UTAH WATERSHED RESTORATION INITIATIVE STUDIES
2007 Pre-treatment Report

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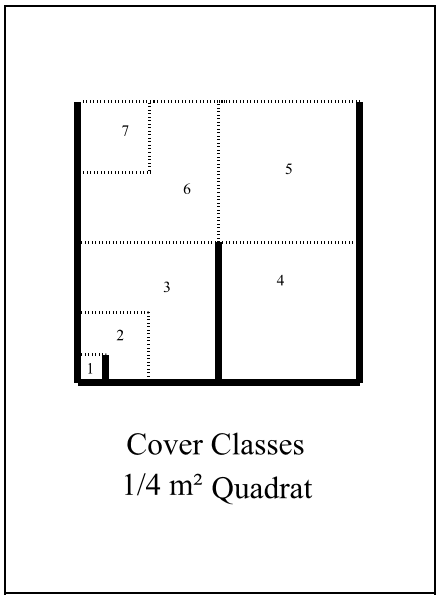
RANGE TREND STUDY METHODS

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 vegetative 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 have 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 critical 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 beginning baseline stake, is marked with a metal tag for proper identification of the transect.

Vegetative composition

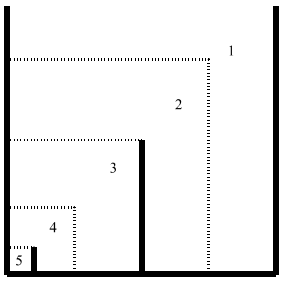
Determining vegetational characteristics for each “key” area is determined by setting up 5 consecutive 100 foot baseline transects in the area of interest. This 500 foot line is the baseline and one, 100 foot belt is placed perpendicular to each 100 foot section of the baseline at random foot marks and 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^2 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.

Cover is determined using a modified Daubenmire 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%. For example, to estimate vegetative 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.



Total canopy cover of shrubs or trees is estimated using the line-intercept method. 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.

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. Sites read before 1992 have a maximum possible score of 400 because they have only 4 sub-quadrats. To compare data collected before and after 1992, sub-quadrats 4 and 5 are merged and a maximum possible score of 400 is used for all years.



Nested Frequency
1/4 m² Quadrat

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 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 values for herbaceous species are not reliable indicators of trend and can fluctuate greatly with precipitation and time of season sampled. Therefore, plant cover and density values can be misleading if used by themselves and do not necessarily indicate changes in composition and/or distribution of key plant species.

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

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 placed in the following five classes. ([1]U.S. Department of Interior Bureau of Land Management 1996).

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 9 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.

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 4 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 at two hundred foot intervals along the baseline. Three hundred feet are 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 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 larger sample will better reflect changing trends in shrub populations, especially those at moderately low densities. 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, form class, and age class are utilized to characterize shrub populations, as well as average height and crown diameter measurements. Particular attention is given to woody plants and their important role as indicators on critical 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 decadent plants, and the percentage of decadent plants that are classified as dying
3) biotic potential or proportion of seedlings to the population
4) proportion of young plants in population
5) proportion of individuals moderately or heavily browsed
6) proportion of plants in poor vigor
7) changes in height and crown diameter measurements for mature age class
8) changes in browse species composition
9) strip frequency values
10) proportion of cover contributed by key species

Trends in herbaceous plants as a group or as a single "key" species can be 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 (Friedman test which is analogous to analysis of variance) (Conover 1980) is conducted on nested frequencies of each species to determine significant changes at alpha = .10. Ground cover parameters are analyzed and compared in the discussions of the reread studies. Trends for soil are determined by comparing basic ground cover measurements and cover composition (herbs vs shrubs) between years as well as comparing photos and observer observations between readings. A ratio of the nested frequency values of protective cover types (vegetation, litter, and cryptogams) to bare soil can also be used to help determine changes in soil trend. Beginning in 2002, an erosion condition class assessment adapted from the Bureau of Land Management is also completed on each study site to provide additional qualitative information on soil condition. On newly established studies, a more subjective or apparent assessment is made from qualitative comparisons.

The following tables and partial tables are taken from study number 23-1 to help illustrate some basic comparisons that can be made with the data. The "Herbaceous Trends" table summarizes 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 23-1. 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, grasses had a combined total cover value of 11.39% in 1998 and 7.08% in 2003. In 1985 and 1991, bluebunch wheatgrass (*Agropyron spicatum*) had a nested frequency value of 227 out of a possible nested frequency score of 400. By 1998, nested frequency declined to 183. The subscript letters indicate that the nested frequency value for *A. spicatum* between 1991 and 1998 declined significantly. Nested frequency declined to 160 in 2003, but the subscript letters indicate that this was not a significant change. Cover was estimated at 7.78% for *A. spicatum* in 1998 declining to 5.59% in 2003. Trend for this grass is down over the life of the transect due to a significant decline in sum of nested frequency since 1991.

HERBACEOUS TRENDS --
Management unit 23 , Study no: 1

Type	Species	Nested Frequency				Average Cover %	
		'85	'91	'98	'03	'98	'03
G	Agropyron spicatum	$_{b}$227	$_{b}$227	$_{a}$183	$_{a}$160	7.78	5.59
G	Bromus tectorum (a)	-	-	$_{b}$42	$_{a}$15	.43	.03
G	Oryzopsis hymenoides	4	12	12	5	.17	.04
G	Poa fendleriana	$_{a}$6	$_{bc}$36	$_{c}$49	$_{ab}$24	.98	.46
G	Poa secunda	$_{a}$3	$_{a}$18	$_{b}$94	$_{b}$80	2.00	.94
G	Sitanion hystrix	$_{c}$25	$_{bc}$20	$_{ab}$6	$_{a}$2	.01	.01
Total for Annual Grasses		0	0	42	15	0.43	0.03
Total for Perennial Grasses		265	313	344	271	10.95	7.05
Total for Grasses		265	313	386	286	11.39	7.08
F	Agoseris glauca	$_{a}$-	$_{a}$10	$_{ab}$1	$_{a}$-	.00	-
F	Arabis spp.	$_{a}$-	$_{b}$18	$_{a}$1	$_{a}$1	.00	.00
F	Astragalus convallarius	2	4	6	6	.15	.10
F	Calochortus nuttallii	4	8	-	-	-	-
F	Crepis acuminata	-	6	7	-	.06	-
F	Eriogonum racemosum	-	-	4	-	.03	-
F	Eriogonum umbellatum	$_{a}$-	$_{a}$1	$_{b}$9	$_{ab}$5	.16	.07
F	Phlox austromontana	-	6	4	6	.16	.15
F	Physaria chambersii	1	4	-	-	-	-
F	Phlox longifolia	$_{a}$8	$_{b}$27	$_{a}$16	$_{a}$6	.20	.02
Total for Annual Forbs		0	0	0	0	0.00	0
Total for Perennial Forbs		15	84	48	24	0.83	0.35
Total for Forbs		15	84	48	24	0.83	0.35

Values with different subscript letters are significantly different at alpha = .10 (annuals excluded)

In 1985, perennial grasses had a sum of nested frequency value of 265. This value steadily increased to 313 in 1991 and 344 in 1998 before declining to 271 in 2003. These changes would indicate a slightly upward perennial grass trend from 1985 to 1998 and a stable trend overall for the life of the transect. The forb trend can be determined in a similar manner. The herbaceous understory trend is determined using both the grass and forb sum of nested frequency values. For example, total herbaceous cover was 12.23% in 1998 with grasses providing the bulk of the cover. Therefore, when determining herbaceous trend, the grass proportion should be weighted more heavily then the forb proportion in this example.

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 23-1 are listed. For example, mountain big sagebrush (*Artemisia tridentata vaseyana)* had a strip frequency of 40 out of a possible 100 in 1998, declining to 26 in 2003. Average cover is determined using cover classes in conjunction with the 1/4m^2 quadrat and estimating the percent of the quadrat covered. In this case, mountain big sagebrush cover was estimated to be 2.54% in 1998, declining to only 0.76% in 2003.

BROWSE TRENDS --
Management unit 23 , Study no: 1

Type	Species	Strip Frequency		Average Cover %	
		'98	'03	'98	'03
B	Artemisia nova	35	26	2.24	2.41
B	Artemisia tridentata vaseyana	40	26	2.54	.76
B	Gutierrezia sarothrae	2	0	-	-
B	Juniperus osteosperma	4	5	5.51	9.29
B	Opuntia spp.	1	2	.15	-
B	Pinus edulis	4	6	5.99	8.81
B	Purshia tridentata	18	15	3.20	4.31
Total for Browse		104	80	19.63	25.58

To 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, Utah juniper (*Juniperus osteosperma*) had an estimated average cover of 23.31% in 2003. Prior to 2002, only trees species were sampled in the line-intercept transect. Beginning in 2002, all woody species are included in the line-intercept transect and a canopy cover value for each is determined. Live browse cover is measured along the belt transects and converted to percent cover. Gaps of six inches or more lacking live browse cover are excluded.

CANOPY COVER, LINE INTERCEPT --
Management unit 23 , Study no: 1

Species	Percent Cover	
	'98	'03
Artemisia nova	-	1.85
Artemisia tridentata vaseyana	-	.55
Juniperus osteosperma	7.19	23.31

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 bitterbrush (*Purshia tridentata*) averaged 4 inches in length while mountain big sagebrush leaders averaged only 1.1 inches in 2003.

KEY BROWSE ANNUAL LEADER GROWTH –
Management unit 23 , Study no: 1

Species	Average leader growth (in) '03
Artemisia tridentata vaseyana	1.1
Purshia tridentata	4.0

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. Data from 2003 estimated 197 juniper and 119 pinyon trees/acre with average basal diameters of 7.0 inches and 5.3 inches respectively.

POINT-QUARTER TREE DATA --
Management unit 23 , Study no: 1

Species	Trees per Acre '98	Trees per Acre '03	Average diameter (in) '98	Average diameter (in) '03
Juniperus osteosperma	213	197	8.8	7.0
Pinus edulis	115	119	4.8	5.3

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 vegetative cover (2.0 and 5.75), while the new method estimates the vertical projection of the crown, or aerial cover (30.04 and 32.5%). Therefore, comparisons can be made for all cover measurements except for general vegetation cover.

BASIC COVER --
Management unit 23 , Study no: 1

Cover Type	Average Cover % '85	'91	'98	'03
Vegetation	2.00	5.75	30.04	32.50
Rock	6.00	5.25	11.18	13.20
Pavement	30.50	24.25	26.32	19.74
Litter	46.50	46.50	42.49	37.44
Cryptogams	5.00	3.00	.93	3.45
Bare Ground	10.00	15.25	21.42	13.10

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, relative site potential, and abundance. Average soil temperature is taken from the deepest probe, one at each of the 5 baseline starting stakes. The temperature is listed in the table as the top measurement (e.g., 62.3°F), with the average depth (in inches) as the lower measurement (12.7). Average soil temperature is re-measured with each reading and the most current soil temperature and depth is listed in the soil analysis table. 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 23, Study # 01, Study Name: Bear Ridge

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%OM	PPM P	PPM K	ds/m
11.2	62.3 (12.7)	7.3	40.0	33.4	26.6	3.4	9.0	57.6	0.5

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

Ultra acid	< 3.5
Extremely acid	3.5-4.4
Very strongly acid	4.5-5.0
Strongly acid	5.1-5.5
Moderately acid	5.6-6.0
Slightly acid	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

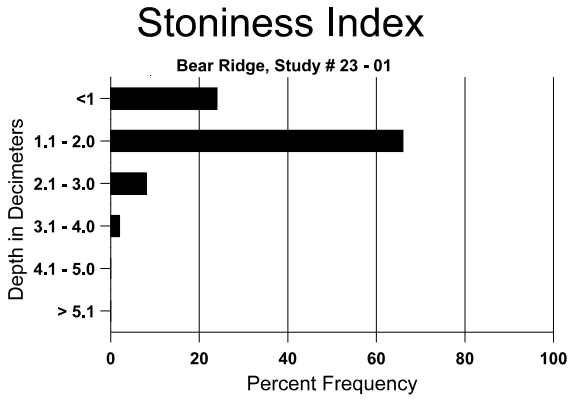
Percent organic matter (% OM) refers to the amount of organic matter in the top 12 inches of the soil profile. Parts per million (ppm) of phosphorus (P) and potassium (K) are also included. Values for phosphorus and potassium less than 10 ppm and 70 ppm respectively may be limiting to plant growth and 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

To determine how rock is distributed throughout the upper soil profile, a stoniness index is determined for each study site. Depth to the nearest rock is estimated on the first 10 feet (at one-foot intervals) along each of the 5 baselines, which allows 50 measurements. These data are then analyzed for each of the 5 incremental decimeter measurements, making it possible to visually determine the proportion (relative percent of rock at each depth) of rock from <1 decimeter to >5 decimeters. In the following example, most of the rock in the soil

profile (~65%) was encountered in the 1 to 2 decimeter (4 to 8 inch) depth range. The distribution of rock in the soil profile can be an important factor for what is growing on the site, relative to site potential and soil temperature.



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 1998, rabbit pellets were found in 25% of the quadrats placed on study 23-1, increasing to 32% in 2003. Quadrat frequency of rabbit or big game pellets indicate a relative amount of use by that particular animal. This data can help characterize changes in wildlife use patterns on the site.

PELLET GROUP DATA --
Management unit 23 , Study no: 1

Type	Quadrat Frequency		Days use/acre (ha)	
	'98	'03	'98	'03
Rabbit	25	32	-	-
Elk	4	-	7 (17)	1 (3)
Deer	36	20	51 (125)	54 (134)

It was determined that additional information on pellet groups was necessary. Therefore, a pellet group transect is now sampled in conjunction with the vegetative transects. The pellet group transect utilizes 50, 100ft^2 circular plots which are placed through the study area. These are usually two parallel transects of 25 plots on each side of the vegetative transect which runs 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. In the above example, deer days use/acre was estimated at 51 in 1998 increasing slightly to 54 in 2003. If a trend study needs to be read annually and more precision is required, the pellet group transect is marked permanently (rebar) and the pellet groups within the circular plots are removed or marked after being counted.

The "Browse Characteristics" table summarizes characteristics of the shrub community on study 23-1. 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 1,400 in 1985, 1,065 in 1991, 1,100 in 1998, and 840 plants/acre in 2003. 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 (more than three times larger) is 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 of the population classified as dying, percent decadence, percent of the population displaying poor vigor, percent heavy hedging, young recruitment, etc. should be given more weight in determining shrub trend when comparing survey years where sample sizes are different.

BROWSE CHARACTERISTICS --
Management unit 23 , Study no: 1

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata vaseyana												
85	**1400**	266	200	400	800	-	67	24	57	-	14	13/15
91	**1065**	333	333	66	666	-	19	6	63	11	38	12/13
98	**1100**	-	100	260	740	2300	56	2	67	27	40	15/23
03	**840**	-	120	140	580	1740	29	0	69	40	40	14/21

The data on mountain big sagebrush shows the proportion of decadent shrubs in the population has steadily increased from 57% in 1985 to 69% by 2003. Plants classified as dying had also increased to 40% by 2003. More seedlings were encountered in 1985 and 1991, with slight fluctuations in the number of young plants. Dead plants, included in sampling after 1992, are abundant at 2,300 plants/acre in 1998 and 1,740 in 2003, and outnumber live plants by a ratio of 2:1 in both years. The percentage of plants displaying poor vigor has increased from 14% in 1985 to 40% in 1998 and 2003. The proportion of shrubs displaying heavy hedging declined from 24% in 1985, to 6% in 1991, and 0% by 2003. The proportion of shrubs displaying moderate use has ranged from 67% in 1985 to 19% in 1991. The average height of mature sagebrush has remained similar in all readings and averaged 14 inches in 2003. Average crown diameter has fluctuated from 13 inches in 1991 to 23 inches in 1998.

Considering all these factors, trend for sagebrush in 2003 is slightly downward due to a decline in density, increased decadence, and an higher proportion of plants classified as dying. No seedlings were encountered in 1998 or 2003 and young plants are only moderately abundant.

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* and *Purshia*, the species names used by the Range Trend Study Plant Species List (Giunta 1983) and the Intermountain Flora (Cronquist et al. 1977) are retained to maintain continuity and alleviate confusion with earlier published reports.

Range trend data have been collected throughout Utah since 1982. In addition to determining trends on winter ranges, a system to determine the condition of these areas was needed. The desirable components index (DCI) was created by Range Trend Project personnel as a tool to address condition and/or value of winter ranges for mule deer. This subjective index is used primarily to determine if a particular site has the vegetation components necessary to be a good winter range for mule deer. Winter range condition is scored based upon several important vegetation components such as, preferred browse cover, shrub decadence and young

recruitment, cover of perennial grasses, perennial forbs, and annual grasses (Clements and Young 1997; Olson 1992; Plummer et al. 1968; Stevens 2004; Wasley 2004). This index is used as one of many factors in big game herd management. It can also be used to identify areas where habitat restoration projects may be needed and assist land managers in determining possible rehabilitation options.

Ideal mule deer winter range provides 12-20% of preferred browse cover, shrub decadence is 20% or less, and has 10% or more of the shrub population that is young. The herbaceous understory contains 8-15% perennial grass cover, 5% perennial forb cover, and less than 5% annual grass cover. The DCI ratings are divided into three categories of winter range based different ecological potential, these include: Lower potential sites (Wyoming big sagebrush and desert shrubs), Mid-level potential (mountain big sagebrush), and High potential (mountain brush communities).

Desirable Components Index Ratings

Lower potential sites (Wyoming Big Sagebrush and Desert Shrub Communities)

> 65 points =	Excellent
45 – 64	Good
25 – 44	Fair
10 – 24	Poor
< 10	Very poor

Mid level potential sites (Mountain Big Sagebrush)

> 80 points =	Excellent
79 – 65	Good
64 – 50	Fair
49 – 35	Poor
< 35	Very poor

Higher potential sites (Mountain Brush Communities)

> 90 points =	Excellent
89 – 70	Good
69 – 55	Fair
54 – 40	Poor
< 39	Very poor

(Black sagebrush and Basin big sagebrush will be placed in Wyoming or Mountain big sagebrush scales based on precipitation and elevation).

Desirable Components Index Scoring

Preferred Browse (60 points)
(Preferred Browse species are favorable or critical to deer)

Preferred Browse Cover (30 pts. possible)
1.5 points for each 1% of preferred browse cover (maximum is 20% or 30 points)

Percent Decadence* (15 points possible)
-0.3 points for each 1% decadence (do not exceed 15 points)

Percent Young* (15 points possible)
0.5 points for each 1% of young

Herbaceous Understory (40 points)

Perennial Grass Cover (30 points possible)
2 points for each 1% cover

Perennial Forb Cover (10 points possible)
2 points for each 1% cover

Annual Grass Cover (-20 points possible)
-0.75 points for each 1% cover

Noxious Weeds (State List)
-2 points for each species present

*If the total preferred browse cover for the year is below 5%, then no points are awarded for percent young in population and percent decadence.

Trend Study 1R-11-07

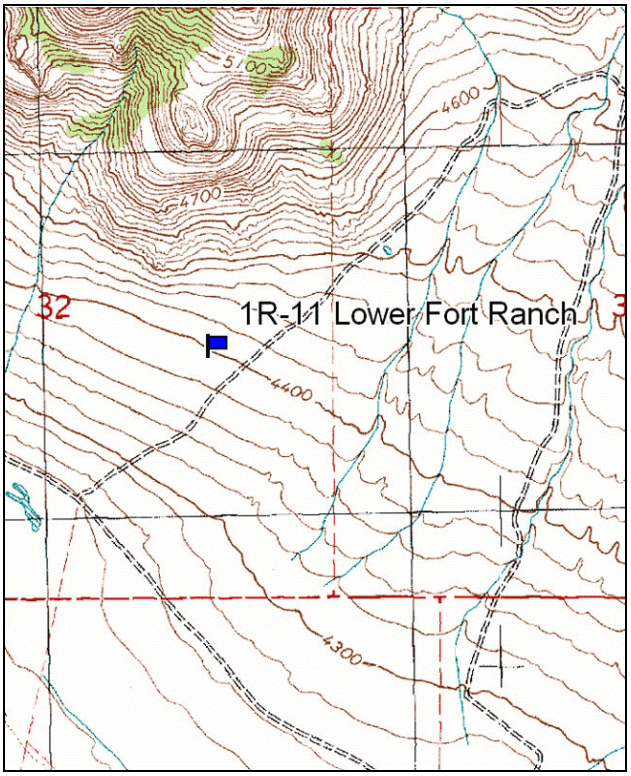
Study site name: Lower Fort Ranch . Vegetation type: Annuals .

Compass bearing: frequency baseline 277 degrees magnetic.

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

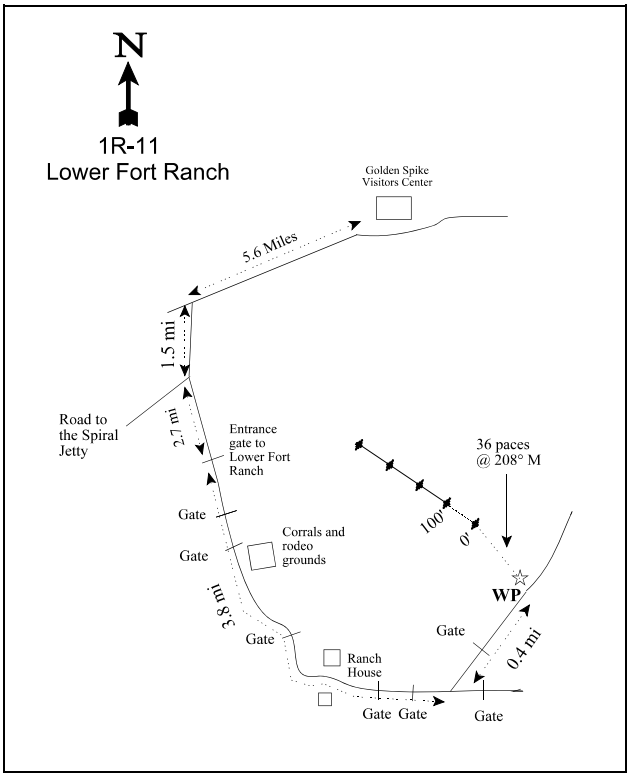
LOCATION DESCRIPTION

From the road south of the Golden Spike Visitor Center travel 5.6 miles to a fork, stay left, traveling 1.5 miles to the fork to the Spiral Jetty. Stay left and continue for 2.7 miles, to the entrance gate to Lower Fort Ranch. From here travel 3.8 miles passing through two gates, past some corrals, rodeo grounds, ranch house and through two more gates to another fork. Taking the left fork, you will go through another gate, traveling 0.4 miles to a witness post on the left hand side of the road. From the witness post, the 0-foot stake is 36 paces at 277°M, and is marked with browse tag #118.



Map Name: Messix Peak

Township 9N , Range 6W , Section 32



Diagrammatic Sketch

GPS: NAD 83 UTM 12T 370389 E 4591629 N

DISCUSSION

Lower Fort Ranch - Trend Study No. 1R-11

Study Information

This study was established in 2007 to monitor a restoration project on deer winter range on the west side of the Promontory Mountains, approximately 1 mile (1.6 km) from the Great Salt Lake [elevation: 4,400 feet (1,341 m), slope: 7%, aspect: south]. In heavy snow winters, approximately 1,000-1,500 deer use the area. Cheatgrass (*Bromus tectorum*) invasion has reduced the habitat quality and increased wildfire hazard. Approximately 1,000 acres (405 ha) of elongated wheatgrass (*Agropyron elongatum*) and greasewood (*Sarcobatus vermiculatus*) will be removed with a heavy disk, leaving patches of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). This area will then be seeded with forbs, grasses, and Wyoming big sagebrush. Additionally, 250 acres (101 ha) will be disked to remove heavy infestations of cheatgrass, leaving a mosaic pattern of sagebrush. The cheatgrass-infested areas will also be treated with Plateau™ to prevent re-emergence. No big game use was evident when the study was sampled in 2007. Cattle use was estimated at 15 days use/acre (38 cdu/ha), and horse use was estimated at 99 days use/acre (246 hdu/ha).

Soil

The soil is classified within the Abela series (USDA-NRCS 2007). Soils in this series are deep and well-drained, and formed in alluvium or lacustrine deposits derived mainly from limestone, sandstone, and quartzite. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 7.2). The soil phosphorus is marginal at 8.3 ppm, and potassium is high at 486.4 ppm (Tiedemann and Lopez 2004). Vegetation and litter comprised 92% of the relative ground cover, and bare ground provided 6%. The soil was described as very hard and compact, and the erosion condition was classified as stable.

Browse

Broom snakeweed (*Gutierrezia sarothrae*) was the only browse species sampled in 2007, and it provided less than 1% cover. Its density was 220 plants/acre (544 plants/ha), and the majority of the sampled plants were mature, with 9% of the population comprised of young plants. All of the plants were vigorous and had not been hedged.

Herbaceous Understory

Grasses, mainly cheatgrass and elongated wheatgrass, dominated the understory. Cheatgrass provided 28% cover and was sampled in all quadrats. Elongated wheatgrass provided 13% cover, and had a quadrat frequency of 82%. This species showed moderate use. Purple three-awn (*Aristida purpurea*) and bottlebrush squirreltail (*Sitanion hystrix*) were also present in very low frequencies. The forb component provided 4% cover, and was dominated by storksbill (*Erodium cicutarium*). Euphorbia (*Euphorbia* sp.), bur buttercup (*Ranunculus testiculatus*), and tumblemustard (*Sisymbrium altissimum*) were also sampled in low frequencies. Storksbill and bur buttercup were desiccated when the study was sampled, while euphorbia was still green.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. No key browse species were sampled. Although perennial grasses provided moderate cover, perennial forb cover was very low. The herbaceous understory was dominated by undesirable species such as cheatgrass and storksbill, which has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003).

winter range condition (DCI) - very poor (5) Low potential scale

HERBACEOUS TRENDS --
Management unit 01R, Study no: 11

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron elongatum	182	12.50
G	Aristida purpurea	3	.03
G	Bromus tectorum (a)	485	27.81
Total for Annual Grasses		485	27.81
Total for Perennial Grasses		185	12.53
Total for Grasses		670	40.35
F	Erodium cicutarium (a)	238	3.50
F	Euphorbia sp.	54	.16
F	Ranunculus testiculatus (a)	11	.02
F	Sisymbrium altissimum (a)	2	.01
Total for Annual Forbs		251	3.52
Total for Perennial Forbs		54	0.16
Total for Forbs		305	3.69

BROWSE TRENDS --
Management unit 01R, Study no: 11

Type	Species	Strip Frequency '07	Average Cover % '07
B	Gutierrezia sarothrae	7	.48
Total for Browse		7	0.48

CANOPY COVER, LINE INTERCEPT --
Management unit 01R, Study no: 11

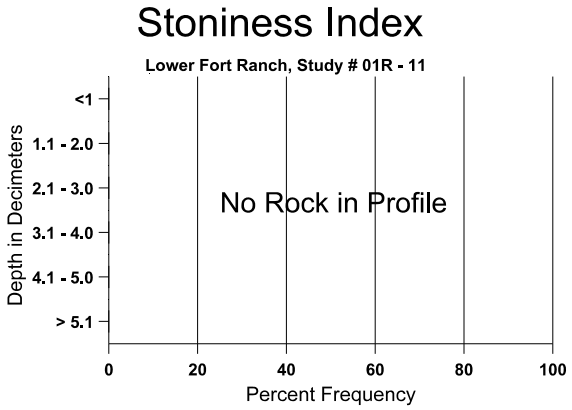
Species	Percent Cover '07
Gutierrezia sarothrae	.36

BASIC COVER --
Management unit 01R, Study no: 11

Cover Type	Average Cover % '07
Vegetation	42.97
Rock	.17
Pavement	2.01
Litter	53.14
Cryptogams	.03
Bare Ground	6.61

SOIL ANALYSIS DATA --
Herd Unit 1R, Study no: 11, Study Name: Lower Fort Ranch

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
4.6	-	7.2	46.2	34.4	19.5	1.9	8.3	486.4	0.6



PELLET GROUP DATA --
Management unit 01R, Study no: 11

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	65	-
Horse	74	100 (246)
Cattle	2	15 (38)

BROWSE CHARACTERISTICS --
Management unit 01R, Study no: 11

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Gutierrezia sarothrae												
07	220	-	20	200	-	-	0	0	-	-	0	10/14

Trend Study 2R-17-07

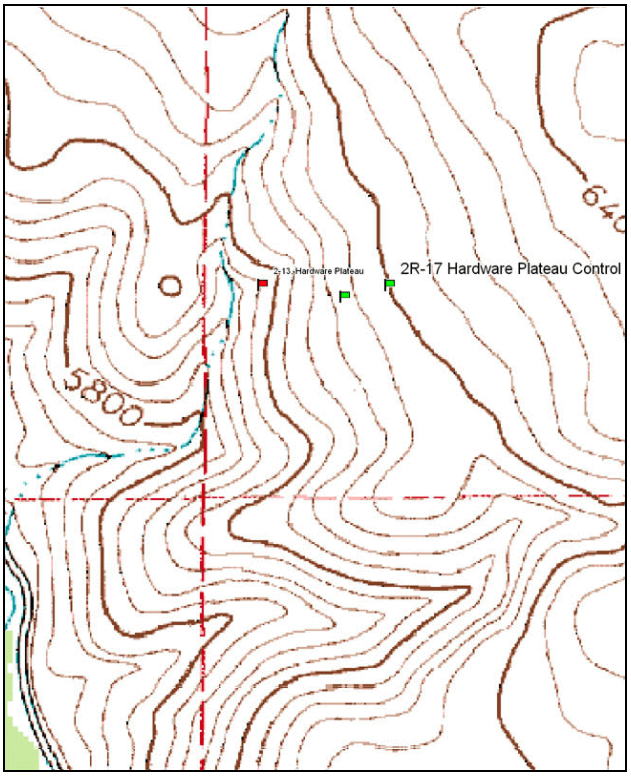
Study site name: Hardware Plateau Control . Vegetation type: Grass/ Mtn. Big Sagebrush.

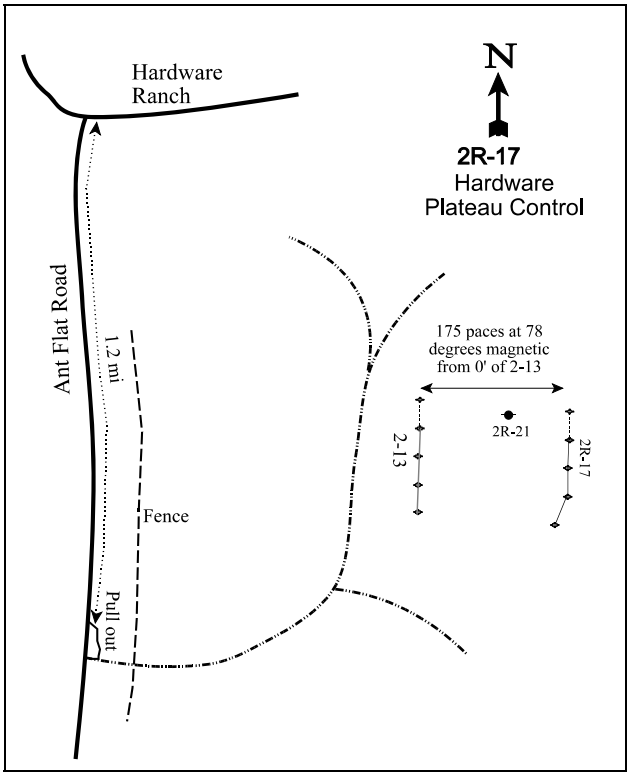
Compass bearing: frequency baseline 145 degrees magnetic.

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

LOCATION DESCRIPTION

From Hardware Ranch, proceed south on the Ant Flat road for 1.2 miles. This mileage should end at a sign that reads: "Welcome to Hardware Ranch Game Management Area." Stop here. Walk up the bottom of the wash (to the east of the sign) 365 paces, to the second very definite fork in the drainage. From the point where the wash divides, walk 32 paces at 80 degrees magnetic to the 0-foot stake for the Hardware Plateau site 02-13, marked by browse tag #7984. From there the 0-foot stake is ~175 paces at 78 degrees magnetic marked with a red browse tag #277.





Map Name: Hardware Ranch

Diagrammatic Sketch

Township 10N , Range 3E , Section 24

GPS: NAD 83, UTM 12T 453603 E 4604170 N

DISCUSSION

Hardware Plateau Control - Trend Study No. 2R-17

Study Information

This study was established on Hardware Plateau approximately 1 mile (1.6 km) southeast of the Hardware Ranch office [elevation: 6,200 feet (1,890 m), slope: 20%, aspect: west]. The closest water source is a spring approximately one-quarter mile (0.4 km) from the study. It was established as part of an intensive grazing project conducted on Hardware Ranch to improve browse composition. As of July 2006, it had been completely excluded from cattle grazing using an electric fence. This study is to act as a control in comparison with the Hardware Plateau Grazed study (2R-21), which is located approximately 200 feet (61 m) to the west and was not excluded from cattle grazing. This study was also sampled in 2006 as a comparison to the permanent Hardware Plateau study (2-13), which is located 570 feet (174 m) to the west. Deer use was estimated at 58 days use/acre (143 ddu/ha) in 2006 and 70 days use/acre (172 ddu/ha) in 2007. Elk use was estimated at 38 days use/acre (94 edu/ha) in 2006 and 68 days use/acre (167 edu/ha) in 2007. Historic cattle use was estimated at 32 days use/acre (79 cdu/ha) in 2006. No fresh cattle pats were sampled in 2006, but a few were sampled in 2007 for an estimated 1 day use/acre (4 cdu/ha).

Soil

The soil is classified within the Yeates Hollow series (USDA-NRCS 2007). The soils in this series are deep and well-drained to moderately well-drained, and are found where bedrock is normally encountered at approximately 4 feet (1.2 m) in depth. Formed in alluvium, colluvium, and residuum from conglomerate, sandstone, and quartzite, these soils have poor permeability and runoff is normally quite rapid. Roots penetrate to bedrock and soil reaction ranges from neutral to slightly acidic (Erickson and Mortensen 1974). The soil texture is loam and the reaction is neutral (pH 7.0). The upper soil profile and surface are rocky. Combined relative rock and pavement cover was 12%-14% in 2006 and 2007, while vegetation, litter, and cryptogamic crust together provided 81%-86% relative cover. Relative bare ground cover was low at 2%-5%. Due to the high protective ground cover, little erosion is occurring. The soil erosion condition was classified as stable in 2006 and 2007.

Browse

Browse is sparse and the preferred species, mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*) provided less than 1% cover combined in 2006 and 2007. Browse densities remained unchanged from 2006 to 2007. Mountain big sagebrush density was 40 plants/acre (99 plants/ha), and bitterbrush and low sagebrush (*Artemisia arbuscula*) densities were 20 plants/acre (49 plants/ha). Bitterbrush and low sagebrush displayed moderate-heavy use, and use on mountain big sagebrush was light-moderate.

Herbaceous Understory

Seven grass species have been sampled on the study, two of which are annuals. The herbaceous understory is dominated by bluebunch wheatgrass (*Agropyron spicatum*), which provided 17%-20% cover in 2006 and 2007. Other abundant perennial grasses include Sandberg bluegrass (*Poa secunda*) and oniongrass (*Melica bulbosa*). The annual grasses, cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*), provided less than 1% cover in 2006 and 2% cover in 2007. Thirty-one forb species have been sampled, 17 of which are annuals. Perennial forbs provided 10%-14% cover in 2006 and 2007. Aster (*Aster* sp.), western yarrow (*Achillea millefolium*), and desert parsley (*Lomatium* sp.) all provided substantial cover. Aster and yellow salsify (*Tragopogon dubius*) were browsed by big game. Although not sampled in any quadrats, Dyer's woad (*Isatis tinctoria*), a noxious weed, was noted as present on the study in 2007. Annual forbs provided 12% cover in 2006 and 22% cover in 2007. The most abundant annuals are storksbill (*Erodium cicutarium*), holosteum (*Holosteum umbellatum*), and draba (*Draba* sp.).

