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a fuels reduction project approximately seven miles northwest of Monticello. Following years of grazing management and fire suppression pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) encroachment and growth created a closed canopy system that reduced the herbaceous understory. After an extended drought, an infestation of bark beetles (*Ips sp.*) killed 40% of the pinyon pine in the area. The area was hand thinned and bullhogged in the fall of 2006 prior to the placement of this study, then the understory was burned and broadcast seeded in fall of 2007 to improve 158 acres of land administered by the Bureau of Land Management (BLM) (WRI Database 2011). Pellet group data estimated light use by cattle, elk and deer in both 2007 and 2010. Rabbit abundance was estimated high in 2007 (Table - Pellet Group Data).

SEED MIX--

Management unit 14R, Study no: 19

Project Name: Peter's Canyon			
WRI Database #: 906			
Application: Broadcast Seeder		Acres: 170	
Seed type		lbs in mix	lbs/acre
G	Blue Grama	200	1.18
G	Canby Bluegrass 'Canbar'	150	0.88
G	Indian Ricegrass 'Rimrock'	300	1.76
G	Sand Dropseed	50	0.29
G	Siberian Wheatgrass 'Vavilov'	350	2.06
G	Thickspike Wheatgrass 'Bannock'	250	1.47
G	Sandberg Bluegrass	100	0.59
B	Bitterbrush	50	0.29
B	Fourwing Saltbush	50	0.29
Total Pounds:		1500	8.82
PLS Pounds:			7.42

Browse: The preferred browse component is sparse, and is dominated by pinyon pine and Utah juniper. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) is the most common preferred browse species on the site, although the population density is very low. Poor vigor and decadence of sagebrush is high. Recruitment of young sagebrush plants has been good over the sample years. Utilization has been mostly light. Other species samples on the site include broom snakeweed (*Gutierrezia sarothrae*), pricklypear cactus (*Opuntia sp.*), and Stansbury cliffrose (*Cowania mexicana* spp. *stansburiana*) (Table - Browse Characteristics). Pinyon pine and Utah juniper has provided the majority of the cover since the outset of the study (Table - Canopy Cover).

Herbaceous Understory: The herbaceous understory is diverse and grasses improved following the treatment. Grasses are abundant and fairly diverse. Bottlebrush squirreltail (*Sitanion hystrix*) and mutton bluegrass (*Poa fendleriana*) are the dominant perennial grass species. Cheatgrass (*Bromus tectorum*) has been fairly abundant since the outset of the study. Seeded species sampled after the treatment were Siberian wheatgrass (*Agropyron fragile*), thickspike wheatgrass (*A. dasystachyum*), blue grama (*Bouteloua gracilis*) Indian ricegrass (*Oryzopsis hymenoides*), and Sandberg bluegrass (*Poa secunda*), though Sandberg bluegrass, Indian ricegrass, and blue grama were present before the seeding. Forbs are diverse but are not very abundant. Perennial forb species are rare, although diverse, while annual forbs are more common. The weedy annual species annual stickseed

(*Lappula occidentalis*) and pinnate tansymustard (*Descurainia pinnata*) are the most common forb species on the site (Table - Herbaceous Trends)

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is moderate with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

**Pre vs. Three Years Post Treatment Assessment, 2007 vs. 2010**

Browse: The area was already hand thinned and bullhogged before the study was read in 2007, but the seed mix and understory burn were applied after the 2007 monitoring. Wyoming big sagebrush density increased 86% from 140 plants/acre to 260 plants/acre, though cover remained extremely low. Utah juniper density decreased from 60 trees/acre to 50 trees/acre and cover decreased from 10% to 8%. Pinyon pine density was essentially unchanged at 42 trees/acre and cover remained similar at 9%. Some litter from trees treated nearby was visible in 2010.

Grasses: The nested frequency of perennial grasses increased 17% and cover increased from 7% to 14%. The majority of the increase in perennial grass cover was due to bottlebrush squirreltail which increased in the cover of from 4% to 8% and significant increase in nested frequency. Mutton bluegrass (*Poa fendleriana*) maintained 3% cover. Two species, Siberian wheatgrass and thickspike wheatgrass, were sampled for the first time. The nested frequency of cheatgrass decreased significantly and cover decreased from 8% to 6%.

Forbs: The nested frequency of perennial forbs decreased significantly (59%) and cover decreased slightly from 2% to 1%. No one perennial species is especially abundant.

HERBACEOUS TRENDS--  
Management unit 14R, Study no: 19

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron dasystachyum	a-	b10	-	.07
G	Agropyron fragile	-	3	-	.21
G	Bouteloua gracilis	11	11	.10	.71
G	Bromus tectorum (a)	b262	a216	8.19	5.53
G	Carex sp.	b13	a-	.03	-
G	Koeleria cristata	7	-	.04	-
G	Oryzopsis hymenoides	a13	b23	.17	1.12
G	Poa fendleriana	b83	a56	2.81	2.73
G	Poa secunda	7	17	.04	.25
G	Sitanion hystrix	a115	b170	3.83	8.30
G	Stipa comata	2	3	.15	.18
G	Vulpia octoflora (a)	5	-	.03	-
Total for Annual Grasses		267	216	8.22	5.53
Total for Perennial Grasses		251	293	7.18	13.58
Total for Grasses		518	509	15.40	19.12
F	Arabis sp.	1	-	.00	-
F	Astragalus sp.	1	3	.15	.03
F	Castilleja sp.	4	-	.01	-
F	Chaenactis douglasii	4	-	.01	-
F	Chenopodium fremontii (a)	a7	b27	.01	.07



Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
F	Cirsium sp.	-	5	.00	.33
F	Cryptantha sp.	<sub>a</sub> 3	<sub>b</sub> 8	.03	.13
F	Descurainia pinnata (a)	<sub>b</sub> 77	<sub>a</sub> 13	3.11	.61
F	Draba sp. (a)	<sub>b</sub> 21	<sub>a</sub> 4	.07	.00
F	Erigeron pumilus	7	9	.05	.56
F	Erodium cicutarium (a)	8	-	.04	-
F	Erysimum sp.	5	-	.01	-
F	Gayophytum ramosissimum(a)	1	1	.00	.00
F	Gilia sp. (a)	18	11	.14	.40
F	Halogeton glomeratus (a)	1	-	.00	-
F	Haplopappus acaulis	5	-	.03	-
F	Ipomopsis aggregata	10	-	.09	-
F	Lactuca serriola (a)	-	3	-	.03
F	Lappula occidentalis (a)	64	44	.52	.87
F	Lesquerella sp.	1	-	.15	-
F	Leucelene ericoides	11	-	.33	-
F	Linum lewisii	3	-	.00	-
F	Machaeranthera grindelioides	-	2	-	.03
F	Microsteris gracilis (a)	<sub>b</sub> 41	<sub>a</sub> 3	.08	.00
F	Pedicularis centranthera	<sub>b</sub> 17	<sub>a</sub> -	.42	-
F	Penstemon cyanocaulis	4	4	.10	.18
F	Petradoria pumila	9	3	.18	.00
F	Phlox hoodii	1	-	.00	-
F	Phlox longifolia	<sub>b</sub> 44	<sub>a</sub> 14	.14	.07
F	Polygonum douglasii (a)	<sub>a</sub> 6	<sub>b</sub> 15	.01	.06
F	Ranunculus testiculatus (a)	<sub>b</sub> 26	<sub>a</sub> 3	.05	.00
F	Salsola iberica (a)	<sub>a</sub> -	<sub>b</sub> 20	-	.20
F	Senecio multilobatus	1	-	.00	-
F	Trifolium sp.	11	10	.02	.05
Total for Annual Forbs		270	144	4.07	2.28
Total for Perennial Forbs		142	58	1.78	1.40
Total for Forbs		412	202	5.85	3.68

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 14R, Study no: 19

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia tridentata wyomingensis	6	9	.18	.06
B	Gutierrezia sarothrae	44	27	.66	.92
B	Juniperus osteosperma	5	4	-	1.00
B	Opuntia sp.	11	5	.30	.33
B	Pinus edulis	5	3	2.23	2.55
Total for Browse		71	48	3.38	4.88

CANOPY COVER, LINE INTERCEPT--

Management unit 14R, Study no: 19

Species	Percent Cover	
	'07	'10
Artemisia tridentata wyomingensis	.20	.18
Gutierrezia sarothrae	2.01	.90
Juniperus osteosperma	10.00	8.21
Opuntia sp.	.01	.06
Pinus edulis	9.38	8.78

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 14R, Study no: 19

Species	Average leader growth (in)	
	'07	'10
Artemisia tridentata wyomingensis	1.8	1.8

POINT-QUARTER TREE DATA--

Management unit 14R, Study no: 19

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	60	50	10	10.1
Pinus edulis	44	42	6.1	5.7

BASIC COVER--

Management unit 14R, Study no: 19

Cover Type	Average Cover %	
	'07	'10
Vegetation	24.65	26.52
Rock	2.01	2.05
Pavement	.39	.66
Litter	61.54	55.84
Cryptogams	.93	.07
Bare Ground	16.95	24.85

SOIL ANALYSIS DATA --

Management unit 14R, Study no: 19, Study Name: Peters Canyon

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.2	38.2	35.0	26.8	2.5	8.7	112.0	0.6

PELLET GROUP DATA--

Management unit 14R, Study no: 19

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	71	2	-	-
Elk	1	4	7 (17)	7 (17)
Deer	5	6	5 (12)	3 (7)
Cattle	1	1	2 (4)	7 (16)

BROWSE CHARACTERISTICS--

Management unit 14R, Study no: 19

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia tridentata wyomingensis</i>									
07	<b>140</b>	29	43	29	200	29	0	29	21/32
10	<b>260</b>	15	54	31	-	0	0	31	16/23
<i>Cowania mexicana stansburiana</i>									
07	<b>0</b>	0	0	-	-	0	0	0	26/42
10	<b>0</b>	0	0	-	-	0	0	0	17/41
<i>Echinocereus triglochidatus</i>									
07	<b>0</b>	0	0	-	-	0	0	0	2/15
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Gutierrezia sarothrae</i>									
07	<b>3480</b>	32	66	2	2200	0	0	1	9/11
10	<b>1300</b>	15	83	2	20	0	0	2	7/9
<i>Juniperus osteosperma</i>									
07	<b>100</b>	0	100	-	40	0	0	0	-/-
10	<b>80</b>	25	75	-	-	0	0	0	-/-
<i>Opuntia sp.</i>									
07	<b>340</b>	12	82	6	-	0	0	6	4/14
10	<b>140</b>	14	86	0	-	0	0	0	5/10
<i>Pinus edulis</i>									
07	<b>140</b>	29	71	-	20	0	0	0	-/-
10	<b>60</b>	33	67	-	20	0	0	0	-/-
<i>Yucca sp.</i>									
07	<b>0</b>	0	0	-	-	0	0	0	32/69
10	<b>0</b>	0	0	-	-	0	0	0	33/34

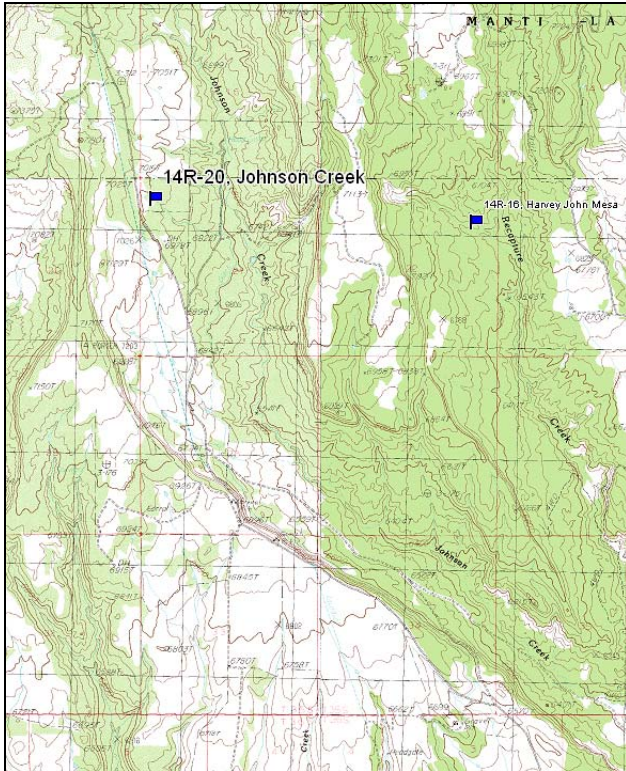
JOHNSON CREEK - TREND STUDY NO. 14R-20-10  
[Project #905](#)

Vegetation Type: Pinyon/Juniper, Mountain Brush  
Range Type: Crucial Deer Summer, Crucial Elk Winter  
NRCS Ecological Site Description: [Upland Loam \(Basin Big Sagebrush\), R035XY306UT](#)  
Land Ownership: BLM  
Elevation: 7,000 ft. (2,134 m)  
Aspect: Southeast  
Slope: 7%  
Transect bearing: 135° magnetic  
Belt placement: line 1 (34ft & 71ft), line 2 (11ft), line 3 (95ft), line 4 (59ft)

Directions:

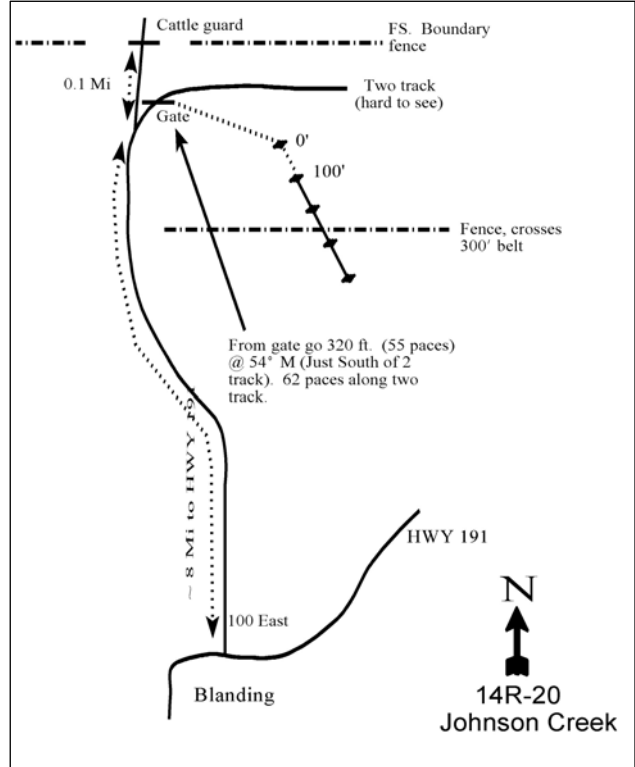
Travel south on Highway 191 to 100 east in Blanding. Turn right here traveling north about 8 miles to a cattle guard. There is a turn off to the right 0.1 miles before reaching the cattle guard. Turn right here coming to a gate, and a 2 track after the gate. From the gate go 320 ft (55 paces) at 46 degrees magnetic to the 0-foot stake just south of the 2 track that is marked with browse tag #181.

Map Name: Mancos Jim Butte



Township: 35S Range: 22E Section: 21

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 630589 E 4176433 N

JOHNSON CREEK - WRI STUDY 14R-20  
[Project #905](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a fuels reduction project approximately seven and a half miles northwest of Blanding. Following years of grazing management and fire suppression pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) encroachment and growth created a closed canopy system that reduced the herbaceous understory. Following an extended drought, an infestation of bark beetles (*Ips sp.*) killed 40% of the pinyon pine in the area. The pinyon pine and Utah juniper treatment was thinned by hand, slash was burned and the area was broadcast seeded using an ATV and harrow. A total of 300 acres were treated to decrease hazardous fuels, increase shrub and herbaceous components and diversify the age of trees within the area (WRI Database 2011). Pellet group data estimated light deer and elk use in 2007 and 2010 and moderate cattle use in 2007 and low cattle use in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 14R, Study no: 20

Project Name: Johnson Creek		
WRI Database #: 905		
Application: Broadcast Seeder	Acres:	326
Seed type	lbs in mix	lbs/acre
G Canby Bluegrass 'Canbar'	400	1.23
G Indian Ricegrass 'Rimrock'	350	1.07
G Sand Dropseed	150	0.46
G Sandberg Bluegrass	350	1.07
G Siberian Wheatgrass 'Vavilov'	800	2.45
G Thickspike Wheatgrass 'Bannock'	550	1.69
G Western Wheatgrass 'Arriba'	400	1.23
F Palmer Penstemon	50	0.15
Total Pounds:	3050	9.36
PLS Pounds:		8.23

Browse: Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), Utah serviceberry (*Amelanchier utahensis*), and Gambel oak (*Quercus gambelii*) are the preferred browse species on the site. The Wyoming big sagebrush is a relatively small population with good vigor and low decadence, although decadence and poor vigor was extremely high in 2007. The recruitment of young sagebrush to the population has been good over the sample years, though recruitment was poor in 2007. Utilization of sagebrush has been light to moderate with moderately heavy use at the outset of the study. Utilization of other preferred browse has been mostly light (Table - Browse Characteristics). Pinyon pine and Utah juniper provided most of the canopy cover in all sample years, though cover was greatly reduced in 2010 (Table - Canopy Cover).

Herbaceous Understory: Grasses are relatively diverse and moderately abundant, although perennial grasses are not very abundant. Cheatgrass (*Bromus tectorum*) is the dominant grass species and provides the majority of the cover. Bottlebrush squirreltail (*Sitanion hystrix*) is the most common perennial grass. Seeded species sampled on the site include Siberian wheatgrass (*Agropyron fragile*), thickspike wheatgrass (*A. dasystachyum*), western wheatgrass (*A. smithii*), Sandberg bluegrass (*Poa secunda*), and Canby bluegrass (*P. canbyi*). Forbs are diverse and moderately abundant. The dominant forb is silvery lupine (*Lupinus argenteus*) which accounted for the majority of forb cover. A variety of annual forb species are found on the site, though many have significantly decreased in frequency and cover since the treatment. Bur buttercup (*Ranunculus testiculatus*) is the most common annual forb (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a slightly acidic soil reaction (pH 6.2) (Table - Soil Analysis Data). Bare ground cover is low with high amount of litter and vegetation providing protective ground cover. Bare ground cover was much higher before the treatment (Table - Basic Cover). The soil erosion condition was classified as stable in 2007 and slight in 2010 due to surface litter movement, rills, and gully formation.

**Pre vs. Three Years Post Treatment Assessment, 2007 vs. 2010**

Browse: Following the treatment none of the preferred browse species provided more than 2% cover. Utah serviceberry cover was reduced from 4% to 2% and density decreased 13% from 320 plants/acre to 280 plants/acre. Recruitment of young serviceberry was good in both sample years at 24% and 36% in 2007 and 2010, respectively. Individuals displaying heavy use remained similar at 36%. Wyoming big sagebrush cover increased from less than 1% to 2% but density remained at 700 plants/acre. The recruitment of young sagebrush plants increased from 6% to 20% and decadence decreased from 77% to 0% of the population. Seedlings were also common in the 2010 sample. Gambel oak cover remained at 2%, although recruitment of young oak plants increased from 39% to 53% of the population. Utah juniper and pinyon pine densities were effectively reduced from 102 trees/acre to 18 trees/acre and 431 trees/acre to 44 trees/acre, respectively.

Grasses: Perennial grasses occurred infrequently prior to treatment and cover was at 1%, following treatment there was a 43% increase in nested frequency and cover increased to 4%. Only bottlebrush squirreltail approached 1% cover in any sample year. Bromus tectorum dominants the understory and increased substantially in frequency and cover increased from 3% to 18%. Thickspike wheatgrass, Siberian wheatgrass, Sandberg bluegrass, Canby bluegrass and western wheatgrass, were seeded species that were sampled.

Forbs: The nested frequency of perennial forbs increased slightly and cover increased significantly from 4% to 15%. The majority of forb cover was from silvery lupine at 4% prior to treatment and 13% following. Forbs were diverse but no other forb species approached 1% cover. The sum of nested frequency annual forbs decreased significantly and cover decreased from 4% to 1%. No seeded species were sampled.

**HERBACEOUS TRENDS--**

Management unit 14R, Study no: 20

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron dasystachyum	a-	b19	-	.45
G	Agropyron fragile	a-	b21	-	.58
G	Agropyron smithii	-	5	-	.03
G	Bouteloua gracilis	10	6	.04	.22
G	Bromus tectorum (a)	a257	b378	3.07	18.28
G	Carex sp.	-	-	.00	-
G	Oryzopsis hymenoides	9	4	.16	.18
G	Poa canbyi	-	7	-	.53
G	Poa pratensis	3	3	.04	.06
G	Poa secunda	b44	a14	.84	.48
G	Sitanion hystrix	a23	b48	.07	.98
G	Vulpia octoflora (a)	b154	a-	.88	-
Total for Annual Grasses		411	378	3.96	18.28
Total for Perennial Grasses		89	127	1.17	3.54
Total for Grasses		500	505	5.13	21.82
F	Allium sp.	-	3	-	.00
F	Arabis sp.	b16	a-	.04	-

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
F	<i>Astragalus convallarius</i>	20	9	.24	.39
F	<i>Astragalus</i> sp.	3	13	.00	.34
F	<i>Calochortus nuttallii</i>	2	-	.00	-
F	<i>Chenopodium fremontii</i> (a)	-	6	-	.02
F	<i>Cirsium</i> sp.	-	3	-	.15
F	<i>Collinsia parviflora</i> (a)	<sub>b</sub> 131	<sub>a</sub> 5	.63	.06
F	<i>Comandra pallida</i>	-	2	-	.01
F	<i>Cryptantha</i> sp.	<sub>b</sub> 14	<sub>a</sub> 7	.04	.33
F	<i>Descurainia pinnata</i> (a)	14	6	.05	.01
F	<i>Draba</i> sp. (a)	<sub>b</sub> 151	<sub>a</sub> -	.36	-
F	<i>Erigeron</i> sp.	-	3	-	.04
F	<i>Eriogonum racemosum</i>	1	6	.00	.03
F	<i>Eriogonum</i> sp.	-	4	-	.03
F	<i>Erodium cicutarium</i> (a)	3	3	.00	.04
F	<i>Gayophytum ramosissimum</i> (a)	-	7	-	.04
F	<i>Gilia</i> sp. (a)	2	13	.00	.07
F	<i>Holosteum umbellatum</i> (a)	1	7	.00	.13
F	<i>Lactuca serriola</i> (a)	-	9	-	.02
F	<i>Lappula occidentalis</i> (a)	<sub>a</sub> 14	<sub>b</sub> 29	.03	.32
F	<i>Lupinus argenteus</i>	68	81	3.57	12.67
F	<i>Machaeranthera grindelioides</i>	-	5	-	.03
F	<i>Microsteris gracilis</i> (a)	-	13	-	.04
F	<i>Pedicularis centranthera</i>	<sub>b</sub> 14	<sub>a</sub> -	.50	-
F	<i>Penstemon</i> sp.	5	3	.04	.04
F	<i>Phlox longifolia</i>	10	5	.02	.04
F	<i>Polygonum douglasii</i> (a)	<sub>a</sub> 9	<sub>b</sub> 28	.02	.14
F	<i>Ranunculus testiculatus</i> (a)	<sub>b</sub> 240	<sub>a</sub> 43	2.64	.36
F	<i>Salsola iberica</i> (a)	2	-	.00	-
F	<i>Schoenocrambe linifolia</i>	-	-	-	.03
F	<i>Tragopogon dubius</i> (a)	1	-	.00	-
F	<i>Verbascum thapsus</i>	<sub>a</sub> -	<sub>b</sub> 22	-	.49
Total for Annual Forbs		568	169	3.77	1.27
Total for Perennial Forbs		153	166	4.47	14.65
Total for Forbs		721	335	8.25	15.93

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 14R, Study no: 20

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Amelanchier utahensis	12	9	2.60	.98
B	Artemisia tridentata wyomingensis	27	20	1.05	3.23
B	Juniperus osteosperma	15	6	3.92	.03
B	Opuntia fragilis	5	3	.01	-
B	Pediocactus simpsonii	0	2	-	-
B	Pinus edulis	17	3	5.07	.71
B	Quercus gambelii	4	3	.63	.88
Total for Browse		80	46	13.31	5.83

CANOPY COVER, LINE INTERCEPT--

Management unit 14R, Study no: 20

Species	Percent Cover	
	'07	'10
Amelanchier utahensis	3.91	1.78
Artemisia tridentata wyomingensis	.56	1.75
Juniperus osteosperma	15.86	3.01
Opuntia fragilis	.03	.10
Pinus edulis	25.96	6.13
Quercus gambelii	2.01	1.78

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 14R, Study no: 20

Species	Average leader growth (in)	
	'07	'10
Amelanchier utahensis	2.3	4.3
Artemisia tridentata wyomingensis	2.7	2.0

POINT-QUARTER TREE DATA--

Management unit 14R, Study no: 20

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	102	18	6.9	2.8
Pinus edulis	431	44	2.1	4.6



BASIC COVER--

Management unit 14R, Study no: 20

Cover Type	Average Cover %	
	'07	'10
Vegetation	24.34	41.50
Rock	.00	0
Pavement	.05	0
Litter	55.96	60.87
Cryptogams	3.76	0
Bare Ground	28.78	15.49

SOIL ANALYSIS DATA --

Management unit 14R, Study no: 20, Study Name: Johnson Creek

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	6.2	42.2	40.0	17.8	2.2	9.9	115.2	0.5

PELLET GROUP DATA--

Management unit 14R, Study no: 20

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	82	2	-	-
Elk	1	1	1 (2)	2 (5)
Deer	1	5	11 (28)	9 (22)
Cattle	9	5	28 (68)	11 (27)

BROWSE CHARACTERISTICS--

Management unit 14R, Study no: 20

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<b>Amelanchier utahensis</b>									
07	<b>320</b>	25	69	6	60	0	38	0	60/68
10	<b>280</b>	36	64	0	-	29	36	0	48/53
<b>Artemisia tridentata wyomingensis</b>									
07	<b>700</b>	6	17	77	200	54	23	69	19/26
10	<b>700</b>	20	80	0	3020	29	11	0	19/26
<b>Juniperus osteosperma</b>									
07	<b>320</b>	25	75	-	-	0	0	6	-/-
10	<b>120</b>	83	17	-	-	0	0	0	-/-
<b>Opuntia fragilis</b>									
07	<b>160</b>	50	25	25	-	0	0	38	3/13
10	<b>60</b>	0	100	0	-	0	0	33	3/8
<b>Pediocactus simpsonii</b>									
07	<b>0</b>	0	0	-	-	0	0	0	2/4
10	<b>40</b>	100	0	-	-	0	0	0	1/3

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Pinus edulis</i>									
07	<b>460</b>	57	39	4	180	0	0	4	-/-
10	<b>60</b>	67	33	0	40	0	0	0	-/-
<i>Quercus gambelii</i>									
07	<b>660</b>	39	55	6	20	0	0	6	96/64
10	<b>340</b>	53	47	0	-	0	0	0	20/47
<i>Tetradymia canescens</i>									
07	<b>0</b>	0	0	-	-	0	0	0	11/19
10	<b>0</b>	0	0	-	-	0	0	0	-/-

INDIAN SPRINGS - TREND STUDY NO. 15R-3-10

[Project #1662](#)

Vegetation Type: Pinyon/Juniper

Range Type: Crucial Deer Winter, Substantial Elk Year-Long

NRCS Ecological Site Description: [Upland Stony Loam \(Pinyon-Utah Juniper\), R035XY321UT](#)

Land Ownership: BLM

Elevation: 6,474 ft. (1,973 m)

Aspect: Southwest

Slope: 6%

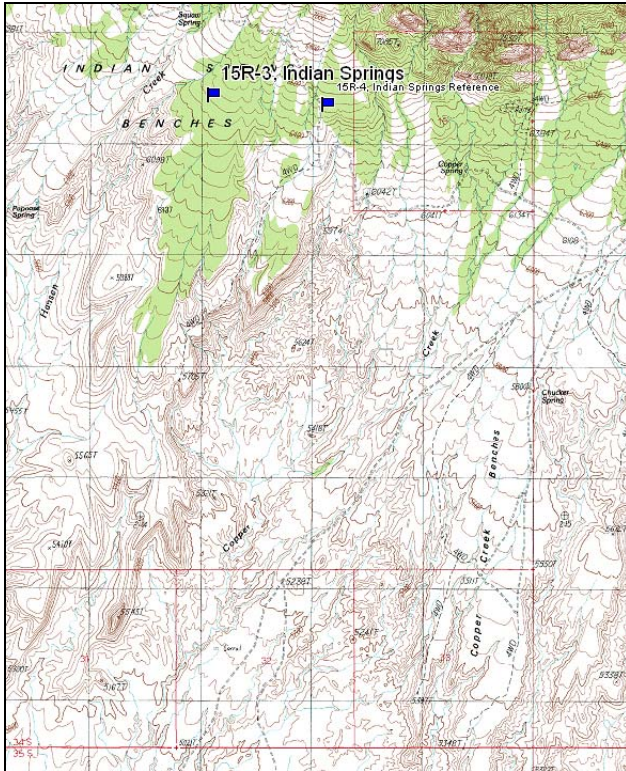
Transect bearing: 207° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

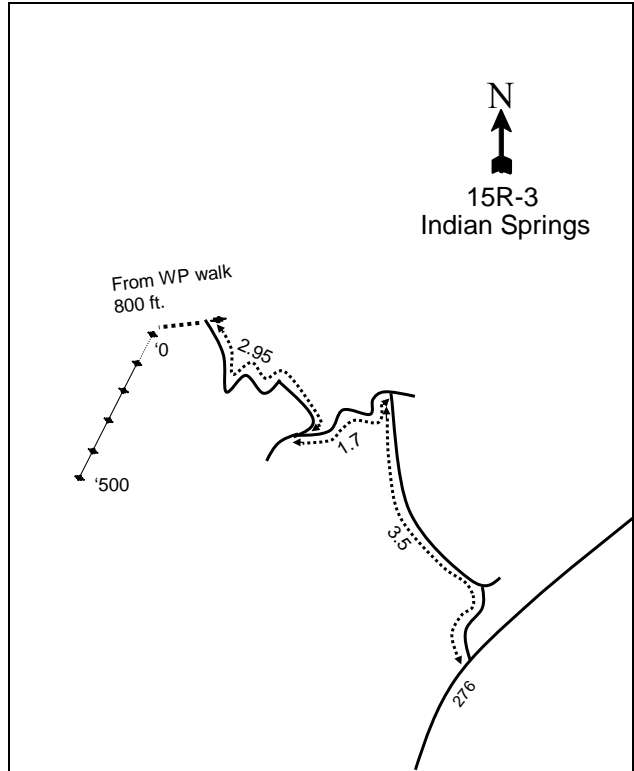
From the Ticaboo turnoff on Highway 95 go 12.5 miles to a turn on the right, toward Starr Springs. Drive 3.5 miles to a sign showing Starr Springs to the right, go left for 1.7 miles to a fork and turn right. Continue for approximately 2.9 miles to a cattle guard. From the cattle guard drive 0.6 miles to a faint road on the south side of the road. Follow this road for 0.35 miles to a witness post on the right. From the witness post take 158 paces at 258°M. The UTM's for the witness post are 12S 524238 E 4189586 N.

Map Name: Copper Creek Benches



Township: 34S Range: 11E Section: Unsurveyed

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 523999 E 4189585 N

INDIAN SPRINGS - WRI STUDY 15R-3

[Project # 1662](#)

**Site Description**

Site Information: The study is located in a bullhog treatment area approximately six and a half miles Northwest of Ticaboo on Indian Spring Benches on the south end of the Henry Mountains. The study was established in 2010 prior to the bullhog treatment of 987 acres Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodland. The site is referenced by Indian Springs Reference (15R-4) study. The proposed project will use a bullhog to thin encroaching pinyon pine and Utah juniper. Strips and patches will be left for habitat for wildlife, nesting birds, and aesthetics. Prior to the treatment a proposed mixture of grasses and forbs will be aerially applied. The proposed treatment would help to reduce competition between livestock and big game by enhancing ecological diversity and improving forage conditions. The reduction of trees will also allow more understory plants to grow, producing beneficial impacts to woodland health, wildlife habitat, rangeland health, and watershed cover (WRI Database 2011). The project was postponed with the possible treatment in the fall of 2011. Utilization of the site was minimal. No pellet groups were sampled on the site in 2010 (Table - Pellet Group Data)

Browse: Preferred browse species are minimal on the site with Utah juniper dominating the site. Slenderbush eriogonum (*Eriogonum microthecum*) mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and green ephedra (*Ephedra viridis*) are the preferred browse species sampled on the site, though populations are really low. Broom snakeweed (*Gutierrezia sarothrae*) was somewhat abundant. Utah juniper provided the majority of the cover on the site.

Herbaceous Understory: Grasses are extremely rare and were not sampled in 2010. Forbs are not diverse or abundant. Perennial forbs are rare and provided little cover in 2010. Annual forb species dominated the site and provided the majority of the forb cover. Birdbeak (*Cordylanthus sp.*) is the most common forb on the site.

Soil: According to NRCS soil maps the soil surface texture is cobbly very fine sandy loam. Bare ground cover is minimal with a high amount of pavement and rock and moderate amount vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

HERBACEOUS TRENDS--

Management unit 15R, Study no: 3

T y P e	Species	Nested Frequency	Average Cover %
		'10	'10
F	Alyssum alyssoides (a)	1	.00
F	Astragalus sp.	7	.02
F	Collinsia parviflora (a)	9	.01
F	Cordylanthus sp. (a)	96	3.21
F	Crepis acuminata	2	.03
F	Cryptantha sp.	39	.41
F	Draba sp. (a)	3	.03
F	Gilia sp. (a)	6	.03
F	Haplopappus acaulis	3	.00
F	Hymenoxys acaulis	28	.33
F	Lappula occidentalis (a)	4	.06
F	Lesquerella sp.	5	.01
F	Streptanthus cordatus	2	.01
Total for Annual Forbs		119	3.36

Type	Species	Nested Frequency	Average Cover %
		'10	'10
Total for Perennial Forbs		86	0.82
Total for Forbs		205	4.18

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 15R, Study no: 3

Type	Species	Strip Frequency	Average Cover %
		'10	'10
B	Artemisia tridentata wyomingensis	1	-
B	Ephedra viridis	3	.88
B	Eriogonum microthecum	9	.03
B	Gutierrezia sarothrae	57	1.16
B	Juniperus osteosperma	15	10.66
B	Opuntia sp.	2	-
B	Pediocactus simpsonii	1	.00
B	Pinus edulis	2	.93
Total for Browse		90	13.68

#### CANOPY COVER, LINE INTERCEPT--

Management unit 15R, Study no: 3

Species	Percent Cover
	'10
Ephedra viridis	.51
Eriogonum microthecum	.06
Gutierrezia sarothrae	1.39
Juniperus osteosperma	26.26
Pinus edulis	1.81

#### POINT-QUARTER TREE DATA--

Management unit 15R, Study no: 3

Species	Trees per Acre	Average diameter (in)
	'10	
Juniperus osteosperma	215	15.9
Pinus edulis	50	4.7

BASIC COVER--

Management unit 15R, Study no: 3

Cover Type	Average Cover % '10
Vegetation	17.54
Rock	17.03
Pavement	42.93
Litter	27.22
Cryptogams	.22
Bare Ground	9.86

BROWSE CHARACTERISTICS--

Management unit 15R, Study no: 3

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata vaseyana</i>									
10	<b>20</b>	0	100	-	-	0	0	0	10/11
<i>Echinocactus sp.</i>									
10	<b>0</b>	0	0	-	-	0	0	0	6/12
<i>Ephedra viridis</i>									
10	<b>60</b>	33	67	-	-	0	0	0	35/45
<i>Eriogonum microthecum</i>									
10	<b>260</b>	31	69	-	-	0	0	0	5/5
<i>Gutierrezia sarothrae</i>									
10	<b>2880</b>	48	37	15	140	5	0	15	6/8
<i>Juniperus osteosperma</i>									
10	<b>320</b>	6	81	13	20	13	0	6	-/-
<i>Opuntia sp.</i>									
10	<b>40</b>	0	50	50	-	0	0	100	4/12
<i>Pediocactus simpsonii</i>									
10	<b>20</b>	0	100	-	-	0	0	0	0/1
<i>Pinus edulis</i>									
10	<b>40</b>	50	50	-	-	0	0	0	-/-

INDIAN SPRINGS REFERENCE - TREND STUDY NO. 15R-4-10  
[Project #1662](#)

Vegetation Type: Pinyon/Juniper

Range Type: Crucial Deer Winter, Substantial Elk Year-Long

NRCS Ecological Site Description: [Upland Stony Loam \(Pinyon-Utah Juniper\), R035XY321UT](#)

Land Ownership: BLM

Elevation: 6,575 ft. (1,973 m)

Aspect: South

Slope: 8%

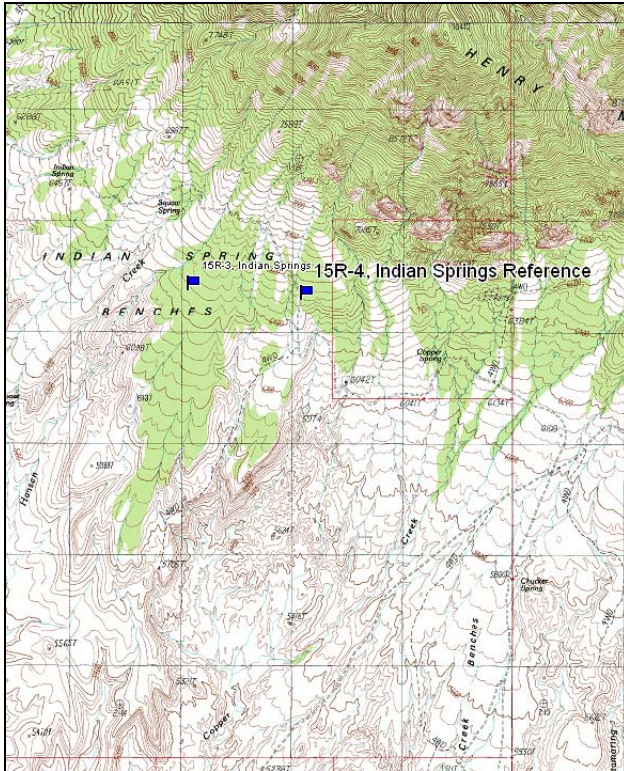
Transect bearing: 354° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

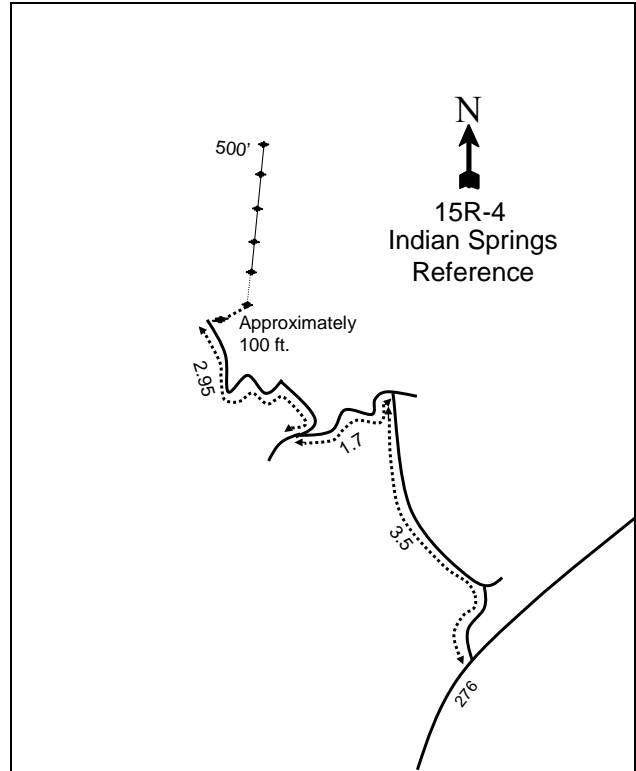
From the Ticaboo turnoff on Highway 95 go 12.5 miles to a turn on the right, toward Starr Springs. Drive 3.5 miles to a sign showing Starr Springs to the right, go left for 1.7 miles to a fork and turn right. Continue for approximately 2.9 miles to a cattle guard. From the cattle guard drive 0.1 miles to a witness post on the right. The driving instructions are missing the degrees and distance to the 0-foot stake.

Map Name: Copper Creek Benches



Township: 34S Range: 11E Section: Unsurveyed

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 525024 E 4189499 N

INDIAN SPRINGS REFERENCE - WRI STUDY 15R-4  
[Project # 1662](#)

**Site Description**

Site Information: The study is located approximately six and a half miles Northwest of Ticaboo on Indian Spring Benches on the south end of the Henry Mountains. The study was established in 2010 prior to the bullhog treatment of 987 acres of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodland. The site is located outside of the proposed treatment area and is the reference site for Indian Springs (15R-3) study (WRI Database 2011). Pellet group data estimated light use by deer in 2010 (Table - Pellet Group Data)

Browse: The preferred browse species on the site is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). The site is dominated by Utah juniper (*Juniperus osteosperma*) which provided the majority of the cover. The mountain big sagebrush is a lightly used mature population with high decadence. Poor vigor of sagebrush is high and recruitment of young sagebrush to the population is poor. Other less common browse species include broom snakeweed (*Gutierrezia sarothrae*), green ephedra (*Ephedra viridis*), and pricklypear cactus (*Opuntia* sp.)

Herbaceous Understory: Grass species are rare and not diverse. The grass component consists of Indian ricegrass (*Oryzopsis hymenoides*), galleta (*Hilaria jamesii*), and bottlebrush squirreltail (*Sitanion hystrix*). Forbs are not overly diverse or abundant. Annual forbs dominate the site with birdbeak (*Cordylanthus* sp.) being the most dominant forb species. Perennial forbs are rare on the site.

Soil: According to NRCS soil maps the soil surface texture is cobbly very fine sandy loam. Bare ground cover is low with a high amount of pavement and rock and moderate amount vegetation and litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

HERBACEOUS TRENDS--

Management unit 15R, Study no: 4

Type	Species	Nested Frequency	Average Cover %
		'10	'10
G	<i>Hilaria jamesii</i>	14	.39
G	<i>Oryzopsis hymenoides</i>	-	.00
G	<i>Sitanion hystrix</i>	8	.12
Total for Annual Grasses		0	0
Total for Perennial Grasses		22	0.51
Total for Grasses		22	0.51
F	<i>Alyssum alyssoides</i> (a)	20	.22
F	<i>Antennaria rosea</i>	11	.02
F	<i>Astragalus</i> sp.	13	.13
F	<i>Calochortus nuttallii</i>	2	.00
F	<i>Chenopodium album</i> (a)	-	.00
F	<i>Collinsia parviflora</i> (a)	12	.07
F	<i>Cordylanthus</i> sp. (a)	191	8.92
F	<i>Cryptantha</i> sp.	16	.10
F	<i>Draba</i> sp. (a)	6	.03
F	<i>Eriogonum cernuum</i> (a)	14	.07
F	<i>Gilia</i> sp. (a)	18	.10



Type	Species	Nested Frequency	Average Cover %
		'10	'10
F	Hymenoxys acaulis	1	.00
F	Lactuca serriola (a)	3	.00
F	Lappula occidentalis (a)	13	.05
F	Lupinus sp.	6	.01
F	Phlox longifolia	22	.12
F	Streptanthus cordatus	7	.04
Total for Annual Forbs		277	9.50
Total for Perennial Forbs		78	0.44
Total for Forbs		355	9.94

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 15R, Study no: 4

Type	Species	Strip Frequency	Average Cover %
		'10	'10
B	Artemisia tridentata vaseyana	38	1.71
B	Gutierrezia sarothrae	24	.53
B	Juniperus osteosperma	12	12.62
B	Opuntia sp.	2	-
B	Pinus edulis	-	.38
Total for Browse		76	15.24

#### CANOPY COVER, LINE INTERCEPT--

Management unit 15R, Study no: 4

Species	Percent Cover '10
Artemisia tridentata vaseyana	3.31
Gutierrezia sarothrae	.16
Juniperus osteosperma	23.61

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 15R, Study no: 4

Species	Average leader growth (in) '10
Artemisia tridentata vaseyana	2.1

POINT-QUARTER TREE DATA--  
Management unit 15R, Study no: 4

Species	Trees per Acre	Average diameter (in)
	'10	'10
Juniperus osteosperma	209	4.7
Pinus edulis	28	3.9

BASIC COVER--  
Management unit 15R, Study no: 4

Cover Type	Average Cover %
	'10
Vegetation	24.01
Rock	32.56
Pavement	14.39
Litter	34.01
Cryptogams	.06
Bare Ground	14.13

PELLET GROUP DATA--  
Management unit 15R, Study no: 4

Type	Quadrat Frequency	Days use per acre (ha)
	'10	'10
Rabbit	5	-
Deer	-	5 (13)

BROWSE CHARACTERISTICS--  
Management unit 15R, Study no: 4

		Age class distribution			Utilization				
Y	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Artemisia tridentata vaseyana									
10	<b>1200</b>	8	62	30	40	8	12	30	17/24
Ephedra viridis									
10	<b>0</b>	0	0	-	-	0	0	0	20/20
Gutierrezia sarothrae									
10	<b>1000</b>	34	66	-	60	0	0	0	6/9
Juniperus osteosperma									
10	<b>240</b>	8	83	8	20	0	0	8	-/-
Opuntia sp.									
10	<b>60</b>	33	67	-	-	0	0	0	6/16

UPPER PORPHYRY BENCH - TREND STUDY NO. 16R-13-10  
[Project #229](#)

Vegetation Type: Wyoming Big Sagebrush

Range Type: Crucial Deer Winter

NRCS Ecological Site Description: [Upland Loam \(Basin Big Sagebrush\), R047XA308UT](#)

Land Ownership: Private

Elevation: 6,300 ft. (1,920 m)

Aspect: Northwest

Slope: 2%

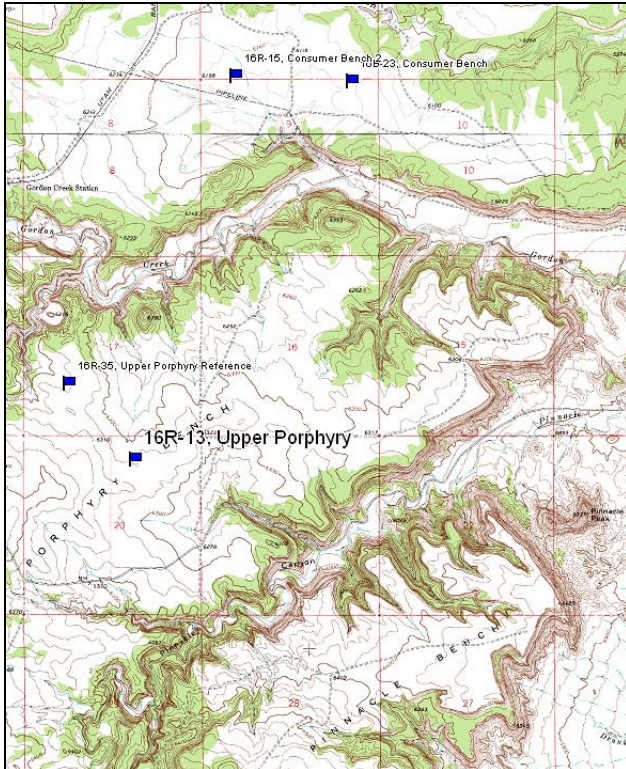
Transect bearing: 249° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95ft)

Directions:

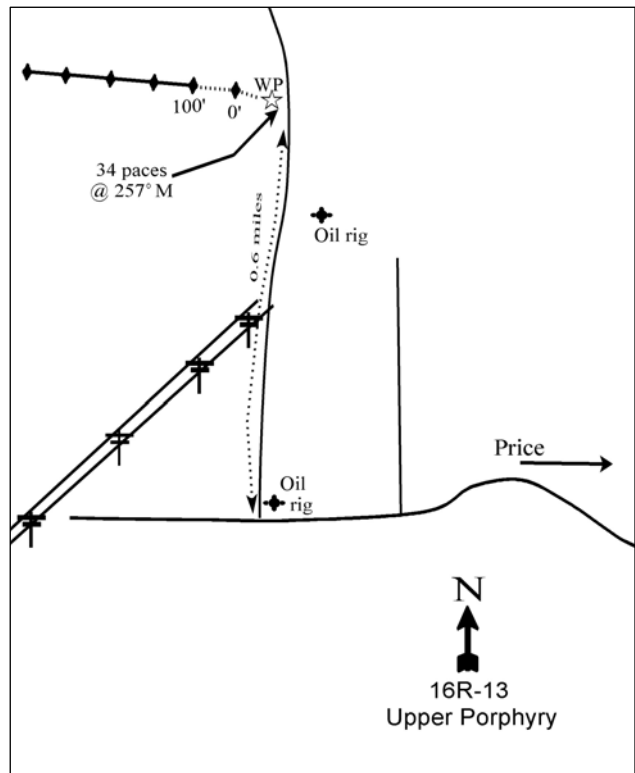
Take Westwood Blvd (1550 W) northwest out of Price 2.35 miles to a major intersection. Turn left onto Gordon Creek Road and travel 0.45 miles to a fork. Bear left away from Gordon Creek, going 0.1 miles to a gravel pit. Continue 5.5 miles on the Pinnacle Peak Road to a 3-way fork at the top of the bench. An oil rig is near this intersection. Take the right fork and drive 0.6 miles to the north past another oil rig, to a witness post on the left side of the road. The 0-foot post is 34 paces from the witness post at 257°M, and is marked with browse tag #51.

Map Name: Pinnacle Peak



Township: 14S Range: 9E Section: 20

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 505484 E 4383157 N

UPPER PORPHYRY BENCH - WRI STUDY 16R-13

[Project #229](#)

**Site Description**

Site Information: The study is located approximately six and a half miles west of Price on Porphyry Bench on private property. The study was established to monitor a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) stand. The site is referenced by Upper Porphyry Reference (16R-35). In spring 2003, approximately 19,000 acres of sagebrush suffered severe die-off and 24,000 acres suffered moderate die-off within a 50 mile radius of Price. Wyoming big sagebrush showed the largest amount of die-off, compared with other sagebrush species and subspecies. This project, the first of several phases, was designed to rehabilitate 1,160 acres of crucial deer winter range and greater sage-grouse habitat on private and Utah Division of Wildlife Resources (UDWR) land. Goals of this project were to treat 50% of dead and decadent sagebrush with a double drum aerator and seed 1,160 acres in fall 2004 to late spring 2005. Seed mixes containing Forage kochia (*Kochia prostrata*), winterfat (*Ceratoides lanata*), fourwing saltbush (*Atriplex canescens*), and Wyoming big sagebrush were aerially applied in December of 2004 and a mixture of forb grass and browse species was drill seeded during the aerator treatment (WRI Database 2011). Pellet group data estimated heavy use by deer in 2004, 2007, 2009, and 2010. Elk use was light in 2007 and 2009. Cattle use was light in 2004, 2007, 2009, and 2010. Horse and sheep use was noted, but minimal, in 2004 and 2009 (Table - Pellet Group Data).

SEED MIX--

Management unit 16R, Study no: 13

Project Name: Porphyry Bench A*				Project Name: Porphyry Bench C1*			
WRI Database #: 229							
Application: Aerial Seed*		Acres:	1160	Application: Drill Seed*		Acres:	410
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix	lbs/acre
B	Forage Kochia 'Immigrant'	865	0.75	G	Crested Wheatgrass 'Douglas'	500	1.22
B	Winterfat	75	0.06	G	Russian Wildrye 'Bozoisky'	880	2.15
Total Pounds:		940	0.81	G	Siberian Wheatgrass 'Vavilov'	450	1.10
PLS Pounds:			0.53	F	Small Burnet 'Delar'	215	0.52
Project name: Porphyry Bench B1*				F Yellow Sweetclover			
Application: Drill seed		Acres:	85	B	Fourwing Saltbush	615	1.50
Seed type		lbs in mix	lbs/acre	Total Pounds:		2885	7.04
B	Sagebrush, Wyoming	75	0.88	PLS Pounds:			5.68
Total Pounds:		75	0.88	Project Name: Porphyry Bench C2*			
PLS Pounds:			0.25	Application: Drill Seed*		Acres:	85
Project name: Porphyry Bench B2*				Seed type		lbs in mix	lbs/acre
Application: Aerial seed*		Acres:	495	G	Great Basin Wildrye 'Trailhead'	90	1.22
Seed type		lbs in mix	lbs/acre	G	Indian Ricegrass 'Rimrock'	85	2.15
B	Sagebrush, Wyoming	440	0.89	G	Sheep Fescue	95	1.10
B	Fourwing Saltbush	128	0.26	G	Western Wheatgrass 'Arriba'	100	0.52
Total Pounds:		568	1.15	F	Blue Flax 'Appar'	9	0.55
PLS Pounds:			0.37	F	Rocky Mountain Beeplant	17	1.50
				B	Fourwing Saltbush	126	0.31
				Total Pounds:		2885	33.94
				PLS Pounds:			5.68

\*Seed mix A and B2 were aerially applied. Seed mix B1, C1, and C2 were drill seeded during the aerator treatment.

Browse: Wyoming big sagebrush is the dominant browse species providing the majority of browse canopy cover. Prior to treatment the Wyoming big sagebrush population was mostly a decadent population with little recruitment and poor vigor. Since the treatment, decadence and poor vigor of sagebrush has steadily decreased and recruitment of young sagebrush has been excellent. Utilization of sagebrush has been mostly light since the outset of the study. Other preferred browse species sampled on the site include Slenderbush eriogonum (*Eriogonum microthecum*), fourwing saltbush, and dwarf rabbitbrush (*Chrysothamnus depressus*). Slenderbush eriogonum occurs in low cover and dwarf rabbitbrush was sampled for the first time in 2009 with moderate canopy cover but was rare in 2010. Forage kochia has been sampled at low density and cover since 2007 (Table - Canopy Cover). Stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) is prevalent on the site (Table - Browse Characteristics).

Herbaceous Understory: Prior to the treatment, three native perennial grasses; Indian ricegrass (*Oryzopsis hymenoides*), bottlebrush squirreltail (*Sitanion hystrix*), and needle-and-thread (*Stipa comata*) were the most common grasses and accounted for the majority of grass cover. Since the treatment grasses have become more abundant and diverse. Crested Wheatgrass (*Agropyron cristatum*) is the dominant grass species on the site and was the most common seeded species. Other common seeded grasses include Siberian wheatgrass (*A. fragile*), western wheatgrass (*A. smithii*), Indian ricegrass (*Oryzopsis hymenoides*) and Russian wildrye (*Elymus junceus*), though Siberian wheatgrass was not sampled in 2010 and western wheatgrass and Indian ricegrass were present before the treatment. The annual species cheatgrass (*Bromus tectorum*) was sampled following the treatment but has remained with low frequency and cover. Forbs are relatively diverse but not overly abundant. Prior to treatment and shortly after, annual forbs dominated the site. Annual forbs have steadily decreased in cover and frequency since 2004. Perennial forbs increased significantly in frequency following the treatment Seeded forbs have not done as well with no seeded forb species sampled. The most common forbs are scarlet globemallow (*Sphaeralcea coccinea*) and Gooseberryleaf globemallow (*S. grossulariifolia*) (Table - Herbaceous Trends).

Soil: The soil texture is a Clay loam with a neutral soil reaction (pH 7.1) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2004 and 2010, but slight in 2007 and 2009 due to pedestalling, flow patterns, and soil movement.

### **Pre vs. Three Years Post Treatment, 2004 vs. 2007**

Browse: Wyoming big sagebrush cover decreased from 6% to 4% and density increased 44% from 2,380 plants/acre to 3,420 plants/acre. The increase in density was primarily due to a large increase in the density of young sagebrush plants from 0% to 37% of the population. Decadence of sagebrush decreased from 96% to 47% and poor vigor decreased from 69% to 30%. Forage kochia was sampled at very low abundance at 60 plants/acre.

Grass: The sum of nested frequency of perennial grasses increased three-fold and cover increased from 1% to 11%. Several seeded species were sampled and included Siberian wheatgrass, crested wheatgrass, western wheatgrass, Indian ricegrass and Russian wildrye. There was a significant increase in the nested frequency of the seeded species crested wheatgrass. Significant increases in nested frequency also occurred for bottlebrush squirreltail, western wheatgrass, and needle-and-thread (*Stipa comata*). Cheatgrass was sampled for the first time at low frequency and cover.

Forb: The sum of nested frequency of perennial forbs increased over two-fold and cover increased from 2% to 3%. There was a slight increase in annual forb sum of nested frequency, but cover decreased from 9% to 5%.

## Trend Assessments

### Browse

- **2007 to 2009 - slightly up (+1):** Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush increased slightly in canopy cover. Dwarf rabbitbrush was sampled for the first time and provided 1% cover. There was a decrease in canopy cover of stickyleaf low rabbitbrush from 4% to 2%.
- **2009 to 2010 - stable (0):** Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush cover decreased slightly from 6% to 5%. Since 2007, there was only a slight increase in density of sagebrush from 3,420 plants/acre to 3,620 plants/acre. In 2010 the recruitment of young sagebrush plants accounted for 43% of the population. Sagebrush decadence and poor vigor have remained high at 27% and 30%, respectively. Dwarf rabbitbrush provided negligible cover and had a density of 160 plants/acre. Slenderbush eriogonum also provided little cover and had an estimated density of 3,760 plants/acre and 89% of which were mature.

### Grasses

- **2007 to 2009 - slightly up (+1):** The sum of nested frequency of perennial grass remained similar and cover increased from 11% to 17%. Cheatgrass decreased significantly in nested frequency and was rare on the site. Crested wheatgrass increased significantly in frequency and cover increased from 1% to 4%. Bottlebrush squirreltail decreased in frequency, though cover increased from 5% to 7%.
- **2009 to 2010 - down (-2):** The sum of nested frequency of perennial grasses decreased 23% and cover decreased slightly to 16%. Crested wheatgrass increased in cover and provided 7% cover. Bottlebrush squirreltail decreased significantly in frequency and cover decreased to 1%. Indian ricegrass increased in cover slightly from 2% to 3%. Western wheatgrass had a significant increase in nested frequency and cover increased from 1% to 2%. Cheatgrass remained rare on the site.

### Forbs

- **2007 to 2009 - slightly down (-1):** The sum of nested frequency of perennial forbs decreased 40% and cover decreased from 3% to 2%. However, the nested frequency of weedy annual species decreased 83% and cover decreased from 5% to 1%.
- **2009 to 2010 - stable (0):** There was little change in the forb community as cover remained at 2% and the sum of nested frequency perennial forbs remained similar. Weedy annual species were rare. Scarlet globemallow is the most common forb and provided 2% cover.