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. Preferred browse cover was very low, although perennial herbaceous cover was excellent. Annual grasses and forbs increased substantially in nested frequency and cover between 2006 and 2007. A noxious weed was also present on the study in 2007.

winter range condition (DCI) - poor (37) Mid-level potential scale

HERBACEOUS TRENDS --
Management unit 02R, Study no: 17

Type	Species	Nested Frequency		Average Cover %	
		'06	'07	'06	'07
G	Agropyron spicatum	305	336	20.13	16.52
G	Bromus japonicus (a)	10	24	.03	.14
G	Bromus tectorum (a)	138	254	.59	1.87
G	Koeleria cristata	1	-	.03	-
G	Melica bulbosa	38	3	1.43	.02
G	Poa bulbosa	11	13	.94	.16
G	Poa secunda	222	268	3.05	4.19
Total for Annual Grasses		148	278	0.62	2.01
Total for Perennial Grasses		577	620	25.60	20.90
Total for Grasses		725	898	26.22	22.91
F	Achillea millefolium	51	52	2.49	1.05
F	Agoseris glauca	69	28	.51	.11
F	Alyssum alyssoides (a)	19	112	.07	.29
F	Allium sp.	28	18	.09	.04
F	Artemisia ludoviciana	1	1	.03	.00
F	Aster sp.	106	117	4.72	4.41
F	Astragalus sp.	8	8	.16	.21
F	Cirsium sp.	-	3	-	.15
F	Collomia linearis (a)	97	130	.29	.38
F	Collinsia parviflora (a)	197	108	.69	.72
F	Crepis acuminata	3	2	.03	.00
F	Descurainia pinnata (a)	-	47	-	.36
F	Draba sp. (a)	63	271	.19	1.20
F	Epilobium brachycarpum (a)	144	32	1.58	.24
F	Eriogonum brevicaule	-	9	-	.07
F	Eriogonum cernuum (a)	91	-	3.90	-
F	Erodium cicutarium (a)	190	388	3.75	11.95
F	Erigeron pumilus	4	-	.30	-

Type	Species	Nested Frequency		Average Cover %	
		'06	'07	'06	'07
F	Galium aparine (a)	2	-	.00	-
F	Gayophytum ramosissimum(a)	-	26	-	.08
F	Hackelia patens	21	15	.54	.14
F	Holosteum umbellatum (a)	196	412	.85	5.70
F	Lappula occidentalis (a)	33	49	.05	.30
F	Lactuca serriola	7	21	.02	.16
F	Lomatium sp.	129	89	4.82	3.34
F	Madia glomerata (a)	3	-	.00	-
F	Microsteris gracilis (a)	89	23	.34	.06
F	Polygonum douglasii (a)	21	51	.05	.08
F	Ranunculus testiculatus (a)	29	14	.11	.03
F	Tragopogon dubius	19	12	.31	.38
F	Unknown forb-annual (a)	-	2	-	.15
Total for Annual Forbs		1174	1665	11.92	21.58
Total for Perennial Forbs		446	375	14.06	10.09
Total for Forbs		1620	2040	25.98	31.68

BROWSE TRENDS --
Management unit 02R, Study no: 17

Type	Species	Strip Frequency		Average Cover %	
		'06	'07	'06	'07
B	Amelanchier alnifolia	0	0	-	-
B	Artemisia arbuscula	1	1	-	-
B	Artemisia tridentata vaseyana	2	2	.38	.63
B	Chrysothamnus viscidiflorus viscidiflorus	0	0	-	-
B	Gutierrezia sarothrae	3	5	.30	.30
B	Purshia tridentata	1	1	.30	.03
Total for Browse		7	9	0.98	0.96

CANOPY COVER, LINE INTERCEPT --
Management unit 02R, Study no: 17

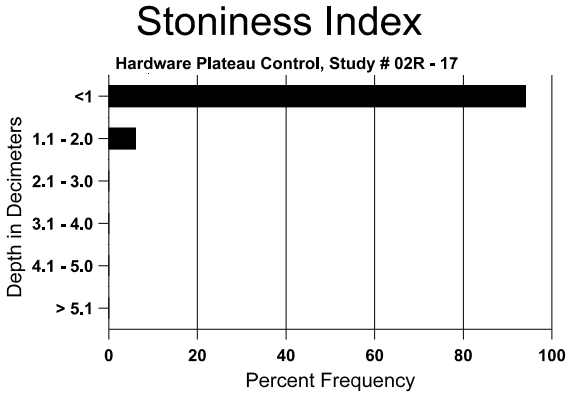
Species	Percent Cover	
	'06	'07
Artemisia tridentata vaseyana	.10	.28
Gutierrezia sarothrae	-	.18
Purshia tridentata	.23	-

BASIC COVER --
Management unit 02R, Study no: 17

Cover Type	Average Cover %	
	'06	'07
Vegetation	46.63	57.70
Rock	13.80	11.41
Pavement	2.02	2.32
Litter	27.45	18.80
Cryptogams	21.06	20.00
Bare Ground	6.31	2.13

SOIL ANALYSIS DATA --
Herd Unit 2R, Study no: 17, Study Name: Hardware Plateau Control

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
5.67	-	7.0	38.6	35.2	26.3	3.1	30.0	332.8	0.8



PELLET GROUP DATA --
Management unit 02R, Study no: 17

Type	Quadrat Frequency		Days use per acre (ha)	
	'06	'07	'06	'07
Rabbit	14	8	-	-
Moose	1	-	-	-
Elk	33	29	38 (94)	68 (167)
Deer	28	37	58 (142)	70 (172)
Cattle	6	4	32 (79)	9 (22)

BROWSE CHARACTERISTICS --
Management unit 02R, Study no: 17

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Amelanchier alnifolia												
06	**0**	-	-	-	-	-	0	0	-	-	0	21/26
07	**0**	-	-	-	-	-	0	0	-	-	0	21/27
Artemisia arbuscula												
06	**20**	-	-	-	20	-	100	0	100	100	100	10/22
07	**20**	-	-	-	20	-	0	100	100	100	100	11/33
Artemisia tridentata vaseyana												
06	**40**	-	-	40	-	120	50	0	0	-	0	30/42
07	**40**	-	-	20	20	120	0	0	50	-	0	25/38
Chrysothamnus viscidiflorus viscidiflorus												
06	**0**	-	-	-	-	-	0	0	-	-	0	9/11
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
06	**140**	-	40	100	-	-	0	0	-	-	0	9/12
07	**160**	-	-	160	-	-	0	0	-	-	0	8/12
Purshia tridentata												
06	**20**	-	-	-	20	20	0	100	100	-	0	32/58
07	**20**	-	-	-	20	-	100	0	100	-	0	34/58

Trend Study 2R-21-07

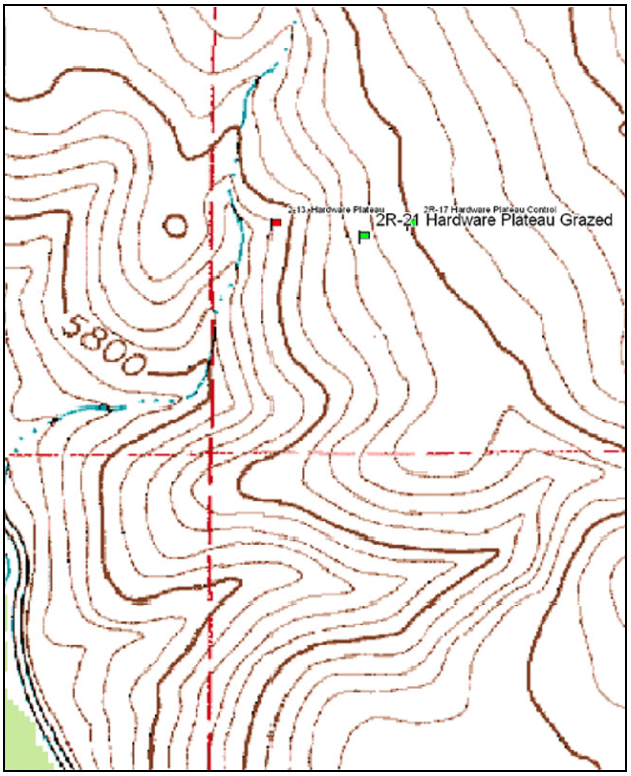
Study site name: Hardware Plateau Grazed . Vegetation type: Grass/Mtn. Big Sagebrush.

Compass bearing: frequency baseline 154 degrees magnetic.

Frequency belt placement: line 1 (11ft & 71 ft), line 2 (59ft), line 3 (34ft & 95ft).

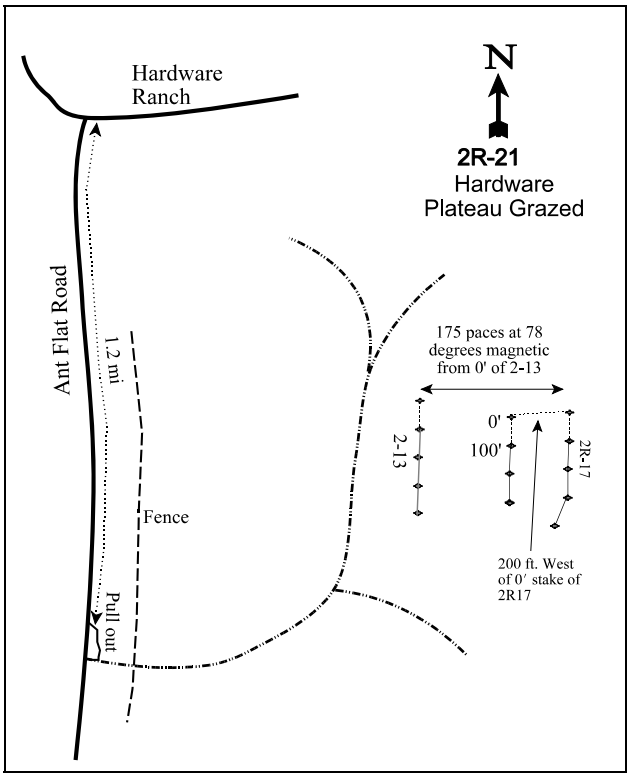
LOCATION DESCRIPTION

From Hardware Ranch proceed south on the Ant Flat road for 1.2 miles. This mileage should end at a sign that reads: "Welcome to Hardware Ranch Game Management Area." Stop here. Walk up the bottom of the wash (to the east of the sign) 365 paces, to the second very definite fork in the drainage. From the point where the wash divides, walk 32 paces at 80 degrees magnetic to the 0-foot stake for the Hardware Plateau site 02-13, marked by browse tag #7984. From there, walk ~175 paces at 78 degrees magnetic to the 0-foot stake for the Hardware Plateau Control site marked with a red browse tag #277. From here, the 0-foot stake is ~200 feet downhill marked with browse tag #196.



Map Name: Hardware Ranch

Township 10N , Range 3E , Section 24



Diagrammatic Sketch

GPS: NAD 83, UTM 12T 453542 E 4604154 N

DISCUSSION

Hardware Plateau Grazed - Trend Study No. 2R-21

Study Information

This study was established on Hardware Plateau approximately 1 mile (1.6 km) southeast of the Hardware Ranch office and approximately 200 feet (61 m) from the Hardware Plateau Control study (2R-17) [elevation: 6,100 feet (1,859 m), slope: 30%, aspect: west]. The closest water source is a spring approximately one-quarter mile (0.4 km) from the study. Both Hardware Plateau studies were established as part of an intensive grazing project conducted on Hardware Ranch to improve browse composition. This study was noted as heavily grazed, while the control study was excluded from cattle grazing by an electric fence. Use was estimated at 13 cattle days use/acre (32 cdu/ha), 43 deer days use/acre (106 ddu/ha), and 46 elk days use/acre (114 edu/ha).

Soil

The soil is classified within the Yeates Hollow series (USDA-NRCS 2007). The soils in this series are deep and well-drained to moderately well-drained, and are found where bedrock is normally encountered at approximately 4 feet (1.2 m) in depth. Formed in alluvium, colluvium, and residuum from conglomerate, sandstone, and quartzite, these soils have poor permeability and runoff is normally quite rapid. Roots penetrate to bedrock and soil reaction ranges from neutral to slightly acidic (Erickson and Mortensen 1974). The soil texture is loam and the reaction is neutral (pH 7.0). The upper soil profile and surface are rocky. Combined relative rock and pavement cover was 8%, while vegetation, litter, and cryptogamic crust together provided 82% relative cover. Relative bare ground cover was 10%. The soil erosion condition was classified as slight due to pedestalling around plants, flow patterns, and evidence of soil movement.

Browse

Several preferred browse species are present, although in very low densities. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) provided little cover, and its density was 40 plants/acre (99 plants/ha). Low sagebrush (*Artemisia arbuscula*) density was 60 plants/acre (148 plants/ha). Serviceberry (*Amelanchier alnifolia*), antelope bitterbrush (*Purshia tridentata*), and red elderberry (*Sambucus racemosa*) were also scattered throughout the study. Sagebrush and serviceberry showed moderate-heavy use.

Herbaceous Understory

Approximately 50% of the herbaceous cover was comprised of grasses, and 50% was comprised of forbs. Grasses provided 21% total cover. Five grass species were sampled, two of which were annuals. Bluebunch wheatgrass (*Agropyron spicatum*) was the dominant grass, providing 12% cover. Sandberg bluegrass (*Poa secunda*) was also abundant, providing 6% cover. Cheatgrass (*Bromus tectorum*) was sampled in 86% of the quadrats, but provided only 3% cover. The forb component was diverse with 26 species sampled, and provided 22% cover in 2007. Half of the species sampled were perennials, however, these species provided very little cover. Annuals comprised 90% of the total forb cover. The most abundant species were storksbill (*Erodium cicutarium*), holosteum (*Holosteum umbellatum*), and draba (*Draba* sp.).

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Preferred browse cover was very low. The grass component was favorable, with high perennial cover and low annual cover. However, perennial forb cover was low. The forb component was dominated by storksbill, which has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003).

winter range condition (DCI) - very poor (32) Mid-level potential scale

HERBACEOUS TRENDS --
Management unit 02R, Study no: 21

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron spicatum	282	12.26
G	Bromus japonicus (a)	1	.01
G	Bromus tectorum (a)	268	2.50
G	Poa bulbosa	14	.39
G	Poa secunda	263	5.55
Total for Annual Grasses		269	2.51
Total for Perennial Grasses		559	18.21
Total for Grasses		828	20.73
F	Achillea millefolium	69	.90
F	Agoseris glauca	43	.15
F	Alyssum alyssoides (a)	141	.49
F	Allium sp.	3	.00
F	Antennaria rosea	1	.00
F	Aster sp.	24	.35
F	Astragalus sp.	2	.00
F	Cirsium sp.	2	.15
F	Collomia linearis (a)	139	.32
F	Collinsia parviflora (a)	123	.51
F	Descurainia pinnata (a)	12	.05
F	Draba sp. (a)	319	1.81
F	Epilobium brachycarpum (a)	18	.05
F	Eriogonum brevicaule	2	.01
F	Erodium cicutarium (a)	398	11.78
F	Erigeron pumilus	1	.00
F	Gayophytum ramosissimum(a)	29	.06
F	Holosteum umbellatum (a)	377	3.72
F	Lappula occidentalis (a)	89	.37
F	Lactuca serriola	12	.06
F	Lomatium sp.	47	.41
F	Microsteris gracilis (a)	34	.09
F	Polygonum douglasii (a)	7	.01
F	Ranunculus testiculatus (a)	66	.24
F	Tragopogon dubius	7	.08
F	Wyethia amplexicaulis	4	.01

Type	Species	Nested Frequency '07	Average Cover % '07
Total for Annual Forbs		1752	19.53
Total for Perennial Forbs		217	2.14
Total for Forbs		1969	21.68

BROWSE TRENDS --
Management unit 02R, Study no: 21

Type	Species	Strip Frequency '07	Average Cover % '07
B	Amelanchier alnifolia	1	-
B	Artemisia arbuscula	2	-
B	Artemisia tridentata vaseyana	2	.03
B	Chrysothamnus viscidiflorus viscidiflorus	1	-
B	Gutierrezia sarothrae	12	.15
B	Purshia tridentata	0	-
B	Sambucus racemosa	0	-
Total for Browse		18	0.18

CANOPY COVER, LINE INTERCEPT --
Management unit 02R, Study no: 21

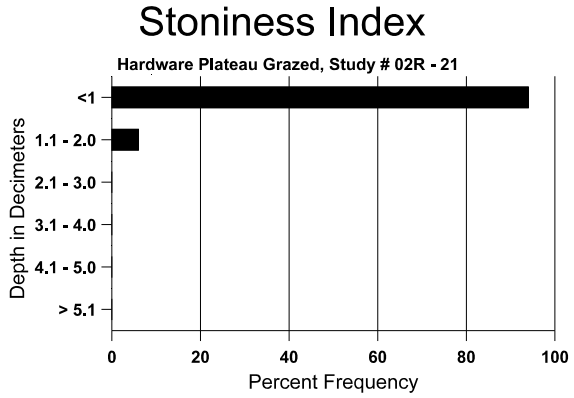
Species	Percent Cover '07
Artemisia arbuscula	.08
Gutierrezia sarothrae	.60

BASIC COVER --
Management unit 02R, Study no: 21

Cover Type	Average Cover % '07
Vegetation	44.73
Rock	5.27
Pavement	3.57
Litter	21.77
Cryptogams	25.54
Bare Ground	11.11

SOIL ANALYSIS DATA --
Herd Unit 2R, Study no: 21, Study Name: Hardware Plateau Grazed

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
5.67	-	7.0	38.6	35.2	26.3	3.1	30.0	332.8	0.8



PELLET GROUP DATA --
Management unit 02R, Study no: 21

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	12	-
Elk	33	46 (114)
Deer	35	43 (106)
Cattle	10	13 (32)

BROWSE CHARACTERISTICS --
Management unit 02R, Study no: 21

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Amelanchier alnifolia												
07	**20**	-	-	20	-	-	0	100	-	-	0	17/19
Artemisia arbuscula												
07	**60**	-	-	60	-	-	100	0	-	-	0	8/19
Artemisia tridentata vaseyana												
07	**40**	-	-	-	40	40	0	50	100	50	50	25/44
Chrysothamnus viscidiflorus viscidiflorus												
07	**20**	-	-	20	-	-	100	0	-	-	0	13/19
Gutierrezia sarothrae												
07	**320**	-	20	300	-	-	31	19	-	-	0	8/13
Purshia tridentata												
07	**0**	-	-	-	-	-	0	0	-	-	0	19/41
Sambucus racemosa												
07	**0**	-	-	-	-	-	0	0	-	-	0	20/44

Summary and Comparison of Hardware Plateau Grazed (2R-21) and Hardware Plateau Control (2R-17)

These studies were established in 2006 and 2007 to monitor the effectiveness of an intensive grazing project on Hardware Ranch. One study was grazed while the other was rested from grazing. The soil, species composition, and aspect were similar for both studies, but the grazed study was approximately 100 feet (30 m) lower in elevation with a slightly steeper slope. There was more evidence of erosion on the grazed study in the form of pedestalling, flow patterns, and soil movement, perhaps due to the steeper slope.

There were few major differences in grass composition, cover, and nested frequency between the two studies, although perennial grass cover and nested frequency were slightly higher on the control study (Figures 1 and 2). Three perennial grass species were sampled on the grazed study, and four were sampled on the control study in 2007. Bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass (*Poa secunda*) were the dominant grasses on both studies. Bulbous bluegrass (*Poa bulbosa*) was also sampled on both studies, but at low nested frequencies and cover. Bulbous bluegrass is a short-lived perennial that has a life cycle similar to that of cheatgrass (Stewart and Hull 1949).

Cheatgrass cover and nested frequency were very similar between the two studies, and were both slightly higher on the grazed study (Figures 1 and 2). Cover was low at less than 3%. Monsen (1994) observed that maintaining a healthy and abundant perennial understory can limit the spread and dominance of cheatgrass, which seems to be the case on these two studies.

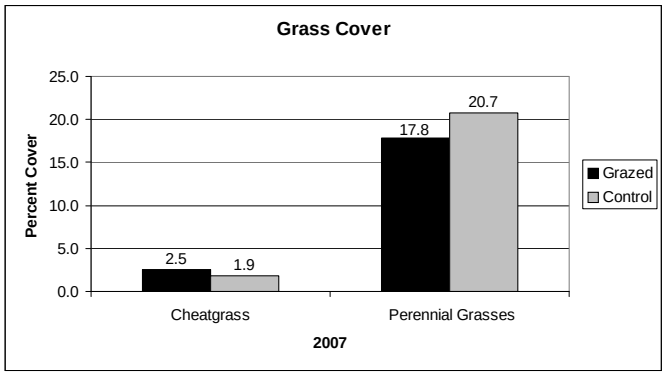


Figure 7. Comparison of pre-treatment cheatgrass and perennial grass cover on the Hardware Plateau studies in 2007, excluding bulbous bluegrass.

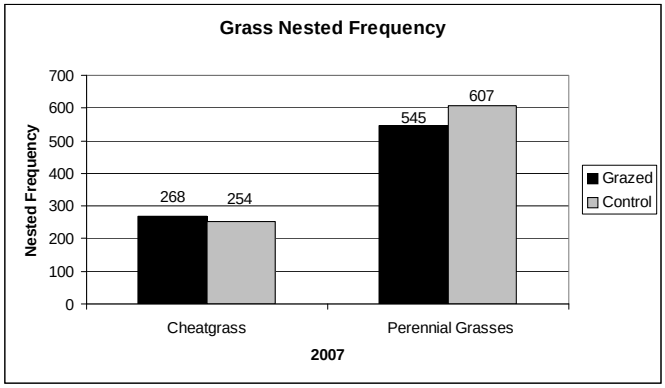


Figure 8. Comparison of pre-treatment cheatgrass and perennial grass nested frequency on the Hardware Plateau studies in 2007, excluding bulbous bluegrass.

Annual forb cover and nested frequency were similar between the two studies, while perennial forb cover and nested frequency were substantially higher on the control study (Figures 3 and 4). Composition was very similar, with 26 forb species sampled on the grazed study and 31 species sampled on the control study. Four more annual species were sampled on the control study. Storksbill (*Erodium cicutarium*), holosteum (*Holosteum umbellatum*), and draba (*Draba* sp.) were the most abundant annuals on both studies, and provided 17% and 19% cover on the grazed and control studies, respectively. The perennial species aster (*Aster* sp.), western yarrow (*Achillea millefolium*), and desert parsley (*Lomatium* sp.) provided 9% cover on the control study. While these species were also present on the grazed study, they only provided approximately 2% cover. Dyer's woad (*Isatis tinctoria*), a perennial noxious weed, was noted on the control study, but not on the grazed study.

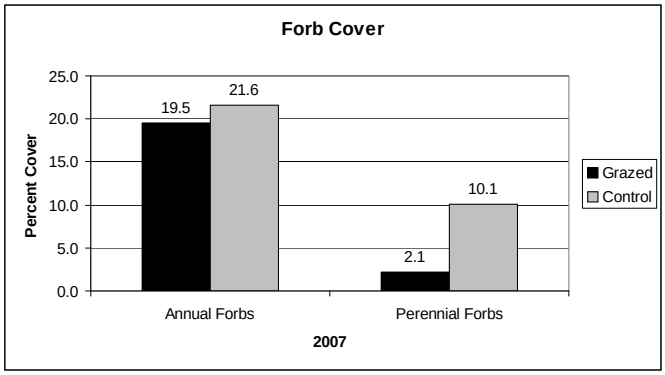


Figure 9. Comparison of pre-treatment annual and perennial forb cover on the Hardware Plateau studies in 2007.

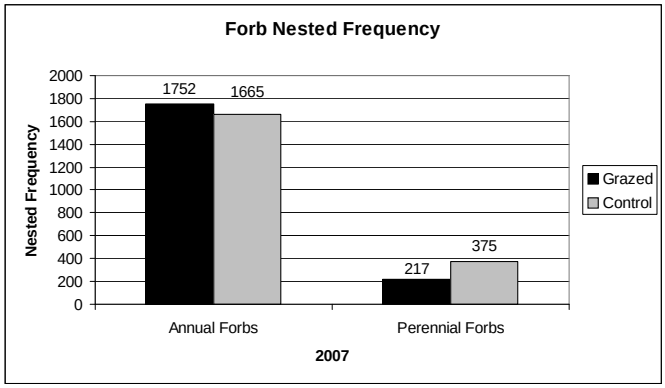


Figure 10. Comparison of pre-treatment annual and perennial forb nested frequency on the Hardware Plateau studies in 2007.

Trend Study 2R-22-07

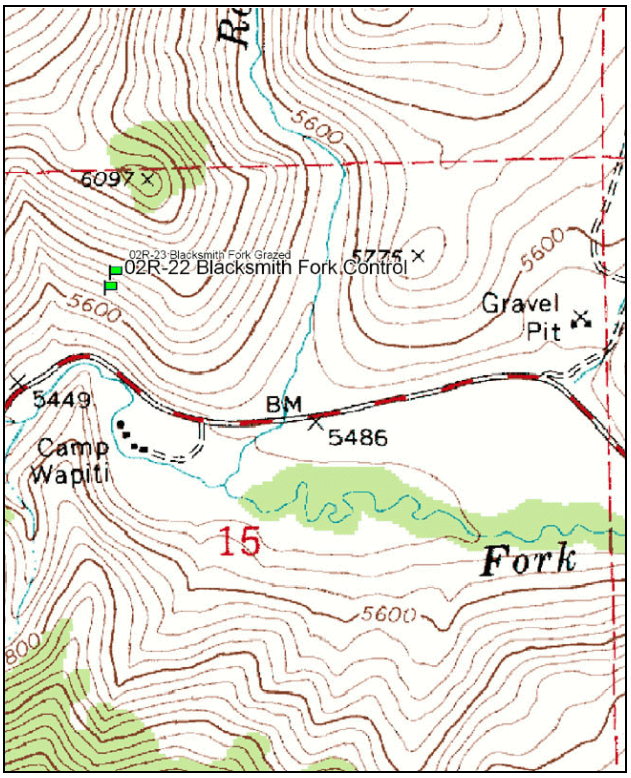
Study site name: Blacksmith Fork Control . Vegetation type: Juniper/Mtn. Big Sagebrush.

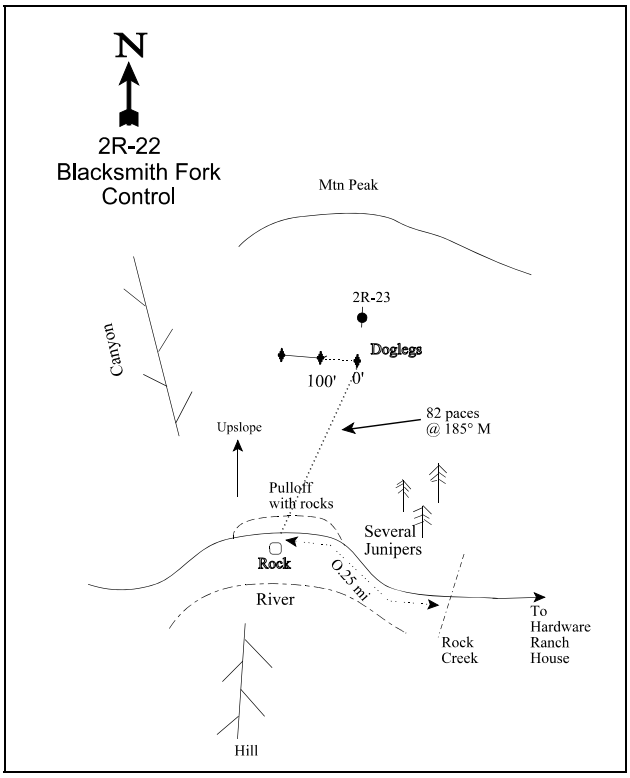
Compass bearing: frequency baseline 280 degrees magnetic.

Frequency belt placement: line 1 (11ft & 59ft & 95ft), line 2 (34ft & 71ft).

LOCATION DESCRIPTION

From Rock Creek, west of Hardware Ranch at the top of Blacksmith Fork Canyon, travel west on state road 101 for 0.25 miles to a pull-off on the right side of the road. From here, take a bearing of 185°M and walk upslope ~82 paces to the 0-foot stake marked with browse tag # 197.





Map Name: Hardware Ranch

Township 10N , Range 3E , Section 15

Diagrammatic Sketch

GPS: NAD 83, UTM 12T 450675 E 4606406 N

DISCUSSION

Blacksmith Fork Control - Trend Study No. 2R-22

Study Information

This study was established in Blacksmith Fork Canyon approximately 1.4 miles (2.3 km) northwest of the Hardware Ranch office [elevation: 5,670 feet (1,728 m), slope: 40%, aspect: south]. The closest water source is a river approximately one-quarter mile (0.4 km) from the study. It was established as part of an intensive grazing project conducted on Hardware Ranch to improve browse composition. This study was excluded from cattle grazing using an electric fence, and is to act as a control in comparison with the Blacksmith Fork Grazed study (2R-23), which is located approximately 110 feet (34 m) to the north and was not excluded from cattle grazing. Both studies were included in a treatment in April 2007 in which 500 acres (202 ha) were aerially seeded with browse and forbs to improve winter range for deer and spring/summer habitat for deer and sage-grouse. Use was estimated at 2 deer days use/acre (5 ddu/ha) and 11 cattle days use/acre (27 cdu/ha). The study was heavily grazed before it was excluded, and four deer were observed just west of the study.

Soil

The soil is classified within the Yeates Hollow series (USDA-NRCS 2007). The soils in this series are deep and well-drained to moderately well-drained, and are found where bedrock is normally encountered at approximately 4 feet (1.2 m) in depth. Formed in alluvium, colluvium, and residuum from conglomerate, sandstone, and quartzite, these soils have poor permeability and runoff is normally quite rapid. Roots penetrate to bedrock and soil reaction ranges from neutral to slightly acidic (Erickson and Mortensen 1974). Textural and chemical analyses identified the soil as a medium loam with a slightly acidic reaction (pH 6.5). The soil phosphorus is high at 29.8 ppm, and potassium is also high at 387.2 ppm (Tiedemann and Lopez 2004). The upper soil profile and surface are rocky. Rock provided 42% relative ground cover. Vegetation and litter comprised 41% of the relative ground cover, and bare ground provided 15%. The soil was described as very compact, and the erosion condition was classified as stable.

Browse

Browse is sparse, and provided a total of 3% cover in 2007. The only preferred browse species sampled within the density strips were mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and Woods' rose (*Rosa woodsii*), both of which had a density of 40 plants/acre (99 plants/ha). Use was moderate-heavy on sagebrush and light on Woods' rose. Average leader growth on sagebrush was 1.6 inches (4 cm). Other preferred browse, such as true mountain mahogany (*Cercocarpus montanus*) and currant (*Ribes* sp.), were scattered throughout the study. The most numerous browse species was Oregon grape (*Mahonia repens*), which was sampled at a density of 17,540 plants/acre (43,341 plants/ha). Oregon grape plants showed an insect infestation.

Herbaceous Understory

Grasses provided only a small portion of the understory cover. Four grass species were sampled. Bluebunch wheatgrass (*Agropyron spicatum*) and Great Basin wildrye (*Elymus cinereus*) were the only perennial species sampled, and provided 1% cover. Bluebunch wheatgrass was heavily grazed. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) provided 3% cover. Forbs comprised 20% of the total ground cover. Nineteen forb species were sampled, eight of which were annuals. Storksbill (*Erodium cicutarium*) was the most abundant forb, and provided 12% cover. Two perennial noxious weeds, Dyer's woad (*Isatis tinctoria*) and common houndstongue (*Cynoglossum officinale*), provided approximately 3% combined cover. American vetch (*Vicia americana*), prickly lettuce (*Lactuca serriola*), cudweed sagewort (*Artemisia ludoviciana*), and western yarrow (*Achillea millefolium*) were also relatively abundant.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Preferred browse cover was very low. The grass component was poor, with low diversity and cheatgrass providing two-thirds of the total grass cover. The forb component was dominated by undesirable and noxious species such as storksbill, Dyer's woad, and houndstongue. Storksbill has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003).

winter range condition (DCI) - very poor (5) Mid-level potential scale

HERBACEOUS TRENDS --
Management unit 02R, Study no: 22

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron spicatum	52	.50
G	Bromus japonicus (a)	32	.21
G	Bromus tectorum (a)	152	2.51
G	Elymus cinereus	14	.49
Total for Annual Grasses		184	2.73
Total for Perennial Grasses		66	0.99
Total for Grasses		250	3.72
F	Achillea millefolium	27	.46
F	Artemisia ludoviciana	29	.79
F	Cirsium sp.	4	.07
F	Collomia linearis (a)	5	.00
F	Collinsia parviflora (a)	9	.02
F	Cynoglossum officinale	17	.46
F	Epilobium brachycarpum (a)	3	.01
F	Erodium cicutarium (a)	305	11.81
F	Galium aparine (a)	7	.04
F	Isatis tinctoria	145	2.99
F	Lactuca serriola	83	.33
F	Lithospermum ruderale	9	.39
F	Microsteris gracilis (a)	4	.00
F	Polygonum douglasii (a)	1	.03
F	Rumex crispus	4	.01
F	Sisymbrium altissimum (a)	3	.15
F	Tragopogon dubius	5	.02
F	Verbascum thapsus	1	.03
F	Vicia americana	117	2.19

Type	Species	Nested Frequency '07	Average Cover % '07
Total for Annual Forbs		337	12.08
Total for Perennial Forbs		441	7.76
Total for Forbs		778	19.85

BROWSE TRENDS --
Management unit 02R, Study no: 22

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata vaseyana	2	.18
B	Cercocarpus montanus	0	-
B	Juniperus osteosperma	1	.98
B	Mahonia repens	20	1.37
B	Ribes sp.	0	-
B	Rosa woodsii	2	-
Total for Browse		25	2.53

CANOPY COVER, LINE INTERCEPT --
Management unit 02R, Study no: 22

Species	Percent Cover '07
Artemisia tridentata vaseyana	.08
Juniperus osteosperma	4.30
Mahonia repens	1.45

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 02R, Study no: 22

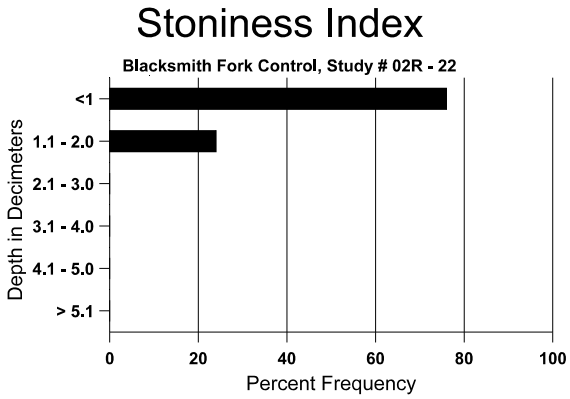
Species	Average leader growth (in) '07
Artemisia tridentata vaseyana	1.6

BASIC COVER --
Management unit 02R, Study no: 22

Cover Type	Average Cover % '07
Vegetation	29.40
Rock	47.14
Pavement	1.73
Litter	17.26
Cryptogams	.01
Bare Ground	16.60

SOIL ANALYSIS DATA --
Herd Unit 2R, Study no: 22, Study Name: Blacksmith Fork Control

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
4.6	-	6.5	45.2	33.4	21.5	2.6	29.8	387.2	0.6



PELLET GROUP DATA --
Management unit 02R, Study no: 22

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Elk	1	-
Deer	2	2 (5)
Cattle	17	11 (27)

BROWSE CHARACTERISTICS --
Management unit 02R, Study no: 22

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata vaseyana												
07	**40**	-	-	20	20	80	50	50	50	-	0	32/45
Cercocarpus montanus												
07	**0**	-	-	-	-	-	0	0	-	-	0	37/42
Juniperus osteosperma												
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Mahonia repens												
07	**17540**	-	240	17300	-	-	13	0	-	-	0	4/4
Ribes sp.												
07	**0**	-	-	-	-	-	0	0	-	-	0	42/46
Rosa woodsii												
07	**40**	-	-	40	-	-	0	0	-	-	0	20/24

Trend Study 2R-23-07

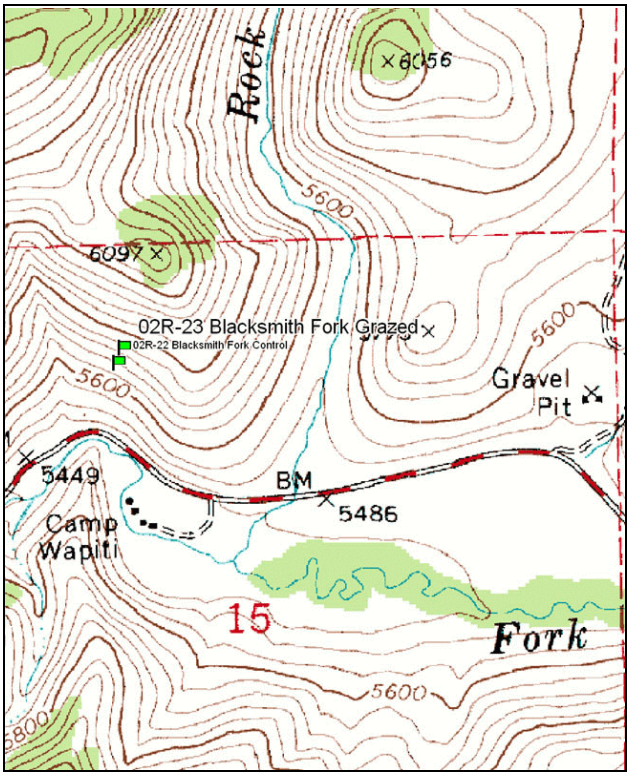
Study site name: Blacksmith Fork Grazed . Vegetation type: Mtn. Big Sagebrush.

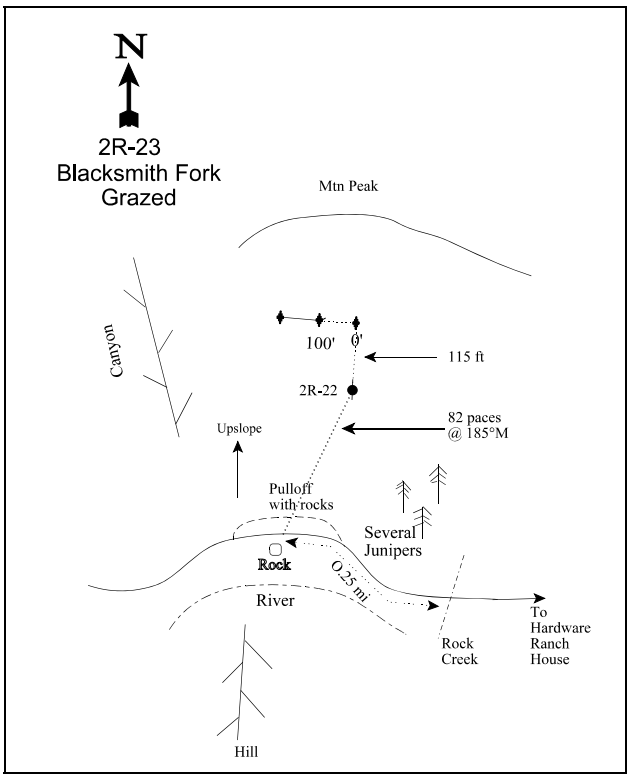
Compass bearing: frequency baseline 280 degrees magnetic.

Frequency belt placement: line 1 (11ft & 95ft), line 2 (34ft & 59ft & 71ft).

LOCATION DESCRIPTION

From Rock Creek, west of Hardware Ranch at the top of Blacksmith Fork Canyon, travel west on state road 101 for 0.25 miles to a pull-off on the right side of the road. From here, take a bearing of 185°M and walk upslope ~82 paces to the 0 foot stake of the Blacksmith Fork Control site (2R-22), marked with browse tag #197. From here, walk upslope ~115 feet to the 0-foot stake marked with browse tag #198.





Map Name: Hardware Ranch

Diagrammatic Sketch

Township 10N , Range 3E , Section 15

GPS: NAD 83, UTM 12T 450686 E 4606439 N

DISCUSSION

Blacksmith Fork Grazed - Trend Study No. 2R-23

Study Information

This study was established in Blacksmith Fork Canyon approximately 1.4 miles (2.3 km) northwest of the Hardware Ranch office [elevation: 5,730 feet (1,747 m), slope: 40%, aspect: south]. The closest water source is a river approximately one-quarter mile (0.4 km) from the study. It was established as part of an intensive grazing project conducted on Hardware Ranch to improve browse composition. This study was grazed intensively with cattle while the Blacksmith Fork Control study (2R-22), located approximately 110 feet (34 m) to the south, was excluded from cattle grazing using an electric fence. Both studies were included in a treatment in April 2007 in which 500 acres (202 ha) were aerially seeded with browse and forbs to improve winter range for deer and spring/summer habitat for deer and sage-grouse. Use was estimated at 7 deer days use/acre (17 ddu/ha), 1 elk day use/acre (2 edu/ha), and 21 cattle days use/acre (52 cdu/ha). The study was very heavily grazed in 2007.

Soil

The soil is classified within the Yeates Hollow series (USDA-NRCS 2007). The soils in this series are deep and well-drained to moderately well-drained, and are found where bedrock is normally encountered at approximately 4 feet (1.2 m) in depth. Formed in alluvium, colluvium, and residuum from conglomerate, sandstone, and quartzite, these soils have poor permeability and runoff is normally quite rapid. Roots penetrate to bedrock and soil reaction ranges from neutral to slightly acidic (Erickson and Mortensen 1974). Textural and chemical analyses identified the soil as a medium loam with a slightly acidic reaction (pH 6.5). The soil phosphorus is high at 29.8 ppm, and potassium is also high at 387.2 ppm (Tiedemann and Lopez 2004). The upper soil profile and surface are rocky. Rock provided 37% relative ground cover. Vegetation and litter comprised 39% of the relative ground cover, and bare ground provided 20%. The soil erosion condition was classified as stable.

Browse

Browse is sparse, and provided a total of 2% cover in 2007. Woods' rose (*Rosa woodsii*) was the most abundant preferred browse species, with a density of 1,860 plants/acre (4,596 plants/ha). Young plants comprised 73% of the population, and use was light-moderate. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) density was 80 plants/acre (198 plants/ha), and also showed light-moderate use. Average leader growth on sagebrush was 1.9 inches (4.9 cm). Currant (*Ribes* sp.) plants were scattered throughout the study. The most numerous browse species was Oregon grape (*Mahonia repens*), which was sampled at a density of 9,900 plants/acre (24,463 plants/ha).

Herbaceous Understory

Grasses provided only a small portion of the understory cover. Three grass species were sampled. Bluebunch wheatgrass (*Agropyron spicatum*) was the only perennial species sampled, and provided less than 1% cover. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) provided 4% cover. Forbs comprised 18% of the total ground cover. Twenty-four forb species were sampled, 13 of which were annuals. Storksbill (*Erodium cicutarium*) was the most abundant forb, and provided 15% cover. Two perennial noxious weeds, Dyer's woad (*Isatis tinctoria*) and common houndstongue (*Cynoglossum officinale*), were present but provided less than 1% combined cover. Cudweed sagewort (*Artemisia ludoviciana*), prickly lettuce (*Lactuca serriola*), western yarrow (*Achillea millefolium*), and American vetch (*Vicia americana*) were also relatively abundant.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Preferred browse cover was very low. The grass component was poor, with low diversity and cheatgrass providing 82% of the total grass cover. The forb component was dominated by storksbill, an undesirable annual. Storksbill

has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003). Two noxious weeds were also sampled.

winter range condition (DCI) - very poor (1) Mid-level potential scale

HERBACEOUS TRENDS --
Management unit 02R, Study no: 23

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron spicatum	88	.66
G	Bromus japonicus (a)	26	.10
G	Bromus tectorum (a)	297	3.48
Total for Annual Grasses		323	3.59
Total for Perennial Grasses		88	0.67
Total for Grasses		411	4.26
F	Achillea millefolium	42	.90
F	Alyssum alyssoides (a)	51	.14
F	Artemisia ludoviciana	54	1.22
F	Camelina microcarpa (a)	5	.01
F	Cirsium sp.	5	.06
F	Collomia linearis (a)	4	.01
F	Cynoglossum officinale	3	.03
F	Descurainia pinnata (a)	-	.00
F	Draba sp. (a)	1	.03
F	Epilobium brachycarpum (a)	5	.04
F	Erodium cicutarium (a)	349	14.50
F	Galium aparine (a)	2	.03
F	Holosteum umbellatum (a)	10	.03
F	Isatis tinctoria	119	.46
F	Lappula occidentalis (a)	30	.19
F	Lactuca serriola	40	.12
F	Lomatium sp.	5	.00
F	Lupinus argenteus	1	.00
F	Microsteris gracilis (a)	2	.00
F	Polygonum douglasii (a)	2	.00
F	Polemoniaceae	8	.04
F	Ranunculus testiculatus (a)	2	.01
F	Tragopogon dubius	5	.04
F	Vicia americana	31	.27

Type	Species	Nested Frequency '07	Average Cover % '07
Total for Annual Forbs		463	15.01
Total for Perennial Forbs		313	3.16
Total for Forbs		776	18.18

BROWSE TRENDS --
Management unit 02R, Study no: 23

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata vaseyana	4	.50
B	Gutierrezia sarothrae	1	-
B	Juniperus osteosperma	1	-
B	Mahonia repens	14	.66
B	Ribes sp.	0	-
B	Rosa woodsii	9	.51
Total for Browse		29	1.67

CANOPY COVER, LINE INTERCEPT --
Management unit 02R, Study no: 23

Species	Percent Cover '07
Artemisia tridentata vaseyana	.76
Juniperus osteosperma	5.59
Mahonia repens	1.29
Rosa woodsii	.50

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 02R, Study no: 23

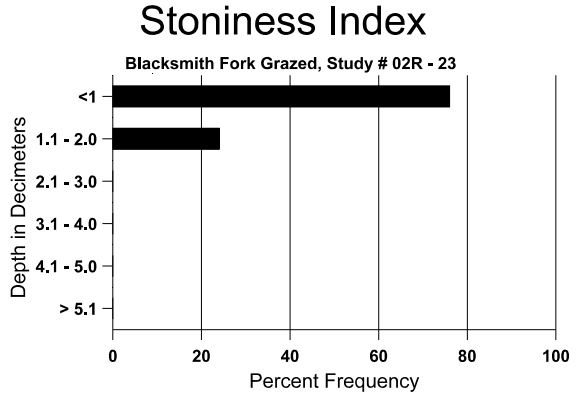
Species	Average leader growth (in) '07
Artemisia tridentata vaseyana	1.9

BASIC COVER --
Management unit 02R, Study no: 23

Cover Type	Average Cover % '07
Vegetation	26.35
Rock	40.64
Pavement	3.76
Litter	15.83
Cryptogams	.07
Bare Ground	22.20

SOIL ANALYSIS DATA --
Herd Unit 2R, Study no: 23, Study Name: Blacksmith Fork Grazed

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
4.6	-	6.5	45.2	33.4	21.5	2.6	29.8	387.2	0.6



PELLET GROUP DATA --
Management unit 02R, Study no: 23

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Elk	4	1 (2)
Deer	7	7 (17)
Cattle	17	21 (52)

BROWSE CHARACTERISTICS --
Management unit 02R, Study no: 23

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata vaseyana												
07	**80**	-	20	40	20	20	25	0	25	-	0	31/52
Gutierrezia sarothrae												
07	**20**	-	-	20	-	-	0	0	-	-	0	4/5
Juniperus osteosperma												
07	**20**	-	-	20	-	-	0	100	-	-	0	-/-
Mahonia repens												
07	**9900**	-	200	9660	40	-	0	5	0	-	0	2/3
Ribes sp.												
07	**0**	-	-	-	-	-	0	0	-	-	0	32/25
Rosa woodsii												
07	**1860**	-	1360	500	-	-	33	5	-	-	0	23/15

Summary and Comparison of Blacksmith Fork Grazed (2R-23) and Blacksmith Fork Control (2R-22)

These studies were established in 2007 to monitor the effects of intensive cattle grazing on a seeding treatment on Hardware Ranch (Table 1). Seed was applied to the south-facing slope of Blacksmith Fork Canyon from Rock Creek west to North Cottonwood Canyon from a fixed-wing airplane in April 2007. The total area of the seeding was 500 acres (202 ha), and the seed application rate was 13 lbs/acre (14.6 kg/ha). One study was grazed heavily, while the other was excluded from grazing by an electric fence. However, the fence was constructed after cattle had already grazed the study to some extent. The soil, species composition, slope, and aspect were similar for both studies, but the grazed study was approximately 60 feet (18 m) higher in elevation.

Table 1. Seed mix applied to Blacksmith Fork studies in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Western Yarrow	100	1
Rocky Mountain Beeplant	100	1
Blue Flax "Appar"	250	4
Alfalfa "Ladak"	350	5
Alfalfa "Ranger"	350	5
Alfalfa "Spredor 4"	350	5
Sainfoin "Eski"	2,000	29
Small Burnet "Delar"	2,500	37
Mountain Sagebrush	240	4
Curl-leaf Mountain Mahogany	61	1
Forage Kochia	500	7
Bitterbrush	25	1
Total	6,826	100

Perennial grass composition, cover, and nested frequency were very similar between the two studies (Figures 1 and 2). Bluebunch wheatgrass (*Agropyron spicatum*) was the only perennial grass sampled on the grazed study, while bluebunch wheatgrass and Great Basin wildrye (*Elymus cinereus*) were sampled on the control study. Perennial grass cover and nested frequency were very low. Cheatgrass cover and nested frequency were higher than perennial grass cover and nested frequency on both studies (Figures 1 and 2). The cover and nested frequency of cheatgrass were also higher on the grazed study than the control study.

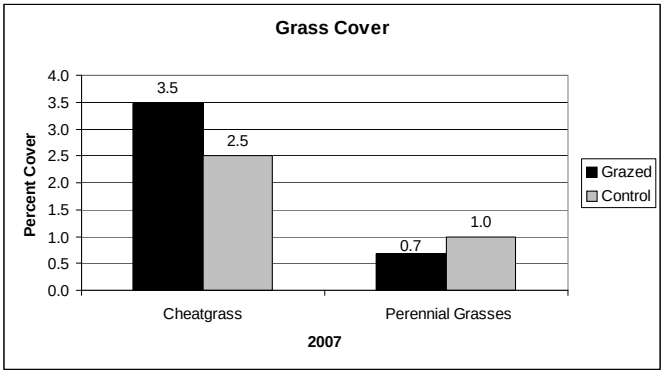


Figure 1. Comparison of pre-treatment cheatgrass and perennial grass cover on the Blacksmith Fork studies in 2007.

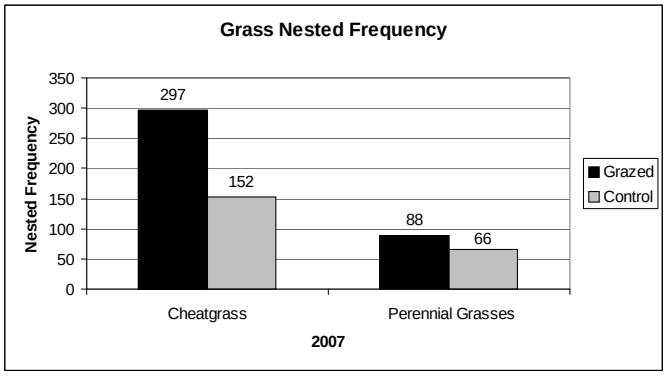


Figure 2. Comparison of pre-treatment cheatgrass and perennial grass cover on the Blacksmith Fork studies in 2007.

Annual forb cover and nested frequency were greater on the grazed study than the control study, while perennial forb cover and nested frequency were greater on the control study than the grazed study (Figures 3 and 4). Composition was very similar, with 24 forb species sampled on the grazed study and 19 species sampled on the control study. Five more annual species were sampled on the grazed study. Storksbill (*Erodium cicutarium*) was the most abundant forb on both studies, providing 15% cover on the grazed study and 12% cover on the control study. American vetch (*Vicia americana*), cudweed sagewort (*Artemisia ludoviciana*), prickly lettuce (*Lactuca serriola*), and western yarrow (*Achillea millefolium*) were also relatively common on both studies. Two perennial noxious weeds, Dyer's woad (*Isatis tinctoria*) and common houndstongue (*Cynoglossum officinale*), were present on both studies but were more abundant on the control study.

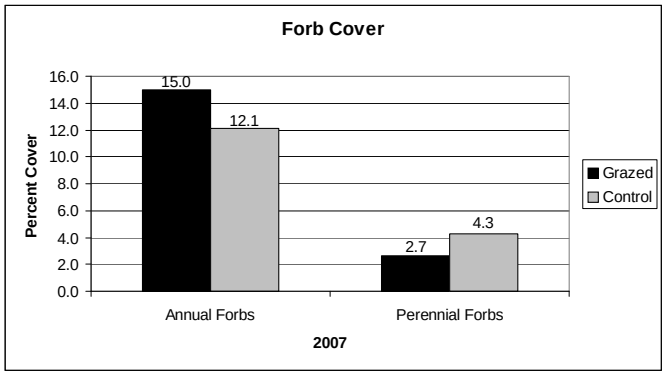


Figure 3. Comparison of pre-treatment annual and perennial forb cover on the Blacksmith Fork studies in 2007, excluding noxious weeds.

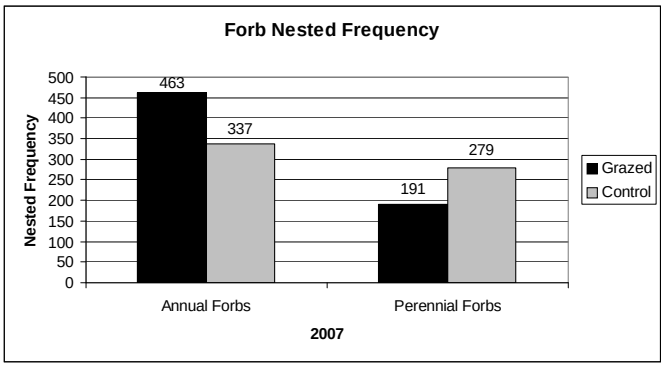


Figure 4. Comparison of pre-treatment annual and perennial forb nested frequency on the Blacksmith Fork studies in 2007, excluding noxious weeds.

Trend Study 6R-3-07

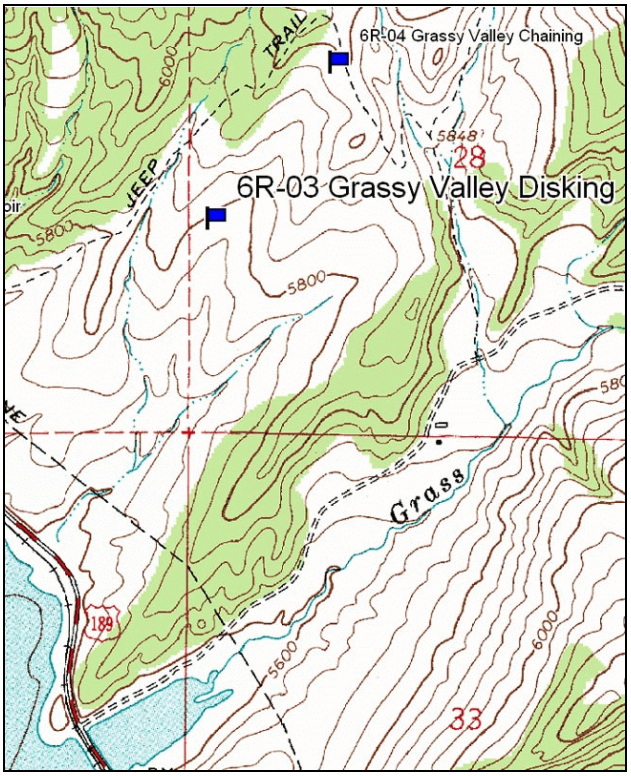
Study site name: Grassy Valley Disking . Vegetation type: Basin Big Sagebrush .

Compass bearing: frequency baseline 76 degrees magnetic.

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

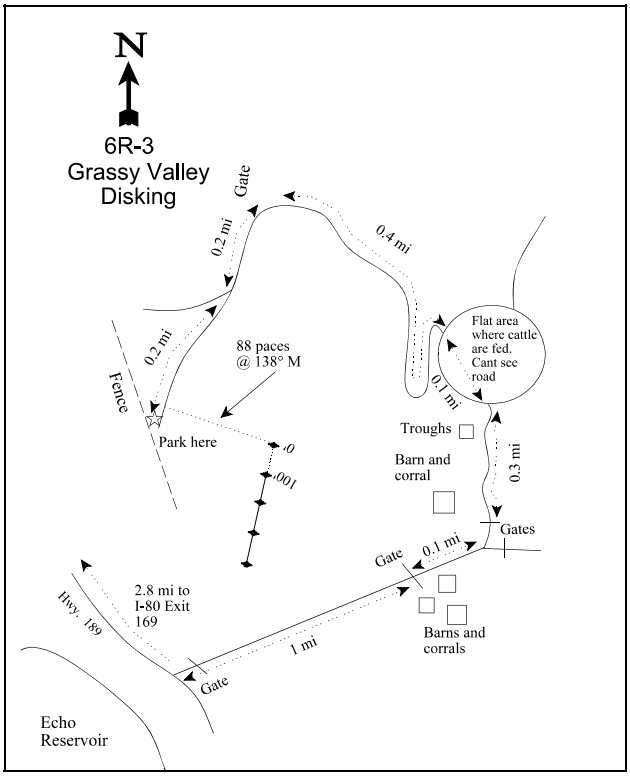
LOCATION DESCRIPTION

From exit 169 of I-80, travel southeast on highway 189 for 2.8 miles to a road with a locked gate on the left. Turn here through the gate and go 1 mile to another gate. From this gate, go 0.1 mile passing some barns and corrals on the right, then some more corrals on the left to a pair of gates. Take the left gate and travel 0.3 miles to a large flat area where cattle are fed, here the road disappears. Travel northeast 0.1 mile across the flat area to the bottom of the hill. Here the road returns. Travel 0.3 miles to the witness post for Grassy Valley Chaining (6R-4) on the left side of the road. From here go 0.1 mile. You will see a gate in front of you, but will stay on the road and head down the ridge 0.2 miles to a fork. From here, stay left and go another 0.2 miles where the road dead ends. From here take a bearing of 138 degrees magnetic and walk 88 paces to the 0-foot stake marked with browse tag #117.



Map Name: Coalville

Township 7S , Range 24E , Section 25



Diagrammatic Sketch

GPS: NAD 83, UTM 12T 466634 E 4534758 N

DISCUSSION

Grassy Valley Disking - Trend Study No. 6R-3

Study Information

This study was established in 2007 to monitor a deer habitat restoration project approximately 0.6 miles (1 km) northeast of Echo Reservoir in Grass Valley Canyon [elevation: 5,800 feet (1,768 m), slope: 12%, aspect: southeast]. This area of Summit County has been identified by the UDWR Northern Region Habitat Section as a high priority area for deer habitat restoration to mitigate ongoing habitat loss in other parts of the county. Encroaching juniper will be thinned in a mosaic pattern using an Ely chain, and some areas will be seeded using a rangeland drill. Herbicide may be applied in the future to control invasive annual species. This project will increase the quality of year-round deer habitat. Use was estimated at 40 deer days use/acre (99 ddu/ha), 11 elk days use/acre (28 edu/ha), 15 cattle days use/acre (36 cdu/ha), and 3 horse days use/acre (7 hdu/ha). Deer and elk pellet groups were mostly from winter and spring use, although there was some summer deer use. A dead deer was observed on the study in 2007. Cattle pats were from spring and early summer use, and horses were present during the 2007 reading.

Soil

The soil is classified within the Fewkes series (USDA-NRCS 2007). The soils in this series are very deep, well-drained, and formed in slope alluvium, residuum, and colluvium derived from quartzite, sandstone, and shale. Textural and chemical analyses identified the soil as a clay loam with a neutral reaction (pH 7.1). Soil phosphorus and potassium are both high at 14.6 ppm and 252.8 ppm (Tiedemann and Lopez 2004). Vegetation, litter, and bare ground each comprised approximately one-third of the relative ground cover. The soil was heavily trampled, compacted, and uneven in 2007. The erosion condition was classified as slight due to flow patterns, gullies, and evidence of soil movement.

Browse

Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) is the dominant preferred browse species, and provided 6% of the total ground cover and 10% canopy cover in 2007. Sagebrush density was 1,160 plants/acre (2,866 plants/ha). Sixty-nine percent of the population was mature, 12% was comprised of young plants, and 19% was decadent. Seedlings were also sampled at a density of 160 plants/acre (395 plants/ha), and the density of dead plants was low at 40 plants/acre (99 plants/ha). Vigor was excellent, although some plants were infested with the sagebrush defoliator moth (*Aroga websteri*). Approximately half of the population showed moderate-heavy use. Average annual leader growth was 2.4 inches (6.1 cm). Dwarf rabbitbrush (*Chrysothamnus depressus*) and Woods' rose (*Rosa woodsii*) are also present in very low densities.

Herbaceous Understory

The understory is dominated by perennial grasses. Crested wheatgrass (*Agropyron spicatum*) and western wheatgrass (*Agropyron smithii*) together provided 15% cover in 2007, and crested wheatgrass was grazed heavily. Kentucky bluegrass (*Poa pratensis*) and Sandberg bluegrass (*Poa secunda*) occur infrequently. Japanese brome (*Bromus japonicus*) was the most abundant annual grass, and provided 7% cover. Cheatgrass (*Bromus tectorum*) and rattlesnake brome (*Bromus brizaeformis*) were also sampled in lower frequencies.

Twelve forb species were sampled, seven of which were annuals. Total forb cover was 3% in 2007, and annuals provided 89% of the total forb cover. Pale alyssum (*Alyssum alyssoides*) and storksbill (*Erodium cicutarium*) were the most abundant forbs. Storksbill has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003). The most abundant perennial forb was scarlet globemallow (*Sphaeralcea coccinea*), which was sampled in 11 quadrats. Field bindweed (*Convolvulus arvensis*), a noxious weed, was sampled in six quadrats, but provided very little cover.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is fair-good. Sagebrush cover was low and decadence was moderately high, but young recruitment was favorable. Perennial grass cover was high, however, annual grass cover was also high. Perennial forb cover was close to 0%, and a noxious weed was sampled.

winter range condition (DCI) - fair-good (46) Low potential scale

HERBACEOUS TRENDS --
Management unit 06R, Study no: 3

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron cristatum	261	12.21
G	Agropyron smithii	154	3.00
G	Bromus brizaeformis (a)	14	.02
G	Bromus japonicus (a)	399	7.09
G	Bromus tectorum (a)	134	1.10
G	Poa pratensis	23	.80
G	Poa secunda	2	.03
Total for Annual Grasses		547	8.22
Total for Perennial Grasses		440	16.04
Total for Grasses		987	24.26
F	Alyssum alyssoides (a)	334	1.12
F	Cirsium sp.	2	.03
F	Convolvulus arvensis	19	.08
F	Collinsia parviflora (a)	3	.00
F	Epilobium brachycarpum (a)	4	.01
F	Erodium cicutarium (a)	56	1.35
F	Erigeron sp.	1	.03
F	Gayophytum ramosissimum(a)	4	.01
F	Grindelia squarrosa	9	.02
F	Holosteum umbellatum (a)	2	.00
F	Ranunculus testiculatus (a)	60	.17
F	Sphaeralcea coccinea	23	.18
Total for Annual Forbs		463	2.68
Total for Perennial Forbs		54	0.33
Total for Forbs		517	3.02

BROWSE TRENDS --
Management unit 06R, Study no: 3

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata tridentata	32	6.34
B	Chrysothamnus depressus	0	-
B	Chrysothamnus nauseosus	0	-
B	Chrysothamnus viscidiflorus viscidiflorus	2	.03
B	Gutierrezia sarothrae	47	.30
Total for Browse		81	6.68

CANOPY COVER, LINE INTERCEPT --
Management unit 06R, Study no: 3

Species	Percent Cover '07
Artemisia tridentata tridentata	9.66
Gutierrezia sarothrae	.41

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 06R, Study no: 3

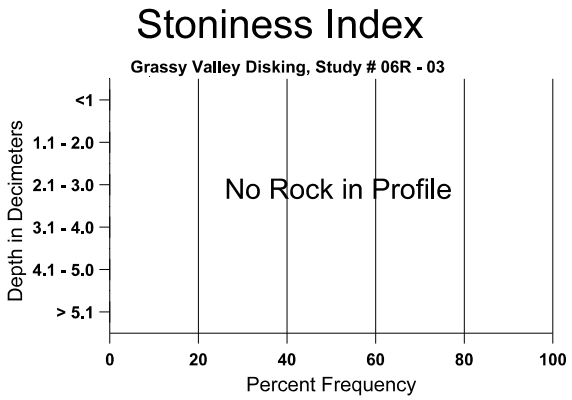
Species	Average leader growth (in) '07
Artemisia tridentata tridentata	2.4

BASIC COVER --
Management unit 06R, Study no: 3

Cover Type	Average Cover % '07
Vegetation	39.08
Pavement	.45
Litter	41.37
Cryptogams	.31
Bare Ground	36.66

SOIL ANALYSIS DATA --
Herd Unit 6R, Study no: 3, Study Name: Grassy Valley Disking

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
8.7	-	7.1	40.2	30.4	29.5	2.3	14.6	252.8	0.4



PELLET GROUP DATA --
Management unit 06R, Study no: 3

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	29	-
Horse	3	3 (7)
Elk	6	11 (28)
Deer	26	40 (99)
Cattle	15	15 (36)

BROWSE CHARACTERISTICS --
Management unit 06R, Study no: 3

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata tridentata												
07	**1160**	160	140	800	220	40	19	29	19	-	0	35/38
Chrysothamnus depressus												
07	**0**	-	-	-	-	-	0	0	-	-	0	17/21
Chrysothamnus nauseosus												
07	**0**	-	-	-	-	-	0	0	-	-	0	28/37
Chrysothamnus viscidiflorus viscidiflorus												
07	**40**	-	-	40	-	-	50	0	-	-	0	11/20

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Gutierrezia sarothrae												
07	**1540**	-	120	1420	-	20	4	0	-	-	0	6/6

Trend Study 6R-4-07

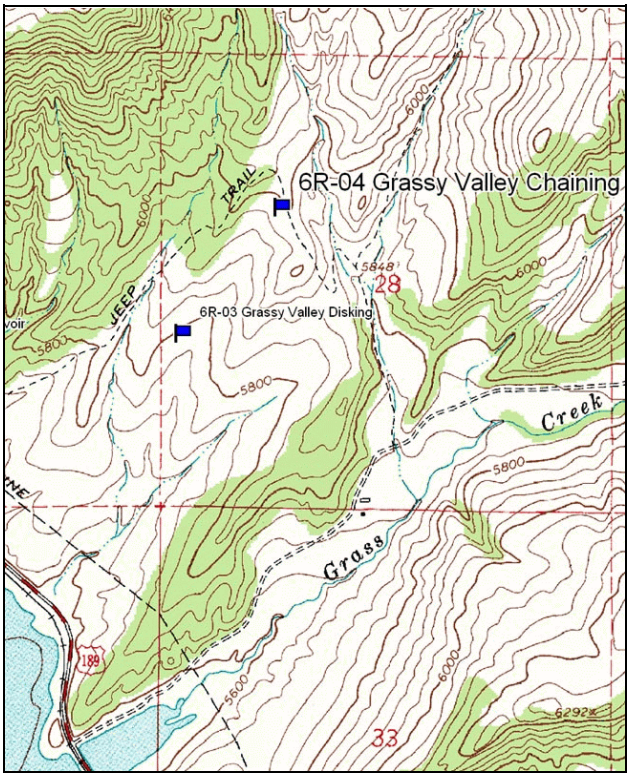
Study site name: Grassy Valley Chaining . Vegetation type: P-J/ WY Big Sagebrush .

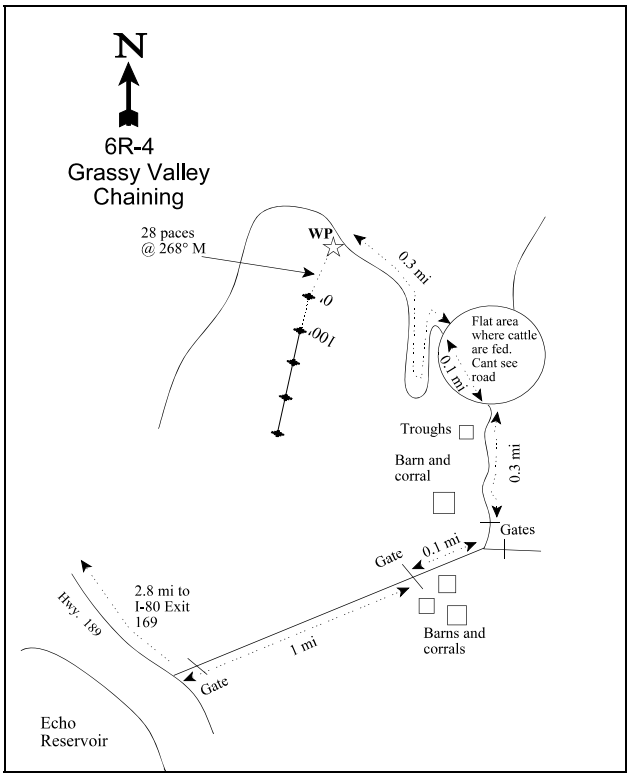
Compass bearing: frequency baseline 195 degrees magnetic.

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

LOCATION DESCRIPTION

From exit 169 of I-80 travel southeast on highway 189 for 2.8 miles to a road with a locked gate on the left. Turn here through the gate and go 1 mile to another gate. From this gate, go 0.1 mile passing some barns and corrals on the right, then some more corrals on the left to a pair of gates. Take the left gate and travel 0.3 miles to a large flat area where cattle are fed, here the road disappears. Travel northeast 0.1 mile across the flat area to the bottom of the hill. Here the road returns. Travel 0.3 miles to the witness post on the left side of the road. The 0-foot stake is 28 paces at 268 degrees magnetic, marked with browse tag #116.





Map Name: Coalville

Diagrammatic Sketch

Township 7S , Range 24E , Section 25

GPS: NAD 83, UTM 12T 466988 E 4535202 N

DISCUSSION

Grassy Valley Chaining - Trend Study No. 6R-4

Study Information

This study was established in 2007 to monitor a deer habitat restoration project approximately 1 mile (1.6 km) northeast of Echo Reservoir in Grass Valley Canyon [elevation: 6,000 feet (1,829 m), slope: 18%, aspect: southwest]. Juniper (*Juniperus osteosperma*) encroachment in this area has resulted in the degradation of deer wintering habitat. The juniper will be thinned in a mosaic pattern using an Ely chain, and some areas will be seeded using a rangeland drill. Herbicide may be applied in the future to control invasive annual species. This project will increase the quality of year-round deer habitat. Use was estimated at 57 deer days use/acre (141 ddu/ha), 9 elk days use/acre (22 edu/ha), 21 cattle days use/acre (52 cdu/ha), and 12 horse days use/acre (30 hdu/ha). Deer bones were found in 2007, and most of the use was noted on the northern side of the study.