HERBACEOUS TRENDS--

Management unit 16R, Study no: 13

Type	Species	Nested Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
G	Agropyron cristatum	a1	b34	c86	c114	.03	.66	4.17	7.27
G	Agropyron fragile	a-	b51	a3	a-	-	1.38	.01	-
G	Agropyron intermedium	-	-	2	-	-	-	.00	-
G	Agropyron smithii	a9	a17	a13	b51	.16	.61	.48	2.41
G	Bouteloua gracilis	1	8	9	-	.03	.53	.30	-
G	Bromus tectorum (a)	a-	b38	a7	ab13	-	.22	.01	.03
G	Elymus junceus	a-	b15	b24	b25	-	.13	.75	1.27
G	Oryzopsis hymenoides	a45	ab51	b85	b78	.15	.76	2.19	2.47
G	Poa fendleriana	-	-	-	1	-	-	-	.00
G	Sitanion hystrix	a59	b217	b175	a47	.70	5.21	6.98	1.00
G	Stipa comata	a32	ab55	b80	ab52	.16	1.45	2.28	1.50
G	Vulpia octoflora (a)	-	5	-	-	-	.02	-	-
Total for Annual Grasses		0	43	7	13	0	0.25	0.01	0.03
Total for Perennial Grasses		147	448	477	368	1.24	10.74	17.19	15.94
Total for Grasses		147	491	484	381	1.24	10.99	17.20	15.97
F	Arabis sp.	2	4	-	-	.03	.00	-	-
F	Astragalus convallarius	5	9	3	-	.09	.21	.03	-
F	Castilleja sp.	4	-	-	-	.00	-	-	-
F	Chenopodium fremontii (a)	3	-	-	2	.21	-	-	.00
F	Chenopodium leptophyllum(a)	c184	a-	a1	b24	4.44	-	.00	.08
F	Cordylanthus sp. (a)	c44	ab13	a-	b14	.64	.02	-	.37
F	Descurainia pinnata (a)	b53	b43	a-	a-	.46	.15	-	-
F	Draba sp. (a)	-	2	-	3	-	.01	-	.00
F	Eriogonum cernuum (a)	15	30	31	25	.16	.12	.26	.14
F	Eriogonum sp.	-	-	1	-	-	-	.00	-
F	Gayophytum ramosissimum(a)	b50	a-	a-	a-	1.25	-	-	-
F	Gilia sp. (a)	2	-	-	-	.00	-	-	-
F	Lappula occidentalis (a)	b42	b273	a-	a7	1.02	4.25	-	.02
F	Lesquerella sp.	-	7	1	-	-	.07	.00	-
F	Penstemon sp.	1	-	-	-	.03	-	-	-
F	Penstemon sp.	6	15	9	5	.07	.08	.04	.03
F	Phlox hoodii	-	3	-	3	-	.03	-	.03
F	Phlox longifolia	a20	b64	a16	a29	.09	.22	.12	.31
F	Plantago patagonica (a)	b26	c75	a-	a3	.47	.57	-	.00
F	Salsola iberica (a)	a8	b27	a5	a2	.31	.05	.01	.00
F	Schoenrambe linifolia	-	4	3	3	-	.01	.00	.03
F	Sphaeralcea coccinea	b49	a-	c85	c95	1.67	-	1.29	1.67
F	Sphaeralcea grossulariifolia	a-	b124	c19	a-	-	2.31	.32	-
F	Unknown forb-annual (a)	a-	a-	b44	a-	-	-	.70	-
Total for Annual Forbs		427	463	81	80	9.01	5.18	0.98	0.63
Total for Perennial Forbs		87	230	137	135	1.98	2.95	1.83	2.09
Total for Forbs		514	693	218	215	11.00	8.14	2.81	2.73

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 16R, Study no: 13

Type	Species	Strip Frequency				Average Cover %			
		'04	'07	'09	'10	'04	'07	'09	'10
B	Artemisia tridentata wyomingensis	74	78	0	73	4.24	5.75	8.01	7.17
B	Chrysothamnus depressus	0	0	0	7	-	-	3.92	.04
B	Chrysothamnus viscidiflorus viscidiflorus	45	83	0	72	1.58	3.29	1.20	4.45
B	Eriogonum microthecum	30	35	0	31	.36	.47	-	1.16
B	Gutierrezia sarothrae	0	28	0	3	-	.10	.18	.06
B	Kochia prostrata	0	3	0	3	-	.00	-	.18
B	Leptodactylon pungens	0	0	0	1	-	-	-	-
B	Opuntia sp.	7	13	0	2	.00	.00	.03	.03
Total for Browse		156	240	0	192	6.19	9.63	13.36	13.11

CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 13

Species	Percent Cover			
	'04	'07	'09	'10
Artemisia tridentata wyomingensis	5.78	4.13	6.41	5.09
Chrysothamnus depressus	-	-	1.23	-
Chrysothamnus viscidiflorus viscidiflorus	1.61	3.71	1.51	3.53
Eriogonum microthecum	.55	.58	-	.71
Gutierrezia sarothrae	-	.18	.25	-
Kochia prostrata	-	.01	.01	-
Opuntia sp.	-	-	.06	.06

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 16R, Study no: 13

Species	Average leader growth (in)			
	'04	'07	'09	'10
Artemisia tridentata wyomingensis	3.5	1.4	1.2	1.5

BASIC COVER--

Management unit 16R, Study no: 13

Cover Type	Average Cover %			
	'04	'07	'09	'10
Vegetation	19.82	30.82	33.70	30.17
Rock	0	0	0	.15
Pavement	0	.01	0	.01
Litter	26.92	29.48	37.84	31.22
Cryptogams	4.80	1.99	2.69	.62
Bare Ground	60.34	52.40	47.34	51.52



SOIL ANALYSIS DATA --

Management unit 16R, Study no: 13, Study Name: Upper Porphyry Bench

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
12.8	7.1	43.6	28.9	27.5	1.7	8.9	80.0	0.5

PELLET GROUP DATA--

Management unit 16R, Study no: 13

Type	Quadrat Frequency				Days use per acre (ha)			
	'04	'07	'09	'10	'04	'07	'09	'10
Rabbit	56	89	63	44	-	-	-	-
Sheep	-	-	-	-	-	-	1 (3)	-
Elk	1	6	6	4	-	1 (3)	14 (35)	-
Deer	47	52	56	50	96 (236)	171 (423)	152 (375)	71 (175)
Cattle	3	2	2	4	1 (2)	5 (12)	13 (32)	4 (11)

BROWSE CHARACTERISTICS--

Management unit 16R, Study no: 13

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia tridentata wyomingensis</i>									
04	<b>2380</b>	0	4	96	-	13	29	69	20/30
07	<b>3420</b>	37	16	47	22960	19	7	30	20/30
09	<b>0</b>	0	0	0	-	0	0	0	15/22
10	<b>3620</b>	43	28	30	260	14	9	27	18/29
<i>Chrysothamnus depressus</i>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	-/-
09	<b>0</b>	0	0	-	-	0	0	0	5/9
10	<b>160</b>	13	88	-	-	0	0	0	5/8
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
04	<b>2080</b>	0	100	0	1580	0	0	0	9/13
07	<b>12100</b>	49	51	0	4540	2	6	0	6/9
09	<b>0</b>	0	0	0	-	0	0	0	7/9
10	<b>5840</b>	15	85	0	-	.68	0	9	6/11
<i>Eriogonum microthecum</i>									
04	<b>2020</b>	19	81	-	-	0	0	0	6/7
07	<b>4760</b>	42	58	-	6200	3	12	0	4/4
09	<b>0</b>	0	0	-	-	0	0	0	3/7
10	<b>3760</b>	11	89	-	20	0	0	0	4/5
<i>Gutierrezia sarothrae</i>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>1260</b>	35	65	-	940	0	0	0	7/7
09	<b>0</b>	0	0	-	-	0	0	0	9/9
10	<b>100</b>	0	100	-	-	0	0	0	8/10

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<b>Kochia prostrata</b>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>60</b>	67	33	-	40	0	0	0	2/3
09	<b>0</b>	0	0	-	-	0	0	0	6/6
10	<b>120</b>	83	17	-	20	0	0	0	5/5
<b>Leptodactylon pungens</b>									
04	<b>0</b>	0	0	-	-	0	0	0	-/-
07	<b>0</b>	0	0	-	-	0	0	0	-/-
09	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>20</b>	0	100	-	-	0	0	0	3/5
<b>Opuntia sp.</b>									
04	<b>140</b>	0	100	0	-	0	0	0	2/8
07	<b>260</b>	38	38	23	-	0	0	0	2/7
09	<b>0</b>	0	0	0	-	0	0	0	4/7
10	<b>40</b>	0	100	0	-	0	0	0	3/9

WILDCAT PUSH - TREND STUDY NO. 16R-16-10

[Project #32](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: Upland Shallow Clay Loam (Utah Juniper-Pinyon), R034XY315UT

Land Ownership: UDWR

Elevation: 6,584 ft. (2,006 m)

Aspect: East

Slope: 5-6%

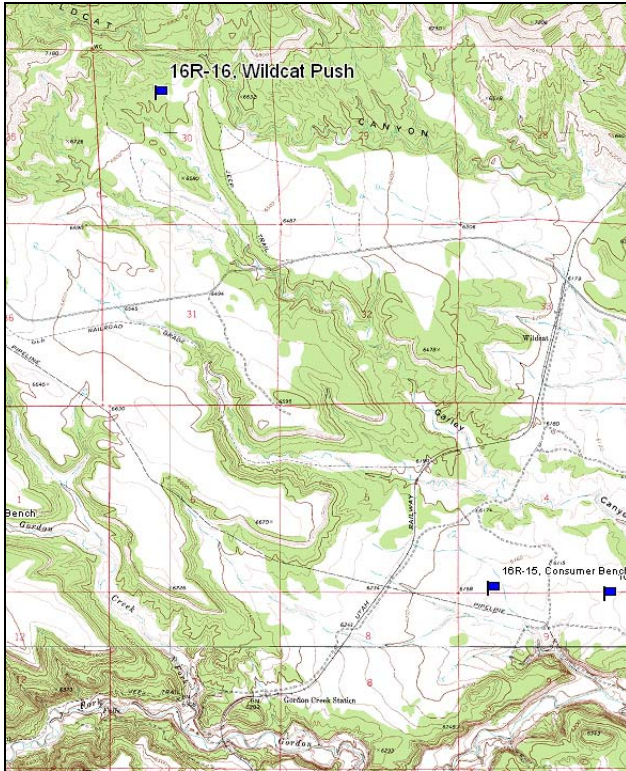
Transect bearing: 350° magnetic

Belt placement: line 1 (11ft & 95), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

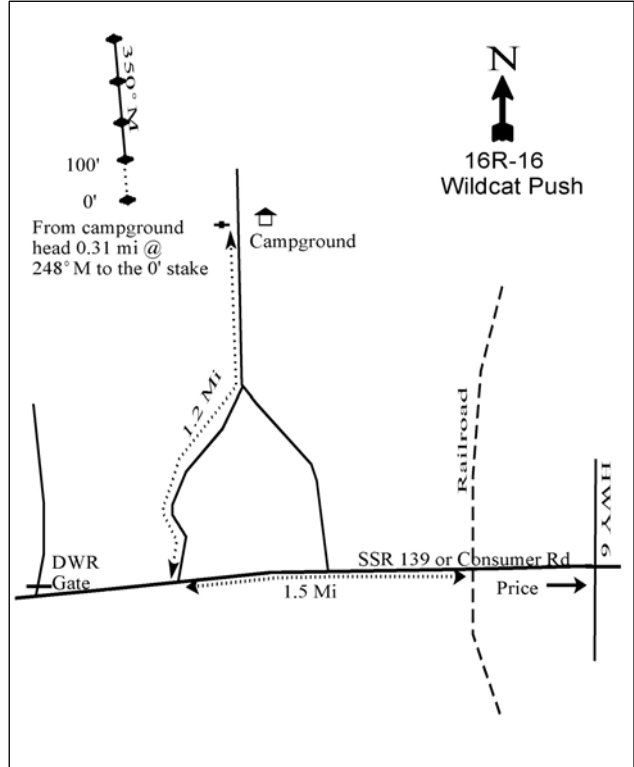
From the junction of US 6 and SSR 139 in Price, drive west on SSR 139 for 3.2 miles to a railroad crossing. Drive over the railroad tracks and continue 1.5 miles to road on the right (north). Turn right on this road and drive 1.2 miles to a campground on the right (east) side of the road. Park at the campground and from the west side of the road, walk 0.31 mile at 248°M to the 0' stake. The 0' stake is marked with browse tag #80.

Map Name: Standardville



Township: 13S Range: 9E Section: 30

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 503387 E 4391049 N

WILDCAT PUSH - WRI STUDY 16R-16

[Project #32](#)

**Site Description**

Site Information: The study was established in 2005 prior to a 2007 bulldozer push, roller chopper, seed dribbler and aerial seeding treatment to reduce pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) on the north end of the Gordon Creek Wildlife Management Area (WMA), about sixteen miles northwest of Price. This area was historically a mix of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), true mountain mahogany (*Cercocarpus montanus* ssp. *montanus*), curleaf mountain mahogany (*Cercocarpus ledifolius*) and Utah serviceberry (*Amelanchier utahensis*). Following a distinct sagebrush die-off in 2003, coupled with pinyon pine and Utah juniper encroachment, there was a need for a habitat improvement project to release palatable browse species. The objective of the project was to improve mule deer winter habitat and potentially improve sage-grouse habitat. The project site is on the border of historic sage-grouse habitat, and is four miles northeast of a sage-grouse reintroduction site (WRI Database 2011). Pellet group data estimated light cattle, deer and elk use in all sample years (Table - Pellet Group Data).

SEED MIX--

Management unit 16R, Study no: 16

Project Name: Wildcat Canyon Pinyon Juniper Removal					
WRI Database #: 32					
Application: Aerial		Acres: 205		Application: Seed Dribbler	
Acres: 205		Acres: 205		Acres: 205	
Seed type		lbs in mix	lbs/acre	Seed type	
G	Bluebunch WG 'Anatone'	250	1.22	B	Fourwing Saltbush
G	Blue Grama	200	0.98	B	Green Ephedra
G	Canby Bluegrass 'Canbar'	100	0.49	Total Pounds:	
G	Crested Wheatgrass 'Douglas'	100	0.49	100	
G	Crested Wheatgrass 'Ephraim'	100	0.49	PLS Pounds:	
G	Indian Ricegrass 'Rimrock'	300	1.46	0.24	
G	Pubescent Wheatgrass	200	0.98		
G	Russian Wildrye	100	0.49		
G	Sandberg Bluegrass	100	0.49		
G	Snake River Wheatgrass 'Secar'	200	0.98		
G	Tall Wheatgrass 'Alkar'	150	0.73		
G	Thickspike Wheatgrass 'Bannock'	250	1.22		
F	Alfalfa 'Ladak'	200	0.98		
F	Alfalfa 'Ranger'	200	0.98		
F	Alfalfa 'Spredor 4'	150	0.73		
F	Rocky Mountain Beeplant	50	0.24		
B	Fourwing Saltbush	25	0.12		
B	Sagebrush, Wyoming	100	0.49		
Total Pounds:		2775	13.54		
PLS Pounds:			11.42		

Browse: Palatable browse cover was limited in all sample years. Neither serviceberry nor mahogany species were sampled in any sample year. The browse composition is dominated by Utah Juniper. Two seeded species, Wyoming big sagebrush, green ephedra (*Ephedra viridis*), and fourwing saltbush (*Atriplex canescens*), were sampled in 2010. Wyoming big sagebrush is the preferred browse species on the site. The sagebrush population is a relatively young population with good vigor and low decadence. Fourwing saltbush

and green ephedra were sampled in low abundance (Table - Browse Characteristics). Prior to treatment, Utah juniper and pinyon pine provided the majority of the canopy cover, but cover decreased significantly after the treatment (Table - Canopy Cover).

Herbaceous Understory: As is the case with many pinyon pine and juniper woodlands, the herbaceous understory was very limited prior to treatment. Salina wildrye (*Elymus salina*) and bottlebrush squirreltail (*Sitanion hystrix*) provided the majority of the cover prior to treatment in 2005. Following the treatment in 2010, pubescent wheatgrass (*Agropyron intermedium*), slender wheatgrass (*A. trachycaulum*), Salina wildrye, and Indian ricegrass (*Oryzopsis hymenoides*) were the dominant species. Several seeded species were sampled after the treatment which include crested wheatgrass (*Agropyron cristatum*), slender wheatgrass, pubescent wheatgrass, bluebunch wheatgrass (*A. spicatum*), blue grama (*Bouteloua gracilis*), Indian ricegrass, and Sandberg bluegrass (*Poa secunda*), though many of the seeded species were present prior to the treatment. Cheatgrass (*Bromus tectorum*) was rare in all sample years. Forbs are not abundant but are moderately diverse. Perennial forbs are rare but annual forb species are fairly common on the site. Prior to the treatment birdbeak (*Cordylanthus sp.*), Gilia (*Gilia sp.*), and annual stickseed (*Lappula occidentalis*) were the most common species but since the treatment all three species decreased in frequency and cover. Nodding eriogonum (*Eriogonum cernuum*) was the dominant forb species in 2010. Alfalfa (*Medicago sativa*) has been the only seeded forb species sampled since the treatment.

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is moderately high with high amount of litter and a moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2010 due to the presence of flow patterns and gullies.

**Pre vs. Three Years Post Treatment, 2005 vs. 2010**

Browse: Utah juniper cover was reduced from 15% to 2% and pinyon pine decreased from 1% to 0%. Wyoming big sagebrush, green ephedra, fourwing saltbush were sampled in 2010 after being seeded. Wyoming big sagebrush density was estimated at 1,560 plants/acre and cover was 1%. The recruitment of young sagebrush was 67% of the population. The density of Green ephedra was 20 plants/acre and the density of fourwing saltbush was 40 plants/acre.

Grasses: The sum of nested frequency of perennial grasses increased by nearly three folds, while cover increased from 3% to 14%. Pubescent wheatgrass cover increased from less than 1% to 5%. Indian ricegrass and slender wheatgrass increased to 2% from less than 1%. Cheatgrass remained rare on the site.

Forbs: Perennial forb species remained rare on the study site. The sum of nested frequency of perennial forbs increased 39% and cover remained similar at 1%. Annual forb cover decreased from 7% to 3% and the sum of nested frequency of annual forbs decreased 16%. Alfalfa was the only seeded forb sampled following the treatment.

**HERBACEOUS TRENDS--  
Management unit 16R, Study no: 16**

T y p e	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
G	Agropyron cristatum	a-	b45	-	.96
G	Agropyron dasystachyum	-	3	-	.00
G	Agropyron intermedium	a12	b136	.18	4.88
G	Agropyron spicatum	-	12	-	.36
G	Agropyron trachycaulum	a-	b78	-	1.92
G	Bouteloua gracilis	21	9	.43	.42

Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
G	Bromus tectorum (a)	<sub>a</sub> 3	<sub>b</sub> 24	.00	.12
G	Elymus salina	50	40	1.25	1.59
G	Oryzopsis hymenoides	<sub>a</sub> 15	<sub>b</sub> 42	.07	1.99
G	Poa secunda	3	6	.01	.04
G	Sitanion hystrix	<sub>b</sub> 44	<sub>a</sub> 21	1.07	.91
G	Stipa comata	<sub>a</sub> 3	<sub>b</sub> 24	.04	.84
Total for Annual Grasses		3	24	0.00	0.12
Total for Perennial Grasses		148	416	3.07	13.93
Total for Grasses		151	440	3.07	14.05
F	Arabis sp.	11	3	.09	.00
F	Astragalus convallarius	15	18	.57	.14
F	Astragalus sp.	-	1	-	.03
F	Chenopodium album (a)	-	10	-	.19
F	Chenopodium fremontii (a)	43	49	.18	.42
F	Chenopodium leptophyllum(a)	<sub>a</sub> 5	<sub>b</sub> 63	.01	.26
F	Chorispora tenella (a)	-	2	-	.00
F	Cordylanthus sp. (a)	<sub>b</sub> 60	<sub>a</sub> 14	2.30	.64
F	Descurainia pinnata (a)	<sub>b</sub> 44	<sub>a</sub> 3	.20	.03
F	Eriogonum cernuum (a)	<sub>a</sub> 14	<sub>b</sub> 113	.05	1.13
F	Gayophytum ramosissimum(a)	<sub>b</sub> 46	<sub>a</sub> -	.11	-
F	Gilia sp. (a)	<sub>b</sub> 127	<sub>a</sub> 20	1.46	.05
F	Lactuca serriola (a)	41	43	.82	.37
F	Lappula occidentalis (a)	50	48	1.95	.19
F	Lepidium sp. (a)	6	-	.04	-
F	Machaeranthera canescens	-	4	-	.03
F	Medicago sativa	<sub>a</sub> -	<sub>b</sub> 19	-	.27
F	Mentzelia sp.	4	3	.06	.01
F	Pedicularis centranthera	8	-	.33	-
F	Penstemon sp.	3	7	.04	.04
F	Phlox longifolia	-	2	-	.00
F	Polygonum douglasii (a)	-	1	-	.00
F	Sisymbrium altissimum (a)	-	-	.00	-
Total for Annual Forbs		436	366	7.16	3.31
Total for Perennial Forbs		41	57	1.09	0.54
Total for Forbs		477	423	8.26	3.86

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 16R, Study no: 16

Type	Species	Strip Frequency		Average Cover %	
		'05	'10	'05	'10
B	Artemisia nova	4	2	.03	.03
B	Artemisia tridentata wyomingensis	0	28	-	.63
B	Atriplex canescens	0	2	-	.00
B	Ephedra viridis	1	1	.15	.03
B	Gutierrezia sarothrae	1	0	-	-
B	Juniperus osteosperma	10	5	3.28	2.14
B	Opuntia sp.	8	2	.01	.03
B	Pediocactus simpsonii	0	1	.04	.03
B	Pinus edulis	3	2	.21	.15
B	Sclerocactus sp.	2	1	-	-
Total for Browse		29	44	3.72	3.05

CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 16

Species	Percent Cover	
	'05	'10
Artemisia nova	.13	-
Artemisia tridentata wyomingensis	-	.81
Ephedra viridis	-	.20
Juniperus osteosperma	15.25	2.29
Opuntia sp.	.58	.38
Pediocactus simpsonii	.03	-
Pinus edulis	1.06	-
Sclerocactus sp.	-	.08

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 16R, Study no: 16

Species	Average leader growth (in)	
	'05	'10
Artemisia tridentata wyomingensis	-	1.4

POINT-QUARTER TREE DATA--

Management unit 16R, Study no: 16

Species	Trees per Acre		Average diameter (in)	
	'05	'10	'05	'10
Juniperus osteosperma	223	80	5.7	5.6
Pinus edulis	31	34	1.6	1.2

BASIC COVER--

Management unit 16R, Study no: 16

Cover Type	Average Cover %	
	'05	'10
Vegetation	15.64	25.78
Rock	.83	.09
Pavement	2.85	1.12
Litter	41.31	50.63
Cryptogams	.75	.30
Bare Ground	46.87	32.38

SOIL ANALYSIS DATA --

Management unit 16R, Study no: 16, Study Name: Wildcat Push

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
14.3	7.2	42.4	28.4	29.2	1.9	5.5	83.2	0.5

PELLET GROUP DATA--

Management unit 16R, Study no: 16

Type	Quadrat Frequency		Days use per acre (ha)	
	'05	'10	'05	'10
Rabbit	59	14	-	-
Elk	3	2	12 (30)	14 (35)
Deer	8	9	3 (7)	16 (40)
Cattle	1	1	-	2 (4)

BROWSE CHARACTERISTICS--

Management unit 16R, Study no: 16

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
<b>Artemisia nova</b>										
05	<b>240</b>	83	8	8	40	0	0	8	8/14	
10	<b>60</b>	0	100	0	-	0	0	0	8/17	
<b>Artemisia tridentata wyomingensis</b>										
05	<b>0</b>	0	0	0	-	0	0	0	-/-	
10	<b>1560</b>	67	32	1	20	0	0	1	12/10	
<b>Atriplex canescens</b>										
05	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>40</b>	0	100	-	20	0	0	0	21/20	
<b>Chrysothamnus nauseosus</b>										
05	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>0</b>	0	0	-	-	0	0	0	15/17	
<b>Chrysothamnus viscidiflorus</b>										
05	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>0</b>	0	0	-	-	0	0	0	9/8	



Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<i>Ephedra viridis</i>									
05	20	0	100	-	-	0	0	0	40/50
10	20	0	100	-	-	0	0	0	26/33
<i>Gutierrezia sarothrae</i>									
05	20	0	100	-	-	0	0	0	10/12
10	0	0	0	-	-	0	0	0	10/15
<i>Juniperus osteosperma</i>									
05	220	27	64	9	-	0	0	0	-/-
10	120	17	50	33	200	0	0	33	-/-
<i>Opuntia sp.</i>									
05	220	0	91	9	-	0	0	9	4/14
10	60	0	100	0	-	0	0	0	3/20
<i>Pediocactus simpsonii</i>									
05	0	0	0	-	20	0	0	0	1/2
10	20	0	100	-	-	0	0	0	2/4
<i>Pinus edulis</i>									
05	60	33	67	-	40	0	0	0	-/-
10	40	50	50	-	40	0	0	0	-/-
<i>Sclerocactus sp.</i>									
05	40	50	50	-	-	0	0	0	5/5
10	20	0	100	-	-	0	0	0	3/6

LOWER FISH CREEK WMA - TREND STUDY NO. 16R-19-10

[Project #17](#)

Vegetation Type: Mountain Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Year-Long

NRCS Ecological Site Description: [Mountain Shallow Loam \(Mountain Big Sagebrush\), R047XA446UT](#)

Land Ownership: UDWR

Elevation: 8,640 ft. (2,633 m)

Aspect: North

Slope: 5%

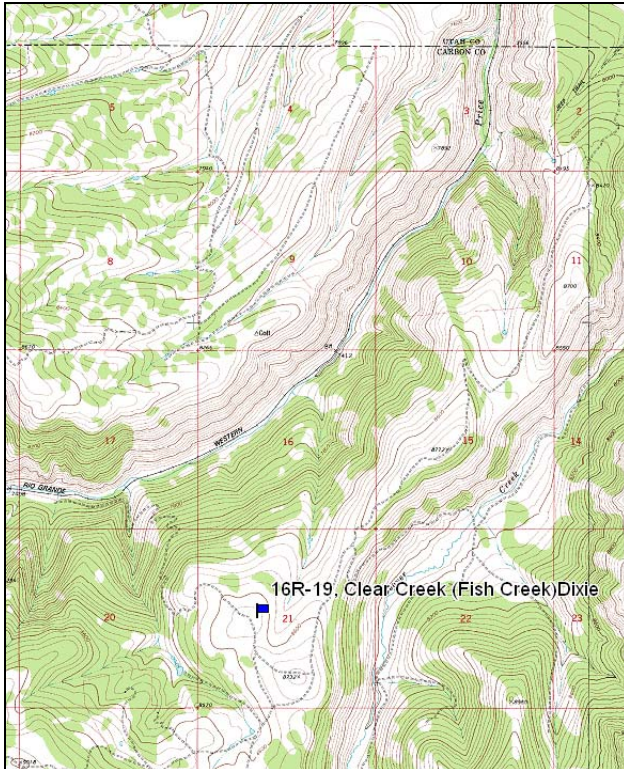
Transect bearing: 304° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

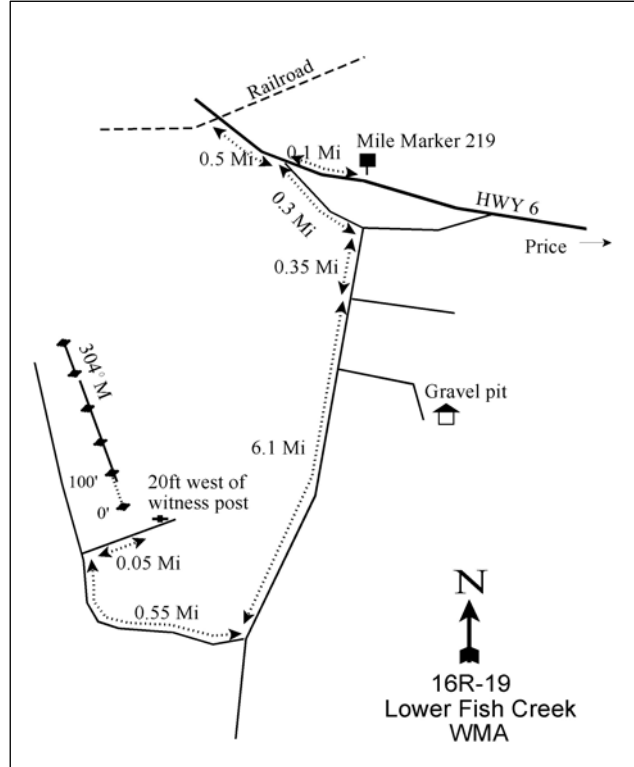
Driving north on US 6 from Price, drive to mile marker 219 and continue 0.1 miles to a road on the left (SW) side of the road. Turn left and drive 0.3 miles to a road on the right (south). Turn right and drive 6.1 miles to a fork. Take the right fork and drive 0.5 miles to a two-track on the right (east) side of the road. Turn right on the two-track and drive 0.05 miles to the witness post. From the witness post, walk 20 feet in a westward direction to the 0' stake. The 0' stake is marked with browse tag #92.

Map Name: Colton



Township: 12S Range: 8E Section: 21

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 496948 E 4401985 N

## LOWER FISH CREEK WMA - WRI STUDY 16R-19

### [Project #17](#)

#### **Site Description**

Site Information: The study is located on a mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) ridge approximately four and a half miles east of Scofield Dam on the Lower Fish Creek Wildlife Management Area (WMA) managed by the Utah Division of Wildlife Resources. The study was established prior to a sagebrush thinning treatment using the herbicides 2,4-D (2,4-Dichlorophenoxyacetic acid) and Tordon (piclarm). Over time, mountain big sagebrush and stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) inhibited the herbaceous understory. In order to create better sage-grouse, mule deer, and elk habitat 74 acres were treated using the herbicide 2,4-D and Tordon in the June of 2006. No seed mix was applied to the treatment due to the elevation and presence of perennial forbs and grasses. The objective of the project was to thin the sagebrush and remove the thick cover of rabbitbrush to enhance the habitat value for sage-grouse, deer, and elk by increasing grass and forb production (WRI Database 2011). Pellet group data estimated moderate cattle, deer and elk use in 2005 along with nine sage-grouse pellet groups/acre. In 2010, cattle deer and elk use was light and five sage-grouse were seen near the site (Table - Pellet Group Data).

Browse: Mountain big sagebrush and stickyleaf low rabbitbrush are the dominant browse species on this site. Mountain big sagebrush is the preferred browse species, but is lightly used in this summer range. Decadence and poor vigor of sagebrush has been low over the sample years, but was high in 2005. Recruitment of young sagebrush plants has been mostly poor since the outset of the study. Other browse species included Dwarf rabbitbrush (*Chrysothamnus depressus*), mountain snowberry (*Symphoricarpos oreophilus*), Woods rose (*Rosa woodsii*), and a currant (*Ribes sp.*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are diverse. Kentucky bluegrass (*Poa pratensis*) is the dominant species and provided the majority of the cover over the sample years. Thickspike wheatgrass (*Agropyron dasystachyum*) was also common. Forbs are abundant and diverse. Perennial forb cover has been very high in all sample years. The most common species included elkweed (*Swertia radiata*), sulfur eriogonum (*Eriogonum umbellatum*), Watson penstemon (*Penstemon watsonii*), silvery lupine (*Lupinus argenteus*) and a milkvetch (*Astragalus sp.*) (Table - Herbaceous Trends).

Soil: The soil texture is a silty clay with a neutral soil reaction (pH 6.8) (Table - Soil Analysis Data). Bare ground cover is minimal with high amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2005 and 2010.

#### **Pre vs. Four Years Post Treatment, 2005 vs. 2010**

Browse: The herbicide treatment was ineffective in accomplishing the goal of reducing shrub dominance. The canopy cover of mountain big sagebrush increased from 19% to 23%, while density decreased 18% from 4,400 plants/acre to 3,600 plants/acre. The recruitment of young sagebrush plants increased slightly from 4% to 11% of the population. Decadence of sagebrush decreased substantially from 66% of the population to 11%. Poor vigor of sagebrush decreased from 41% to 11%. Stickyleaf low rabbitbrush cover decreased from 25% to 20% while density remained similar. Other palatable browse species accounted for little cover.

Grasses: The sum of nested frequency of perennial grasses decreased 20% while cover increased from 15% to 21%. Kentucky bluegrass increased significantly in nested frequency and cover increased from 8% to 17%. Slender wheatgrass decreased in nested frequency but cover remained similar at 3%. Subalpine needlegrass decreased significantly in nested frequency and cover decreased from 2% to less than 1% cover.

Forbs: The sum of nested frequency of perennial forbs remained similar and cover decreased from 23% to 21%. Watson penstemon cover increased from 3% to 4%, elkweed cover increased from 4% to 6%, milkvetch

cover decreased from 4% to 3% and silvery lupine significantly decreased in nested frequency while cover decreased from 8% to 2%.

HERBACEOUS TRENDS--  
Management unit 16R, Study no: 19

Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
G	Agropyron dasystachyum	<sub>b</sub> 178	<sub>a</sub> 92	2.75	2.59
G	Agropyron trachycaulum	32	19	.67	.42
G	Bromus anomalus	<sub>b</sub> 40	<sub>a</sub> 13	.64	.21
G	Carex sp.	<sub>b</sub> 8	<sub>a</sub> -	.22	-
G	Festuca ovina	4	12	.03	.23
G	Koeleria cristata	8	1	.09	.03
G	Poa fendleriana	-	1	-	.03
G	Poa pratensis	<sub>a</sub> 233	<sub>b</sub> 325	7.92	16.90
G	Poa secunda	18	19	.45	.16
G	Sitanion hystrix	2	-	.06	-
G	Stipa columbiana	<sub>b</sub> 96	<sub>a</sub> 15	2.31	.37
Total for Annual Grasses		0	0	0	0
Total for Perennial Grasses		619	497	15.17	20.97
Total for Grasses		619	497	15.17	20.97
F	Achillea millefolium	2	4	.00	.18
F	Androsace septentrionalis (a)	5	1	.01	.00
F	Antennaria rosea	1	2	.00	.03
F	Aquilegia sp.	-	-	.00	-
F	Arabis sp.	3	-	.01	-
F	Aster sp.	<sub>a</sub> 5	<sub>b</sub> 66	.05	1.37
F	Astragalus convallarius	<sub>b</sub> 41	<sub>a</sub> 12	.22	.09
F	Astragalus sp.	88	85	3.75	2.82
F	Astragalus utahensis	11	6	.10	.21
F	Castilleja flava	13	-	.36	-
F	Chaenactis douglasii	6	-	.07	-
F	Erigeron eatonii	11	4	.13	.04
F	Erigeron sp.	-	1	-	.00
F	Eriogonum umbellatum	<sub>a</sub> 30	<sub>b</sub> 63	1.07	2.03
F	Geranium sp.	54	40	.49	1.66
F	Gilia sp. (a)	3	-	.00	-
F	Helenium hoopesii	<sub>b</sub> 14	<sub>a</sub> -	.16	-
F	Ipomopsis aggregata	3	2	.03	.00
F	Lupinus argenteus	<sub>b</sub> 118	<sub>a</sub> 65	7.91	1.49
F	Machaeranthera grindelioides	-	-	-	.00
F	Mertensia sp.	<sub>a</sub> -	<sub>b</sub> 49	-	.91
F	Orthocarpus sp. (a)	<sub>b</sub> 32	<sub>a</sub> -	1.04	-
F	Penstemon sp.	1	-	.03	-
F	Penstemon watsonii	122	114	2.87	3.50
F	Phacelia sp.	-	1	-	.15
F	Phlox longifolia	<sub>b</sub> 60	<sub>a</sub> 26	.21	.30
F	Polygonum douglasii (a)	7	-	.03	-

Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
F	Potentilla gracilis	3	4	.15	.15
F	Senecio integerrimus	-	5	-	.15
F	Senecio multilobatus	3	5	.15	.18
F	Swertia radiata	89	89	3.82	5.55
F	Taraxacum officinale	31	23	.65	.21
F	Tragopogon dubius	3	-	.00	-
F	Trifolium sp.	1	-	.00	-
F	Veronica biloba (a)	<sub>a</sub> 1	<sub>b</sub> 23	.00	.75
F	Vicia americana	<sub>b</sub> 48	<sub>a</sub> 25	.63	.19
Total for Annual Forbs		48	24	1.09	0.75
Total for Perennial Forbs		761	691	22.92	21.28
Total for Forbs		809	715	24.01	22.04

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 16R, Study no: 19

Type	Species	Strip Frequency		Average Cover %	
		'05	'10	'05	'10
B	Amelanchier utahensis	2	2	-	-
B	Artemisia tridentata vaseyana	88	83	13.73	18.56
B	Chrysothamnus viscidiflorus viscidiflorus	88	89	17.24	18.72
B	Ribes sp.	2	3	.18	.06
B	Rosa woodsii	10	7	.24	.06
B	Symphoricarpos oreophilus	39	32	4.80	5.21
B	Tetradymia canescens	0	1	-	-
Total for Browse		229	217	36.19	42.62

#### CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 19

Species	Percent Cover	
	'05	'10
Artemisia tridentata vaseyana	18.58	22.78
Chrysothamnus depressus	-	5.38
Chrysothamnus viscidiflorus viscidiflorus	24.78	20.31
Ribes sp.	.21	.06
Rosa woodsii	.06	.40
Symphoricarpos oreophilus	9.83	9.91

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 16R, Study no: 19

Species	Average leader growth (in)	
	'05	'10
Artemisia tridentata vaseyana	2.3	1.7

BASIC COVER--

Management unit 16R, Study no: 19

Cover Type	Average Cover %	
	'05	'10
Vegetation	65.77	69.09
Rock	.21	0
Pavement	.02	0
Litter	58.90	59.43
Cryptogams	.03	.03
Bare Ground	3.90	3.84

SOIL ANALYSIS DATA --

Management unit 16R, Study no: 19, Study Name: Lower Fish Creek WMA

Effective rooting depth (in)	pH	silty clay			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
18.0	6.8	16.0	41.4	42.6	5.9	18.5	268.8	0.8

PELLET GROUP DATA--

Management unit 16R, Study no: 19

Type	Quadrat Frequency		Days use per acre (ha)	
	'05	'10	'05	'10
Rabbit	1	2	-	-
Grouse	-	-	9/acre	-
Elk	9	1	31 (760)	2 (5)
Deer	9	15	23 (56)	15 (36)
Cattle	4	7	21 (52)	12 (29)

BROWSE CHARACTERISTICS--  
Management unit 16R, Study no: 19

		Age class distribution					Utilization			
Y e a r	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Amelanchier utahensis</i>										
05	<b>40</b>	0	100	-	20	50	50	0	25/20	
10	<b>40</b>	50	50	-	-	0	0	0	27/26	
<i>Artemisia tridentata vaseyana</i>										
05	<b>4400</b>	4	30	66	220	20	4	41	28/29	
10	<b>3600</b>	11	78	11	100	28	5	11	29/36	
<i>Chrysothamnus viscidiflorus viscidiflorus</i>										
05	<b>11540</b>	1	99	-	60	0	0	0	13/18	
10	<b>11380</b>	16	84	-	460	.17	0	0	13/18	
<i>Ribes sp.</i>										
05	<b>40</b>	0	100	-	-	0	0	0	23/22	
10	<b>60</b>	33	67	-	-	0	0	0	17/17	
<i>Rosa woodsii</i>										
05	<b>480</b>	25	75	-	-	0	0	0	9/7	
10	<b>360</b>	22	78	-	20	0	0	0	15/9	
<i>Symphoricarpos oreophilus</i>										
05	<b>1480</b>	7	92	1	-	0	0	0	24/32	
10	<b>1080</b>	2	98	0	-	2	0	0	28/41	
<i>Tetradymia canescens</i>										
05	<b>0</b>	0	0	-	-	0	0	0	10/13	
10	<b>20</b>	100	0	-	-	0	0	0	10/11	

STUMP FLAT - TREND STUDY NO. 16R-21-10

[Project #431](#)

Vegetation Type: Pinyon/Juniper, Perennial Grass

Range Type: Crucial Deer Winter, Substantial Elk Winter

NRCS Ecological Site Description: Semidesert Bouldery Loam (Shadscale), R034XY202UT

Land Ownership: SITLA

Elevation: 6,900 ft. (2,103 m)

Aspect: Northeast

Slope: 8%

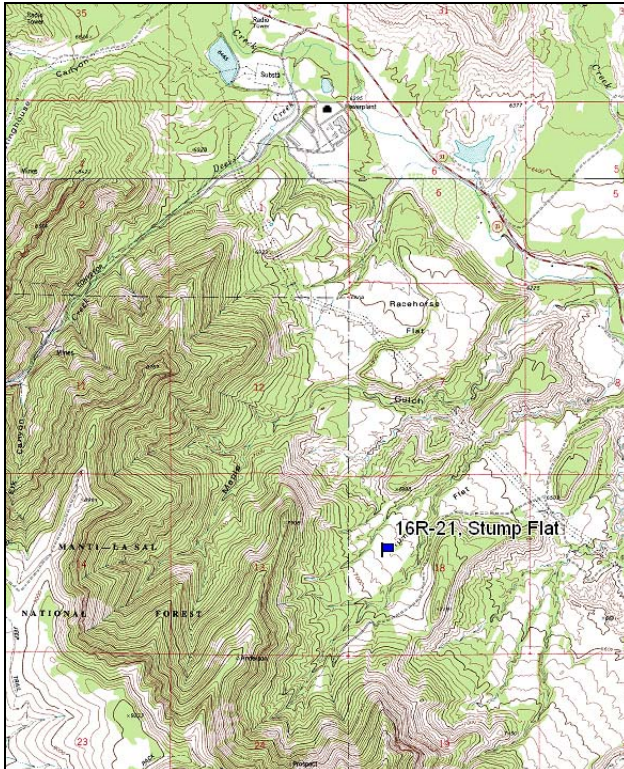
Transect bearing: 11° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

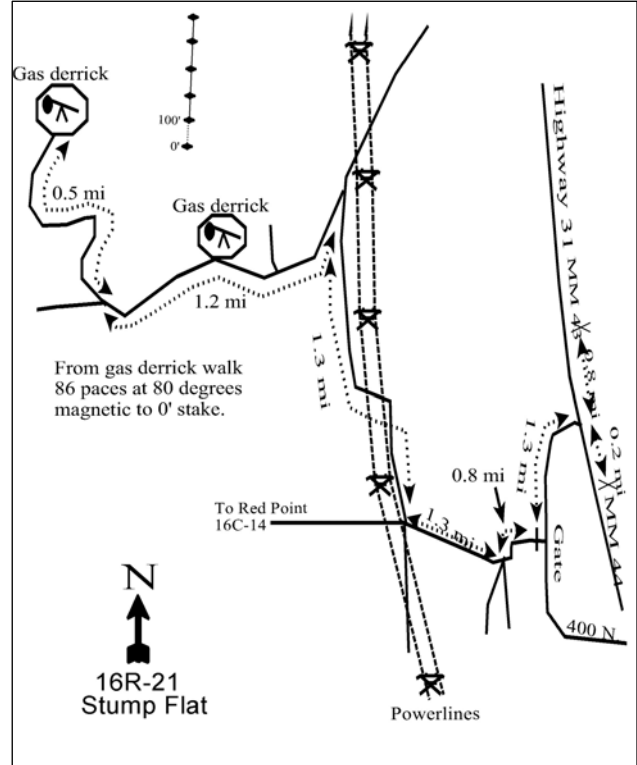
From Highway 31 heading south from mile marker 43 drive 0.8 miles to a road on the right, or heading north drive 0.2 miles from mile marker 44. Turn here and drive 1.3 miles to a road on the right (west) and a gate. Go through the gate and drive 0.8 miles to a fork and stay right. Drive 1.3 miles to a fork and some power lines. Go right following the power lines for 1.3 miles to another fork. Turn left here and drive 1.2 miles to a fork passing a road and gas derrick on the right side of the road. At the fork turn right and drive 0.5 miles to a gas derrick. From the gas derrick walk 86 paces at 80 degrees magnetic to the 0' stake marked with browse tag #153.

Map Name: Red Point



Township: 17S Range: 8E Section: 18

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 493633 E 4354996 N



STUMP FLAT - WRI STUDY 16R-21  
[Project #431](#)

## Site Description

Site Information: This study was established in an old chaining six miles west of Huntington. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) had regained dominance on the flat. The study site was retreated in the fall of 2006 with a roller chopper to remove encroaching pinyon pine and Utah juniper. The area receives substantial winter use by big game. The objectives of the project were to enhance winter habitat for elk and mule deer by reducing the pinyon pine and Utah juniper cover and increasing perennial grasses, forbs and preferred browse species (WRI Database 2011). Pellet group data estimated use by elk to be heavy while deer and cattle use was light in 2006. In 2010, deer use was moderate and elk and cattle use was light (Table - Pellet Group Data).

Browse: The palatable browse species black sagebrush (*Artemisia nova*) Wyoming sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and true mountain mahogany (*Cercocarpus montanus*) were rare on this site. The sagebrush populations are relatively young with good vigor and low decadence. The recruitment of young was high for both populations in 2010 (Table - Browse Characteristics). Pinyon pine was the dominant woody species prior to treatment, but was effectively removed and was not sampled in 2010 (Table - Canopy Cover).

Herbaceous Understory: Grasses are not diverse but are abundant. Crested wheatgrass (*Agropyron cristatum*) is the dominant grass species and accounts for the majority of the grass cover on the site. Other grass species are very rare on the site. Forbs are not abundant but are moderately diverse. Alfalfa (*Medicago sativa*) was the most common perennial species. Annual forbs were rare before the treatment but have become more common after the treatment. Russian thistle is the most common annual forb on the site (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.3) (Table - Soil Analysis Data). Bare ground cover is moderately high with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

## Pre vs. Four Post Treatment, 2006 vs. 2010

Browse: Pinyon pine canopy cover was reduced from 7% to 0% and density was reduced from 64 trees/acre to 27 trees/acre while Utah juniper canopy cover was below 1% in all sample years and density was reduced from 41 trees/acre to 25 trees/acre. Black sagebrush density increased from 120 plants/acre to 320 plants/acre while canopy cover remained below 1%. Wyoming big sagebrush was sample for the first time after the treatment with a density of 260 plants/acre.

Grasses: The sum of nested frequency of perennial grasses decreased 17 % and cover decreased from 18% to 16%. The nested frequency of crested wheatgrass declined significantly while cover decreased from 17 % to 16%. No other grass species was sampled in more than three quadrats.

Forbs: The sum of nested frequency of perennial forbs remained similar and cover increased from 3% to 4%. Alfalfa accounted for 36% of forb cover in 2010 and was the only perennial species to provide 1% or more cover. The sum of nested frequency of annual forbs increased substantially and cover increased from less than 1% to 3%. Russian thistle was sampled for the first time after the treatment at 2% cover

HERBACEOUS TRENDS--

Management unit 16R, Study no: 21

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	<sub>b</sub> 333	<sub>a</sub> 280	17.18	16.16
G	Agropyron intermedium	7	6	.19	.16
G	Elymus junceus	2	-	.15	-
G	Elymus salina	3	-	.15	-
G	Oryzopsis hymenoides	2	3	.00	.00
G	Sitanion hystrix	-	-	.00	-
Total for Annual Grasses		0	0	0	0
Total for Perennial Grasses		347	289	17.68	16.32
Total for Grasses		347	289	17.68	16.32
F	Arabis sp.	<sub>a</sub> 1	<sub>b</sub> 46	.00	.87
F	Astragalus convallarius	11	25	.25	.26
F	Chenopodium fremontii (a)	<sub>a</sub> -	<sub>b</sub> 13	-	.05
F	Cryptantha sp.	18	19	.31	.55
F	Eriogonum umbellatum	4	-	.03	-
F	Hedysarum boreale	4	3	.09	.15
F	Ipomopsis aggregata	1	1	.00	.06
F	Lactuca serriola (a)	-	3	-	.03
F	Lappula occidentalis (a)	<sub>a</sub> 12	<sub>b</sub> 58	.02	.85
F	Lesquerella sp.	7	-	.01	-
F	Machaeranthera grindelioides	5	3	.18	.00
F	Medicago sativa	31	24	.55	1.54
F	Penstemon sp.	14	14	.37	.32
F	Salsola iberica (a)	<sub>a</sub> -	<sub>b</sub> 53	-	1.52
F	Schoenrambe linifolia	<sub>a</sub> 6	<sub>b</sub> 21	.07	.35
F	Senecio multilobatus	8	-	.06	-
F	Stanleya pinnata	<sub>b</sub> 40	<sub>a</sub> -	.98	-
F	Tragopogon dubius (a)	-	8	-	.04
Total for Annual Forbs		12	135	0.02	2.49
Total for Perennial Forbs		150	156	2.95	4.13
Total for Forbs		162	291	2.98	6.62

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 16R, Study no: 21

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia nova	4	5	.48	.31
B	Artemisia tridentata wyomingensis	0	8	-	-
B	Cercocarpus montanus	3	1	.67	.03
B	Ephedra viridis	1	1	.00	.38
B	Gutierrezia sarothrae	0	1	-	.03
B	Juniperus osteosperma	2	1	1.00	.15
B	Opuntia sp.	1	0	-	-
B	Pinus edulis	6	0	6.40	-
Total for Browse		17	17	8.56	0.89

CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 21

Species	Percent Cover	
	'06	'10
Artemisia nova	.25	.31
Cercocarpus montanus	1.58	.45
Ephedra viridis	-	.28
Juniperus osteosperma	-	.40
Pinus edulis	7.09	-

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 16R, Study no: 21

Species	Average leader growth (in)	
	'06	'10
Cercocarpus montanus	6.6	2.5

POINT-QUARTER TREE DATA--

Management unit 16R, Study no: 21

Species	Trees per Acre		Average diameter (in)	
	'06	'10	'06	'10
Juniperus osteosperma	41	25	4.4	1.5
Pinus edulis	64	27	5.0	2.3

BASIC COVER--

Management unit 16R, Study no: 21

Cover Type	Average Cover %	
	'06	'10
Vegetation	27.17	21.98
Rock	4.67	6.33
Pavement	2.02	5.92
Litter	47.02	49.31
Cryptogams	1.21	.03
Bare Ground	30.35	25.32

SOIL ANALYSIS DATA --

Management unit 16R, Study no: 21, Study Name: Stump Flat

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
28.2	7.3	40.2	33.0	26.8	3.6	14.3	96.0	0.7

PELLET GROUP DATA--

Management unit 16R, Study no: 21

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	49	20	-	-
Elk	38	3	94 (231)	3 (8)
Deer	3	22	9 (23)	32 (78)
Cattle	3	5	10 (25)	15 (36)

BROWSE CHARACTERISTICS--

Management unit 16R, Study no: 21

		Age class distribution					Utilization		
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<b>Amelanchier utahensis</b>									
06	0	0	0	-	-	0	0	0	32/30
10	0	0	0	-	-	0	0	0	-/-
<b>Artemisia nova</b>									
06	120	67	33	0	2080	17	0	0	13/28
10	320	38	56	6	240	31	0	6	8/14
<b>Artemisia tridentata wyomingensis</b>									
06	0	0	0	-	-	0	0	0	-/-
10	260	38	62	-	-	0	0	0	15/20
<b>Ceratoides lanata</b>									
06	0	0	0	-	-	0	0	0	21/16
10	0	0	0	-	-	0	0	0	14/15
<b>Cercocarpus montanus</b>									
06	60	0	100	-	20	0	33	0	64/64
10	80	0	100	-	-	0	100	0	42/52

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Chrysothamnus nauseosus</i>									
06	0	0	0	-	-	0	0	0	34/39
10	0	0	0	-	-	0	0	0	18/27
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
06	0	0	0	-	-	0	0	0	10/13
10	0	0	0	-	-	0	0	0	7/12
<i>Cowania mexicana stansburiana</i>									
06	0	0	0	-	-	0	0	0	39/41
10	0	0	0	-	-	0	0	0	39/38
<i>Ephedra viridis</i>									
06	20	100	0	-	-	0	0	0	33/60
10	20	0	100	-	-	0	100	0	22/35
<i>Eriogonum microthecum</i>									
06	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	4/5
<i>Gutierrezia sarothrae</i>									
06	0	0	0	-	-	0	0	0	9/11
10	20	0	100	-	-	0	0	0	9/10
<i>Juniperus osteosperma</i>									
06	40	100	0	-	-	0	0	0	-/-
10	20	100	0	-	-	0	0	0	-/-
<i>Opuntia sp.</i>									
06	20	0	100	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	-/-
<i>Pinus edulis</i>									
06	120	17	83	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	-/-
<i>Purshia tridentata</i>									
06	0	0	0	-	-	0	0	0	25/48
10	0	0	0	-	-	0	0	0	16/36

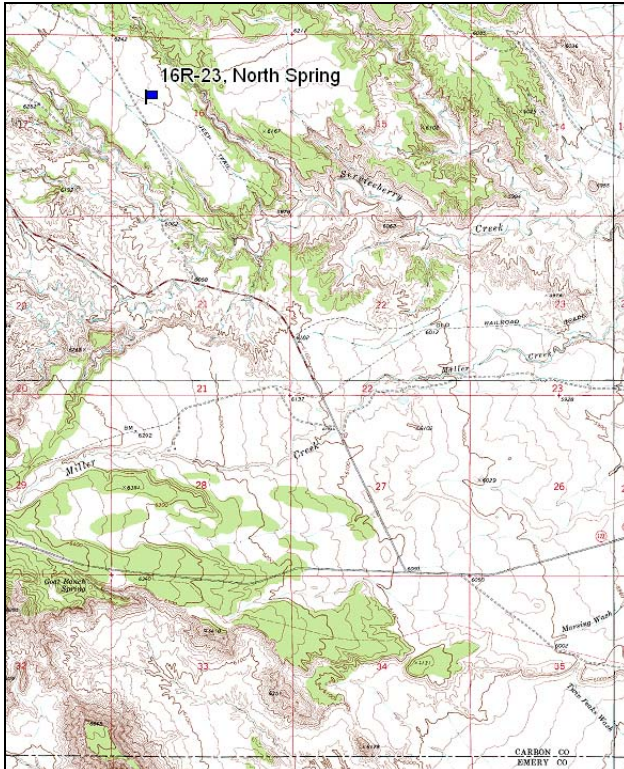
NORTH SPRING - TREND STUDY NO. 16R-23-10  
[Project #430](#)

Vegetation Type: Wyoming Big Sagebrush  
Range Type: Crucial Deer Winter, Crucial Elk Winter  
NRCS Ecological Site Description: Semidesert Loam (Wyoming Big Sagebrush), R034XY212UT  
Land Ownership: SITLA  
Elevation: 6,200 ft. (1,890 m)  
Aspect: South  
Slope: 1%  
Transect bearing: 116° magnetic  
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft).  
Notes: No Rebar, Line 4 is 83' long to avoid a gully.

Directions:

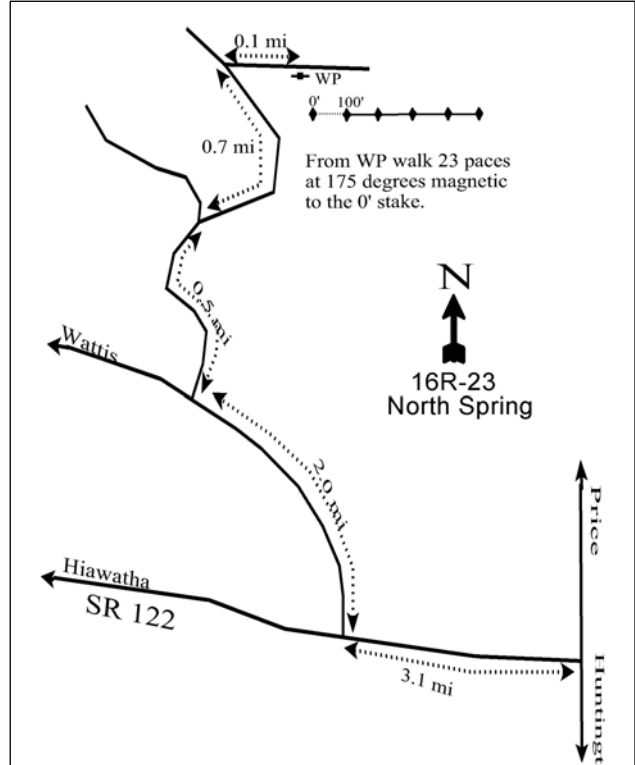
From the turn off from SR 10 onto SR 122 from Price or Huntington, drive 3.1 miles to a road on the right. Turn here and drive 2.0 miles to another right. Turn here and drive 0.5 miles to a fork and stay right for another 0.7 miles to a road on the right heading southeast. Turn right and go 0.1 miles to a witness post on the right. From the witness post walk 23 paces at 175 degrees magnetic to the 0' stake marked with browse tag #175.

Map Name: Pinnacle Peak



Township: 15S Range: 9E Section: 16

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 506474 E 4374741 N

NORTH SPRING - WRI STUDY 16R-23

[Project #430](#)

**Site Description**

Site Information: The study was established in 2006 in a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) community approximately seven miles southwest of Price to monitor the effects of a one-way Dixie harrow and broadcast seeding. The project was completed in the fall of 2006. The project objectives were to improve 340 acres of critical mule deer winter range following a systemic sagebrush die-off in the area west of Price. This area is heavily used by the oil and gas industry (WRI Database 2011). Pellet group data estimated heavy deer and light elk use in each sample year (Table - Pellet Group Data).

SEED MIX--

Management unit 16R, Study no: 23

Project Name: Price West Benches--Phase 3			
WRI Database #: 430			
Application: Broadcast Seeder		Acres:	340
Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Hycrest'	350	1.03
G	Indian Ricegrass 'Rimrock'	350	1.03
G	Russian Wildrye	1314	3.86
G	Sheep Fescue	175	0.51
G	Siberian Wheatgrass 'Vavilov'	675	1.99
G	Western Wheatgrass 'Arriba'	350	1.03
F	Alfalfa 'Ranger'	175	0.51
F	Alfalfa 'Spredor 4'	175	0.51
F	Sainfoin 'Eski'	350	1.03
F	Small Burnet 'Delar'	175	0.51
B	Fourwing Saltbush	500	1.47
B	Sagebrush, Wyoming	175	0.51
Total Pounds:		4764	14.01
PLS Pounds:			11.41

Browse: The key browse species is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). Shadscale (*Atriplex confertifolia*) and winterfat (*Ceratoides lanata*) are the only other palatable browse found on site. Prior to the treatment, Wyoming big sagebrush was in poor health with high amount of decadence and poor vigor in the population. After the treatment, the sagebrush improved remarkably with a significant decrease in the amount of decadence and poor vigor in the population. The recruitment of young sagebrush plants was poor prior to treatment but was excellent in 2010. Other sampled shrubs included: narrowleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *stenophyllus*), broom snakeweed (*Gutierrezia sarothrae*) and pricklypear cactus (*Opuntia* sp.) (Table - Canopy Cover).

Herbaceous Understory: Grasses are fairly abundant and diverse. Blue grama (*Bouteloa gracilis*) and bottlebrush squirreltail (*Sitanion hystrix*) are the dominant grass species on the site. Other common grasses include Indian ricegrass (*Oryzopsis hymenoides*) and crested wheatgrass (*Agropyron cristatum*). Cheatgrass (*Bromus tectorum*) was the only annual species sampled and was rare on the site. Forbs are not overly abundant and somewhat diverse. Perennial forbs have limited diversity and provide little cover (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a slightly alkaline soil reaction (pH 7.5) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation providing protective ground cover

(Table - Basic Cover). The soil erosion condition was classified as moderate in 2006 due to litter and soil movement, flow patterns, and rill development. In 2010, the soil erosion condition was classified as slight due to pedestalling slight soil movement, flow patterns and gully formation.

**Pre vs. Four Years Post Treatment, 2006 vs. 2010**

Browse: Wyoming big sagebrush canopy cover declined from 11% to 8% while density increased from 3,700 plants/acre to 7,700 plants/acre. The recruitment of young sagebrush plants increased from 6% to 51% while the percent decadent decreased from 70% to 12%. Poor vigor of sagebrush decreased from 59% to 13% of the population. Shadscale density remained similar at 140 plants/acre and cover remained below 1%. Winterfat occurred infrequently in each sample.

Grasses: The sum of nested frequency of perennial grasses remained similar and cover remained similar at 10%. Bottlebrush squirrel tail cover decreased from 5% to 4% and blue grama cover decreased from 4% to 3%.

Forbs: Forbs are rare on the site. The sum of nested frequency of perennial forbs significantly decreased 73%, though cover remained similar at 1%. No one species was dominant.

HERBACEOUS TRENDS--

Management unit 16R, Study no: 23

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	a-	b47	-	1.40
G	Agropyron intermedium	-	1	-	.03
G	Bouteloua gracilis	66	53	3.93	3.40
G	Bromus tectorum (a)	13	9	.10	.02
G	Oryzopsis hymenoides	b80	a38	1.13	1.56
G	Poa secunda	2	2	.03	.00
G	Sitanion hystrix	179	170	4.62	3.63
G	Stipa comata	5	1	.01	.00
G	Stipa thurberiana	1	-	.03	-
G	Vulpia octoflora (a)	13	-	.09	-
Total for Annual Grasses		26	9	0.20	0.01
Total for Perennial Grasses		333	312	9.76	10.04
Total for Grasses		359	321	9.96	10.06
F	Alyssum alyssoides (a)	2	1	.01	.00
F	Calochortus nuttallii	-	3	-	.00
F	Chaenactis douglasii	1	-	.00	-
F	Chenopodium leptophyllum(a)	-	5	-	.00
F	Crepis acuminata	1	-	.03	-
F	Cryptantha sp.	10	-	.07	-
F	Descurainia pinnata (a)	b24	a2	.12	.03
F	Eriogonum cernuum (a)	b44	a28	.20	.27
F	Halogeton glomeratus (a)	b10	a-	.07	-
F	Lappula occidentalis (a)	4	1	.03	.00
F	Lepidium montanum	b23	a1	.41	.15
F	Leucelene ericoides	10	7	.18	.15
F	Lupinus sp.	1	-	.03	-



Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	<i>Machaeranthera grindelioides</i>	<sub>b</sub> 21	<sub>a</sub> 7	.59	.66
F	<i>Plantago patagonica</i> (a)	6	7	.01	.01
F	<i>Ranunculus testiculatus</i> (a)	3	-	.00	-
F	<i>Salsola iberica</i> (a)	<sub>b</sub> 18	<sub>a</sub> -	.09	-
F	<i>Schoenrambe linifolia</i>	15	3	.03	.21
F	<i>Sisymbrium altissimum</i> (a)	7	-	.02	-
F	<i>Sphaeralcea coccinea</i>	3	2	.01	.03
Total for Annual Forbs		118	44	0.57	0.33
Total for Perennial Forbs		85	23	1.36	1.22
Total for Forbs		203	67	1.94	1.55

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 16R, Study no: 23

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	<i>Artemisia tridentata wyomingensis</i>	81	88	9.32	9.02
B	<i>Atriplex confertifolia</i>	5	5	.41	.30
B	<i>Ceratoides lanata</i>	1	2	.00	.15
B	<i>Chrysothamnus viscidiflorus stenophyllus</i>	20	37	.98	1.36
B	<i>Gutierrezia sarothrae</i>	27	29	.60	1.37
B	<i>Opuntia</i> sp.	73	55	6.02	2.84
Total for Browse		207	216	17.36	15.05

#### CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 23

Species	Percent Cover	
	'06	'10
<i>Artemisia tridentata wyomingensis</i>	10.86	8.33
<i>Atriplex confertifolia</i>	.75	.05
<i>Chrysothamnus viscidiflorus stenophyllus</i>	.60	1.20
<i>Gutierrezia sarothrae</i>	.71	1.35
<i>Opuntia</i> sp.	4.96	2.75

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 16R, Study no: 23

Species	Average leader growth (in)	
	'06	'10
<i>Artemisia tridentata wyomingensis</i>	1.0	1.6

BASIC COVER--

Management unit 16R, Study no: 23

Cover Type	Average Cover %	
	'06	'10
Vegetation	24.47	25.67
Rock	.04	1.01
Pavement	.07	.20
Litter	29.24	29.51
Cryptogams	4.09	.21
Bare Ground	57.20	57.72

SOIL ANALYSIS DATA --

Management unit 16R, Study no: 23, Study Name: North Spring

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
11.7	7.5	41.2	33.0	25.8	3.3	12.1	118.4	0.5

PELLET GROUP DATA--

Management unit 16R, Study no: 23

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	33	12	-	-
Elk	22	-	5 (13)	1 (3)
Deer	32	65	121 (299)	114 (281)

BROWSE CHARACTERISTICS--  
Management unit 16R, Study no: 23

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata wyomingensis</i>										
06	<b>3700</b>	6	24	70	41260	29	46	59	18/26	
10	<b>7700</b>	51	37	12	1600	25	11	13	15/26	
<i>Atriplex confertifolia</i>										
06	<b>140</b>	57	43	-	20	14	14	0	16/30	
10	<b>140</b>	29	71	-	-	0	0	0	15/32	
<i>Ceratoides lanata</i>										
06	<b>20</b>	0	100	-	-	0	100	0	15/12	
10	<b>40</b>	0	100	-	-	50	0	0	14/11	
<i>Chrysothamnus viscidiflorus stenophyllus</i>										
06	<b>640</b>	25	69	6	100	0	25	6	9/17	
10	<b>1540</b>	6	94	0	-	3	0	0	8/12	
<i>Gutierrezia sarothrae</i>										
06	<b>980</b>	43	57	0	520	0	0	0	11/13	
10	<b>1780</b>	2	91	7	-	0	0	9	8/9	
<i>Opuntia sp.</i>										
06	<b>4840</b>	1	98	1	20	0	0	.82	3/12	
10	<b>2300</b>	1	92	7	40	0	0	9	3/15	
<i>Yucca sp.</i>										
06	<b>0</b>	0	0	-	-	0	0	0	17/27	
10	<b>0</b>	0	0	-	-	0	0	0	13/28	

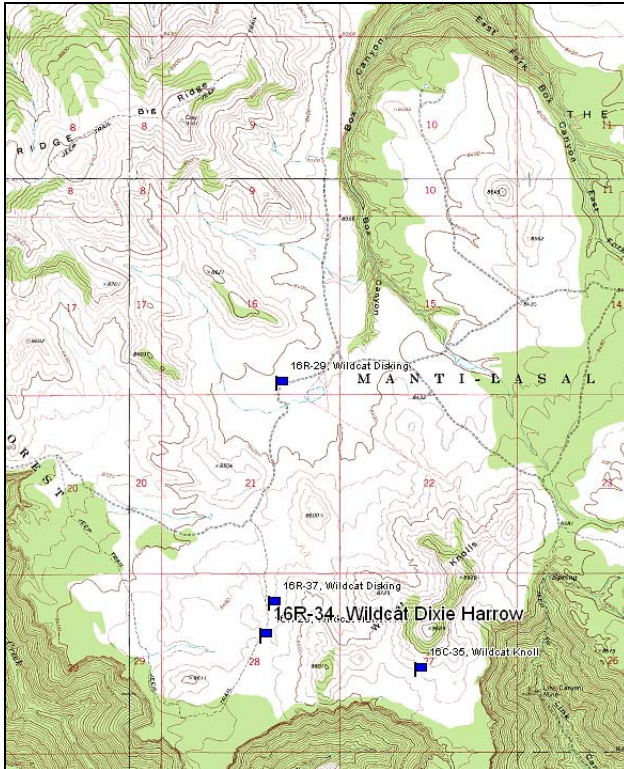
WILDCAT DIXIE HARROW - TREND STUDY NO. 16R-34-10  
[Project #1161](#)

Vegetation Type: Mountain Big Sagebrush  
Range Type: Crucial Deer Winter, Substantial Elk Winter  
NRCS Ecological Site Description: Not available  
Land Ownership: USFS  
Elevation: 8,457 ft. (2,579 m)  
Aspect: North  
Slope: 4%  
Transect bearing: 120° magnetic  
Belt placement: line 1 (11ft & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)  
Notes: line 4 is 75ft in length

Directions:

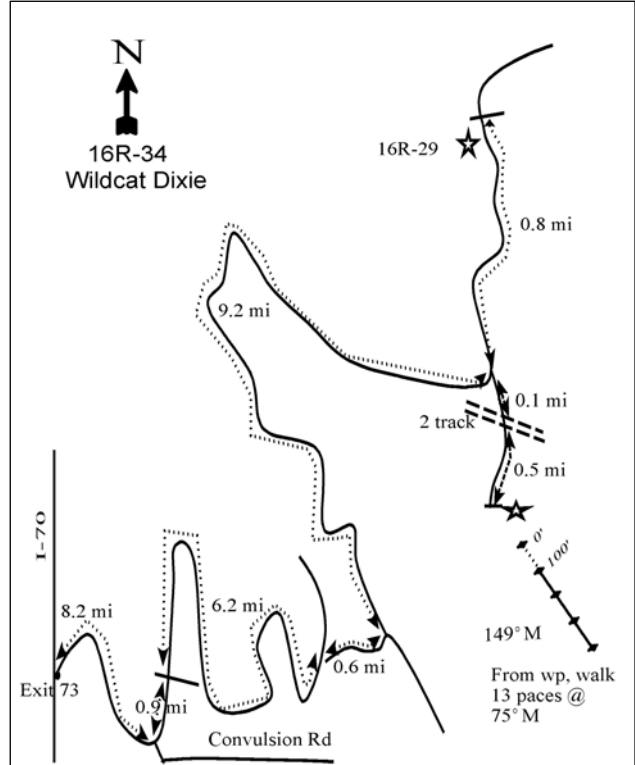
From Exit 73 on I-70, drive 8.2 miles turn on a road on the left and continue 0.9 miles follow signs for Duncan Mountain. On Convulsion Road, drive 6.2 miles to a fork. Go right for 0.6 miles to another fork. Go left and continue for 9.2 miles to a two track road on the right. Drive 0.1 miles on the two track to a fork and go right. Continue 0.5 miles to the witness post. The 0' stake is 19 paces from the witness post at 60°M. The 0' stake is marked with browse tag # 235.

Map Name: Emery West



Township: 21S Range: 5E Section: 28

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 468628 E 4312661 N

WILDCAT DIXIE HARROW - WRI STUDY 16R-34

[Project #1161](#)

**Site Information:** The study is located approximately six and a half miles northwest of Emery on the west side of Wildcat Knolls. This site was established in 2008 prior to a one-way Dixie harrow treatment designed to diversify the age classes of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) community and invigorate herbaceous understory growth on about 400 acres. The area was seeded with grasses and forbs using a broadcast seeder just prior to the Dixie harrow treatment in the fall of 2008 (WRI Database 2011). Pellet group data estimated heavy elk use and moderate cattle use in 2008 and 2009, and light deer use in 2009. Elk, deer and cattle use was light in 2010 and nine sage grouse pellets groups/acre were sampled (Table - Pellet Group Data).

SEED MIX--

Management unit 16R, Study no: 34

Project Name: Wildcat Knolls Habitat Improvement			
WRI Database #: 1161			
Application: Broadcast Seeder		Acres: 1000	
Seed type		lbs in mix	lbs/acre
G	Bottlebrush Squirreltail 'Toe Jam'	500	0.50
G	Great Basin Wildrye 'Trailhead'	1000	1.00
G	Sandberg Bluegrass	1000	1.00
G	Slender Wheatgrass 'San Luis'	2027	2.03
G	Western Wheatgrass 'Arriba'	1000	1.00
F	Blue Flax 'Appar'	1000	1.00
F	Cicer Milkvetch 'Lutana'	1000	1.00
F	Prickly Lettuce	137	0.14
F	Rocky Mountain Penstemon 'Bandera'	71	0.07
F	Showy Goldeneye	25	0.03
F	Small Burnet 'Delar'	1500	1.50
F	Utah Sweetvech	249	0.25
F	Western Yarrow	100	0.10
B	Sagebrush, Mountain	500	0.50
Total Pounds:		10109	10.11
PLS Pounds:			8.52

**Browse:** Mountain big sagebrush was the predominant browse species prior to, and following the treatment. Mountain big sagebrush is the preferred browse species on the site. The recruitment of young sagebrush plants has been relatively good over the sample years. Decadence of sagebrush has been low, but was high prior to the treatment. Poor vigor has been low since the outset of the study (Table - Browse Characteristics). The canopy cover of sagebrush was reduced substantially by the treatment (Table - Canopy Cover). Other common browse on the site includes stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus*) and (*C. viscidiflorus* ssp. *viscidiflorus*) (Table - Browse Characteristics).

**Herbaceous Understory:** Grasses are abundant but not overly diverse. The dominant grass species on the site are mutton bluegrass (*Poa fendleriana*) and western wheatgrass (*Agropyron smithii*). Prairie junegrass (*Koeleria cristata*) and sedge (*Carex* sp.) have decreased substantially and were not sampled on the site in 2010 and prairie junegrass was not sampled in 2009. Seeded species sampled after the treatment include western wheatgrass, Sandberg bluegrass (*Poa secunda*), and bottlebrush squirreltail, though all three species were present prior to the treatment. Perennial forb species are diverse and fairly abundant. Fleabane (*Erigeron* sp.), redroot buckwheat (*Eriogonum racemosum*), and Wyoming painted cup (*Castilleja linariaefolia*) have been the dominant forb species since the outset of the study although Wyoming painted cup

has steadily decreased in dominance. Lewis flax (*Linum lewisii*) was the only seeded forb species sampled after the treatment (Table - Herbaceous Trends).

Soil: The soil texture is a sandy clay loam with a moderate acidic soil reaction (pH 5.7) (Table - Soil Analysis Data). Bare ground cover is high with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### **Pre vs. One Year Post Treatment, 2008 vs. 2009**

Browse: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Mountain big sagebrush canopy cover decreased from 32% to 4%. The average height of sagebrush decreased from 18 inches to 12 inches, while the average crown width decreased from 30 inches to 15 inches.

Grass: The sum of nested frequency of perennial grasses decreased 36% and cover decreased from 17% to 12%, although the site had not yet gone through a complete growing season after the treatment. The only species that showed significant increases in nested frequency and cover was sedge. No seeded grass species were sampled in 2009 that had not already been sampled in 2008.

Forb: The sum of nested frequency of perennial forbs decreased 46% and cover decreased from 13% to 7%. Lewis flax was the only seeded forb species sampled at low frequency and cover.

### **Trend Assessments**

#### Browse

- **2009 to 2010 - slightly up (+1)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Mountain big sagebrush canopy cover increased from 4% to 6%. The recruitment of young sagebrush plants was moderate at 17% and decadence was low at 8% of the population. Stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus*) canopy cover increased from 3% to 6%.

#### Grasses

- **2009 to 2010 - stable (0)**: The sum of nested frequency of perennial grasses remained similar while cover declined from 12% to 10%. Western wheatgrass increased significantly in nested frequency while cover increased from 3% to 4%. Mutton bluegrass cover decreased from 6% to 4% with no significant change in nested frequency. The sedge species was not sampled in 2010.

#### Forbs

- **2009 to 2010 - slightly up (+1)**: The sum of nested frequency of perennial forbs increased 18% while cover increased from 7% to 8%. Fleabane (*Erigeron sp.*) and redroot buckwheat were the most common species sampled. No seeded forbs were sampled.

HERBACEOUS TRENDS--

Management unit 16R, Study no: 34

T y p e	Species	Nested Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
G	Agropyron smithii	a138	a128	b190	1.29	2.52	3.51
G	Agropyron spicatum	2	8	-	.00	.45	-
G	Bromus inermis	7	-	-	.04	-	.00
G	Carex sp.	b66	c106	a-	.45	2.06	-
G	Koeleria cristata	b55	a-	a-	1.33	-	-
G	Poa fendleriana	b250	ab191	a156	9.88	6.28	4.48
G	Poa secunda	ab16	a8	b39	.26	.21	.92
G	Sitanion hystrix	b58	a3	a5	.65	.06	.03
G	Stipa comata	b30	a-	a	.60	-	-
G	Stipa lettermani	b92	a14	a37	2.04	.22	1.40
Total for Annual Grasses		0	0	0	0	0	0
Total for Perennial Grasses		714	458	427	16.56	11.83	10.37
Total for Grasses		714	458	427	16.56	11.83	10.37
F	Agoseris glauca	a-	a-	a10	-	-	.39
F	Antennaria rosea	7	1	2	.01	.00	.03
F	Arabis sp.	5	-	4	.01	-	.06
F	Aster sp.	2	-	-	.01	-	-
F	Astragalus convallarius	47	44	41	1.55	.65	.82
F	Castilleja linariaefolia	b53	ab36	a28	1.95	1.53	.95
F	Castilleja sp.	-	-	5	-	-	.12
F	Chaenactis douglasii	4	4	2	.06	.01	.03
F	Chenopodium album (a)	-	4	9	-	.00	.04
F	Chenopodium leptophyllum(a)	a-	b27	c61	-	.13	.17
F	Collinsia parviflora (a)	b28	a-	a1	.04	-	.00
F	Comandra pallida	b72	a34	a29	.52	.52	.22
F	Crepis acuminata	5	3	9	.10	.00	.24
F	Erigeron sp.	b139	a64	a64	1.88	1.42	1.53
F	Eriogonum racemosum	b134	a57	b123	3.07	.58	1.66
F	Eriogonum sp.	3	-	4	.00	-	.03
F	Eriogonum umbellatum	a25	b43	a13	.68	.76	.04
F	Gayophytum ramosissimum(a)	a-	a7	b195	-	.03	2.70
F	Ipomopsis aggregata	ab18	a3	b28	.14	.06	.57
F	Lappula occidentalis (a)	-	-	3	-	-	.03
F	Lesquerella sp.	-	5	-	-	.01	-
F	Linum lewisii	-	12	-	-	.02	.03
F	Lithospermum ruderales	1	-	-	.00	-	-
F	Lupinus argenteus	b32	a8	a3	1.97	.48	.00
F	Lupinus sp.	ab3	a-	b12	.00	-	.63
F	Machaeranthera canescens	5	-	3	.07	.03	.03
F	Microsteris gracilis (a)	-	-	1	-	-	.00
F	Orobancha sp.	1	-	-	.00	-	-
F	Penstemon sp.	b46	a-	a1	.27	-	.03
F	Penstemon sp.	30	25	19	.73	.32	.68

Type	Species	Nested Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
F	<i>Polygonum douglasii</i> (a)	<sub>b</sub> 49	<sub>a</sub> 2	<sub>a</sub> 4	.09	.00	.02
F	<i>Sanguisorba minor</i>	3	-	-	.01	-	-
F	<i>Senecio multilobatus</i>	-	3	1	-	.01	.00
F	<i>Trifolium</i> sp.	-	-	2	-	-	.00
F	<i>Viguiera multiflora</i>	-	1	-	-	.15	-
F	<i>Zigadenus paniculatus</i>	5	-	2	.06	-	.03
Total for Annual Forbs		77	40	274	0.13	0.17	2.97
Total for Perennial Forbs		640	343	405	13.15	6.61	8.20
Total for Forbs		717	383	679	13.29	6.79	11.18

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 16R, Study no: 34

Type	Species	Strip Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
B	<i>Artemisia tridentata vaseyana</i>	98	0	84	24.71	5.12	6.20
B	<i>Chrysothamnus viscidiflorus</i>	27	0	72	1.50	3.10	4.11
B	<i>Chrysothamnus viscidiflorus viscidiflorus</i>	76	0	25	2.47	1.05	2.32
B	<i>Symphoricarpos oreophilus</i>	3	0	9	.00	.10	.42
B	<i>Tetradymia canescens</i>	0	0	11	-	.31	.35
Total for Browse		204	0	201	28.68	9.71	13.42

#### CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 34

Species	Percent Cover		
	'08	'09	'10
<i>Artemisia tridentata vaseyana</i>	32.08	3.68	5.56
<i>Chrysothamnus viscidiflorus</i>	1.81	2.71	5.83
<i>Chrysothamnus viscidiflorus viscidiflorus</i>	3.65	.51	.43
<i>Symphoricarpos oreophilus</i>	-	.25	.36
<i>Tetradymia canescens</i>	-	.05	.13

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 16R, Study no: 34

Species	Average leader growth (in)		
	'08	'09	'10
<i>Artemisia tridentata vaseyana</i>	0.7	-	1.5



BASIC COVER--

Management unit 16R, Study no: 34

Cover Type	Average Cover %		
	'08	'09	'10
Vegetation	55.50	26.02	33.63
Rock	0	.03	.03
Pavement	.04	.05	.01
Litter	45.60	44.32	43.56
Cryptogams	.27	0	0
Bare Ground	23.45	40.69	40.39

SOIL ANALYSIS DATA --

Management unit 16R, Study no: 34, Study Name: Wildcat Dixie Harrow

Effective rooting depth (in)	pH	sandy clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	5.7	56.7	20.7	22.6	1.8	12.6	195.2	1.0

PELLET GROUP DATA--

Management unit 16R, Study no: 34

Type	Quadrat Frequency			Days use per acre (ha)		
	'08	'09	'10	'08	'09	'10
Rabbit	10	3	4	-	-	-
Grouse	1	-	2	17/acre	-	9/acre
Elk	59	22	17	63 (155)	38 (94)	15 (38)
Deer	4	23	24	-	1 (2)	19 (48)
Cattle	2	10	1	25 (63)	18 (45)	2 (5)

BROWSE CHARACTERISTICS--

Management unit 16R, Study no: 34

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
<b>Artemisia nova</b>										
08	0	0	0	-	-	0	0	0	-/-	
09	No density data collected									9/7
10	0	0	0	-	-	0	0	0	-/-	
<b>Artemisia tridentata vaseyana</b>										
08	8420	6	53	41	180	16	1	8	18/30	
09	No density data collected									12/15
10	5200	17	75	8	60	8	0	7	13/18	
<b>Chrysothamnus nauseosus</b>										
08	0	0	0	-	-	0	0	0	-/-	
09	No density data collected									10/13
10	0	0	0	-	-	0	0	0	-/-	

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<b>Chrysothamnus viscidiflorus</b>									
08	<b>3060</b>	1	95	4	-	0	1	0	5/10
09	No density data collected								8/11
10	<b>5680</b>	13	87	0	80	0	0	0	8/12
<b>Chrysothamnus viscidiflorus viscidiflorus</b>									
08	<b>5520</b>	25	71	4	-	0	0	.72	9/12
09	No density data collected								6/10
10	<b>980</b>	8	92	0	20	0	0	0	7/13
<b>Gutierrezia sarothrae</b>									
08	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	11/13
<b>Rosa woodsii</b>									
08	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								5/6
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<b>Symphoricarpos oreophilus</b>									
08	<b>60</b>	67	33	-	20	0	0	0	11/25
09	No density data collected								9/10
10	<b>620</b>	19	81	-	20	0	0	0	10/15
<b>Tetradymia canescens</b>									
08	<b>0</b>	0	0	-	-	0	0	0	9/14
09	No density data collected								5/6
10	<b>440</b>	27	73	-	180	0	0	0	7/11

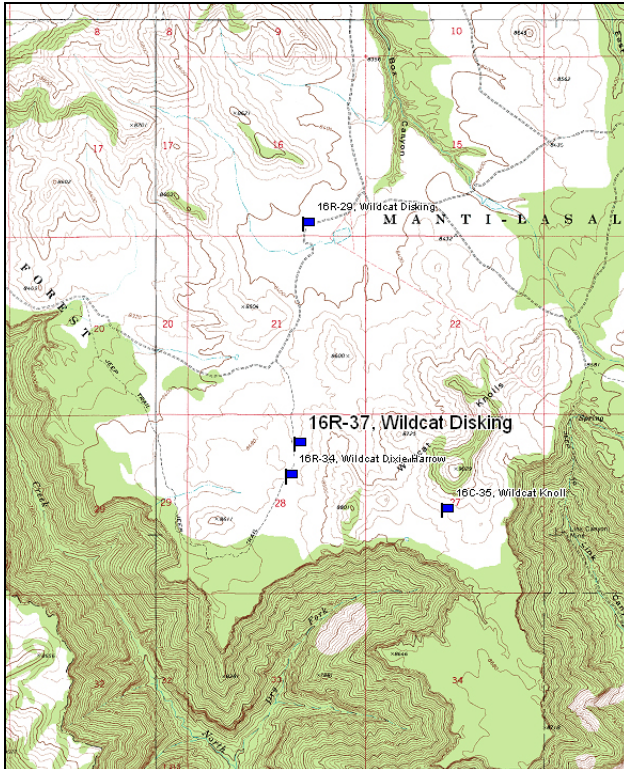
WILDCAT DISKING - TREND STUDY NO. 16R-37-10  
[Project #1161](#) and [Project #1392](#)

Vegetation Type: Mountain Big Sagebrush  
Range Type: Crucial Deer Winter, Substantial Elk Winter  
NRCS Ecological Site Description: Not available  
Land Ownership: USFS  
Elevation: 8,443 ft. (2,573 m)  
Aspect: North  
Slope: 3%  
Transect bearing: 160° magnetic  
Belt placement: Read Baseline, No Belts

Directions:

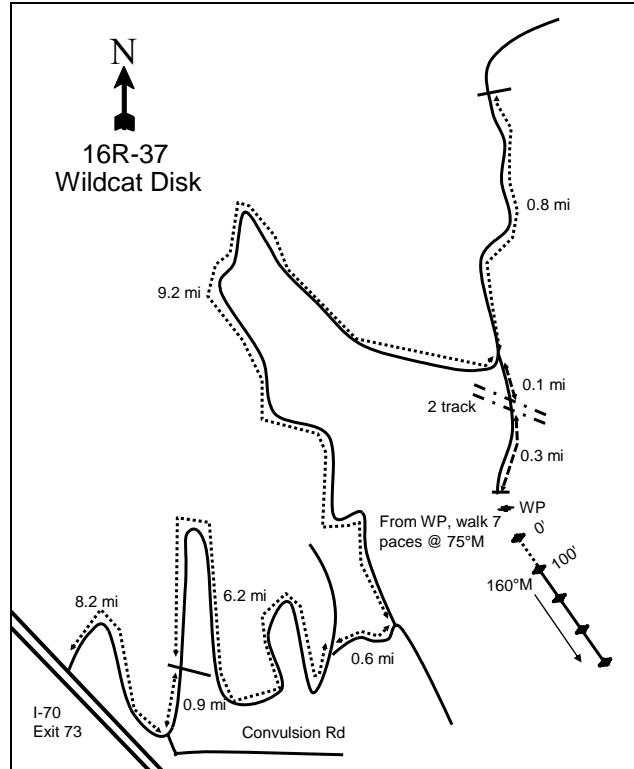
From Exit 73 on I-70, drive 8.2 miles turn on a road on the left and continue 0.9 miles follow signs to Duncan Mountain. On Convulsion Road, drive 6.2 miles to a fork. Go right for 0.6 miles to another fork. Go left and continue for 9.2 miles to a two track road on the right. Drive 0.1 miles on the two track to a fork and go right. Continue 0.3 miles to the witness post and then 7 paces at 75°M to the 0' stake.

Map Name: Emery West



Township: 21S Range: 5E Section: 28

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 468707 E 4312960 N

WILDCAT DISKING - WRI STUDY 16R-37  
[Project #1161](#) and [Project #1392](#)

**Site Description**

Site Information: The study is located approximately six and a half miles northwest of Emery on the west side of Wildcat Knolls. This study was established in 2009 to monitor a disking treatment as part of the Wildcat Habitat Improvement Project. The area was double disked in the fall of 2008 then grasses and forbs were seeded using a broadcast spreader. In the fall of 2009 the area was reseeded using a rangeland drill. The treatment is designed to create a mosaic stand of various sagebrush age classes and to reduce the quantity of crested wheatgrass, thus increasing the amount of native grasses and forbs that are more beneficial to sage-grouse and other wildlife species (WRI Database 2011). Pellet group data estimated light elk and cattle use in 2009 and 2010 (Table - Pellet Group Data). Soil erosion condition was classified as stable in 2009 and 2010.

**SEED MIX--**

Management unit 16R, Study no: 34

Project Name: Wildcat Knolls Habitat Improvement WRI Database #: 1161				Project Name: Wildcat Sagebrush Restoration Project Phase 2 WRI Database #: 1392			
Application: Broadcast		Acres: 1000		Application: Drill		Acres: 500	
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix	lbs/acre
G	Bottlebrush Squirreltail 'Toe Jam'	500	0.50	G	Bottlebrush Squirreltail 'Toe Jam'	250	0.50
G	Great Basin Wildrye 'Trailhead'	1000	1.00	G	Great Basin Wildrye 'Trailhead'	500	1.00
G	Sandberg Bluegrass	1000	1.00	G	Sandberg Bluegrass	375	0.75
G	Slender Wheatgrass 'San Luis'	2027	2.03	G	Slender Wheatgrass 'San Luis'	1000	2.00
G	Western Wheatgrass 'Arriba'	1000	1.00	G	Western Wheatgrass 'Arriba'	500	1.00
F	Blue Flax 'Appar'	1000	1.00	F	Blue Flax 'Appar'	500	1.00
F	Cicer Milkvetch 'Lutana'	1000	1.00	F	Cicer Milkvetch 'Lutana'	500	1.00
F	Prickly Lettuce	137	0.14	F	Prickly Lettuce	50	0.10
F	Rocky Mountain Penstemon 'Bandera'	71	0.07	F	Rocky Mountain Penstemon 'Bandera'	50	0.10
F	Showy Goldeneye	25	0.03	F	Showy Goldeneye	13	0.03
F	Small Burnet 'Delar'	1500	1.50	F	Small Burnet 'Delar'	750	1.50
F	Utah Sweetvech	249	0.25	F	Utah Sweetvech 'Timp'	125	0.25
F	Western Yarrow	100	0.10	F	Western Yarrow	50	0.10
B	Sagebrush, Mountain	500	0.50	B	Sagebrush, Mountain	250	0.25
Total Pounds:		10109	10.11	Total Pounds:		4913	9.83
PLS Pounds:			8.52	PLS Pounds:			8.50

Browse: The disking treatment effectively removed all woody vegetation within the treatment area, although it is unknown what the browse component was prior to treatment. There was no canopy cover of any browse species sampled in 2009 (Table - Canopy Cover). Only rubber rabbitbrush (*Chrysothamnus nauseosus*) and stickyleaf low rabbitbrush (*C viscidiflorus*) was sampled solely for height/crown purposes (Table - Browse Characteristics).

Herbaceous Understory: Grasses are not abundant or diverse. Perennial grasses decreased in frequency and cover. The seeded species, western wheatgrass (*Agropyron smithii*), has been the most common grass on the site. Western wheatgrass was likely well established before the treatment as it was common on other study sites in the immediate proximity. Crested wheatgrass (*Agropyron cristatum*) and smooth brome (*Bromus inermis*) were also sampled in each year. Much of the grass growth occurred in furrows that ran somewhat parallel to the baseline. Seeded grass species sampled include western wheatgrass, bottlebrush squirreltail (*Sitanion hystrix*), and Sandberg bluegrass (*Poa secunda*). Perennial forbs were rare on the site. Seeded forb species sampled include blue flax (*Linum lewisii*), small burnet (*Sanguisorba minor*), western yarrow (*Achillea*

*millefolium*) and prickly lettuce (*Lactuca serriola*). Forbs were dominated by annuals with slimleaf goosefoot (*Chenopodium leptophyllum*) being the dominant forb species (Table - Herbaceous Trends).

Soil: The soil texture is a sandy clay loam with a moderate acidic soil reaction (pH 5.7) (Table - Soil Analysis Data). Bare ground cover is high with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2009 and 2010.

### Trend Assessments

Browse:

- **2009 to 2010 - stable (0)**: No browse were sampled, other than low rabbitbrush and rubber rabbitbrush for height and crown measurements.

Grasses:

- **2009 to 2010 - down (-2)**: The nested frequency of perennial grasses decreased 23% while cover decreased from 5% to 1%. Crested wheatgrass significantly decreased in nested frequency and western wheatgrass cover declined from 3% to 1%.

Forbs:

- **2009 to 2010 - slightly down (-1)**: The sum of nested frequency of perennial forbs remained similar but cover decreased from 2% to 1%. Annual forbs increased substantially in nested frequency and cover increased from 25% to 31%. Slimleaf goosefoot remains the predominant forb and provided 23% cover. Seeded species sampled in 2010 included: blue flax, prickly lettuce, small burnet, and western yarrow.

HERBACEOUS TRENDS--

Management unit 16R, Study no: 37

Type	Species	Nested Frequency		Average Cover %	
		'09	'10	'09	'10
G	Agropyron cristatum	<sub>b</sub> 72	<sub>a</sub> 34	.52	.14
G	Agropyron smithii	148	135	3.27	.75
G	Bromus inermis	27	17	.71	.24
G	Bromus tectorum (a)	-	3	-	.03
G	Poa fendleriana	2	6	.00	.02
G	Poa secunda	10	12	.13	.02
G	Sitanion hystrix	6	-	.03	-
Total for Annual Grasses		0	3	0	0.03
Total for Perennial Grasses		265	204	4.68	1.18
Total for Grasses		265	207	4.68	1.21
F	Achillea millefolium	-	3	-	.01
F	Agoseris glauca	-	2	-	.03
F	Astragalus sp.	5	1	.00	.00
F	Calochortus nuttallii	-	1	-	.01
F	Chenopodium leptophyllum(a)	262	398	24.21	22.84
F	Collinsia parviflora (a)	-	2	-	.03
F	Comandra pallida	<sub>a</sub> -	<sub>b</sub> 36	-	.26
F	Crepis acuminata	1	-	.01	-
F	Eriogonum umbellatum	-	4	-	.01

Type	Species	Nested Frequency		Average Cover %	
		'09	'10	'09	'10
F	Gayophytum ramosissimum(a)	a <sup>-</sup>	b <sup>38</sup>	-	.38
F	Lactuca serriola (a)	a <sup>3</sup>	b <sup>38</sup>	.03	.22
F	Lappula occidentalis (a)	a <sup>-</sup>	b <sup>74</sup>	-	1.00
F	Linum lewisii	b <sup>150</sup>	a <sup>6</sup>	1.72	.02
F	Lithophragma sp.	-	9	-	.02
F	Monolepis nuttalliana (a)	a <sup>-</sup>	b <sup>147</sup>	-	5.84
F	Polygonum douglasii (a)	48	33	.54	.21
F	Sanguisorba minor	b <sup>12</sup>	a <sup>-</sup>	.02	-
F	Trifolium sp.	a <sup>-</sup>	b <sup>81</sup>	-	.23
F	Zigadenus paniculatus	a <sup>-</sup>	b <sup>12</sup>	-	.02
Total for Annual Forbs		313	730	24.78	30.53
Total for Perennial Forbs		168	155	1.76	0.63
Total for Forbs		481	885	26.55	31.17

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 16R, Study no: 37

Type	Species	Strip Frequency		Average Cover %	
		'09	'10	'09	'10

#### BASIC COVER--

Management unit 16R, Study no: 37

Cover Type	Average Cover %	
	'09	'10
Vegetation	27.95	31.67
Rock	.09	.05
Pavement	.01	0
Litter	24.11	12.19
Bare Ground	60.01	72.50

#### PELLET GROUP DATA--

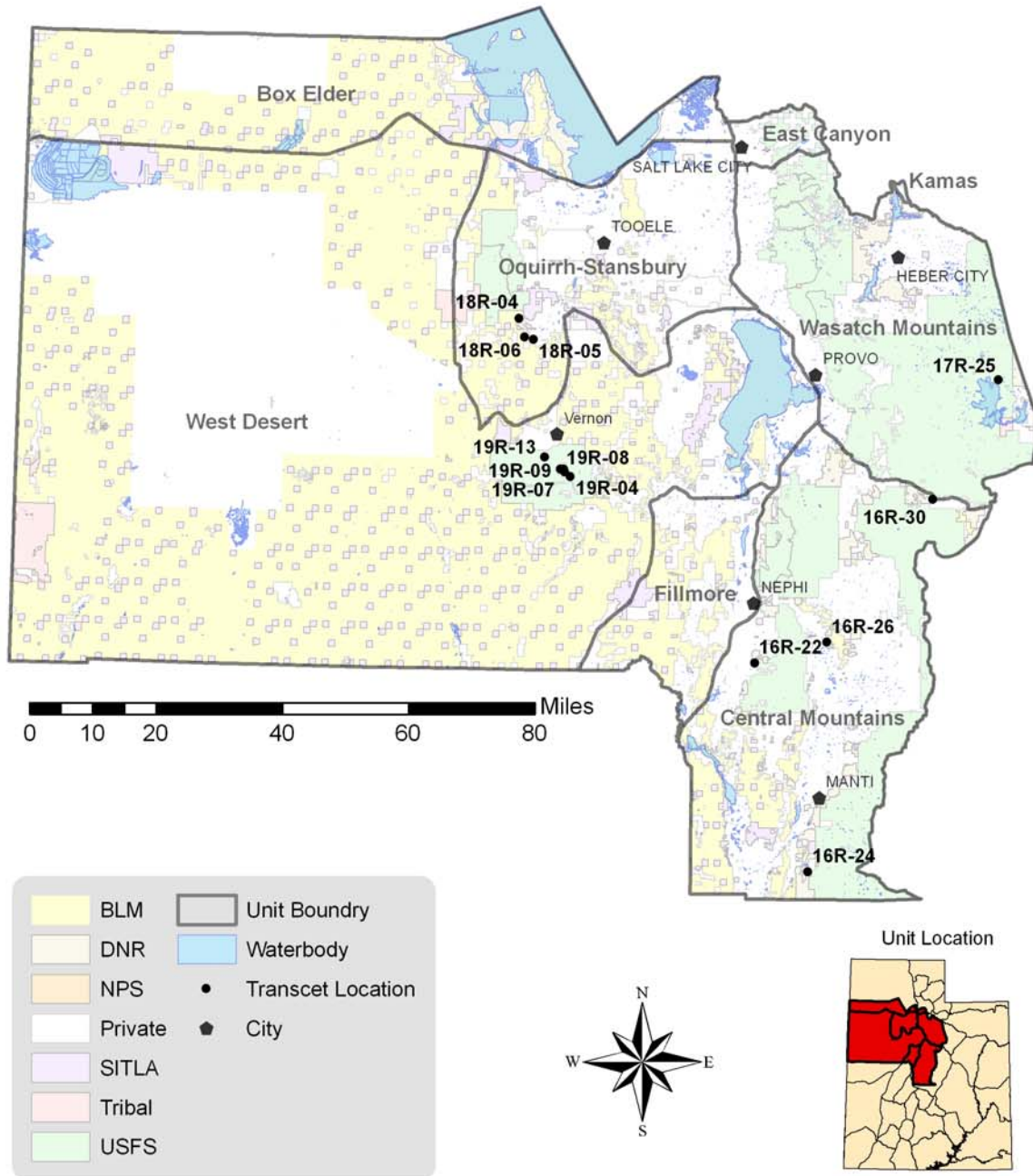
Management unit 16R, Study no: 37

Type	Quadrat Frequency		Days use per acre (ha)	
	'09	'10	'09	'10
Rabbit	3	3	-	-
Grouse	-	-	-	35/acre
Elk	8	14	6 (15)	11 (26)
Deer	6	1	-	1 (3)
Cattle	4	-	9 (22)	-

BROWSE CHARACTERISTICS--  
 Management unit 16R, Study no: 37

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Chrysothamnus nauseosus									
09	No density data collected								16/12
10	0	0	0	-	-	0	0	0	14/10
Chrysothamnus viscidiflorus									
09	No density data collected								-/-
10	0	0	0	-	-	0	0	0	5/6

# Central Region WRI Studies 2010





LEVAN SPRAY AND DRILL - TREND STUDY NO. 16R-22-10

[Project #271](#)

Vegetation Type: Perennial Grass/Forb

Range Type: Crucial Deer Winter

NRCS Ecological Site Description: [Upland Stony Loam \(Mountain Big Sagebrush\), R028AY334UT](#)

Land Ownership: UDWR

Elevation: 5,500 ft. (1,676 m)

Aspect: West

Slope: 5%

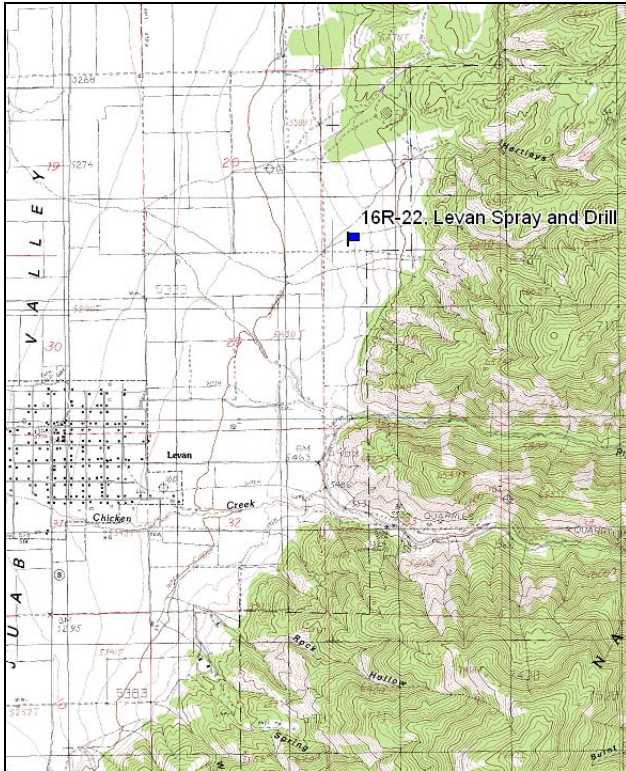
Transect bearing: 16° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

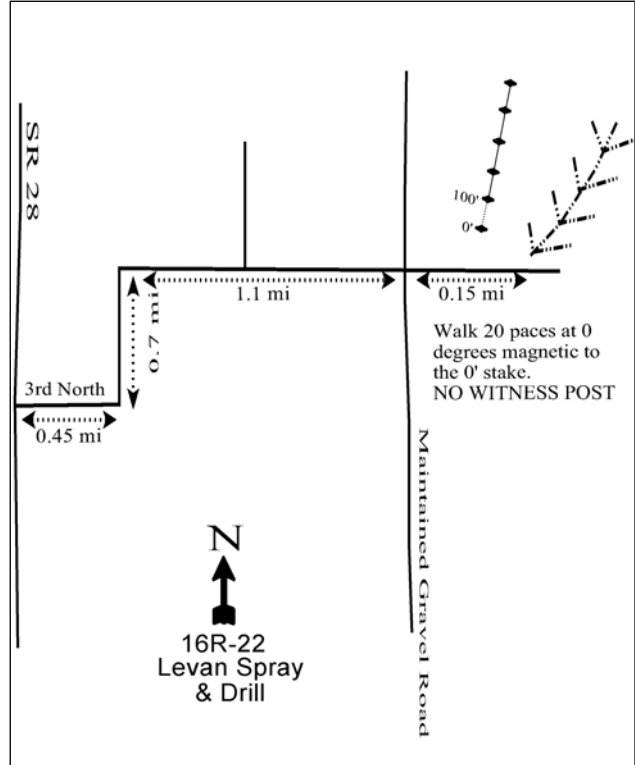
From Highway SR 28 turn east onto 3<sup>rd</sup> North in Levan. On 3<sup>rd</sup> north drive 0.45 miles and turn north on 5<sup>th</sup> East (may not be a street sign) and drive 0.7 miles then turn east. Drive 1.1 miles passing a road on the left to a well maintained gravel road. Cross this street and drive 0.15 miles and park. No witness post was put in. From here walk 20 paces at 0 degrees magnetic to the 0' stake marked with browse tag #200.

Map Name: Levan



Township: 14S Range: 1E Section: 21

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 428499 E 4380754 N

LEVAN SPRAY/DRILL - WRI STUDY 16R-22

[Project #271](#)

**Site Description**

Site Information: The study was established in 2006 within the South Nebo Wildlife Management Area (WMA) on historic farmland, approximately two miles northeast of Levan to monitor a weed control treatment on mule deer winter range, part of a larger lop and scatter. Jointed goatgrass (*Aegilops cylindrica*) and field bindweed (*Convolvulus arvensis*) were sprayed with a mixture of a generic Plateau herbicide (Panoramic) and Roundup (glyphosate), then disked and drill seeded in October of 2007. The objective of the project was to enhance mule deer and elk winter range habitat (WRI Database 2011). Pellet group data estimated heavy cattle use in 2006 while no pellet groups were sampled in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 16R, Study no: 22

Project Name: Levan Farm WMA		
WRI Database #: 271		
Application: Drill Seed	Acres:	70
Seed type	lbs in mix	lbs/acre
G Bluebunch WG 'Anatone'	70	1.00
G Canby Bluegrass 'Canbar'	35	0.50
G Crested Wheatgrass 'Douglas'	70	1.00
G Crested Wheatgrass 'Ephraim'	70	1.00
G Indian Ricegrass 'Rimrock'	35	0.50
G Intermediate Wheatgrass	140	2.00
G Orchardgrass 'Paiute'	35	0.50
G Snake River Wheatgrass 'Secar'	140	2.00
F Alfalfa 'Ladak'	20	0.29
F Alfalfa 'Spredor 4'	50	0.71
F Sainfoin 'Eski'	140	2.00
F Small Burnet 'Delar'	140	2.00
F Western Yarrow	7	0.10
F Yellow Sweetclover	18	0.26
B Fourwing Saltbush	35	0.50
B Forage Kochia 'Immigrant'	70	1.00
Total Pounds:	1075	15.36
PLS Pounds:		13.70

Browse: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) populations are located to the north and east of the study but only broom snakeweed (*Gutierrezia sarothrae*) was sampled on this site. Broom snakeweed decreased significantly following treatment. Other species sampled in the height crown measurements included: white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*) and forage kochia (*Kochia prostrata*) (Table - Browse Characteristics).

Herbaceous Understory: Jointed goatgrass dominates this site. In 2010, it was recorded that multiple past years' growth of jointed goatgrass were overlaid and intermingled with field bindweed and current year's growth. Field bindweed accounted for the majority of the forb cover in each sample year. The treatment has failed to control jointed goatgrass. Most of the successfully seeded grasses were found on the edge of the treatment where the cover of jointed goat grass was not as high. The seeded species sampled on the site include crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*A. intermedium*), and bluebunch

wheatgrass (*A. spicatum*), though crested wheatgrass was present before the treatment (Table - Herbaceous Trends).

Soil: The soil texture is a sandy clay loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is low with extremely high amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2006 and 2010 due to high vegetation and litter cover.

**Pre vs. Three Years Post Treatment, 2006 vs. 2010**

Browse: Browse species are rare on this site. The density of broom snakeweed decreased from 940 plants/acre to 20 plants/acre.

Grasses: The nested frequency of perennial grasses increased substantially and cover increased from 2% to 7%. Intermediate wheatgrass (*Agropyron intermedium*), a seeded species, was the most common perennial species in 2010 at 5%. Crested wheatgrass (*A. cristatum*), redundantly seeded, provided 2% cover in each year, but decreased significantly in nested frequency. Jointed goatgrass cover increased from 15% to 65%. Past years' growth was intact and covered nearly the entire site, as noted in the Basic Cover table, as vegetation and litter were near 100% cover.

Forbs: The noxious weed field bindweed increased significantly in nested frequency and cover increased from 14% to 19%. Field bindweed was intertwined throughout the layers of the matted jointed goatgrass. No seeded forbs were sampled. Other perennial forbs are rare on the site. Annual forb species increased substantially in nested frequency and cover increased to 1%.

HERBACEOUS TRENDS--  
Management unit 16R, Study no: 22

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	<i>Aegilops cylindrica</i> (a)	a 394	b 441	14.76	64.80
G	<i>Agropyron cristatum</i>	b 65	a 15	2.38	1.47
G	<i>Agropyron intermedium</i>	a -	b 59	-	4.98
G	<i>Agropyron spicatum</i>	-	4	-	.09
G	<i>Bromus japonicus</i> (a)	b 55	a -	.61	-
G	<i>Bromus tectorum</i> (a)	b 32	a 9	.26	.04
G	<i>Poa secunda</i>	-	5	.00	.06
G	<i>Vulpia octoflora</i> (a)	-	4	-	.03
Total for Annual Grasses		481	454	15.63	64.88
Total for Perennial Grasses		65	83	2.39	6.59
Total for Grasses		546	537	18.03	71.48
F	<i>Alyssum alyssoides</i> (a)	a 7	b 44	.01	.33
F	<i>Astragalus</i> sp.	3	-	.03	-
F	<i>Convolvulus arvensis</i>	319	307	13.85	19.43
F	<i>Helianthus annuus</i> (a)	1	-	.00	-
F	<i>Lactuca serriola</i> (a)	2	4	.01	.15
F	<i>Lithospermum ruderales</i>	5	-	.15	-
F	<i>Onobrychis viciaefolia</i>	-	-	-	.00
F	<i>Phlox longifolia</i>	12	6	.08	.01
F	<i>Ranunculus testiculatus</i> (a)	a -	b 65	-	.79

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	Sphaeralcea coccinea	1	6	.00	.03
F	Tragopogon dubius (a)	4	3	.01	.00
Total for Annual Forbs		14	116	0.03	1.28
Total for Perennial Forbs		340	319	14.12	19.47
Total for Forbs		354	435	14.16	20.76

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 16R, Study no: 22

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Gutierrezia sarothrae	15	1	.40	-
Total for Browse		15	1	0.40	0

#### CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 22

Species	Percent Cover	
	'06	'10
Gutierrezia sarothrae	.36	.11

#### BASIC COVER--

Management unit 16R, Study no: 22

Cover Type	Average Cover %	
	'06	'10
Vegetation	34.87	77.65
Rock	.93	1.33
Pavement	2.27	.40
Litter	68.88	67.43
Bare Ground	5.35	8.57

#### SOIL ANALYSIS DATA --

Management unit 16R, Study no: 22, Study Name: Levan Spray and Drill

Effective rooting depth (in)	pH	sandy clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
7.8	7.2	56.0	18.1	25.9	2.6	14.7	352.0	0.8

#### PELLET GROUP DATA--

Management unit 16R, Study no: 22

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	25	-	-	-
Cattle	13	-	55 (136)	-

BROWSE CHARACTERISTICS--  
Management unit 16R, Study no: 22

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata vaseyana</i>									
06	0	0	0	-	-	0	0	0	28/61
10	0	0	0	-	-	0	0	0	46/71
<i>Chrysothamnus nauseosus albicaulis</i>									
06	0	0	0	-	-	0	0	0	21/25
10	0	0	0	-	-	0	0	0	-/-
<i>Gutierrezia sarothrae</i>									
06	940	2	32	66	-	0	0	55	9/10
10	20	0	100	0	-	0	0	0	14/19
<i>Kochia prostrata</i>									
06	0	0	0	-	-	0	0	0	13/33
10	0	0	0	-	-	0	0	0	-/-
<i>Tetradymia canescens</i>									
06	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	26/19

12 MILE DIXIE - TREND STUDY NO. 16R-24-10  
[Project #273](#)

Vegetation Type: Annual Grass/Forb  
Range Type: Crucial Deer Winter/Spring, Crucial Elk Winter  
NRCS Ecological Site Description: [Upland Loam \(Basin Big Sagebrush\), R047XA308UT](#)  
Land Ownership: UDWR  
Elevation: 6,200 ft. (1,890 m)  
Aspect: West  
Slope: 3%  
Transect bearing: 333° magnetic  
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)  
Notes: No Rebar

Directions:

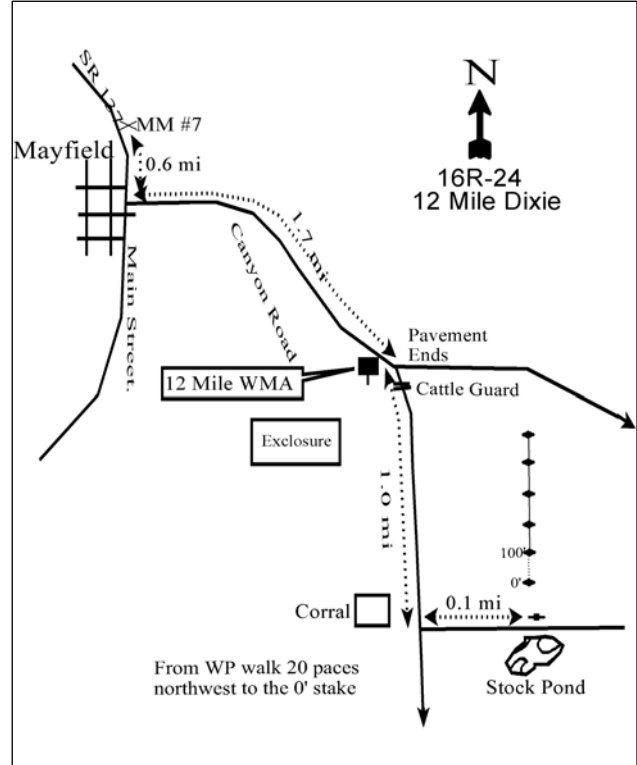
Drive south on SR 137 toward Mayfield. From mile marker #7 drive 0.6 miles and turn left (east) onto Canyon Road. Drive on this paved road for 1.7 miles to a fork and the end of the pavement and beginning of the dirt road with a sign showing “12 Mile WMA”. From the dirt road, cross a cattle guard and drive 1.0 mile passing a road on the right to a corral on the right and road on the left (east). Turn here and drive 0.1 miles to a half high witness post on the left. From here walk 20 paces northwest to the 0' stake marked with browse tag #199.

Map Name: Mayfield



Township: 20S Range: 2E Section: 3

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 442056 E 4327496 N

12 MILE DIXIE - WRI STUDY 16R-24

[Project #273](#)

**Site Description**

Site Information: The study was established in 2006, two and a half miles southeast of Mayfield within the Southwest Manti Wildlife Management Area (WMA)-Mayfield Unit to monitor a former 40 acre agricultural parcel, located in a small valley surrounded by pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands and scattered sagebrush but is very poorly vegetated, dominated by jointed goatgrass (*Aegilops cylindrica*), cheatgrass (*Bromus tectorum*), and other weeds. The area was treated with Paramount (quinclorac) and Roundup (glyphosate) herbicides in the fall of 2006, left fallow, and retreated with Roundup in spring 2007 and then drill seeded in the fall of 2007 (WRI Database 2011). Pellet group data estimated light use by deer and elk in all sample years (Table - Pellet Group Data).

SEED MIX--

Management unit 16R, Study no: 23

Project Name: 12 Mile WMA			
WRI Database #: 273			
Application: Drill Seeder		Acres: 60	
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Anatone'	60	1.00
G	Canby Bluegrass 'Canbar'	30	0.50
G	Crested Wheatgrass 'Douglas'	60	1.00
G	Crested Wheatgrass 'Hycrest'	60	1.00
G	Indian Ricegrass 'Rimrock'	30	0.50
G	Intermediate Wheatgrass	120	2.00
G	Orchardgrass 'Paiute'	30	0.50
G	Russian Wildrye	120	2.00
G	Snake River Wheatgrass 'Secar'	120	2.00
F	Alfalfa 'Ladak'	60	1.00
F	Blue Flax 'Appar'	30	0.50
F	Cicer Milkvetch 'Lutana'	30	0.50
F	Small Burnet 'Delar'	120	2.00
F	Western Yarrow	15	0.25
F	Yellow Sweetclover	15	0.25
B	Forage Kochia 'Immigrant'	60	1.00
B	Bitterbrush	30	0.50
Total Pounds:		990	16.50
PLS Pounds:			14.78

Browse: Browse species are rare on the site. Broom snakeweed (*Gutierrezia sarothrae*) was the only shrub sampled in 2006. Rubber rabbitbrush (*Chrysothamnus nauseosus*) and (*C. n. ssp. hololeucus*) were the only shrub species sampled in 2010 (Table - Browse Characteristics).

Herbaceous Understory: Perennial grasses were rare before the treatment, but following the treatment perennial grasses have become abundant and somewhat diverse. The dominant grass species is intermediate wheatgrass (*Agropyron intermedium*) which accounted for the majority of the grass cover in 2010. Other common grass species include crested wheatgrass (*Agropyron cristatum*) and bluebunch or Snake River wheatgrass (*Agropyron spicatum*). Several seeded grass species were sampled following the treatment include crested wheatgrass, intermediate wheatgrass, Snake River wheatgrass, and Russian wildrye (*Elymus junceus*). Prior to the treatment, cheatgrass provided the majority of grass cover but after the treatment cheatgrass has

become rare on the site. Jointed goatgrass has decreased in abundance since the treatment. Forbs are abundant but not overly diverse. Field bindweed (*Convolvulus arvensis*) was the most common forb in all sample years and has provided the majority of forb cover in each year. Annual forbs are abundant and are dominated by storksbill (*Erodium cicutarium*) and bur buttercup (*Ranunculus testiculatus*). Small burnet (*Sanguisorba minor*) was the only seeded forb sampled. The noxious weed Squarrose knapweed (*Centaurea virgata*) was sampled for the first time in 2010 (Table - Herbaceous Trends).

Soil: The soil texture is a sandy clay loam with a slightly alkaline soil reaction (pH 7.6) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2006 due to slight surface litter movement, minor surface rock movement, minor pedestalling, flow patterns, and slight soil movement. The soil erosion condition was classified as stable in 2007.

### Pre vs. Three Years Post Treatment, 2006 vs. 2010

Browse: No palatable browse species were sampled. Rubber rabbitbrush (*Chrysothamnus nauseosus*) was sampled 740 plants/acre and (*C. n. ssp. hololeucus*) 40 plant/acre following the treatment and provided less than 1% cover.

Grasses: The sum of nested frequency of perennial grasses increased five fold and cover increased from 2% to 13%. Cheatgrass was the dominant grass species in 2006 and provided 10% cover; following the treatment cheatgrass was substantially reduced to less than 1% cover accompanied by a significant decrease in nested frequency. Intermediate wheatgrass became the dominant grass species at 9% cover. Crested wheatgrass provided 2% cover and Snake River wheatgrass provided 1%.

Forbs: The sum of nested frequency of perennial forbs remained similar, though cover increased from 11% to 16%. The dominant perennial forb in both samples was field bindweed which increased in cover from 11% to 16%. Two annual species, storksbill and bur buttercup, combined to provide 8% cover in 2006 and 10% cover in 2010. Squarrose knapweed was sampled in one quadrat but was seen throughout the site, many of which were removed by the crew during the sampling.

### HERBACEOUS TRENDS--

Management unit 16R, Study no: 24

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	<i>Aegilops cylindrica</i> (a)	b53	a19	.95	.26
G	<i>Agropyron cristatum</i>	a-	b53	-	2.01
G	<i>Agropyron intermedium</i>	a-	b218	-	9.19
G	<i>Agropyron spicatum</i>	a-	b38	-	1.15
G	<i>Bromus tectorum</i> (a)	b189	a44	10.09	.38
G	<i>Elymus junceus</i>	-	1	-	.15
G	<i>Hordeum pusillum</i>	27	11	1.58	.39
G	<i>Poa bulbosa</i>	b47	a26	.67	.36
G	<i>Poa secunda</i>	-	2	-	.03
Total for Annual Grasses		242	63	11.04	0.63
Total for Perennial Grasses		74	349	2.26	13.29
Total for Grasses		316	412	13.30	13.93
F	<i>Alyssum alyssoides</i> (a)	3	5	.01	.01
F	<i>Centaurea virgata</i>	-	1	-	.18



Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	<i>Collinsia parviflora</i> (a)	3	-	.03	-
F	<i>Convolvulus arvensis</i>	302	320	11.05	15.69
F	<i>Cryptantha</i> sp.	3	-	.00	-
F	<i>Descurainia pinnata</i> (a)	2	12	.01	.04
F	<i>Erodium cicutarium</i> (a)	<sub>b</sub> 211	<sub>a</sub> 87	5.26	2.34
F	<i>Helianthus annuus</i> (a)	-	9	-	.01
F	<i>Medicago sativa</i>	1	-	.03	-
F	<i>Ranunculus testiculatus</i> (a)	309	333	2.42	7.24
F	<i>Salsola iberica</i> (a)	<sub>a</sub> -	<sub>b</sub> 27	-	.26
F	<i>Sanguisorba minor</i>	-	2	-	.03
F	<i>Sisymbrium altissimum</i> (a)	-	1	.00	.00
F	<i>Tragopogon dubius</i>	3	-	.01	-
F	<i>Veronica biloba</i> (a)	5	-	.01	-
Total for Annual Forbs		533	474	7.76	9.92
Total for Perennial Forbs		309	323	11.09	15.90
Total for Forbs		842	797	18.86	25.83

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 16R, Study no: 24

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	<i>Chrysothamnus nauseosus</i>	0	12	-	.88
B	<i>Chrysothamnus nauseosus hololeucus</i>	0	2	-	-
B	<i>Gutierrezia sarothrae</i>	1	0	-	-
Total for Browse		1	14	0	0.87

#### CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 24

Species	Percent Cover	
	'06	'10
<i>Chrysothamnus nauseosus</i>	-	.63
<i>Chrysothamnus nauseosus hololeucus</i>	-	.11
<i>Gutierrezia sarothrae</i>	.40	-

BASIC COVER--

Management unit 16R, Study no: 24

Cover Type	Average Cover %	
	'06	'10
Vegetation	35.77	37.63
Rock	1.02	.38
Pavement	7.66	8.12
Litter	24.57	26.57
Cryptogams	.38	0
Bare Ground	41.93	41.45

SOIL ANALYSIS DATA --

Management unit 16R, Study no: 24, Study Name: 12 Mile Dixie

Effective rooting depth (in)	pH	sandy clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
9.3	7.6	48.7	17.5	33.8	2.5	17.2	224.0	0.7

PELLET GROUP DATA--

Management unit 16R, Study no: 24

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	38	4	-	-
Deer	8	4	20 (30)	3 (8)
Cattle	7	3	11 (27)	14 (34)

BROWSE CHARACTERISTICS--

Management unit 16R, Study no: 24

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
<b>Chrysothamnus nauseosus</b>										
06	<b>0</b>	0	0	-	-	0	0	0	39/65	
10	<b>740</b>	97	3	-	-	3	0	0	25/19	
<b>Chrysothamnus nauseosus hololeucus</b>										
06	<b>0</b>	0	0	-	-	0	0	0	30/44	
10	<b>40</b>	50	50	-	-	50	0	0	20/20	
<b>Gutierrezia sarothrae</b>										
06	<b>20</b>	0	100	-	-	0	0	0	-/-	
10	<b>0</b>	0	0	-	-	0	0	0	12/17	

FOUNTAIN GREEN DIXIE AND PLATEAU - TREND STUDY NO. 16R-26-10  
[Project #288](#)

Vegetation Type: Basin Big Sagebrush

Range Type: Crucial Deer Winter, Crucial Elk Winter

NRCS Ecological Site Description: [Upland Stony Loam \(Mountain Big Sagebrush\), R028AY334UT](#)

Land Ownership: UDWR

Elevation: 5,850 ft. (1,783 m)

Aspect: Southwest

Slope: 3%

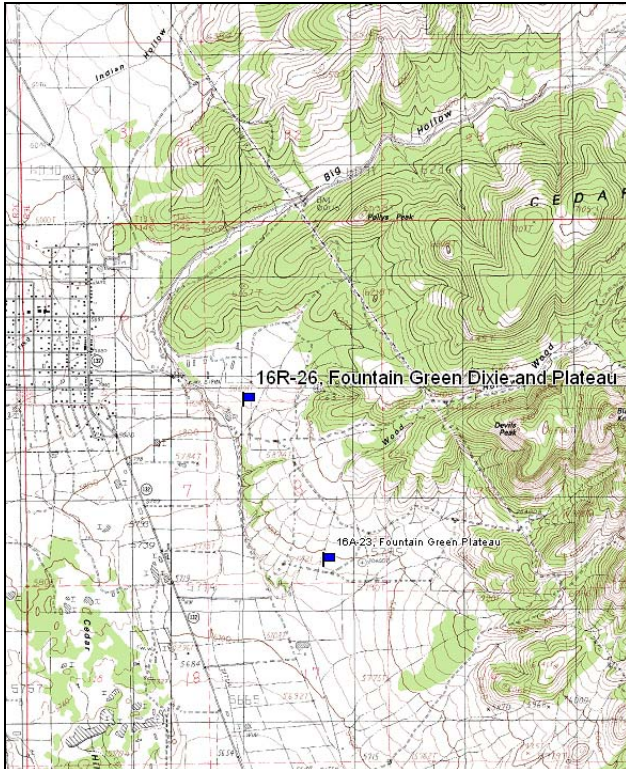
Transect bearing: 335° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

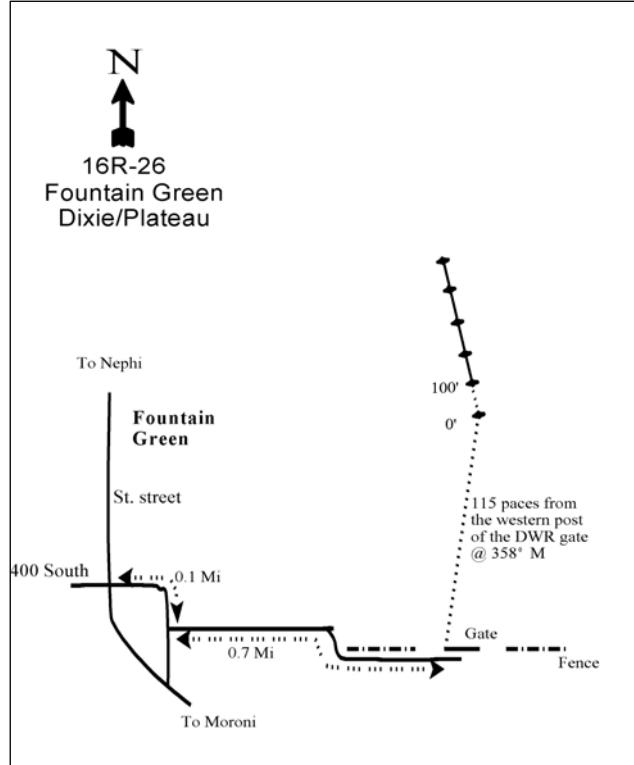
Traveling south through Fountain Greek on State Road 132 go to 400 south. Take a left here and go 0.1 miles to another left. Go left (east) from here 0.7 miles to a DWR gate on the left. The 0-foot stake is about 115 paces from the western post of the gate at 358 degrees magnetic and is marked with browse tag #192.

Map Name: Moroni



Township: 14S Range: 3E Section: 8

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 446953 E 4386063 N

FOUNTAIN GREEN DIXIE AND PLATEAU - WRI STUDY 16R-26

[Project #288](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a winter range rehabilitation project on the Fountain Green Wildlife Management Area (WMA) approximately one mile west of Fountain Green. The area supports high numbers of deer in the winter months. This concentrated use, combined with several years of drought, caused a decline in the health and vigor of the basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) population. Additionally, cheatgrass (*Bromus tectorum*) became abundant. In order to control cheatgrass and improve winter range, this 275 acre area was grazed by sheep in early spring of 2007 and treated with Plateau herbicide (Imazapic) in the fall of 2007. Thirty-five acres were harrowed and broadcast seeded (WRI Database 2011). Pellet group data from 2007 estimated light elk use, moderate deer use, and heavy sheep use as a result of the treatment. In 2010, elk, deer and sheep use was light (Table - Pellet Group Table).

SEED MIX--

Management unit 16R, Study no: 26

Project Name: Fountain Green Harrow			
WRI Database #: 288			
Application: Broadcast Seeder		Acres: 30	
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Anatone'	30	1.00
G	Crested Wheatgrass 'Douglas'	30	1.00
G	Crested Wheatgrass 'Hycrest'	30	1.00
G	Great Basin Wildrye 'Trailhead'	30	1.00
G	Indian Ricegrass 'Rimrock'	30	1.00
G	Intermediate Wheatgrass	60	2.00
G	Orchardgrass 'Paiute'	15	0.50
G	Sandberg Bluegrass	15	0.50
G	Siberian Wheatgrass 'Vavilov'	30	1.00
F	Alfalfa 'Ladak'	30	1.00
F	Alfalfa 'Ranger'	30	1.00
F	Sainfoin 'Eski'	60	2.00
F	Small Burnet 'Delar'	60	2.00
F	Western Yarrow	5	0.17
Total Pounds:		455	15.17
PLS Pounds:			13.83

Browse: Basin big sagebrush is the most common shrub species and is the preferred browse species on the site. Prior to the treatment, the Basin big sagebrush was an extremely used decadent population with a high amount of poor vigor in the population. Following the treatment, the Basin big sagebrush is a moderately used mature population with good vigor and low decadence. The recruitment of young sagebrush plants was poor prior to the treatment but has been excellent following the treatment. Pricklypear cactus (*Opuntia* sp.) and gray horsebrush (*Tetradymia canescens*) also occurred infrequently. Species sampled in height and crown measurement included white rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), yellow rabbitbrush (*C. viscidiflorus* ssp. *stenophyllus*), Stansbury Cliffrose (*Cowania mexicana* ssp. *stansburiana*), and broom snakeweed (*Gutierrezia sarothrae*).