Soil

The soil is classified within the Fewkes series (USDA-NRCS 2007). The soils in this series are very deep, well-drained, and formed in slope alluvium, residuum, and colluvium derived from quartzite, sandstone, and shale. Textural and chemical analyses identified the soil as a clay loam with a neutral reaction (pH 6.7). Soil phosphorus and potassium are both high at 15.5 ppm and 211.2 ppm, respectively (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 55%, while relative bare ground cover was 39%. The soil erosion condition was classified as moderate due to evidence of surface litter and soil movement, pedestalling around plants, and the presence of flow patterns and rills.

Browse

Total browse cover was 11% in 2007. Wyoming big sagebrush was the most abundant preferred browse species and provided 2% cover. Its density was 840 plants/acre (2,076 plants/ha). Sixty-four percent of the population was decadent, 26% was comprised of mature plants, 10% were young. Seedlings were sampled at a density of 20 plants/acre (49 plants/ha), and the density of dead plants was 320 plants/acre (791 plants/ha). Thirty-six percent of the population was classified as dying, and use was moderate-heavy. Average annual leader growth was 1.6 inches (4.1 cm). Utah serviceberry (*Amelanchier utahensis*) and eriogonum (*Eriogonum* sp.) were also scattered throughout the study.

Juniper provided 4% of the total ground cover and 12% canopy cover. Point-centered quarter data estimated juniper density at 102 trees/acre (252 trees/ha). Average trunk diameter was 9.1 inches (23.1 cm). Fifty-five percent of the sampled trees were greater than 12 feet (3.7 m) tall, and 33% were 4-8 feet (1.2-2.4 m) tall. Many of the trees were highlined.

Herbaceous Understory

Grasses provided 11% cover. Perennial species comprised approximately half of the total grass cover. Bluebunch wheatgrass (*Agropyron spicatum*), western wheatgrass (*Agropyron smithii*), Kentucky bluegrass (*Poa pratensis*), Indian ricegrass (*Oryzopsis hymenoides*), and Sandberg bluegrass (*Poa secunda*) were the most abundant perennials. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) each provided approximately 3% cover.

Forbs provided 5% cover, 73% of which was composed of perennial species. Penstemon (*Penstemon* spp.), rose pussytoes (*Antennaria rosea*), desert phlox (*Phlox austromontana*), and Utah locoweed (*Astragalus utahensis*) were the most common perennial forbs. Pale alyssum (*Alyssum alyssoides*) and bur buttercup (*Ranunculus testiculatus*) were the most abundant annuals. Although there were no noxious weeds sampled on the study, musk thistle (*Carduus nutans*) was found by the road.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. Preferred browse cover was very low, and perennial herbaceous cover was moderate. Cheatgrass and Japanese brome each provided more cover than any of the perennial grasses.

winter range condition (DCI) - poor (19) Low potential scale

HERBACEOUS TRENDS --
Management unit 06R, Study no: 4

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron smithii	104	1.32
G	Agropyron spicatum	128	1.66
G	Bromus japonicus (a)	131	2.60
G	Bromus tectorum (a)	151	2.74
G	Elymus junceus	5	.15
G	Koeleria cristata	1	.01
G	Oryzopsis hymenoides	56	.79
G	Poa pratensis	59	1.06
G	Poa secunda	73	.73
G	Sitanion hystrix	3	.00
G	Stipa comata	17	.34
Total for Annual Grasses		282	5.35
Total for Perennial Grasses		446	6.08
Total for Grasses		728	11.43
F	Achillea millefolium	13	.10
F	Alyssum alyssoides (a)	244	.81
F	Antennaria rosea	17	.57
F	Aster chilensis	2	.01
F	Astragalus convallarius	8	.12
F	Astragalus sp.	2	.00
F	Astragalus utahensis	27	.44
F	Cirsium sp.	6	.02
F	Comandra pallida	12	.05
F	Collinsia parviflora (a)	3	.01
F	Cymopterus sp.	2	.01
F	Descurainia pinnata (a)	2	.00
F	Erodium cicutarium (a)	4	.03
F	Holosteum umbellatum (a)	2	.00
F	Lappula occidentalis (a)	6	.01

Type	Species	Nested Frequency '07	Average Cover % '07
F	Machaeranthera grindelioides	3	.03
F	Penstemon humilis	20	.58
F	Penstemon sp.	35	1.03
F	Phlox austromontana	28	.54
F	Phlox longifolia	11	.03
F	Ranunculus testiculatus (a)	90	.53
F	Sphaeralcea coccinea	31	.22
Total for Annual Forbs		351	1.41
Total for Perennial Forbs		217	3.79
Total for Forbs		568	5.20

BROWSE TRENDS --
Management unit 06R, Study no: 4

Type	Species	Strip Frequency '07	Average Cover % '07
B	Amelanchier utahensis	0	-
B	Artemisia tridentata wyomingensis	30	2.24
B	Chrysothamnus viscidiflorus viscidiflorus	70	3.72
B	Eriogonum sp.	0	-
B	Gutierrezia sarothrae	22	.22
B	Juniperus osteosperma	2	3.80
B	Opuntia sp.	12	.89
B	Symphoricarpos oreophilus	0	-
B	Tetradymia canescens	3	.03
Total for Browse		139	10.91

CANOPY COVER, LINE INTERCEPT --
Management unit 06R, Study no: 4

Species	Percent Cover '07
Artemisia tridentata wyomingensis	1.75
Chrysothamnus viscidiflorus viscidiflorus	4.31
Gutierrezia sarothrae	.11
Juniperus osteosperma	11.58
Opuntia sp.	.76
Tetradymia canescens	.40

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 06R, Study no: 4

Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	1.6

POINT-QUARTER TREE DATA --
Management unit 06R, Study no: 4

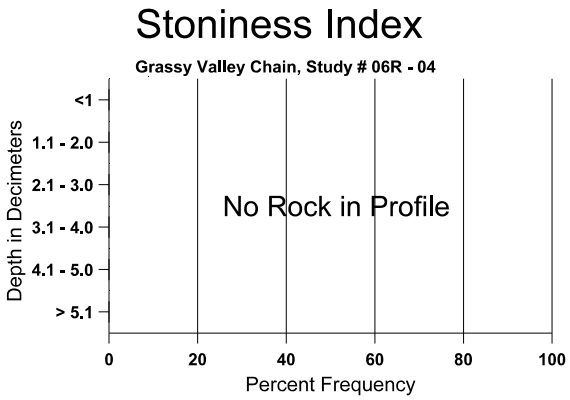
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	102	9.1

BASIC COVER --
Management unit 06R, Study no: 4

Cover Type	Average Cover % '07
Vegetation	26.40
Rock	.61
Pavement	3.24
Litter	36.38
Cryptogams	2.34
Bare Ground	45.01

SOIL ANALYSIS DATA --
Herd Unit 6R, Study no: 4, Study Name: Grassy Valley Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
5.5	-	6.7	30.2	36.4	33.5	3.2	15.5	211.2	0.6



PELLET GROUP DATA --
Management unit 06R, Study no: 4

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	17	-
Horse	16	12 (30)
Elk	11	9 (22)
Deer	48	57 (141)
Cattle	24	21 (52)

BROWSE CHARACTERISTICS --
Management unit 06R, Study no: 4

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Amelanchier utahensis												
07	**0**	-	-	-	-	-	0	0	-	-	0	14/20
Artemisia tridentata wyomingensis												
07	**840**	20	80	220	540	320	21	62	64	36	36	18/27
Chrysothamnus viscidiflorus viscidiflorus												
07	**5120**	160	400	4100	620	20	27	19	12	5	5	8/13
Eriogonum sp.												
07	**0**	20	-	-	-	-	0	0	-	-	0	7/14

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Gutierrezia sarothrae												
07	**940**	20	-	920	20	-	0	0	2	2	2	7/7
Juniperus osteosperma												
07	**40**	80	20	20	-	-	0	50	-	-	0	-/-
Opuntia sp.												
07	**320**	-	40	280	-	-	0	0	-	-	0	6/18
Symphoricarpos oreophilus												
07	**0**	-	-	-	-	-	0	0	-	-	0	6/7
Tetradymia canescens												
07	**100**	-	-	100	-	-	20	0	-	-	0	7/13

Trend Study 8R-2-07

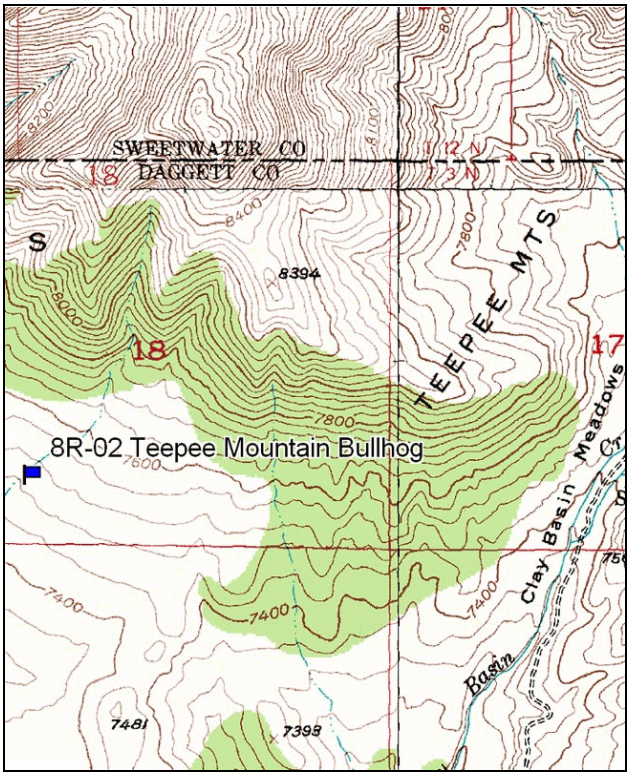
Study site name: Teepee Mtn. Bullhog . Vegetation type: P-J & Wyoming Big Sagebrush .

Compass bearing: frequency baseline 341 degrees magnetic.

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

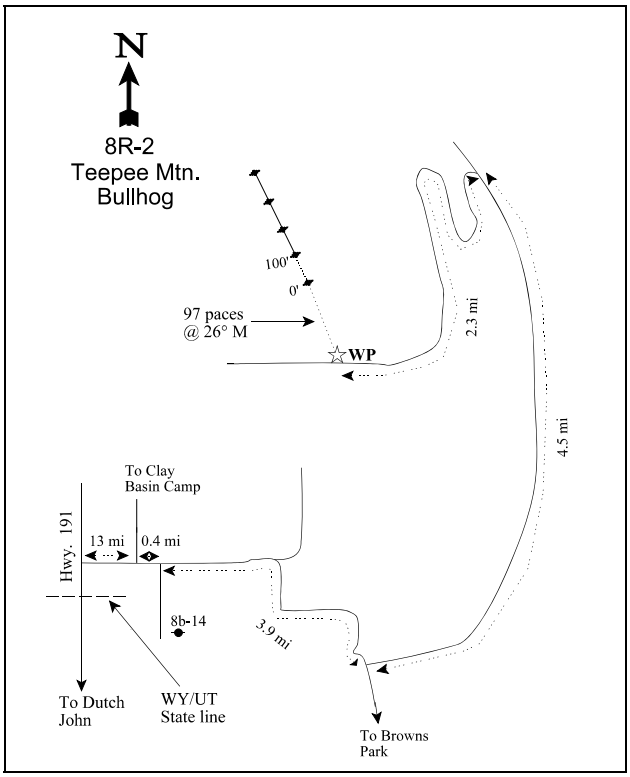
LOCATION DESCRIPTION

From Dutch John, proceed north toward Antelope Flat on 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 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 7S , Range 24E , Section 25



Diagrammatic Sketch

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

DISCUSSION

Teepee Mountain Bullhog - Trend Study No. 8R-2

Study Information

This study was established in 2007 to evaluate the success of a habitat improvement project at the base of Teepee Mountain [elevation: 7,500 feet (2,286 m), slope: 10%-12%, aspect: southwest]. The area serves as wintering habitat for deer and elk, as well as nesting, brood-rearing, and wintering habitat for sage-grouse. The treatment will be within 2 miles (3.2 km) of an active sage-grouse lek. Encroaching Utah juniper (*Juniperus osteosperma*) will be removed from 500 acres (202 ha) of sagebrush communities using a bullhog machine. The tree density is low and the herbaceous understory is abundant enough that seed application will not be needed. Use was estimated at 17 deer days use/acre (41 ddu/ha), 10 elk days use/acre (25 edu/ha), 17 cattle days use/acre (41 cdu/ha), and 1 horse day use/acre (3 hdu/ha).

Soil

The soil is classified as a Brownsto-Luhon-McFadden complex (USDA-NRCS 2007). The soils in the Brownsto series are very deep and well-drained, and formed in alluvium, colluvium, and glacial outwash. The Luhon series consists of soils that are deep and well-drained, and formed in calcareous alluvium from soft sedimentary rocks. The soils in the McFadden series are very deep and well-drained, and formed in alluvium. Textural and chemical analyses identified the soil as a sandy loam with a neutral reaction (pH 6.9). Soil phosphorus and potassium are both high at 35.3 ppm and 140.8 ppm, respectively (Tiedemann and Lopez 2004). Combined relative vegetation and litter cover was 66%, and relative bare ground cover was 23%. The soil is very rocky, with large and cobble-sized rocks on the surface and throughout the profile. The erosion condition was classified as slight due to the presence of rills and gullies.

Browse

The total browse cover was 17% in 2007, approximately half of which was provided by preferred species. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) was the most abundant preferred browse species, and provided 5% of the total ground cover and 9% canopy cover. Its density was 1,640 plants/acre (4,052 plants/ha). Approximately half of the population was mature, with 46% decadence and 5% young recruitment. Seedlings were sampled at a density of 60 plants/acre (148 plants/ha), and the density of dead plants was 300 plants/acre (741 plants/ha). Thirty-five percent of the population displayed poor vigor, and 27% was classified as dying. Fifty-seven percent of the plants showed moderate-heavy use. Annual leader growth averaged 1.1 inches (2.9 cm).

Low sagebrush (*Artemisia arbuscula*) provided 1% of the total ground cover and 3% canopy cover. Its density was similar to that of big sagebrush at 1,620 plants/acre (4,002 plants/ha). The population was largely mature, with 22% decadence and 5% young recruitment. Seedlings were sampled at a density of 160 plants/acre (395 plants/ha), and the density of dead plants was 60 plants/acre (148 plants/ha). Vigor was good on most plants, and use was mostly light. Average annual leader growth was 0.6 inches (1.5 cm).

Slenderbush eriogonum (*Eriogonum microthecum*) provided 2% of the total ground cover and 2% canopy cover. Its density was 4,680 plants/acre (11,564 plants/ha). Ninety-two percent of the sampled plants were mature, with 6% young and 2% decadent. Seedlings and dead plants were sampled at very low densities. Vigor was excellent on most plants, and use was mostly light. Winterfat (*Ceratoides lanata*), true mountain mahogany (*Cercocarpus montanus*), serviceberry (*Amelanchier alnifolia*), and antelope bitterbrush (*Purshia tridentata*) were also present in very low densities.

Juniper provided 11% canopy cover, and the point-centered quarter data estimated density at 132 trees/acre (326 trees/ha). Average trunk diameter was 4.7 inches (11.9 cm). The majority of the sampled trees were 1-8 feet (0.3-2.4 m) in height.

Herbaceous Understory

The herbaceous understory is abundant and diverse. Average perennial grass cover was high at 19%. Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Agropyron spicatum*) were dominant, and needle-and-thread (*Stipa comata*), mutton bluegrass (*Poa fendleriana*), and prairie junegrass (*Koeleria cristata*) were also common. Cheatgrass (*Bromus tectorum*) was the only annual grass sampled, and provided less than 1% cover.

Total forb cover was 14%. Thirty-two forb species were sampled, 25 of which were perennials. Arrowleaf balsamroot (*Balsamorhiza sagittata*) and timber poisonvetch (*Astragalus convallarius*) were the most abundant forbs, providing 80% of the total forb cover. Annual forb cover was less than 1%. Slender phlox (*Microsteris gracilis*) was the most common annual forb.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is good. The preferred browse component provided little cover with high decadence and low young recruitment. The understory, however, was in excellent condition. Perennial herbaceous cover was high, and annual grass cover was low. No noxious weeds were noted on the study.

winter range condition (DCI) - good (59) Low potential scale

HERBACEOUS TRENDS --
Management unit 08R, Study no: 2

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron intermedium	3	.03
G	Agropyron spicatum	213	6.96
G	Bromus tectorum (a)	36	.42
G	Carex sp.	-	.00
G	Koeleria cristata	61	1.03
G	Oryzopsis hymenoides	16	.42
G	Poa fendleriana	53	1.24
G	Poa secunda	252	7.61
G	Sitanion hystrix	2	.01
G	Stipa comata	74	1.65
Total for Annual Grasses		36	0.42
Total for Perennial Grasses		674	18.98
Total for Grasses		710	19.41
F	Agoseris glauca	12	.06
F	Antennaria rosea	3	.00
F	Arabis sp.	14	.07
F	Astragalus convallarius	62	3.48
F	Balsamorhiza sagittata	93	7.87
F	Castilleja flava	3	.00

Type	Species	Nested Frequency '07	Average Cover % '07
F	Calochortus nuttallii	18	.04
F	Chenopodium album (a)	4	.03
F	Comandra pallida	23	.48
F	Collinsia parviflora (a)	37	.07
F	Crepis acuminata	5	.06
F	Cryptantha sp.	17	.12
F	Cymopterus sp.	16	.11
F	Delphinium nuttallianum	1	.00
F	Descurainia pinnata (a)	8	.02
F	Draba sp. (a)	7	.01
F	Erigeron sp.	5	.04
F	Gayophytum ramosissimum(a)	3	.00
F	Haplopappus acaulis	17	.22
F	Ipomopsis aggregata	12	.10
F	Lappula occidentalis (a)	3	.01
F	Lesquerella sp.	1	.00
F	Lomatium sp.	4	.04
F	Lomatium triternatum	2	.00
F	Machaeranthera grindelioides	-	.00
F	Microsteris gracilis (a)	120	.37
F	Penstemon humilis	5	.03
F	Penstemon sp.	6	.21
F	Petradoria pumila	4	.30
F	Phlox hoodii	46	.35
F	Phlox longifolia	22	.05
F	Tragopogon dubius	2	.00
Total for Annual Forbs		182	0.52
Total for Perennial Forbs		393	13.70
Total for Forbs		575	14.22

BROWSE TRENDS --
Management unit 08R, Study no: 2

Type	Species	Strip Frequency '07	Average Cover % '07
B	Amelanchier alnifolia	0	-
B	Artemisia arbuscula	24	1.41
B	Artemisia tridentata wyomingensis	59	4.72
B	Ceratoides lanata	2	.03
B	Cercocarpus montanus	0	.03
B	Chrysothamnus nauseosus	3	.15
B	Chrysothamnus viscidiflorus viscidiflorus	40	2.23
B	Eriogonum microthecum	56	2.12
B	Gutierrezia sarothrae	1	.03
B	Juniperus osteosperma	5	5.55
B	Leptodactylon pungens	8	.45
B	Opuntia sp.	2	.00
B	Pediocactus simpsonii	5	.12
B	Purshia tridentata	0	-
B	Tetradymia canescens	2	-
Total for Browse			16.85

CANOPY COVER, LINE INTERCEPT --
Management unit 08R, Study no: 2

Species	Percent Cover '07
Artemisia arbuscula	2.68
Artemisia tridentata wyomingensis	8.86
Ceratoides lanata	.25
Chrysothamnus nauseosus	.26
Chrysothamnus viscidiflorus viscidiflorus	.45
Eriogonum microthecum	2.13
Juniperus osteosperma	10.89
Leptodactylon pungens	.08

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 08R, Study no: 2

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

POINT-QUARTER TREE DATA --
Management unit 08R, Study no: 2

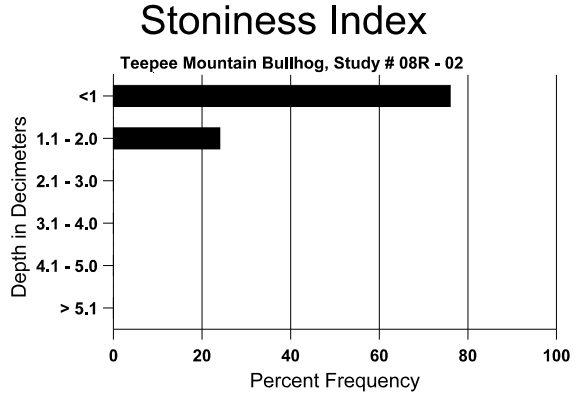
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	132	4.7

BASIC COVER --
Management unit 08R, Study no: 2

Cover Type	Average Cover % '07
Vegetation	45.26
Rock	3.47
Pavement	3.39
Litter	29.85
Cryptogams	5.68
Bare Ground	26.84

SOIL ANALYSIS DATA --
Herd Unit 8R, Study no: 2, Study Name: Teepee Mountain Bullhog

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
4.6	-	6.9	63.2	23.4	13.5	1.9	35.3	140.8	0.6



PELLET GROUP DATA --
Management unit 08R, Study no: 2

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

BROWSE CHARACTERISTICS –
Management unit 08R, Study no: 2

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Amelanchier alnifolia												
07	**0**	-	-	-	-	-	0	0	-	-	0	31/44
Artemisia arbuscula												
07	**1620**	160	80	1180	360	60	10	2	22	1	2	11/19
Artemisia tridentata wyomingensis												
07	**1640**	60	80	800	760	300	24	33	46	27	35	24/37
Ceratoides lanata												
07	**40**	-	-	40	-	-	0	50	-	-	0	5/10
Cercocarpus montanus												
07	**0**	-	-	-	-	-	0	0	-	-	0	26/34
Chrysothamnus nauseosus												
07	**60**	-	-	60	-	-	0	0	-	-	0	25/28
Chrysothamnus viscidiflorus viscidiflorus												
07	**1460**	-	60	1340	60	20	3	0	4	3	4	9/14
Eriogonum microthecum												
07	**4680**	60	280	4300	100	40	15	.85	2	2	2	7/10
Gutierrezia sarothrae												
07	**20**	-	-	20	-	-	0	0	-	-	0	8/8
Juniperus osteosperma												
07	**120**	60	60	60	-	-	0	0	-	-	0	-/-
Leptodactylon pungens												
07	**200**	-	-	160	40	-	0	0	20	20	20	6/13
Opuntia sp.												
07	**80**	-	-	20	60	-	0	0	75	-	0	3/6

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Pediocactus simpsonii												
07	**160**	-	-	160	-	-	0	0	-	-	0	1/3
Purshia tridentata												
07	**0**	-	-	-	-	-	0	0	-	-	0	6/11
Tetradymia canescens												
07	**40**	-	20	20	-	-	100	0	-	-	0	9/15

Trend Study 9R-14-07

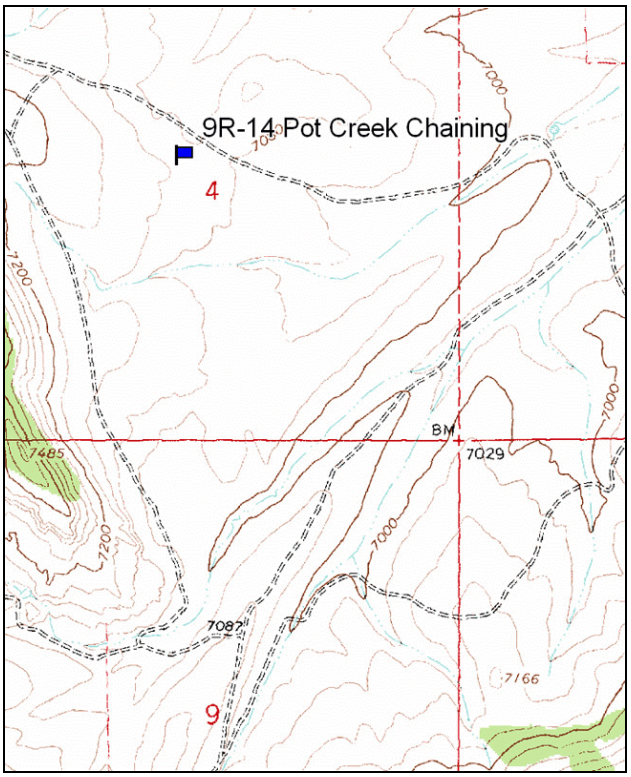
Study site name: Pot Creek Chaining . Vegetation type: Burn/Perennial Grass .

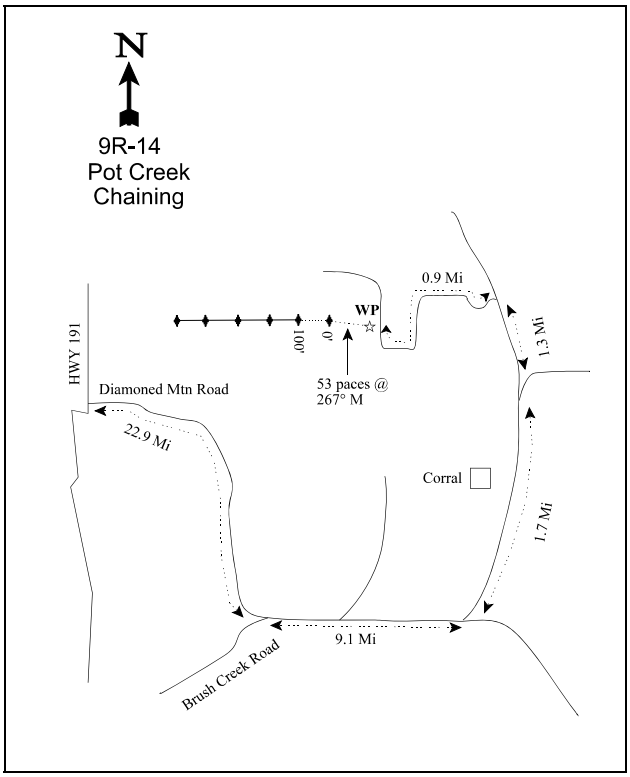
Compass bearing: frequency baseline 239 degrees magnetic.

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

LOCATION DESCRIPTION

From Vernal, drive north on U.S. 191 to mile marker 225. Turn right (east) to the Diamond Mountain road. Drive for 13.6 miles to a fork. Take the left fork and drive east on Jones Hole Rd for 9.1 miles to a fork to the right and a sign that reads "Pot Creek Turnoff". Turn left and drive 1.7 miles to a fork. Stay left at the fork and drive 1.3 miles to a faint road on the left. Turn left and go 0.9 miles to the witness post. From the witness post, the 0-foot stake is 53 paces at 267 degrees magnetic, and marked with browse tag #132.





Map Name: Hoy Mountain

Township 2S , Range 25E , Section 4

Diagrammatic Sketch

GPS: NAD 83, UTM 12T 659296 E 4504680 N

DISCUSSION

Pot Creek Chaining - Trend Study No. 9R-14

Study Information

This study was established in 2007 to monitor a wildfire rehabilitation project in the southwest corner of the Ruple Cabin/Pot Creek basin [elevation: 7,120 feet (2,170 m), slope: 4%, aspect: northeast]. Approximately 1,400 acres (567 ha) burned adjacent to a 1,550 acre (627 ha) range renovation project that was completed in 2005. The area is important peripheral breeding and brood-rearing habitat for the Diamond Mountain sage-grouse population. Grasses and forbs were aerially seeded (Table 1) in September 2006, followed by an Ely chaining. Shrub seed was applied in December 2006 (Table 2). The treatment was designed to prevent the spread of cheatgrass, reestablish a sagebrush/bitterbrush canopy, and create a diverse understory to benefit sage-grouse, big game, and cattle grazing. Use was estimated at 3 deer days use/acre (8 ddu/ha), 3 elk days use/acre (8 edu/ha), and 2 cattle days use/acre (4 cdu/ha).

Soil

The soil is classified as a Cortyzack-Flynncove complex (USDA-NRCS 2007). The soils in the Cortyzack series are very deep, well-drained, and formed in eolian deposits and slope alluvium derived from sandstone. The Flynncove series consists of very deep, well-drained soils that formed in slope alluvium and colluvium derived from sandstone and quartzite. Textural and chemical analyses identified the soil as a sandy clay loam with a neutral reaction (pH 6.6). Soil phosphorus and potassium are both high at 17.4 ppm and 195.2 ppm, respectively (Tiedemann and Lopez 2004). Approximately 60% of the relative ground cover was bare, and vegetation and litter combined provided the large majority of the remaining relative cover. The soil was described as very compact, and the erosion condition was classified as stable.

Browse

Browse is very limited and provided less than 1% total cover. Young and mature Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), slenderbush eriogonum (*Eriogonum microthecum*), and antelope bitterbrush (*Purshia tridentata*) were all sampled at a density of 20 plants/acre (49 plants/ha). Sagebrush seedlings were also sampled at a density of 340 plants/acre (840 plants/ha). The bitterbrush plant that was sampled showed heavy use.

Herbaceous Understory

The understory is abundant and provided 32% of the total ground cover in 2007. Approximately half of this cover was composed of perennial grasses and half was composed of forbs. Sandberg bluegrass (*Poa secunda*) and western wheatgrass (*Agropyron smithii*) were the most abundant grass species. Mutton bluegrass (*Poa fendleriana*), bluebunch wheatgrass (*Agropyron spicatum*), and sedge (*Carex* sp.) were also sampled in low frequencies. Cheatgrass (*Bromus tectorum*) was sampled in only one quadrat.

Twenty-six forb species were sampled, 18 of which were perennials. Timber poisonvetch (*Astragalus convallarius*), common sainfoin (*Onobrychis viciaefolia*), longleaf phlox (*Phlox longifolia*), and false dandelion (*Agoseris glauca*) were the most abundant perennial species, while blue-eyed Mary (*Collinsia parviflora*) was the most common annual. There was no use on the understory, and the plants were very robust.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is fair. The browse component was very sparse, and the majority of the sampled plants were sagebrush seedlings. The understory, however, was abundant and in excellent condition. Perennial grasses and forbs provided ample cover, and annual grass cover was very low. No noxious weed species were sampled.

winter range condition (DCI) - fair (41) Low potential scale

Table 1. Seed mix applied to the Pot Creek chaining in September 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Bluebunch Wheatgrass "Goldar"	601	4
Orchardgrass "Paiute"	300	2
Snake River Wheatgrass "Secar"	600	4
Hard Fescue "Durar"	30	<1
Hard Fescue	300	2
Big Bluegrass "Sherman"	250	2
Canby Bluegrass "Canbar"	250	2
Western Yarrow "SID Columbia"	50	<1
Cicer Milkvetch "Lutana"	900	6
Alfalfa "Ladak"	900	6
Alfalfa "Nomad"	900	6
Sainfoin "Eski"	6217	42
Small Burnet "Delar"	3300	22
Bitterbrush	181	1
Total	14779	100

Table 2. Sagebrush seed applied to the Pot Creek chaining in December 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Wyoming Big Sagebrush	1151	100

HERBACEOUS TRENDS --
Management unit 09R, Study no: 14

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron smithii	278	7.35
G	Agropyron spicatum	11	.05
G	Bromus tectorum (a)	4	.04
G	Carex sp.	28	.10
G	Poa fendleriana	30	.40
G	Poa secunda	216	9.01
Total for Annual Grasses		4	0.03
Total for Perennial Grasses		563	16.92
Total for Grasses		567	16.96
F	Achillea millefolium	14	.11
F	Agoseris glauca	70	.91
F	Arabis sp.	3	.00
F	Astragalus convallarius	140	4.14

Type	Species	Nested Frequency '07	Average Cover % '07
F	Aster sp.	5	.01
F	Castilleja linariaefolia	7	.01
F	Calochortus nuttallii	31	.13
F	Chorispora tenella (a)	18	.71
F	Collomia linearis (a)	7	.09
F	Collinsia parviflora (a)	223	2.84
F	Crepis acuminata	13	.45
F	Cymopterus sp.	7	.07
F	Delphinium nuttallianum	41	.17
F	Descurainia pinnata (a)	1	.00
F	Gayophytum ramosissimum(a)	7	.22
F	Lepidium sp. (a)	3	.00
F	Medicago sativa	49	.36
F	Microsteris gracilis (a)	21	.18
F	Onobrychis viciaefolia	122	1.83
F	Phlox austromontana	5	.04
F	Phlox longifolia	149	1.10
F	Polygonum douglasii (a)	41	.23
F	Sanguisorba minor	82	.65
F	Sphaeralcea coccinea	14	.41
F	Trifolium sp.	101	.45
F	Zigadenus paniculatus	1	.06
Total for Annual Forbs		321	4.28
Total for Perennial Forbs		854	10.96
Total for Forbs		1175	15.24

BROWSE TRENDS --
Management unit 09R, Study no: 14

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	1	.01
B	Eriogonum microthecum	1	-
B	Opuntia sp.	2	.00
B	Purshia tridentata	1	.38
B	Symphoricarpos oreophilus	0	-
B	Tetradymia canescens	0	-
Total for Browse		5	0.39

CANOPY COVER, LINE INTERCEPT --
Management unit 09R, Study no: 14

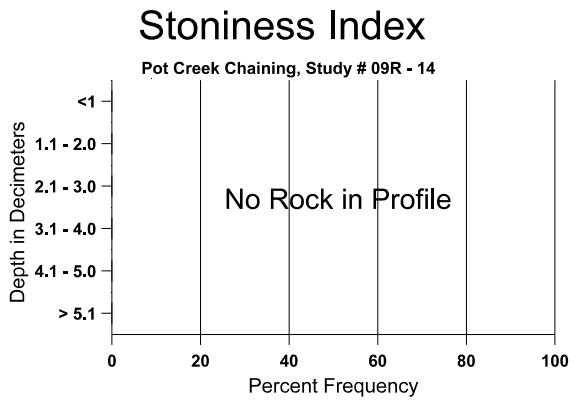
Species	Percent Cover '07
Purshia tridentata	.05

BASIC COVER --
Management unit 09R, Study no: 14

Cover Type	Average Cover % '07
Vegetation	33.59
Rock	.05
Pavement	.73
Litter	11.78
Cryptogams	.05
Bare Ground	65.52

SOIL ANALYSIS DATA --
Herd Unit 9R, Study no: 14, Study Name: Pot Creek Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
8.0	-	6.6	50.2	25.4	24.5	2.6	17.4	195.2	0.6



PELLET GROUP DATA --
Management unit 09R, Study no: 14

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	8	-
Elk	6	3 (8)
Deer	1	3 (8)
Cattle	2	2 (4)

BROWSE CHARACTERISTICS --
Management unit 09R, Study no: 14

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**20**	340	20	-	-	-	0	0	-	-	0	-/-
Eriogonum microthecum												
07	**20**	-	-	20	-	-	0	0	-	-	0	7/9
Opuntia sp.												
07	**40**	20	-	40	-	-	0	0	-	-	0	3/7
Purshia tridentata												
07	**20**	-	-	20	-	-	0	100	-	-	0	6/28
Symphoricarpos oreophilus												
07	**0**	-	-	-	-	-	0	0	-	-	0	19/35
Tetradymia canescens												
07	**0**	-	-	-	-	-	0	0	-	-	0	9/12

Trend Study 9R-15-07

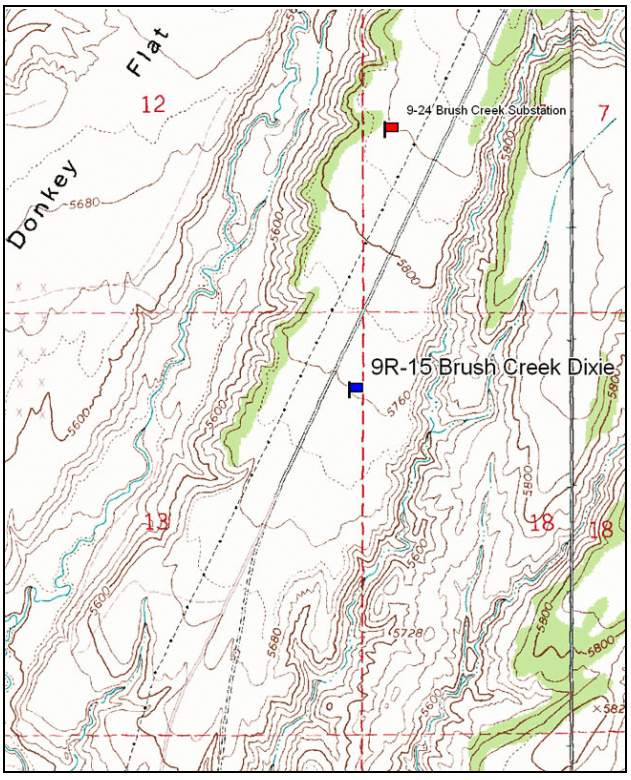
Study site name: Brush Creek Dixie . Vegetation type: Wyoming Big Sagebrush .