Herbaceous Understory: Prior to treatment, perennial grasses were extremely rare, but increased in abundance following the treatment. Western wheatgrass (*Agropyron smithii*) is the dominant perennial grass species.

The annual grass, cheatgrass dominates the site and was not greatly affected by the treatment. Western wheatgrass was growing in a large patch that the study intersected on one side. Crested wheatgrass (*A. cristatum*), intermediate wheatgrass (*A. intermedium*), bluebunch wheatgrass (*A. spicatum*) and Sandberg bluegrass (*Poa secunda*) were seeded species sampled for the first time in 2010. Forbs are abundant but are dominated by annual species. Perennial forbs were limited prior to treatment, but improved due to the seeding of alfalfa (*Medicago sativa*). Storksbill (*Erodium cicutarium*) and annual kochia (*Kochia scoparia*) were the most common forbs in 2007 and 2010, respectively. Weedy and annual species continue to dominate this site. Fire is still a threat to existing browse species due to the abundance of cheatgrass; however, perennial grasses have established a foothold that may compete with cheatgrass.

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 7.2) (Table - Soil Analysis Data). Bare ground cover is moderately high with high amount of litter and vegetation and a moderate amount of rock providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

**Pre vs. Three Year Post Treatment Assessment, 2007 vs. 2010**

Browse: Basin big sagebrush density decreased 78% from 1,020 plants/acre to 220 plants/acre. Sagebrush health increased as plants demonstrating poor vigor decreased from 51% to 0% and decadent plants decreased from 82% to 0% of the population. The recruitment of young sagebrush plants improved from 2% to 27% of the population.

Grasses: The sum of nested frequency of perennial grasses increased 48% and cover increased from 1% to 6%. Western wheatgrass accounted for most of the increase in perennial grass cover which increased from 1% to 5%. The nested frequency of cheatgrass decreased significantly while cover declined slightly from 23% to 20%. No other perennial species provided 1% cover.

Forbs: The sum of nested frequency of perennial forbs slightly decreased 13 %, though cover increased from 2% to 6%. Prior to treatment, scarlet globemallow (*Sphaeralcea coccinea*) provided nearly all perennial forb cover at 1% and storksbill was the most common annual species at 13% cover. Following treatment, alfalfa provided 5% cover and annual kochia provided 15% cover.

HERBACEOUS TRENDS--  
Management unit 16R, Study no: 26

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron cristatum	-	13	-	.04
G	Agropyron intermedium	-	9	-	.55
G	Agropyron smithii	64	76	.42	5.09
G	Agropyron spicatum	-	11	-	.22
G	Bromus tectorum (a)	<sub>b</sub> 475	<sub>a</sub> 335	22.50	19.69
G	Oryzopsis hymenoides	4	2	.03	.04
G	Poa secunda	-	7	-	.04
G	Sitanion hystrix	16	7	.14	.48
G	Vulpia octoflora (a)	5	-	.01	-
Total for Annual Grasses		480	335	22.51	19.69
Total for Perennial Grasses		84	125	0.60	6.47
Total for Grasses		564	460	23.11	26.17
F	Alyssum alyssoides (a)	<sub>b</sub> 292	<sub>a</sub> 109	.63	1.50

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
F	Camelina microcarpa (a)	9	-	.01	-
F	Cardaria draba	<sub>b</sub> 36	<sub>a</sub> 11	.37	.34
F	Chorisporea tenella (a)	3	-	.06	-
F	Descurainia pinnata (a)	<sub>a</sub> 2	<sub>b</sub> 12	.01	.04
F	Erodium cicutarium (a)	<sub>b</sub> 382	<sub>a</sub> 4	12.80	.09
F	Kochia scoparia (a)	<sub>b</sub> -	<sub>a</sub> 189	-	14.65
F	Lactuca serriola (a)	8	12	.02	.17
F	Lappula occidentalis (a)	4	2	.01	.00
F	Medicago sativa	<sub>a</sub> -	<sub>b</sub> 52	-	5.14
F	Ranunculus testiculatus (a)	<sub>b</sub> 165	<sub>a</sub> 66	.50	1.06
F	Salsola iberica (a)	<sub>a</sub> -	<sub>b</sub> 136	-	4.25
F	Sisymbrium altissimum (a)	<sub>b</sub> 83	<sub>a</sub> 32	1.08	1.69
F	Sphaeralcea coccinea	<sub>b</sub> 71	<sub>a</sub> 30	1.36	.58
F	Tragopogon dubius (a)	6	-	.01	-
Total for Annual Forbs		954	562	15.16	23.49
Total for Perennial Forbs		107	93	1.74	6.06
Total for Forbs		1061	655	16.90	29.56

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 16R, Study no: 26

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia tridentata tridentata	37	11	2.79	.58
B	Opuntia sp.	1	2	.38	-
B	Tetradymia canescens	0	1	-	-
Total for Browse		38	14	3.17	0.58

#### CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 26

Species	Percent Cover	
	'07	'10
Artemisia tridentata tridentata	2.01	.80

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 16R, Study no: 26

Species	Average leader growth (in)	
	'07	'10
Artemisia tridentata tridentata	1.6	2.2

BASIC COVER--

Management unit 16R, Study no: 26

Cover Type	Average Cover %	
	'07	'10
Vegetation	43.34	51.86
Rock	5.58	5.01
Pavement	1.49	1.99
Litter	43.18	44.90
Cryptogams	1.88	0
Bare Ground	14.97	25.37

SOIL ANALYSIS DATA --

Management unit 16R, Study no: 26, Study Name: Fountain Green Dixie and Plateau

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.2	34.2	38.0	27.8	1.4	11.4	304.0	0.7

PELLET GROUP DATA--

Management unit 16R, Study no: 26

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Sheep	82	-	127 (312)	1 (2)
Rabbit	25	7	-	-
Elk	2	3	5 (12)	7 (17)
Deer	31	27	23 (56)	15 (36)
Cattle	4	-	-	-

BROWSE CHARACTERISTICS--  
Management unit 16R, Study no: 26

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata tridentata</i>										
07	<b>1020</b>	2	16	82	-	0	100	51	30/38	
10	<b>220</b>	27	73	0	400	45	9	0	19/27	
<i>Chrysothamnus nauseosus albicaulis</i>										
07	<b>0</b>	0	0	-	-	0	0	0	19/13	
10	<b>0</b>	0	0	-	-	0	0	0	21/31	
<i>Chrysothamnus viscidiflorus stenophyllus</i>										
07	<b>0</b>	0	0	-	-	0	0	0	8/9	
10	<b>0</b>	0	0	-	-	0	0	0	17/27	
<i>Cowania mexicana stansburiana</i>										
07	<b>0</b>	0	0	-	-	0	0	0	22/16	
10	<b>0</b>	0	0	-	-	0	0	0	-/-	
<i>Gutierrezia sarothrae</i>										
07	<b>0</b>	0	0	-	-	0	0	0	6/6	
10	<b>0</b>	0	0	-	-	0	0	0	-/-	
<i>Opuntia sp.</i>										
07	<b>20</b>	0	100	-	-	0	0	100	7/18	
10	<b>40</b>	0	100	-	-	0	0	0	8/10	
<i>Tetradymia canescens</i>										
07	<b>0</b>	0	0	-	-	0	0	0	20/24	
10	<b>20</b>	0	100	-	-	0	0	0	26/26	



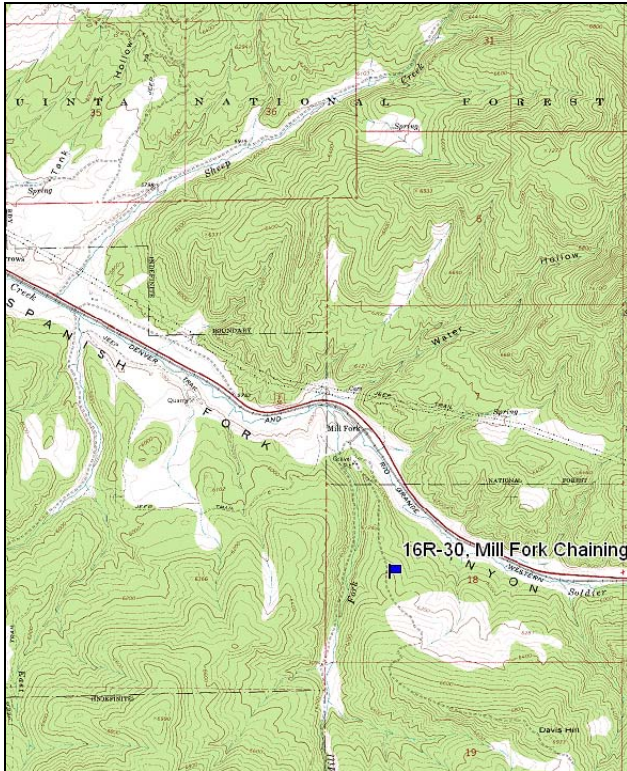
MILL FORK CHAINING - TREND STUDY NO. 16R-30-10  
[Project #716](#)

Vegetation Type: Utah Juniper  
Range Type: Crucial Deer Winter/Spring, Crucial Elk Winter  
NRCS Ecological Site Description: Not available  
Land Ownership: Private  
Elevation: 6,200 ft. (1,890 m)  
Aspect: North  
Slope: 3-5%  
Transect bearing: 44° magnetic  
Belt placement: line 1 (11ft & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

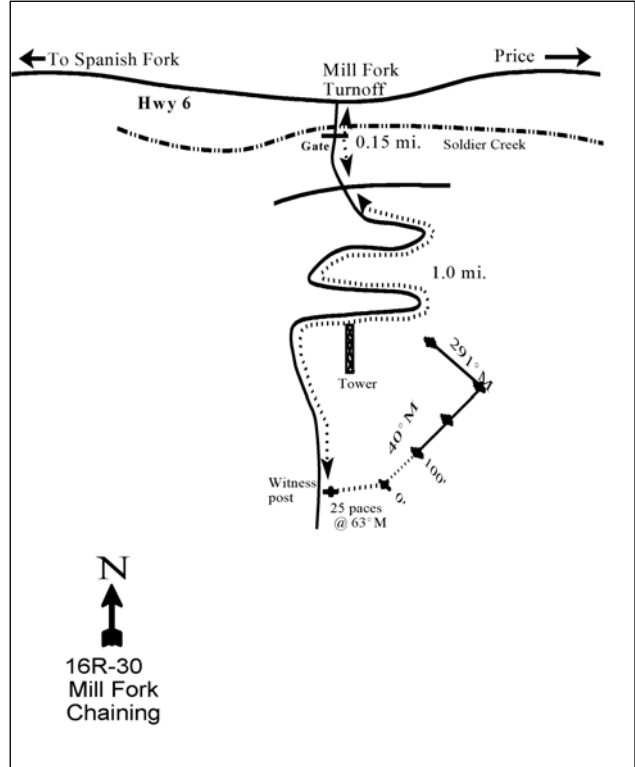
Directions:

From the Sheep Creek Cafe and Sheep Creek Turnoff on Highway 6, travel east on Highway 6 (toward Price) for 1.9 miles to the Mill Fork turnoff on the south side of the highway. Take this road 0.15 miles through a gate and crossing the river to a fork. Stay left (east) and go up the hill 1 mile to a witness post on the east side of the road. From the witness post the 0-foot baseline stake is 25 paces away at 63 degrees magnetic. It is marked by browse tag #111.

Map Name: Mill Fork



Diagrammatic Sketch:



Township: 10S Range: 5E Section: 13

GPS: NAD 83, UTM 12S 473937 E 4422428 N

MILL FORK CHAINING - WRI STUDY 16R-30

[Project #716](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a big game winter range improvement project in Spanish Fork Canyon. A large portion of the sagebrush habitats in the canyon have become decadent or have been invaded by pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). These rangelands have been heavily grazed by sheep and cattle for decades, leaving little herbaceous understory. This project was conducted on private property that has the potential to serve as quality big game winter range habitat. In fall 2006, Spike (Tebuthiuron) herbicide was aerially applied to 105 acres to thin sagebrush. In October 2007, 350 acres of thick sagebrush, pinyon and juniper trees were chained one-way with an Ely chain. Grass and forb seed were then aerially applied to 462 acres, including most of the area that was treated with Spike and gullies and islands that were not chained. A second chaining pass was done with a smooth chain to cover seed and complete the kill of trees. Dribblers were used to seed bitterbrush and fourwing saltbush. The study site is located in the chaining and seeded section which was not treated with spike. The objectives of the project were to improve private property to provide winter habitat for mule deer and elk and potentially reduce the amount of vehicle collisions of wintering deer and elk crossing US-6. A secondary goal is to reduce erosion and the sediment load in the Spanish Fork River (WRI Database 2011). Pellet group data estimated light use by elk and deer in 2007 and 2010 (Table- Pellet Group Data).

SEED MIX--

Management unit 16R, Study no: 30

Project Name: Mill Fork Chaining					
WRI Database #: 716					
Application: Aerial Seed		Acres: 472		Application: Seed Dribbler	
				Acres: 370	
Seed type		lbs in mix	lbs/acre	Seed type	
G	Bluebunch WG 'Anatone'	450	0.95	B	Bitterbrush
G	Canby Bluegrass 'Canbar'	200	0.42	B	Fourwing Saltbush
G	Crested Wheatgrass 'Douglas'	250	0.53	Total Pounds:	
G	Crested Wheatgrass 'Ephraim'	250	0.53	200	
G	Crested Wheatgrass 'Hycrest'	200	0.42	PLS Pounds:	
G	Great Basin Wildrye 'Trailhead'	250	0.53	0.35	
G	Indian Ricegrass 'Rimrock'	450	0.95		
G	Intermediate Wheatgrass	450	0.95		
G	Mountain Brome	400	0.85		
G	Orchardgrass 'Paiute'	200	0.42		
G	Siberian Wheatgrass 'Vavilov'	400	0.85		
F	Alfalfa 'Ladak'	300	0.64		
F	Alfalfa 'Ranger'	300	0.64		
F	Alfalfa 'Spredor 4'	300	0.64		
F	Cicer Milkvetch 'Lutana'	250	0.53		
F	Sainfoin 'Eski'	900	1.91		
F	Small Burnet 'Delar'	883	1.87		
F	Western Yarrow	48	0.10		
Total Pounds:		6481	13.73		
PLS Pounds:			12.44		

Browse: Prior to the treatment the site was dominated by Utah juniper but following the treatment Utah juniper has been effectively reduced allowing more preferred browse species to establish. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), antelope bitterbrush (*Purshia tridentata*), and fourwing saltbush (*Atriplex canescens*) were sampled for the first time following the treatment, though few in numbers (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant and fairly diverse. Grasses increased in abundance following the treatment. Cheatgrass (*Bromus tectorum*) dominates the site and increased significantly following the treatment. Sandberg bluegrass (*Poa secunda*) and bottlebrush squirreltail (*Sitanion hystrix*) were the dominant perennial grass species prior to the treatment. Sandberg bluegrass decreased substantially following the treatment and is now rare on the site. Bottlebrush squirreltail remained the most abundant perennial grass species, although it has decreased in frequency since the treatment. Several seeded species were sampled following the treatment which include crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*A. intermedium*), mountain brome (*Bromus carinatus*), orchard grass (*Dactylis glomerata*), and Indian ricegrass (*Oryzopsis hymenoides*), though Indian rice grass was present prior to treatment. Forbs are not abundant but are somewhat diverse. The annual species prickly lettuce (*Lactuca serriola*) is the dominant forb species. A few seeded forbs were sampled after the treatment which include alfalfa (*Medicago sativa*), sainfoin (*Onobrychis viciaefolia*), and small burnet (*Sanguisorba minor*) (Table - Herbaceous Trends).

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 6.9) (Table - Soil Analysis Data). Bare ground cover is low with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2007 due to the formation of flow patterns, rills, and litter and rock movement. Soil erosion was classified as stable with no signs of erosion in 2010.

### **Pre vs. Three Years Post Treatment Assessment, 2007 vs. 2010**

Browse: Utah juniper canopy was reduced from 39% to 1% while density was decreased from 272 trees/acre to 72 trees/acre. 50% of the trees sampled were knocked down, had one live branch, or were affected by the treatment in some other way. In 2007, all sagebrush plants sampled in frequency belts were dead. In 2010 estimated shrub densities were; sagebrush 20 plants/acre, fourwing saltbush 40 plants/acre, and bitterbrush 20 plants/acre.

Grasses: The sum of nested frequency of perennial grasses significantly decreased 40% and cover increased from 4% to 6%. Bottlebrush squirreltail decreased significantly in nested frequency while cover increased from 1% to 3%. Sandberg bluegrass significantly decreased in nested frequency and cover declined from 3% to less than 1%. No other perennial species provided more than 1% cover. Cheatgrass cover increased from 2% to 14% and nested frequency increased significantly.

Forbs: The nested frequency of perennial forbs increased 22% and cover increased from less than 1% to 2%. The undesired annual species bur buttercup (*Ranunculus testiculatus*) and pinnate mustard weed (*Descurainia pinnata*) decreased significantly in nested frequency. Prickly lettuce was sampled for the first time following the treatment at 4 % cover.

HERBACEOUS TRENDS--  
Management unit 16R, Study no: 30

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron cristatum	a-	b15	-	.93
G	Agropyron intermedium	a-	b19	-	.84
G	Bromus carinatus	a-	b11	-	.48
G	Bromus tectorum (a)	a226	b313	2.45	13.56
G	Dactylis glomerata	-	7	-	.33
G	Oryzopsis hymenoides	5	6	.05	.04
G	Poa pratensis	5	18	.03	.34
G	Poa secunda	b130	a14	2.71	.27
G	Sitanion hystrix	b117	a65	1.37	2.53
Total for Annual Grasses		226	313	2.45	13.56
Total for Perennial Grasses		257	155	4.16	5.79
Total for Grasses		483	468	6.61	19.35
F	Agoseris glauca	-	2	-	.15
F	Alyssum alyssoides (a)	25	38	.09	.32
F	Antennaria rosea	12	2	.04	.03
F	Astragalus convallarius	1	-	.03	-
F	Astragalus utahensis	4	1	.04	.03
F	Calochortus nuttallii	-	1	-	.00
F	Chaenactis douglasii	2	8	.00	.03
F	Cirsium sp.	-	3	-	.18
F	Collinsia parviflora (a)	13	-	.02	-
F	Cymopterus sp.	-	4	-	.03
F	Descurainia pinnata (a)	b86	a30	.23	.42
F	Eriogonum sp.	a-	b36	-	.40
F	Lactuca serriola (a)	a-	b199	-	3.47
F	Machaeranthera grindelioides	-	3	-	.00
F	Medicago sativa	-	7	-	.10
F	Microsteris gracilis (a)	b28	a-	.05	-
F	Onobrychis viciaefolia	-	4	-	.33
F	Penstemon caespitosus	25	6	.23	.48
F	Phlox longifolia	b28	a2	.13	.00
F	Ranunculus testiculatus (a)	b148	a12	.51	.05
F	Sanguisorba minor	-	6	-	.21
F	Senecio multilobatus	6	7	.01	.01
F	Streptanthus cordatus	1	-	.00	-
F	Taraxacum officinale	-	4	-	.03
Total for Annual Forbs		300	279	0.90	4.26
Total for Perennial Forbs		79	96	0.50	2.04
Total for Forbs		379	375	1.40	6.31

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 16R, Study no: 30

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia tridentata vaseyana	0	1	-	-
B	Atriplex canescens	0	1	-	.06
B	Gutierrezia sarothrae	2	2	.03	.06
B	Juniperus osteosperma	16	5	7.01	1.64
B	Leptodactylon pungens	1	1	-	.15
B	Opuntia fragilis	30	16	1.15	.57
B	Purshia tridentata	0	1	-	-
Total for Browse		49	27	8.20	2.49

CANOPY COVER, LINE INTERCEPT--

Management unit 16R, Study no: 30

Species	Percent Cover	
	'07	'10
Atriplex canescens	-	.56
Gutierrezia sarothrae	.11	.05
Juniperus osteosperma	39.18	1.11
Opuntia fragilis	.86	.05

POINT-QUARTER TREE DATA--

Management unit 16R, Study no: 30

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	272	72	5.5	5.3
Pinus edulis	-	20	-	0.8

BASIC COVER--

Management unit 16R, Study no: 30

Cover Type	Average Cover %	
	'07	'10
Vegetation	15.61	29.93
Rock	5.48	3.59
Pavement	17.96	4.61
Litter	50.14	60.80
Cryptogams	11.75	.41
Bare Ground	16.05	18.23

SOIL ANALYSIS DATA --

Management unit 16R, Study no: 30, Study Name: Mill Fork Chaining

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	6.9	34.4	37.0	28.6	3.7	8.9	179.2	0.7

PELLET GROUP DATA--

Management unit 16R, Study no: 30

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	23	8	-	-
Elk	2	1	3 (7)	11 (26)
Deer	6	4	5 (12)	7 (18)

BROWSE CHARACTERISTICS--

Management unit 16R, Study no: 30

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia tridentata vaseyana</i>									
07	0	0	0	-	-	0	0	0	10/10
10	20	0	100	-	-	0	0	0	13/16
<i>Atriplex canescens</i>									
07	0	0	0	-	-	0	0	0	-/-
10	40	100	0	-	-	0	0	0	18/23
<i>Ceratoides lanata</i>									
07	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	17/25
<i>Gutierrezia sarothrae</i>									
07	40	0	100	0	-	0	0	0	9/12
10	220	55	36	9	20	0	0	9	12/16
<i>Juniperus osteosperma</i>									
07	340	6	76	18	40	0	0	0	-/-
10	100	40	40	20	20	0	0	20	-/-
<i>Leptodactylon pungens</i>									
07	20	100	0	-	-	0	0	0	-/-
10	60	0	100	-	-	0	0	0	1/4
<i>Opuntia fragilis</i>									
07	1060	15	79	6	-	0	0	2	3/14
10	440	9	91	0	-	0	0	0	4/9
<i>Purshia tridentata</i>									
07	0	0	0	-	-	0	0	0	-/-
10	20	100	0	-	-	0	0	0	9/13
<i>Tetradymia canescens</i>									
07	0	0	0	-	-	0	0	0	-/-
10	0	0	0	-	-	0	0	0	12/16

TROUT CREEK DIXIE - TREND STUDY NO. 17R-25-10

[Project #323](#)

Vegetation Type: Mountain Big Sagebrush

Range Type: Substantial Deer Summer/Fall, Crucial Elk Summer

NRCS Ecological Site Description: Not available

Land Ownership: USFS

Elevation: 7,650 ft. (2,332 m)

Aspect: South

Slope: 3%

Transect bearing: 313° magnetic

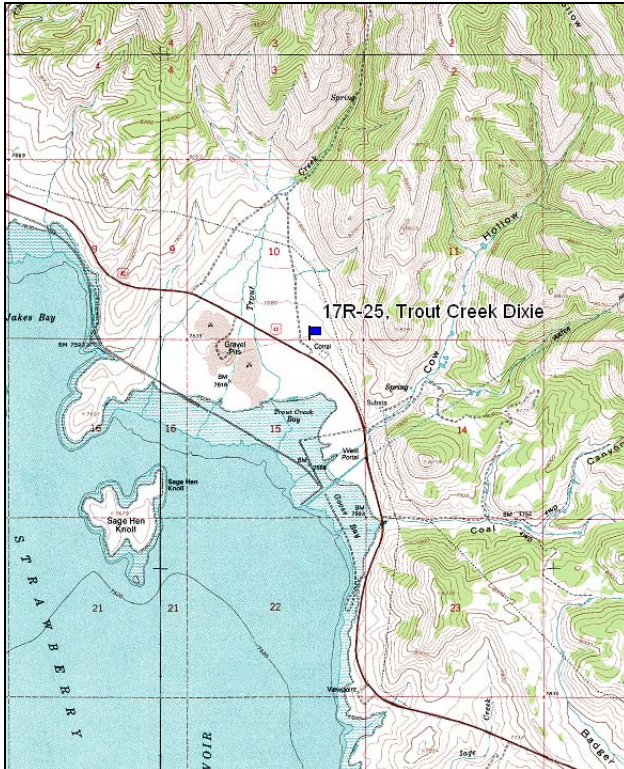
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

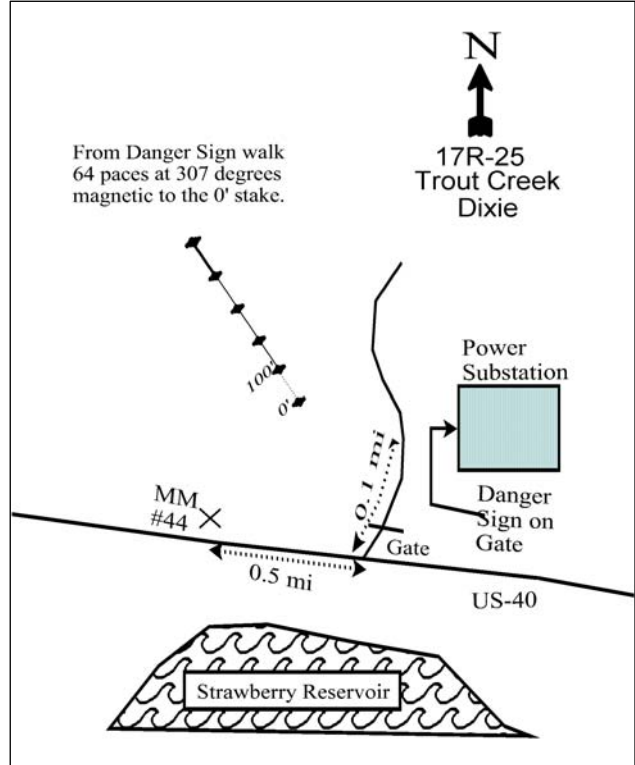
Drive east on US-40 around Strawberry Reservoir to mile marker 44. From there drive 0.5 miles to a road with a gate on the left (north). Turn here and proceed 0.1 miles through the gate to a power substation. From the “danger” sign on the substation gate walk 64 paces at 307 degrees magnetic to the 0' stake marked with browse tag #161.

Map Name: Strawberry Reservoir NE



Township: 3S Range: 11W Section: 15

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 490656 E 4452940 N

TROUT CREEK DIXIE - WRI STUDY 17R-25

[Project #323](#)

**Site Description**

Site Information: This study was established in 2006 to monitor the effects of a Dixie harrow and brush beater treatment on 180 acres just north of Strawberry Reservoir on the west side of Trout Creek. The area was a very dense mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) community. The study was harrowed and seeded with native forbs to open the sagebrush canopy to improve sage-grouse habitat in the fall of 2007. In early October of 2007, a radio collared sage-grouse hen was located in the Trout Creek project area, just a month after treatments were completed. No sage-grouse previously used the area (WRI Database 2011). Pellet group data estimated very light deer use in all sample years. Most of the sagebrush is so dense that only one or two game trails exist and that is where all pellet groups were sampled (Table - Pellet Group Data).

SEED MIX--

Management unit 17R, Study no: 25

Project name: Trout Creek			
WRI Database #: 323			
Application: Broadcast		Acres:	85
Seed type		lbs in mix	lbs/acre
F	Blue Flax ' Appar	85	1.00
F	Penstemon, Rocky Mountain 'Bandera'	22	0.26
F	Utah Sweetvech	25	0.29
F	Western Yarrow	22	0.26
Total Pounds:		154	1.81
PLS Pounds:			1.64

Browse: Mountain big sagebrush is the preferred browse species on the site and has dominated the site in each sample year. The harrow treatment changed the dynamics of the sagebrush population. By opening the shrub canopy, grass and forb cover increased and the sagebrush age classes diversified, allowing recruitment and removing decadent plants. Since the treatment, the mountain big sagebrush is a healthy population with low decadence and good vigor. Recruitment of young sagebrush to the population has been excellent following the treatment. Utilization of sagebrush has been light since the outset of the study. Other browse species sampled on the site include Wyeth eriogonum (*Eriogonum heracleoides*) and Stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are exceptionally abundant and diverse. Thickspike wheatgrass (*Agropyron dasystachyum*) is the dominant grass species on the site. Other common species included prairie junegrass (*Koeleria cristata*), Kentucky bluegrass (*Poa pratensis*), needle-and-thread grass (*Stipa comata*), and Letterman needlegrass (*S. lettermani*). No annual grasses were sampled. The forb community is not diverse but is fairly abundant. Perennial forb cover and nested frequency increased following treatment. Silvery lupine (*Lupinus argenteus*) was the most common forb, accounting for majority of forb cover in all sample years. Other common forb species sampled on the site include spotted stickseed (*Hackelia patens*) and penstemon (*Penstemon* sp.). No seeded species have been sampled following the treatment (Table - Herbaceous Trends)

Soil: The soil texture is a sandy clay loam with a slightly acidic soil reaction (pH 6.1) (Table - Soil Analysis Data). Bare ground cover is low with high amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.



## Pre vs. Four Years Post Treatment Assessment, 2006 vs. 2010

**Browse:** Mountain big sagebrush canopy cover declined from 46% to 22% and density decreased 12% from 7,500 plants/acre to 6,620 plants/acre. The recruitment of young sagebrush plants to the population improved from 1% to 47% while decadence decreased from 20% to 7% and poor vigor decreased from 11% to 1%. Wyeth eriogonum was common, scattered throughout the treated area. Canopy cover of Wyeth eriogonum remained similar between samples at 2%, but density increased two fold from 1,100 plants/acre to 2,360 plants/acre.

**Grasses:** The sum of nested frequency of perennial grasses remained similar between samples and cover increased from 20% to 34%. Thickspike wheatgrass saw a significant increase in nested frequency and cover increased from 2% to 12%. Kentucky bluegrass also increased significantly in nested frequency and cover increased from 1% to 8%. Prairie junegrass, needle-and-thread grass, and Letterman needlegrass all decreased significantly in nested frequency while their combined cover decreased from 16% to 12%.

**Forbs:** The sum of nested frequency of perennial forbs increased two fold while cover increased from 5% to 12%. Silvery lupine was the most common forb and increased significantly in nested frequency while cover increased from 5% to 10%. Spotted stickseed was the only other forb to provide 1% cover.

### HERBACEOUS TRENDS--

Management unit 17R, Study no: 25

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron dasystachyum	<sub>a</sub> 235	<sub>b</sub> 309	1.98	12.22
G	Carex sp.	16	38	.18	.50
G	Dactylis glomerata	-	4	-	.03
G	Koeleria cristata	<sub>b</sub> 175	<sub>a</sub> 137	5.32	6.17
G	Melica bulbosa	-	-	.00	-
G	Poa fendleriana	<sub>a</sub> 4	<sub>b</sub> 21	.18	.75
G	Poa pratensis	<sub>a</sub> 52	<sub>b</sub> 164	1.30	7.61
G	Poa secunda	33	24	.83	.19
G	Stipa comata	<sub>b</sub> 119	<sub>a</sub> 39	4.28	1.52
G	Stipa lettermani	209	96	5.98	4.57
Total for Annual Grasses		0	0	0	0
Total for Perennial Grasses		843	832	20.10	33.58
Total for Grasses		843	832	20.10	33.58
F	Agoseris glauca	2	-	.00	-
F	Castilleja flava	-	9	-	.07
F	Chaenactis douglasii	1	-	.00	-
F	Collinsia parviflora (a)	-	3	-	.01
F	Hackelia patens	<sub>a</sub> 6	<sub>b</sub> 127	.04	1.53
F	Lappula occidentalis (a)	-	9	-	.01
F	Lotus utahensis	-	4	-	.15
F	Lupinus argenteus	<sub>a</sub> 166	<sub>b</sub> 235	4.78	9.86
F	Penstemon sp.	<sub>a</sub> 2	<sub>b</sub> 37	.00	.45
F	Polygonum douglasii (a)	<sub>a</sub> 14	<sub>b</sub> 50	.03	.17
F	Tragopogon dubius (a)	-	-	-	.00
Total for Annual Forbs		14	62	0.03	0.20

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
Total for Perennial Forbs		177	412	4.83	12.07
Total for Forbs		191	474	4.86	12.27

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 17R, Study no: 25

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata vaseyana	99	86	34.90	18.67
B	Chrysothamnus viscidiflorus viscidiflorus	2	6	.03	.15
B	Eriogonum heracleoides	19	39	1.50	2.03
Total for Browse		120	131	36.44	20.85

#### CANOPY COVER, LINE INTERCEPT--

Management unit 17R, Study no: 25

Species	Percent Cover	
	'06	'10
Artemisia tridentata vaseyana	46.09	21.51
Chrysothamnus viscidiflorus viscidiflorus	-	.31
Eriogonum heracleoides	1.68	1.98

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 17R, Study no: 25

Species	Average leader growth (in)	
	'06	'10
Artemisia tridentata vaseyana	1.8	1.7

#### BASIC COVER--

Management unit 17R, Study no: 25

Cover Type	Average Cover %	
	'06	'10
Vegetation	55.04	64.93
Rock	.21	.20
Pavement	.33	.44
Litter	47.61	50.57
Cryptogams	.13	0
Bare Ground	16.87	10.85

SOIL ANALYSIS DATA --

Management unit 17R, Study no: 25, Study Name: Trout Creek Dixie

Effective rooting depth (in)	pH	sandy clay loma			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
10.0	6.1	50.7	21.5	27.8	3.9	60.5	224.0	0.4

PELLET GROUP DATA--

Management unit 17R, Study no: 25

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	3	1	-	-
Grouse	3	-	-	-
Deer	2	1	1 (3)	1 (2)

BROWSE CHARACTERISTICS--

Management unit 17R, Study no: 25

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia tridentata vaseyana</i>									
06	<b>7500</b>	1	70	29	3260	0	0	11	23/30
10	<b>6620</b>	47	45	7	34680	13	.30	.90	19/30
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
06	<b>40</b>	0	100	-	-	0	0	0	10/7
10	<b>120</b>	0	100	-	-	0	0	0	11/17
<i>Eriogonum heracleoides</i>									
06	<b>1100</b>	4	96	0	-	0	2	0	3/14
10	<b>2360</b>	16	83	1	1220	.84	0	3	4/14

BIG HOLLOW BULLHOG - TREND STUDY NO. 18R-4-10  
[Project #1380](#)

Vegetation Type: Pinyon/Juniper, Mountain Big Sagebrush

Range Type: Crucial Deer Spring/Fall

NRCS Ecological Site Description: Not available

Land Ownership: BLM

Elevation: 6,300 ft. (1,920 m)

Aspect: East

Slope: 2-6%

Transect bearing: 26° magnetic

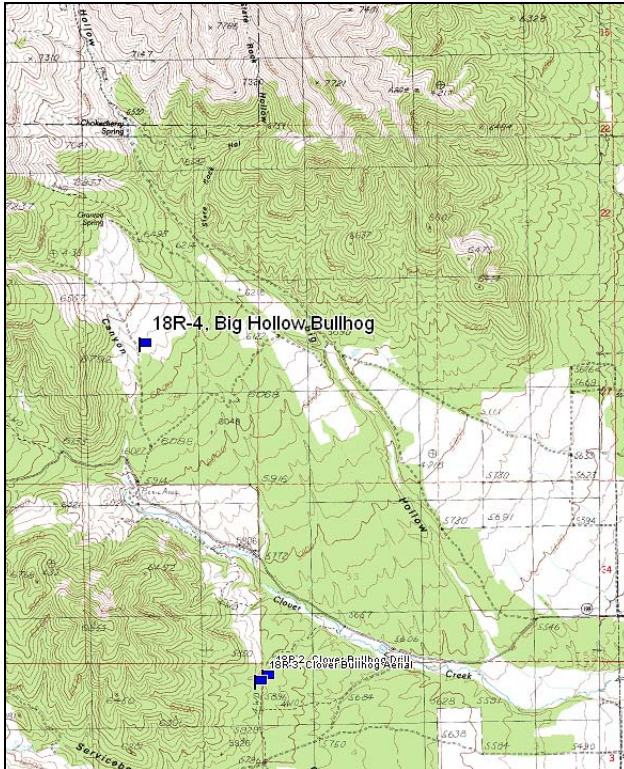
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

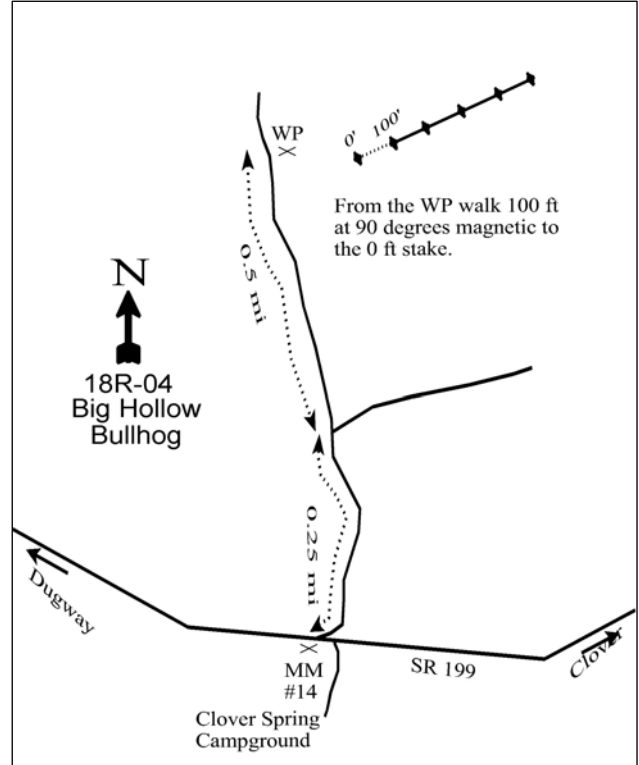
On SR-199 drive west from Clover. Turn north at mile marker #14 on the road across the street from the road that goes to Clover Spring Campground. From the turnoff drive 0.25 miles to a fork, stay left and drive 0.5 miles to a witness post on the right. Walk 100 feet at 90 degrees magnetic to the 0 foot stake marked with browse tag #155.

Map Name: Johnson Pass



Township: 5S Range: 6W Section: 29

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 368429 E 4468585 N

BIG HOLLOW BULLHOG - WRI STUDY 18R-4  
[Project #1380](#)

## Site Description

Site Information: This study was established in 2006 to monitor a bullhog and lop and scatter project approximately six miles west of Clover and north of SR 199. The site was treated by a bullhog to reduce the density of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) by 90%. The project was completed in the summer of 2009. No seed mix was applied to the site. The objectives of the treatment were to enhance preferred browse species, grasses, and forbs by reducing the density and cover of pinyon pine and Utah juniper and to improve wildlife habitat (WRI Database 2011). Pellet group data estimated light deer and elk use in all sample years (Table - Pellet Group Data).

Browse: The key browse species is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). The mountain big sagebrush is a lightly use mature population with moderate decadence and poor vigor over the sample years. Utah juniper (*Juniperus osteosperma*) was effectively reduced by the treatment. Other browse species sampled included: whitestem rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), sticklyleaf low rabbitbrush (*C. viscidiflorus* ssp. *viscidiflorus*), Mexican cliffrose (*Cowania mexicana* ssp. *stansburiana*), broom snakeweed (*Gutierrezia sarothrae*), antelope bitterbrush (*Purshia tridentata*), gray horsebrush (*Tetradymia canescens*), pricklypear cactus (*Opuntia* sp.), Utah serviceberry (*Amelanchier utahensis*) and snowberry (*Symphoricarpos oreophilus*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are diverse and abundant. The dominant perennial grass species on the site are crested wheatgrass (*Agropyron cristatum*) and thickspike wheatgrass (*A. dasystachyum*). Other common grass species include bluebunch wheatgrass (*Agropyron spicatum*), bulbous bluegrass (*Poa bulbosa*), Kentucky bluegrass (*P. pratensis*), and Sandberg bluegrass (*P. secunda*). Forbs are not very abundant or diverse. Perennial forbs are rare on the site. Bastard toadflax (*Comandra pallida*) and American vetch (*Vicia americana*) are the most common forb species on the site (Table - Herbaceous Trends).

Soil: The soil texture is a sandy loam with a neutral soil reaction (pH 7.1) (Table - Soil Analysis Data). Bare ground cover is low with high amount of litter and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2006 due to slight surface litter and soil movement, pedestalling flow patterns and gully formation. The soil erosion condition was classified as stable in 2010.

## Pre vs. One Year Post Treatment, 2006 vs. 2010

Browse: The study site was treated shortly before the 2010 reading; as a result, vegetation did not have time to respond to treatment. Mountain big sagebrush canopy cover decreased from 11% to 5% and density decreased 23% from 1,580 plants/acre to 1,220 plants/acre. The recruitment young sagebrush plants to the population remained poor at 2%. Decadence of sagebrush decreased slightly from 24% to 18%. Utilization increased, as plants showing moderate to heavy use increased from 10% to 33%. Antelope bitterbrush utilization has been heavy or moderate on at least 91% of plants in both years. Utah juniper canopy cover was reduced from 14% to 2% while density was reduced from 140 trees/acre to 26 trees/acre. The average diameter was 7.5 inches in 2006 and 3.8 inches in 2010.

Grasses: The sum of nested frequency of perennial grasses decreased 45% and cover decreased from 12% to 10%. Crested wheatgrass increased significantly in nested frequency while cover increased from 2% to 4%. Bluebunch wheatgrass decreased significantly in nested frequency while cover decreased from 3% to 1%. Thickspike wheatgrass cover remained similar at 2%

Forbs: There was little change in the sparse perennial forb community. Bastard toadflax and American vetch each provide 1% cover.

HERBACEOUS TRENDS--  
Management unit 18R, Study no: 4

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	a32	b55	1.59	3.84
G	Agropyron dasystachyum	69	57	2.71	2.22
G	Agropyron spicatum	b61	a	2.69	1.19
G	Bromus tectorum (a)	b45	a22	.30	.16
G	Oryzopsis hymenoides	b17	a2	.23	.30
G	Poa bulbosa	55	32	1.15	.43
G	Poa fendleriana	b25	a-	.66	-
G	Poa pratensis	b61	a24	.97	1.53
G	Poa secunda	b99	a45	1.68	.72
G	Sitanion hystrix	b19	a1	.38	.00
Total for Annual Grasses		45	22	0.30	0.16
Total for Perennial Grasses		438	242	12.09	10.25
Total for Grasses		483	264	12.39	10.42
F	Agoseris glauca	5	2	.03	.03
F	Allium sp.	-	5	-	.01
F	Alyssum alyssoides (a)	b168	a100	.42	.73
F	Astragalus cibarius	1	-	.00	-
F	Calochortus nuttallii	-	3	-	.01
F	Chaenactis douglasii	1	-	.00	-
F	Collinsia parviflora (a)	25	21	.05	.22
F	Comandra pallida	19	22	.17	.87
F	Crepis acuminata	1	-	.03	-
F	Epilobium brachycarpum (a)	2	-	.00	-
F	Eriogonum racemosum	3	-	.00	-
F	Linum lewisii	24	11	.13	.25
F	Microsteris gracilis (a)	8	-	.01	-
F	Phlox longifolia	b41	a11	.22	.07
F	Polygonum douglasii (a)	b18	a4	.04	.01
F	Ranunculus testiculatus (a)	b159	a-	.45	-
F	Veronica biloba (a)	b74	a-	.13	-
F	Vicia americana	b108	a17	.90	.88
F	Zigadenus paniculatus	3	-	.01	-
Total for Annual Forbs		454	125	1.13	0.96
Total for Perennial Forbs		206	71	1.53	2.14
Total for Forbs		660	196	2.66	3.10

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 18R, Study no: 4

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata vaseyana	45	31	7.81	5.64
B	Chrysothamnus nauseosus albicaulis	2	2	.33	.03
B	Chrysothamnus viscidiflorus viscidiflorus	2	3	.15	-
B	Cowania mexicana stansburiana	0	0	.38	-
B	Gutierrezia sarothrae	13	9	.03	.19
B	Juniperus osteosperma	4	1	7.72	.41
B	Opuntia sp.	3	1	-	-
B	Purshia tridentata	10	6	1.16	.53
B	Tetradymia canescens	4	1	.00	-
Total for Browse		83	54	17.59	6.80

CANOPY COVER, LINE INTERCEPT--

Management unit 18R, Study no: 4

Species	Percent Cover	
	'06	'10
Artemisia tridentata vaseyana	10.68	5.26
Chrysothamnus nauseosus albicaulis	-	.20
Chrysothamnus viscidiflorus viscidiflorus	.18	.05
Gutierrezia sarothrae	-	.18
Juniperus osteosperma	13.68	1.91
Purshia tridentata	5.46	1.01

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 18R, Study no: 4

Species	Average leader growth (in)	
	'06	'10
Artemisia tridentata vaseyana	1.9	1.8
Purshia tridentata	2.2	3.4

POINT-QUARTER TREE DATA--

Management unit 18R, Study no: 4

Species	Trees per Acre		Average diameter (in)	
	'06	'10	'06	'10
Juniperus osteosperma	140	26	7.5	3.8

BASIC COVER--

Management unit 18R, Study no: 4

Cover Type	Average Cover %	
	'06	'10
Vegetation	29.17	18.78
Rock	6.32	9.40
Pavement	14.86	4.09
Litter	39.44	61.31
Cryptogams	.92	.03
Bare Ground	28.34	14.57

SOIL ANALYSIS DATA --

Management unit 18R, Study no: 4, Study Name: Big Hollow Bullhog

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
11.7	7.1	60.7	33.9	5.4	3.3	12.5	268.8	0.7

PELLET GROUP DATA--

Management unit 18R, Study no: 4

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	60	3	-	-
Elk	-	-	-	1 (2)
Deer	12	5	7 (17)	2 (5)

BROWSE CHARACTERISTICS--

Management unit 18R, Study no: 4

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<b>Amelanchier utahensis</b>									
06	<b>0</b>	0	0	-	-	0	0	0	23/35
10	<b>0</b>	0	0	-	-	0	0	0	20/32
<b>Artemisia tridentata vaseyana</b>									
06	<b>1580</b>	0	76	24	60	9	1	15	22/30
10	<b>1220</b>	2	80	18	-	26	7	13	22/31
<b>Chrysothamnus nauseosus albicaulis</b>									
06	<b>40</b>	50	0	50	-	0	0	0	20/27
10	<b>40</b>	0	50	50	-	0	0	50	26/26
<b>Chrysothamnus viscidiflorus viscidiflorus</b>									
06	<b>40</b>	0	100	0	-	0	0	0	16/22
10	<b>80</b>	0	75	25	-	0	25	25	12/19
<b>Cowania mexicana stansburiana</b>									
06	<b>0</b>	0	0	-	-	0	0	0	20/27
10	<b>0</b>	0	0	-	-	0	0	0	31/45



Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Gutierrezia sarothrae</i>									
06	<b>440</b>	32	64	5	240	0	0	0	7/8
10	<b>260</b>	46	54	0	-	0	0	0	10/11
<i>Juniperus osteosperma</i>									
06	<b>100</b>	60	40	-	80	0	0	0	-/-
10	<b>20</b>	100	0	-	20	0	0	0	-/-
<i>Opuntia sp.</i>									
06	<b>60</b>	0	100	-	-	0	0	0	5/14
10	<b>20</b>	0	100	-	-	0	0	0	5/15
<i>Purshia tridentata</i>									
06	<b>320</b>	6	69	25	-	6	94	0	15/37
10	<b>220</b>	45	55	0	-	64	27	0	19/45
<i>Symphoricarpos oreophilus</i>									
06	<b>0</b>	0	0	-	-	0	0	0	13/18
10	<b>0</b>	0	0	-	-	0	0	0	16/34
<i>Tetradymia canescens</i>									
06	<b>120</b>	33	50	17	60	0	50	0	9/11
10	<b>20</b>	0	0	100	-	0	0	0	9/17

CLOVER CREEK CHAINING - TREND STUDY NO. 18R-5-10  
[Project #712](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sage

Range Type: Crucial Deer Winter/Spring

NRCS Ecological Site Description: [Upland Loam \(Mountain Big Sagebrush\), R028AY310UT](#)

Land Ownership: Private

Elevation: 5,550 ft. (1,692 m)

Aspect: East

Slope: 1%

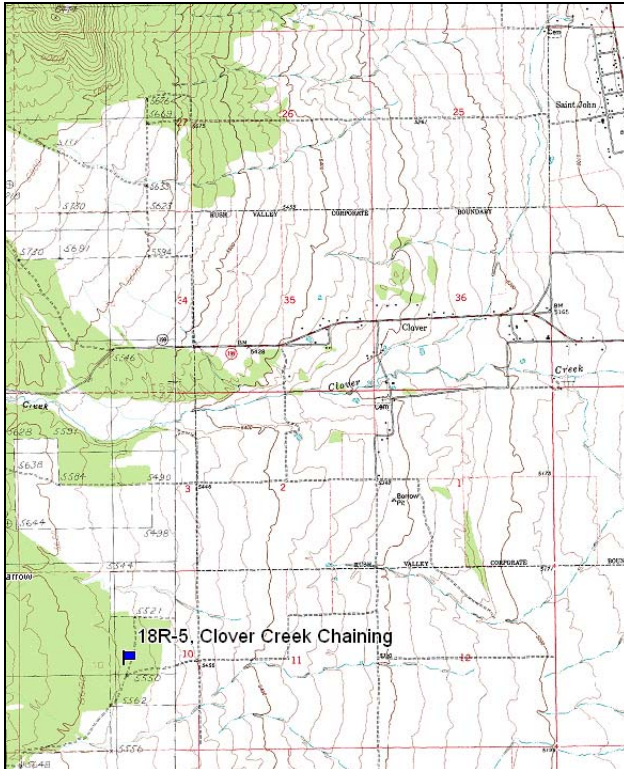
Transect bearing: 250° magnetic

Belt placement: line 1 (11ft & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

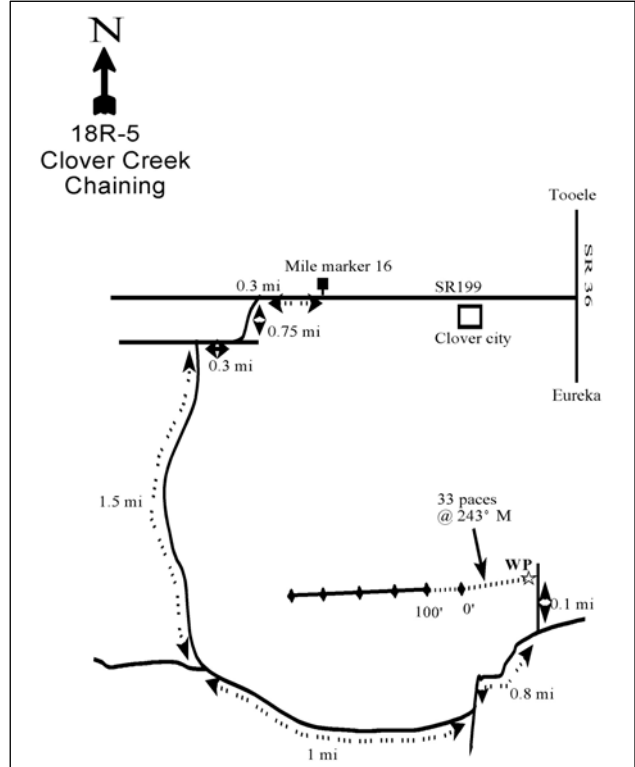
From Lehi, drive west on SR 73 (Main St.) to the junction of SR 36. Turn left (south) and drive 3.7 miles to the SR 199. Turn right on SR 199 and drive to mile marker 16. Continue 0.3 miles to a road on the left (south) near a power pole. Turn left and drive 0.75 miles to a fork. Stay right (west) and drive 0.3 miles to an intersection. Turn left (south) and go 0.7 miles, here you will find the witness post for the Clover Creek Harrow site (18R-6). From here continue on 0.8 miles to a fork, stay left (west) for 1 mile to a T in the road, go left and travel 0.8 miles to a fork. Here stay left and go 0.1 miles to a witness post on the left. From the witness post the 0-foot stake is 33 paces at 243 degrees magnetic with browse tag #114.

Map Name: Johnson Pass



Township: 6S Range: 6W Section: 10

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 372018 E 4463281 N

CLOVER CREEK CHAINING - WRI STUDY 18R-5

[Project #712](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) thinning project approximately four miles southeast of Rush Valley in the Clover Creek watershed. Pinyon pine and Utah juniper have invaded and dominated the flats and low foothills surrounding Clover Creek. An old dryland farm was dominated by thick, decadent Wyoming sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) with a depleted understory. The riparian corridor is dominated by rabbitbrush (*Chrysothamnus* sp.), Wyoming big sagebrush and weeds. Whitetop (*Cardaria draba*) is a problem in the area. The area is crucial winter range for mule deer, historic greater sage-grouse habitat and year round turkey habitat. This study monitors a smooth chaining and aerial seeding of pinyon pine and Utah juniper. The area was treated in the fall of 2007 with a smooth chain and was aerial seeded and back chained in spring of 2008. The Objectives for this project included improving wildlife habitat, livestock grazing and increased water yields (WRI Database 2011). Pellet group data estimated light deer and cattle use in all sample years. An old cow carcass was observed in 2007 on the site (Table - Pellet Group Data).

SEED MIX--

Management unit 18R, Study no: 5

Project Name: Clover Creek Chaining (FY08)			
WRI Database #:712			
Application: Aerial Seed		Acres:	200
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Anatone'	100	0.50
G	Western Wheatgrass 'Arriba'	200	1.00
G	Crested Wheatgrass 'Douglas'	200	1.00
G	Crested Wheatgrass 'Nordan'	200	1.00
G	Indian Ricegrass 'Rimrock'	150	0.75
G	Intermediate Wheatgrass 'Oahe'	500	2.50
G	Orchardgrass 'Paiute'	150	0.75
F	Alfalfa 'Ladak'	150	0.75
F	Alfalfa 'Ranger'	150	0.75
F	Blue Flax 'Appar'	100	0.50
F	Sainfoin 'Eski'	500	2.50
F	Small Burnet 'Delar'	500	2.50
F	Western Yarrow	20	0.10
F	Yellow Sweetclover	200	1.00
Total Pounds:		3120	15.60
PLS Pounds:			13.61

Browse: The preferred browse species on the site is Wyoming big sagebrush, though providing little cover (Table - Canopy Cover) and low in density. Prior to treatment the Wyoming big sagebrush population was a decadent population with extremely poor vigor and heavily utilized. After the treatment the health of the Wyoming big sagebrush population improved with decadence and poor vigor of the population decreasing significantly. Utilization of sagebrush has been light since the treatment. Recruitment of young sagebrush plants to the population has been poor since the out set of the study. Broom snakeweed (*Gutierrezia sarothrae*) rubber rabbitbrush (*Chrysothamnus nauseosus*), gray horsebrush (*Tetradymia canescens*) and pricklypear cactus (*Opuntia* sp.) were also sampled (Table - Browse Characteristics). Utah juniper provided the vast majority of browse cover in each sample year but was significantly reduced after the treatment (Table - Canopy Cover).

**Herbaceous Understory:** Removal of the juniper overstory allowed the expansion of the herbaceous understory. Perennial grass cover doubled following treatment, primarily due to seeded species establishing and thriving. Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Agropyron spicatum*) were the most common grass prior to treatment. Following treatment the seeded species crested wheatgrass (*A. cristatum*) and intermediate wheatgrass (*A. intermedium*) became the most common perennial species along with bluebunch wheatgrass and Sandberg bluegrass. Other seeded species sampled after the treatment include orchard grass (*Dactylis glomerata*) and Indian ricegrass (*Oryzopsis hymenoides*), though Indian ricegrass was present prior to the treatment. Cheatgrass (*Bromus tectorum*) has increased significantly after the treatment. Prior to treatment perennial forbs were exceedingly rare and represented by desert phlox (*Phlox austromontana*) and longleaf phlox (*P. longifolia*). Perennial forbs improved following treatment. Small burnet (*Sanguisorba minor*), a seeded species, provided the most cover. Other seeded species sampled included: Lewis flax (*Linum lewisii*), alfalfa (*Medicago sativa*), yellow sweetclover (*Melilotus officinale*) and sainfoin (*Onobrychis viciaefolia*).

**Soil:** The soil texture is a loam with a neutral soil reaction (pH 7.0) (Table - Soil Analysis Data). Bare ground cover is moderately high with high amount of litter and moderate amount of vegetation providing protective ground cover. Cryptograms decreased in basic ground cover following treatment (Table - Basic Cover). The soil erosion condition was classified as moderate in 2007 due to litter, rock and soil movement and the formation of pedestals, flow patterns, and rills. Following treatment the erosion condition was stable in 2010.

**Pre vs. Three Years Post Treatment, 2007 vs. 2010**

**Browse:** Wyoming big sagebrush cover remained below 1% while density decreased 83% from 460 plants/acre to 80 plants/acre. The overall health of sagebrush improved with decadence and poor vigor decreasing significantly from 100% to 25% of the population. Recruitment of young sagebrush plants to the population was extremely poor at 0% in both sample years. Utah juniper canopy cover decreased from 27% to 3% and density decreased from 236 trees/acre to 67 trees/acre.

**Grasses:** The nested frequency of perennial grasses decreased 14% while cover doubled from 8% to 17%. Bluebunch wheatgrass saw a significant decrease in nested frequency while cover remained similar and Sandberg bluegrass also saw a significant decrease in nested frequency and cover decreased from 5% to 3%. The seeded grass species did well. Crested wheatgrass provided 3% cover while intermediate wheatgrass provided 5% cover. Cheatgrass increased significantly in nested frequency and cover increased from less than 1% cover to 7%.

**Forbs:** Perennial forbs provided less than 1% cover prior to treatment and increased to 4% cover after the treatment. Although still somewhat uncommon, the perennial forb community has improved. Seeded species provided 87% of perennial forb cover. Small burnet was the most common species providing 3% cover.

**HERBACEOUS TRENDS--**

Management unit 18R, Study no: 5

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron cristatum	a-	b60	-	3.41
G	Agropyron intermedium	a-	b101	-	5.22
G	Agropyron smithii	42	39	.76	1.65
G	Agropyron spicatum	b55	a22	2.25	2.33
G	Bromus tectorum (a)	a19	b222	.14	6.64
G	Dactylis glomerata	-	-	-	.03
G	Oryzopsis hymenoides	5	6	.07	.04
G	Poa pratensis	a-	b12	-	.39

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	<i>Poa secunda</i>	<sub>b</sub> 241	<sub>a</sub> 57	4.67	2.51
G	<i>Sitanion hystrix</i>	29	23	.36	1.26
Total for Annual Grasses		19	222	0.14	6.64
Total for Perennial Grasses		372	320	8.11	16.88
Total for Grasses		391	542	8.26	23.52
F	<i>Allium</i> sp.	-	1	-	.00
F	<i>Alyssum alyssoides</i> (a)	<sub>a</sub> 46	<sub>b</sub> 138	.08	1.17
F	<i>Arabis</i> sp.	3	-	.00	-
F	<i>Descurainia pinnata</i> (a)	5	3	.00	.03
F	<i>Helianthus annuus</i> (a)	-	1	-	.03
F	<i>Lactuca serriola</i> (a)	<sub>a</sub> -	<sub>b</sub> 26	-	.37
F	<i>Linum lewisii</i>	-	10	-	.12
F	<i>Medicago sativa</i>	-	9	-	.59
F	<i>Melilotus officinalis</i>	-	2	-	.03
F	<i>Onobrychis viciaefolia</i>	-	5	-	.33
F	<i>Phlox austromontana</i>	6	2	.07	.15
F	<i>Phlox longifolia</i>	8	-	.02	-
F	<i>Ranunculus testiculatus</i> (a)	<sub>a</sub> 56	<sub>b</sub> 110	.16	1.01
F	<i>Salsola iberica</i> (a)	<sub>a</sub> -	<sub>b</sub> 12	-	.08
F	<i>Sanguisorba minor</i>	<sub>a</sub> -	<sub>b</sub> 55	-	2.72
F	<i>Zigadenus paniculatus</i>	-	5	-	.03
Total for Annual Forbs		107	290	0.25	2.70
Total for Perennial Forbs		17	89	0.09	3.99
Total for Forbs		124	379	0.34	6.69

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 18R, Study no: 5

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	<i>Artemisia tridentata wyomingensis</i>	18	4	.36	.15
B	<i>Gutierrezia sarothrae</i>	1	1	-	.15
B	<i>Juniperus osteosperma</i>	9	8	15.88	2.41
B	<i>Opuntia</i> sp.	1	2	.15	.00
Total for Browse		29	15	16.40	2.71

CANOPY COVER, LINE INTERCEPT--

Management unit 18R, Study no: 5

Species	Percent Cover	
	'07	'10
Artemisia tridentata wyomingensis	.66	.18
Juniperus osteosperma	26.88	2.75
Opuntia sp.	.10	-

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 18R, Study no: 5

Species	Average leader growth (in)	
	'07	'10
Artemisia tridentata wyomingensis	1.0	2.4

POINT-QUARTER TREE DATA--

Management unit 18R, Study no: 5

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	236	67	8.7	3.7

BASIC COVER--

Management unit 18R, Study no: 5

Cover Type	Average Cover %	
	'07	'10
Vegetation	22.61	33.39
Rock	.06	.20
Pavement	1.40	1.48
Litter	33.09	46.40
Cryptogams	17.11	.45
Bare Ground	43.29	33.56

SOIL ANALYSIS DATA --

Management unit 18R, Study no: 5, Study Name: Clover Creek Chaining

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.0	31.4	42.0	26.6	2.1	8.0	220.8	0.6

PELLET GROUP DATA--

Management unit 18R, Study no: 5

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	67	16	-	-
Deer	-	2	8 (20)	14 (35)
Cattle	-	2	-	3 (4)

BROWSE CHARACTERISTICS--  
Management unit 18R, Study no: 5

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata wyomingensis</i>									
07	<b>460</b>	0	0	100	-	9	74	100	15/21
10	<b>80</b>	0	75	25	20	0	0	25	19/19
<i>Chrysothamnus nauseosus</i>									
07	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	22/30
<i>Gutierrezia sarothrae</i>									
07	<b>20</b>	100	0	-	-	0	0	0	5/5
10	<b>20</b>	0	100	-	-	0	0	0	14/17
<i>Juniperus osteosperma</i>									
07	<b>200</b>	10	90	-	40	0	0	0	-/-
10	<b>200</b>	80	20	-	40	0	0	0	-/-
<i>Opuntia sp.</i>									
07	<b>20</b>	0	100	-	-	0	0	0	6/18
10	<b>40</b>	0	100	-	-	0	0	0	6/14
<i>Tetradymia canescens</i>									
07	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	8/11

CLOVER CREEK DRY FARM - TREND STUDY NO. 18R-6-10  
[Project #712](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter/Spring

NRCS Ecological Site Description: Not available

Land Ownership: Private

Elevation: 5,800 ft. (1,768 m)

Aspect: Northeast

Slope: 6%

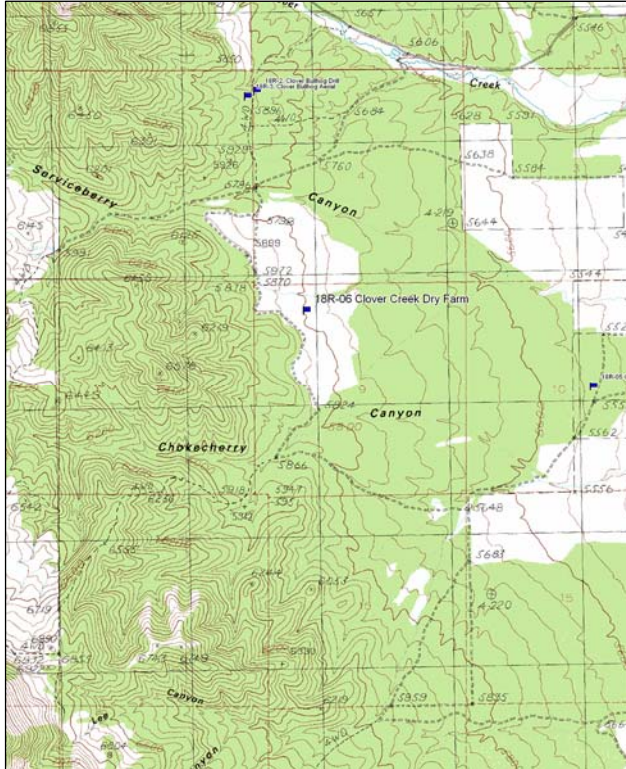
Transect bearing: 94° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

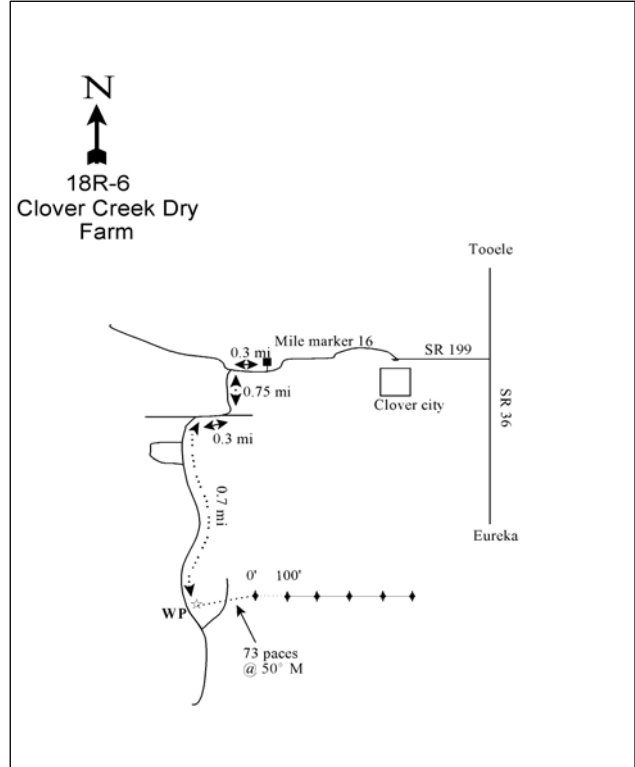
From Lehi, drive west on SR 73 (Main street) to the junction of SR 36. Turn left (south) and drive 3.7 miles to the SR 199. Turn right on SR 199 and drive to mile marker 16. Continue 0.3 miles to a road on the left (south) near a power pole. Turn left and drive 0.75 miles to a fork. Stay right (west) and drive 0.3 miles to an intersection. Turn left (south) and go 0.7 miles to a witness post on the left side of the road. The 0-foot stake is 73 paces at 50 degrees magnetic with browse tag #115.

Map Name: Johnson Pass



Township: 6S Range: 6W Section: 9

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 369837 E 4463898 N



CLOVER CREEK DRY FARM - WRI STUDY 18R-6  
[Project #712](#)

**Site Description**

Site Information: This study was established in 2007 to monitor the effects of a pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) thinning project approximately 5mles southwest of Rush Valley in the Clover Creek watershed. Pinyon pine and Utah juniper invaded and dominated the flats and low foothills surrounding clover Creek. An old dryland farm in this area was dominated by thick, decadent Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) with a depleted understory. Initially the study was established to monitor a harrow treatment but the harrow continued to clog so a chain was chosen in its place. Juniper trees were pushed over with a dozer by the landowner prior to the study establishment in 2007. The rest of the area was not treated until 2008 with an Ely chain and a smooth chain on the second pass. The objectives for this project include improving wildlife habitat, livestock grazing and increased water yields. Increases in annual grasses have been recognized and the area was sprayed with Plateau (Imazapic) in the fall of 2010 after the study was monitored 2010 so results of that treatment are not reflected in the data presented here (WRI Database 2011). Pellet group data estimated light use by deer in each sample year, while sheep use was light in 2007 and cattle use light in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 18R, Study no: 6

Project Name: Clover Creek Chain (FY09)			
WRI Database #: 721			
Application: Aerial Seed		Acres: 250	
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Anatone'	250	1.00
G	Canby Bluegrass 'Canbar'	150	0.60
G	Crested Wheatgrass 'Douglas'	150	0.60
G	Crested Wheatgrass 'Ephraim'	150	0.60
G	Crested Wheatgrass 'Hycrest'	200	0.80
G	Indian Ricegrass 'Rimrock'	150	0.60
G	Intermediate Wheatgrass	500	2.00
G	Orchardgrass 'Paiute'	200	0.80
G	Siberian Wheatgrass 'Vavilov'	450	1.80
F	Alfalfa 'Ladak'	100	0.40
F	Alfalfa 'Ranger'	100	0.40
F	Alfalfa 'Spredor 4'	100	0.40
F	Blue Flax 'Appar'	100	0.40
F	Sainfoin 'Eski'	500	2.00
F	Small Burnet 'Delar'	500	2.00
F	Western Yarrow	25	0.10
F	Yellow Sweetclover	200	0.80
Total Pounds:		3825	15.30
PLS Pounds:			13.78

Browse: Wyoming big sagebrush is the dominant preferred browse species. Decadence and poor vigor of sagebrush plants has been relatively low following the treatment, but decadence and poor vigor were high at the outset of the study. The recruitment of young sagebrush plants to the population has been good, though it was poor in 2007. Utilization of sagebrush has been light over the sample years. Other species sampled included antelope bitterbrush (*Purshia tridentata*) and broom snakeweed (*Gutierrezia sarothrae*). Utah

juniper was treated prior to the establishment of the study and was mostly removed from the treatment site (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant and moderately diverse. Annual grass species cheatgrass (*Bromus tectorum*) and Japanese chess (*Bromus japonicus*) are the dominant species on the site and provide the majority of the cover. Kentucky bluegrass (*Poa pratensis*) and mountain brome (*Bromus carinatus*) are the most common perennial grass species. Crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*A. intermedium*) and Indian ricegrass (*Oryzopsis hymenoides*) were seeded species sampled for the first time in 2010. Forbs are not diverse or overly abundant. Perennial forbs were limited in all sample years. Annual forbs dominate the forb component. Pale alyssum (*Alyssum alyssoides*) is the dominant forb species and provides the majority of forb cover. Small burnet (*Sanguisorba minor*) was the only seeded forb species sampled (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.0) (Table - Soil Analysis Data). Bare ground cover is low with high amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2007 due to pedestalling around plants and the formation of flow patterns. The soil erosion condition was stable in 2010.

**Pre vs. Two Years Post Treatment Assessment, 2007 vs. 2010**

Browse: Wyoming big sagebrush canopy cover decreased from 11% to 8% and density decreased 37% from 4,320 plants/acre to 4,680 plants/acre. The population’s health improved as the recruitment of young plants increased from 1% to 13% of the population and decadence decreased from 68% to 7%. Plants exhibiting poor vigor decreased from 88% to 6%. Utah juniper density remained similar to 2007 levels at 53 trees/acre.

Grasses: The nested frequency of perennial grasses increased nearly three-fold and cover increased from 2% to 8%. Kentucky bluegrass cover increased from 1% to 3%. Mountain brome also provided 3% cover. However, Japanese chess and cheatgrass combined to provide 28% cover, which was up from only 3% cover.

Forbs: Perennial forbs were rare in each sample and provided less than 1% cover. Only small burnet was sampled of the seeded species. Annual forb species increased in cover from 4% to 6%, though the sum of nested frequency slightly decreased 12%. Pale alyssum increased in cover from 3% to 5%.

HERBACEOUS TRENDS--  
Management unit 18R, Study no: 6

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron cristatum	a-	b14	-	.30
G	Agropyron intermedium	a-	b38	-	.87
G	Agropyron spicatum	1	-	.00	-
G	Bromus carinatus	a-	b80	-	2.86
G	Bromus japonicus (a)	a141	b270	1.18	14.83
G	Bromus tectorum (a)	a222	b378	1.66	13.43
G	Oryzopsis hymenoides	-	5	-	.00
G	Poa bulbosa	1	7	.00	.06
G	Poa pratensis	61	90	1.45	3.38
G	Poa secunda	a4	b16	.15	.95
Total for Annual Grasses		363	648	2.84	28.27
Total for Perennial Grasses		67	250	1.62	8.43

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
	Total for Grasses	430	898	4.46	36.71
F	Agoseris glauca	1	-	.00	-
F	Alyssum alyssoides (a)	360	306	2.50	4.83
F	Arabis sp.	3	-	.02	-
F	Astragalus convallarius	2	3	.15	.00
F	Cirsium sp.	-	4	.03	.19
F	Crepis acuminata	-	2	-	.03
F	Epilobium brachycarpum (a)	<sub>b</sub> 25	<sub>a</sub> -	.42	-
F	Helianthus annuus (a)	<sub>a</sub> 7	<sub>b</sub> 49	.23	.34
F	Lactuca serriola (a)	<sub>a</sub> 4	<sub>b</sub> 36	.02	.61
F	Lappula occidentalis (a)	1	-	.00	-
F	Polygonum douglasii (a)	-	2	-	.01
F	Ranunculus testiculatus (a)	<sub>b</sub> 62	<sub>a</sub> 10	.39	.12
F	Sanguisorba minor	<sub>a</sub> -	<sub>b</sub> 18	-	.54
F	Sisymbrium altissimum (a)	-	-	-	.03
F	Sphaeralcea munroana	<sub>b</sub> 37	<sub>a</sub> 5	.12	.04
	Total for Annual Forbs	459	403	3.58	5.95
	Total for Perennial Forbs	43	32	0.32	0.81
	Total for Forbs	502	435	3.90	6.76

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 18R, Study no: 6

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia tridentata wyomingensis	86	66	10.30	6.46
B	Chrysothamnus nauseosus	1	0	-	-
B	Gutierrezia sarothrae	72	68	1.71	5.60
B	Juniperus osteosperma	4	1	1.23	.03
B	Pediocactus simpsonii	0	1	-	-
B	Purshia tridentata	3	2	.21	-
	Total for Browse	166	138	13.46	12.10

#### CANOPY COVER, LINE INTERCEPT--

Management unit 18R, Study no: 6

Species	Percent Cover	
	'07	'10
Artemisia tridentata wyomingensis	11.36	7.76
Gutierrezia sarothrae	2.25	6.30
Juniperus osteosperma	.23	.53
Purshia tridentata	1.33	-

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 18R, Study no: 6

Species	Average leader growth (in)	
	'07	'10
Artemisia tridentata wyomingensis	1.5	1.7

POINT-QUARTER TREE DATA--

Management unit 18R, Study no: 6

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	58	53	3.1	1.5

BASIC COVER--

Management unit 18R, Study no: 6

Cover Type	Average Cover %	
	'07	'10
Vegetation	21.67	51.06
Rock	.30	.38
Pavement	3.80	2.47
Litter	53.14	51.50
Cryptogams	1.37	.15
Bare Ground	34.26	19.56

SOIL ANALYSIS DATA --

Management unit 18R, Study no: 6, Study Name: Clover Creek Dry Farm

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.0	31.4	44.0	24.6	2.2	19.6	444.8	0.5

PELLET GROUP DATA--

Management unit 18R, Study no: 6

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	29	-	-	-
Sheep	-	-	2 (5)	-
Deer	9	-	5 (13)	1 (3)
Cattle	-	-	-	1 (2)

BROWSE CHARACTERISTICS--  
 Management unit 18R, Study no: 6

		Age class distribution				Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata wyomingensis</i>									
07	<b>4320</b>	1	31	68	1580	14	13	88	20/25
10	<b>2740</b>	13	80	7	40	10	0	6	19/24
<i>Chrysothamnus nauseosus</i>									
07	<b>20</b>	100	0	-	-	0	0	0	19/20
10	<b>0</b>	0	0	-	-	0	0	0	27/27
<i>Gutierrezia sarothrae</i>									
07	<b>5880</b>	37	61	2	6080	0	0	2	7/7
10	<b>4680</b>	7	92	1	-	0	0	.85	12/14
<i>Juniperus osteosperma</i>									
07	<b>80</b>	75	25	-	20	0	0	50	-/-
10	<b>40</b>	100	0	-	20	0	0	0	-/-
<i>Pediocactus simpsonii</i>									
07	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>20</b>	100	0	-	-	0	0	0	-/-
<i>Purshia tridentata</i>									
07	<b>60</b>	33	0	67	-	0	100	67	14/26
10	<b>40</b>	100	0	0	-	0	0	0	23/13

BENNION CHAINING - TREND STUDY NO. 19R-4-10

[Project #55](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Substantial Deer Spring/Fall

NRCS Ecological Site Description: Not available

Land Ownership: Private

Elevation: 6,080 ft. (1,853 m)

Aspect: South

Slope: 20%

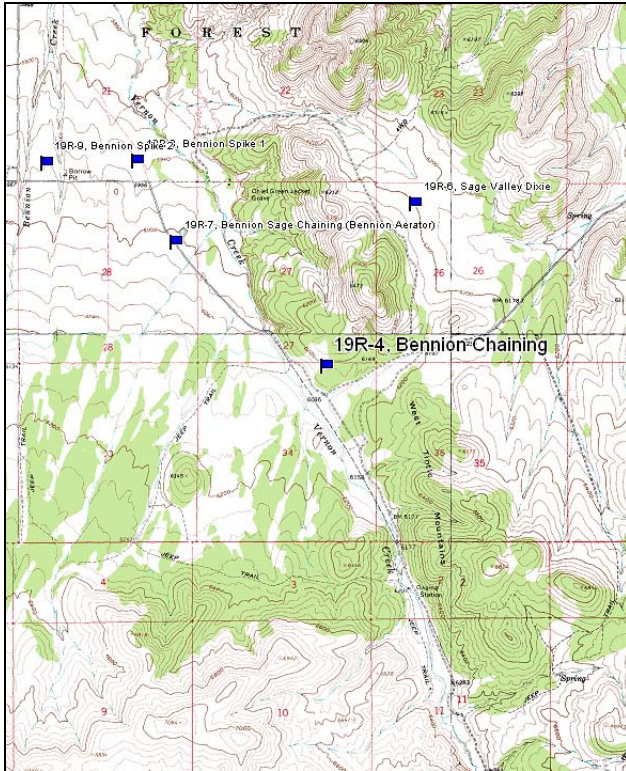
Transect bearing: 345° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

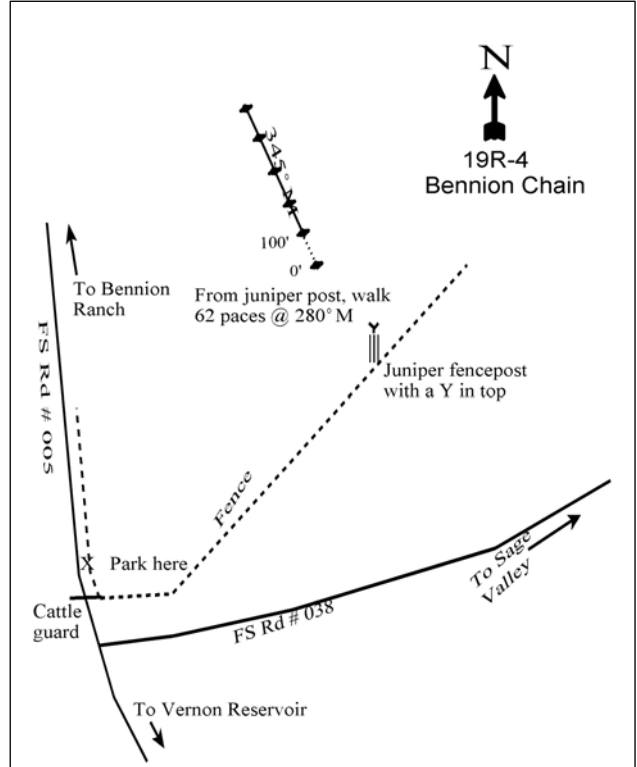
From Eureka, drive southwest on US 6 to Tintic Junction (SR36 and 67). Turn right (NW) on SR 36 and drive 19.5 miles to two road that go west, take the first road that goes south towards Vernon Reservoir. Drive south for 7.3 miles to a cattle guard just before the junction of FS road #038 and park here. Walk along the fence line ~800 feet to a juniper fence post. From the fence post, walk 62 paces at 280°M to the 0' stake. The 0' stake is marked with browse tag #99.

Map Name: Dutch Peak



Township: 9S Range: 5W Section: 34

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 381389 E 4428351 N

BENNION CHAINING - WRI STUDY 19R-4

[Project #55](#)

**Site Description**

Site Information: The study was established in 2005 to monitor a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) community improvement project designed to improve valuable deer winter range and sage-grouse brood and winter habitat while providing forage for livestock on the privately owned Bennion Ranch. The sagebrush community has lost much of its herbaceous understory following over-grazing, fire, pinyon pine (*Pinus edulis*), singleleaf pinyon (*Pinus monophylla*), and Utah juniper (*Juniperus osteosperma*) encroachment, and drought. To improve the community, 450 acres was two-way chained in the fall of 2005 and fall of 2006. Seed was applied aerially following the first chaining pass and 50 acres were treated by plow and then drill seeded. An additional seed mix of fourwing saltbush (*Atriplex canescens*) and antelope bitterbrush (*Purshia tridentata*) was also applied during the chaining treatment by seed dribbler. Forage kochia (*Kochia prostrata*) and Wyoming sagebrush were applied following all treatments (WRI Database 2011). Pellet group data estimated light deer use in all sample years and cattle use was light in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 19R, Study no: 4

Project Name: Bennion Ranch Chaining 3					
WRI Database #: 55					
Application: Aerial Seed		Acres: 175		Application: Seed Dribbler	
Seed type		lbs in mix	lbs/acre	Acres: 320	
G	Bluebunch WG 'Anatone'	100	0.57	B	Bitterbrush
G	Crested Wheatgrass 'Douglas'	100	0.57	B	Fourwing Saltbush
G	Indian Ricegrass 'Rimrock'	100	0.57	Total Pounds:	
G	Intermediate Wheatgrass	150	0.86	150 0.47	
G	Russian Wildrye 'Bozoisky'	200	1.14	PLS Pounds:	
G	Snake River Wheatgrass 'Secar'	150	0.86	0.24	
F	Alfalfa 'Ladak'	100	0.57	Application: Broadcast seeder	
F	Alfalfa 'Ranger'	100	0.57	Acres: 320	
F	Alfalfa 'Spredor 4'	100	0.57	Seed type	
F	Sainfoin 'Eski'	350	2.00	B	Forage Kochia
F	Small Burnet 'Delar'	350	2.00	B	Sagebrush, Wyoming
Total Pounds:		1800 10.29		Total Pounds:	
PLS Pounds:		9.13		790 2.47	
				PLS Pounds:	
				0.80	

Browse: The preferred browse species on the site are Wyoming big sagebrush, fourwing saltbush, and forage kochia each of which were seeded during the treatment, though Wyoming big sagebrush was present prior to the treatment. Forage kochia is the dominant browse species. Utilization of forage kochia was moderate in 2010. Wyoming big sagebrush and fourwing saltbush are rare on the site (Table - Browse Characteristics). Prior to treatment canopy cover was dominated by Utah juniper, singleleaf pinyon, and pinyon pine and after the treatment the canopy cover was substantially reduced (Table - Canopy Cover).

Herbaceous Understory: Grasses are abundant and fairly diverse. Prior to treatment perennial grasses were very rare, but became more common following the treatment due to the presents of seeded species. Bluebunch wheatgrass (*Agropyron. spicatum*) and intermediate wheatgrass (*A. intermedium*) are the dominant perennial grass species, although prior to treatment Sandberg bluegrass (*Poa secunda*) was the dominant species but has

become rare following the treatment. Cheatgrass (*Bromus tectorum*) increased significantly in frequency and cover following the treatment and became the most common grass species in 2010. Seeded species sampled after the treatment included: crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass, Russian wildrye (*Elymus junceus*) and Indian ricegrass (*Oryzopsis hymenoides*). Forbs are abundant but not overly diverse. Prior to treatment perennial forbs were extremely rare, but have become abundant following the treatment. Milkvetch (*Astragalus sp.*) and alfalfa (*Medicago sativa*) became the dominant forb species. Other seeded forbs sampled included: sainfoin (*Onobrychis viciaefolia*) and small burnet (*Sanguisorba minor*).

Soil: The soil texture is a loam with a slightly alkaline soil reaction (pH 7.5) (Table - Soil Analysis Data). Bare ground cover is low with high amount of litter, rock, and pavement and a moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

### Pre vs. Five Years Post Treatment Assessment, 2005 vs. 2010

Browse: Wyoming big sagebrush canopy cover remained less than 1% while density increased from 60 plants/acre to 100 plants/acre with high recruitment of young at 60% of the population. Forage kochia canopy cover was 4% in 2010 with a density of 2,860 plants/acre. Combined, Utah juniper and pinyon pine canopy cover was at 45% prior to treatment and 1% following. Utah juniper density was reduced from 392 trees/acre to 45 trees/acre while singleleaf pinyon was reduced from 32 trees/acre to zero trees sampled.

Grasses: The sum of nested frequency of perennial grasses increased 24% while cover increased from 2% to 8%. Bluebunch wheatgrass cover increased from less than 1% to 4% with significant increase in nested frequency. Sandberg bluegrass decreased significantly in nested frequency while cover declined from 2% to less than 1%. Cheatgrass cover increased from less than 1% to 10% and became the dominant grass species on site.

Forbs: The removal of the pinyon and juniper overstory released the forb understory. The sum of nested frequency of perennial forbs increased nine fold and cover increased from less than 1% to 12%. Milkvetch that was not sampled in 2007 but in 2010 provided 9% cover. Alfalfa was the only other perennial forb to provide more than 1% cover.

#### HERBACEOUS TRENDS--

Management unit 19R, Study no: 4

Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
G	Agropyron cristatum	a <sup>-</sup>	b <sup>20</sup>	-	.54
G	Agropyron intermedium	a <sup>-</sup>	b <sup>30</sup>	-	1.41
G	Agropyron smithii	-	1	-	.03
G	Agropyron spicatum	a <sup>15</sup>	b <sup>64</sup>	.16	4.24
G	Bromus tectorum (a)	a <sup>19</sup>	b <sup>341</sup>	.07	9.94
G	Elymus junceus	-	4	-	.21
G	Oryzopsis hymenoides	-	11	.00	.09
G	Poa bulbosa	-	3	-	.00
G	Poa secunda	b <sup>125</sup>	a <sup>26</sup>	1.77	.32
G	Sitanion hystrix	a <sup>4</sup>	b <sup>19</sup>	.04	.78
Total for Annual Grasses		19	341	0.07	9.94
Total for Perennial Grasses		144	178	1.99	7.64
Total for Grasses		163	519	2.06	17.59



Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
F	Agoseris glauca	2	-	.00	-
F	Alyssum alyssoides (a)	<sub>a</sub> 126	<sub>b</sub> 291	.31	4.58
F	Antennaria rosea	1	-	.03	-
F	Argemone corymbosa	-	-	-	.63
F	Astragalus convallarius	3	-	.00	-
F	Astragalus sp.	<sub>a</sub> -	<sub>b</sub> 100	-	8.54
F	Astragalus utahensis	<sub>a</sub> 4	<sub>b</sub> 18	.01	.39
F	Chaenactis douglasii	-	9	-	.06
F	Crepis acuminata	-	3	-	.03
F	Cryptantha sp.	4	1	.00	.03
F	Cymopterus sp.	-	2	-	.01
F	Descurainia pinnata (a)	16	19	.09	.28
F	Gilia sp. (a)	<sub>b</sub> 58	<sub>a</sub> -	.31	-
F	Lactuca serriola (a)	<sub>a</sub> -	<sub>b</sub> 45	.00	.75
F	Lygodesmia spinosa	4	1	.00	.00
F	Medicago sativa	<sub>a</sub> -	<sub>b</sub> 24	-	1.25
F	Microsteris gracilis (a)	-	2	-	.03
F	Onobrychis viciaefolia	-	1	-	.03
F	Ranunculus testiculatus (a)	<sub>b</sub> 16	<sub>a</sub> -	.03	-
F	Sanguisorba minor	<sub>a</sub> -	<sub>b</sub> 19	-	.85
F	Senecio multilobatus	<sub>a</sub> -	<sub>b</sub> 10	-	.10
F	Tragopogon dubius (a)	-	1	-	.03
F	Trifolium sp.	3	-	.00	-
Total for Annual Forbs		216	358	0.74	5.68
Total for Perennial Forbs		21	188	0.06	11.94
Total for Forbs		237	546	0.80	17.62

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 19R, Study no: 4

Type	Species	Strip Frequency		Average Cover %	
		'05	'10	'05	'10
B	Artemisia tridentata wyomingensis	2	4	-	-
B	Atriplex canescens	0	1	-	-
B	Chrysothamnus nauseosus	0	2	-	.38
B	Chrysothamnus viscidiflorus stenophyllus	0	1	-	.15
B	Gutierrezia sarothrae	0	1	-	-
B	Juniperus osteosperma	23	0	12.33	.33
B	Kochia prostrata	0	41	-	2.01
B	Opuntia sp.	7	5	.15	.18
B	Pinus edulis	-	-	1.00	-
B	Pinus monophylla	1	0	4.61	-
Total for Browse		33	55	18.11	3.06

CANOPY COVER, LINE INTERCEPT--

Management unit 19R, Study no: 4

Species	Percent Cover	
	'05	'10
Artemisia tridentata wyomingensis	.06	.10
Atriplex canescens	-	.05
Chrysothamnus nauseosus	-	.30
Juniperus osteosperma	33.90	.56
Kochia prostrata	-	4.48
Opuntia sp.	-	.01
Pinus edulis	1.70	-
Pinus monophylla	9.19	-

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 19R, Study no: 4

Species	Average leader growth (in) '10
Artemisia tridentata wyomingensis	2.3
Kochia prostrate	2.4

POINT-QUARTER TREE DATA--

Management unit 19R, Study no: 4

Species	Trees per Acre		Average diameter (in)	
	'05	'10	'05	'10
Juniperus osteosperma	392	45	5.1	2.0
Pinus monophylla	32	-	8.6	-

BASIC COVER--

Management unit 19R, Study no: 4

Cover Type	Average Cover %	
	'05	'10
Vegetation	20.04	36.90
Rock	8.97	8.88
Pavement	31.68	9.27
Litter	39.37	49.47
Cryptogams	.62	.53
Bare Ground	16.62	12.57

SOIL ANALYSIS DATA --

Management unit 19R, Study no: 4, Study Name: Bennion Chaining

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
9.5	7.5	37.4	36.0	26.6	2.4	9.7	169.6	0.6

PELLET GROUP DATA--

Management unit 19R, Study no: 4

Type	Quadrat Frequency		Days use per acre (ha)	
	'05	'10	'05	'10
Rabbit	62	2	-	-
Elk	-	1	-	-
Deer	1	7	1 (2)	7 (18)
Cattle	-	2	-	2 (5)

BROWSE CHARACTERISTICS--

Management unit 19R, Study no: 4

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia tridentata wyomingensis</i>									
05	<b>60</b>	0	33	67	-	0	0	33	12/17
10	<b>100</b>	60	40	0	-	0	0	0	20/21
<i>Atriplex canescens</i>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>60</b>	67	33	-	-	0	0	0	21/17
<i>Chrysothamnus nauseosus</i>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>40</b>	0	100	-	-	0	0	0	21/22
<i>Chrysothamnus viscidiflorus stenophyllus</i>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>20</b>	0	100	-	-	0	0	0	15/23
<i>Gutierrezia sarothrae</i>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>20</b>	0	100	-	-	0	0	0	-/-

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<b>Juniperus osteosperma</b>									
05	<b>560</b>	18	82	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<b>Kochia prostrata</b>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>2860</b>	12	88	-	-	38	0	0	17/22
<b>Opuntia sp.</b>									
05	<b>180</b>	33	67	0	-	0	0	0	4/11
10	<b>100</b>	0	80	20	-	20	0	20	4/10
<b>Pinus monophylla</b>									
05	<b>20</b>	0	100	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<b>Tetradymia canescens</b>									
05	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	10/13

BENNION SAGEBRUSH CHAINING - TREND STUDY NO. 19R-7-10

[Project #396](#)

Vegetation Type: Utah Juniper, Wyoming Big Sagebrush

Range Type: Substantial Deer Spring/Fall

NRCS Ecological Site Description: Not available

Land Ownership: Private

Elevation: 6,000 ft. (1,829 m)

Aspect: East

Slope: 1%

Transect bearing: 194° magnetic

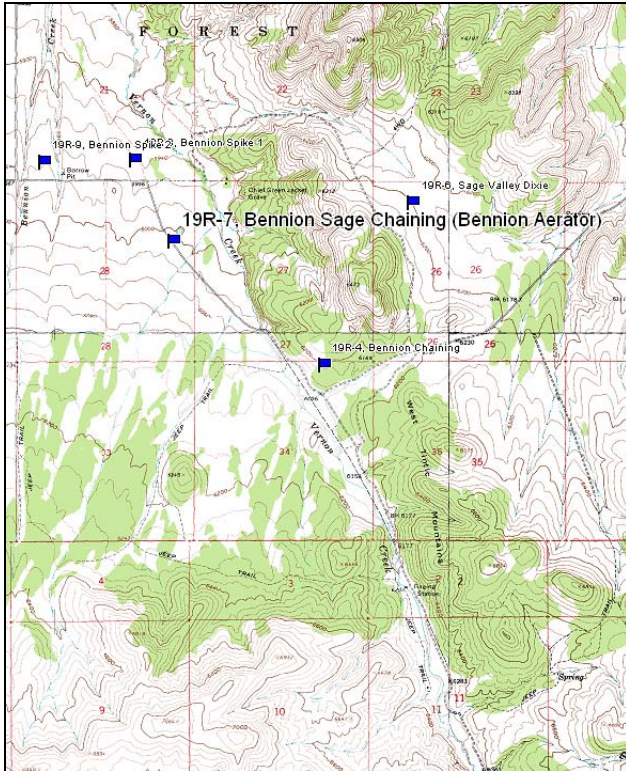
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

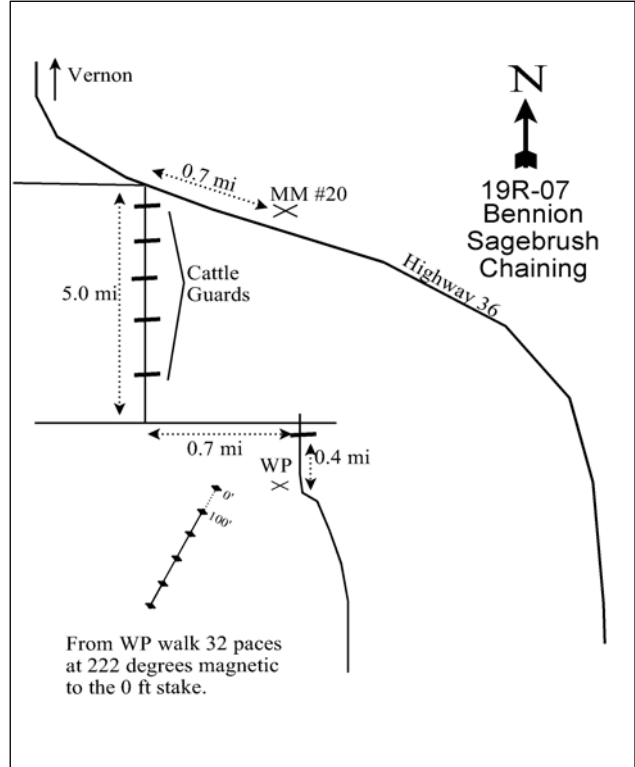
From highway 36 south of Vernon, drive to mile marker #20. From there, drive 0.7 miles to a turn off on the left (west). Turn there and drive south for 5.0 miles passing several (4 or 5) cattle guards to a fork. Turn left and drive 0.7 miles to an intersection. Turn right (south) crossing a cattle guard and drive 0.4 miles to a witness post on the right. Walk 32 paces at 222 degrees magnetic to the 0 foot stake (no browse tag).

Map Name: Vernon



Township: 9S Range: 5W Section: 28

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 380054 E 4429455 N

BENNION SAGEBRUSH CHAINING - WRI STUDY 19R-7

[Project #396](#)

**Site Description**

Site Information: This study was established in 2006 to monitor a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) community improvement project approximately five and a half miles south of Vernon on the privately owned Bennion Ranch. Initially the study was established to monitor a Lawson aerator and chaining treatment but due to time limitation the area was not aerated. One hundred ninety two acres of a Wyoming big sagebrush community encroached by Utah juniper (*Juniperus osteosperma*) were two-way chained using a Ely chain and seed was aerially applied between chaining passes in the fall of 2006. Seed dribblers were used on the second pass to plant antelope bitterbrush (*Purshia tridentata*) and fourwing saltbush (*Atriplex canescens*). The objectives of the project were to provide improved brood-rearing habitat for sage-grouse and improve transitional and winter ranges for mule deer (WRI Database 2011). Pellet group data estimated light use by deer, elk and cattle in 2006 and light use by cattle in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 19R, Study no: 7

Project Name: Bennion Ranch Chaining 2					
WRI Database #: 396					
Application: Aerial Seed		Acres: 180		Application: Seed Dribbler	
				Acres: 320	
Seed type		lbs in mix	lbs/acre	Seed type	
G	Bluebunch WG 'Anatone'	150	0.83	B	Bitterbrush
G	Crested Wheatgrass 'Hycrest'*	200	1.11	B	Fourwing Saltbush
G	Crested Wheatgrass VNS*	200	1.11	Total Pounds:	
G	Indian Ricegrass 'Rimrock'	90	0.50	150	
G	Pubescent Wheatgrass	150	0.83	PLS Pounds:	
G	Russian Wildrye 'Bozoisky'*	200	1.11	0.24	
G	Siberian Wheatgrass 'Vavilov'*	200	1.11	Application: Broadcast seeder	
F	Alfalfa 'Ladak'	75	0.42	Acres: 320	
F	Alfalfa 'Ranger'	75	0.42	Seed type	
F	Alfalfa 'Spredor 4'	75	0.42	B	Forage Kochia
F	Sainfoin 'Eski'	350	1.94	B	Sagebrush, Wyoming
F	Small Burnet 'Delar'	350	1.94	Total Pounds:	
F	Yellow Sweetclover	30	0.17	790	
Total Pounds:		2145		PLS Pounds:	
		11.92		0.80	
PLS Pounds:		10.54			

Browse: The preferred browse species on the site is Wyoming big sagebrush. The Wyoming big sagebrush is a lightly used population with moderate to high decadence and poor vigor over the sample years, though decadence and poor vigor have improved since the chaining treatment. The recruitment of young sagebrush plants to the population has been good following the treatment but prior to treatment recruitment of young plants to the population was poor. Other species sampled on the site include stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), narrowleaf rabbitbrush (*C. v.* ssp. *stenophyllus*), and white rubber rabbitbrush (*C. nauseosus* ssp. *albicaulis*). Utah juniper population was effectively decreased following the treatment (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant and diverse. The dominant grass species is western wheatgrass (*Agropyron smithii*) which provides the majority of the grass cover on the site. Other common grass species

sampled on the site include crested wheatgrass (*A. cristatum*), pubescent wheatgrass (*A. intermedium*), bluebunch wheatgrass (*A. spicatum*), cheatgrass (*Bromus tectorum*), Indian ricegrass (*Oryzopsis hymenoides*), and Sandberg bluegrass (*Poa secunda*). Following the treatment cheatgrass significantly increased in frequency and cover while Sandberg bluegrass substantially decreased in frequency and cover. Seeded species sampled following the treatment include crested wheatgrass, bluebunch wheatgrass, Russian wildrye (*Elymus junceus*), and Indian ricegrass. Forbs are moderately abundant and moderately diverse. The annual species bur buttercup (*Ranunculus testiculatus*) and pale alyssum (*Alyssum alyssoides*) and the perennial species desert phlox (*Phlox austromontana*) are the dominant species. Diversity of forbs increased significantly following the treatment with several species being sampled for the first time, though occurring in low frequency and cover. The seeded species sainfoin (*Onobrychis viciaefolia*) was sampled following the treatment (Table - Herbaceous Trends).

Soil: The soil texture is a silt loam with a slightly alkaline soil reaction (pH 7.5) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2007 due to pedestaling, rills, gully formation, and slight soil movement. The soil erosion condition was not assessed in 2010.

### Pre vs. Four Years Post Treatment Assessment, 2006 vs. 2010

Browse: Wyoming big sagebrush canopy cover decreased from 15% to 1% and density decreased 64% from 2,140 plants/acre to 780 plants/acre. The health of the sagebrush population improved with decadence decreasing from 51% to 26% and poor vigor decreased from 52% to 28% of the population. The recruitment of young sagebrush increased from 1% to 31%. Utah juniper density was reduced from 63 trees/acre to 19 trees/acre.

Grasses: The sum of nested frequency of perennial grasses increased 18% while cover increased from 16% to 21%. Western wheatgrass significantly decreased in frequency but cover increased from 5% to 11%. Sandberg bluegrass decreased significantly in nested frequency and cover decreased from 7% to 1%. Cheatgrass cover increased from 1% to 3%. The seeded species Indian ricegrass, crested wheatgrass, and bluebunch wheatgrass each provided 2% cover following the treatment.

Forbs: The sum of nested frequency of perennial forbs remained similar and cover increased from 3% to 5%. Desert phlox remained similar at 3% cover. The annual species bur buttercup significantly decreased in nested frequency and cover decreased from 4% to 1% and pale alyssum significantly increased in nested frequency and cover increased from less than 1% to 4%.

### HERBACEOUS TRENDS-- Management unit 19R, Study no: 7

T y p e	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	a-	b42	-	1.99
G	Agropyron intermedium	a6	b57	.03	2.00
G	Agropyron smithii	b229	a177	4.59	10.92
G	Agropyron spicatum	44	34	1.73	1.83
G	Bromus tectorum (a)	a65	b89	1.14	3.37
G	Elymus cinereus	-	3	-	.15
G	Elymus junceus	-	3	-	.15
G	Oryzopsis hymenoides	24	28	1.48	1.58
G	Poa bulbosa	45	59	.80	.70
G	Poa secunda	b212	a68	6.71	1.31

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	<i>Sitanion hystrix</i>	<sub>b</sub> 18	<sub>a</sub> 6	.56	.29
	Total for Annual Grasses	65	89	1.14	3.37
	Total for Perennial Grasses	578	477	15.93	20.95
	Total for Grasses	643	566	17.08	24.32
F	<i>Agoseris glauca</i>	-	5	-	.03
F	<i>Allium</i> sp.	7	9	.02	.05
F	<i>Alyssum alyssoides</i> (a)	<sub>a</sub> 112	<sub>b</sub> 222	.26	4.22
F	<i>Alyssum desertorum</i> (a)	-	3	-	.03
F	<i>Astragalus convallarius</i>	19	21	.16	.59
F	<i>Calochortus nuttallii</i>	-	1	-	.00
F	<i>Comandra pallida</i>	19	23	.19	.39
F	<i>Crepis acuminata</i>	8	5	.02	.10
F	<i>Cymopterus</i> sp.	3	11	.00	.24
F	<i>Ipomopsis congesta</i>	4	4	.01	.06
F	<i>Lactuca serriola</i> (a)	<sub>a</sub> -	<sub>b</sub> 11	-	.08
F	<i>Lepidium</i> sp. (a)	-	1	-	.03
F	<i>Machaeranthera canescens</i>	1	-	.00	-
F	<i>Microsteris gracilis</i> (a)	-	5	-	.03
F	<i>Onobrychis viciaefolia</i>	-	5	-	.15
F	<i>Phlox austromontana</i>	80	85	2.50	2.84
F	<i>Phlox longifolia</i>	7	3	.02	.04
F	<i>Ranunculus testiculatus</i> (a)	<sub>b</sub> 262	<sub>a</sub> 85	3.89	1.32
F	<i>Senecio integerrimus</i>	-	5	-	.03
F	<i>Tragopogon dubius</i> (a)	-	-	-	.00
F	<i>Vicia americana</i>	<sub>b</sub> 23	<sub>a</sub> 6	.16	.09
F	<i>Zigadenus paniculatus</i>	2	-	.06	.00
	Total for Annual Forbs	374	327	4.15	5.72
	Total for Perennial Forbs	173	183	3.17	4.64
	Total for Forbs	547	510	7.32	10.36

Values with different subscript letters are significantly different at alpha = 0.10



BROWSE TRENDS--

Management unit 19R, Study no: 7

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata wyomingensis	58	27	10.82	.64
B	Chrysothamnus nauseosus albicaulis	1	1	-	-
B	Chrysothamnus viscidiflorus stenophyllus	2	3	.15	-
B	Chrysothamnus viscidiflorus viscidiflorus	49	50	2.20	6.08
B	Juniperus osteosperma	1	0	.15	-
Total for Browse		111	81	13.33	6.72

CANOPY COVER, LINE INTERCEPT--

Management unit 19R, Study no: 7

Species	Percent Cover	
	'06	'10
Artemisia tridentata wyomingensis	15.36	1.28
Chrysothamnus nauseosus albicaulis	.18	.56
Chrysothamnus viscidiflorus stenophyllus	.06	.20
Chrysothamnus viscidiflorus viscidiflorus	1.75	6.86

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 19R, Study no: 7

Species	Average leader growth (in)	
	'06	'10
Artemisia tridentata	1.2	1.9

POINT-QUARTER TREE DATA--

Management unit 19R, Study no: 7

Species	Trees per Acre		Average diameter (in)	
	'06	'10	'06	'10
Juniperus osteosperma	63	19	2.5	1.5

BASIC COVER--

Management unit 19R, Study no: 7

Cover Type	Average Cover %	
	'06	'10
Vegetation	33.43	40.15
Rock	.10	.63
Pavement	.42	1.02
Litter	30.59	39.76
Cryptogams	2.03	.18
Bare Ground	46.04	35.25

SOIL ANALYSIS DATA --

Management unit 19R, Study no: 7, Study Name: Bennion Sagebrush Chaining

Effective rooting depth (in)	pH	silt loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
12.9	7.5	28.2	56.0	15.8	1.7	10.3	316.8	0.6

PELLET GROUP DATA--

Management unit 19R, Study no: 7

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	59	12	-	-
Elk	1	-	2 (5)	-
Deer	5	-	3 (7)	-
Cattle	1	3	5 (13)	9 (23)

BROWSE CHARACTERISTICS--

Management unit 19R, Study no: 7

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata wyomingensis</i>										
06	<b>2140</b>	1	47	52	320	7	0	51	25/32	
10	<b>780</b>	31	41	28	-	3	0	26	20/23	
<i>Chrysothamnus nauseosus</i>										
06	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>0</b>	0	0	-	-	0	0	0	21/22	
<i>Chrysothamnus nauseosus albicaulis</i>										
06	<b>20</b>	0	100	-	-	0	0	0	19/19	
10	<b>20</b>	0	100	-	-	0	0	0	27/44	
<i>Chrysothamnus viscidiflorus stenophyllus</i>										
06	<b>40</b>	0	100	-	-	0	0	0	13/32	
10	<b>120</b>	0	100	-	-	0	0	0	14/24	
<i>Chrysothamnus viscidiflorus viscidiflorus</i>										
06	<b>3100</b>	15	85	-	20	0	3	0	9/12	
10	<b>2260</b>	3	97	-	-	0	0	10	13/22	

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Juniperus osteosperma									
06	<b>20</b>	100	0	-	-	0	0	0	-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-

BENNION SPIKE 1 - TREND STUDY NO. 19R-8-10

[Project #396](#)

Vegetation Type: Wyoming Big Sagebrush

Range Type: Substantial Deer Spring/Fall

NRCS Ecological Site Description: [Upland Loam \(Mountain Big Sagebrush\), R028AY310UT](#)

Land Ownership: USFS

Elevation: 5,895 ft. (1,797 m)

Aspect: Northeast

Slope: 2%

Transect bearing: 337° magnetic

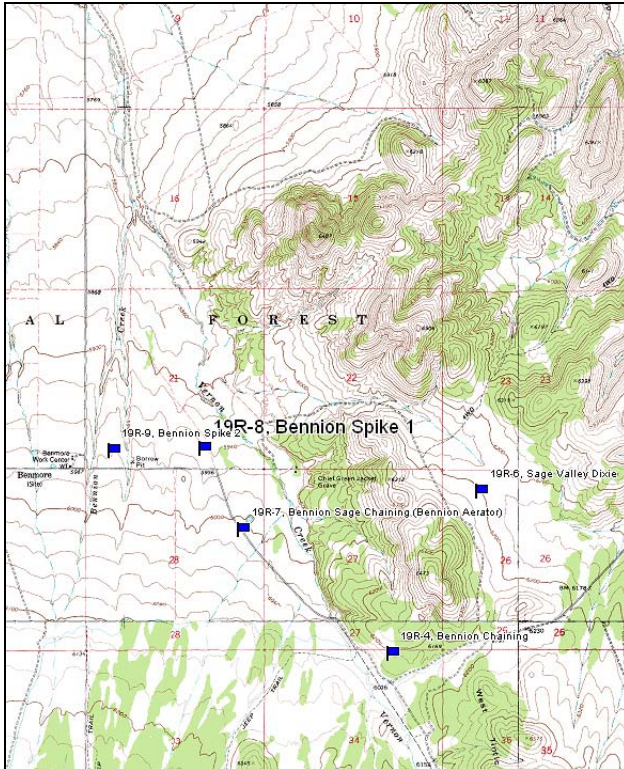
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

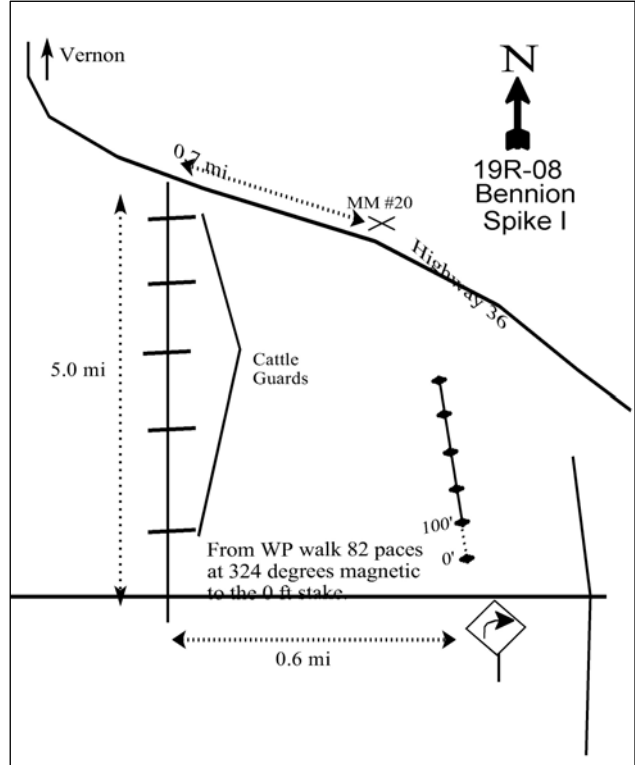
From highway 36 south of Vernon, drive to mile marker #20. From there, drive 0.7 miles to a turn off on the left (west). Turn there and drive south for 5.0 miles passing several (4 or 5) cattle guards to a fork. Turn left and drive 0.6 miles to a road sign showing a bend in the road. Walk 82 paces at 324 degrees magnetic to the 0 foot stake marked with browse tag #176.

Map Name: Vernon



Township: 9S Range: 5W Section: 21

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 379721 E 4430198 N

## BENNION SPIKE 1 - WRI STUDY 19R-8

### [Project #396](#)

#### Site Description

Site Information: The study was established in 2006 to monitor a Spike (Tebuthiuron) treatment of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) community approximately five miles south of Vernon on the privately owned Bennion Ranch. Spike was applied on 158 acres to thin sagebrush and kill small juniper trees. The Spike treatment was used on a portion of the area at varying concentrations with islands of sagebrush left untreated to provide a mosaic of habitat types. The objectives of the project were to provide improved brood-rearing habitat for sage-grouse and improve transitional and winter ranges for mule deer (WRI Database 2011). Pellet group data estimated light use by deer in all sample years and use by cattle was heavy in 2006 and moderate in 2010 (Table - Pellet Group Data).

#### Browse:

The key browse species on the site is Wyoming big sagebrush. The sagebrush population was effectively reduced following the treatment. Decadence and poor vigor of sagebrush plants has remained extremely high over the sample years. The recruitment of young sagebrush plants to the population has been poor. Utilization of sagebrush has been light since the outset of the study. Other species sampled on the site include stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), narrowleaf rabbitbrush (*C. v.* ssp. *stenophyllus*), and white rubber rabbitbrush (*C. nauseosus* ssp. *albicaulis*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant and fairly diverse. The dominant grass species include intermediate wheatgrass (*Agropyron intermedium*), western wheatgrass (*A. smithii*), and Sandberg bluegrass (*Poa secunda*). Sandberg bluegrass decreased significantly in nested frequency and cover following the Spike treatment. Cheatgrass (*Bromus tectorum*) increased in abundance. Intermediate wheatgrass was sampled for the first time in 2010. Other common perennial grass species sampled on the site include Indian rice grass (*Oryzopsis hymenoides*) and bottlebrush squirreltail (*Sitanion hystrix*). Forbs are not particularly abundant or diverse. Perennial forbs are rare on the site. The annual species bur buttercup (*Ranunculus testiculatus*) is the dominant forb species on the site and provides the majority of the forb cover on the site (Table - Herbaceous Trends).

Soil: The soil texture is a clay loam with a slightly alkaline soil reaction (pH 7.5) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

#### **Pre vs. Four Years Post Treatment Assessment, 2006 vs. 2010**

Browse: The density of Wyoming big sagebrush decreased substantially by 79% following the treatment of Spike from 3,280 plants/acre to 700 plants/acre and cover decreased from 15% to 2%. The health of the sagebrush population remained in poor condition with decadence increasing from 49% to 86% and poor vigor increasing from 40% to 89%. The recruitment of young sagebrush to the population increased slightly from 0% to 6%.

Grasses: the sum of nested frequency of perennial grasses decreased 24%, but cover increased slightly from 16% to 17%. Sandberg bluegrass decreased significantly in nested frequency and cover decreased from 11% to 4%. Intermediate wheatgrass was sampled for the first time following the treatment at 3% cover. Western wheatgrass significantly decreased in nested frequency but increased in cover from 3% to 6%. Cheatgrass increased considerably in nested frequency and provided 1% cover.

Forbs: The sum of nested frequency of perennial forbs decreased 25%, though cover remained similar at 2%. Perennial forbs are rare on the site. Desert phlox decreased significantly in nested frequency and cover decreased from 2% to less than 1% cover. The annual species bur buttercup increased from 3% to 5% cover.

HERBACEOUS TRENDS--

Management unit 19R, Study no: 8

T y p e	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	14	11	.27	.60
G	Agropyron intermedium	a <sup>-</sup>	b <sup>71</sup>	-	3.08
G	Agropyron smithii	176	139	2.67	5.64
G	Agropyron spicatum	19	11	.68	.37
G	Bromus tectorum (a)	a <sup>7</sup>	b <sup>64</sup>	.07	1.18
G	Oryzopsis hymenoides	15	19	.51	1.05
G	Poa bulbosa	a <sup>-</sup>	b <sup>19</sup>	-	.41
G	Poa secunda	b <sup>276</sup>	a <sup>111</sup>	10.66	4.32
G	Sitanion hystrix	30	24	.66	1.29
Total for Annual Grasses		7	64	0.07	1.18
Total for Perennial Grasses		530	405	15.46	16.79
Total for Grasses		537	469	15.53	17.97
F	Alyssum alyssoides (a)	a <sup>24</sup>	b <sup>40</sup>	.05	.97
F	Astragalus convallarius	5	9	.06	.33
F	Calochortus nuttallii	-	3	-	.00
F	Crepis acuminata	3	4	.03	.18
F	Cymopterus sp.	a <sup>7</sup>	b <sup>27</sup>	.04	.38
F	Lactuca serriola (a)	-	4	-	.09
F	Phlox austromontana	b <sup>79</sup>	a <sup>27</sup>	1.54	.58
F	Phlox longifolia	2	1	.01	.00
F	Ranunculus testiculatus (a)	276	260	2.94	5.13
F	Salsola iberica (a)	-	1	-	.03
F	Zigadenus paniculatus	-	1	-	.03
Total for Annual Forbs		300	305	2.99	6.23
Total for Perennial Forbs		96	72	1.70	1.52
Total for Forbs		396	377	4.69	7.75

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 19R, Study no: 8

T y p e	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata wyomingensis	81	27	8.63	.90
B	Chrysothamnus nauseosus	0	6	-	.21
B	Chrysothamnus viscidiflorus stenophyllus	11	0	.15	.03
B	Chrysothamnus viscidiflorus viscidiflorus	0	17	.00	1.04
B	Juniperus osteosperma	2	2	-	.15
B	Leptodactylon pungens	0	1	-	-
Total for Browse		94	53	8.79	2.34

CANOPY COVER, LINE INTERCEPT--

Management unit 19R, Study no: 8

Species	Percent Cover	
	'06	'10
Artemisia tridentata wyomingensis	15.19	1.93
Chrysothamnus nauseosus	-	.06
Chrysothamnus viscidiflorus stenophyllus	.80	.26
Chrysothamnus viscidiflorus viscidiflorus	-	1.04
Juniperus osteosperma	.05	.26

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 19R, Study no: 8

Species	Average leader growth (in)	
	'06	'10
Artemisia tridentata wyomingensis	1.7	1.3

BASIC COVER--

Management unit 19R, Study no: 8

Cover Type	Average Cover %	
	'06	'10
Vegetation	28.52	27.17
Rock	.19	.03
Pavement	.46	1.77
Litter	35.15	36.96
Cryptogams	2.77	4.50
Bare Ground	50.37	43.11

SOIL ANALYSIS DATA --

Management unit 19R, Study no: 8, Study Name: Bennion Spike I

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
12.6	7.5	25.2	45.0	29.8	1.9	8.7	467.2	0.6

PELLET GROUP DATA--

Management unit 19R, Study no: 8

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	52	6	-	-
Horse	1	-	-	-
Deer	2	-	4 (10)	1 (2)
Cattle	9	5	19 (47)	9 (23)

BROWSE CHARACTERISTICS--  
Management unit 19R, Study no: 8

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata wyomingensis</i>										
06	<b>3280</b>	0	51	49	180	6	3	40	28/31	
10	<b>700</b>	6	9	86	20	11	6	89	21/20	
<i>Chrysothamnus nauseosus</i>										
06	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>220</b>	82	18	-	80	0	0	0	25/26	
<i>Chrysothamnus viscidiflorus stenophyllus</i>										
06	<b>240</b>	0	100	-	60	17	0	0	12/14	
10	<b>0</b>	0	0	-	-	0	0	0	14/19	
<i>Chrysothamnus viscidiflorus viscidiflorus</i>										
06	<b>0</b>	0	0	0	-	0	0	0	14/19	
10	<b>1160</b>	47	52	2	40	0	0	2	12/20	
<i>Juniperus osteosperma</i>										
06	<b>40</b>	50	50	-	20	0	0	50	-/-	
10	<b>40</b>	100	0	-	-	0	0	0	-/-	
<i>Leptodactylon pungens</i>										
06	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>20</b>	100	0	-	-	0	0	0	-/-	
<i>Opuntia sp.</i>										
06	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>0</b>	0	0	-	-	0	0	0	6/17	



BENION SPIKE 2 - TREND STUDY NO. 19R-9-10

[Project #396](#)

Vegetation Type: Wyoming Big Sagebrush

Range Type: Substantial Deer Spring/Fall

NRCS Ecological Site Description: Not available

Land Ownership: USFS

Elevation: 6,000 ft. (1,829 m)

Aspect: North

Slope: 2%

Transect bearing: 346° magnetic

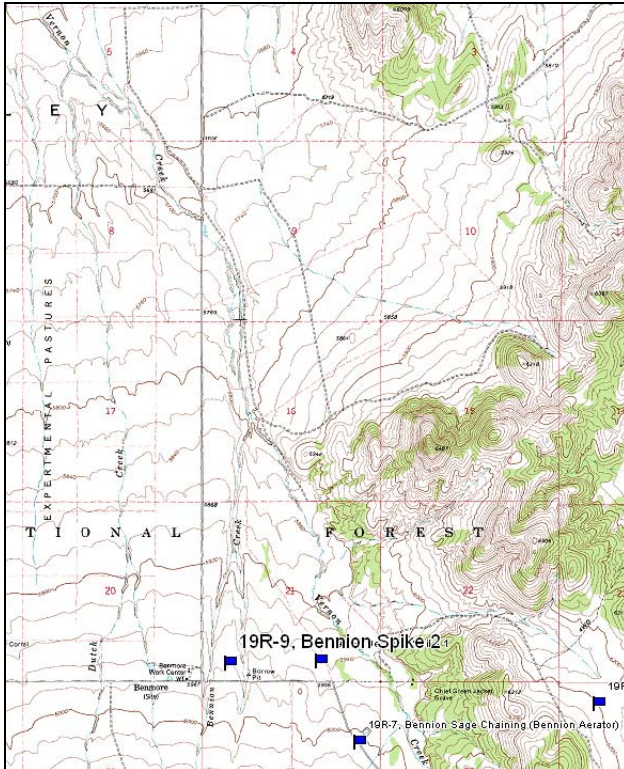
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

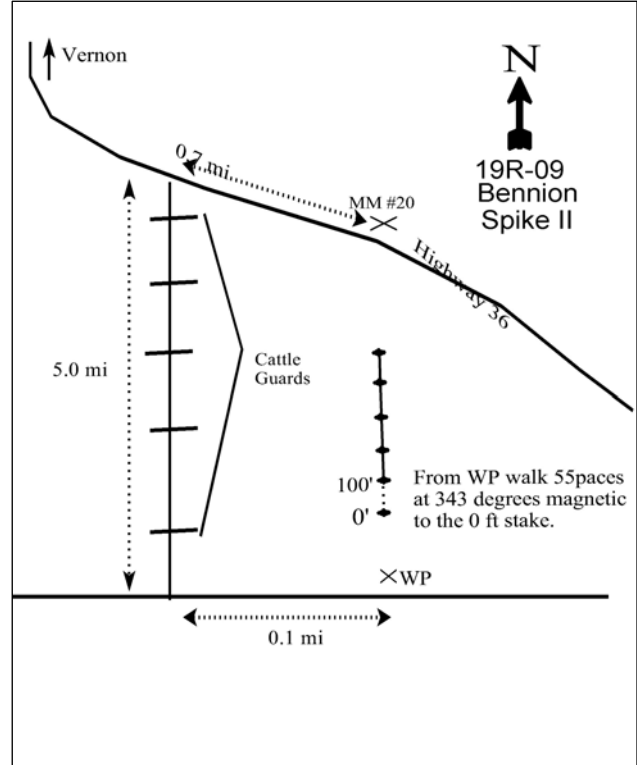
From highway 36 south of Vernon, drive to mile marker #20. From there, drive 0.7 miles to a turn off on the left (west). Turn there and drive south for 5.0 miles passing several (4 or 5) cattle guards to a fork. Turn left and drive 0.1 miles to a witness post on the left. Walk 55 paces at 343 degrees magnetic to the 0 foot stake marked with browse tag #174.

Map Name: Vernon



Township: 9S Range: 5W Section: 21

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 378898 E 4430193 N

## BENNION SPIKE 2 - WRI STUDY 19R-9

### [Project #396](#)

#### Site Description

Site Information: The study was established in 2006 to monitor a Spike (Tebuthiuron) treatment of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) community approximately five miles south of Vernon on the privately owned Bennion Ranch. Spike was applied on 158 acres to thin sagebrush and kill small juniper trees. The Spike treatment was used on a portion of the area at varying concentrations with islands of sagebrush left untreated to provide a mosaic of habitat types. The objectives of the project were to provide improved brood-rearing habitat for sage-grouse and improve transitional and winter ranges for mule deer (WRI Database 2011). Pellet group data estimated light use by deer in all sample years and use by cattle was moderate in 2006 and light in 2010. Antelope use was light in 2010 (Table - Pellet Group Data).

Browse: Browse species became rare following the treatment with Spike. The preferred browse species on the site is Wyoming big sagebrush. The Spike treatment substantially reduced the population of Wyoming big sagebrush. The Wyoming big sagebrush population is lightly used mostly decadent population over the sample years. Poor vigor of sagebrush has been high since the outset of the study. Recruitment of young sagebrush to the population improved following the treatment. Other browse species sampled on the site include rubber rabbitbrush (*Chrysothamnus nauseosus*), Utah serviceberry (*Amelanchier utahensis*), and gray horsebrush (*Tetradymia canescens*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant and fairly diverse. The dominant species is crested wheatgrass (*Agropyron cristatum*) which provides the majority of the grass cover on the site. Other common grass species sampled on the site include western wheatgrass (*A. smithii*), bulbous bluegrass (*Poa bulbosa*), and Sandberg bluegrass (*P. secunda*). The annual species cheatgrass (*Bromus tectorum*) and rattlesnake brome (*B. brizaeformis*) are present on the site, though cheatgrass has increased significantly since the Spike treatment. Forbs are somewhat abundant and not particularly diverse. Perennial forbs are extremely rare on the site. Annual species dominant the forb component with pale alyssum (*Alyssum alyssoides*) and bur buttercup (*Ranunculus testiculatus*) providing the majority of the forb cover (Table - Herbaceous Trends).