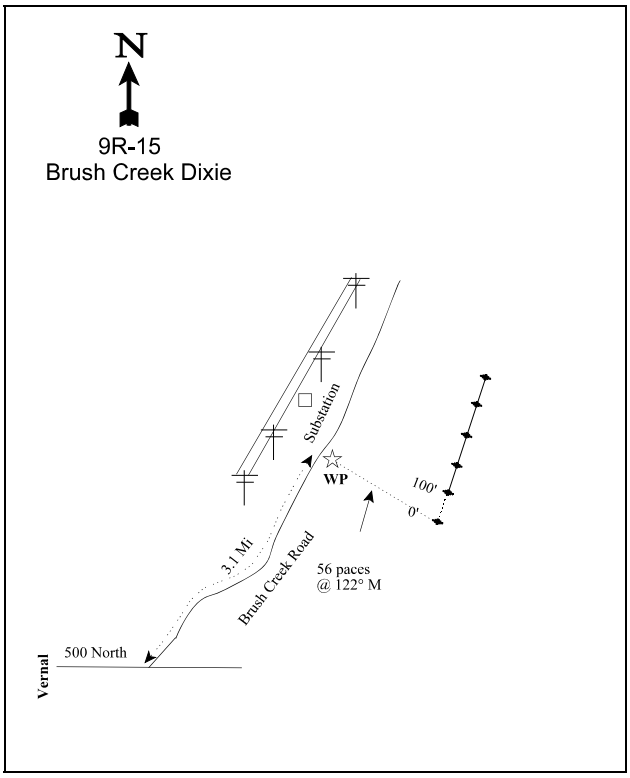
Compass bearing: frequency baseline 22 degrees magnetic.

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

LOCATION DESCRIPTION

From 500 North in Vernal, travel north on Brush Creek Road for 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 12T 636649 E 4491523 N

DISCUSSION

Brush Creek Dixie - Trend Study No. 9R-15

Study Information

This study was established in 2007 to monitor a sagebrush restoration project [elevation: 5,770 feet (1,759 m), slope: 4%, aspect: southeast]. The proposed project included treating approximately 300 acres of decadent and dead Wyoming big sagebrush (*Artemisia tridentata* ssp. *tridentata*) one-way with a Dixie harrow and spraying with Plateau™. The area serves as wintering habitat for deer and elk. Use was estimated at 64 deer days use/acre (159 ddu/ha), 2 elk days use/acre (5 edu/ha), and 6 cattle days use/acre (14 cdu/ha). Coyote and sage-grouse pellets were also noted in low frequencies.

Soil

The soil is classified within the Solirec series (USDA-NRCS 2007). The soils in this series are very deep, well-drained, and formed in eolian deposits over slope alluvium or colluvium derived from sandstone and shale. Textural and chemical analyses identified the soil as a sandy clay loam with a neutral reaction (pH 6.7). The soil phosphorus and potassium are both high at 19.6 ppm and 176 ppm, respectively (Tiedemann and Lopez 2004). Combined relative vegetation and litter cover was 78%, and relative bare ground cover was 21%. The soil erosion condition was classified as stable.

Browse

Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) provided the majority of the browse cover at 6%. Sagebrush density was 4,420 plants/acre (10,922 plants/ha). Ninety percent of the population was decadent, and 10% was mature. Seedlings were sampled at a density of 2,640 plants/acre (6,523 plants/ha), and the density of dead plants was 4,360 plants/acre (10,773 plants/ha). Sixty percent of the population was classified as dying, and use was moderate-heavy. Annual leader growth averaged 1.5 inches (3.7 cm). Winterfat (*Ceratoides lanata*) was also sampled at a density of 20 plants/acre (49 plants/ha), and was heavily hedged.

Herbaceous Understory

The understory is dominated by annual grasses. Cheatgrass (*Bromus tectorum*) was sampled in all quadrats, and provided 31% cover. Sixweeks fescue (*Vulpia octoflora*) was also sampled in approximately one-third of the quadrats. Perennial grasses provided less than 1% cover. Five perennial species were sampled, the most common being needle-and-thread (*Stipa comata*) and bottlebrush squirreltail (*Sitanion hystrix*).

Total forb cover was 4%, two-thirds of which was comprised of perennials. Forb diversity was low, with eleven species sampled. Scarlet globemallow (*Sphaeralcea coccinea*) and wooly plantain (*Plantago patagonica*) together provided 91% of the total forb cover.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Sagebrush was the only preferred browse sampled and provided little cover. The large majority of the population was decadent, and almost no young plants were sampled. The understory was dominated by annual grasses, with almost no perennial grass cover and very low perennial forb cover. No noxious weeds were sampled.

winter range condition (DCI) - very poor (-18) Low potential scale

HERBACEOUS TRENDS --
Management unit 09R, Study no: 15

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron smithii	10	.09
G	Bromus tectorum (a)	480	30.54
G	Oryzopsis hymenoides	5	.04
G	Poa secunda	4	.04
G	Sitanion hystrix	13	.25
G	Stipa comata	19	.43
G	Vulpia octoflora (a)	108	1.24
Total for Annual Grasses		588	31.78
Total for Perennial Grasses		51	0.86
Total for Grasses		639	32.64
F	Allium sp.	7	.02
F	Astragalus convallarius	1	.03
F	Descurainia pinnata (a)	44	.09
F	Lappula occidentalis (a)	36	.12
F	Machaeranthera canescens	1	.00
F	Penstemon sp.	9	.01
F	Phlox longifolia	1	.00
F	Plantago patagonica (a)	178	1.02
F	Salsola iberica (a)	4	.00
F	Sphaeralcea coccinea	159	2.25
F	Townsendia sp.	2	.00
Total for Annual Forbs		262	1.25
Total for Perennial Forbs		180	2.34
Total for Forbs		442	3.59

BROWSE TRENDS --
Management unit 09R, Study no: 15

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	95	5.96
B	Ceratoides lanata	1	-
B	Gutierrezia sarothrae	4	.15
B	Opuntia sp.	7	.15
Total for Browse		107	6.26

CANOPY COVER, LINE INTERCEPT --
Management unit 09R, Study no: 15

Species	Percent Cover '07
Artemisia tridentata wyomingensis	6.69
Gutierrezia sarothrae	.11
Opuntia sp.	.21

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 09R, Study no: 15

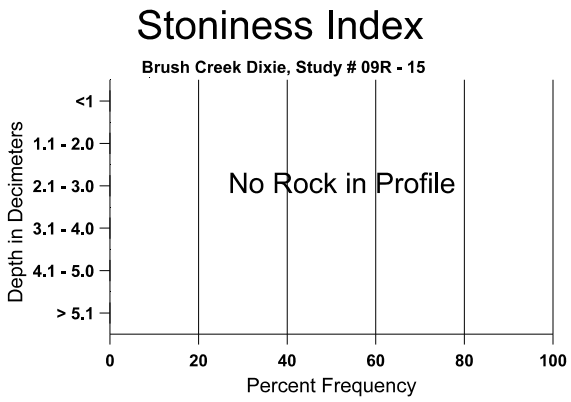
Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	1.5

BASIC COVER --
Management unit 09R, Study no: 15

Cover Type	Average Cover % '07
Vegetation	41.43
Rock	.03
Pavement	.15
Litter	46.23
Cryptogams	1.02
Bare Ground	23.17

SOIL ANALYSIS DATA --
Herd Unit 9R, Study no: 15, Study Name: Brush Creek Dixie

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
10.8	-	6.7	52.2	26.4	21.5	1.1	19.6	176.0	0.5



PELLET GROUP DATA --
Management unit 09R, Study no: 15

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	49	-
Grouse	1	-
Elk	4	2 (5)
Deer	48	64 (159)
Cattle	1	6 (14)

BROWSE CHARACTERISTICS --
Management unit 09R, Study no: 15

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**4420**	2640	20	420	3980	4360	64	28	90	60	62	13/19
Ceratoides lanata												
07	**20**	-	-	20	-	-	0	100	-	-	0	9/10
Gutierrezia sarothrae												
07	**220**	-	20	200	-	20	0	0	-	-	0	8/10
Opuntia sp.												
07	**140**	-	-	80	60	-	0	0	43	29	43	4/12

Trend Study 10R-39-07

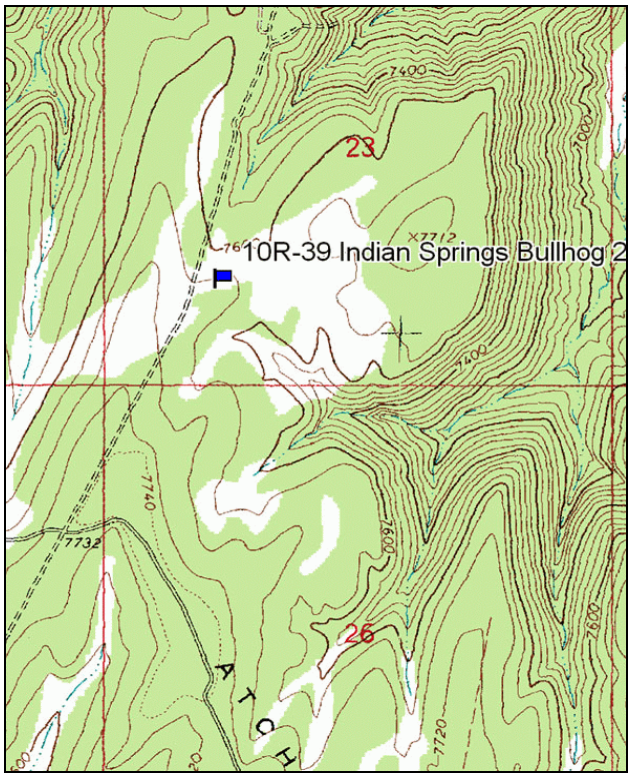
Study site name: Indian Springs Bullhog 2 . Vegetation type: P-J, Mountain Browse.

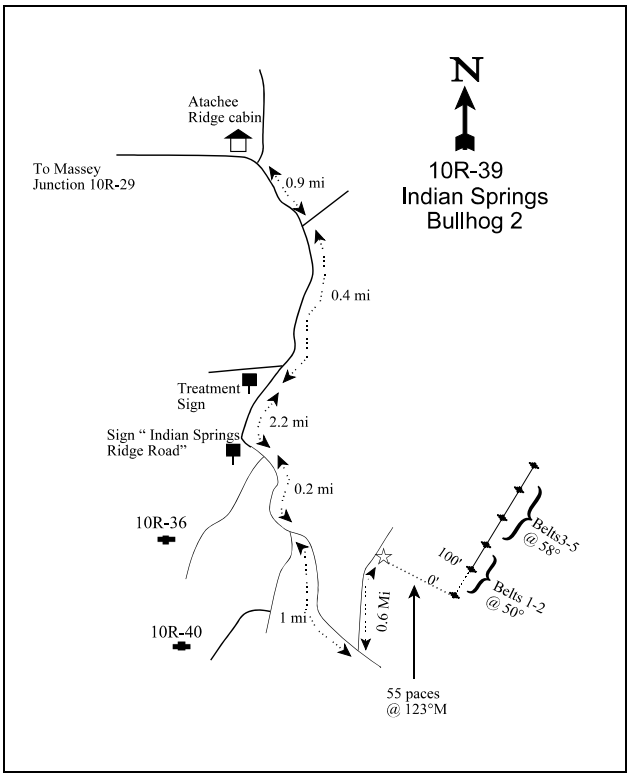
Compass bearing: frequency baseline 50 degrees magnetic (belts 1&2), 58 degrees magnetic (belts 3-5).

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

LOCATION DESCRIPTION

From Seep Ridge Road, about 10 miles north of Pine Spring, turn onto the Bitter Creek Road near McCoy Reservoir. Drive east on this road for 10.9 miles to where the road tops out, and 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". Stay left and continue on for 0.2 miles to another fork, stay left here also and go 1 mile to a road coming in from left (north) side of the road. Turn here and drive 0.6 miles to a witness post on the right side of the road. From the witness post, the 0-foot stake is 55 paces at 123 degrees magnetic and is marked with browse tag #200.





Map Name: Davis Canyon . Diagrammatic Sketch

Township 13S , Range 25E , Section 23 GPS: NAD 83, UTM 12S 663761 E 4392640 N

DISCUSSION

Indian Springs Bullhog 2 - Trend Study No. 10R-39

Study Information

This study was established in 2007 to monitor a restoration project on Atchee Ridge [elevation: 7,640 feet (2,329 m), slope: 15%, aspect: northeast]. Pinyon-juniper encroachment has forced elk to winter at lower elevations in crucial deer wintering habitat. The project has several objectives: to reduce pinyon-juniper cover to reduce the risk of fire and improve the browse community, to improve elk wintering habitat and reduce elk use at lower elevations, and to create transitional range for deer to further reduce pressure on wintering areas. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees will be removed from 300 acres (121.4 ha) using a bullhog machine. The shredded tree material will be left in the treatment area. No seeding was planned due to an ample understory. Use was estimated at 84 elk days use/acre (208 edu/ha), 8 deer days use/acre (20 ddu/ha), and 2 cattle days use/acre (4 cdu/ha). Cattle pats were noted in a grassy, burned area that may have been part of a prescribed fire from 2000.

Soil

The soil is classified as a Moonset-Whetrock complex (USDA-NRCS 2007). The soils in the Moonset series are shallow and well-drained, and formed in slope alluvium and colluvium derived from sandstone and shale. The Whetrock series consists of moderately deep, well-drained soils that formed in slope alluvium and colluvium over residuum derived from sandstone and shale. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 6.8). The soil phosphorus was marginal-high at 11.1 ppm, and potassium was marginal at 86.4 ppm (Tiedemann and Lopez 2004). Combined relative vegetation and litter cover was 77%, while relative bare ground cover was 18%. The erosion condition was classified as slight due to surface litter movement and the presence of flow patterns and rills.

Browse

Total browse cover in 2007 was 21%. The majority of the preferred browse was comprised of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and Utah serviceberry (*Amelanchier utahensis*), which provided 8% combined cover. Sagebrush density was 1,920 plants/acre (4,744 plants/ha). Decadence was high at 46% of the population, while young recruitment was very low at 2% of the population. Eighteen percent of the sampled plants were classified as dying. Seedlings were sampled at a density of 320 plants/acre (791 plants/ha), and dead plant density was 580 plants/acre (1,433 plants/ha). Twenty percent of the population displayed poor vigor, and use was mostly light-moderate. Annual leader growth averaged 1.7 inches (4.4 cm).

Utah serviceberry density was 1,160 plants/acre (2,866 plants/ha). The majority of the population was mature, with 29% young and 2% decadence. Seedling density was 140 plants/acre (346 plants/ha). Vigor was good on most plants, and use was mostly light-moderate. Average annual leader growth was 1.4 inches (3.5 cm). Antelope bitterbrush (*Purshia tridentata*) density was 560 plants/acre (1,384 plants/ha), and it provided 2% cover. Approximately 90% of the population was mature, with low young recruitment and decadence. All of the sampled plants were vigorous, and use was light-moderate. Annual leader growth averaged 4.1 inches (10.5 cm).

True mountain mahogany (*Cercocarpus montanus*), dwarf rabbitbrush (*Chrysothamnus depressus*), white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), and Gambel oak (*Quercus gambelii*) each provided less than 1% cover. Mountain mahogany density was 440 plants/acre (1,087 plants/ha), and the population was comprised mostly of young and mature individuals. Vigor was good on most plants, and use was mostly light-moderate. Annual leader growth averaged 3.3 inches (8.3 cm). Dwarf rabbitbrush and white rubber rabbitbrush densities were 280 plants/acre (692 plants/ha) and 100 plants/acre (247 plants/ha), respectively. Use on white rubber rabbitbrush was light, while dwarf rabbitbrush displayed moderate-heavy

use. Gambel oak density was 660 plants/acre (1,631 plants/ha), and 94% of the population was young. Browse use on oak was light.

From the point-centered quarter data, juniper density was estimated at 34 trees/acre (84 trees/ha). The average trunk diameter was 3.4 inches (8.6 cm), and all of the trees sampled were 1-12 feet (0.3-3.7 m) in height. Pinyon density was 152 trees/acre (376 trees/ha). Average trunk diameter was 4.6 inches (11.7 cm), and the majority of the sampled trees were in the 8-12 foot (2.4-3.7 m) height class.

Herbaceous Understory

Grasses provided 8% cover and approximately half of the total understory cover. The majority of the grass cover was composed of perennial species. Mutton bluegrass (*Poa fendleriana*), needle-and-thread (*Stipa comata*), thickspike wheatgrass (*Agropyron dasystachyum*), and sedge (*Carex* sp.) were the most abundant grasses. The only annual species sampled was cheatgrass (*Bromus tectorum*), which provided less than 1% cover.

The forb component was abundant and diverse. Thirty-three forb species were sampled, 28 of which were perennials. Penstemon (*Penstemon* sp.), desert phlox (*Phlox austromontana*), and rose pussytoes (*Antennaria rosea*) were the most abundant forbs. Annual forb cover was nearly 0%.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is fair. The preferred browse community was diverse, and cover, decadence, and young recruitment were moderate. Perennial grasses also provided moderate cover, while annual grass cover was very low. Perennial forb cover was high, and no noxious weeds were sampled.

winter range condition (DCI) - fair (60) Mid-level potential scale

HERBACEOUS TRENDS --
Management unit 10R, Study no: 39

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron dasystachyum	80	1.11
G	Agropyron spicatum	2	.00
G	Bouteloua gracilis	23	.54
G	Bromus tectorum (a)	40	.52
G	Carex sp.	66	1.11
G	Koeleria cristata	21	.76
G	Oryzopsis hymenoides	4	.06
G	Poa fendleriana	71	1.92
G	Poa secunda	38	.28
G	Sitanion hystrix	22	.21
G	Stipa comata	36	1.62

Type	Species	Nested Frequency '07	Average Cover % '07
Total for Annual Grasses		40	0.52
Total for Perennial Grasses		363	7.64
Total for Grasses		403	8.17
F	Agoseris glauca	2	.00
F	Antennaria rosea	44	1.16
F	Arabis sp.	20	.04
F	Artemisia ludoviciana	4	.03
F	Astragalus sp.	8	.04
F	Balsamorhiza sagittata	1	.15
F	Castilleja linariaefolia	8	.05
F	Comandra pallida	11	.31
F	Collinsia parviflora (a)	2	.00
F	Crepis acuminata	10	.18
F	Cryptantha sp.	4	.06
F	Delphinium bicolor	6	.02
F	Eriogonum alatum	15	.20
F	Erigeron sp.	23	.21
F	Erigeron pumilus	5	.03
F	Gayophytum ramosissimum(a)	7	.01
F	Gilia sp. (a)	19	.06
F	Haplopappus acaulis	2	.00
F	Heterotheca villosa	-	.03
F	Ipomopsis aggregata	45	.17
F	Machaeranthera canescens	4	.01
F	Microsteris gracilis (a)	5	.01
F	Penstemon sp.	11	.24
F	Penstemon sp.	83	2.24
F	Phlox austromontana	64	1.50
F	Phlox longifolia	65	.48
F	Polygonum douglasii (a)	23	.05
F	Schoencrambe linifolia	3	.03
F	Senecio integerrimus	12	.04
F	Sedum lanceolatum	5	.03
F	Senecio multilobatus	1	.03
F	Sphaeralcea coccinea	11	.07
F	Zigadenus paniculatus	2	.04

Type	Species	Nested Frequency '07	Average Cover % '07
Total for Annual Forbs		56	0.15
Total for Perennial Forbs		469	7.48
Total for Forbs		525	7.63

BROWSE TRENDS --
Management unit 10R, Study no: 39

Type	Species	Strip Frequency '07	Average Cover % '07
B	Amelanchier utahensis	30	4.25
B	Artemisia tridentata vaseyana	45	4.13
B	Cercocarpus montanus	15	.86
B	Chrysothamnus depressus	9	.09
B	Chrysothamnus nauseosus albicaulis	4	.15
B	Chrysothamnus viscidiflorus viscidiflorus	4	-
B	Gutierrezia sarothrae	2	.18
B	Juniperus osteosperma	4	.38
B	Opuntia fragilis	4	-
B	Pediocactus simpsonii	1	-
B	Pinus edulis	21	7.97
B	Purshia tridentata	21	2.14
B	Quercus gambelii	5	.21
B	Symphoricarpos oreophilus	29	.80
B	Tetradymia canescens	1	.03
Total for Browse		195	21.23

CANOPY COVER, LINE INTERCEPT --
Management unit 10R, Study no: 39

Species	Percent Cover '07
Amelanchier utahensis	8.05
Artemisia tridentata vaseyana	5.63
Cercocarpus montanus	1.41
Chrysothamnus depressus	.13
Chrysothamnus nauseosus albicaulis	-
Chrysothamnus viscidiflorus viscidiflorus	.20
Gutierrezia sarothrae	.06
Juniperus osteosperma	.56
Opuntia fragilis	.05
Pediocactus simpsonii	.03
Pinus edulis	21.91
Purshia tridentata	2.91
Quercus gambelii	.68
Symphoricarpos oreophilus	1.75

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 10R, Study no: 39

Species	Average leader growth (in) '07
Amelanchier utahensis	1.4
Artemisia tridentata vaseyana	1.7
Cercocarpus montanus	3.3
Purshia tridentata	4.1

POINT-QUARTER TREE DATA --
Management unit 10R, Study no: 39

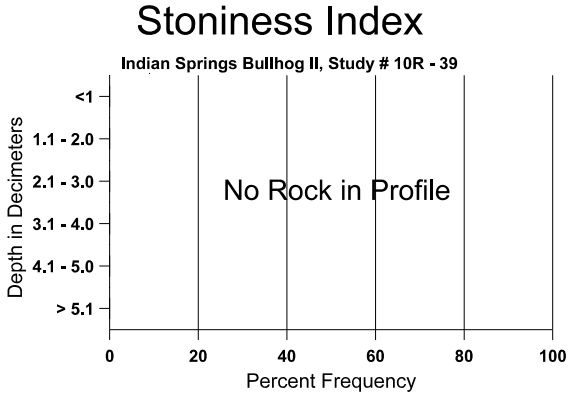
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	34	3.4
Pinus edulis	152	4.6

BASIC COVER --
Management unit 10R, Study no: 39

Cover Type	Average Cover % '07
Vegetation	38.42
Rock	1.85
Pavement	1.71
Litter	52.82
Cryptogams	2.29
Bare Ground	21.35

SOIL ANALYSIS DATA --
Herd Unit 10R, Study no: 39, Study Name: Indian Springs Bullhog 2

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
9.7	-	6.8	45.2	34.4	20.5	5.5	11.1	86.4	0.8



PELLET GROUP DATA –
Management unit 10R, Study no: 39

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	24	-
Elk	21	84 (208)
Deer	9	8 (20)
Cattle	1	2 (4)

BROWSE CHARACTERISTICS --
Management unit 10R, Study no: 39

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Amelanchier utahensis												
07	**1160**	140	340	800	20	40	28	0	2	2	3	41/39
Artemisia tridentata vaseyana												
07	**1920**	320	40	1000	880	580	33	4	46	18	20	20/26
Cercocarpus montanus												
07	**440**	-	200	200	40	-	27	5	9	-	5	48/41
Chrysothamnus depressus												
07	**280**	20	-	260	20	-	29	29	7	7	7	6/9
Chrysothamnus nauseosus albicaulis												
07	**100**	-	-	100	-	-	0	0	-	-	0	17/24
Chrysothamnus viscidiflorus viscidiflorus												
07	**100**	-	-	100	-	-	0	0	-	-	0	15/13
Gutierrezia sarothrae												
07	**60**	-	-	40	20	-	0	0	33	33	33	6/7
Juniperus osteosperma												
07	**80**	-	60	20	-	40	0	0	-	-	0	-/-
Opuntia fragilis												
07	**80**	-	-	80	-	-	0	0	-	-	0	3/7
Pediocactus simpsonii												
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Pinus edulis												
07	**480**	100	300	160	20	20	0	4	4	-	4	-/-
Purshia tridentata												
07	**560**	-	40	500	20	20	54	7	4	-	0	19/36
Quercus gambelii												
07	**660**	-	620	40	-	160	0	0	-	-	0	52/22
Symphoricarpos oreophilus												
07	**2040**	40	740	1300	-	-	0	0	-	-	0	13/23
Tetradymia canescens												
07	**20**	-	-	20	-	-	0	0	-	-	0	6/7

Trend Study 10R-40-07

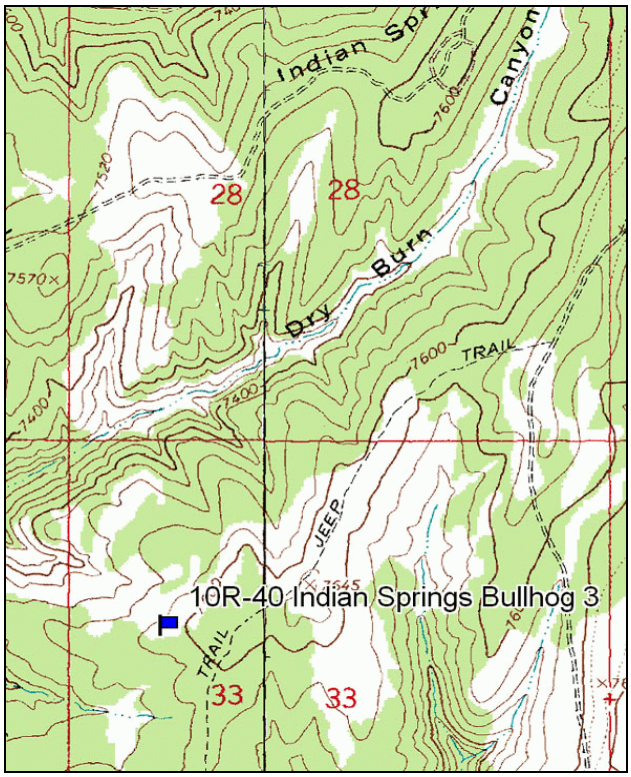
Study site name: Indian Springs Bullhog 3 . Vegetation type: Pinyon-Juniper.

Compass bearing: frequency baseline 219 degrees magnetic.

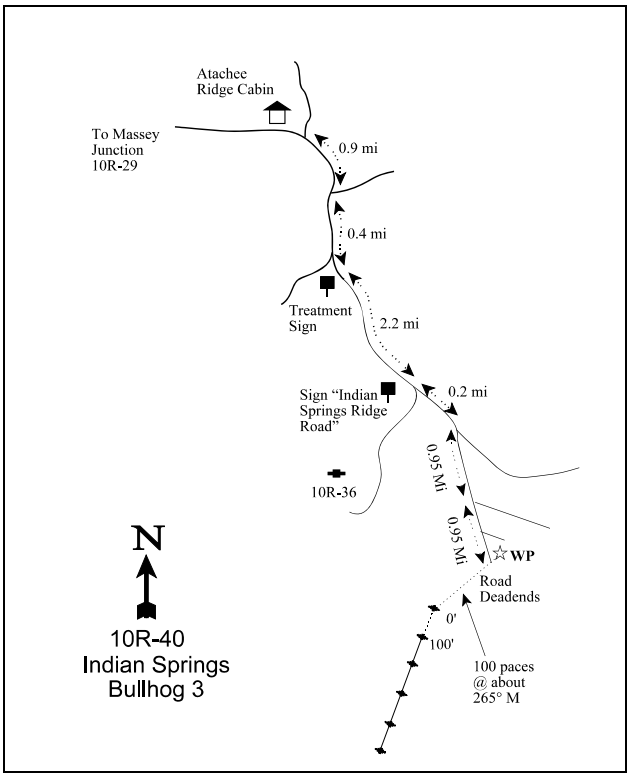
Frequency belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (95ft), line 5 (71ft).

LOCATION DESCRIPTION

From Seep Ridge Road, about 10 miles north of Pine Spring, turn onto the Bitter Creek Road near McCoy Reservoir. Drive east on this road for 10.9 miles to where the road tops out, and 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". Stay left and continue on for 0.2 miles to another fork, take a right here and go 0.95 miles to a fork, staying right continue on for another 0.95 miles to where the road dead ends, and there is a witness post on the left side of the road. From the witness post, the 0-foot stake is 100 paces at 265 degrees magnetic.



Map Name: Burnt Timber Canyon .



Diagrammatic Sketch

Township 13S , Range 25E , Section 33

GPS: NAD 83, UTM 12S 660513.8 E 4390037.1 N

DISCUSSION

Indian Springs Bullhog 3 - Trend Study No. 10R-40

Study Information

This study was established in 2007 to monitor a restoration project on Atchee Ridge [elevation: 7,580 feet (2,310 m), slope: 4%, aspect: southwest]. Pinyon-juniper encroachment has forced elk to winter at lower elevations in crucial deer wintering habitat. The project has several objectives: to reduce pinyon-juniper cover to reduce the risk of fire and improve the browse community, to improve elk wintering habitat and reduce elk use at lower elevations, and to create transitional range for deer to further reduce pressure on wintering areas. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees will be removed from 300 acres (121.4 ha) using a bullhog machine. The shredded tree material will be left in the treatment area. No seeding was planned due to an ample understory. Use was estimated at 15 elk days use/acre (38 edu/ha) and 11 deer days use/acre (28 ddu/ha).

Soil

The soil is classified as a Moonset-Whetrock complex (USDA-NRCS 2007). The soils in the Moonset series are shallow and well-drained, and formed in slope alluvium and colluvium derived from sandstone and shale. The Whetrock series consists of moderately deep, well-drained soils that formed in slope alluvium and colluvium over residuum derived from sandstone and shale. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 6.8). The soil phosphorus and potassium were both high at 27.8 ppm and 185.6 ppm, respectively (Tiedemann and Lopez 2004). Relative litter cover was 57%, while relative vegetation cover was only 14%. Relative pavement cover was 16%, and relative bare ground cover was 12%. The erosion condition was classified as slight mostly due to pedestalling around plants and the presence of flow patterns.

Browse

Total browse cover was 11% in 2007, however, only 30% of the cover was provided by preferred species. True mountain mahogany (*Cercocarpus montanus*) was the most abundant preferred species, with a density of 460 plants/acre (1,137 plants/ha). The population was largely mature. Young recruitment was high at 17% of the population, while decadence was low at 9%. Seedlings were also sampled at a density of 160 plants/acre (395 plants/ha). Vigor was good on most plants, and use was mostly light-moderate, with some heavy hedging. Annual leader growth averaged 3.7 inches (9.4 cm).

Antelope bitterbrush (*Purshia tridentata*) density was 380 plants/acre (939 plants/ha). Decadence was high at 21% of the population, and young recruitment was low at 5% of the population. Five percent of the sampled plants were classified as dying. Vigor was good, and use was light-moderate. Average annual leader growth was 4.5 inches (11.5 cm). Young and mature Utah serviceberry (*Amelanchier utahensis*) and decadent mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) were sampled in low densities. Use was light on sagebrush, while 25% of the serviceberry plants showed heavy use. Average annual leader growth was 1.9 inches (4.9 cm) on serviceberry and 1.8 inches (4.5 cm) on sagebrush.

Pinyon and juniper trees provided the majority of the browse cover. From the point-centered quarter data, pinyon density was estimated at 403 trees/acre (996 trees/ha). The average trunk diameter was 9.6 inches (24.4 cm), and the majority of the sampled trees were taller than 12 feet (3.7 m). Juniper density was estimated at 93 trees/acre (230 trees/ha). The average trunk diameter was 9.9 inches (25.1 cm). Approximately half of the sampled trees were less than 8 feet (2.4 m) in height, and half were greater than 8 feet (2.4 m) in height.

Herbaceous Understory

The understory is sparse, and diversity is low. Only perennial species were sampled in 2007. Mutton bluegrass (*Poa fendleriana*) and sedge (*Carex* sp.) were the only grass and grass-like species sampled and

provided 2% cover. Forbs also provided approximately 2% cover. Eleven species were sampled, but desert phlox (*Phlox austromontana*) and rock goldenrod (*Petradoria pumila*) provided the majority of the cover.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Preferred browse cover was very low, and pinyon and juniper trees dominated the area. The herbaceous understory was very sparse and provided little cover. However, no annual species or noxious weeds were sampled.

winter range condition (DCI) - very poor (13) Mid-level potential scale

HERBACEOUS TRENDS --
Management unit 10R, Study no: 40

Type	Species	Nested Frequency '07	Average Cover % '07
G	Carex sp.	44	.99
G	Poa fendleriana	41	1.14
Total for Annual Grasses		0	0
Total for Perennial Grasses		85	2.13
Total for Grasses		85	2.13
F	Antennaria rosea	2	.03
F	Arabis sp.	5	.02
F	Chaenactis douglasii	7	.07
F	Erigeron sp.	17	.09
F	Lesquerella sp.	6	.01
F	Machaeranthera grindelioides	1	.00
F	Penstemon caespitosus	5	.03
F	Penstemon sp.	3	.01
F	Penstemon sp.	9	.02
F	Petradoria pumila	14	.39
F	Phlox austromontana	62	.99
Total for Annual Forbs		0	0
Total for Perennial Forbs		131	1.67
Total for Forbs		131	1.67

BROWSE TRENDS --
Management unit 10R, Study no: 40

Type	Species	Strip Frequency '07	Average Cover % '07
B	Amelanchier utahensis	4	.30
B	Artemisia tridentata vaseyana	1	.01
B	Cercocarpus montanus	20	2.42
B	Juniperus osteosperma	11	1.87
B	Pinus edulis	15	5.55
B	Purshia tridentata	13	.67
B	Symphoricarpos oreophilus	10	.45
Total for Browse		74	11.30

CANOPY COVER, LINE INTERCEPT --
Management unit 10R, Study no: 40

Species	Percent Cover '07
Amelanchier utahensis	1.46
Cercocarpus montanus	4.83
Juniperus osteosperma	6.86
Pinus edulis	26.43
Purshia tridentata	.88
Symphoricarpos oreophilus	.81

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 10R, Study no: 40

Species	Average leader growth (in) '07
Amelanchier utahensis	1.9
Artemisia tridentata vaseyana	1.8
Cercocarpus montanus	3.7
Purshia tridentata	4.5

POINT-QUARTER TREE DATA --
Management unit 10R, Study no: 40

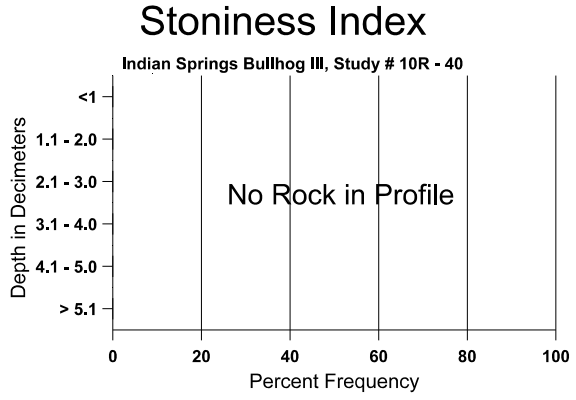
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	93	9.9
Pinus edulis	403	9.6

BASIC COVER --
Management unit 10R, Study no: 40

Cover Type	Average Cover % '07
Vegetation	15.43
Rock	2.05
Pavement	17.76
Litter	63.15
Cryptogams	.38
Bare Ground	12.95

SOIL ANALYSIS DATA --
Herd Unit 10R, Study no: 40, Study Name: Indian Springs Bullhog 3

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
10.5	-	6.8	42.2	35.4	22.5	6.3	27.8	185.6	1.2



PELLET GROUP DATA --
Management unit 10R, Study no: 40

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	18	-
Elk	6	15 (38)
Deer	6	11 (28)

BROWSE CHARACTERISTICS --
Management unit 10R, Study no: 40

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Amelanchier utahensis												
07	**80**	-	40	40	-	-	0	25	-	-	0	59/53
Artemisia tridentata vaseyana												
07	**40**	20	-	-	40	-	0	0	100	-	0	18/23
Cercocarpus montanus												
07	**460**	160	80	340	40	-	48	17	9	-	4	50/50
Juniperus osteosperma												
07	**220**	60	60	140	20	-	0	0	9	9	9	-/-
Pinus edulis												
07	**420**	540	200	200	20	40	0	0	5	-	0	-/-
Purshia tridentata												
07	**380**	-	20	280	80	-	16	0	21	5	5	20/30
Symphoricarpos oreophilus												
07	**500**	20	220	280	-	-	0	0	-	-	0	10/20

Trend Study 10R-41-07

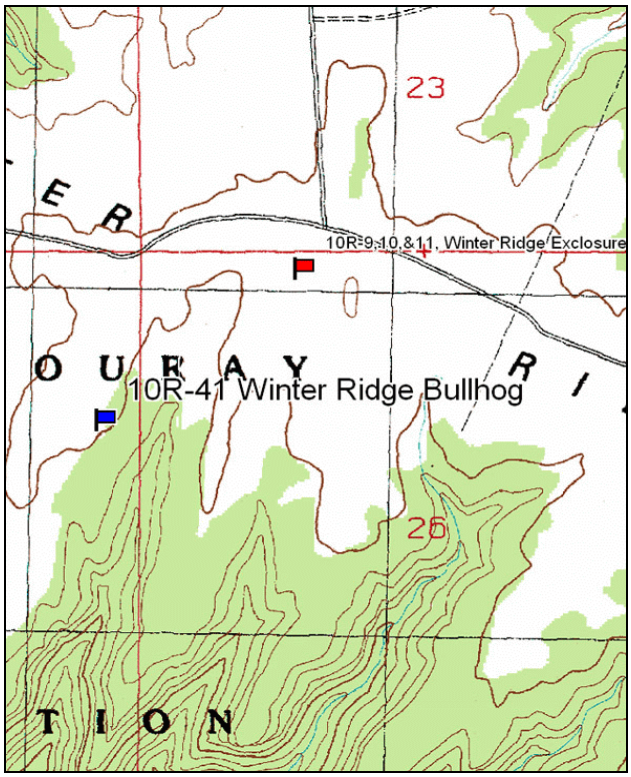
Study site name: Winter Ridge Bullhog . Vegetation type: Pinyon-Juniper.