Soil: The soil texture is a clay loam with a slightly alkaline soil reaction (pH 7.6) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was slight in 2006 due to sparsely scattered pedestals and light soil movement. The soil erosion condition was classified as stable in 2010.

#### Pre vs. Four Years Post Treatment Assessment, 2006 vs. 2010

Browse: The density of Wyoming big sagebrush substantially decreased 94% following the treatment of Spike from 2,800 plants/acre to 160 plants/acre and cover decreased from 19% to 1%. The health of the sagebrush population remained in poor condition with decadence increasing from 41% to 50% and poor vigor increasing from 26% to 63%. The recruitment of young sagebrush plants to the population increased from 8% to 25%. Browse became rare on the site after the treatment of Spike.

Grasses: The sum of nested frequency of perennial grasses increased 25% and cover increased slightly from 5% to 20%. Crested wheatgrass increased significantly in nested frequency and increased in cover from 3% to 12%. Sandberg bluegrass decreased significantly in nested frequency, but cover remained similar at 1%. Western wheatgrass significantly decreased in nested frequency but increased in cover from less than 1% to 3%. Cheatgrass increased considerably in nested frequency and provided 1% cover.

Forbs: The sum of nested frequency of perennial forbs decreased 72% and cover remained similar at less than 1%. Perennial forbs are very rare on the site. Desert phlox decreased significantly in nested frequency and

cover and became rare on the site. The annual species bur buttercup increased from 1% to 5% cover and pale alyssum increased from less than 1% to 6% cover.

HERBACEOUS TRENDS--

Management unit 19R, Study no: 9

Type	Species	Nestled Frequency		Average Cover %	
		'06	'10	'06	'10
G	Agropyron cristatum	<sub>a</sub> 132	<sub>b</sub> 213	3.42	12.06
G	Agropyron smithii	<sub>b</sub> 82	<sub>a</sub> 57	.29	3.16
G	Bromus brizaeformis (a)	-	3	-	.03
G	Bromus tectorum (a)	<sub>a</sub> 19	<sub>b</sub> 56	.09	.87
G	Oryzopsis hymenoides	6	4	.05	.41
G	Poa bulbosa	<sub>a</sub> -	<sub>b</sub> 116	-	3.46
G	Poa secunda	<sub>b</sub> 102	<sub>a</sub> 27	.91	1.01
G	Sitanion hystrix	13	3	.25	.03
Total for Annual Grasses		19	59	0.08	0.89
Total for Perennial Grasses		335	420	4.93	20.14
Total for Grasses		354	479	5.02	21.04
F	Alyssum alyssoides (a)	<sub>a</sub> 128	<sub>b</sub> 214	.26	6.00
F	Arenaria sp.	4	-	.00	-
F	Argemone corymbosa	-	1	-	.00
F	Crepis acuminata	3	1	.00	.00
F	Descurainia pinnata (a)	-	3	-	.03
F	Lactuca serriola (a)	-	6	-	.16
F	Lygodesmia sp.	-	1	-	.03
F	Phlox austromontana	<sub>b</sub> 21	<sub>a</sub> 2	.69	.06
F	Ranunculus testiculatus (a)	212	225	.72	4.62
F	Senecio integerrimus	-	1	-	.03
F	Sphaeralcea grossulariifolia	-	2	-	.00
F	Zigadenus paniculatus	1	-	.00	-
Total for Annual Forbs		340	448	0.98	10.81
Total for Perennial Forbs		29	8	0.71	0.13
Total for Forbs		369	456	1.69	10.95

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 19R, Study no: 9

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Amelanchier utahensis	1	0	-	-
B	Artemisia tridentata wyomingensis	74	7	11.19	.06
B	Chrysothamnus nauseosus	0	2	-	.15
B	Tetradymia canescens	1	1	.03	.00
Total for Browse		76	10	11.22	0.21

CANOPY COVER, LINE INTERCEPT--

Management unit 19R, Study no: 9

Species	Percent Cover	
	'06	'10
Artemisia tridentata wyomingensis	18.64	.35

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 19R, Study no: 9

Species	Average leader growth (in)	
	'06	'10
Artemisia tridentata wyomingensis	1.4	1.5

BASIC COVER--

Management unit 19R, Study no: 9

Cover Type	Average Cover %	
	'06	'10
Vegetation	15.19	29.72
Rock	.63	1.08
Pavement	2.42	2.07
Litter	36.13	39.80
Cryptogams	2.89	.57
Bare Ground	54.09	42.43

SOIL ANALYSIS DATA --

Management unit 19R, Study no: 9, Study Name: Bennion Spike II

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
8.8	7.6	33.2	36.0	30.8	1.6	21.2	336.0	0.6

PELLET GROUP DATA--

Management unit 19R, Study no: 9

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	86	16	-	-
Deer/Antelope	-	-	1 (2)	1 (2)
Cattle	1	2	12 (30)	7 (16)

BROWSE CHARACTERISTICS--  
 Management unit 19R, Study no: 9

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Amelanchier utahensis</i>										
06	<b>40</b>	0	0	100	-	0	0	100	-/-	
10	<b>0</b>	0	0	0	-	0	0	0	-/-	
<i>Artemisia tridentata wyomingensis</i>										
06	<b>2800</b>	8	51	41	180	5	0	26	29/39	
10	<b>160</b>	25	25	50	20	0	13	63	16/15	
<i>Chrysothamnus nauseosus</i>										
06	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>40</b>	100	0	-	-	0	0	0	21/25	
<i>Chrysothamnus viscidiflorus viscidiflorus</i>										
06	<b>0</b>	0	0	-	-	0	0	0	-/-	
10	<b>0</b>	0	0	-	-	0	0	0	14/19	
<i>Tetradymia canescens</i>										
06	<b>40</b>	0	0	100	-	0	100	100	15/26	
10	<b>20</b>	0	0	100	-	0	0	100	15/24	

DIAGONAL/ELECTRIC HARROW - TREND STUDY NO. 19R-13-10

[Project #659](#)

Vegetation Type: Wyoming Big Sagebrush

Range Type: Substantial Deer Spring/Fall

NRCS Ecological Site Description: [Semidesert Loam \(Wyoming Big Sagebrush\), R028AY220UT](#)

Land Ownership: USFS

Elevation: 5,697 ft. (1,736 m)

Aspect: North

Slope: 1%

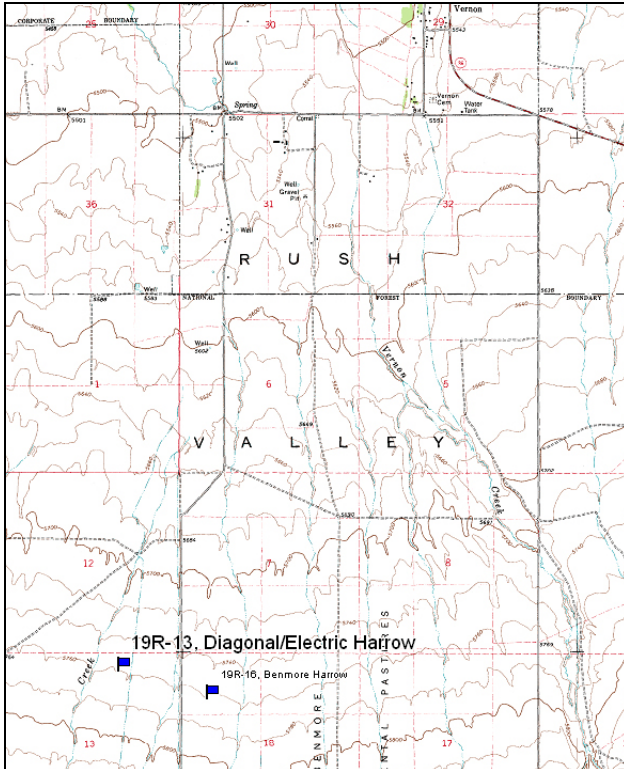
Transect bearing: 176° magnetic

Belt placement: line 1 (11ft & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

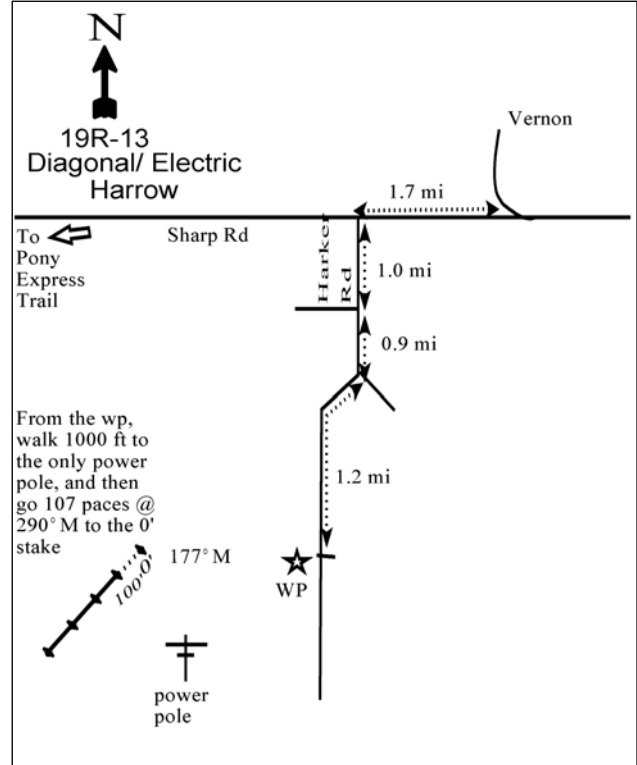
From Vernon, drive 1.7 miles on Sharp Road (leads to the Pony Express Trail). Turn left onto Harker Road and drive 1.0 miles to a fork. Stay left and drive 0.9 miles to another fork. Keep to the right and drive 1.2 miles to the witness post. From the witness post, walk 1,000 feet to the only power pole and then go 107 paces at 290° M. The 0' stake does not have a browse tag.

Map Name: Vernon



Township: 9S Range: 6W Section: 13

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 374945 E 4433229 N

DIAGONAL/ELECTRIC HARROW - WRI STUDY 19R-13

[Project #659](#)

**Site Description**

Site Information: The study is located four miles south of Vernon on land administered by the US Forest Service. The study was established in 2008 to monitor the effects of harrow treatment in Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). One thousand acres of the 2,500 acre treatment area was one-way harrowed and two-way harrowed in the center of each polygon in the fall of 2008 to create openings in the thick sagebrush stand. A combination of grass, forb, and shrub seed were broadcast between harrow passes. The project objectives were to improve sage-grouse brood rearing habitat by reducing canopy cover of Wyoming big sagebrush to 5% to 10% and increase openings and improve the herbaceous understory by establishing perennial grasses, and forbs (WRI Database 2011). Pellet group data estimated the use by cattle to be light in 2008 and 2009. Rabbits use was heavy in 2008 and 2009. Three sage-grouse pellets were sampled in 2010. Deer use was light in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 19R, Study no: 13

Project Name: Diagonal-Electric Sagebrush Improvement			
WRI Database #: 659			
Application:		Acres:	1000
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Anatone'	2002	2.00
G	Great Basin Wildrye 'Trailhead'	976	0.98
G	Indian Ricegrass 'Rimrock'	1500	1.50
G	Snake River Wheatgrass 'Secar'	992	0.99
G	Western Wheatgrass 'Arriba'	2000	2.00
F	Alfalfa 'Ladak'	1500	1.50
F	Blue Flax 'Appar'	500	0.50
F	Rocky Mountain Beeplant	250	0.25
F	Sainfoin 'Eski'	3000	3.00
F	Small Burnet 'Delar'	2000	2.00
F	Western Yarrow	100	0.10
Total Pounds:		14820	14.82
PLS Pounds:			12.87

Browse: The preferred browse species on the site is Wyoming big sagebrush. Prior to the treatment the Wyoming big sagebrush was a moderately used decadent population exhibiting poor vigor. After the treatment decadence and poor vigor have been low and utilization has been light. The recruitment of young sagebrush plants to the population has been good since the treatment. Other browse species sampled on the site include low rabbitbrush (*Chrysothamnus viscidiflorus*) and broom snakeweed (*Gutierrezia sarothrae*).

Herbaceous Understory: Grasses are abundant but not particularly diverse. Created wheatgrass (*Agropyron cristatum*) and Sandberg bluegrass (*Poa secunda*) are the dominant grass species. Sandberg bluegrass was significantly affected by the treatment and decreased in abundance following the treatment. Cheatgrass (*Bromus tectorum*) was sampled on the site in 2009 in very low abundance but was not sampled in any other sample year. Seeded species sampled on the site following the treatment include Indian rice grass (*Oryzopsis hymenoides*) and western wheatgrass (*Agropyron smithii*). Forbs are not diverse but are moderately abundant. Diversity has steadily increased since the treatment. The dominant forb species is bur buttercup (*Ranunculus testiculatus*) which has provided the majority of the forb cover since the outset of the study. Desert phlox (*Phlox austromontana*) is the most common perennial forb species. Several seeded forb species have been

sampled since the treatment which include Rocky Mountain beeplant (*Cleome serrulata*), Lewis flax (*Linum lewisii*), alfalfa (*Medicago sativa*), sainfoin (*Onobrychis viciaefolia*), and small burnet (*Sanguisorba minor*).

Soil: The soil texture is a clay loam with a neutral soil reaction (pH 7.2). Phosphorus may have limited availability for plant growth and development at 2.7 ppm (Tiedemann and Lopez 2004) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation providing protective ground cover. Prior to treatment, cryptogram cover was high but decreased after treatment (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### **Pre vs. One Year Post Treatment Assessment, 2008 vs. 2009**

Browse: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. The harrow treatment effectively decreased the canopy cover of Wyoming big sagebrush from 13% to 3%.

Grasses: The sum of nested frequency of perennial grasses decreased 36% and cover decreased from 17% to 6%. Crested wheatgrass remained similar in nested frequency but cover decreased from 9% to 5%. Sandberg bluegrass decreased significantly in nested frequency and cover decreased from 8% to 1%. Cheatgrass was sampled after the treatment in low frequency and cover.

Forbs: The sum of nested frequency of perennial forbs increased 17% and cover remained similar at less than 1%. Perennial forbs are very rare on the site. The annual species bur buttercup increased from 1% to 4% cover

### **Trend Assessments**

#### Browse

- **2009 to 2010 - slightly up (+1)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush canopy cover increased from 3% to 6%.

#### Grass

- **2009 to 2010 - slightly up (+1)**: The sum of nested frequency of perennial grasses increased 19% and cover increased from 6% to 13%. The nested frequency of crested wheatgrass remained similar and cover increased from 5% to 11%. Sandberg bluegrass cover increased slightly from 1% to 2%.

#### Forb

- **2009 to 2010 - stable (0)**: Perennial forbs were rare in each sample, though cover increased from less than 1% to 2%. The sum of nested frequency of annual forbs significantly increased and cover increased from 4% to 8%. Bur buttercup significantly increased in nested frequency and cover increased from 4% to 8%.



HERBACEOUS TRENDS--

Management unit 19R, Study no: 13

Type	Species	Nested Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
G	Agropyron cristatum	230	216	229	8.62	4.97	10.76
G	Agropyron intermedium	3	9	1	.15	.01	.03
G	Agropyron smithii	a <sup>-</sup>	a <sup>-</sup>	b <sup>19</sup>	-	-	.17
G	Bromus tectorum (a)	-	3	-	-	.00	-
G	Oryzopsis hymenoides	-	-	3	-	-	.01
G	Poa secunda	b <sup>268</sup>	a <sup>94</sup>	a <sup>128</sup>	7.73	1.19	2.11
Total for Annual Grasses		0	3	0	0	0.00	0
Total for Perennial Grasses		501	319	380	16.51	6.17	13.09
Total for Grasses		501	322	380	16.51	6.18	13.09
F	Alyssum alyssoides (a)	b <sup>14</sup>	a <sup>-</sup>	b <sup>10</sup>	.03	-	.03
F	Astragalus sp.	1	4	3	.03	.01	.00
F	Cleome serrulata (a)	-	-	7	-	-	.02
F	Linum lewisii	-	2	9	-	.00	.04
F	Medicago sativa	-	3	-	-	.01	-
F	Onobrychis viciaefolia	a <sup>-</sup>	b <sup>10</sup>	ab <sup>4</sup>	-	.03	.03
F	Phlox austromontana	44	30	37	.34	.33	1.43
F	Phlox longifolia	2	1	-	.00	.00	-
F	Ranunculus testiculatus (a)	ab <sup>264</sup>	a <sup>314</sup>	b <sup>358</sup>	1.37	4.17	8.17
F	Salsola iberica (a)	-	4	-	-	.00	-
F	Sanguisorba minor	-	4	1	-	.01	.03
F	Senecio multilobatus	1	2	-	.00	.03	-
F	Unknown forb-annual (a)	-	5	-	-	.02	-
Total for Annual Forbs		278	323	375	1.41	4.20	8.22
Total for Perennial Forbs		48	56	54	0.38	0.43	1.53
Total for Forbs		326	379	429	1.79	4.63	9.76

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 19R, Study no: 13

Type	Species	Strip Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
B	Artemisia tridentata wyomingensis	78	0	70	8.29	3.35	4.57
B	Chrysothamnus viscidiflorus	2	0	5	.18	.09	.06
B	Gutierrezia sarothrae	2	0	0	-	-	-
Total for Browse		82	0	75	8.48	3.45	4.63

CANOPY COVER, LINE INTERCEPT--

Management unit 19R, Study no: 13

Species	Percent Cover		
	'08	'09	'10
Artemisia tridentata wyomingensis	12.78	3.41	6.05

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 19R, Study no: 13

Species	Average leader growth (in)		
	'08	'09	'10
Artemisia tridentata wyomingensis	1.6	-	1.7

BASIC COVER--

Management unit 19R, Study no: 13

Cover Type	Average Cover %		
	'08	'09	'10
Vegetation	28.02	14.21	26.03
Rock	.02	.30	.23
Pavement	3.16	4.34	4.74
Litter	31.36	23.13	23.03
Cryptogams	11.80	.53	.21
Bare Ground	40.70	67.86	53.83

SOIL ANALYSIS DATA --

Management unit 19R, Study no: 13, Study Name: Diagonal Electric Harrow

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.2	34.0	34.4	31.6	1.1	2.7	326.4	1.1

PELLET GROUP DATA--

Management unit 19R, Study no: 13

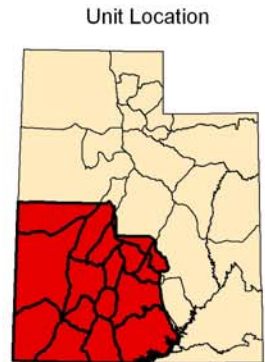
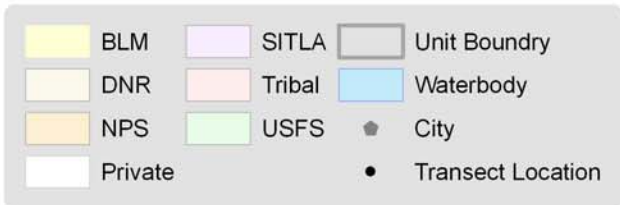
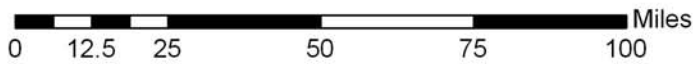
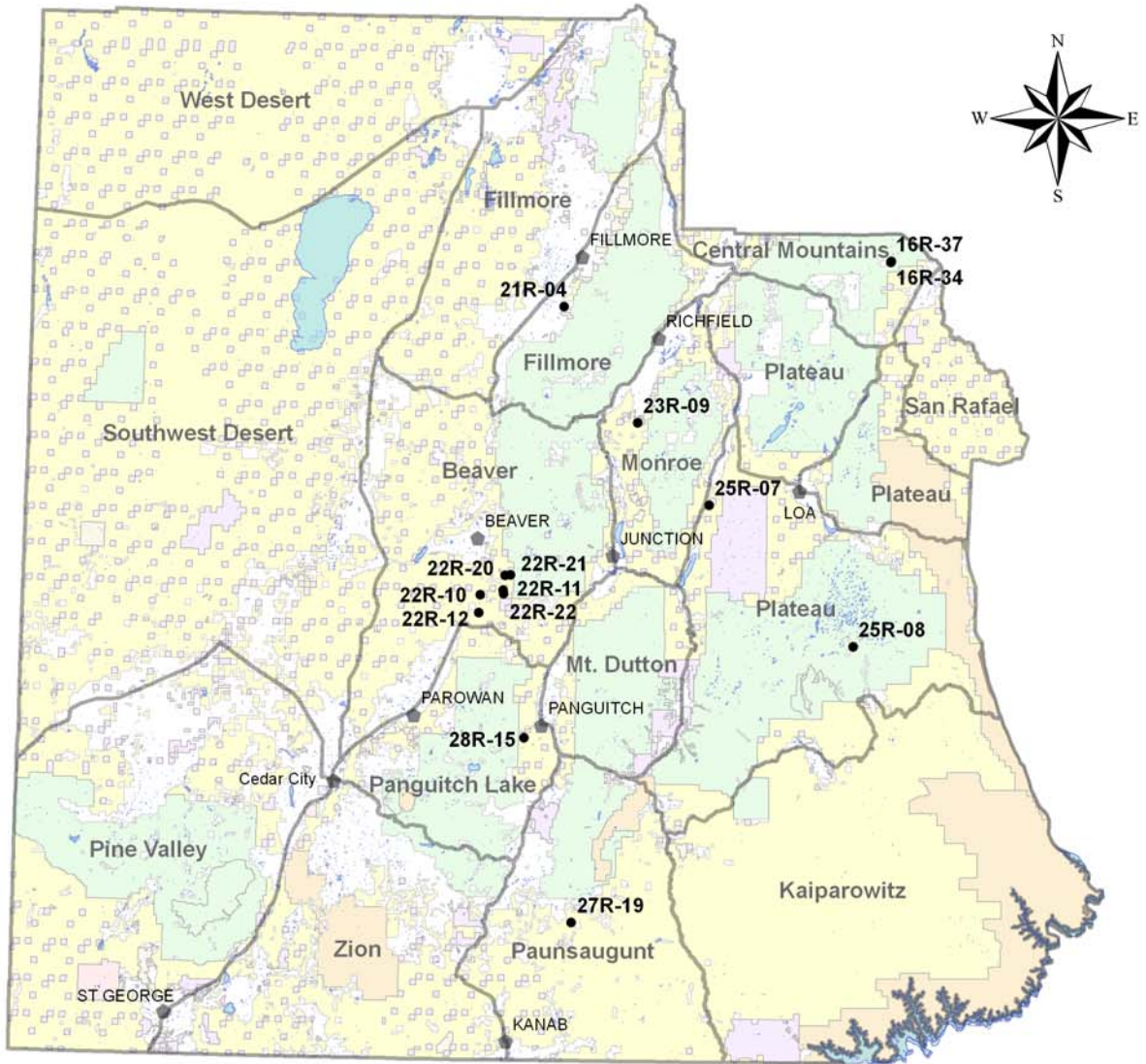
Type	Quadrat Frequency		
	'08	'09	'10
Rabbit	97	49	29
Deer	1	6	-
Cattle	7	2	-
Grouse	-	-	-

Days use per acre (ha)		
'08	'09	'10
-	-	-
-	-	2 (5)
9 (23)	1 (2)	-
-	-	26/acre

BROWSE CHARACTERISTICS--  
 Management unit 19R, Study no: 13

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<i>Artemisia tridentata wyomingensis</i>									
08	<b>3020</b>	9	37	54	80	30	3	32	24/32
09	No density data collected								13/18
10	<b>3240</b>	58	35	7	2200	5	0	6	19/25
<i>Chrysothamnus nauseosus</i>									
08	<b>0</b>	0	0	-	-	0	0	0	17/17
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Chrysothamnus viscidiflorus</i>									
08	<b>80</b>	0	100	-	-	0	0	0	7/9
09	No density data collected								9/10
10	<b>120</b>	33	67	-	-	0	0	0	9/9
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
08	<b>0</b>	0	0	-	-	0	0	0	6/8
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Gutierrezia sarothrae</i>									
08	<b>40</b>	0	100	-	-	0	0	0	8/8
09	No density data collected								12/13
10	<b>0</b>	0	0	-	-	0	0	0	-/-

# Southern Region WRI Studies 2010



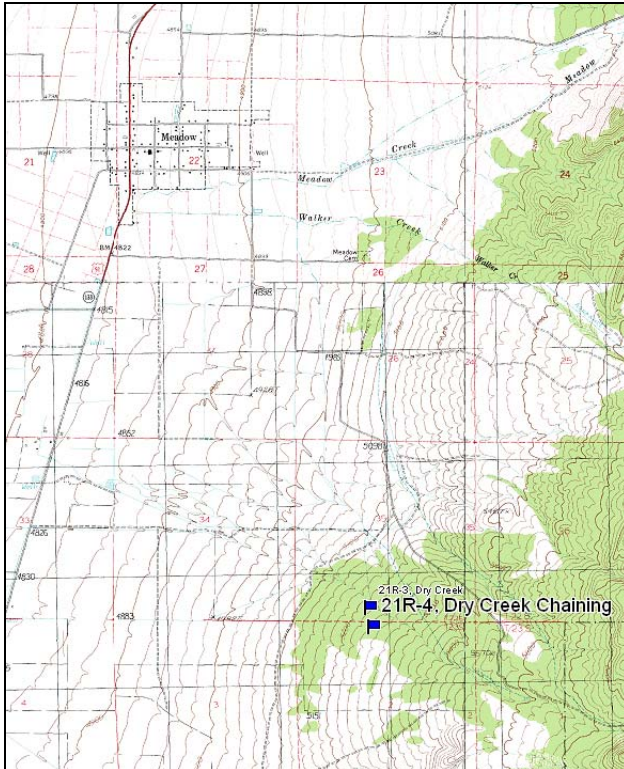
DRY CREEK CHAINING - TREND STUDY NO. 21R-4-10  
[Project #86](#)

Vegetation Type: Wyoming Big Sagebrush  
Range Type: Crucial Deer Winter, Substantial Elk Winter  
NRCS Ecological Site Description: [Upland Stony Loam \(Mountain Big Sagebrush\), R028AY334UT](#)  
Land Ownership: Private  
Elevation: 5,249 ft. (1,600 m)  
Aspect: West  
Slope: 4%  
Transect bearing: 161° magnetic  
Belt placement: line 1 (11ft and 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft).  
Notes: Rebar for belt 1 is on the 5ft, belt 4 is on the 58ft; the rest are on 0ft.

Directions:

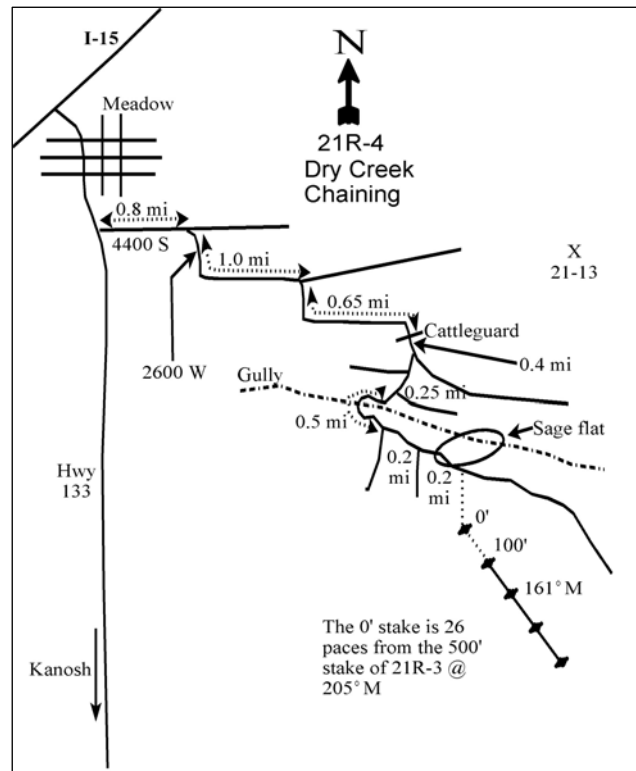
Go south from Meadow (southwest of Fillmore) on SR 133 to mile marker 6. Continue approximately 0.05 miles further south on SR 133 and turn east on a gravel road (4400 South). Go east 0.8 miles to a junction. Turn right onto 200 West and follow this road for 1 mile around several bends until the main road turns back to the south. Follow this main road for another 0.65 miles to a cattle guard. Continue 0.4 miles to a road that will come in on the right. Turn right onto this road and drive 0.25 miles staying left at the first fork and going right at the second fork. From the second fork continue 0.5 miles around a 90 degree bend to another fork. From this fork stay left and continue 0.2 miles staying to the left. The 0' stake is 26 paces from the 500 stake of 21R-3 at 205° M. The 0' stake is marked with browse tag#105.

Map Name: Kanosh



Township: 23S Range: 5W Section: 2

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 379755 E 4300660 N

DRY CREEK CHAINING - WRI STUDY 21R-4

[Project #86](#)

**Site Description**

Site Information: The study is located three miles southeast of Meadow within a treated pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodland. The study was established in 2008 to monitor an Ely chaining project completed in the spring of 2007. Study site Dry Creek (21R-3) was established in 2004 prior to the treatment to monitor the chaining, but was not treated and is now used as a reference site. The site was two-way Ely chained in the winter of 2006-07 and seed was aerielly applied between chaining passes. The objectives of the project were to improve winter range conditions for mule deer and elk by increasing the diversity of vegetation while still maintaining adequate escape cover, and to establish vegetation to protect soil from erosion and improve water infiltration and retention (WRI Database 2011). Pellet group data estimated heavy use by deer in 2009 and moderate use in 2010. Elk use was light in 2009 and 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 21R, Study no: 4

Project Name: Dry Creek			
WRI Database #: 86			
Application:		Acres:	915
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Goldar'	550	0.60
G	Canby Bluegrass 'Canbar'	125	0.14
G	Crested Wheatgrass 'Douglas'	450	0.49
G	Crested Wheatgrass 'Hycrest'	450	0.49
G	Orchardgrass 'Paiute'	100	0.11
G	Slender Wheatgrass 'San Luis'	550	0.60
G	Snake River Wheatgrass 'Secar'	500	0.55
G	Thickspike Wheatgrass 'Bannock'	500	0.55
F	Alfalfa 'Ladak'	1050	1.15
F	Blue Flax	250	0.27
F	Cicer Milkvetch 'Lutana'	570	0.62
F	Sainfoin 'Eski'	2150	2.35
F	Small Burnet 'Delar'	1050	1.15
F	Western Yarrow 'SID Columbia'	26	0.03
B	Bitterbrush	100	0.11
B	Forage Kochia	700	0.77
B	Sagebrush, Wyoming	450	0.49
Total Pounds:		9571	10.46
PLS Pounds:			8.87

Browse: The preferred browse species on the site are Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and forage kochia (*Kochia prostrata*). The Wyoming big sagebrush is lightly used mature population with low decadence and good vigor over the sample years, though in 2008 decadence and poor vigor was high. The recruitment of young sagebrush plants to the population has been good since the outset of the study. Utilization of forage kochia has been light and the recruitment of young forage kochia plants has been very good over the sample years. Other browse species sampled on the site include pinyon pine, Utah juniper, skunk bush (*Rhus trilobata*), broom snakeweed (*Gutierrezia sarothrae*), and antelope bitterbrush (*Purshia tridentata*) (Table Browse Characteristics). Pinyon pine and Utah juniper have remained sparse since the chaining treatment (Table - Point-Quarter Tree Data).

Herbaceous Understory: Grasses are somewhat diverse and abundant. Cheatgrass (*Bromus tectorum*) dominates the herbaceous understory. Perennial grasses are sparse. The most common perennial grass species are purple three-awns (*Aristida purpurea*), Sandberg bluegrass (*Poa secunda*), and crested wheatgrass (*Agropyron cristatum*). Forbs are not particularly diverse but are moderately abundant. The seeded species small burnet (*Sanguisorba minor*) is the dominant forb species on the site and has provided the majority of the forb cover over the sample years. Other common forb species include pale alyssum (*Alyssum alyssoides*), daisy (*Erigeron sp.*), and prickly lettuce (*Lactuca serriola*). Seeded species sampled on the site include western yarrow (*Achillea millefolium*), Lewis flax (*Linum lewisii*), alfalfa (*Medicago sativa*), sainfoin (*Onobrychis viciaefolia*), and small burnet (Table - Herbaceous Trends).

Soil: The soil analysis was collected on the original site Dry Creek (21R-3) and data was used for this site due to the close proximity. The soil texture is a sandy loam with a neutral soil reaction (pH 6.6) (Table - Soil Analysis Data). Bare ground cover is very low with high amount of litter, vegetation, and rock providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

## Trend Assessments

### Browse

- **2008 to 2009 - stable (0)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush canopy cover increased slightly from 1% to 2%. Forage kochia canopy cover remained similar at 1% cover. The density of Utah juniper was 106 trees/acre in 2009 and cover increase slightly from 1% to 2%.
- **2009 to 2010 - stable (0)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush canopy cover remained similar at 2% and forage kochia canopy cover remained similar at 1%. The density of Utah juniper increased from 106 trees/acre to 140 trees/acre and canopy cover remained similar at 2%.

### Grass

- **2008 to 2009 - down (-2)**: The sum of nested frequency of perennial grasses significantly decreased 29% and cover remained similar at 3%. Perennial grasses are sparse. Sandberg bluegrass decreased significantly in nested frequency though cover remained similar at 1%. Cheatgrass was the dominant species in both sample years with nested frequency remaining similar and cover increasing from 28% to 33%.
- **2009 to 2010 - slightly up (+1)**: The sum of nested frequency of perennial grasses slightly increased 15% though cover remained similar at 3%. Sandberg bluegrass slightly decreased in nested frequency and cover remained similar at 1%.

### Forb

- **2008 to 2009 - up (+2)**: The sum of nested frequency of perennial forbs significantly increased 32% and cover remained similar at 5%. The seeded species small burnet significantly increased in frequency and cover remained similar at 3%.
- **2009 to 2010 - stable (0)**: The sum of nested frequency of perennial forbs remained similar and cover remained similar at 5%. Small burnet significantly increased in nested frequency and cover increased slightly from 3% to 4%. The annual species prickly lettuce increased substantially in nested frequency and cover increased from less than 1% to 2%.

HERBACEOUS TRENDS--  
Management unit 21R, Study no: 4

T y p e	Species	Nested Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
G	Agropyron cristatum	b33	a2	b27	.44	.06	.51
G	Agropyron dasystachyum	-	-	5	-	-	.06
G	Agropyron intermedium	20	8	13	.25	.22	.30
G	Agropyron spicatum	4	12	5	.05	.21	.06
G	Agropyron trachycaulum	b18	a6	a2	.60	.10	.03
G	Aristida purpurea	a13	b31	b28	.82	1.41	1.12
G	Bromus tectorum (a)	420	410	432	28.39	32.77	28.73
G	Dactylis glomerata	8	12	21	.15	.14	.14
G	Poa secunda	b60	ab40	a27	1.01	.53	.77
G	Vulpia octoflora (a)	b49	a8	a-	.74	.04	-
Total for Annual Grasses		469	418	432	29.14	32.81	28.73
Total for Perennial Grasses		156	111	128	3.33	2.68	3.01
Total for Grasses		625	529	560	32.47	35.50	31.74
F	Achillea millefolium	1	-	1	.00	.01	.06
F	Allium sp.	-	1	2	-	.00	.00
F	Alyssum alyssoides (a)	a34	b52	b68	.49	.63	2.11
F	Astragalus sp.	-	-	5	-	.00	.18
F	Cryptantha sp.	1	-	-	.00	-	-
F	Erigeron sp.	2	8	12	.00	.22	1.07
F	Erodium cicutarium (a)	1	-	-	.03	-	-
F	Gayophytum ramosissimum(a)	b13	a-	a-	.05	-	-
F	Helianthus annuus (a)	b23	a-	b22	.05	.00	.07
F	Holosteum umbellatum (a)	7	-	-	.01	-	-
F	Lactuca serriola (a)	b97	a24	c148	.63	.09	2.23
F	Linum lewisii	16	2	-	.47	.07	-
F	Machaeranthera canescens	a-	a-	b12	-	-	.10
F	Medicago sativa	b9	b11	a-	.21	.06	.12
F	Microsteris gracilis (a)	3	7	-	.00	.01	-
F	Onobrychis viciaefolia	b24	b17	a-	.45	.46	-
F	Polygonum douglasii (a)	14	8	7	.19	.01	.01
F	Ranunculus testiculatus (a)	b18	a2	a-	.04	.00	-
F	Sanguisorba minor	a41	b77	b100	2.66	3.40	3.70
F	Tragopogon dubius (a)	1	3	5	.01	.01	.04
F	Verbascum thapsus	ab1	b9	a-	.18	.10	-
F	Verbena bracteata	4	6	-	.53	.21	-
Total for Annual Forbs		211	96	250	1.52	0.76	4.47
Total for Perennial Forbs		99	131	132	4.53	4.55	5.24
Total for Forbs		310	227	382	6.06	5.32	9.71

Values with different subscript letters are significantly different at alpha = 0.10



BROWSE TRENDS--

Management unit 21R, Study no: 4

Type	Species	Strip Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
B	Artemisia tridentata wyomingensis	23	0	27	1.70	2.12	3.02
B	Gutierrezia sarothrae	14	0	15	.07	.21	.23
B	Juniperus osteosperma	4	0	6	1.24	1.01	1.25
B	Kochia prostrata	27	0	30	.15	.34	.48
B	Purshia tridentata	0	0	1	-	-	-
B	Rhus trilobata	0	0	0	-	.15	-
Total for Browse		68	0	79	3.16	3.84	5.01

CANOPY COVER, LINE INTERCEPT--

Management unit 21R, Study no: 4

Species	Percent Cover		
	'08	'09	'10
Artemisia tridentata wyomingensis	1.10	1.53	1.71
Gutierrezia sarothrae	.31	.31	.53
Juniperus osteosperma	1.00	1.48	1.83
Kochia prostrata	.11	.46	1.00

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 21R, Study no: 4

Species	Average leader growth (in)	
	'09	'10
Artemisia tridentata wyomingensis	2.5	2.1
Kochia prostrate	6.7	3.8

POINT-QUARTER TREE DATA--

Management unit 21R, Study no: 4

Species	Trees per Acre		Average diameter (in)	
	'09	'10	'09	'10
Juniperus osteosperma	106	140	2.2	2.0

BASIC COVER--

Management unit 21R, Study no: 4

Cover Type	Average Cover %		
	'08	'09	'10
Vegetation	38.68	45.56	44.12
Rock	19.53	16.55	17.97
Pavement	2.53	1.53	1.33
Litter	35.88	47.25	53.58
Cryptogams	.90	.90	.21
Bare Ground	13.93	10.96	9.38

SOIL ANALYSIS DATA --

Management unit 21R, Study no: 3, Study Name: Dry Creek

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
8.5	6.6	61.4	25.1	13.5	1.9	14.2	134.4	0.6

PELLET GROUP DATA--

Management unit 21R, Study no: 4

Type	Quadrat Frequency			Days use per acre (ha)		
	'08	'09	'10	'08	'09	'10
Rabbit	9	15	6	-	-	-
Elk	-	-	2	-	2 (5)	6 (15)
Deer	19	27	19	-	53 (131)	42 (103)

BROWSE CHARACTERISTICS--

Management unit 21R, Study no: 4

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata wyomingensis</i>										
08	<b>580</b>	10	52	38	100	17	7	59	17/24	
09	No density data collected								17/24	
10	<b>640</b>	19	78	3	20	9	3	0	18/25	
<i>Gutierrezia sarothrae</i>										
08	<b>440</b>	0	100	-	-	0	0	0	9/12	
09	No density data collected								8/13	
10	<b>400</b>	15	85	-	-	0	0	0	11/15	
<i>Juniperus osteosperma</i>										
08	<b>80</b>	75	25	-	-	0	0	50	-/-	
09	No density data collected								-/-	
10	<b>120</b>	33	67	-	60	0	0	0	-/-	
<i>Kochia prostrata</i>										
08	<b>820</b>	29	71	-	300	10	0	0	6/7	
09	No density data collected								9/10	
10	<b>1220</b>	44	56	-	-	0	0	0	11/11	
<i>Pinus edulis</i>										
08	<b>0</b>	0	0	-	-	0	0	0	-/-	
09	No density data collected								-/-	
10	<b>0</b>	0	0	-	40	0	0	0	-/-	
<i>Purshia tridentata</i>										
08	<b>0</b>	0	0	-	-	0	0	0	-/-	
09	No density data collected								-/-	
10	<b>20</b>	100	0	-	-	0	0	0	17/17	

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Rhus trilobata									
08	0	0	0	-	-	0	0	0	53/121
09	No density data collected								59/138
10	0	0	0	-	-	0	0	0	52/136

SOUTH BEAVER BULLHOG - TREND STUDY NO. 22R-10-10  
[Project #1224](#)

Vegetation Type: Wyoming Big Sagebrush, Pinyon/Juniper

Range Type: Crucial Deer Winter,

NRCS Ecological Site Description: [Upland Gravelly Loam \(Bonneville Big Sagebrush\), R028AY306UT](#)

Land Ownership: BLM

Elevation: 6,200 ft. (1,890 m)

Aspect: Southeast

Slope: 6%

Transect bearing: 300° magnetic

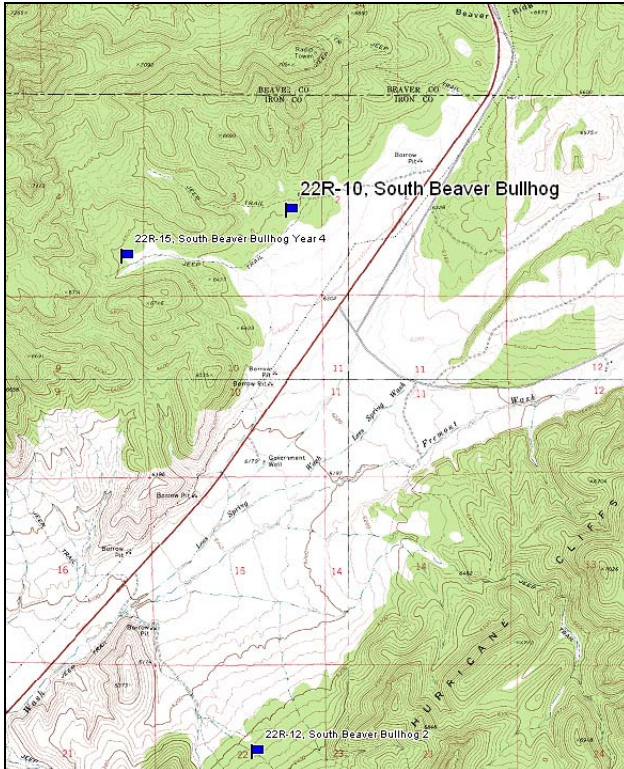
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Notes: No rebar

Directions:

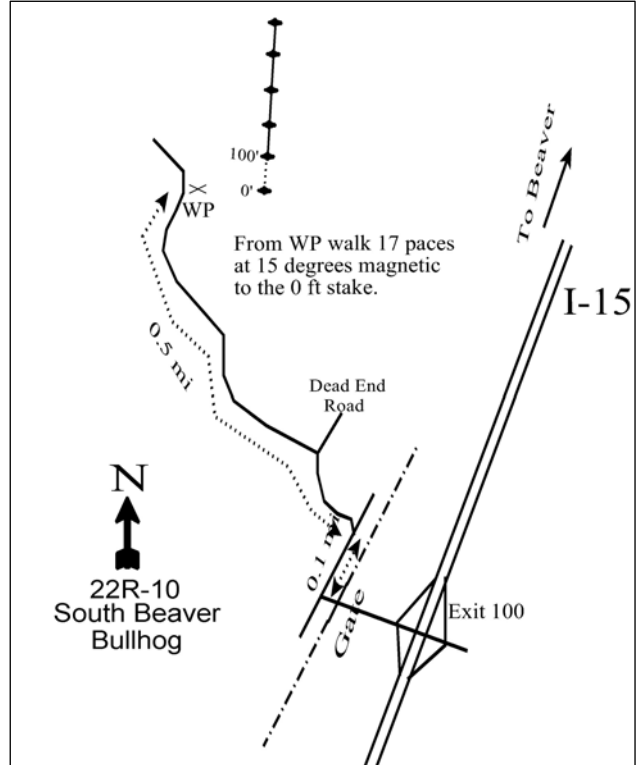
Take exit 100 from I-15. From the off-ramp turn right and proceed to a gate. Go through the gate and turn right. Drive 0.1 miles to a fork. Turn left and drive 0.5 miles on a two track road through a harrow project to a witness post on the right. Walk 17 paces at 15 degrees magnetic to the 0 foot stake marked with browse tag #167.

Map Name: Greenville Bench



Township: 31S Range: 7W Section: 3

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 356966 E 4222402 N

SOUTH BEAVER BULLHOG - WRI STUDY 22R-10  
[Project #1224](#)

**Site Description**

Site Information: The study is located approximately nine miles south of Beaver and one mile west of I-15 within a bullhog project treatment of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodland. The study was established in 2006 to monitor a bullhog mastication treatment to restore Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) habitat. About 1,520 acres of pinyon pine and Utah juniper trees were treated in the spring of 2009. A seed mix of grasses and forbs was aerial applied prior to bullhog treatment. The objectives of the project were to restore and enhance important big game and sage-grouse habitat, create wildlife corridors, reduce hazardous fuels, and improve watershed conditions and water quality (WRI Database 2011). Pellet group data estimated light use by deer in 2010. No pellet groups were sampled in 2006.

SEED MIX--  
 Management unit 22R, Study no: 10

Project Name: South Beaver Vegetation Enhancement			
WRI Database #: 1224			
Application: Aerial Seed		Acres:	1480
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Anatone'	1430	0.97
G	Bluebunch WG 'Goldar'	50	0.03
G	Crested Wheatgrass 'Douglas'	1150	0.78
G	Crested Wheatgrass 'Nordan'	1150	0.78
G	Indian Ricegrass 'Rimrock'	1500	1.01
G	Intermediate Wheatgrass 'Oahe'	750	0.51
G	Pubescent Wheatgrass 'Luna'	3000	2.03
G	Sandberg Bluegrass	400	0.27
G	Siberian Wheatgrass 'Vavilov'	2250	1.52
G	Snake River Wheatgrass 'Secar'	2250	1.52
F	Alfalfa 'Ladak 65'	750	0.51
F	Alfalfa 'Ranger'	750	0.51
F	Blue Flax 'Appar'	750	0.51
F	Palmer Penstemon	150	0.10
F	Sainfoin 'Eski'	750	0.51
F	Small Burnet 'Delar'	1500	1.01
F	Yellow Sweetclover	750	0.51
Total Pounds:		19330	13.06
PLS Pounds:			11.65

Browse: Wyoming big sagebrush is the key browse species. The treatment of pinyon pine and Utah juniper trees improved the overall health of the Wyoming big sagebrush stand. Decadence and poor vigor were high prior to treatment but improved following the treatment. Utilization of sagebrush has been light since the outset of the study. The recruitment of young sagebrush plants to the population was excellent following the treatment, though prior to the treatment recruitment of young plants was meager (Table - Browse Characteristics). Pinyon pine and Utah juniper were effectively reduced on the site and were not sampled in 2010 following the treatment (Table - Point-Quarter Tree Data).

Herbaceous Understory: Grasses are not abundant but are fairly diverse. The dominant perennial grass species is bottlebrush squirreltail (*Sitanion hystrix*). Cheatgrass (*Bromus tectorum*) was prevalent prior to treatment

but has significantly decreased in frequency and cover. Diversity of grass species increased following the treatment with several seeded grass species sampled which include crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*A. intermedium*), Indian ricegrass (*Oryzopsis hymenoides*), and Sandberg bluegrass (*Poa secunda*), though Indian ricegrass and Sandberg bluegrass were present prior to treatment. Forbs are rare on the site. Annual forbs provided the majority of the forb cover after the treatment. Seeded species sampled on the site following the treatment include Lewis flax (*Linum lewisii*), yellow sweetclover (*Melilotus officinalis*), and small burnet (*Sanguisorba minor*) (Table - Herbaceous trend).

Soil: The soil texture is a loam with a neutral soil reaction (pH 6.9) (Table - Soil Analysis Data). Bare ground cover is low with high amount of litter providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2006 due to surface litter movement, pedestalling, flow patterns, and slight soil movement. The soil erosion condition was classified as stable in 2010.

**Pre vs. Two Years Post Treatment Assessment, 2006 vs. 2010**

Browse: The density of Wyoming big sagebrush decreased 31% from 2,460 plants/acre to 1,700 plants/acre and canopy cover decreased from 8% to 4%. The health of sagebrush improved with decadence of sagebrush decreasing from 41% to 2% and poor vigor decreasing from 25% to 2%. The recruitment of young sagebrush plants to the population increased from 5% to 48% of the population. The density of Utah juniper decreased from 53 trees/acre to 0 trees/ acre and the density of pinyon pine decreased from 177 trees/acre to 0 trees/acre.

Grasses: The sum of nested frequency of perennial grasses significantly increased 84% and cover increased from 1% to 3%. Bottlebrush squirreltail significantly increased in frequency and cover increased from 1% to 2%. Cheatgrass was the dominant species in both sample years, though nested frequency decreased significantly and cover decreased from 13% to 2%.

Forbs: Forbs are rare on the site. No single perennial forb provided more than 1% cover in either sample year. The annual species gilia (*Gilia sp.*) provided 2% cover following the treatment.

HERBACEOUS TRENDS--

Management unit 22R, Study no: 10

T y p e	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
G	<i>Agropyron cristatum</i>	a-	b15	-	.08
G	<i>Agropyron intermedium</i>	-	3	-	.01
G	<i>Aristida purpurea</i>	a-	b34	-	.43
G	<i>Bouteloua gracilis</i>	12	8	.13	.51
G	<i>Bromus tectorum</i> (a)	b340	a110	12.64	1.50
G	<i>Oryzopsis hymenoides</i>	b12	a5	.20	.01
G	<i>Poa secunda</i>	5	1	.03	.00
G	<i>Sitanion hystrix</i>	a37	b67	.77	1.67
G	<i>Stipa comata</i>	-	5	-	.18
G	<i>Stipa lettermani</i>	9	-	.09	-
G	<i>Vulpia octoflora</i> (a)	b64	a13	.26	.07
Total for Annual Grasses		404	123	12.91	1.57
Total for Perennial Grasses		75	138	1.24	2.90
Total for Grasses		479	261	14.15	4.47
F	<i>Alyssum alyssoides</i> (a)	5	-	.01	-
F	<i>Caulanthus crassicaulis</i>	4	-	.01	-

Type	Species	Nested Frequency		Average Cover %	
		'06	'10	'06	'10
F	Chaenactis douglasii	5	-	.01	-
F	Euphorbia sp.	5	-	.01	-
F	Gayophytum ramosissimum(a)	a-	b55	-	.60
F	Gilia sp. (a)	a-	b65	-	1.45
F	Hedysarum boreale	-	2	-	.00
F	Ipomopsis aggregata	1	-	.03	-
F	Lactuca serriola (a)	a-	b21	-	.31
F	Linum lewisii	a-	b13	-	.04
F	Lygodesmia sp.	-	1	-	.00
F	Melilotus officinalis	-	1	-	.00
F	Microsteris gracilis (a)	a-	b34	-	.13
F	Polygonum douglasii (a)	-	2	-	.00
F	Ranunculus testiculatus (a)	-	3	-	.00
F	Sanguisorba minor	-	2	-	.03
F	Sphaeralcea coccinea	1	1	.00	.00
Total for Annual Forbs		5	180	0.00	2.51
Total for Perennial Forbs		16	20	0.06	0.09
Total for Forbs		21	200	0.07	2.60

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 22R, Study no: 10

Type	Species	Strip Frequency		Average Cover %	
		'06	'10	'06	'10
B	Artemisia tridentata wyomingensis	67	40	7.00	4.21
B	Gutierrezia sarothrae	29	5	.80	.22
B	Juniperus osteosperma	1	0	1.63	-
B	Leptodactylon pungens	5	3	.30	.15
B	Pinus edulis	10	0	10.01	-
Total for Browse		112	48	19.75	4.57

#### CANOPY COVER, LINE INTERCEPT--

Management unit 22R, Study no: 10

Species	Percent Cover	
	'06	'10
Artemisia tridentata wyomingensis	8.00	3.48
Gutierrezia sarothrae	1.43	-
Juniperus osteosperma	9.80	-
Leptodactylon pungens	.13	-
Pinus edulis	21.29	-

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 22R, Study no: 10

Species	Average leader growth (in)	
	'06	'10
Artemisia tridentata wyomingensis	0.6	1.5

POINT-QUARTER TREE DATA--

Management unit 22R, Study no: 10

Species	Trees per Acre		Average diameter (in)	
	'06	'10	'06	'10
Juniperus osteosperma	53	-	7.2	-
Pinus edulis	177	-	3.8	-

BASIC COVER--

Management unit 22R, Study no: 10

Cover Type	Average Cover %	
	'06	'10
Vegetation	33.05	10.94
Rock	8.02	2.17
Pavement	14.64	14.47
Litter	45.77	60.80
Cryptogams	.01	.15
Bare Ground	18.84	16.46

SOIL ANALYSIS DATA --

Management unit 22R, Study no: 10, Study Name: South Beaver Bullhog

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
12.1	6.9	38.0	39.1	22.9	1.5	22.7	182.4	0.6

PELLET GROUP DATA--

Management unit 22R, Study no: 10

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'10	'06	'10
Rabbit	51	3	-	-
Deer	-	1	-	1 (2)



BROWSE CHARACTERISTICS--  
Management unit 22R, Study no: 10

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata wyomingensis</i>									
06	<b>2460</b>	5	54	41	840	2	2	25	23/30
10	<b>1700</b>	48	49	2	20	9	5	2	16/26
<i>Gutierrezia sarothrae</i>									
06	<b>1800</b>	7	90	3	20	0	1	0	10/10
10	<b>180</b>	0	100	0	40	0	0	0	9/11
<i>Juniperus osteosperma</i>									
06	<b>20</b>	0	100	-	40	0	0	0	-/-
10	<b>0</b>	0	0	-	20	0	0	0	-/-
<i>Leptodactylon pungens</i>									
06	<b>100</b>	0	100	-	20	20	0	0	6/10
10	<b>80</b>	0	100	-	-	0	0	0	6/10
<i>Opuntia sp.</i>									
06	<b>0</b>	0	0	-	-	0	0	0	4/10
10	<b>0</b>	0	0	-	-	0	0	0	3/5
<i>Pediocactus simpsonii</i>									
06	<b>0</b>	0	0	-	-	0	0	0	2/3
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Pinus edulis</i>									
06	<b>220</b>	55	45	-	220	0	0	0	-/-
10	<b>0</b>	0	0	-	20	0	0	0	-/-

SOUTH BEAVER SITLA CHAINING - TREND STUDY NO. 22R-11-10

[Project #918](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Substantial Elk Winter

NRCS Ecological Site Description: Not available

Land Ownership: SITLA

Elevation: 6,771 ft. (2,063 m)

Aspect: Northwest

Slope: 4%

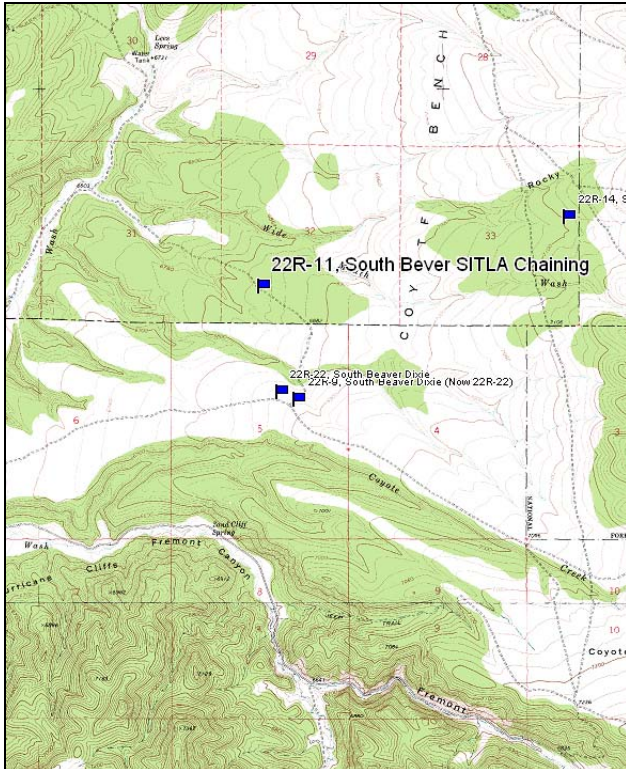
Transect bearing: 124° magnetic

Belt placement: line 1 (11ft & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

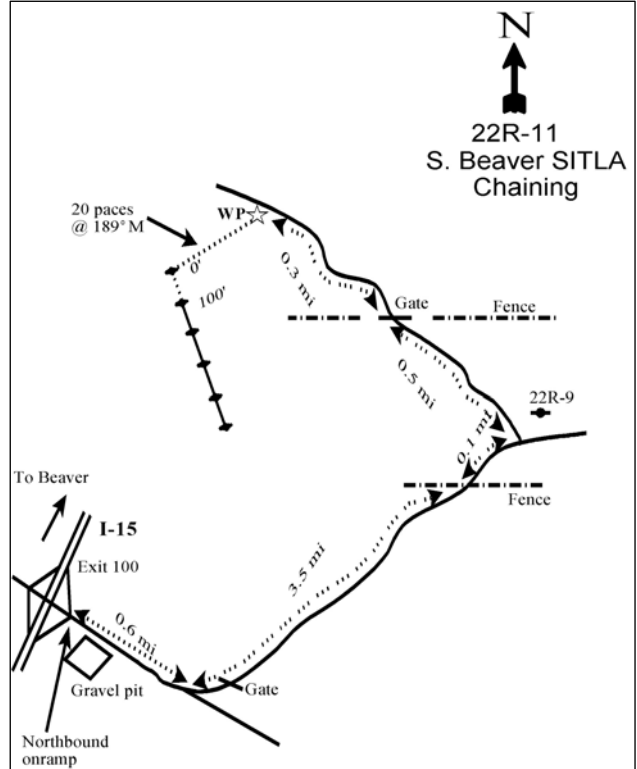
Take exit 100 from I-15. From the northbound on-ramp drive east 0.6 miles to a fork. Turn left and drive through a gate, continue 3.5 miles to a fence. From the fence drive 0.1 miles to another fork and a witness post between the forks. From here take the left fork and go 0.5 miles to a gate. From the gate go another 0.3 miles to a witness post on the left side of the road. From the witness post the 0-foot stake is 20 paces at 189 degrees magnetic.

Map Name: Kane Canyon



Township: 30S Range: 6W Section: 32

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 636188 E 4223621 N

SOUTH BEAVER SITLA CHAINING - WRI STUDY 22R-11

[Project #918](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) removal project on Utah State Institutional Trust Land (SITLA) approximately ten miles southeast of Beaver. Pinyon pine and Utah juniper have expanded into the area, which was historically dominated by a sagebrush semi-desert ecosystem. The area is used heavily by deer and elk, and also once served as sage-grouse habitat. The objective of this project is to restore the sagebrush semi-desert ecosystem by removing pinyon and juniper trees and seeding desirable grass, forb, and browse species. These improvements will enhance habitat for big game and sage-grouse, as well as forage for livestock. To attain these goals, pinyon and juniper trees were two-way chained in the fall of 2008 on 700 acres with an Ely chain on the first pass and smooth chain on the second pass, and the treated area was aerially seeded between the first and second passes of the chain and a seed dribbler was used on the second pass to seed antelope bitterbrush (*Purshia tridentata*) and small burnet (*Sanguisorba minor*) (WRI Database 2011). Pellet group data estimated light deer use in all sample years and light elk use in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 22R, Study no: 11

Project Name: South Beaver SITLA vegetation enhancement					
WRI Database #: 918					
Application: Aerial Seed		Acres: 450		Application: Seed Dribbler	
				Acres: 450	
Seed type		lbs in mix	lbs/acre	Seed type	
G	Bluebunch WG 'Anatone'	450	1.00	F	Small Burnet 'Delar'
G	Crested Wheatgrass 'Nordan'	450	1.00	B	Bitterbrush
G	Orchardgrass 'Paiute'	200	0.44	Total Pounds:	
G	Pubescent Wheatgrass 'Luna'	900	2.00	200	
G	Sandberg Bluegrass	150	0.33	PLS Pounds:	
G	Siberian Wheatgrass 'Vavilov'	450	1.00	0.39	
G	Snake River Wheatgrass 'Secar'	450	1.00		
F	Alfalfa 'Ladak'	150	0.33		
F	Alfalfa 'Ranger'	150	0.33		
F	Blue Flax 'Appar'	100	0.22		
F	Sainfoin 'Eski'	900	2.00		
F	Small Burnet 'Delar'	900	2.00		
F	Yellow Sweetclover	150	0.33		
B	Forage Kochia	200	0.44		
Total Pounds:		5600	12.44		
PLS Pounds:			11.16		

Browse: Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) is the preferred browse species on the site. The overall health of the sagebrush stand improved significantly following the chaining treatment. Decadence and poor vigor of sagebrush has been low since the treatment. Utilization of sagebrush plants was moderately heavy prior to treatment but has since been light. The recruitment of young sagebrush plants to the population has been poor over the sample years. Other browse species sampled on the site include narrowleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *stenophyllus*), stickyleaf low rabbitbrush (*C. v. ssp. viscidiflorus*), broom snakeweed (*Gutierrezia sarothrae*), forage kochia (*Kochia prostrata*), and prickly phlox (*Leptodactylon pungens*). Of the browse species seeded to the site, forage kochia has been the only species

sampled (Table - Browse Characteristics). Pinyon pine and Utah juniper were effectively decreased from the site following the treatment (Table - Point-Quarter Tree Data).

Herbaceous Understory: Grasses are marginally abundant and fairly diverse. Bluebunch wheatgrass (*Agropyron spicatum*) is the dominant perennial grass species. Cheatgrass (*Bromus tectorum*) is present on the site in low abundance. Seeded species sampled on the site include crested wheatgrass (*Agropyron cristatum*), bluebunch wheatgrass (*A. spicatum*), orchardgrass (*Dactylis glomerata*), and Sandberg bluegrass (*Poa secunda*), though bluebunch wheatgrass was present prior to the treatment. Forbs are abundant and diverse on the site. The dominant perennial forb is specklepod locoweed (*Astragalus lentiginosus*). Annual forb species were as prevalent as perennial forb species following the treatment. The most common annual forb species are groundsmoke (*Gayophytum ramosissimum*), prickly lettuce (*Lactuca serriola*), and gilia (*Gilia sp.*) (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.3) (Table - Soil Analysis Data). Bare ground cover is moderate with high amount of litter and a moderate amount of pavement and rock providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2007 due to evidence of surface litter and soil movement, pedestalling around plants, and the formation of some small flow patterns and rills. The soil erosion condition was classified as stable in 2010.

### Pre vs. Two Years Post Treatment Assessment, 2007 vs. 2010

Browse: The density of Wyoming big sagebrush decreased 68% from 1,540 plants/acre to 500 plants/acre and canopy cover remained similar at 2%. The health of sagebrush improved with decadence of sagebrush decreasing from 53% to 12% and poor vigor decreasing from 25% to 0%. The recruitment of young sagebrush plants to the population remained poor at 1% of the population. The density of Utah juniper decreased from 259 trees/acre to 74 trees/ acre and pinyon pine decreased from 168 trees/acre to 42 trees/acre.

Grasses: The sum of nested frequency of perennial grasses remained similar and cover decreased from 4% to 3%. Bluebunch wheatgrass decreased significantly in nested frequency and cover decreased from 3% to 1%. Cheatgrass decreased significantly in nested frequency and remained rare on the site.

Forbs: The sum of nested frequency of perennial forbs significantly increased 39% and cover increased from 4% to 5%. Desert phlox (*Phlox austromontana*) was the dominant forb species prior to the treatment but decreased significantly in nested frequency and became rare on the site following the treatment. Specklepod locoweed increased substantially in nested frequency and cover increased from less than 1% to 3%. Annual forb species increased in cover from 1% to 7%. The annual species gilia provided 4% cover and groundsmoke provided 2% cover following the treatment. Prickly lettuce was sampled for the first time following the treatment at 1% cover.

### HERBACEOUS TRENDS--

Management unit 22R, Study no: 11

T y p e	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	<i>Agropyron cristatum</i>	a-	b20	-	.36
G	<i>Agropyron dasystachyum</i>	-	5	-	.06
G	<i>Agropyron intermedium</i>	a-	b19	-	.08
G	<i>Agropyron spicatum</i>	b127	a50	3.13	1.27
G	<i>Bromus tectorum</i> (a)	b27	a1	.06	.00
G	<i>Dactylis glomerata</i>	-	5	-	.18
G	<i>Oryzopsis hymenoides</i>	b36	a6	.39	.27
G	<i>Poa secunda</i>	-	2	-	.00

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	<i>Sitanion hystrix</i>	<sub>a</sub> 1	<sub>b</sub> 40	.00	.43
G	<i>Stipa comata</i>	6	7	.03	.09
Total for Annual Grasses		27	1	0.06	0.00
Total for Perennial Grasses		170	154	3.56	2.75
Total for Grasses		197	155	3.62	2.75
F	<i>Agoseris glauca</i>	-	1	-	.00
F	<i>Antennaria rosea</i>	3	-	.00	-
F	<i>Arabis</i> sp.	11	3	.02	.00
F	<i>Astragalus lentiginosus</i>	<sub>a</sub> 9	<sub>b</sub> 39	.03	2.63
F	<i>Calochortus nuttallii</i>	-	3	-	.00
F	<i>Castilleja linariaefolia</i>	-	-	-	.03
F	<i>Chaenactis douglasii</i>	<sub>a</sub> 6	<sub>b</sub> 15	.01	.23
F	<i>Collinsia parviflora</i> (a)	1	-	.00	-
F	<i>Cryptantha</i> sp.	-	2	-	.15
F	<i>Erigeron pumilus</i>	-	4	-	.04
F	<i>Erigeron</i> sp.	-	1	-	.00
F	<i>Eriogonum umbellatum</i>	5	2	.33	.01
F	<i>Gayophytum ramosissimum</i> (a)	<sub>a</sub> -	<sub>b</sub> 53	-	2.11
F	<i>Geranium</i> sp.	-	3	-	.04
F	<i>Gilia</i> sp. (a)	<sub>a</sub> 65	<sub>b</sub> 101	.13	3.82
F	<i>Hedysarum boreale</i>	-	5	-	.03
F	<i>Hymenoxys acaulis</i>	<sub>b</sub> 17	<sub>a</sub> -	.09	-
F	<i>Lactuca serriola</i> (a)	<sub>a</sub> -	<sub>b</sub> 52	-	1.06
F	<i>Lesquerella</i> sp.	6	4	.02	.07
F	<i>Linum lewisii</i>	<sub>a</sub> -	<sub>b</sub> 20	-	.44
F	<i>Lygodesmia spinosa</i>	3	16	.03	.13
F	<i>Melilotus officinalis</i>	-	7	-	.33
F	<i>Microsteris gracilis</i> (a)	<sub>b</sub> 54	<sub>a</sub> 14	.14	.10
F	<i>Onobrychis viciaefolia</i>	<sub>a</sub> -	<sub>b</sub> 48	-	.42
F	<i>Penstemon</i> sp.	-	2	-	.06
F	<i>Phlox austromontana</i>	<sub>b</sub> 96	<sub>a</sub> 33	3.06	.28
F	<i>Polygonum douglasii</i> (a)	-	2	-	.00
F	<i>Ranunculus testiculatus</i> (a)	<sub>b</sub> 82	<sub>a</sub> 51	.18	.69
F	<i>Sanguisorba minor</i>	-	1	-	.09
F	<i>Senecio multilobatus</i>	-	8	-	.03
Total for Annual Forbs		202	273	0.45	7.80
Total for Perennial Forbs		156	217	3.61	5.08
Total for Forbs		358	490	4.06	12.88

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 22R, Study no: 11

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia tridentata wyomingensis	53	17	1.14	1.82
B	Chrysothamnus viscidiflorus stenophyllus	11	0	.04	-
B	Chrysothamnus viscidiflorus viscidiflorus	0	1	-	.03
B	Gutierrezia sarothrae	10	4	.21	.03
B	Juniperus osteosperma	6	3	4.17	.53
B	Kochia prostrata	0	1	-	-
B	Leptodactylon pungens	13	3	.36	.00
B	Opuntia sp.	1	1	-	-
B	Pinus edulis	15	4	8.91	.00
Total for Browse		109	34	14.85	2.42

CANOPY COVER, LINE INTERCEPT--

Management unit 22R, Study no: 11

Species	Percent Cover	
	'07	'10
Artemisia tridentata wyomingensis	2.26	1.54
Chrysothamnus viscidiflorus stenophyllus	-	-
Chrysothamnus viscidiflorus viscidiflorus	-	.08
Gutierrezia sarothrae	.18	.11
Juniperus osteosperma	10.44	1.00
Leptodactylon pungens	.36	-
Opuntia sp.	-	.03
Pinus edulis	16.78	.20

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 22R, Study no: 11

Species	Average leader growth (in) '10
Artemisia tridentata wyomingensis	2.1

POINT-QUARTER TREE DATA--

Management unit 22R, Study no: 11

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	259	74	5.3	1.7
Pinus edulis	168	42	5.3	1.2

BASIC COVER--

Management unit 22R, Study no: 11

Cover Type	Average Cover %	
	'07	'10
Vegetation	22.86	18.72
Rock	15.13	6.04
Pavement	20.00	5.85
Litter	34.03	54.13
Cryptogams	1.59	.15
Bare Ground	24.18	23.17

SOIL ANALYSIS DATA --

Management unit 22R, Study no: 11, Study Name: South Beaver SITLA Chaining

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.3	43.4	35.0	21.6	2.1	8.7	156.8	0.5

PELLET GROUP DATA--

Management unit 22R, Study no: 11

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	52	21	-	-
Elk	-	-	-	2 (5)
Deer	-	2	-	3 (7)

BROWSE CHARACTERISTICS--

Management unit 22R, Study no: 11

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia tridentata wyomingensis</i>									
07	<b>1540</b>	1	45	53	20	12	39	25	16/22
10	<b>500</b>	0	88	12	20	0	0	0	17/23
<i>Chrysothamnus viscidiflorus stenophyllus</i>									
07	<b>240</b>	0	83	17	-	25	58	8	6/7
10	<b>0</b>	0	0	0	-	0	0	0	-/-
<i>Chrysothamnus viscidiflorus viscidiflorus</i>									
07	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>40</b>	0	100	-	-	0	0	0	11/12
<i>Gutierrezia sarothrae</i>									
07	<b>240</b>	8	92	-	-	0	0	0	7/5
10	<b>100</b>	0	100	-	-	0	0	0	10/11
<i>Juniperus osteosperma</i>									
07	<b>120</b>	17	83	-	100	0	0	0	-/-
10	<b>80</b>	75	25	-	80	0	0	0	-/-

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<b>Kochia prostrata</b>									
07	<b>0</b>	0	0	-	-	0	0	0	-/-
10	<b>20</b>	0	100	-	-	0	0	0	10/15
<b>Leptodactylon pungens</b>									
07	<b>820</b>	0	98	2	20	0	0	2	5/8
10	<b>60</b>	0	100	0	-	0	0	0	6/12
<b>Opuntia sp.</b>									
07	<b>20</b>	0	100	-	-	0	0	0	4/8
10	<b>20</b>	0	100	-	-	0	0	0	4/7
<b>Pinus edulis</b>									
07	<b>300</b>	47	53	-	100	0	0	0	-/-
10	<b>80</b>	75	25	-	-	0	0	0	-/-
<b>Purshia tridentata</b>									
07	<b>0</b>	0	0	-	-	0	0	0	28/48
10	<b>0</b>	0	0	-	-	0	0	0	18/35



SOUTH BEAVER BULLHOG 2 - TREND STUDY NO. 22R-12-10

[Project #895](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Substantial Elk Winter

NRCS Ecological Site Description: [Upland Gravelly Loam \(Bonneville Big Sagebrush\), R028AY306UT](#)

Land Ownership: BLM

Elevation: 6,350 ft. (1,935 m)

Aspect: West

Slope: 6%

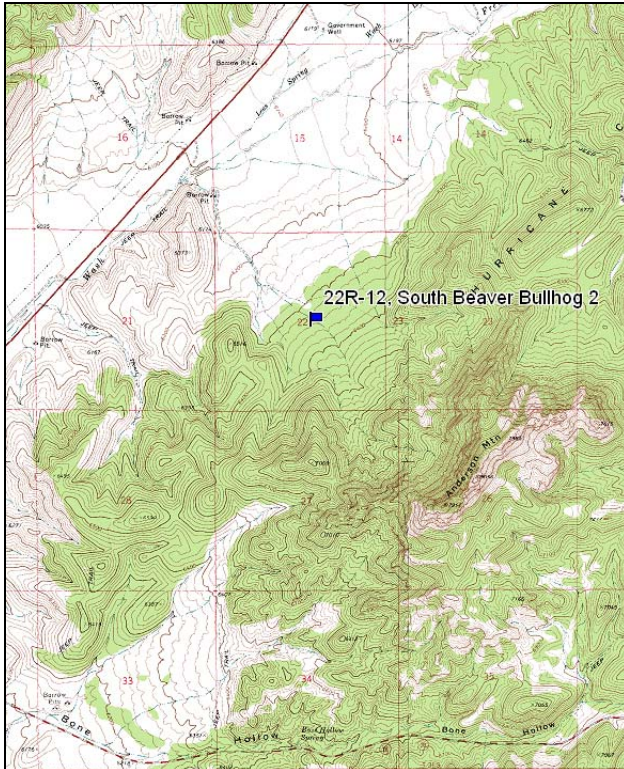
Transect bearing: 243° magnetic

Belt placement: line 1 (11ft & 95 ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

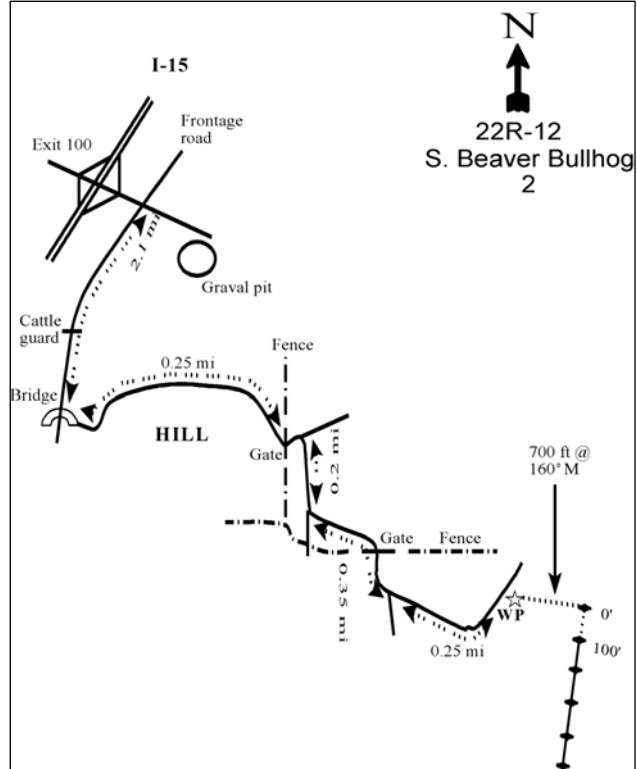
From I-15 take exit 100 and go east to the frontage road running parallel and just east of the Interstate. Travel south on the frontage road 2.1 miles to a small bridge, here you will see a faint road on the left. Turn left (east), 0.25 miles around a hill and passing through a gate, to a fork. Take the right fork (south) 0.2 miles, to another fork. Take the left fork and drive 0.35 miles passing through another gate and to another fork. Go left for 0.25 miles to a witness post on the right side of the road. From the witness post the 0-foot stake is 700 feet at 160 degrees magnetic.

Map Name: Buckhorn Flat



Township: 31S Range: 7W Section: 22

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 356563 E 4217544 N

SOUTH BEAVER BULLHOG 2 - WRI STUDY 22R-12

[Project #895](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a large scale pinyon pine (*Pine edulis*) and Utah juniper (*Juniperus osteosperma*) removal project south of Beaver. Pinyon pine and Utah juniper have expanded into the area, which was historically dominated by a sagebrush semi-desert ecosystem. The area is used heavily by deer and elk, and also once served as sage-grouse habitat. A total 385 acres of pinyon pine and Utah juniper trees were treated with a bullhog in the winter of 2007-08. The treatment area was aerially seeded in the spring of 2008. The objectives of this project were to restore the sagebrush semi-desert ecosystem by removing pinyon and juniper trees and seeding desirable grass, forb, and browse species. These improvements will enhance habitat for big game and sage-grouse, as well as forage for livestock. They will also aid in increasing water quantity and quality in riparian areas (WRI Database 2011). Pellet group data estimated light use by deer in all sample years (Table - Pellet Group Data).

SEED MIX--

Management unit 22R, Study no: 12

Project Name: South Beaver Vegetation Enhancement YR3			
WRI Database #: 895			
Application: Aerial Seed		Acres:	300
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Anatone'	300	1.00
G	Crested Wheatgrass 'Hycrest'	300	1.00
G	Orchardgrass 'Paiute'	150	0.50
G	Pubescent Wheatgrass	600	2.00
G	Sandberg Bluegrass	100	0.33
G	Siberian Wheatgrass 'Vavilov'	200	0.67
G	Snake River Wheatgrass 'Secar'	450	1.50
F	Alfalfa 'Ladak'	200	0.67
F	Alfalfa 'Ranger'	200	0.67
F	Blue Flax 'Appar'	150	0.50
F	Sainfoin 'Eski'	650	2.17
F	Small Burnet 'Delar'	600	2.00
F	Yellow Sweetclover	50	0.17
B	Bitterbrush	50	0.17
Total Pounds:		4000	13.33
PLS Pounds:			11.62

Browse: Browse species are sparse on the site. The preferred browse species on the site is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), though occurring in very low abundance. Utilization of sagebrush plants was heavy in 2007 and was moderate in 2010. Other browse species on the site include crispleaf buckwheat (*Eriogonum corymbosum*) and slenderbush eriogonum (*E. microthecum*) (Table - Browse Characteristics). Pinyon pine and Utah juniper were effectively reduced but still remain in low abundance on the site (Table - Point-Quarter Tree Data).

Herbaceous Understory: Grasses are sparse on the site and are dominated by the annual species cheatgrass (*Bromus tectorum*). Perennial grasses are rare on the site. Bottlebrush squirreltail (*Sitanion hystrix*) is the most common perennial grass species, though occurring in low frequency and cover. Forbs are abundant and diverse on the site. Prickly lettuce (*Lactuca serriola*) and Utah deervetch (*Lotus utahensis*) are the dominant forb species on the site and provided the majority of the forb cover. Seeded species sampled after the

treatment include Lewis flax (*Linum lewisii*), alfalfa (*Medicago sativa*), and yellow sweetclover (*Melilotus officinalis*) (Table - Herbaceous Trends).

Soil: The soil texture is a sandy clay loam with a neutral soil reaction (pH 6.7) (Table - Soil Analysis Data). Bare ground cover is moderate with high amount of litter and a moderate amount of pavement, rock, and vegetation providing protective ground cover. Cryptograms protective ground cover was high in 2007 but following the treatment was low (Table - Basic Cover). The soil erosion condition was classified as moderate in 2007 due to evidence of soil movement and the formation of flow patterns, rills, and gullies. The soil erosion condition was classified as stable in 2010.

**Pre vs. Three Years Post Treatment Assessment, 2007 vs. 2010**

Browse: Browse species are rare on the site. The density of Wyoming big sagebrush remained similar and cover remained sparse. Pinyon pine density decreased from 171 trees/acre to 2 trees/acre and canopy cover decreased from 25% to 6%. Utah juniper decreased from 76 trees/acre to 6 trees/acre and canopy cover decreased from 15% to 7%.

Grasses: Perennial grasses remained very rare on the site. Cheatgrass significantly increased in nested frequency and cover increased from 1% to 5%. No single perennial grass species provided more than 1% cover in either sample year.

Forbs: The sum of nested frequency of perennial forbs increased two fold and cover increased from less than 1% to 4%. Utah deervetch increased significantly in nested frequency and cover increased from less than 1% to 2%. The sum of nested frequency of annual forbs increased three fold and cover increased from less than 1% to 13%, though most of the increase in cover is attributed to prickly lettuce which is palatable forage for big game animals. Prickly lettuce was sampled for the first time following the treatment with 7% cover.

HERBACEOUS TRENDS--  
Management unit 22R, Study no: 12

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron intermedium	-	8	-	.01
G	Bouteloua gracilis	2	-	.00	-
G	Bromus tectorum (a)	<sub>a</sub> 116	<sub>b</sub> 172	.86	5.34
G	Poa fendleriana	-	2	-	.00
G	Sitanion hystrix	22	16	.10	.22
Total for Annual Grasses		116	172	0.86	5.34
Total for Perennial Grasses		24	26	0.11	0.24
Total for Grasses		140	198	0.97	5.59
F	Arabis sp.	6	-	.01	-
F	Astragalus sp.	1	-	.00	-
F	Chaenactis douglasii	-	5	-	.03
F	Cryptantha sp.	5	2	.01	.00
F	Descurainia pinnata (a)	41	38	.07	.50
F	Draba sp. (a)	-	1	-	.00
F	Eriogonum cernuum (a)	<sub>a</sub> 6	<sub>b</sub> 63	.01	.93
F	Eriogonum umbellatum	<sub>a</sub> 7	<sub>b</sub> 38	.08	.31
F	Erodium cicutarium (a)	<sub>a</sub> -	<sub>b</sub> 28	-	.39
F	Euphorbia sp.	3	-	.00	-

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
F	Gayophytum ramosissimum(a)	a1	b82	.00	1.22
F	Gilia sp. (a)	a31	b90	.06	1.12
F	Hymenoxys richardsonii	-	12	-	.60
F	Ipomopsis aggregata	11	7	.02	.01
F	Lactuca serriola (a)	a-	b280	-	7.27
F	Lappula occidentalis (a)	-	7	-	.06
F	Linum lewisii	-	6	-	.01
F	Lotus utahensis	11	19	.02	2.15
F	Lygodesmia sp.	a-	b14	-	.07
F	Machaeranthera grindelioides	a-	b17	-	.10
F	Medicago sativa	-	3	-	.15
F	Melilotus officinalis	-	9	-	.30
F	Mentzelia albicaulis (a)	-	12	-	.09
F	Microsteris gracilis (a)	57	84	.12	1.12
F	Polygonum douglasii (a)	b108	a59	.24	.35
F	Ranunculus testiculatus (a)	10	-	.02	-
F	Streptanthus cordatus	9	-	.02	-
Total for Annual Forbs		254	744	0.53	13.09
Total for Perennial Forbs		53	132	0.17	3.76
Total for Forbs		307	876	0.71	16.85

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 22R, Study no: 12

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia tridentata wyomingensis	2	2	-	.00
B	Eriogonum corymbosum	0	4	-	.18
B	Eriogonum microthecum	1	1	-	.00
B	Juniperus osteosperma	5	1	2.24	4.76
B	Pinus edulis	11	1	3.07	.88
Total for Browse		19	9	5.31	5.84

#### CANOPY COVER, LINE INTERCEPT--

Management unit 22R, Study no: 12

Species	Percent Cover	
	'07	'10
Artemisia tridentata wyomingensis	.23	-
Eriogonum corymbosum	-	.06
Juniperus osteosperma	15.26	6.46
Pinus edulis	24.88	5.84

POINT-QUARTER TREE DATA--  
 Management unit 22R, Study no: 12

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	76	6	10	16.3
Pinus edulis	171	2	6.3	4.9

BASIC COVER--  
 Management unit 22R, Study no: 12

Cover Type	Average Cover %	
	'07	'10
Vegetation	6.78	29.43
Rock	16.91	7.15
Pavement	25.74	8.87
Litter	52.07	62.34
Cryptogams	7.55	.18
Bare Ground	3.97	8.16

SOIL ANALYSIS DATA --

Management unit 22R, Study no: 12, Study Name: South Beaver Bullhog 2

Effective rooting depth (in)	pH	sandy clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	6.7	53.4	19.0	27.6	1.7	11.3	256.0	0.5

PELLET GROUP DATA--  
 Management unit 22R, Study no: 12

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	82	7	-	-
Elk	-	2	-	-
Deer	3	5	1 (2)	3 (7)

BROWSE CHARACTERISTICS--  
Management unit 22R, Study no: 12

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<i>Artemisia tridentata wyomingensis</i>										
07	40	0	0	100	-	0	100	100	39/55	
10	60	0	100	0	20	33	0	0	19/15	
<i>Chrysothamnus nauseosus</i>										
07	0	0	0	-	-	0	0	0	-/-	
10	0	0	0	-	-	0	0	0	14/16	
<i>Eriogonum corymbosum</i>										
07	0	0	0	-	-	0	0	0	-/-	
10	80	0	100	-	-	0	0	0	8/13	
<i>Eriogonum microthecum</i>										
07	20	0	100	-	-	0	0	0	6/6	
10	20	100	0	-	-	0	0	0	-/-	
<i>Juniperus osteosperma</i>										
07	100	20	80	-	-	0	0	0	-/-	
10	20	0	100	-	-	0	0	0	-/-	
<i>Kochia prostrata</i>										
07	0	0	0	-	-	0	0	0	-/-	
10	0	0	0	-	-	0	0	0	16/16	
<i>Opuntia sp.</i>										
07	0	0	0	-	-	0	0	0	6/15	
10	0	0	0	-	-	0	0	0	5/11	
<i>Pinus edulis</i>										
07	420	29	67	5	100	0	0	0	-/-	
10	20	0	100	0	-	0	0	0	-/-	

SOUTH BEAVER YEAR 5 - TREND STUDY NO. 22R-20-10

[Project #1711](#)

Vegetation Type: Pinyon/Juniper, Wyoming Big Sagebrush

Range Type: Crucial Deer Winter, Substantial Elk Winter

NRCS Ecological Site Description: Not available

Land Ownership: BLM

Elevation: 6,931 ft. (2,113 m)

Aspect: West

Slope: 2%

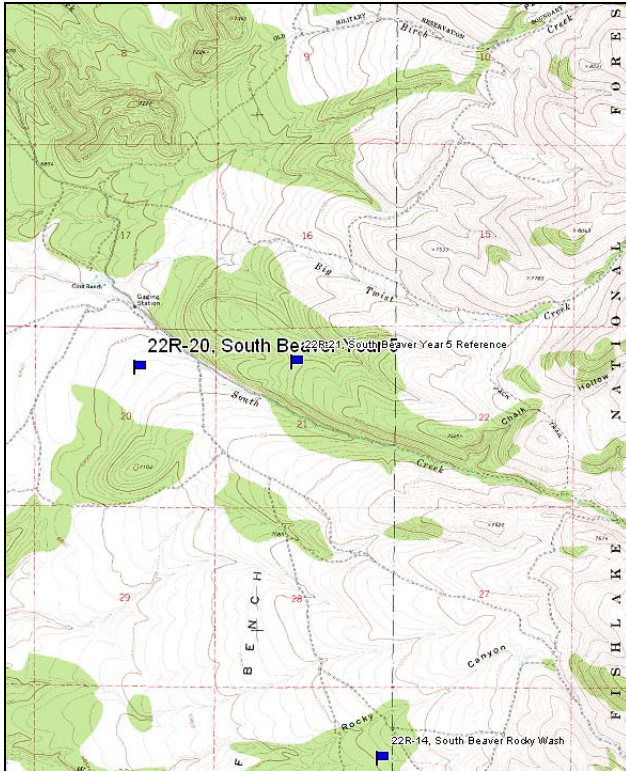
Transect bearing: 228° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

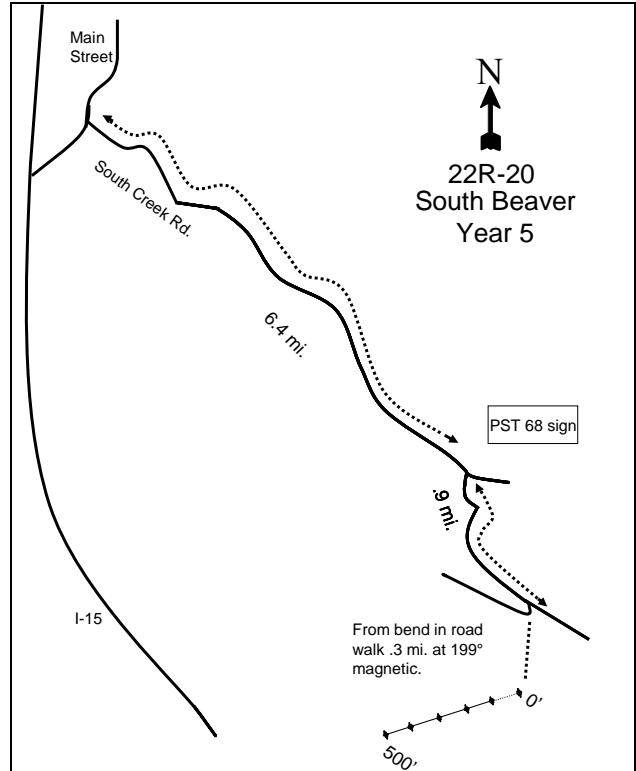
From Main St. in Beaver head south towards the I-15 interchange, before Main St. bends to the west turn east onto South Creek Road. Stay on the main road for 6.4 miles to PST 68 sign. From the sign go 0.9 miles to a turn to the west. Cross the stream, park at a bend in the road about 100' past the stream. Walk 0.29 miles at 199°M to the 0-foot post.

Map Name: Kane Canyon



Township: 30S Range: 6W Section: 20

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 363881 E 4227750 N

SOUTH BEAVER YEAR 5 - WRI STUDY 22R-20  
[Project # 1711](#)

**Site Description**

Site Information: The study is located approximate eight miles southeast of Beaver in a proposed bullhog treatment of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodland. The study was established to monitor a bullhog treatment in 2010. Pinyon pine and Utah juniper have expanded into the area, which was historically dominated by a sagebrush semi-desert ecosystem. The area is used heavily by deer and elk, and also once served as sage-grouse habitat. The project area will be treated with bullhog to remove juniper and pinyon trees. A seed mix of forbs and grasses will be applied prior to the bullhog treatment. An untreated site South Beaver Year 5 Reference (22R-21) was established as a reference site (WRI Database 2011). Pellet group data estimated heavy use by deer and light use by elk in 2010 (Table - Pellet Group Data).

SEED MIX--  
 Management unit 22R, Study no: 20

Project Name: South Beaver Vegetation Enhancement Year 5			
WRI Database #: 1711			
Application: Aerial Seed		Acres: 1771	
Seed type		lbs in mix	lbs/acre
G	Bluebunch WG 'Anatone'	1684	0.95
G	Bluebunch Wheatgrass 'Anatone	950	0.54
G	Crested Wheatgrass 'Hycrest'	2650	1.50
G	Indian Ricegrass 'Rimrock'	1800	1.02
G	Intermediate Wheatgrass 'Oahe'	850	0.48
G	Pubescent Wheatgrass 'Luna'	3550	2.00
G	Sandberg Bluegrass	450	0.25
G	Siberian Wheatgrass 'Vavilov'	2650	1.50
G	Snake River Wheatgrass 'Secar'	2650	1.50
F	Alfalfa 'Ladak'	1750	0.99
F	Blue Flax 'Appar'	900	0.51
F	Palmer Penstemon	175	0.10
F	Sainfoin 'Eski'	1800	1.02
F	Small Burnet 'Delar'	1800	1.02
F	Yellow Sweetclover	910	0.51
Total Pounds:		24569	13.87
PLS Pounds:			12.31

Browse: Prior to treatment the site was dominated by pinyon pine and Utah juniper. The preferred browse species is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). Poor vigor and decadence of sagebrush plants was high. The recruitment of young sagebrush plants to the population was good. Utilization of sagebrush was light. Other browse species sampled on the site include Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), prickly phlox (*Leptodactylon pungens*), pricklypear cactus (*Opuntia* sp.) and yucca (*Yucca* sp.) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are not particularly abundant or diverse. Bottlebrush squirreltail (*Sitanion hystrix*) is the dominant perennial grass species. Cheatgrass (*Bromus tectorum*) is present on the site in low abundance. Other perennial grass species sampled on the site include Sandberg bluegrass (*Poa secunda*) and mutton grass (*P. fendleriana*). Forbs are not abundant or diverse. Perennial forbs are rare on the site. Desert



phlox (*Phlox austromontana*) is the most common perennial forb species sampled on the site (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a very cobbly loam. Bare ground cover is moderate with a high amount of litter and a moderate amount of vegetation, rock, and pavement providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

HERBACEOUS TRENDS--  
Management unit 22R, Study no: 20

Type	Species	Nested	Average
		Frequency	Cover %
		'10	'10
G	Bromus tectorum (a)	58	.66
G	Poa fendleriana	3	.03
G	Poa secunda	20	.08
G	Sitanion hystrix	101	1.41
Total for Annual Grasses		58	0.66
Total for Perennial Grasses		124	1.52
Total for Grasses		182	2.19
F	Astragalus sp.	8	.04
F	Astragalus utahensis	3	.03
F	Chaenactis douglasii	10	.04
F	Collinsia parviflora (a)	1	.00
F	Comandra pallida	20	.10
F	Cryptantha sp.	4	.03
F	Erigeron pumilus	14	.05
F	Eriogonum sp.	3	.00
F	Eriogonum umbellatum	3	.03
F	Gayophytum ramosissimum(a)	42	.27
F	Gilia sp. (a)	4	.00
F	Hedysarum boreale	2	.03
F	Microsteris gracilis (a)	50	.18
F	Penstemon sp.	1	.03
F	Phlox austromontana	54	.57
F	Phlox longifolia	3	.01
F	Polygonum douglasii (a)	45	.13
F	Ranunculus testiculatus (a)	8	.01
F	Schoenrambe linifolia	3	.03
F	Senecio multilobatus	7	.02
F	Streptanthus cordatus	27	.13
Total for Annual Forbs		150	0.60
Total for Perennial Forbs		162	1.18
Total for Forbs		312	1.78

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS--

Management unit 22R, Study no: 20

Type	Species	Strip Frequency	Average Cover %
		'10	'10
B	Artemisia tridentata wyomingensis	50	3.46
B	Juniperus osteosperma	9	17.36
B	Leptodactylon pungens	5	.21
B	Opuntia sp.	2	.03
B	Pinus edulis	18	11.03
B	Yucca sp.	1	-
Total for Browse		85	32.11

CANOPY COVER, LINE INTERCEPT--

Management unit 22R, Study no: 20

Species	Percent Cover
	'10
Artemisia tridentata wyomingensis	3.46
Juniperus osteosperma	29.16
Leptodactylon pungens	.61
Pinus edulis	18.28
Yucca sp.	.40

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 22R, Study no: 20

Species	Average leader growth (in)
	'10
Artemisia tridentata wyomingensis	1.3
Purshia tridentata	3.3

POINT-QUARTER TREE DATA--

Management unit 22R, Study no: 20

Species	Trees per Acre	Average diameter (in)
	'10	'10
Juniperus osteosperma	200	5.6
Pinus edulis	413	1.7

BASIC COVER--

Management unit 22R, Study no: 20

Cover Type	Average Cover % '10
Vegetation	35.07
Rock	7.65
Pavement	13.51
Litter	53.66
Cryptogams	.16
Bare Ground	19.88

PELLET GROUP DATA--

Management unit 22R, Study no: 20

Type	Quadrat Frequency '10	Days use per acre (ha) '10
Rabbit	27	-
Elk	1	1 (3)
Deer	11	40 (98)

BROWSE CHARACTERISTICS--

Management unit 22R, Study no: 20

Y e a r	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<i>Artemisia tridentata vaseyana</i>									
10	0	0	0	-	-	0	0	0	16/28
<i>Artemisia tridentata wyomingensis</i>									
10	1600	10	60	30	20	13	1	38	18/24
<i>Cowania mexicana stansburiana</i>									
10	0	0	0	-	-	0	0	0	37/70
<i>Gutierrezia sarothrae</i>									
10	0	0	0	-	-	0	0	0	7/7
<i>Juniperus osteosperma</i>									
10	220	27	73	-	80	0	0	0	-/-
<i>Leptodactylon pungens</i>									
10	340	12	88	-	-	0	0	0	7/10
<i>Opuntia sp.</i>									
10	40	50	50	-	-	0	0	0	4/9
<i>Pinus edulis</i>									
10	400	55	45	-	80	0	0	0	-/-
<i>Purshia tridentata</i>									
10	0	0	0	-	-	0	0	0	21/49
<i>Yucca sp.</i>									
10	20	0	100	-	-	0	0	0	17/22

SOUTH BEAVER YEAR 5 REFERENCE - TREND STUDY NO. 22R-21-10  
[Project #1711](#)

Vegetation Type: Pinyon/Juniper

Range Type: Crucial Deer Winter, Substantial Elk Winter

NRCS Ecological Site Description: [Upland Loam \(Mountain Big Sagebrush\), R028AY310UT](#)

Land Ownership: BLM

Elevation: 7,173 ft. (2,186 m)

Aspect: North

Slope: 4%

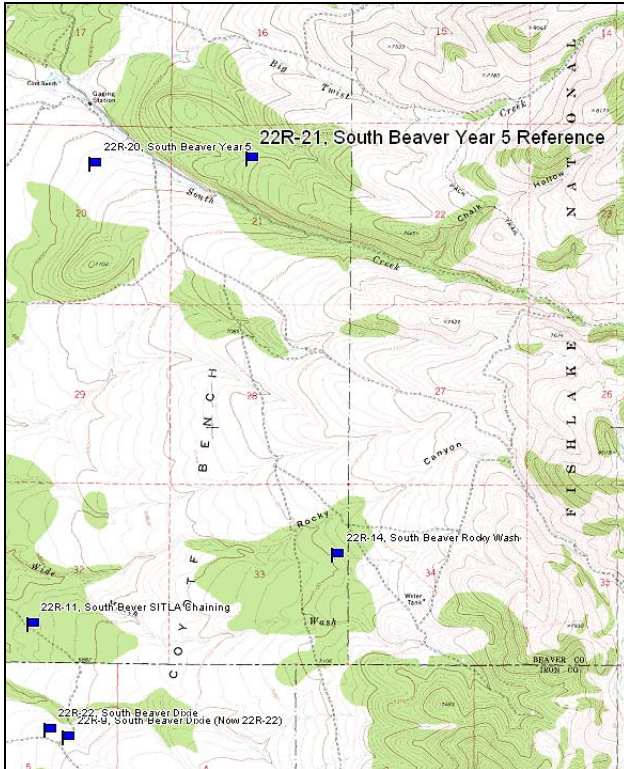
Transect bearing: 348° magnetic

Belt placement: line 1 (10ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

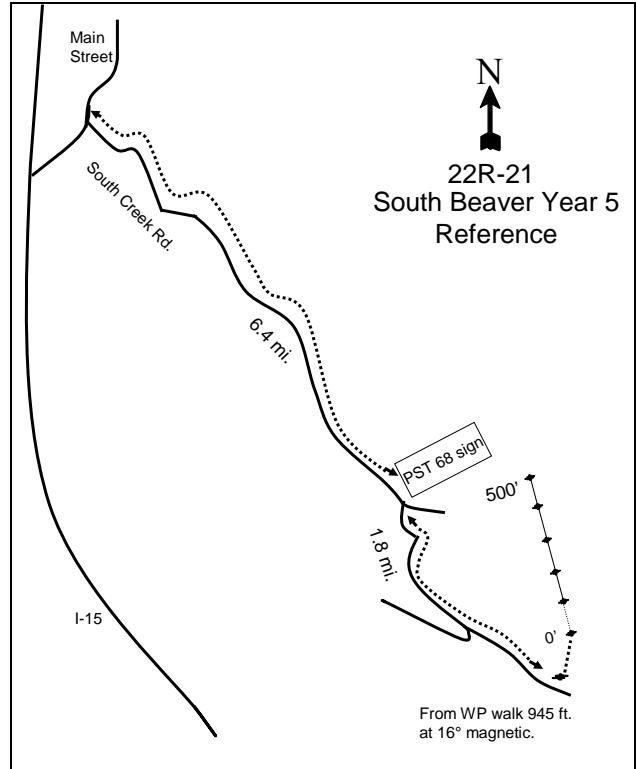
From Main St. in Beaver, head south and turn onto South Creek Road. Stay on the main road for 6.4 miles to the PST 68 sign. From the sign go 1.8 miles to a witness post on the left side of the road. From the witness post, from the witness post continue at 16°M for 945 feet to the 0-foot stake.

Map Name: Kane Canyon



Township: 30S Range: 6W Section: 21

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 365233 E 4227768 N

SOUTH BEAVER YEAR 5 REFERENCE - WRI STUDY 22R-21

[Project # 1711](#)

**Site Description**

Site Information: The study is located approximately eight miles southeast of Beaver on a ridge north of South Creek in a Pinyon pine (*Pinus Edulis*) and Utah Juniper (*Juniperus osteosperma*) woodland. The site was established as a reference site for study South Beaver Year 5 (22R-20). Pinyon pine and Utah juniper have expanded into the area, which was historically dominated by a sagebrush semi-desert ecosystem. The area is used heavily by deer and elk, and also once served as sage-grouse habitat (WRI Database 2011). Pellet group data estimated light use by deer in 2010 (Table - Pellet Group Data).

Browse: Preferred browse species are rare on the site. The key browse species is a small population of lightly used Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). The sagebrush population is in poor health with high amounts of decadence and poor vigor within the population. The recruitment of young sagebrush to the population was good. Other preferred browse species sampled on the site include Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) and curleaf mountain mahogany (*Cercocarpus ledifolius*). Pinyon pine and Utah juniper dominates the site and limits the growth of the herbaceous understory and preferred browse species on the site (Table - Browse Characteristics).

Herbaceous Understory: Grasses are extremely rare on the site. Bottlebrush squirreltail (*Sitanion hystrix*) and Sandberg bluegrass (*Poa secunda*) were the only perennial grasses sampled on the site in 2010. Cheatgrass (*Bromus tectorum*) was sampled on the site in very low abundance. Forbs are rare on the site. The annual species Douglas knotweed (*Polygonum douglasii*) and slender phlox (*Microsteris gracilis*) are the most common forb species on the site (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a very cobbly loam. Bare ground cover is low with a high amount of litter, vegetation, rock, and pavement providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

HERBACEOUS TRENDS--

Management unit 22R, Study no: 21

Type	Species	Nested	Average
		Frequency	Cover %
		'10	'10
G	Bromus tectorum (a)	15	.02
G	Poa secunda	-	.00
G	Sitanion hystrix	54	.28
Total for Annual Grasses		15	0.02
Total for Perennial Grasses		54	0.28
Total for Grasses		69	0.31
F	Arabis sp.	2	.03
F	Astragalus convallarius	-	.15
F	Astragalus utahensis	12	.02
F	Chaenactis douglasii	3	.00
F	Gayophytum ramosissimum(a)	5	.01
F	Lactuca serriola (a)	1	.00
F	Lesquerella sp.	9	.02
F	Microsteris gracilis (a)	78	.21

Type	Species	Nested Frequency	Average Cover %
		'10	'10
F	Phlox longifolia	1	.01
F	Polygonum douglasii (a)	106	.28
F	Ranunculus testiculatus (a)	1	.00
Total for Annual Forbs		191	0.51
Total for Perennial Forbs		27	0.24
Total for Forbs		218	0.76

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 22R, Study no: 21

Type	Species	Strip Frequency	Average Cover %
		'10	'10
B	Artemisia tridentata wyomingensis	8	.15
B	Juniperus osteosperma	14	15.80
B	Pinus edulis	27	21.22
B	Yucca sp.	1	.01
Total for Browse		50	37.18

#### CANOPY COVER, LINE INTERCEPT--

Management unit 22R, Study no: 21

Species	Percent Cover '10
Artemisia tridentata wyomingensis	.03
Juniperus osteosperma	25.41
Pinus edulis	35.71

#### POINT-QUARTER TREE DATA--

Management unit 22R, Study no: 21

Species	Trees per Acre	Average diameter (in)
	'10	'10
Juniperus osteosperma	640	1.7
Pinus edulis	219	6.7

BASIC COVER--

Management unit 22R, Study no: 21

Cover Type	Average Cover % '10
Vegetation	38.29
Rock	12.33
Pavement	15.05
Litter	64.55
Cryptogams	1.24
Bare Ground	5.09

PELLET GROUP DATA--

Management unit 22R, Study no: 21

Type	Quadrat Frequency '10	Days use per acre (ha) '10
Rabbit	7	-
Deer	1	1 (3)

BROWSE CHARACTERISTICS--

Management unit 22R, Study no: 21

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor	
<i>Artemisia tridentata wyomingensis</i>									
10	<b>180</b>	11	11	78	-	0	0	89	18/21
<i>Cercocarpus ledifolius</i>									
10	<b>0</b>	0	0	-	-	0	0	0	14/19
<i>Cowania mexicana stansburiana</i>									
10	<b>0</b>	0	0	-	-	0	0	0	25/48
<i>Juniperus osteosperma</i>									
10	<b>280</b>	43	57	-	20	0	0	0	-/-
<i>Opuntia sp.</i>									
10	<b>0</b>	0	0	-	-	0	0	0	3/13
<i>Pinus edulis</i>									
10	<b>800</b>	75	25	-	820	0	0	0	-/-
<i>Yucca sp.</i>									
10	<b>40</b>	0	100	-	-	0	0	0	12/14

SOUTH BEAVER DIXIE - TREND STUDY NO. 22R-22-10  
[Project #104](#)

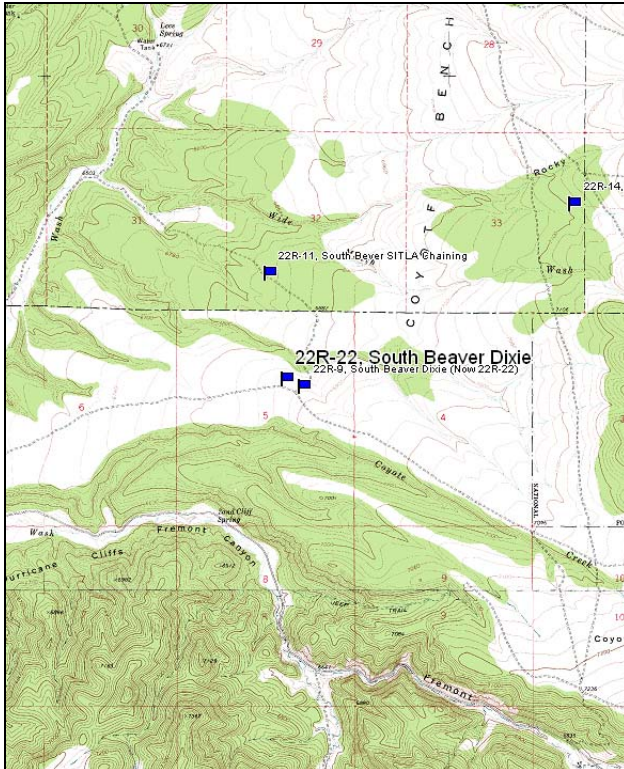
Vegetation Type: Wyoming Big Sagebrush, Pinyon/Juniper  
Range Type: Crucial Deer Winter, Substantial Elk Winter  
NRCS Ecological Site Description: [Upland Shallow Hardpan \(Pinyon-Utah Juniper\), R028AY320UT](#)  
Land Ownership: BLM  
Elevation: 6,792 ft. (2,070 m)  
Aspect: North  
Slope: 2%  
Transect bearing: 330° magnetic  
Belt placement: line 1 (11ft & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:

Take exit 100 from I-15. From the northbound on-ramp drive east 0.6 miles to a fork. Turn left and drive through a gate, continue 3.5 miles to a just before a fence. You will see a witness post on the north side of the road. From the witness post walk 14 paces at 300° M to the 0-foot stake.

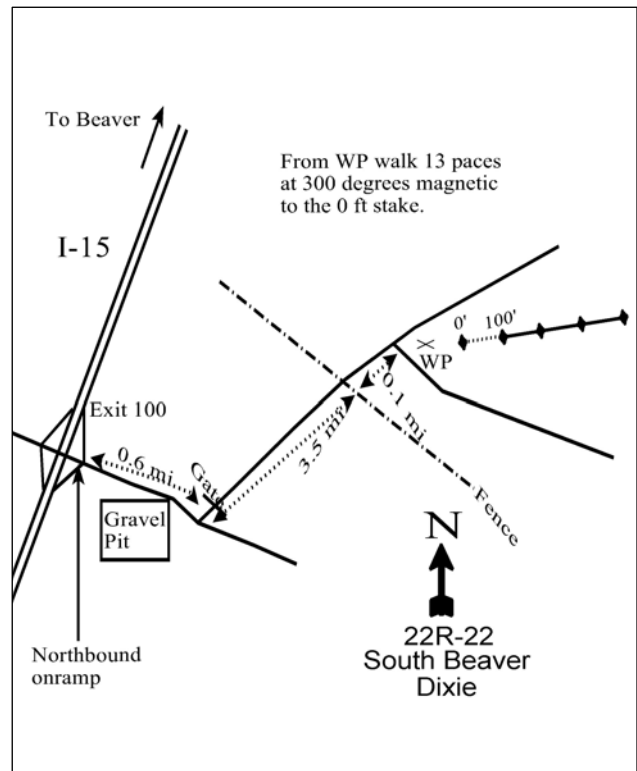
This study replaces 22R-9, which was out of the treated area.

Map Name: Kane Canyon



Township: 31S Range: 6W Section: 5

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 363328 E 4222667 N



SOUTH BEAVER DIXIE - WRI STUDY 22R-22

[Project #104](#)

**Site Description**

Site Information: The study is located approximately ten miles southeast of Beaver on the east side of I-15 on Coyote Bench. The study was established in 2010 to monitor a one-way Dixie harrow project of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) with scattered young pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) mixed throughout the site. A seed mix of grass, forb, and browse species was broadcast seeded ahead of the harrow. The area was historically a chaining project that removed the majority of the pinyon pine and Utah juniper but over time juniper and pinyon trees began to reestablish within the area. A Dixie harrow project removed most of the encroaching pinyon and juniper trees and reduced the cover of Wyoming big sagebrush in the winters of 2005-06 prior to the establishment of the study. Study 22R-9 was established prior to treatment, but was not within the treatment polygon. The objectives of the project were to enhance the sagebrush steppe ecosystem, greater sage grouse habitat; riparian systems and water quality, and big game habitat on public lands (WRI Database 2011). Pellet group data estimated light use by deer and cattle and moderate use by elk in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 22R, Study no: 22

Project Name: South Beaver Vegetation Enhancement Year 5			
WRI Database #: 104			
Application: Broadcast Seeder		Acres:	1900
Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Douglas'	1108	0.58
G	Siberian Wheatgrass 'Vavilov'	400	0.21
G	Siberian Wheatgrass 'Vavilov'	1500	0.79
G	Bluebunch WG 'Goldar'	1900	1.00
G	Pubescent Wheatgrass	3800	2.00
G	Snake River Wheatgrass 'Secar'	1900	1.00
G	Indian Ricegrass 'Rimrock'	950	0.50
G	Sandberg Bluegrass 'Toole MT'	500	0.26
G	Orchardgrass 'Paiute'	950	0.50
F	Blue Flax	300	0.16
F	Yellow Sweetclover	950	0.50
F	Alfalfa 'Spredor 4'	1900	1.00
F	Small Burnet 'Delar'	2000	1.05
F	Palmer Penstemon	200	0.11
B	Bitterbrush	200	0.11
Total Pounds:		18558	9.77
PLS Pounds:			8.67

Browse: The preferred browse species is Wyoming big sagebrush. The sagebrush is a relatively healthy population with decadence and poor vigor being fairly low within the population. The utilization of sagebrush was mostly light and the recruitment of young sagebrush plants to the population was good. Other preferred browse species sampled on the site include antelope bitterbrush (*Purshia tridentata*) and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) (Table - Browse Characteristics). Pinyon pine and Utah juniper trees were fairly young and scattered over the site in low densities (Table - Point-Quarter Tree Data).

Herbaceous Understory: Grasses are abundant and diverse. Crested wheatgrass (*Agropyron cristatum*) is the dominant grass species on the site and provided the majority of the grass cover. Cheatgrass (*Bromus tectorum*)

is present on the site in relatively moderate abundance. Other less common perennial grass species sampled on the site include bluebunch wheatgrass (*Agropyron spicatum*), Sandberg bluegrass (*Poa secunda*), and bottlebrush squirreltail (*Sitanion hystrix*). Forbs are not overly abundant but are fairly diverse. The dominant perennial forb is desert phlox (*Phlox austromontana*) and the dominant annual species are pale alyssum (*Alyssum alyssoides*) and bur buttercup (*Ranunculus testiculatus*) (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a cobbly loam. Bare ground cover is moderate with a high amount of litter, rock, and pavement and moderate amount of vegetation providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

HERBACEOUS TRENDS--

Management unit 22R, Study no: 22

Type	Species	Nested	Average
		Frequency	Cover %
		'10	'10
G	<i>Agropyron cristatum</i>	225	11.54
G	<i>Agropyron dasystachyum</i>	5	.18
G	<i>Agropyron intermedium</i>	9	.10
G	<i>Agropyron spicatum</i>	26	.92
G	<i>Bromus tectorum</i> (a)	182	1.64
G	<i>Oryzopsis hymenoides</i>	2	.30
G	<i>Poa secunda</i>	15	.07
G	<i>Sitanion hystrix</i>	53	.86
G	<i>Stipa comata</i>	1	.03
Total for Annual Grasses		182	1.64
Total for Perennial Grasses		336	14.01
Total for Grasses		518	15.65
F	<i>Alyssum alyssoides</i> (a)	106	2.16
F	<i>Androsace septentrionalis</i> (a)	1	.15
F	<i>Astragalus</i> sp.	2	.01
F	<i>Calochortus nuttallii</i>	9	.04
F	<i>Castilleja linariaefolia</i>	1	.03
F	<i>Chaenactis douglasii</i>	123	.80
F	<i>Cirsium</i> sp.	1	.03
F	<i>Collinsia parviflora</i> (a)	3	.15
F	<i>Comandra pallida</i>	3	.03
F	<i>Cryptantha</i> sp.	2	.00
F	<i>Erigeron pumilus</i>	26	.40
F	<i>Eriogonum cernuum</i> (a)	4	.00
F	<i>Gayophytum ramosissimum</i> (a)	13	.07
F	<i>Geranium</i> sp.	5	.03
F	<i>Gilia</i> sp. (a)	7	.04
F	<i>Hedysarum boreale</i>	5	.01
F	<i>Linum lewisii</i>	11	.25
F	<i>Lygodesmia</i> sp.	1	.00
F	<i>Medicago sativa</i>	1	.03
F	<i>Microsteris gracilis</i> (a)	52	.16
F	<i>Phlox austromontana</i>	58	1.50
F	<i>Ranunculus testiculatus</i> (a)	162	1.89

Type	Species	Nested Frequency '10	Average Cover % '10
	Total for Annual Forbs	348	4.65
	Total for Perennial Forbs	248	3.19
	Total for Forbs	596	7.85

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 22R, Study no: 22

Type	Species	Strip Frequency '10	Average Cover % '10
B	Artemisia tridentata vaseyana	1	-
B	Artemisia tridentata wyomingensis	70	8.44
B	Gutierrezia sarothrae	24	.30
B	Opuntia sp.	1	.00
B	Pinus edulis	3	.18
B	Purshia tridentata	1	.18
	Total for Browse	100	9.11

#### CANOPY COVER, LINE INTERCEPT--

Management unit 22R, Study no: 22

Species	Percent Cover '10
Artemisia tridentata wyomingensis	8.06
Gutierrezia sarothrae	.48
Pinus edulis	.48

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 22R, Study no: 22

Species	Average leader growth (in) '10
Artemisia tridentata wyomingensis	1.4

#### POINT-QUARTER TREE DATA--

Management unit 22R, Study no: 22

Species	Trees per Acre '10	Average diameter (in) '10
Juniperus osteosperma	21	2.9
Pinus edulis	96	0.9

BASIC COVER--

Management unit 22R, Study no: 22

Cover Type	Average Cover % '10
Vegetation	32.77
Rock	11.35
Pavement	5.83
Litter	40.65
Cryptogams	.38
Bare Ground	24.51

PELLET GROUP DATA--

Management unit 22R, Study no: 22

Type	Quadrat Frequency '10	Days use per acre (ha) '10
Rabbit	32	-
Elk	5	10 (25)
Deer	8	6 (15)
Cattle	1	7 (16)

BROWSE CHARACTERISTICS--

Management unit 22R, Study no: 22

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization			Average Height Crown (in)	
		% Young	% Mature	% Decadent		% moderate	% heavy	% poor vigor		
<i>Artemisia tridentata vaseyana</i>										
10	<b>40</b>	0	100	-	-	0	0	0	-/-	
<i>Artemisia tridentata wyomingensis</i>										
10	<b>2300</b>	9	82	10	40	17	2	10	18/22	
<i>Gutierrezia sarothrae</i>										
10	<b>800</b>	15	85	-	-	0	0	0	8/9	
<i>Opuntia sp.</i>										
10	<b>20</b>	0	100	-	-	0	0	0	4/9	
<i>Pinus edulis</i>										
10	<b>60</b>	67	0	33	-	0	33	33	-/-	
<i>Purshia tridentata</i>										
10	<b>20</b>	100	0	-	-	0	0	0	23/51	

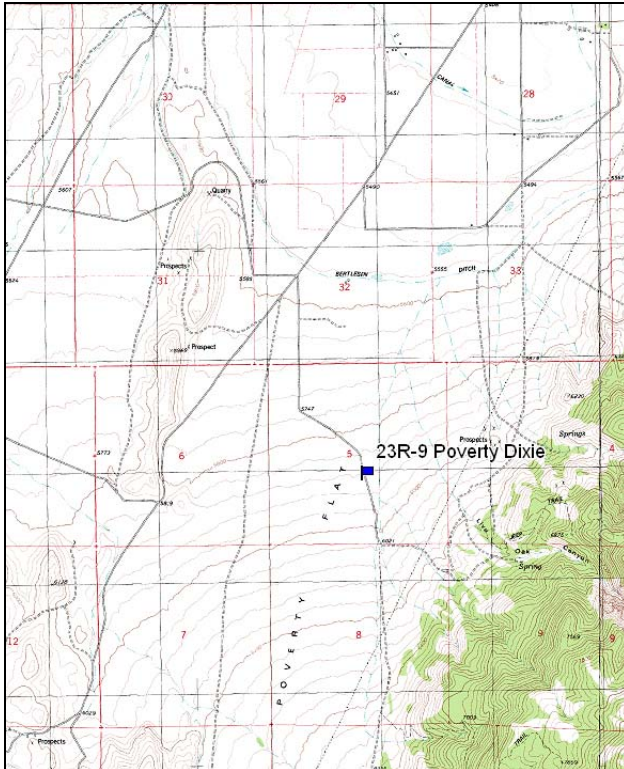
POVERTY DIXIE - TREND STUDY NO. 23R-9-10  
[Project #139](#)

Vegetation Type: Perennial Grass  
Range Type: Crucial Deer Winter  
NRCS Ecological Site Description: Not available  
Land Ownership: BLM  
Elevation: 5,816 ft. (1,773 m)  
Aspect: North  
Slope: 5%  
Transect bearing: 245° magnetic  
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

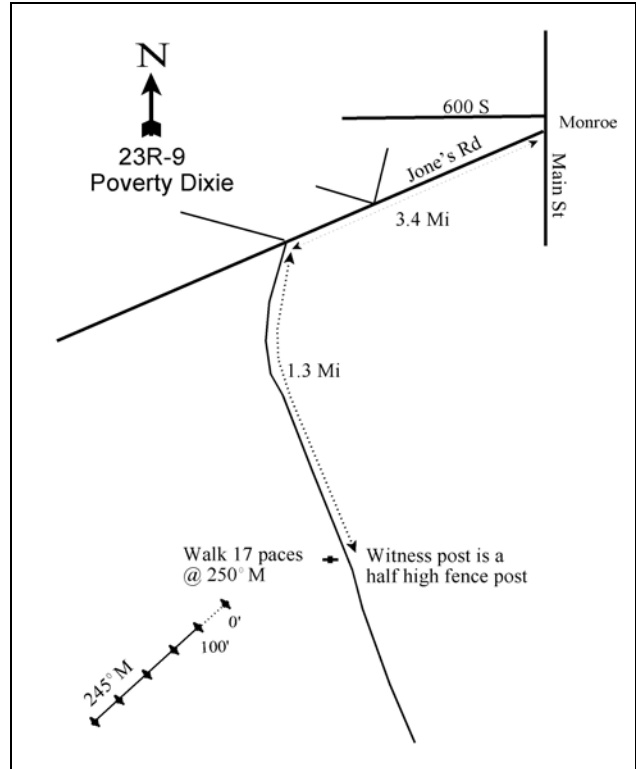
From 600 South and Main in Monroe, turn southwest on Jones Road, a gravel road coming in at a 45 degree angle. Proceed 3.4 miles to a junction, stay left. Proceed on this road 1.3 miles to the half-high witness post on the right (west). From the half-high witness post, walk 17 paces at 250°M to the 0' stake. The 0' stake is marked with browse tag #76.

Map Name: Antelope Range



Township: 26S Range: 3W Section: 5

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 399782 E 4269106 N

PROVERTY DIXIE - WRI STUDY 23R-9

[Project #139](#)

**Site Description**

Site Information: The study is located approximately five miles southwest of Monroe on a crested wheatgrass (*Agropyron cristatum*) and forage kochia (*Kochia prostrata*) flat. A wildfire occurred in this area during July of 1997 and devastated the Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) component. The area was drill seeded with a mixture of grasses and forbs. Wyoming sagebrush and forage kochia were also aerially applied. However, this original seeding process failed due to lack of spring moisture and extreme competition with existing cheatgrass (*Bromus tectorum*). The study was established to monitor one-way Dixie harrow and broadcast seeding of grass, forb, and browse species. The area was treated in the fall of 2005. The objectives of the project were to enhance the vegetation and provide forage for wintering big game animals (WRI Database 2011). The pellet group data estimated light use by elk, deer, and cattle in 2005. In 2010 use was estimated light for deer and heavy for cattle (Table - Pellet Group Data).

SEED MIX--

Management unit 23R, Study no: 9

Project Name: Poverty Flat			
WRI Database #: 139			
Application: Broadcast seeder		Acres: 2000	
Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Hycrest'	2000	1.00
G	Great Basin Wildrye 'Trailhead'	1981	0.99
G	Pubescent Wheatgrass	4000	2.00
G	Russian Wildrye	2000	1.00
G	Sandberg Bluegrass 'SID OR'	1500	0.75
F	Alfalfa 'Ladak+'	300	0.15
F	Alfalfa 'Nomad'	350	0.18
F	Alfalfa 'Spredor 4'	350	0.18
F	Annual Sunflower	1294	0.65
F	Blue Flax	1650	0.83
F	Sainfoin 'Eski'	5000	2.50
F	Small Burnet 'Delar'	4000	2.00
F	Yellow Sweetclover	500	0.25
B	Fourwing Saltbush	1250	0.63
Total Pounds:		26175	13.09
PLS Pounds:			11.25

Browse: Historically the key browse species was Wyoming big sagebrush but since the fire in 1997 the browse component has been marginal. Forage kochia is the preferred browse species on the site. The forage kochia is a lightly used population with low decadence and good vigor within the population. The recruitment of young forage kochia plants to the population has been good over the sample years. Other less common browse species samples on the site include fourwing saltbush (*Atriplex canescens*) Wyoming big sagebrush, and pricklypear cactus (*Opuntia sp.*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant but not particularly diverse. Cheatgrass and crested wheatgrass are the dominant species on the site. Cheatgrass significantly decreased in frequency following the treatment but still remained very abundant on the site, although crested wheatgrass increased in abundance following the treatment. Other perennial grass species sampled on the site include intermediate wheatgrass (*Agropyron intermedium*), blue grama (*Bouteloua gracilis*), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass

(*Poa secunda*), and bottlebrush squirreltail (*Sitanion hystrix*). Seeded species sampled after the treatment include intermediate wheatgrass, crested wheatgrass, and Sandberg bluegrass. Forbs are very rare on the site. Prior to the treatment annual forbs were abundant with Russian thistle (*Salsola iberica*) and tumbled mustard (*Sisymbrium altissimum*) dominating the forb component, but decreased substantially after the treatment and became rare on the site (Table - Herbaceous Trends).

Soil: The soil texture is a sandy loam with a neutral soil reaction (pH 6.8) (Table - Soil Analysis Data). Bare ground cover is moderate with moderate amount of litter and vegetation, and a high amount of pavement and rock providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

**Pre vs. Five Years Post Treatment Assessment, 2005 vs. 2010**

Browse: The density of forage kochia decreased 22% from 4,000 plants/acre to 3,140 plants/acre but cover increased from 1% to 9%. Cover increased with the establishment of mature plants within the population. The composition of the population changed from mostly young to mature plants within the population. The recruitment of young plants to the population decreased from 81% to 14%. The density of fourwing saltbush increased from 20 plants/ acre to 60 plants/acre and cover increased from 1% to 2%.