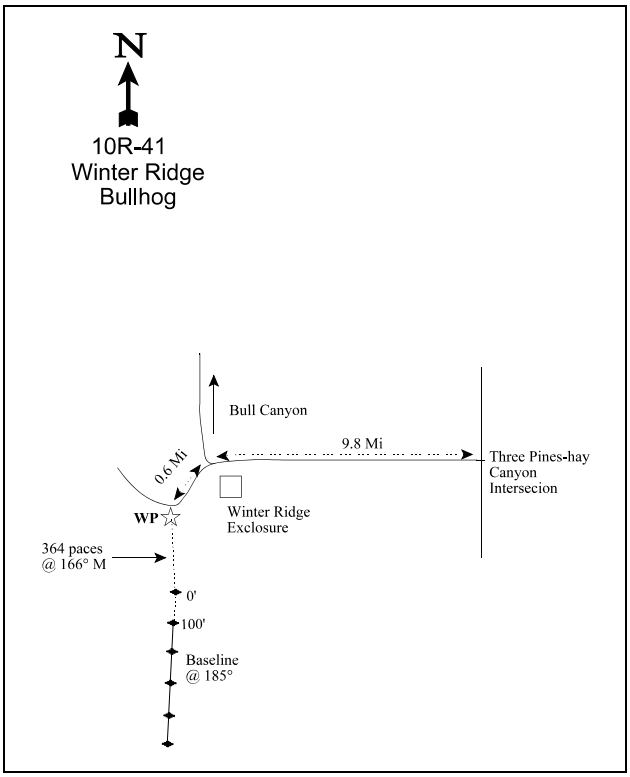
Compass bearing: frequency baseline 185 degrees magnetic.

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

LOCATION DESCRIPTION

From the intersection of 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 9.8 miles to a fork. Stay left, continuing 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, and is marked by browse tag #141.





Map Name: Tenmile Canyon North .

Diagrammatic Sketch

Township 15S , Range 21E , Section 27

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

DISCUSSION

Winter Ridge Bullhog - Trend Study No. 10R-41

Study Information

This study was established in 2007 to monitor a pinyon-juniper removal project on Winter Ridge [elevation: 7,380 feet (2,249 m), slope: 4%, aspect: southeast]. Pinyon pine (*Pinus edulis*) and juniper (*Juniperus* spp.) have encroached on the entire Winter Ridge area. The UDWR and BLM have cooperated on lop and scatter treatments on over 7,000 acres (2,833 ha), however, the trees are too thick for this treatment on several hundred acres. This study monitors a 400 acre (162 ha) area on which thick pinyon-juniper will be removed using a bullhog machine. The trees will be shredded in place and the litter will be left on the ground. The project will enhance sagebrush communities and improve habitat for sage-grouse and big game. Animal use was estimated at 6 elk days use/acre (15 edu/ha), 3 deer days use/acre (7 ddu/ha), 3 cattle days use/acre (7 cdu/ha), and 5 horse days use/acre (13 hdu/ha). Some deer sheds and horse bones were found on the study in 2007.

Soil

The soil is classified as a Winteridge-Moonset complex (USDA-NRCS 2007). The soils in the Winteridge series are very deep, well-drained, and formed in eolian deposits over slope alluvium derived from shale, sandstone, siltstone, and limestone rocks. The Moonset series consists of shallow and well-drained soils formed in slope alluvium and colluvium derived from sandstone and shale. Textural and chemical analyses identified the soil as a clay loam with a neutral reaction (pH 7.3). The soil phosphorus was marginal at 9.2 ppm, and potassium was low at 51.2 ppm (Tiedemann and Lopez 2004). Approximately 75% of the ground was covered by litter or was bare. Relative vegetation cover was 15%, and relative combined rock and pavement cover was 6%. The soil erosion condition was classified as critical due to pedestalling around most of the shrubs, evidence of surface litter, rock, and soil movement, and the formation of flow patterns and rills.

Browse

Browse provided 11% of the total ground cover in 2007. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) comprised 30% of the total browse cover, and its density was 1,560 plants/acre (3,855 plants/ha). Sixty-five percent of the population was decadent, with low reproduction and recruitment. Plants classified as dying composed 42% of the population. Dead plants were sampled at a density of 940 plants/acre (2,323 plants/ha). Use was mostly light, with 24% of the sampled plants showing moderate-heavy browsing. Annual leader growth averaged 1.4 inches (3.6 cm).

Dwarf rabbitbrush (*Chrysothamnus depressus*) was also present at a density of 500 plants/acre (1,235 plants/ha). The population was mostly mature, with 28% decadence. No seedlings or young plants were sampled. Twelve percent of the population was classified as dying. Use was mostly light, with 16% of the population displaying moderate-heavy hedging.

Pinyon and Utah juniper (*Juniperus osteosperma*) provided 30% combined canopy cover. From the point-centered quarter data, pinyon pine density was estimated at 837 trees/acre (2,068 trees/ha). The average trunk diameter was 2.4 inches (6.1 cm), and half of the sampled trees were seedlings. The remaining half ranged from 1 to 12 feet (0.3 to 3.7 m) in height. Juniper density was 103 trees/acre (255 trees/ha). Average trunk diameter was 5.5 inches (14 cm). Forty percent of the sampled trees were 1-4 feet (0.3-1.2 m) in height, while another 40% were in the 4-12 foot (1.2-3.7 m) height class.

Herbaceous Understory

The understory provided 5% of the total ground cover, and no annual species were sampled. Grasses comprised approximately half of the understory cover. Nine grass species were sampled, but none were particularly abundant. Some of the most common grasses included Sandberg bluegrass (*Poa secunda*), prairie junegrass (*Koeleria cristata*), needle-and-thread (*Stipa comata*), bluebunch wheatgrass (*Agropyron spicatum*),

and Indian ricegrass (*Oryzopsis hymenoides*). Fifteen forb species were sampled, and no species were particularly dominant. Common forbs included desert phlox (*Phlox austromontana*), bladderpod (*Lesquerella* sp.), mat penstemon (*Penstemon caespitosus*), and stemless goldenweed (*Haplopappus acaulis*).

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Preferred browse and perennial herbaceous cover were very low, due to the thick pinyon-juniper canopy. However, the understory composition was favorable, with only perennial species being sampled. No noxious species were present.

winter range condition (DCI) - very poor (14) Mid-level potential scale

HERBACEOUS TRENDS --
Management unit 10R, Study no: 41

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron dasystachyum	5	.01
G	Agropyron spicatum	26	.54
G	Bouteloua gracilis	6	.06
G	Carex sp.	25	.10
G	Koeleria cristata	51	.31
G	Oryzopsis hymenoides	34	.35
G	Poa secunda	46	.44
G	Sitanion hystrix	12	.02
G	Stipa comata	51	.52
Total for Annual Grasses		0	0
Total for Perennial Grasses		256	2.37
Total for Grasses		256	2.37
F	Arabis sp.	9	.09
F	Arenaria sp.	24	.12
F	Astragalus convallarius	2	.00
F	Astragalus spatulatus	12	.03
F	Astragalus sp.	4	.01
F	Eriogonum alatum	1	.03
F	Erigeron sp.	22	.16
F	Haplopappus acaulis	34	.58
F	Hymenoxys acaulis	12	.05
F	Lesquerella sp.	68	.31
F	Machaeranthera grindelioides	15	.13
F	Penstemon caespitosus	31	.45
F	Penstemon sp.	5	.03

Type	Species	Nested Frequency '07	Average Cover % '07
F	Phlox austromontana	74	.62
F	Tragopogon dubius	4	.01
Total for Annual Forbs		0	0
Total for Perennial Forbs		317	2.65
Total for Forbs		317	2.65

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

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata vaseyana	47	3.21
B	Chrysothamnus depressus	12	
B	Gutierrezia sarothrae	40	.88
B	Juniperus osteosperma	5	1.78
B	Opuntia sp.	3	.00
B	Pinus edulis	24	4.81
Total for Browse		131	10.71

CANOPY COVER, LINE INTERCEPT --
Management unit 10R, Study no: 41

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

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 10R, Study no: 41

Species	Average leader growth (in) '07
Artemisia tridentata vaseyana	1.4

POINT-QUARTER TREE DATA –
Management unit 10R, Study no: 41

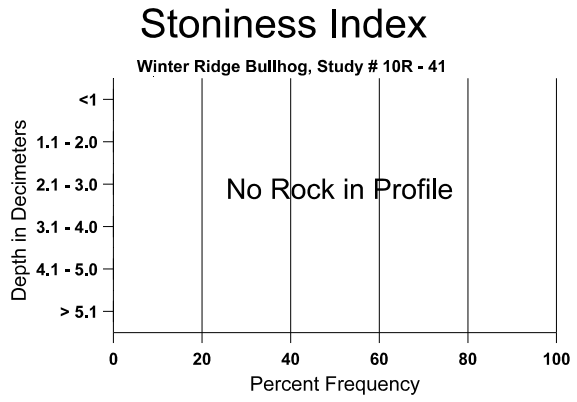
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	103	5.5
Pinus edulis	837	2.4

BASIC COVER --
Management unit 10R, Study no: 41

Cover Type	Average Cover % '07
Vegetation	16.72
Rock	5.05
Pavement	2.32
Litter	45.18
Cryptogams	4.11
Bare Ground	40.31

SOIL ANALYSIS DATA --
Herd Unit 10R, Study no: 41, Study Name: Winter Ridge Bullhog

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
9.1	-	7.3	28.2	40.4	31.5	3.8	9.2	51.2	0.6



PELLET GROUP DATA --
Management unit 10R, Study no: 41

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	51	-
Horse	3	5 (13)
Elk	10	6 (15)
Deer	1	3 (7)
Cattle	-	3 (7)

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

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata vaseyana												
07	**1560**	20	80	460	1020	940	19	5	65	42	44	19/23
Chrysothamnus depressus												
07	**500**	-	-	360	140	20	4	12	28	12	12	4/6
Gutierrezia sarothrae												
07	**3600**	360	180	3380	40	-	0	0	1	.55	1	8/6
Juniperus osteosperma												
07	**120**	-	60	60	-	-	0	0	-	-	0	-/-
Opuntia sp.												
07	**60**	20	-	60	-	-	0	0	-	-	0	2/7
Pinus edulis												
07	**660**	240	440	220	-	-	3	0	-	-	0	-/-

Trend Study 10R-42-07

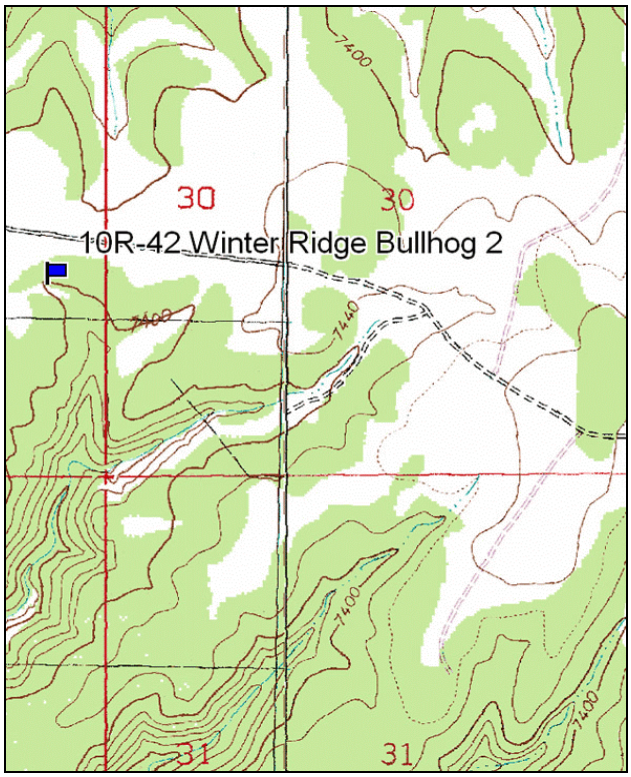
Study site name: Winter Ridge Bullhog 2. Vegetation type: Pinyon-Juniper.

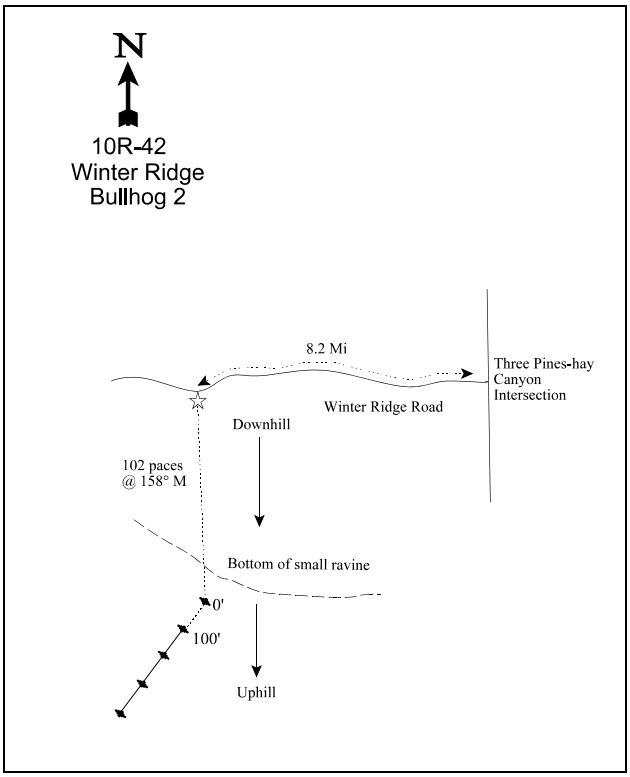
Compass bearing: frequency baseline 240 degrees magnetic.

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

LOCATION DESCRIPTION

From the intersection of 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 102 paces at 158 degrees magnetic, near the bottom of a small gully. The 0-foot stake is marked with browse tag #140.





Map Name: Tenmile Canyon North .

Diagrammatic Sketch

Township 15S , Range 21E , Section 25

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

DISCUSSION

Winter Ridge Bullhog 2 - Trend Study No. 10R-42

Study Information

This study was established in 2007 to monitor a pinyon-juniper removal project on Winter Ridge, approximately 2 miles (3.2 km) east of the Winter Ridge Bullhog study (10R-41) [elevation: 7,400 feet (2,256 m), slope: 7%, aspect: southeast]. Pinyon pine (*Pinus edulis*) and juniper (*Juniperus* spp.) have encroached on the entire Winter Ridge area. The UDWR and BLM have cooperated on lop and scatter treatments on over 7,000 acres (2,833 ha), however, the trees are too thick for this treatment on several hundred acres. This study monitors a 400 acre (162 ha) area on which thick pinyon-juniper will be removed using a bullhog machine. The trees will be shredded in place and the litter will be left on the ground. The project will enhance sagebrush communities and improve habitat for sage-grouse and big game. Animal use was estimated at 7 elk days use/acre (17 edu/ha), 7 deer days use/acre (17 ddu/ha), 3 cattle days use/acre (7 cdu/ha), and 6 horse days use/acre (14 hdu/ha).

Soil

The soil is classified as a Winteridge-Moonset complex (USDA-NRCS 2007). The soils in the Winteridge series are very deep, well-drained, and formed in eolian deposits over slope alluvium derived from shale, sandstone, siltstone, and limestone rocks. The Moonset series consists of shallow and well-drained soils formed in slope alluvium and colluvium derived from sandstone and shale. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 7.2). The soil phosphorus was marginal-high at 10.9 ppm, and potassium was marginal at 83.2 ppm (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 62%, and relative bare ground cover was 29%. Relative combined rock and pavement cover was 3%, and cryptogams provided 6% of the relative cover. The soil erosion condition was classified as critical due to pedestalling, evidence of surface litter, rock, and soil movement, and the formation of flow patterns, rills, and gullies.

Browse

Browse species provided 16% of the total ground cover in 2007. Preferred browse comprised 6% of the total browse cover. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) density was 1,800 plants/acre (4,448 plants/ha). The population was 70% decadent, with little reproduction or recruitment. Dead plants were sampled at a density of 540 plants/acre (1,334 plants/ha), and 22% of the live plants sampled were classified as dying. Use was light-moderate, and annual leader growth averaged 1.6 inches (4.1 cm).

Antelope bitterbrush (*Purshia tridentata*) density was 280 plants/acre (692 plants/ha). The majority of the population was mature, with 7% young recruitment and 14% decadence. Use was mostly light, with 28% of the sampled plants showing moderate-heavy hedging. Average annual leader growth was 4.2 inches (10.7 cm). Dwarf rabbitbrush (*Chrysothamnus depressus*) was the most numerous browse species, with a density of 9,300 plants/acre (22,980 plants/ha). The population was largely mature, with 6% young recruitment and 3% decadence. Use was mostly light, with 20% of the plants displaying moderate-heavy use. True mountain mahogany (*Cercocarpus montanus*) was also present at a very low density.

Several tree species were present, including Utah juniper (*Juniperus osteosperma*), Rocky Mountain juniper (*Juniperus scopulorum*), pinyon pine, ponderosa pine (*Pinus ponderosa*), and fir (*Abies* sp.). These species provided 28% combined canopy cover. From the point-centered quarter data, pinyon density was 297 trees/acre (734 trees/ha). Average trunk diameter was 3.6 inches (9.1 cm), and 60% of the sampled trees were 1-8 feet (0.3-2.4 m) tall. Utah juniper density was 69 trees/acre (170 trees/ha), and average trunk diameter was 8.6 inches (21.8 cm). Forty-two percent of the sampled trees were in the 4-8 foot (1.2-2.4 m) height class, and 47% were taller than 8 feet (2.4 m).

Herbaceous Understory

The herbaceous component was diverse and abundant. Only perennial grasses were sampled, and provided 10% cover. Of the 10 sampled species, the most abundant were prairie junegrass (*Koeleria cristata*), blue grama (*Bouteloua gracilis*), Sandberg bluegrass (*Poa secunda*), and needle-and-thread (*Stipa comata*). Forbs provided 7% cover. Twenty-five forb species were sampled, three of which were annuals. Owlclover (*Orthocarpus* sp.) was the most abundant annual forb. Rose pussytoes (*Antennaria rosea*), fleabane (*Erigeron* sp.), mat penstemon (*Penstemon caespitosus*), and desert phlox (*Phlox austromontana*) were the most common perennial forbs.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. The area was dominated by pinyon and juniper trees, and preferred browse cover was very low. The understory was favorable, with 15% perennial herbaceous cover. Cheatgrass and noxious weeds were not present.

winter range condition (DCI) - poor (44) Mid-level potential scale

HERBACEOUS TRENDS --
Management unit 10R, Study no: 42

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron dasystachyum	46	.36
G	Agropyron spicatum	30	.25
G	Bouteloua gracilis	92	3.23
G	Carex sp.	38	.22
G	Elymus junceus	3	.03
G	Koeleria cristata	120	2.60
G	Oryzopsis hymenoides	11	.36
G	Poa fendleriana	50	.62
G	Poa secunda	133	.97
G	Stipa comata	76	1.11
Total for Annual Grasses		0	0
Total for Perennial Grasses		599	9.77
Total for Grasses		599	9.77
F	Antennaria rosea	146	2.76
F	Arabis sp.	4	.01
F	Astragalus convallarius	8	.04
F	Astragalus spatulatus	5	.04
F	Crepis acuminata	8	.03
F	Cryptantha sp.	5	.00
F	Draba sp. (a)	-	.00
F	Eriogonum alatum	12	.11
F	Erigeron sp.	51	.27

Type	Species	Nested Frequency '07	Average Cover % '07
F	Erigeron pumilus	5	.01
F	Euphorbia sp.	1	.03
F	Haplopappus acaulis	11	.04
F	Hymenoxys acaulis	2	.00
F	Ipomopsis aggregata	-	.00
F	Lesquerella sp.	28	.18
F	Lupinus argenteus	4	.01
F	Machaeranthera grindelioides	16	.07
F	Orthocarpus sp. (a)	91	1.20
F	Penstemon caespitosus	54	.52
F	Penstemon sp.	2	.15
F	Phlox austromontana	44	.88
F	Phlox longifolia	38	.19
F	Senecio multilobatus	-	.00
F	Sphaeralcea grossulariifolia	11	.08
F	Unknown forb-annual (a)	1	.00
Total for Annual Forbs		92	1.21
Total for Perennial Forbs		455	5.49
Total for Forbs		547	6.70

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

Type	Species	Strip Frequency '07	Average Cover % '07
B	Abies sp.	1	.38
B	Artemisia tridentata vaseyana	46	2.58
B	Cercocarpus montanus	2	-
B	Chrysothamnus depressus	69	2.40
B	Chrysothamnus viscidiflorus viscidiflorus	4	.03
B	Gutierrezia sarothrae	58	1.57
B	Juniperus osteosperma	6	1.99
B	Juniperus scopulorum	5	1.46

B	Pinus edulis	16	3.59
B	Pinus ponderosa	4	.86
B	Purshia tridentata	11	.86
B	Tetradymia canescens	0	-
Total for Browse		222	15.74

CANOPY COVER, LINE INTERCEPT --
Management unit 10R, Study no: 42

Species	Percent Cover '07
Abies sp.	.01
Artemisia tridentata vaseyana	4.03
Cercocarpus montanus	.30
Chrysothamnus depressus	3.00
Gutierrezia sarothrae	1.68
Juniperus osteosperma	7.75
Juniperus scopulorum	4.40
Pinus edulis	14.46
Pinus ponderosa	.96
Purshia tridentata	1.10

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 10R, Study no: 42

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

POINT-QUARTER TREE DATA --
Management unit 10R, Study no: 42

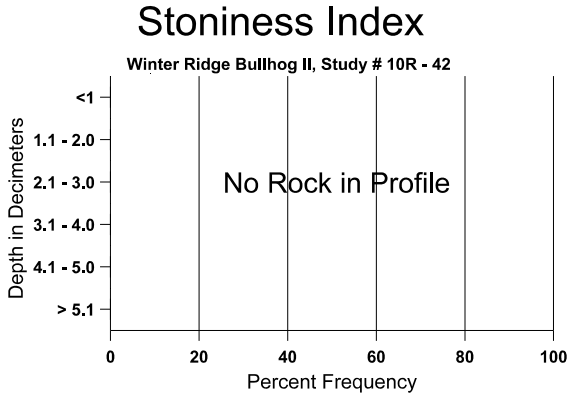
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	69	8.6
Pinus edulis	297	3.6

BASIC COVER --
Management unit 10R, Study no: 42

Cover Type	Average Cover % '07
Vegetation	33.20
Rock	.94
Pavement	2.65
Litter	37.62
Cryptogams	6.46
Bare Ground	33.34

SOIL ANALYSIS DATA --
Herd Unit 10R, Study no: 42, Study Name: Winter Ridge Bullhog 2

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
6.6	-	7.2	30.2	42.4	27.5	1.9	10.9	83.2	0.5



PELLET GROUP DATA --
Management unit 10R, Study no: 42

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

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

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Abies sp.												
07	**20**	40	20	-	-	-	0	0	-	-	0	-/-
Artemisia tridentata vaseyana												
07	**1800**	20	60	480	1260	540	36	6	70	22	32	26/26
Cercocarpus montanus												
07	**60**	-	40	20	-	-	33	33	-	-	0	22/19
Chrysothamnus depressus												
07	**9300**	20	520	8540	240	40	7	13	3	.43	.43	5/8
Chrysothamnus viscidiflorus viscidiflorus												
07	**100**	-	-	100	-	-	0	0	-	-	0	8/7
Gutierrezia sarothrae												
07	**5020**	280	160	4740	120	-	0	0	2	2	2	7/7
Juniperus osteosperma												
07	**140**	40	60	60	20	40	0	0	14	-	0	-/-
Juniperus scopulorum												
07	**100**	-	60	40	-	-	0	0	-	-	0	-/-
Pinus edulis												
07	**340**	580	180	140	20	20	0	0	6	-	0	-/-
Pinus ponderosa												
07	**80**	-	60	20	-	-	0	0	-	-	50	-/-
Purshia tridentata												
07	**280**	-	20	220	40	-	14	14	14	7	7	20/36
Tetradymia canescens												
07	**0**	-	-	-	-	-	0	0	-	-	0	7/7

Trend Study 11R-10-07

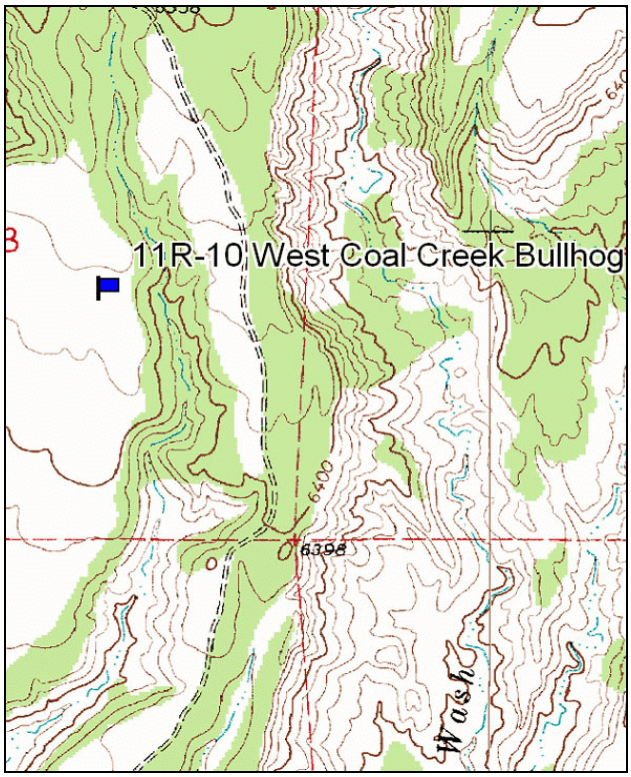
Study site name: West Coal Creek Bullhog. Vegetation type: Black Sagebrush, P-J.

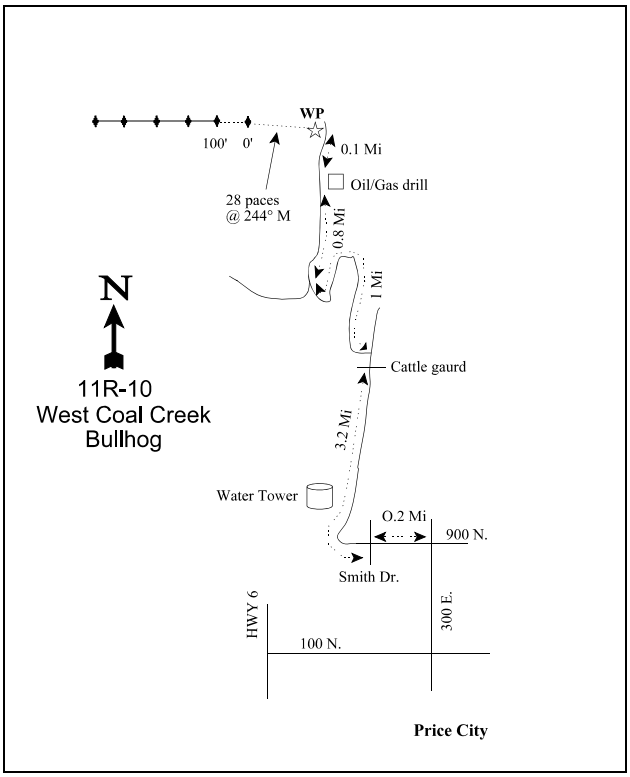
Compass bearing: frequency baseline 235 degrees magnetic.

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

LOCATION DESCRIPTION

From 300 East in Price, turn left (west) on 900 North and go 0.2 miles to Smith Dr. Continue west on 900 North, eventually heading north past a water tower and out of town 3.2 miles, just past a cattle guard to a fork. Go left and continue on 1 mile to an intersection. Turn right (north) and go 0.8 miles to an oil/gas pump on the right side of the road. From here, travel north 0.1 mile to a witness post on the left side of the road. The 0-foot stake is 28 paces from the witness post at 244 degrees magnetic, and is marked with browse tag #189.





Map Name: Helper .

Diagrammatic Sketch

Township 13S , Range 10E , Section 28

GPS: NAD 83, UTM 12S 516812 E 4390586.5 N

DISCUSSION

West Coal Creek Bullhog - Trend Study No. 11R-10

Study Information

This study was established in 2007 to monitor a rehabilitation project on big game wintering habitat south of Kenilworth [elevation: 6,470 feet (1,972 m), slope: 4%, aspect: southwest]. Wildfire suppression and livestock management actions had resulted in pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) dominance on public lands in Carbon County. In the 1950s, the Coal Creek area was two-way chained and seeded to reduce pinyon-juniper canopy and improve the shrub and understory components. In the years following the chaining, the area was continually grazed but received no follow-up treatments or maintenance in the chained area. The lack of maintenance resulted in regenerated pinyon-juniper forest with sections of dead material from the chaining. In 2007, a 1,912 acre (774 ha) bullhog treatment was proposed to thin pinyon-juniper encroachment, reduce hazardous fire fuels, and subsequently increase understory production. Use was estimated at 3 deer days use/acre (8 ddu/ha), 3 elk days use/acre (7 edu/ha), and 2 cattle days use/acre (4 cdu/ha). Deer and elk pellet groups were from winter and spring use. Rabbit pellet quadrat frequency was 81%.

Soil

The soil is classified within the Strych series (USDA-NRCS 2007). The soils in this series are very deep, well-drained, and formed in mixed alluvium and colluvium derived from sandstone shale and conglomerate. Textural and chemical analyses identified the soil as a sandy clay loam with a neutral reaction (pH 7.2). Soil phosphorus and potassium are marginal at 10.9 ppm and 64 ppm, respectively (Tiedemann and Lopez 2004). Relative vegetation cover was 14%. Relative litter cover was 35%, and was composed mostly of needles and the remains of chained trees. Some crypogamic crust was also present at 4% relative cover. Relative bare ground cover was 32%. The soil erosion condition was classified as moderate due to evidence of surface litter and soil movement, pedestalling around plants, and the presence of flow patterns.

Browse

Total browse cover was 15% in 2007. The majority of the preferred browse cover was comprised of black sagebrush (*Artemisia nova*), which provided 9% of the total ground cover and 10% canopy cover. Decadence was high at 30% of the population, while young recruitment was low at 2% of the population. Seedlings were abundant at a density of 4,160 plants/acre (10,279 plants/ha), and dead plants were sampled at a density of 1,280 plants/acre (3,163 plants/ha). Eleven percent of the population was classified as dying. Use on sagebrush was moderate. Annual leader growth averaged 1.1 inches (2.8 cm). Fourwing saltbush (*Atriplex canescens*), Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), and antelope bitterbrush (*Purshia tridentata*) were also scattered throughout the study. Average annual leader growth on bitterbrush was 3.7 inches (9.4 cm).

Pinyon and juniper provided 7% combined ground cover and 10% canopy cover in 2007. From the point-centered quarter data, pinyon density was estimated at 121 trees/acre (299 trees/ha). Average trunk diameter was 3.9 inches (9.9 cm), and the majority of the sampled trees were in the 4-8 foot (1.2-2.4 m) height class. Juniper density was 178 trees/acre (440 trees/ha). Average trunk diameter was 3.9 inches (9.9 cm), and most of the sampled trees were 1-8 feet (0.3-2.4 m) tall.

Herbaceous Understory

The understory was very sparse, and diversity was low. Only perennial grasses were sampled, and crested wheatgrass (*Agropyron spicatum*) provided the only significant amount of cover at 1%. Blue grama (*Bouteloua gracilis*), Sandberg bluegrass (*Poa secunda*), and bottlebrush squirreltail (*Sitanion hystrix*) were also present in one quadrat each. Seven forb species were sampled, two of which were annuals. Total forb

cover was less than 1%. Penstemon (*Penstemon* sp.), euphorbia (*Euphorbia* sp.), and nodding eriogonum (*Eriogonum cernuum*) were the most common species.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. Some preferred browse cover was available, mostly black sagebrush, but cover was low. Perennial understory cover was also low, and few species were present. No annual grasses or noxious weeds were sampled.

winter range condition (DCI) - poor (20) Low potential scale

HERBACEOUS TRENDS --
Management unit 11R, Study no: 10

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron cristatum	120	1.06
G	Bouteloua gracilis	1	.00
G	Poa secunda	2	.00
G	Sitanion hystrix	1	.00
Total for Annual Grasses		0	0
Total for Perennial Grasses		124	1.07
Total for Grasses		124	1.07
F	Astragalus convallarius	1	.00
F	Aster sp.	1	.00
F	Descurainia pinnata (a)	2	.03
F	Eriogonum cernuum (a)	7	.06
F	Euphorbia sp.	12	.20
F	Penstemon sp.	30	.09
F	Townsendia sp.	1	.00
Total for Annual Forbs		9	0.09
Total for Perennial Forbs		45	0.30
Total for Forbs		54	0.40

BROWSE TRENDS --
Management unit 11R, Study no: 10

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia nova	85	8.51
B	Atriplex canescens	0	-
B	Cowania mexicana stansburiana	0	-
B	Juniperus osteosperma	6	1.65
B	Opuntia sp.	2	.00
B	Pinus edulis	6	4.99
B	Purshia tridentata	0	.00
Total for Browse		99	15.16

CANOPY COVER, LINE INTERCEPT --
Management unit 11R, Study no: 10

Species	Percent Cover '07
Artemisia nova	10.43
Juniperus osteosperma	2.70
Opuntia sp.	.13
Pinus edulis	7.36

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 11R, Study no: 10

Species	Average leader growth (in) '07
Artemisia nova	1.1
Purshia tridentata	3.7

POINT-QUARTER TREE DATA --
Management unit 11R, Study no: 10

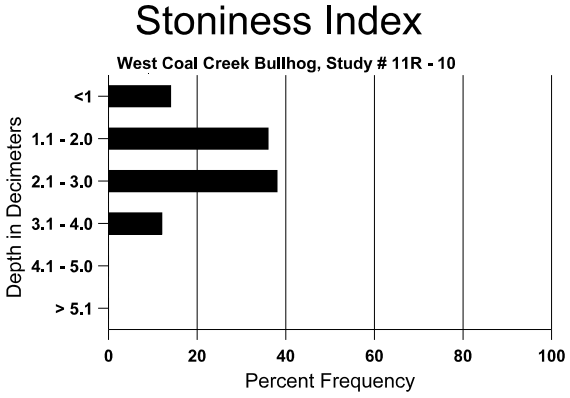
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	178	3.9
Pinus edulis	121	3.9

BASIC COVER –
Management unit 11R, Study no: 10

Cover Type	Average Cover % '07
Vegetation	15.89
Rock	3.86
Pavement	13.04
Litter	39.01
Cryptogams	4.59
Bare Ground	35.43

SOIL ANALYSIS DATA --
Herd Unit 11R, Study no: 10, Study Name: West Coal Creek Bullhog

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
11.2	-	7.2	48.2	28.4	23.5	2.7	10.9	64.0	0.6



PELLET GROUP DATA --
Management unit 11R, Study no: 10

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	81	-
Elk	1	3 (7)
Deer	1	3 (8)
Cattle	1	2 (4)

BROWSE CHARACTERISTICS --
Management unit 11R, Study no: 10

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia nova												
07	**7220**	4160	160	4920	2140	1280	58	8	30	11	12	13/22
Atriplex canescens												
07	**0**	-	-	-	-	-	0	0	-	-	0	48/49
Cowania mexicana stansburiana												
07	**0**	-	-	-	-	-	0	0	-	-	0	43/31
Juniperus osteosperma												
07	**120**	-	80	40	-	-	0	0	-	-	0	-/-
Opuntia sp.												
07	**140**	-	20	120	-	-	0	0	-	-	0	3/7
Pinus edulis												
07	**160**	-	40	120	-	-	0	0	-	-	0	-/-
Purshia tridentata												
07	**0**	-	-	-	-	-	0	0	-	-	0	50/86

Trend Study 13R-01-07

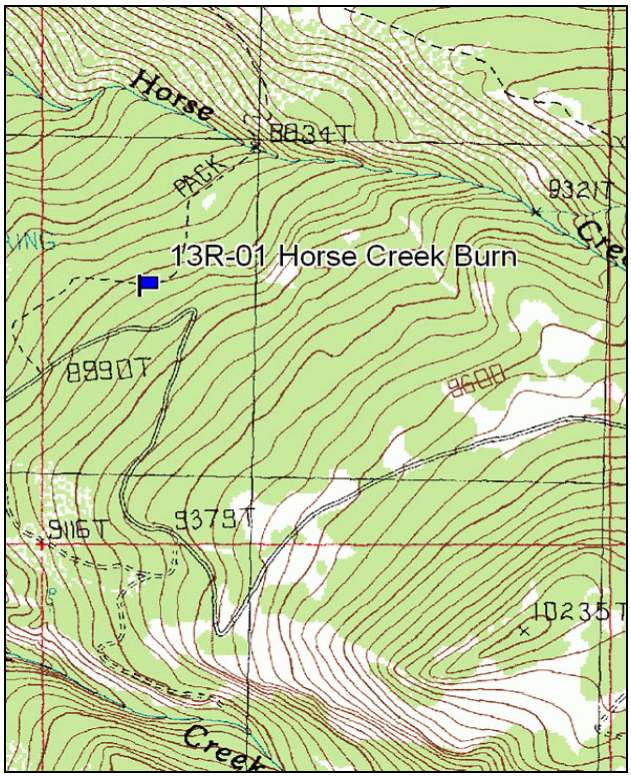
Study site name: Horse Creek Burn. Vegetation type: Aspen.

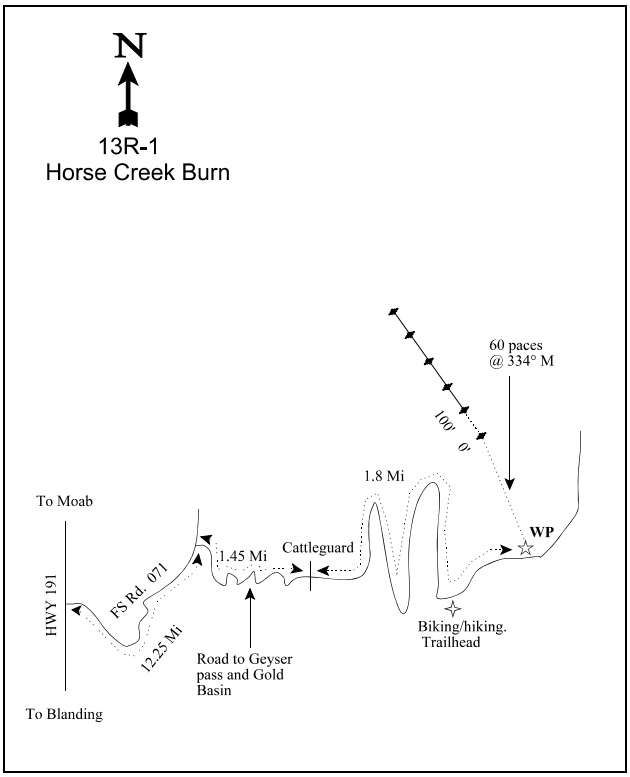
Compass bearing: frequency baseline 319 degrees magnetic.

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

LOCATION DESCRIPTION

Travel south from Moab on Highway 191 to mile marker 118, and continue 0.1 mile. Turn left and go 0.5 miles to a T in the road. Take the right on F.S. Road #071 going to the La Sal Mountains, from here travel 12.25 miles to the road to Geyser Pass and Gold Basin coming in from the right. Turn right here and travel 1.45 miles coming to a cattle guard, continue on for another 1.8 miles to the witness post on the left side of the road. From the witness post the 0-foot stake is 60 paces at 334 degrees magnetic and is marked with browse tag #180.





Map Name: Mount Tukuhnivatz .

Diagrammatic Sketch

Township 27S , Range 34E , Section 4

GPS: NAD 83, UTM 12S 649609.5 E 4260729.2 N

DISCUSSION

Horse Creek Burn - Trend Study No. 13R-1

Study Information

This study was established in 2007 to monitor the progress of an aspen (*Populus tremuloides*) regeneration project approximately 16 miles (25.7 km) southeast of Moab [elevation: 9,050 feet (2,758 m), slope: 17%, aspect: north]. Disturbance is needed to regenerate aspen, and with the suppression of fire across the west, aspen stands have been outcompeted by conifers. A prescribed burn was proposed on 1,000 acres (405 ha) to stimulate aspen regeneration, therefore increasing vegetation diversity and productivity, reducing accumulated fuels, and improving forage for big game and livestock, as well as habitat for species of concern such as the northern goshawk and the three-toed woodpecker. The main objective was to allow aspen regeneration over 40%-80% of the treatment area in a mosaic pattern. This area serves as summer range for deer and elk. Use was estimated at 7 deer days use/acre (18 ddu/ha) and 1 elk day use/acre (3 edu/ha), however, the study was sampled in mid-June, before many deer or elk had visited the area.

Soil

The soil is classified within the Flygare series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in glacial drift or alluvium and colluvium from andesite, quartzite, and some limestone. Textural and chemical analyses identified the soil as a medium loam with a moderately acidic reaction (pH 5.7). Organic matter content was higher than on most studies at 9%. The soil phosphorus and potassium were both high at 12.2 ppm and 313.6 ppm, respectively (Tiedemann and Lopez 2004). Relative vegetation cover was 52%, and relative litter cover was 48%. The erosion condition was classified as stable.

Browse

Total browse cover was 36% in 2007, although preferred species only provided 1% cover. Woods' rose (*Rosa woodsii*) was sampled at a density of 760 plants/acre (1,878 plants/ha). Forty-five percent of the population was composed of young plants, and 55% was composed of mature plants. Seedlings were also sampled at a density of 40 plants/acre (99 plants/ha). Chokecherry (*Prunus virginiana*) density was 200 plants/acre (494 plants/ha). Young plants comprised 80% of the population, while the remaining 20% of the plants were mature. Vigor was excellent on both preferred browse species. Use was mostly light, with 10% of the chokecherry individuals displaying moderate use.

Oregon grape (*Mahonia repens*) and snowberry (*Symphoricarpos oreophilus*) were the most abundant shrubs, with densities of 53,800 plants/acre (132,938 plants/ha) and 8,200 plants/acre (20,262 plants/ha), respectively. Serviceberry (*Amelanchier alnifolia*), Rocky Mountain maple (*Acer glabrum*), and Colorado blue spruce (*Picea pungens*) were also present in low densities. From the point-centered quarter data, aspen density was estimated at 825 trees/acre (2,039 trees/ha). Trunk diameter averaged 3.9 inches (9.9 cm). Fifty-five percent of the trees were 1-8 feet (0.3-2.4 m) in height, and 40% were greater than 12 feet (3.7 m) tall. Subalpine fir (*Abies lasiocarpa*) density was 41 trees/acre (101 trees/ha), and average trunk diameter was 6 inches (15.2 cm). The majority of the sampled trees were greater than 12 feet (3.7 m) in height.

Herbaceous Understory

The herbaceous understory was abundant, providing 53% cover, and only perennial species were sampled. Grasses and grass-like species comprised approximately one-third of the total understory cover. Elk sedge (*Carex geyeri*) was the most abundant of these species, providing 16% cover. Smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*) were also sampled in small frequencies. Thirteen forb species were sampled. American vetch (*Vicia americana*), Fendler meadowrue (*Thalictrum fendleri*), Canada violet (*Viola canadensis*), and Porter ligusticum (*Ligusticum porteri*) were the most abundant forbs, and provided 35% combined cover.

2007 Pre-treatment Assessment

The Desirable Components Index (DCI) was not calculated for this study because it is found on summer range. Preferred browse cover was very low, while other non-preferred species, particularly Oregon grape and snowberry, were abundant. The understory was abundant, although not very diverse. No annual species or noxious weeds were sampled.

winter range condition (DCI) - Not applicable, summer range

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

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bromus inermis	12	.34
G	Carex geyeri	406	16.27
G	Poa pratensis	1	.03
Total for Annual Grasses		0	0
Total for Perennial Grasses		419	16.64
Total for Grasses		419	16.64
F	Achillea millefolium	21	.26
F	Astragalus convallarius	16	.02
F	Ligusticum porteri	46	2.56
F	Oreoxis bakeri	9	.10
F	Osmorhiza depauperata	27	.28
F	Smilacina stellata	9	.24
F	Swertia radiata	1	.03
F	Taraxacum officinale	3	.16
F	Thalictrum fendleri	178	13.38
F	Thermopsis montana	17	.12
F	Vicia americana	307	14.90
F	Viola canadensis	212	4.52
F	Viguiera multiflora	3	.03
Total for Annual Forbs		0	0
Total for Perennial Forbs		849	36.65
Total for Forbs		849	36.65

BROWSE TRENDS --
Management unit 13R, Study no: 1

Type	Species	Strip Frequency '07	Average Cover % '07
B	Abies lasiocarpa	0	.85
B	Acer glabrum	1	-
B	Amelanchier alnifolia	1	-
B	Mahonia repens	85	6.09
B	Picea pungens	-	.15
B	Populus tremuloides	46	1.99
B	Prunus virginiana	6	.30
B	Rosa woodsii	17	.90
B	Symphoricarpos oreophilus	96	25.72
Total for Browse		252	36.01

CANOPY COVER, LINE INTERCEPT --
Management unit 13R, Study no: 1

Species	Percent Cover '07
Abies lasiocarpa	2.40
Mahonia repens	8.00
Populus tremuloides	35.98
Prunus virginiana	2.00
Rosa woodsii	.35
Symphoricarpos oreophilus	43.71

POINT-QUARTER TREE DATA --
Management unit 13R, Study no: 1

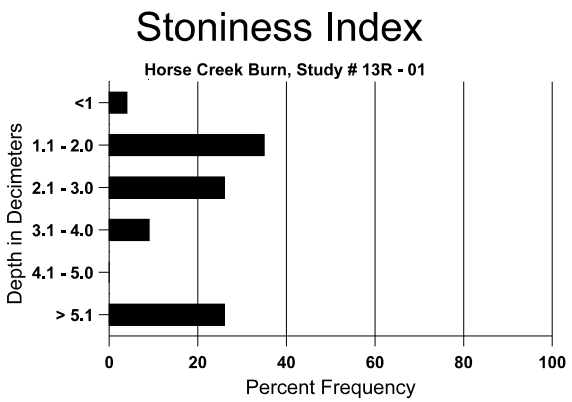
Species	Trees per Acre '07	Average diameter (in) '07
Abies lasiocarpa	41	6.0
Populus tremuloides	825	3.9

BASIC COVER --
Management unit 13R, Study no: 1

Cover Type	Average Cover % '07
Vegetation	76.31
Rock	.38
Litter	70.36
Cryptogams	.06

SOIL ANALYSIS DATA --
Herd Unit 13R, Study no: 1, Study Name: Horse Creek Burn

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
17.0	-	5.7	36.2	47.4	16.5	9.3	12.2	313.6	0.6



PELLET GROUP DATA --
Management unit 13R, Study no: 1

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Elk	-	1 (3)
Deer	-	7 (18)

BROWSE CHARACTERISTICS --
Management unit 13R, Study no: 1

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Abies lasiocarpa												
07	**0**	20	-	-	-	20	0	0	-	-	0	-/-
Acer glabrum												
07	**20**	-	-	-	20	-	0	0	100	-	0	64/34
Amelanchier alnifolia												
07	**20**	-	20	-	-	-	0	0	-	-	0	30/19
Mahonia repens												
07	**53800**	20	19300	34500	-	-	1	0	-	-	0	6/6
Populus tremuloides												
07	**1900**	220	1620	220	60	240	23	8	3	3	6	-/-
Prunus virginiana												
07	**200**	-	160	40	-	-	10	0	-	-	0	72/51
Rosa woodsii												
07	**760**	40	340	420	-	-	0	0	-	-	0	39/17
Symphoricarpos oreophilus												
07	**8200**	100	260	7680	260	60	0	0	3	.48	.48	34/37

Trend Study 13R-02-07

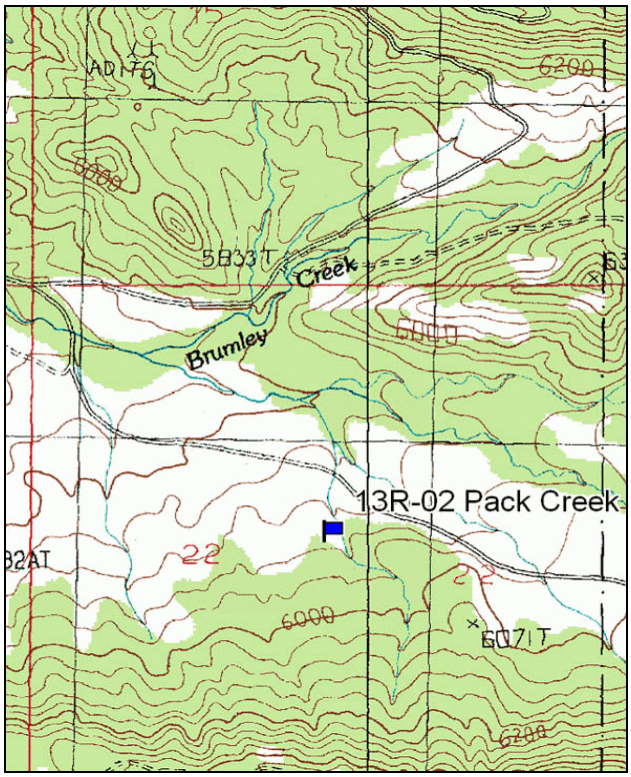
Study site name: Pack Creek. Vegetation type: P-J, Blackbrush, & Wyoming Big Sagebrush.

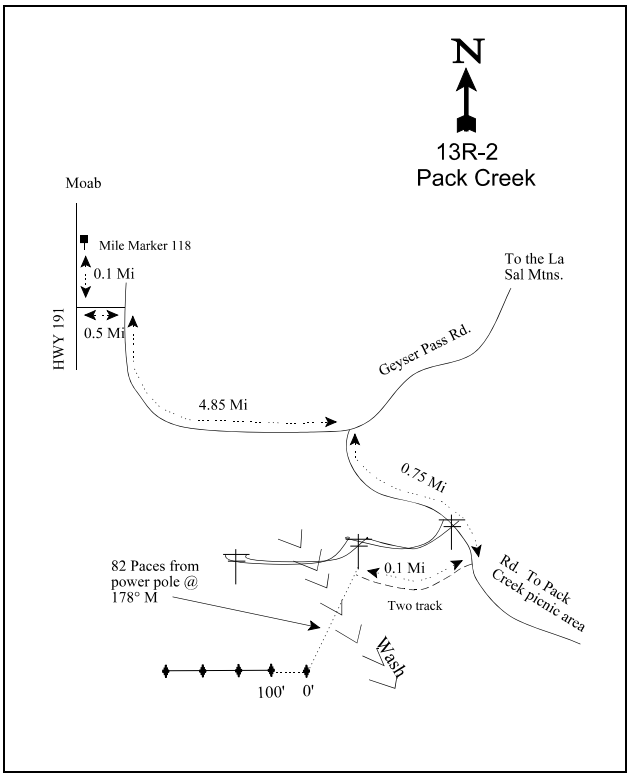
Compass bearing: frequency baseline 245 degrees magnetic.

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

LOCATION DESCRIPTION

Travel south from Moab on Highway 191 to mile marker 118 and continue 0.1 mile. 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 .

Diagrammatic Sketch

Township 27S , Range 23E , Section 22

GPS: NAD 83, UTM 12S 641638.5 E 4255898.6 N

DISCUSSION

Pack Creek - Trend Study No. 13R-2

Study Information

This study was established in 2007 to monitor maintenance work on a project implemented on BLM land approximately 13 miles southeast of Moab [elevation: 5,900 feet (1,798 m), slope: 7%, aspect: north]. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees were thinned and the slash was piled and burned in 2004-2005. 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 and dominated the understory. Maintenance was proposed to further reduce hazardous fuels and improve wildlife habitat on 300 acres (121 ha). This maintenance included using a bullhog to remove standing dead trees, burning the understory, and broadcast seeding native and non-native species with ATVs and a harrow (Table 1). The mechanical treatment was scheduled for spring 2007, with the burn and seeding following in fall 2007. Use was estimated at 85 elk days use/acre (210 edu/ha) and 32 deer days use/acre (79 ddu/ha).

Soil

The soil is classified within the Moab series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in alluvium derived mostly from intermediate igneous rocks and sandstone. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 7.2). Soil phosphorus and potassium were both marginal at 10.4 ppm and 108.8 ppm, respectively (Tiedemann and Lopez 2004). Combined relative vegetation and litter cover was 63%, and combined relative rock and pavement cover was 23%. Relative bare ground cover was 12%. The soil erosion condition was classified as stable.

Browse

Total browse cover was 13% in 2007. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) was the only preferred browse species sampled, and provided 2% cover. Its density was 1,100 plants/acre (2,718 plants/ha). Decadence was high at 56% of the population, and young plants comprised 6% of the population. Thirty-three percent of the sampled plants were classified as dying, and another 11% of the population displayed poor vigor. Use was light-moderate. Annual leader growth averaged 1.3 inches (3.3 cm). Blackbrush (*Coleogyne ramosissima*) density was 1,680 plants/acre (4,151 plants/ha), and it provided 5% cover. The population was largely mature, with 23% decadence and 6% young recruitment. Vigor was good on most plants, and use was light-moderate. Annual leader growth was 1.7 inches (4.4 cm).

From the point-centered quarter data, juniper density was estimated at 32 trees/acre (79 trees/ha). The average trunk diameter was 13.7 inches (34.8 cm). The majority of the sampled trees were in the 8-12 foot (2.4-3.7 m) height class, and were highlined. Pinyon density was 20 trees/acre (49 trees/ha). Average trunk diameter was 0.7 inches (1.8 cm), and the sampled trees were either seedlings or less than 4 feet (1.2 m) tall.

Herbaceous Understory

The understory was dominated by cheatgrass, which provided 26% cover. Sixweeks fescue (*Vulpia octoflora*) was the only other annual grass sampled, but provided almost 0% cover. Perennial grasses provided 3% cover. The most common perennial grass was bottlebrush squirreltail (*Sitanion hystrix*), and Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Oryzopsis hymenoides*), and galleta (*Hilaria jamesii*) were also sampled in low frequencies.

The forb component was diverse and provided 5% cover. Twenty-seven species were sampled, 20 of which were perennials. Bluestem beardtongue (*Penstemon cyanocaulis*), Zion milkvetch (*Astragalus zionis*), longleaf phlox (*Phlox longifolia*), and cryptantha (*Cryptantha* sp.) were the most common perennials. Gilia (*Gilia* sp.), Russian thistle (*Salsola iberica*), bur buttercup (*Ranunculus testiculatus*), and draba (*Draba* sp.) were the most abundant annual forbs.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor-poor. Preferred browse cover was very low. Perennial herbaceous cover was also low, while cheatgrass was dominant. No noxious weeds were sampled.

winter range condition (DCI) - very poor-poor (10) Low potential scale

Table 1. Seed mix applied to the Pack Creek project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Canby Bluegrass "Canbar"	150	9
Indian Ricegrass "Rimrock"	200	11
Sandberg Bluegrass	100	6
Sand Dropseed	50	3
Siberian Wheatgrass "Vavilov"	450	26
Thickspike Wheatgrass "Bannock"	400	23
Western Wheatgrass "Arriba"	300	17
Fourwing Saltbush	100	6
Palmer Penstemon	8	<1
Total	1758	100

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

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bromus tectorum (a)	457	26.22
G	Hilaria jamesii	5	.01
G	Oryzopsis hymenoides	3	.16
G	Poa secunda	23	.67
G	Sitanion hystrix	68	2.62
G	Vulpia octoflora (a)	35	.09
Total for Annual Grasses		492	26.31
Total for Perennial Grasses		99	3.46
Total for Grasses		591	29.77
F	Astragalus flexuosus	3	.24
F	Astragalus sp.	4	.00
F	Astragalus zionis	52	.20
F	Calochortus nuttallii	2	.01
F	Cryptantha sp.	42	.56
F	Cymopterus sp.	3	.01
F	Delphinium nuttallianum	1	.00
F	Draba sp. (a)	58	.14
F	Eriogonum cernuum (a)	4	.03

Type	Species	Nested Frequency '07	Average Cover % '07
F	Eriogonum corymbosum	2	.00
F	Eriogonum ovalifolium	3	.01
F	Gilia sp. (a)	106	.74
F	Helianthus annuus (a)	1	.01
F	Holosteum umbellatum (a)	1	.00
F	Hymenoxys acaulis	1	.04
F	Lactuca serriola	6	.01
F	Lesquerella sp.	4	.04
F	Linum lewisii	1	.00
F	Lygodesmia spinosa	5	.01
F	Machaeranthera canescens	3	.01
F	Penstemon cyanocaulis	27	1.28
F	Petradoria pumila	4	.66
F	Phlox longifolia	51	.21
F	Ranunculus testiculatus (a)	66	.31
F	Salsola iberica (a)	100	.42
F	Sphaeralcea grossulariifolia	12	.34
F	Townsendia sp.	31	.13
Total for Annual Forbs		336	1.66
Total for Perennial Forbs		257	3.81
Total for Forbs		593	5.48

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

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	33	1.91
B	Atriplex canescens	0	-
B	Chrysothamnus nauseosus	14	.59
B	Coleogyne ramosissima	30	4.85
B	Echinocereus triglochidatus	4	.03
B	Ephedra torreyana	2	-
B	Eriogonum corymbosum	3	.30
B	Gutierrezia sarothrae	54	4.45
B	Juniperus osteosperma	1	.85
B	Opuntia sp.	0	-
B	Pinus edulis	1	.15
B	Symphoricarpos oreophilus	0	-
B	Yucca sp.	0	-
Total for Browse		142	13.15

CANOPY COVER, LINE INTERCEPT --
Management unit 13R, Study no: 2

Species	Percent Cover '07
Artemisia tridentata wyomingensis	1.66
Coleogyne ramosissima	4.50
Eriogonum corymbosum	.03
Gutierrezia sarothrae	4.46
Juniperus osteosperma	3.20

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 13R, Study no: 2

Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	1.3
Coleogyne ramosissima	1.7

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

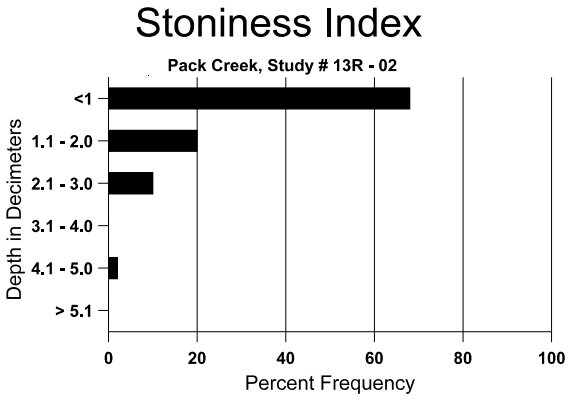
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	32	13.7
Pinus edulis	20	0.7

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

Cover Type	Average Cover % '07
Vegetation	49.04
Rock	13.73
Pavement	13.09
Litter	22.51
Cryptogams	1.72
Bare Ground	13.86

SOIL ANALYSIS DATA --
Herd Unit 13R, Study no: 2, Study Name: Pack Creek

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
5.5	-	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 '07	Days use per acre (ha) '07
Rabbit	16	-
Elk	3	85 (210)
Deer	36	32 (79)

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

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**1100**	40	60	420	620	540	29	2	56	33	44	15/25
Atriplex canescens												
07	**0**	-	-	-	-	-	0	0	-	-	0	36/54
Chrysothamnus nauseosus												
07	**740**	-	-	720	20	20	3	0	3	-	8	20/27
Coleogyne ramosissima												
07	**1680**	-	100	1200	380	60	39	0	23	2	4	10/21
Echinocereus triglochidatus												
07	**80**	-	-	80	-	20	0	0	-	-	0	4/3
Ephedra torreyana												
07	**40**	-	-	40	-	-	0	0	-	-	0	17/22
Eriogonum corymbosum												
07	**160**	20	80	80	-	-	0	0	-	-	0	12/13
Gutierrezia sarothrae												
07	**4340**	3180	540	3660	140	140	0	0	3	3	3	10/15
Juniperus osteosperma												
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Opuntia sp.												
07	**0**	-	-	-	-	-	0	0	-	-	0	5/8
Pinus edulis												
07	**20**	-	20	-	-	-	0	0	-	-	0	-/-
Symphoricarpos oreophilus												
07	**0**	-	-	-	-	20	0	0	-	-	0	-/-
Yucca sp.												
07	**0**	-	-	-	-	-	0	0	-	-	0	27/53

Trend Study 14R-19-07

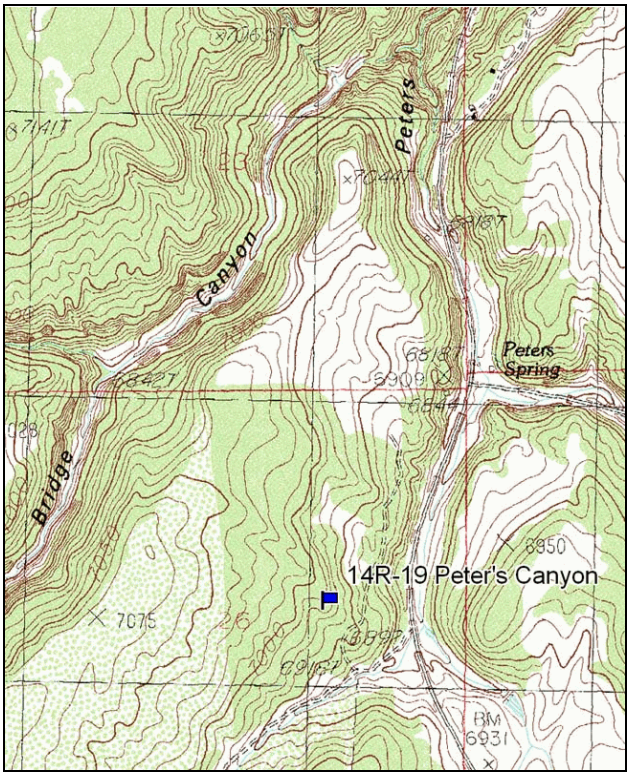
Study site name: Peters Canyon . Vegetation type: Pinyon-Juniper.

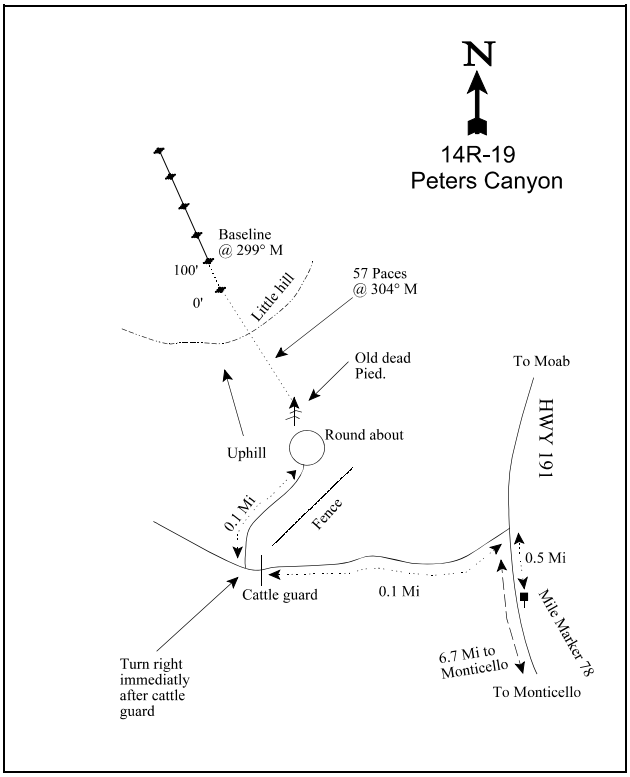
Compass bearing: frequency baseline 299 degrees magnetic.

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

LOCATION DESCRIPTION

Travel north on US 191 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 a dead pinyon on the northwest part of the round-about, and is marked by browse tag #182.





Map Name: Monticello North

Diagrammatic Sketch

Township 32S , Range 23E , Section 26

GPS: NAD 83, UTM 12S 643988.8 E 4203464.6 N

DISCUSSION

Peters Canyon - Trend Study No. 14R-19

Study Information

This study was established in 2007 to monitor a fuels reduction project approximately 7 miles (11.3 km) northwest of Monticello and 0.2 miles (0.3 km) west of US-191 [elevation: 6,990 feet (2,131 m), slope: 2%, aspect: southeast]. Pinyon-juniper encroachment and growth in the area resulted in a closed canopy system with a drastically reduced herbaceous understory. Additionally, years of extended drought throughout the region resulted in an outbreak of insect infestations and disease. Approximately 40% of the pinyon pine (*Pinus edulis*) trees in the area were dead or dying from bark beetle (*Ips* sp.) infestation. The resulting dried needles and dead wood created a fire hazard. The area was bullhogged several years prior to the establishment of the study, and maintenance was needed. Mechanical treatment, underburning, and broadcast seeding were implemented on 158 acres (64 ha) of land administered by the BLM (Table 1). Animal use was estimated at 5 deer days use/acre (12 ddu/ha), 7 elk days use/acre (17 edu/ha), and 2 cattle days use/acre (4 cdu/ha). Rabbit pellet quadrat frequency was 71%.

Soil

The soil is classified within the Northdale series (USDA-NRCS 2007). The soils in this series are moderately deep, well-drained, and formed in eolian deposits and material weathered from sandstone. Textural and chemical analyses identified the soil as medium loam with a neutral reaction (pH 7.2). The soil phosphorus and potassium were both marginal at 8.7 ppm and 112 ppm, respectively (Tiedemann and Lopez 2004). Relative litter cover was 58%, while relative vegetation cover was 23%. Relative bare ground cover was 16%. The soil erosion condition was classified as stable.

Browse

The browse component was sparse, and was dominated by pinyon pine and Utah juniper (*Juniperus osteosperma*). Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) was sampled at a density of 140 plants/acre (346 plants/ha) and provided less than 1% cover. Twenty-nine percent of the population was decadent, and 29% was composed of young plants. The sampled decadent plants were classified as dying. Use was light-moderate, and annual leader growth averaged 1.8 inches (4.5 cm). Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) was also present at a very low density.

Pinyon pine and juniper provided 19% combined canopy cover. From the point-centered quarter data, pinyon density was 44 trees/acre (109 trees/ha). Average trunk diameter was 6.1 inches (15.5 cm), and most of the sampled trees were greater than 12 feet (3.7 m) in height. Juniper density was 60 trees/acre (148 trees/ha). Forty-two percent of the sampled trees were 1-8 feet (0.3-2.4 m) in height, and 42% were taller than 12 feet (3.7 m). The remaining 16% were seedlings.

Herbaceous Understory

Grasses provided 15% cover. Approximately 50% of the total grass cover was provided by perennials. Bottlebrush squirreltail (*Sitanion hystrix*) and mutton bluegrass (*Poa fendleriana*) were the most abundant perennials. Other perennial species included Indian ricegrass (*Oryzopsis hymenoides*), blue grama (*Bouteloua gracilis*), and sedge (*Carex* sp.). Cheatgrass (*Bromus tectorum*) was the most abundant grass and provided 8% cover.