Grasses: The sum of nested frequency of perennial grasses decreased 20% and cover increased from 7% to 11%. Crested wheatgrass increased in cover from 5% to 10%. Cheatgrass significantly decreased in nested frequency and cover decreased slightly from 15% to 14%, but still remained the predominant grass species on the site.

Forbs: The sum of nested frequency of perennial forbs substantially decreased 91% and cover decreased from 1% to almost 0%. Perennial forbs are extremely rare on the site. The sum of nested frequency of annual forbs significantly decreased 87% and cover decreased from 8% to 1%. The weedy annual species tumbled mustard decreased significantly in nested frequency and cover decreased from 7% to 0% and became rare on the site. Russian thistle also became rare on the site with a substantial decrease in nested frequency and cover decreased from 2% to less than 1%.

HERBACEOUS TRENDS--  
Management unit 23R, Study no: 9

Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
G	Agropyron cristatum	135	157	4.82	10.42
G	Agropyron intermedium	16	4	.71	.15
G	Bouteloua gracilis	3	-	.03	-
G	Bromus tectorum (a)	413	363	15.41	14.26
G	Oryzopsis hymenoides	-	-	.00	-
G	Poa secunda	-	3	-	.00
G	Sitanion hystrix	82	24	1.24	.68
Total for Annual Grasses		413	363	15.41	14.26
Total for Perennial Grasses		236	188	6.82	11.25
Total for Grasses		649	551	22.24	25.52
F	Amaranthus blitoides	34	-	.22	-
F	Collinsia parviflora (a)	21	-	.05	-
F	Cryptantha sp.	3	-	.00	-
F	Descurainia pinnata (a)	39	5	.08	.09

Type	Species	Nested Frequency		Average Cover %	
		'05	'10	'05	'10
F	Draba sp. (a)	9	-	.02	-
F	Euphorbia sp.	16	5	.03	.06
F	Lactuca serriola (a)	-	2	-	.03
F	Medicago sativa	3	-	.38	-
F	Ranunculus testiculatus (a)	22	-	.09	-
F	Salsola iberica (a)	279	34	1.53	.45
F	Sisymbrium altissimum (a)	205	-	6.58	.00
F	Unknown forb-annual (a)	-	32	-	.12
Total for Annual Forbs		575	73	8.36	0.70
Total for Perennial Forbs		56	5	0.64	0.06
Total for Forbs		631	78	9.01	0.76

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 23R, Study no: 9

Type	Species	Strip Frequency		Average Cover %	
		'05	'10	'05	'10
B	Atriplex canescens	1	3	.56	2.24
B	Atriplex confertifolia	-	-	-	.38
B	Kochia prostrata	24	27	.61	4.63
B	Opuntia sp.	1	3	-	-
Total for Browse		26	33	1.17	7.25

#### CANOPY COVER, LINE INTERCEPT--

Management unit 23R, Study no: 9

Species	Percent Cover	
	'05	'10
Atriplex canescens	.91	2.88
Kochia prostrata	1.14	8.76
Opuntia sp.	-	.21

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 23R, Study no: 9

Species	Average leader growth (in)	
	'05	'10
Atriplex canescens	.91	5.0
Kochia prostrate	1.14	5.7



BASIC COVER--

Management unit 23R, Study no: 9

Cover Type	Average Cover %	
	'05	'10
Vegetation	30.21	33.59
Rock	9.46	10.26
Pavement	13.16	20.97
Litter	33.25	23.51
Cryptogams	0	.15
Bare Ground	22.98	24.82

SOIL ANALYSIS DATA --

Management unit 23R, Study no: 9, Study Name: Poverty Dixie

Effective rooting depth (in)	pH	sandy loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
6.6	6.8	60.4	24.7	14.9	2.4	16.1	204.8	0.5

PELLET GROUP DATA--

Management unit 23R, Study no: 9

Type	Quadrat Frequency		Days use per acre (ha)	
	'05	'10	'05	'10
Rabbit	14	2	-	-
Elk	2	-	3 (7)	-
Deer	-	-	2 (5)	1 (2)
Cattle	4	7	16 (40)	29 (72)

BROWSE CHARACTERISTICS--

Management unit 23R, Study no: 9

		Age class distribution					Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)	
<b>Artemisia tridentata wyomingensis</b>										
05	<b>0</b>	0	0	-	-	0	0	0	11/15	
10	<b>0</b>	0	0	-	-	0	0	0	17/23	
<b>Atriplex canescens</b>										
05	<b>20</b>	0	100	-	-	0	0	0	35/48	
10	<b>60</b>	0	100	-	20	0	0	0	39/67	
<b>Kochia prostrata</b>										
05	<b>4000</b>	81	17	3	11320	0	0	0	18/20	
10	<b>3140</b>	14	86	0	6720	0	0	0	22/34	
<b>Opuntia sp.</b>										
05	<b>20</b>	0	100	-	20	0	0	100	7/24	
10	<b>80</b>	0	100	-	-	0	0	0	7/28	

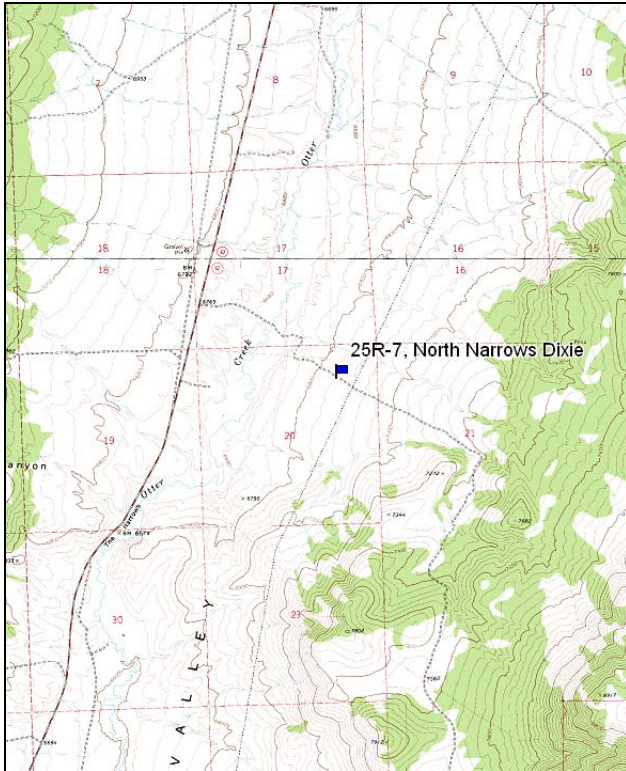
NORTH NARROWS - TREND STUDY NO. 25R-7-10  
[Project #1155](#)

Vegetation Type: Wyoming Big Sagebrush  
Range Type: Crucial Deer Winter, Substantial Elk Winter  
NRCS Ecological Site Description: Not available  
Land Ownership: BLM  
Elevation: 6,775 ft. (2,065 m)  
Aspect: West  
Slope: 8%  
Transect bearing: 177° magnetic  
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

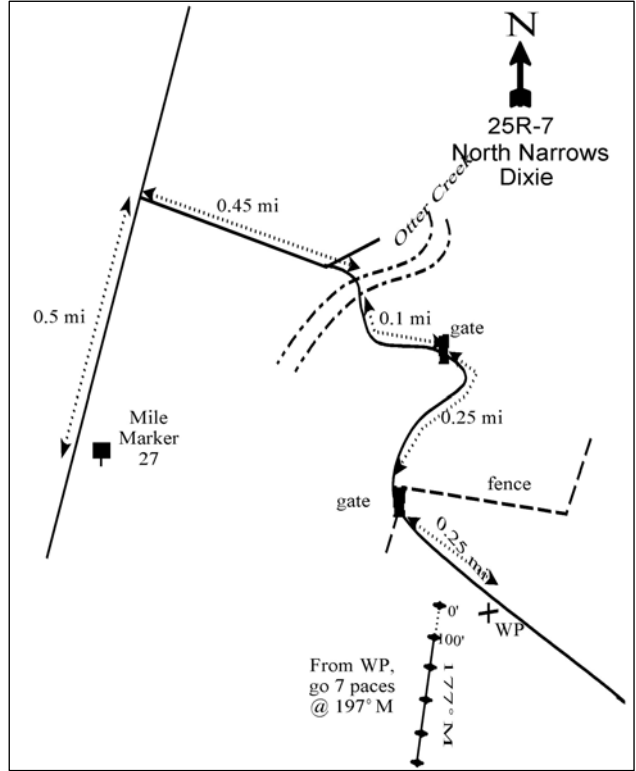
Proceed south of Koosharem on SR62. Turn left (east) 0.5 miles before mile marker 27. Drive 0.45 miles to Otter Creek and continue 0.1 miles to a gate. Drive 0.25 miles to another gate, and go 0.25 miles to the witness post on the right, the 0' stake is 7 paces from the witness post at 197°M. The 0' stake is marked with browse tag# 110.

Map Name: Parker Knoll



Township: 28S Range: 1W Section: 20

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 419225 E 4246756 N

NORTH NARROWS DIXIE - WRI STUDY 25R-7  
[Project #1155](#)

**Site Description**

Site Information: The study is located four and a half miles south of Greenwich on the east side of Grass Valley within a treated Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) flat. The study was established in 2008 prior to a two-way Dixie harrow project of 1,368 acres. The study site was treated in the fall of 2008. A seed mix of forb and grass species were broadcast seeded during the second pass of the harrow. Forage kochia (*Kochia prostrata*) was broadcast seeded after the harrow work was completed. The objectives of the project were to increase the density, cover, and diversity of the herbaceous understory and decrease the cover of sagebrush. Pellet group data estimated heavy deer use in 2008 prior to the treatment and light deer use in 2009 and 2010 following the treatment (WRI Database 2011). Estimated cattle use was light in all of the sample years (Table - Pellet Group Data). In 2008, a deer shed and carcass were found on the site, as well as dead rabbit remains. Coyote scat, elk pellets, sage grouse pellets, and horse droppings were also on the site in 2008, but did not fall in the sample area.

SEED MIX--

Management unit 25R, Study no: 7

Project Name: North Narrows East					
WRI Database #: 1155					
Application: Broadcast seeder		Acres: 2050		Application: Broadcast Seeder	
Seed type		lbs in mix	lbs/acre	Acres: 2050	
G	Crested Wheatgrass 'Douglas'	250	0.12	B	Forage Kochia
G	Crested Wheatgrass 'Hycrest'	250	0.12	Total Pounds:	
G	Great Basin Wildrye 'Trailhead'	1500	0.73	1250 0.61	
G	Pubescent Wheatgrass 'Luna'	3061	1.49	PLS Pounds:	
G	Russian Wildrye 'Bozoisky'	2450	1.20	0.41	
G	Sheep Fescue	500	0.24		
G	Snake River Wheatgrass 'Secar'	1025	0.50		
F	Alfalfa 'Ladak'	500	0.24		
F	Alfalfa 'Ranger'	500	0.24		
F	Annual Sunflower	941	0.46		
F	Blue Flax 'Appar'	510	0.25		
F	Cicer Milkvetch 'Lutana'	800	0.39		
F	Small Burnet 'Delar'	6145	3.00		
F	Yellow Sweetclover	2050	1.00		
B	Fourwing Saltbush	500	0.24		
Total Pounds:		20982	10.24		
PLS Pounds:			8.99		

Browse: The preferred browse species is Wyoming big sagebrush. Prior to the treatment, Wyoming big sagebrush was fairly dense population with a high amount of decadence within the population, and the recruitment of young plants to the population was poor. After the treatment, the health of the sagebrush population improved with low amounts of decadence and poor vigor within the population. The recruitment of young sagebrush plants has been good following the treatment. Utilization of sagebrush was moderate prior to the treatment but after the treatment use has been fairly light. Forage kochia has established since being seeded during the treatment. Other browse species sampled on the site include rubber rabbitbrush (*Chrysothamnus nauseosus*), low rabbitbrush (*C. viscidiflorus*), and broom snakeweed (*Gutierrezia sarothrae*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are fairly diverse and abundant. The dominant grass species on the site is Indian ricegrass (*Oryzopsis hymenoides*) with other common grass species which include crested wheatgrass (*Agropyron cristatum*), blue grama (*Bouteloua gracilis*), bottlebrush squirreltail (*Sitanion hystrix*), and needle-and-thread (*Stipa comata*). Following the treatment there were four seeded grass species sampled which include crested wheatgrass (*Agropyron cristatum*), pubescent wheatgrass (*Agropyron intermedium*), Russian wildrye (*Elymus junceus*), and Great Basin wildrye (*Elymus cinereus*). Forbs were somewhat diverse and moderately abundant. Annual forb species dominate the forb composition. The dominant forb on the site is Russian thistle (*Salsola iberica*). Seeded species sampled after the treatment include common sunflower (*Helianthus annuus*), Lewis flax (*Linum lewisii*), alfalfa (*Medicago sativa*), yellow sweetclover (*Melilotus officinalis*), and small burnet (*Sanguisorba minor*) (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a neutral soil reaction (pH 7.1) (Table - Soil Analysis Data). Bare ground cover is high with moderate amount of litter and vegetation, and a high amount of pavement and rock providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as slight in 2008 due to soil litter movement, flow patterns, and surface rock and soil movement. Soil condition improved to stable in 2009. The soil erosion condition was classified as slight in 2010 due to soil litter, rock, and soil movement, flow patterns, and rills.

### **Pre vs. One Year Post Treatment Assessment, 2008 vs. 2009**

Browse: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush cover was effectively reduced by the treatment. Canopy cover of sagebrush decreased from 23% to 5%. The average height of sagebrush decreased from 14 inches to 9 inches and the crown from 22 inches to 13 inches following the treatment. The seeded species, forage kochia, was sampled for the first time with small stature and low cover.

Grass: The sum of nested frequency of perennial grasses significantly decreased 21% and cover decreased from 9% to 5%. However, diversity of grass species increased due to the establishment of seeded species. Cheatgrass (*Bromus tectorum*) was sampled in very low frequency and cover was minute after the treatment. Indian ricegrass cover slightly decreased from 3% to 2%. Blue grama and bottlebrush squirreltail significantly decreased in nested frequency and cover decreased from 2% to 1%. Four seeded species were sampled include crested wheatgrass, pubescent wheatgrass, Great Basin wildrye, and Russian wildrye, though occurring in low frequency and cover.

Forb: The sum of nested frequency of perennial forbs increased more than two-fold after the treatment but cover remained similar at 1%. Perennial forbs remained rare on the site, though diversity of forbs was higher after the treatment. Five seeded species were sampled include common sunflower, Lewis flax, alfalfa, yellow sweetclover, and small burnet, though occurring in low frequency and cover.

### **Trend Assessments**

#### Browse

- **2009 to 2010 - up (+2)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Wyoming big sagebrush canopy cover increased from 5% to 9% and forage kochia canopy cover increased from 1% to 4%.

#### Grass

- **2009 to 2010 - up (+2)**: The sum of nested frequency of perennial grasses significantly increased 35% and cover increased from 5% to 14%. Indian ricegrass remained the dominant grass species and significantly increased in nested frequency and cover increased from 2% to 6%. Crested wheatgrass, blue grama, and bottlebrush squirreltail increased in cover from 1% to 2%.

Forb

- **2009 to 2010 - slightly down (-1):** The sum of nested frequency of perennial forbs significantly decreased 39%, though cover increased from 1% to 2%. The sum of nested frequency of annual forbs substantially increased and cover increased from 2% to 9%. Slimleaf goosefoot (*Chenopodium leptophyllum*) was sampled for the first time in 2010 at 2% cover. Russian thistle increased significantly in nested frequency and cover increased from 1% to 4%.

HERBACEOUS TRENDS--  
Management unit 25R, Study no: 7

Type	Species	Nested Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
G	Agropyron cristatum	a-	b58	b45	-	.70	2.21
G	Agropyron intermedium	a-	a3	b32	-	.00	.87
G	Bouteloua gracilis	b79	a33	b63	2.25	.88	1.80
G	Bromus tectorum (a)	-	3	2	-	.03	.04
G	Elymus cinereus	a-	b31	a-	-	.41	-
G	Elymus junceus	-	6	-	-	.09	.16
G	Oryzopsis hymenoides	a89	a72	b118	3.28	1.90	5.52
G	Sitanion hystrix	b126	a40	a72	1.86	.77	1.86
G	Sporobolus cryptandrus	-	4	10	-	.03	.04
G	Stipa comata	53	29	32	1.12	.50	1.16
Total for Annual Grasses		0	3	2	0	0.03	0.04
Total for Perennial Grasses		347	276	372	8.53	5.30	13.64
Total for Grasses		347	279	374	8.53	5.34	13.69
F	Astragalus cibarius	a-	ab3	b10	-	.06	.10
F	Astragalus sp.	-	1	-	-	.00	-
F	Chenopodium album (a)	a-	b15	a-	-	.42	-
F	Chenopodium leptophyllum(a)	a-	a-	b60	-	-	2.36
F	Cleome serrulata (a)	a-	a-	b10	-	-	.25
F	Cymopterus sp.	2	-	-	.00	-	-
F	Descurainia pinnata (a)	a-	a-	b24	-	-	.24
F	Erigeron pumilus	-	2	6	-	.03	.04
F	Erigeron sp.	6	4	-	.02	.09	-
F	Eriogonum ovalifolium	ab4	a-	b12	.18	-	.60
F	Eriogonum sp.	-	1	-	-	.00	-
F	Eriogonum umbellatum	a-	a-	b12	-	-	.74
F	Gayophytum ramosissimum(a)	-	-	2	-	-	.33
F	Helianthus annuus (a)	a-	b14	b20	-	.58	.61
F	Lappula occidentalis (a)	a6	a5	b49	.02	.06	1.14
F	Linum lewisii	-	5	6	-	.06	.04
F	Medicago sativa	a-	c27	b10	-	.08	.07
F	Melilotus officinalis	a-	b24	a2	-	.16	.16
F	Phlox longifolia	32	30	16	.13	.14	.22
F	Salsola iberica (a)	a3	a15	b76	.00	.72	3.94
F	Sanguisorba minor	a-	b20	a-	-	.04	-
F	Sphaeralcea grossulariifolia	-	-	-	-	.03	.03
F	Trifolium sp.	2	4	-	.00	.01	-
F	Unknown forb-annual (a)	-	7	-	-	.06	-

Type	Species	Nested Frequency			Average Cover %		
		'08	'09	'10	'08	'09	'10
	Total for Annual Forbs	9	56	241	0.02	1.85	8.88
	Total for Perennial Forbs	46	121	74	0.34	0.72	2.00
	Total for Forbs	55	177	315	0.37	2.57	10.89

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 25R, Study no: 7

Type	Species				Average Cover %		
		'08	'09	'10	'08	'09	'10
B	Artemisia tridentata wyomingensis	97	0	61	24.97	4.95	8.42
B	Chrysothamnus nauseosus	0	0	1	-	-	-
B	Chrysothamnus viscidiflorus	9	0	9	.33	.33	.77
B	Gutierrezia sarothrae	15	0	0	.05	-	-
B	Kochia prostrata	0	0	38	-	.15	1.82
B	Opuntia sp.	15	0	4	.47	.00	.03
B	Pediocactus simpsonii	1	0	0	-	-	-
	Total for Browse	137	0	113	25.82	5.44	11.05

#### CANOPY COVER, LINE INTERCEPT--

Management unit 25R, Study no: 7

Species	Percent Cover		
	'08	'09	'10
Artemisia tridentata wyomingensis	22.70	5.26	8.81
Chrysothamnus viscidiflorus	.20	.25	.13
Gutierrezia sarothrae	.10	.01	.10
Kochia prostrata	-	.41	3.70
Opuntia sp.	.13	-	-

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 25R, Study no: 7

Species	Average leader growth (in)		
	'08	'09	'10
Artemisia tridentata wyomingensis	0.8	1.9	1.5
Kochia prostrata	-	4.7	2.7

BASIC COVER--

Management unit 25R, Study no: 7

Cover Type	Average Cover %		
	'08	'09	'10
Vegetation	32.04	14.96	32.73
Rock	12.76	15.08	18.68
Pavement	18.31	8.01	9.39
Litter	24.59	24.65	23.70
Cryptogams	.39	.26	.09
Bare Ground	23.36	38.77	30.76

SOIL ANALYSIS DATA --

Management unit 25R, Study no: 7, Study Name: North Narrows Dixie

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
	7.1	50.0	29.4	20.6	1.5	9.4	176.0	0.6

PELLET GROUP DATA--

Management unit 25R, Study no: 7

Type	Quadrat Frequency		
	'08	'09	'10
Rabbit	72	24	2
Grouse	1	-	-
Elk	3	2	-
Deer	20	12	1
Cattle	1	-	1

Days use per acre (ha)		
'08	'09	'10
-	-	-
-	-	-
2 (5)	-	-
59 (146)	11 (26)	4 (10)
4 (11)	1 (2)	1 (2)

BROWSE CHARACTERISTICS--  
Management unit 25R, Study no: 7

Year	Plants per Acre (excluding seedlings)	Age class distribution			Seedling (plants/acre)	Utilization		% poor vigor	Average Height Crown (in)
		% Young	% Mature	% Decadent		% moderate	% heavy		
<i>Artemisia tridentata wyomingensis</i>									
08	<b>7100</b>	6	48	46	540	30	18	20	14/22
09	No density data collected								9/13
10	<b>2880</b>	19	68	13	280	2	0	10	15/22
<i>Chrysothamnus nauseosus</i>									
08	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								7/9
10	<b>20</b>	0	100	-	-	0	0	0	13/13
<i>Chrysothamnus viscidiflorus</i>									
08	<b>340</b>	0	88	12	-	53	18	12	4/7
09	<b>0</b>	0	0	0	-	0	0	0	6/8
10	<b>260</b>	0	100	0	380	0	0	0	8/13
<i>Echinocactus sp.</i>									
08	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								1/2
10	<b>0</b>	0	0	-	-	0	0	0	-/-
<i>Gutierrezia sarothrae</i>									
08	<b>700</b>	0	74	26	80	29	34	20	5/6
09	No density data collected								6/7
10	<b>0</b>	0	0	0	-	0	0	0	9/11
<i>Kochia prostrata</i>									
08	<b>0</b>	0	0	-	-	0	0	0	-/-
09	No density data collected								7/9
10	<b>1340</b>	13	87	-	320	0	0	0	16/19
<i>Opuntia sp.</i>									
08	<b>320</b>	0	81	19	-	0	0	6	4/9
09	No density data collected								3/6
10	<b>80</b>	0	100	0	-	0	0	0	4/7
<i>Pediocactus simpsonii</i>									
08	<b>20</b>	0	100	-	-	0	0	0	1/2
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	-/-



SAWMILL POINT ASPEN - TREND STUDY NO. 25R-8-10

[Project #1691](#)

Vegetation Type: Aspen/Ponderosa Pine

Range Type: Substantial Deer Summer, Substantial Elk Summer

NRCS Ecological Site Description: Not available

Land Ownership: USFS

Elevation: 8,745 ft. (2,665 m)

Aspect: East

Slope: 3-21%

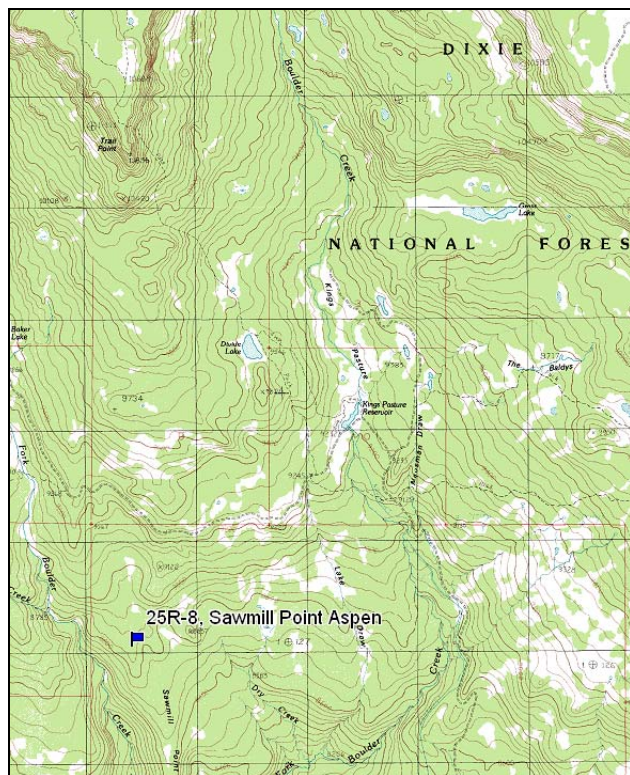
Transect bearing: 0'-200' 358° magnetic, 300'-500' 331° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

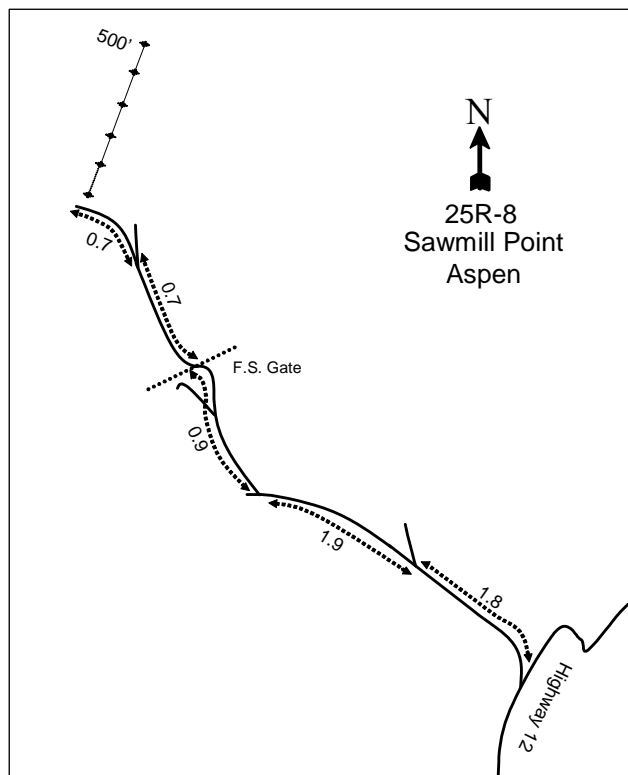
On the Boulder Highway go 0.1 miles north of mile marker 92 and turn left (west) towards the GarKane power plant. Go 1.8 miles to a fork towards Bear Creek; stay left on FS Road 166. Continue for 1.9 miles to a road on the right. Turn and go 0.9 miles, passing through a Forest Service gate shortly after turning right at a fork. Go 0.7 miles to a fork, go left. Drive another 0.7 miles to a witness post on the right. The witness post is the 0-foot stake.

Map Name: Deer Creek Lake



Township: 32S Range: 4E Section: 16

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 458359 E 4208268 N

SAWMILL POINT ASPEN - WRI STUDY 25R-8  
[Project #1691](#)

**Site Description**

Site Information: The study site is located in a mixed conifer and quaking aspen (*Populus tremuloides*) tree stand eight and a half miles north of Boulder on Sawmill point on the Dixie National Forest. The study was established to monitor a quaking aspen improvement project of 894 acres. Many of the aspen clones are succeeding to conifer trees and are at risk of being replaced by conifer throughout the landscape. The project consist of rejuvenating quaking aspen stands by removing conifer species and converting mature and over-mature, seral aspen stands to the regeneration stage. The objectives of the project were to improve both the distribution and balance of the age-classes (seedling/saplings, young to mature, and older than 80 years) and aspen composition within aspen clones using commercial and noncommercial tree cutting methods (WRI Database 2011). Pellet group data estimated light use by deer and moderate use by cattle in 2010 (Table - Pellet Group Data).

Browse: The site consists of a mix conifer and quaking aspen overstory with a browse understory of mountain snowberry (*Symphoricarpos oreophilus*) and antelope bitterbrush (*Purshia tridentata*). The preferred browse species on the site is mountain snowberry. The snowberry is a lightly used mature population with low decadence and good vigor within the population. The recruitment of young snowberry plants to the population was good. Utilization of snowberry was mostly light. The antelope bitterbrush population is a heavily used population which occurs in low abundance. The overstory tree component consists of quaking aspen, ponderosa pine (*Pinus ponderosa*), and Douglas-fir (*Pseudotsuga menziesii*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are abundant and fairly diverse. The dominant grass species is Kentucky bluegrass (*Poa pratensis*). Other common grass species sampled on the site include sedge (*Carex sp.*), bottlebrush squirreltail (*Sitanion hystrix*), needle-and-thread (*Stipa comata*), mutton grass (*Poa fendleriana*), and prairie Junegrass (*Koeleria cristata*). Forbs are an important source of forage for deer and elk on the summer range. Forbs are fairly diverse and abundant on the site. Rose pussytoes (*Antennaria rosea*) is the dominant forb species on the site. Other common forbs samples on the site include silvery lupine (*Lupinus argenteus*) western yarrow (*Achillea millefolium*), trailing fleabane (*Erigeron flagellaris*), cinquefoil (*Potentilla sp.*), and lobeleaf groundsel (*Senecio multilobatus*) (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a loam. Bare ground cover is low with a very high amount of litter and a moderate amount of vegetation and rock providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in 2010.

HERBACEOUS TRENDS--  
 Management unit 25R, Study no: 8

T y p e	Species	Nested Frequency	Average Cover %
		'10	'10
G	Carex sp.	55	1.25
G	Hilaria jamesii	15	.24
G	Koeleria cristata	16	.69
G	Poa fendleriana	29	.67
G	Poa pratensis	200	5.93
G	Poa secunda	2	.01
G	Sitanion hystrix	109	2.55
G	Stipa comata	23	.99
Total for Annual Grasses		0	0

Type	Species	Nested	Average
		Frequency	Cover %
		'10	'10
	Total for Perennial Grasses	449	12.36
	Total for Grasses	449	12.36
F	Achillea millefolium	64	1.19
F	Antennaria rosea	143	4.46
F	Chaenactis douglasii	3	.03
F	Cryptantha sp.	1	.03
F	Descurainia pinnata (a)	9	.09
F	Erigeron flagellaris	58	1.35
F	Eriogonum racemosum	10	.04
F	Gayophytum ramosissimum(a)	3	.03
F	Hymenoxys acaulis	1	.00
F	Hymenoxys richardsonii	7	.01
F	Lomatium sp.	5	.03
F	Lupinus argenteus	38	3.36
F	Lychnis drummondii	2	.01
F	Musineon sp.	36	.52
F	Penstemon sp.	10	.09
F	Polygonum douglasii (a)	14	.03
F	Potentilla sp.	52	1.60
F	Senecio multilobatus	16	1.12
F	Streptanthus cordatus	2	.00
F	Taraxacum officinale	69	.89
	Total for Annual Forbs	26	0.15
	Total for Perennial Forbs	517	14.76
	Total for Forbs	543	14.92

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 25R, Study no: 8

Type	Species		Average
			Cover %
			'10
B	Pinus ponderosa	11	3.20
B	Populus tremuloides	17	.23
B	Pseudotsuga menziesii	0	.15
B	Purshia tridentata	2	-
B	Symphoricarpos oreophilus	40	7.40
	Total for Browse	70	11.00

CANOPY COVER, LINE INTERCEPT--  
Management unit 25R, Study no: 8

Species	Percent Cover '10
Pinus ponderosa	21.68
Populus tremuloides	37.63
Pseudotsuga menziesii	.20
Symphoricarpos oreophilus	8.39

POINT-QUARTER TREE DATA--  
Management unit 25R, Study no: 8

Species	Trees per Acre '10	Average diameter (in) '10
Populus tremuloides	128	6.5
Pinus ponderosa	180	7.4
Pseudotsuga menziesii	19	3.1

BASIC COVER--  
Management unit 25R, Study no: 8

Cover Type	Average Cover % '10
Vegetation	34.70
Rock	3.35
Pavement	.07
Litter	71.66
Cryptogams	.06
Bare Ground	4.45

PELLET GROUP DATA--  
Management unit 25R, Study no: 8

Type	Quadrat Frequency '10	Days use per acre (ha) '10
Cattle	1	10 (25)
Deer	-	1 (3)

BROWSE CHARACTERISTICS--  
 Management unit 25R, Study no: 8

		Age class distribution			Utilization				
Y e a r	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Pinus ponderosa</i>									
10	<b>260</b>	62	38	-	20	0	0	0	-/-
<i>Populus tremuloides</i>									
10	<b>400</b>	65	35	-	-	0	0	0	-/-
<i>Pseudotsuga menziesii</i>									
10	<b>0</b>	0	0	-	20	0	0	0	-/-
<i>Purshia tridentata</i>									
10	<b>40</b>	50	50	-	-	0	100	0	4/10
<i>Symphoricarpos oreophilus</i>									
10	<b>1940</b>	27	73	-	-	15	0	0	18/34

ALTON MILLCREEK 2 - TREND STUDY NO. 27R-19-10  
[Project #900](#) and [Project #1313](#)

Vegetation Type: Pinyon/Juniper, Black Sagebrush/Wyoming Sagebrush

Range Type: Substantial Deer Summer, Substantial Elk Year-Long

NRCS Ecological Site Description: Not available

Land Ownership: BLM

Elevation: 6,580 ft. (2,006 m)

Aspect: Southeast

Slope: 2%

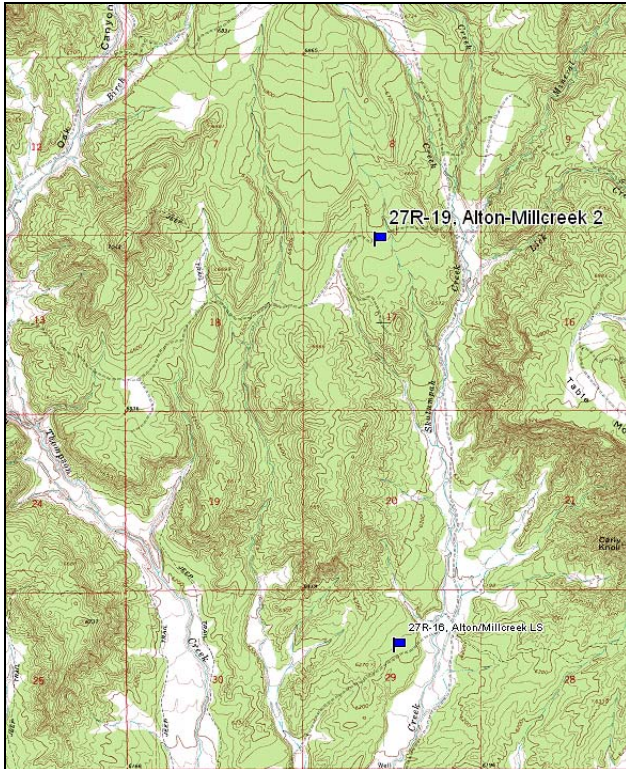
Transect bearing: 129° magnetic

Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

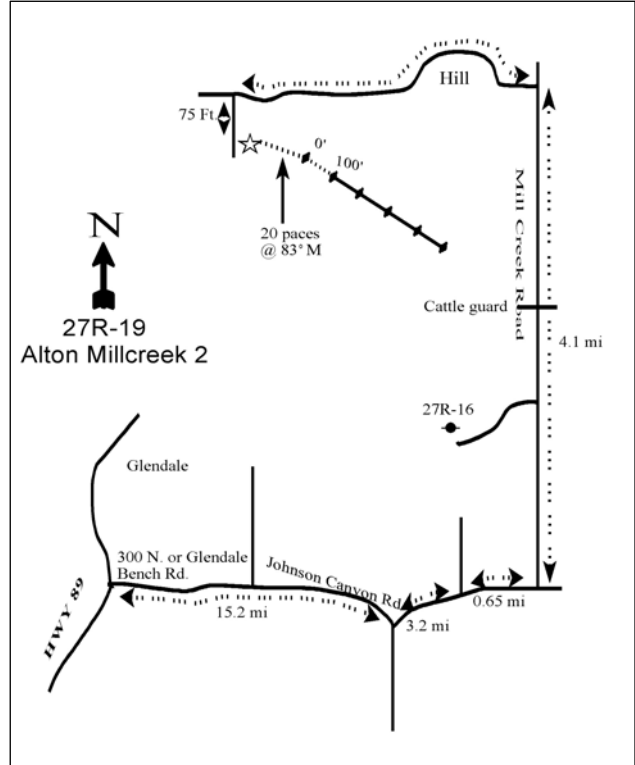
From the junction of US 89 and 300 north (Glendale Bench Rd) in Glendale, drive east on 300 north for 14.9 miles to a fork or a road going northeast (there is a sign that says Deer Spring Ranch and Cannonville). Turn left and drive 2.6 miles to fork with a sign reading “Deer Spring Ranch.” Stay right and drive 0.65 miles to a road on the left with a stop sign. Turn left (north) and drive 2.0 miles passing two cattle guards to a fork. Stay right traveling north 2.1 miles to another fork. Take a left here going through a gate 0.5 miles to a 2 track to the left. 75 feet down the 2 track is the witness post on the left side. From the witness post the 0-foot stake is 20 paces at 83 degrees magnetic, with browse tag #183.

Map Name: Skutumpah Creek



Township: 40S Range: 4.5W Section: 17

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 381746 E 4133373 N

ALTON-MILLCREEK 2 - WRI STUDY 27R-19  
[Project #900](#) and [Project #1313](#)

**Site Description**

Site Information: The study was established in 2007 to monitor a pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) removal project on Bureau of Land Management (BLM) land approximately ten miles southeast of Alton on a bench west of Skutumpah Creek. The project area encompasses 3,400 acres in historically occupied sage-grouse habitat, and is three miles from the Ford Pasture historic lek. Pinyon pine and Utah juniper were thinned with a lop and scatter treatment before the study was sampled in the summer of 2007. In the winter of 2008-09 the study site was retreated with a bullhog treatment because of the size and density of the trees and the amount of residue left from the lop and scatter treatment. The area was aerially seeded with a grass, forb, and browse seed mix in the fall of 2008 prior to the bullhog treatment. The objectives of the project were to reduce pinyon pine and Utah juniper in the area and increased cover of sagebrush (*Artemisia spp.*) (WRI Database 2011). Pellet group data estimated light use by deer and elk in 2007 and in 2010 use was moderate for deer and light use elk (Table - Pellet Group Data). A dead elk was found on the study site in 2007.

SEED MIX--  
 Management unit 27R, Study no: 19

Project Name: Mill Creek Seeding			
WRI Database #: 1313			
Application:		Acres: 900	
Seed type		lbs in mix	lbs/acre
G	Crested Wheatgrass 'Douglas'	1100	1.22
G	Crested Wheatgrass 'Nordan'	1100	1.22
G	Indian Ricegrass 'Rimrock'	1250	1.39
G	Intermediate Wheatgrass 'Oahe'	1775	1.97
G	Snake River Wheatgrass 'Secar'	2250	2.50
F	Alfalfa 'Ladak'	900	1.00
F	Blue Flax 'Appar'	450	0.50
F	Small Burnet 'Delar'	900	1.00
B	Forage Kochia 'Immigrant'	450	0.50
Total Pounds:		10175	11.31
PLS Pounds:			9.67

Browse: The preferred browse species on the site are Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and black sagebrush (*A. nova*). Prior to the treatment the sagebrush populations were heavily utilized and poor vigor and decadence was high within the population. The health of the sagebrush plants improved substantially after the treatment with poor vigor and decadence being low within the population. Utilization of sagebrush has been mostly light to moderate since the treatment. Prior to the treatment pinyon pine and Utah juniper dominate the site, but the treatment removed most of the pinyon and juniper trees from the site (Table - Browse Characteristics).

Herbaceous Understory: Grasses are fairly abundant and diverse, but prior to the treatment grasses were very rare on the site. The dominant grass species on the site are crested wheatgrass (*Agropyron cristatum*), thickspike wheatgrass (*A. dasystachyum*), and intermediate wheatgrass (*A. intermedium*). Cheatgrass (*Bromus tectorum*) was the dominant grass prior to the treatment but became rare following the treatment. Seeded species sampled on the site following the treatment include crested wheatgrass, intermediate wheatgrass, and Indian ricegrass (*Oryzopsis hymenoides*). Forbs are divers and abundant on the site. The diversity of forbs increased significantly with several new species being sample after the treatment. The dominant perennial

forb is low penstemon (*Penstemon humilis*). Other common forb species sampled on the site include prickly lettuce (*Lactuca serriola*) and Lewis flax (*Linum lewisii*). Seeded species sampled on the site following the treatment include Lewis flax, Alfalfa (*Medicago sativa*), and small burnet (*Sanguisorba minor*) (Table - Herbaceous Trends).

Soil: The soil texture is a loam with a neutral soil reaction (pH 6.7) (Table - Soil Analysis Data). Bare ground cover is high with high amount of litter providing protective ground cover (Table - Basic Cover). The soil erosion was classified as slight in 2007 due to evidence of soil movement, pedestalling around plants, and the formation of flow patterns and rills. The soil erosion was classified as stable in 2010.

**Pre vs. Three Years Post Treatment Assessment, 2007 vs. 2010**

Browse: The density of black sagebrush decreased 60% from 860 plants/acre to 340 plants/acre and cover decreased from 2% to 1%. The health of black sagebrush improved with decadence of plants decreasing from 65% to 0% and poor vigor decreasing from 40% to 0%. The density of Wyoming big sagebrush increased four fold from 140 plants/acre to 540 plants/acre and cover increased to 1%. The overall health of the Wyoming big sagebrush plants improved with decadence decreasing from 56% to 0% and poor vigor decreasing from 43% to 0%. Utah juniper density decreased from 237 trees/acre to 7 trees/acre and canopy cover decreased from 18% to 0%. Pinyon pine density decreased from 29 trees/acre to 5 tree/acre and cover decreased from 1% to 0%.

Grass: The sum of nested frequency of perennial grasses substantially increased sixteen fold and cover increased from 0% to 4%. Moreover, diversity of grass species increased due partially to the establishment of seeded species which included crested wheatgrass, intermediate wheatgrass, and Indian ricegrass. Thickspike wheatgrass was sampled following the treatment for the first and provided 2% cover. Crested wheatgrass and intermediate wheatgrass each provided 1% cover. Cheatgrass (*Bromus tectorum*) significantly decreased in frequency and cover was minute after the treatment.

Forb: The sum of nested frequency of perennial forbs increased 86% after the treatment and cover increased from 1% to 6%. Diversity of forbs significantly increased following the treatment with several new forb species being sampled. Three seeded species were sampled include Lewis flax, alfalfa, and small burnet. Low penstemon increased in cover from 1% to 3% and Lewis flax provided 1% cover.

HERBACEOUS TRENDS--  
Management unit 27R, Study no: 19

Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
G	Agropyron cristatum	a-	b52	-	1.08
G	Agropyron dasystachyum	a-	b26	-	1.51
G	Agropyron intermedium	a-	b34	-	1.12
G	Agropyron spicatum	-	3	-	.04
G	Bromus tectorum (a)	b33	a9	.10	.04
G	Oryzopsis hymenoides	-	1	-	.03
G	Poa fendleriana	-	2	-	.00
G	Sitanion hystrix	8	13	.01	.10
G	Vulpia octoflora (a)	9	5	.01	.00
Total for Annual Grasses		42	14	0.11	0.04
Total for Perennial Grasses		8	131	0.01	3.91
Total for Grasses		50	145	0.12	3.96



Type	Species	Nested Frequency		Average Cover %	
		'07	'10	'07	'10
F	Arabis sp.	-	1	-	.03
F	Astragalus convallarius	-	2	-	.03
F	Astragalus sp.	-	1	-	.03
F	Caulanthus crassicaulis	2	-	.00	-
F	Chaenactis douglasii	3	2	.03	.03
F	Collinsia parviflora (a)	-	2	-	.03
F	Cordylanthus sp. (a)	a-	b46	-	1.38
F	Cymopterus sp.	-	1	-	.15
F	Descurainia pinnata (a)	b10	a4	.05	.03
F	Eriogonum cernuum (a)	-	9	-	.02
F	Eriogonum umbellatum	1	12	.00	.07
F	Erodium cicutarium (a)	-	3	-	.03
F	Gayophytum ramosissimum(a)	a-	b38	-	1.05
F	Gilia sp. (a)	a4	b83	.01	1.18
F	Lactuca serriola (a)	a-	b57	-	1.43
F	Lappula occidentalis (a)	a-	b10	-	.48
F	Linum lewisii	a-	b36	-	1.42
F	Lupinus sp.	a-	b18	-	.49
F	Medicago sativa	a-	b14	-	.11
F	Microsteris gracilis (a)	2	11	.00	.02
F	Penstemon humilis	99	90	.91	2.86
F	Penstemon sp.	-	1	-	.00
F	Phlox longifolia	2	1	.00	.00
F	Polygonum douglasii (a)	-	4	-	.04
F	Sanguisorba minor	-	9	-	.06
F	Taraxacum officinale	-	1	-	.03
F	Trifolium sp.	a3	b15	.01	.25
Total for Annual Forbs		16	267	0.07	5.73
Total for Perennial Forbs		110	204	0.97	5.60
Total for Forbs		126	471	1.04	11.33

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 27R, Study no: 19

Type	Species	Strip Frequency		Average Cover %	
		'07	'10	'07	'10
B	Artemisia nova	20	9	1.25	.30
B	Artemisia tridentata wyomingensis	6	10	.01	.48
B	Juniperus osteosperma	18	1	3.86	-
B	Pinus edulis	3	0	.33	.00
Total for Browse		47	20	5.46	0.79

CANOPY COVER, LINE INTERCEPT--

Management unit 27R, Study no: 19

Species	Percent Cover	
	'07	'10
Artemisia nova	1.56	.86
Artemisia tridentata wyomingensis	-	.75
Juniperus osteosperma	17.98	-
Pinus edulis	.56	-
Quercus gambelii	.10	-

KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 27R, Study no: 19

Species	Average leader growth (in)	
	'07	'10
Artemisia nova	1.5	1.2

POINT-QUARTER TREE DATA--

Management unit 27R, Study no: 19

Species	Trees per Acre		Average diameter (in)	
	'07	'10	'07	'10
Juniperus osteosperma	237	7	6.5	0.7
Pinus edulis	29	5	2.7	0.6

BASIC COVER--

Management unit 27R, Study no: 19

Cover Type	Average Cover %	
	'07	'10
Vegetation	6.96	15.68
Rock	.28	.31
Pavement	.41	.22
Litter	45.48	54.79
Cryptogams	3.01	0
Bare Ground	48.80	40.46

SOIL ANALYSIS DATA --

Management unit 27R, Study no: 19, Study Name: Alton-Millcreek 2

Effective rooting depth (in)	pH	loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
6.7		37.4	38.0	24.6	2.0	9.0	182.4	0.7

PELLET GROUP DATA--

Management unit 27R, Study no: 19

Type	Quadrat Frequency		Days use per acre (ha)	
	'07	'10	'07	'10
Rabbit	53	12	-	-
Elk	1	1	1 (3)	6 (15)
Deer	2	4	7 (18)	14 (35)

BROWSE CHARACTERISTICS--  
Management unit 27R, Study no: 19

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia nova</i>									
07	<b>860</b>	0	35	65	-	35	65	40	11/19
10	<b>340</b>	24	76	0	40	35	0	0	16/23
<i>Artemisia tridentata wyomingensis</i>									
07	<b>140</b>	14	29	57	-	14	86	43	17/18
10	<b>540</b>	63	37	0	-	0	0	0	15/17
<i>Juniperus osteosperma</i>									
07	<b>460</b>	22	52	26	80	0	26	30	-/-
10	<b>20</b>	100	0	0	-	0	0	0	-/-
<i>Pinus edulis</i>									
07	<b>60</b>	33	67	-	40	0	0	33	-/-
10	<b>0</b>	0	0	-	20	0	0	0	-/-
<i>Purshia tridentata</i>									
07	<b>0</b>	0	0	-	-	0	0	0	15/35
10	<b>0</b>	0	0	-	-	0	0	0	14/20
<i>Quercus gambelii</i>									
07	<b>0</b>	0	0	-	-	0	0	0	36/31
10	<b>0</b>	0	0	-	-	0	0	0	24/49

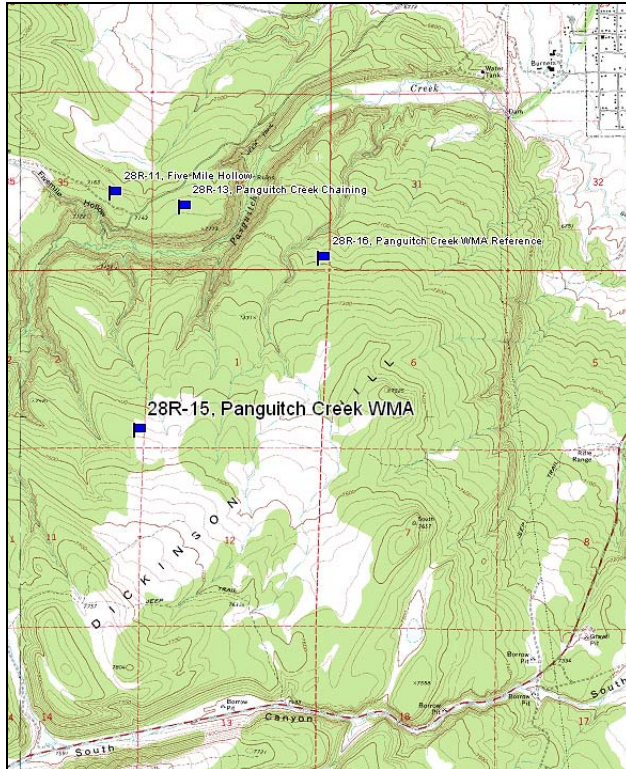
PANGUITCH CREEK WMA - TREND STUDY NO. 28R-15-10  
[Project #1206](#)

Vegetation Type: Pinyon pine, Black Sagebrush  
Range Type: Crucial Deer Winter, Substantial Elk Winter  
NRCS Ecological Site Description: [Upland Stony Loam \(Mountain Big Sagebrush\), R047XB336UT](#)  
Land Ownership: UDWR  
Elevation: 7,400 ft. (2,255 m)  
Aspect: Northwest  
Slope: 2-3%  
Transect bearing: 316° magnetic  
Belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95 ft)

Directions:

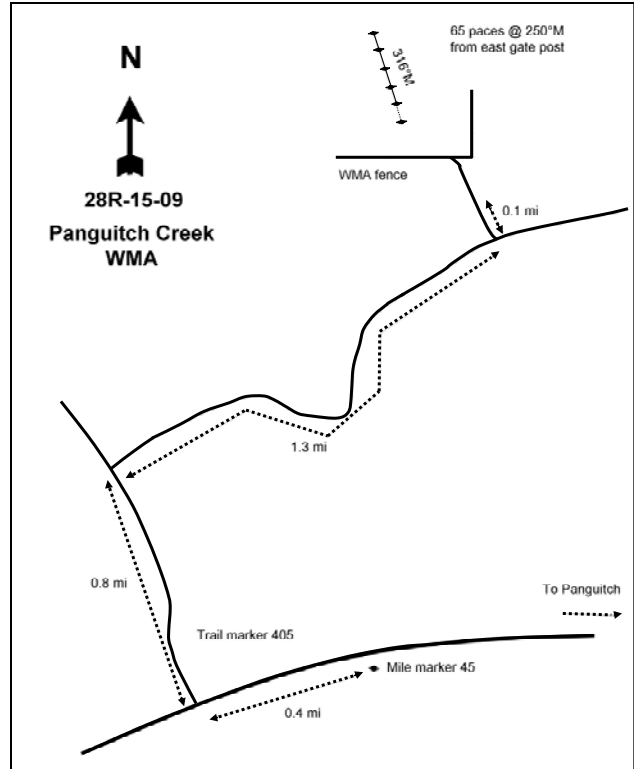
From the stoplight in Panguitch, take Highway 143 (also known as “Not 89”). Turn right (north) 0.4 miles west from mile post 45. From Highway trail marker 405 go through gate for 0.8 miles, turn right and go 0.6 miles, turn left and go 0.7 miles, turn left again and go 0.1 miles. Walk down the trail to the WMA fence. From the east gate post proceed 65 paces at 250°M.

Map Name: Panguitch



Township: 35S Range: 6W Section: 2

Diagrammatic Sketch:



GPS: NAD 83, UTM 12S 368890 E 4183562 N

PANGUITCH CREEK WMA - WRI STUDY 28R-15  
[Project #1206](#)

**Site Description**

Site Information: The study is located approximately three miles southwest of Panguitch on a pinyon pine (*Pinus edulis*) and Utah Juniper (*Juniperus osteosperma*) bench south of Panguitch Creek on the Panguitch Creek Mountain Wildlife Management Area (WMA). The study was established in 2009, after treatment, to monitor a pinyon pine and Utah juniper chaining and seeding treatment which occurred in the spring of 2009 prior to the placement of the study transect. About 333 acres were two-way chained with an Ely chain on the first pass and a smooth chain on the second pass. A seed mix of forb, grass, and browse species was aerially applied between the chaining passes. The objective of the project were to increase use by game species by providing beneficial forage, increasing beneficial browse and herbaceous understory, and decreasing the pinyon pine and Utah juniper overstory (WRI Database 2011). In 2009, data was collected along the baseline and belt transects were not used. In 2010, the study was converted to the normal methodology with belts intersecting the baseline at randomized intervals. Pellet group data estimated light use by deer in 2009 and 2010. Elk use was estimated light in 2010 (Table - Pellet Group Data).

SEED MIX--

Management unit 28R, Study no: 15

Project Name: Panguitch Creek WMA PJ Chain/Bullhog									
WRI Database #: 1206									
Application: Aerial Seed			Acres: 383		Application: Seed Dribbler			Acres: 332	
Seed type		lbs in mix	lbs/acre	Seed type		lbs in mix	lbs/acre		
G	Bottlebrush Squirreltail 'Toe Jam'	50	0.13	B	Bitterbrush	150	0.45		
G	Canby Bluegrass 'Canbar'	150	0.39	B	Curleaf Mountain Mahogany	50	0.15		
G	Indian Ricegrass 'Rimrock'	350	0.91	B	Forage Kochia 'Immigrant'	100	0.30		
G	Intermediate Wheatgrass 'Oahe'	600	1.57	B	Stansbury Cliffrose	60	0.18		
G	Russian Wildrye 'Bozoisky'	400	1.04	Total Pounds:		360	1.08		
G	Snake River Wheatgrass 'Secar'	400	1.04	PLS Pounds:			0.82		
F	Alfalfa 'Ladak'	200	0.52						
F	Alfalfa 'Ranger'	200	0.52						
F	Blue Flax 'Appar'	150	0.39						
F	Palmer Penstemon	100	0.26						
F	Small Burnet 'Delar'	450	1.17						
B	Forage Kochia 'Immigrant'	200	0.52						
B	Sagebrush, Mountain	200	0.52						
Total Pounds:		3450	9.01						
PLS Pounds:			7.34						

Browse: The preferred browse species on the site is black sagebrush (*Artemisia nova*). The black sagebrush is a lightly used mature population with low decadence and good vigor. The recruitment of young sagebrush to the population has been fairly good. Other browse species sampled on the site occurring on low abundance include broom snakeweed (*Gutierrezia sarothrae*) and pricklypear cactus (*Opuntia sp.*) (Table - Browse Characteristics). The density of pinyon pine has been low since the treatment (Table - Point-Quarter tree Data).

Herbaceous Understory: Grasses are fairly abundant and diverse. Blue grama (*Bouteloua gracilis*) is the dominant grass species on the site. Other common grass species sampled on the site include bottlebrush

squirreltail (*Sitanion hystrix*) and intermediate wheatgrass (*Agropyron intermedium*). Cheatgrass (*Bromus tectorum*) was sampled in 2010 for the first time in low frequency and cover. Several seeded species were sampled following the treatment include intermediate wheatgrass, Russian wildrye (*Elymus junceus*), Indian ricegrass (*Oryzopsis hymenoides*), Canby bluegrass (*Poa canbyi*), and bottlebrush squirreltail. Forbs are not overly abundant but are moderately diverse. Lobeleaf groundsel (*Senecio multilobatus*) is the dominant forb species on the site, though occurring in very low abundance (Table - Herbaceous Trends).

Soil: According to NRCS soil maps the soil surface texture is a very cobbly loam. Bare ground cover is low with a very high amount of litter, rock and pavement providing protective ground cover (Table - Basic Cover). The soil erosion condition was classified as stable in all sample years.

### Trend Assessments

#### Browse

- **2009 to 2010 - slightly up (+1)**: Density of browse species was not sampled in 2009; therefore comparisons are based on line intercept canopy cover. Black sagebrush canopy cover increased from 7% to 11%. Pinyon pine density increased from 37 trees/acre to 101 tree/acre and cover remained similar at 1%.

#### Grass

- **2009 to 2010 - slightly up (+1)**: The sum of nested frequency of perennial grasses slightly increased 11% and cover remained similar at 4%. Blue grama remained the dominant grass species but decreased in cover from 3% to 2%.

#### Forb

- **2009 to 2010 - up (+2)**: The sum of nested frequency of perennial forbs significantly increased three fold and cover increased from less than 1% to 2%. Diversity of species increased significantly with several new species being sampled. No single forb species provided more than 1% cover.

### HERBACEOUS TRENDS--

Management unit 28R, Study no: 15

Type	Species	Nested Frequency		Average Cover %	
		'09	'10	'09	'10
G	Agropyron cristatum	11	2	.04	.03
G	Agropyron intermedium	6	13	.03	.34
G	Bouteloua gracilis	88	67	3.28	2.33
G	Bromus tectorum (a)	-	2	-	.03
G	Elymus junceus	-	2	-	.03
G	Oryzopsis hymenoides	16	6	.11	.09
G	Poa canbyi	-	9	-	.10
G	Sitanion hystrix	<sub>a</sub> 4	<sub>b</sub> 48	.01	1.03
G	Stipa comata	10	3	.10	.03
Total for Annual Grasses		0	2	0	0.03
Total for Perennial Grasses		135	150	3.58	4.00
Total for Grasses		135	152	3.58	4.03
F	Astragalus sp.	-	2	-	.30
F	Chenopodium album (a)	1	3	.00	.19
F	Chenopodium leptophyllum(a)	<sub>a</sub> -	<sub>b</sub> 17	-	.21
F	Cryptantha sp.	1	3	.00	.15
F	Descurainia pinnata (a)	-	6	-	.04
F	Draba sp. (a)	-	3	-	.15

Type	Species	Nested Frequency		Average Cover %	
		'09	'10	'09	'10
F	Erigeron pumilus	2	3	.00	.03
F	Gayophytum ramosissimum(a)	-	7	-	.76
F	Gilia sp. (a)	-	2	-	.00
F	Lactuca serriola (a)	-	3	-	.04
F	Lesquerella sp.	-	2	-	.15
F	Linum lewisii	-	4	-	.08
F	Lygodesmia sp.	-	2	-	.15
F	Medicago sativa	2	2	.00	.03
F	Penstemon sp.	-	2	-	.15
F	Phlox longifolia	7	7	.01	.01
F	Senecio multilobatus	<sub>a</sub> 9	<sub>b</sub> 27	.07	.42
F	Sphaeralcea coccinea	-	2	-	.00
F	Trifolium sp.	-	2	-	.00
Total for Annual Forbs		1	41	0.00	1.39
Total for Perennial Forbs		21	58	0.10	1.50
Total for Forbs		22	99	0.10	2.90

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS--

Management unit 28R, Study no: 15

Type	Species	Strip Frequency		Average Cover %	
		'09	'10	'09	'10
B	Artemisia nova	0	75	7.05	7.85
B	Gutierrezia sarothrae	0	8	.11	.22
B	Opuntia sp.	0	6	.15	.33
B	Pinus edulis	0	4	1.22	.96
Total for Browse		0	93	8.54	9.36

#### CANOPY COVER, LINE INTERCEPT--

Management unit 28R, Study no: 15

Species	Percent Cover	
	'09	'10
Artemisia nova	7.26	10.50
Gutierrezia sarothrae	.10	-
Opuntia sp.	-	.06
Pinus edulis	2.86	1.39

#### KEY BROWSE ANNUAL LEADER GROWTH--

Management unit 28R, Study no: 15

Species	Average leader growth (in)	
	'09	'10
Artemisia nova	1.0	1.6

POINT-QUARTER TREE DATA--  
 Management unit 28R, Study no: 15

Species	Trees per Acre		Average diameter (in)	
	'09	'10	'09	'10
Juniperus osteosperma	<18	-	1.2	-
Pinus edulis	37	101	1.6	1.9

BASIC COVER--  
 Management unit 28R, Study no: 15

Cover Type	Average Cover %	
	'09	'10
Vegetation	15.16	17.25
Rock	11.15	12.01
Pavement	6.37	8.11
Litter	52.51	57.09
Cryptogams	.30	.03
Bare Ground	18.99	16.48

PELLET GROUP DATA--  
 Management unit 28R, Study no: 15

Type	Quadrat Frequency		Days use per acre (ha)	
	'09	'10	'09	'10
Rabbit	6	7	-	-
Elk	1	1	-	1 (2)
Deer	5	6	7 (17)	3 (7)



BROWSE CHARACTERISTICS--  
 Management unit 28R, Study no: 15

		Age class distribution			Utilization				
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
<i>Artemisia nova</i>									
09	No density data collected								10/18
10	<b>3800</b>	9	87	4	80	1	0	5	14/21
<i>Gutierrezia sarothrae</i>									
09	No density data collected								6/6
10	<b>220</b>	9	91	-	-	0	0	0	9/10
<i>Kochia prostrata</i>									
09	No density data collected								-/-
10	<b>0</b>	0	0	-	-	0	0	0	15/13
<i>Opuntia sp.</i>									
09	No density data collected								7/14
10	<b>160</b>	25	75	-	-	0	0	0	5/9
<i>Pinus edulis</i>									
09	No density data collected								-/-
10	<b>80</b>	75	25	-	-	0	0	0	-/-

## REFERENCES

- Tiedemann, A. R. and C. F. Lopez. 2004. Assessing Soil Factors in Wildland Improvement Programs. *In*: S.B. Monsen, R. Stevens, and N. Shaw (compilers) Restoring Western Ranges and Wildlands. Gen. Tech. Rep. RMRS-GTR-136-vol 1. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 39-56.
- U. S. Dept. of Agriculture - Soil Conservation Service. 1972. Soil survey of Utah County, Utah - central part. U. S. Govt. Printing Office, Wash. D. C. 161 pp.
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<<http://wri.utah.gov/WRI/>>