Forbs were abundant and provided 6% cover. Thirty-one species were sampled, 20 of which were perennials. Longleaf phlox (*Phlox longifolia*) and dwarf lousewort (*Pedicularis centranthera*) were the most common perennial species. Tansymustard (*Descurainia pinnata*) was the most abundant annual and provided 3% cover.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor-poor. There was almost no preferred browse cover. Perennial grass cover was moderate, but cheatgrass dominated the understory. Perennial forb cover was low. There were no noxious weeds sampled.

winter range condition (DCI) - very poor-poor (12) Low potential scale

Table 1. Seed mix applied to the Peters Canyon project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Bitterbrush	50	3
Blue Grama	200	13
Canby Bluegrass "Canbar"	150	10
Fourwing Saltbush	50	3
Indian Ricegrass "Rimrock"	300	20
Sand Dropseed	50	3
Siberian Wheatgrass "Vavilov"	350	24
Thickspike Wheatgrass "Bannock"	250	17
Sandberg Bluegrass	100	7
Total	1500	100

HERBACEOUS TRENDS --

Management unit 14R, Study no: 19

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bouteloua gracilis	11	.10
G	Bromus tectorum (a)	262	8.19
G	Carex sp.	13	.03
G	Koeleria cristata	7	.04
G	Oryzopsis hymenoides	13	.17
G	Poa fendleriana	83	2.81
G	Poa secunda	7	.04
G	Sitanion hystrix	115	3.83
G	Stipa comata	2	.15
G	Vulpia octoflora (a)	5	.03
Total for Annual Grasses		267	8.22
Total for Perennial Grasses		251	7.18
Total for Grasses		518	15.40
F	Arabis sp.	1	.00
F	Astragalus sp.	1	.15
F	Castilleja sp.	4	.01
F	Chaenactis douglasii	4	.01
F	Chenopodium fremontii (a)	7	.01

Type	Species	Nested Frequency '07	Average Cover % '07
F	Cirsium sp.	-	.00
F	Cryptantha sp.	3	.03
F	Descurainia pinnata (a)	77	3.11
F	Draba sp. (a)	21	.07
F	Erodium cicutarium (a)	8	.04
F	Erigeron pumilus	7	.05
F	Erysimum sp.	5	.01
F	Gayophytum ramosissimum(a)	1	.00
F	Gilia sp. (a)	18	.14
F	Haplopappus acaulis	5	.03
F	Halogeton glomeratus (a)	1	.00
F	Ipomopsis aggregata	10	.09
F	Lappula occidentalis (a)	64	.52
F	Leucelene ericoides	11	.33
F	Lesquerella sp.	1	.15
F	Linum lewisii	3	.00
F	Microsteris gracilis (a)	41	.08
F	Pedicularis centranthera	17	.42
F	Penstemon cyanocaulis	4	.10
F	Petradoria pumila	9	.18
F	Phlox hoodii	1	.00
F	Phlox longifolia	44	.14
F	Polygonum douglasii (a)	6	.01
F	Ranunculus testiculatus (a)	26	.05
F	Senecio multilobatus	1	.00
F	Trifolium sp.	11	.02
Total for Annual Forbs		270	4.07
Total for Perennial Forbs		142	1.78
Total for Forbs		412	5.85

BROWSE TRENDS --
Management unit 14R, Study no: 19

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	6	.18
B	Cowania mexicana stansburiana	0	-
B	Echinocereus triglochidatus	0	.00
B	Gutierrezia sarothrae	44	.66
B	Juniperus osteosperma	5	-
B	Opuntia sp.	11	.30
B	Pinus edulis	5	2.23
B	Yucca sp.	0	-
Total for Browse		71	3.38

CANOPY COVER, LINE INTERCEPT --
Management unit 14R, Study no: 19

Species	Percent Cover '07
Artemisia tridentata wyomingensis	.20
Gutierrezia sarothrae	2.01
Juniperus osteosperma	10.00
Opuntia sp.	.01
Pinus edulis	9.38

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 14R, Study no: 19

Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	1.8

POINT-QUARTER TREE DATA --
Management unit 14R, Study no: 19

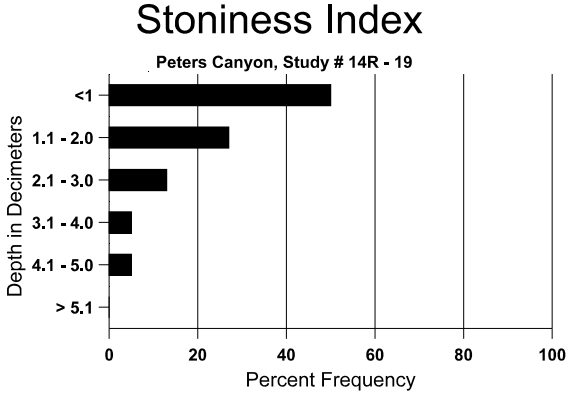
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	60	10.0
Pinus edulis	44	6.1

BASIC COVER --
Management unit 14R, Study no: 19

Cover Type	Average Cover % '07
Vegetation	24.65
Rock	2.01
Pavement	.39
Litter	61.54
Cryptogams	.93
Bare Ground	16.95

SOIL ANALYSIS DATA --
Herd Unit 14R, Study no: 19, Study Name: Peters Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
13.3	-	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 '07	Days use per acre (ha) '07
Rabbit	71	-
Elk	1	7 (17)
Deer	5	5 (12)
Cattle	1	2 (4)

BROWSE CHARACTERISTICS --
Management unit 14R, Study no: 19

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**140**	200	40	60	40	40	29	0	29	29	29	21/32
Cowania mexicana stansburiana												
07	**0**	-	-	-	-	-	0	0	-	-	0	26/42
Echinocereus triglochidatus												
07	**0**	-	-	-	-	-	0	0	-	-	0	2/15
Gutierrezia sarothrae												
07	**3480**	2200	1120	2280	80	-	0	0	2	1	1	9/11
Juniperus osteosperma												
07	**100**	40	-	100	-	20	0	0	-	-	0	-/-
Opuntia sp.												
07	**340**	-	40	280	20	-	0	0	6	6	6	4/14
Pinus edulis												
07	**140**	20	40	100	-	140	0	0	-	-	0	-/-
Yucca sp.												
07	**0**	-	-	-	-	-	0	0	-	-	0	32/69

Trend Study 14R-20-07

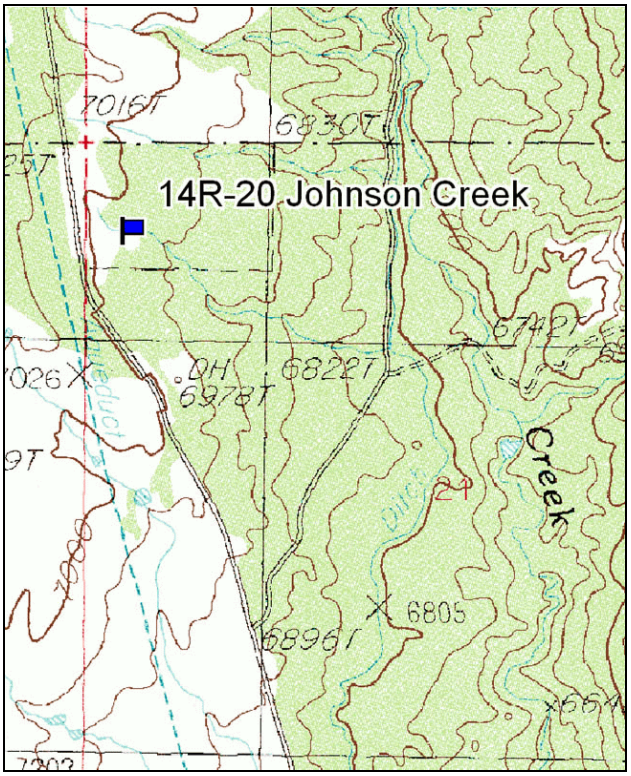
Study site name: Johnson Creek . Vegetation type: P-J, Gambel Oak.

Compass bearing: frequency baseline 135 degrees magnetic.

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

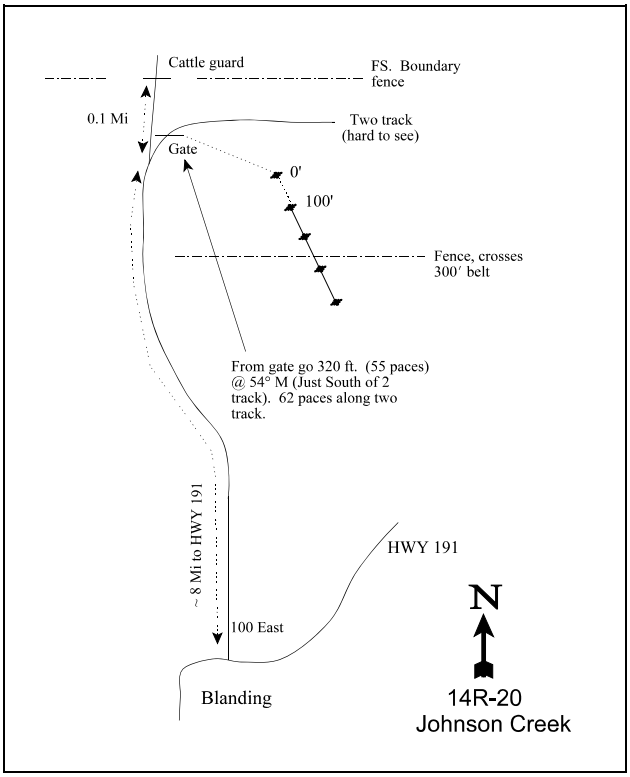
LOCATION DESCRIPTION

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 54 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 630588.7 E 4176433 N

DISCUSSION

Johnson Creek - Trend Study No. 14R-20

Study Information

This study was established in 2007 to monitor a fuels reduction project on BLM land approximately 7.5 miles (12.1 km) northwest of Blanding [elevation: 7,000 feet (2,134 m), slope: 7%, aspect: southeast]. Past wildfire suppression and livestock management actions allowed pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) to dominate the area, drastically reducing the herbaceous understory. Additionally, years of extended drought throughout the region resulted in an outbreak of insect infestations and disease. Approximately 40% of the pinyon trees in the area were dead or dying from bark beetle (*Ips* sp.) infestation. The resulting dried needles and dead wood created a fire hazard. The 300 acre (121 ha) treatment included thinning the pinyon-juniper by hand, piling and burning the slash, and broadcast seeding native and non-native species with ATVs and a harrow (Table 1). The main objectives were to reduce catastrophic fire potential, increase the shrub and perennial herbaceous components, and diversify the age class of trees within the area. Animal use was estimated at 11 deer days use/acre (28 ddu/ha), 1 elk day use/acre (2 edu/ha), and 28 cattle days use/acre (68 cdu/ha).

Soil

The soil is classified as a Barx-Strych-Skos complex (USDA-NRCS 2007). The soils in the Barx series are very deep and well-drained, and formed in alluvium and reworked eolian material derived from sandstone. The Strych series consists of very deep, well-drained soils that formed in mixed alluvium and colluvium derived from sandstone shale and conglomerate. The soils in the Skos series are very shallow to shallow, well-drained, and formed in residuum and colluvium from interbedded sandstone, siltstone, and shale. Textural and chemical analyses identified the soil as a medium loam with a slightly acidic reaction (pH 6.2). The soil phosphorus and potassium were both marginal at 9.9 ppm and 115.2 ppm, respectively (Tiedemann and Lopez 2004). Approximately 50% of the relative ground cover was provided by litter. Relative vegetative cover was 22%, and relative bare ground cover was 25%. The soil erosion condition was classified as stable.

Browse

Total browse cover was 13% in 2007. Preferred and key browse species provided approximately one-third of the total browse cover. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) was the most numerous preferred browse species, with a density of 700 plants/acre (1,730 plants/ha). Seventy-seven percent of the population was decadent, with 6% young recruitment. Fifty-seven percent of the sampled plants were classified as dying. Dead plants were sampled at a density of 1,080 plants/acre (2,669 plants/ha), and seedling density was 200 plants/acre (494 plants/ha). Use was moderate-heavy. Annual leader growth averaged 2.7 inches (6.9 cm).

Utah serviceberry (*Amelanchier utahensis*) density was 320 plants/acre (791 plants/ha). The population was mostly mature, with 25% young recruitment and 6% decadence. Seedling and dead plant densities were low at 60 plants/acre (148 plants/ha) and 20 plants/acre (49 plants/ha), respectively. Vigor was excellent, and use was mostly light, with 38% of the sampled plants displaying heavy use. Average annual leader growth was 2.3 inches (5.7 cm). Gambel oak (*Quercus gambelii*) density was 660 plants/acre (1,631 plants/ha). The population was mostly young and mature, with 6% decadence. Vigor was good on most plants, and use was light.

Pinyon pine and juniper provided the remaining two-thirds of the total browse cover. Pinyon-juniper combined canopy cover was 42%. From the point-centered quarter data, pinyon density was estimated at 431 trees/acre (1,065 trees/ha). Sixty percent of the sampled trees were less than 4 feet (1.2 m) tall, and the average trunk diameter was 2.1 inches (5.3 cm). Juniper density was 102 trees/acre (252 trees/ha). Average trunk diameter was 6.9 inches (17.5 cm), and almost all of the sampled trees were greater than 8 feet (2.4 m) in height.

Herbaceous Understory

Grasses provided 5% total cover. The majority of this cover was composed of annual species, particularly cheatgrass (*Bromus tectorum*) and sixweeks fescue (*Vulpia octoflora*). Perennial species were less common, and included Sandberg bluegrass (*Poa secunda*), bottlebrush squirreltail (*Sitanion hystrix*), Indian ricegrass (*Oryzopsis hymenoides*), and blue grama (*Bouteloua gracilis*). Total forb cover was 8%, approximately half of which was provided by perennials. Silvery lupine (*Lupinus argenteus*) was the most common perennial species. Bur buttercup (*Ranunculus testiculatus*), draba (*Draba* sp.), and blue-eyed Mary (*Collinsia parviflora*) were the most abundant annual forbs.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. Preferred and key browse provided little cover, and the majority of the sagebrush population was decadent. Most of the grass cover was composed of cheatgrass, and there were few abundant perennial forbs. The most abundant annual forb, bur buttercup, is allelopathic and prevents the establishment of native species (Buchanan et al. 1978).

winter range condition (DCI) - poor (14) Low potential scale

Table 1. Seed mix applied to the Johnson Creek project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Canby Bluegrass "Canbar"	400	13
Indian Ricegrass "Rimrock"	350	11
Sandberg Bluegrass	350	11
Sand Dropseed	150	5
Siberian Wheatgrass "Vavilov"	800	26
Thickspike Wheatgrass "Bannock"	550	18
Western Wheatgrass "Arriba"	400	13
Palmer Penstemon	50	2
Total	3050	100

HERBACEOUS TRENDS --
Management unit 14R, Study no: 20

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bouteloua gracilis	10	.04
G	Bromus tectorum (a)	257	3.07
G	Carex sp.	-	.00
G	Oryzopsis hymenoides	9	.16
G	Poa pratensis	3	.04
G	Poa secunda	44	.84
G	Sitanion hystrix	23	.07
G	Vulpia octoflora (a)	154	.88
Total for Annual Grasses		411	3.96
Total for Perennial Grasses		89	1.17
Total for Grasses		500	5.13

Type	Species	Nested Frequency '07	Average Cover % '07
F	Arabis sp.	16	.04
F	Astragalus convallarius	20	.24
F	Astragalus sp.	3	.00
F	Calochortus nuttallii	2	.00
F	Collinsia parviflora (a)	131	.63
F	Cryptantha sp.	14	.04
F	Descurainia pinnata (a)	14	.05
F	Draba sp. (a)	151	.36
F	Erodium cicutarium (a)	3	.00
F	Eriogonum racemosum	1	.00
F	Gilia sp. (a)	2	.00
F	Holosteum umbellatum (a)	1	.00
F	Lappula occidentalis (a)	14	.03
F	Lupinus argenteus	68	3.57
F	Pedicularis centranthera	14	.50
F	Penstemon sp.	5	.04
F	Phlox longifolia	10	.02
F	Polygonum douglasii (a)	9	.02
F	Ranunculus testiculatus (a)	240	2.64
F	Salsola iberica (a)	2	.00
F	Tragopogon dubius	1	.00
Total for Annual Forbs		567	3.77
Total for Perennial Forbs		154	4.48
Total for Forbs		721	8.25

BROWSE TRENDS --
Management unit 14R, Study no: 20

Type	Species	Strip Frequency '07	Average Cover % '07
B	Amelanchier utahensis	12	2.60
B	Artemisia tridentata wyomingensis	27	1.05
B	Juniperus osteosperma	15	3.92
B	Opuntia fragilis	5	.00
B	Opuntia sp.	0	.00
B	Pediocactus simpsonii	0	-
B	Pinus edulis	17	5.07
B	Quercus gambelii	4	.63
B	Tetradymia canescens	0	-
Total for Browse		80	13.31

CANOPY COVER, LINE INTERCEPT --
Management unit 14R, Study no: 20

Species	Percent Cover '07
Amelanchier utahensis	3.91
Artemisia tridentata wyomingensis	.56
Juniperus osteosperma	15.86
Opuntia sp.	.03
Pinus edulis	25.96
Quercus gambelii	2.01

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 14R, Study no: 20

Species	Average leader growth (in) '07
Amelanchier utahensis	2.3
Artemisia tridentata wyomingensis	2.7

POINT-QUARTER TREE DATA –
Management unit 14R, Study no: 20

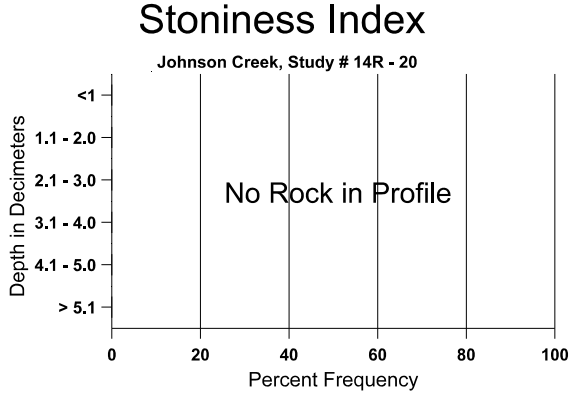
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	102	6.9
Pinus edulis	431	2.1

BASIC COVER --
Management unit 14R, Study no: 20

Cover Type	Average Cover % '07
Vegetation	24.34
Rock	.00
Pavement	.05
Litter	55.96
Cryptogams	3.76
Bare Ground	28.78

SOIL ANALYSIS DATA --
Herd Unit 14R, Study no: 20, Study Name: Johnson Creek

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
9.0	-	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 '07	Days use per acre (ha) '07
Rabbit	82	-
Elk	1	1 (2)
Deer	1	11 (28)
Cattle	9	28 (68)

BROWSE CHARACTERISTICS --
Management unit 14R, Study no: 20

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Amelanchier utahensis												
07	**320**	60	80	220	20	20	0	38	6	-	0	60/68
Artemisia tridentata wyomingensis												
07	**700**	200	40	120	540	1080	54	23	77	57	69	19/26
Juniperus osteosperma												
07	**320**	-	80	240	-	60	0	0	-	-	6	-/-
Opuntia fragilis												
07	**160**	-	80	40	40	60	0	0	25	25	38	3/16
Opuntia sp.												
07	**0**	-	-	-	-	-	0	0	-	-	0	3/3
Pediocactus simpsonii												
07	**0**	-	-	-	-	-	0	0	-	-	0	2/4
Pinus edulis												
07	**460**	180	260	180	20	140	0	0	4	4	4	-/-
Quercus gambelii												
07	**660**	20	260	360	40	140	0	0	6	6	6	96/64
Tetradymia canescens												
07	**0**	-	-	-	-	-	0	0	-	-	0	11/19

Trend Study 16R-26-07

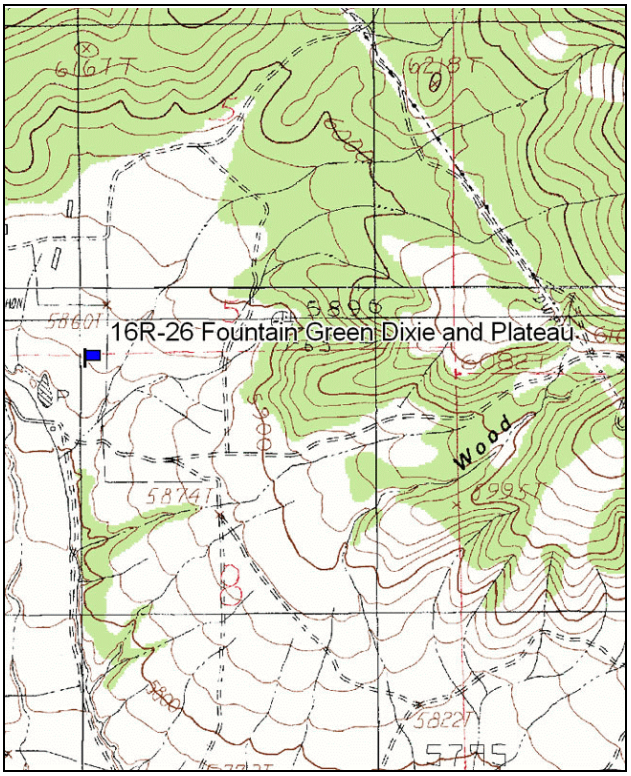
Study site name: Fountain Green Dixie/Plateau . Vegetation type: Wyoming & Basin Big Sagebrush .

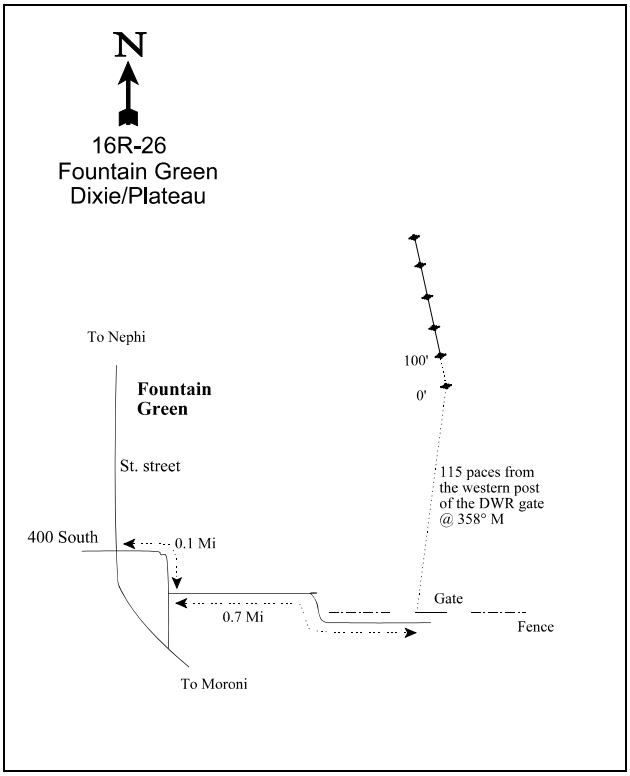
Compass bearing: frequency baseline 335 degrees magnetic.

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

LOCATION DESCRIPTION

Traveling south through Fountain Green 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 115 paces from the western post of the gate at 358 degrees magnetic, and is marked with browse tag #192.





Map Name: Moroni

Diagrammatic Sketch

Township 14S , Range 3E , Section 8

GPS: NAD 83, UTM 12S 446952.7 E 4386036.1 N

DISCUSSION

Fountain Green Dixie Plateau - Trend Study No. 16R-26

Study Information

This study was established in 2007 to monitor a winter range rehabilitation project on the Fountain Green Wildlife Management Area [elevation: 5,850 feet (1,783 m), slope: 3%, aspect: southwest]. This 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 sagebrush population. Additionally, cheatgrass (*Bromus tectorum*) became abundant, providing competition with desirable perennial herbaceous species and inhibiting sagebrush recruitment. The high cheatgrass cover was also a potential fire hazard. The area was heavily grazed by sheep in spring 2007 to remove as much cheatgrass as possible. In fall 2007, Plateau™ herbicide was sprayed on 186 acres (75 ha) to control cheatgrass and release the existing perennial vegetation. An additional 33 acres (13 ha) without perennial vegetation were Dixie harrowed and seeded with a mixture of grasses, forbs, and shrubs (Table 1). Animal use was estimated at 23 deer days use/acre (56 ddu/ha), 5 elk days use/acre (12 edu/ha), and 127 sheep days use/acre (312 sdu/ha). Several dead sheep and deer were found on the study.

Soil

The soil is classified within the Mountainville series (USDA-NRCS 2007). The soils within this series are very deep, well-drained, and formed in alluvium. Textural and chemical analyses identified the soil as a sandy loam with a neutral reaction (pH 7.0). The soil phosphorus and potassium are both high at 12.3 ppm and 486.4 ppm, respectively (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 78%. Relative bare ground cover was 14%, and relative combined rock and pavement cover was 6%. The soil erosion condition was classified as stable.

Browse

The only abundant browse species on the study was basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), which provided 3% cover. Sagebrush density was 1,020 plants/acre (2,520 plants/ha). Eighty-two percent of the population was decadent, and reproduction and recruitment were very low. Thirty-three percent of the sampled plants were classified as dying, and dead plants were sampled at a density of 900 plants/acre (2,224 plants/ha). Some of the sagebrush plants were infested by insects. Use was heavy. Average annual leader growth was 1.6 inches (4 cm). White rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*) and Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) were also scattered throughout the study.

Herbaceous Understory

Herbaceous species provided 40% cover, however, the majority of this cover was composed of undesirable species. Grasses comprised 58% of the total herbaceous cover. Cheatgrass was the most abundant grass species, providing 23% cover. Three perennial grass species were sampled, including western wheatgrass (*Agropyron smithii*), bottlebrush squirreltail (*Sitanion hystrix*), and Indian ricegrass (*Oryzopsis hymenoides*), but these species provided less than 1% combined cover.

The forb component was dominated by annual species. Storksbill (*Erodium cicutarium*) and tumblemustard (*Sisymbrium altissimum*) were the most abundant annual forbs. Scarlet globemallow (*Sphaeralcea coccinea*) was the most abundant perennial forb. Whitetop (*Cardaria draba*), a noxious weed, was also sampled in 16% of the quadrats.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Preferred browse cover was very low, and the majority of the sagebrush population was decadent. The herbaceous understory was composed mostly of undesirable species. Cheatgrass and storksbill were the most abundant

herbaceous species. Storksbill has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003). A noxious weed was also present.

winter range condition (DCI) - very poor (-11) Low potential scale

Table 1. Seed mix applied to the Fountain Green project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	30	7
Alfalfa "Ranger"	30	7
Bluebunch Wheatgrass "Anatone"	30	7
Crested Wheatgrass "Douglas"	30	7
Crested Wheatgrass "Hycrest"	30	7
Great Basin Wildrye "Trailhead"	30	7
Indian Ricegrass "Rimrock"	30	7
Intermediate Wheatgrass	60	13
Orchardgrass "Paiute"	15	3
Sainfoin "Eski"	60	13
Sandberg Bluegrass	15	3
Siberian Wheatgrass "Vavilov"	30	7
Small Burnet "Delar"	60	13
Western Yarrow	5	1
Total	455	100

HERBACEOUS TRENDS --
Management unit 16R, Study no: 26

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron smithii	64	.42
G	Bromus tectorum (a)	475	22.50
G	Oryzopsis hymenoides	4	.03
G	Sitanion hystrix	16	.14
G	Vulpia octoflora (a)	5	.01
Total for Annual Grasses		480	22.51
Total for Perennial Grasses		84	0.60
Total for Grasses		564	23.11
F	Alyssum alyssoides (a)	292	.63
F	Cardaria draba	36	.37
F	Camelina microcarpa (a)	9	.01
F	Chorispora tenella (a)	3	.06
F	Descurainia pinnata (a)	2	.01
F	Erodium cicutarium (a)	382	12.80
F	Lappula occidentalis (a)	4	.01
F	Lactuca serriola	8	.02

Type	Species	Nested Frequency '07	Average Cover % '07
F	Ranunculus testiculatus (a)	165	.50
F	Sisymbrium altissimum (a)	83	1.08
F	Sphaeralcea coccinea	71	1.36
F	Tragopogon dubius	6	.01
Total for Annual Forbs		940	15.12
Total for Perennial Forbs		121	1.77
Total for Forbs		1061	16.90

BROWSE TRENDS --
Management unit 16R, Study no: 26

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata tridentata	37	2.79
B	Chrysothamnus nauseosus albicaulis	0	-
B	Chrysothamnus viscidiflorus stenophyllus	0	-
B	Cowania mexicana stansburiana	0	-
B	Gutierrezia sarothrae	0	-
B	Opuntia sp.	1	.38
B	Tetradymia canescens	0	-
Total for Browse		38	3.17

CANOPY COVER, LINE INTERCEPT --
Management unit 16R, Study no: 26

Species	Percent Cover '07
Artemisia tridentata tridentata	2.01

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16R, Study no: 26

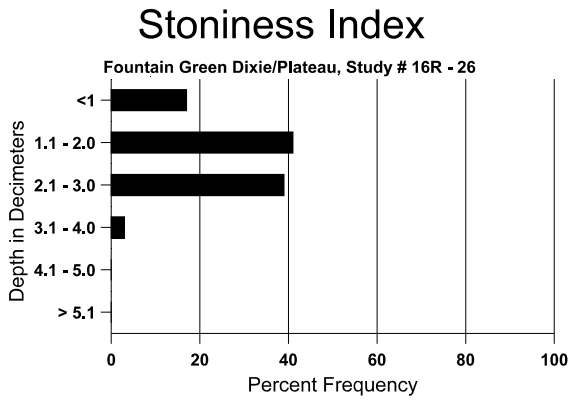
Species	Average leader growth (in) '07
Artemisia tridentata tridentata	1.6

BASIC COVER --
Management unit 16R, Study no: 26

Cover Type	Average Cover % '07
Vegetation	43.34
Rock	5.58
Pavement	1.49
Litter	43.18
Cryptogams	1.88
Bare Ground	14.97

SOIL ANALYSIS DATA --
Herd Unit 16R, Study no: 26, Study Name: Fountain Green Dixie Plateau

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
10.1	-	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 '07	Days use per acre (ha) '07
Sheep	82	127 (312)
Rabbit	25	-
Elk	2	5 (12)
Deer	31	23 (56)
Cattle	4	-

BROWSE CHARACTERISTICS --
Management unit 16R, Study no: 26

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata tridentata												
07	**1020**	-	20	160	840	900	0	100	82	33	51	30/38
Chrysothamnus nauseosus albicaulis												
07	**0**	-	-	-	-	-	0	0	-	-	0	19/13
Chrysothamnus viscidiflorus stenophyllus												
07	**0**	-	-	-	-	-	0	0	-	-	0	8/9
Cowania mexicana stansburiana												
07	**0**	-	-	-	-	-	0	0	-	-	0	22/16
Gutierrezia sarothrae												
07	**0**	-	-	-	-	-	0	0	-	-	0	6/6
Opuntia sp.												
07	**20**	-	-	20	-	-	0	0	-	-	100	7/18
Tetradymia canescens												
07	**0**	-	-	-	-	-	0	0	-	-	0	20/24

Trend Study 16R-27-07

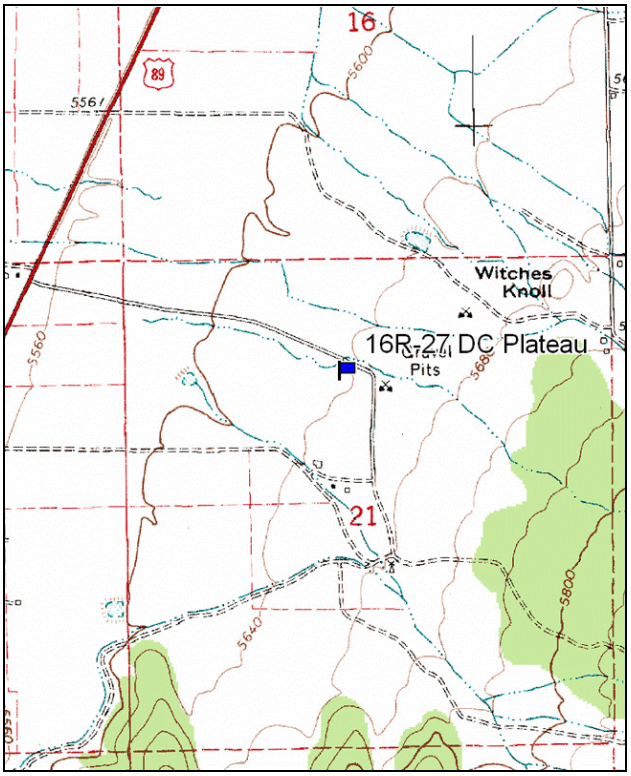
Study site name: DC Plateau . Vegetation type: Annual Weeds .

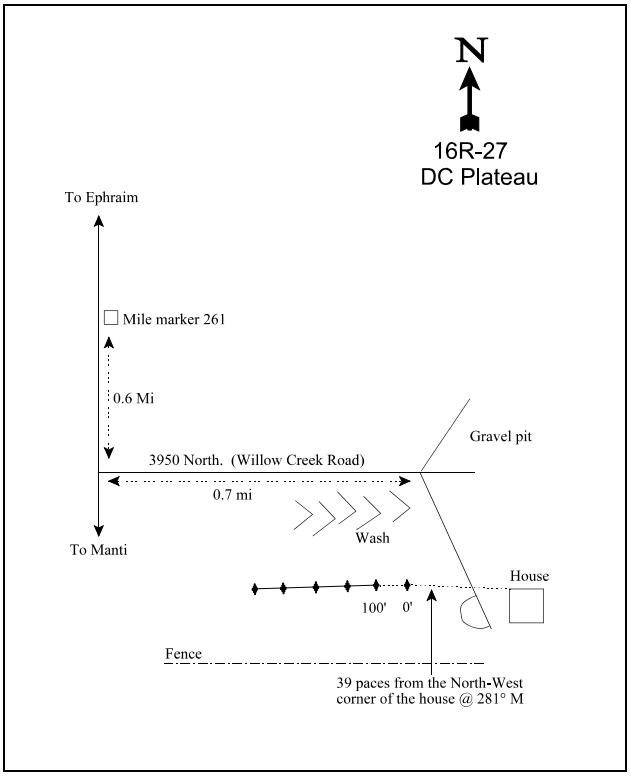
Compass bearing: frequency baseline 272 degrees magnetic.

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

LOCATION DESCRIPTION

Traveling south on highway 89 south of Ephraim, go 0.6 miles from mile marker 261. Here you will turn left onto Willow Creek Road (3950 North) and go 0.7 miles to a private residency on the right. Here you will turn right and get permission by the land owner to park in front of his house. The 0-foot stake is 39 paces from the northwest corner of the house at 281 degrees magnetic, and is marked by browse tag #138.





Map Name: Moroni

Diagrammatic Sketch

Township 17S , Range 3E , Section 21

GPS: NAD 83, UTM 12S 449212 E 4353076 N

DISCUSSION

DC Plateau - Trend Study No. 16R-27

Study Information

This study was established in 2007 to monitor a big game winter range rehabilitation project approximately 2 miles (3.2 km) south of Ephraim (elevation: 5,650 feet (1,722 m), slope: 2%, aspect: west]. The area has been grazed heavily by sheep for decades, leaving an understory dominated by cheatgrass (*Bromus tectorum*) and weedy species. This type of vegetative cover provides little forage for wintering deer and elk, and is a potential fire hazard. The project was initiated as a small-scale demonstration of how to properly apply Plateau™ to rehabilitate cheatgrass dominated rangelands. Eleven acres (4.5 ha) were sprayed with the herbicide at a rate of 6-8 oz/acre (439-585 mL/ha) in early September. The area was then drill seeded with a mix of shrubs and perennial grasses and forbs in late October (Table 1). A similar treatment was implemented near Spring City in 2005, on which Plateau™ was applied after seeding. This project is being monitored by the Howerton's study (16R-20). Animal use was estimated at 15 deer days use/acre (38 ddu/ha) and 2 elk days use/acre (5 edu/ha).

Soil

The soil is classified within the Quaker series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in alluvium dominantly from limestone and shale. Textural and chemical analyses identified the soil as a clay loam with a neutral reaction (pH 7.0). The soil phosphorus and potassium are both high at 11.4 ppm and 246.4 ppm, respectively (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 84%, and relative bare ground cover was 14%. The soil erosion condition was classified as stable.

Browse

The browse component was very sparse, and only consisted of scattered Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and broom snakeweed (*Gutierrezia sarothrae*) plants. Several Utah juniper (*Juniperus osteosperma*) trees were also present in a gully north of the study.

Herbaceous Understory

The understory was dominated by annuals and undesirable species. Cheatgrass was the dominant species, providing 27% cover. Several perennial grass species were sampled, including bulbous bluegrass (*Poa bulbosa*), crested wheatgrass (*Agropyron cristatum*), western wheatgrass (*Agropyron smithii*), and sedge (*Carex* sp.), but these species provided only 1% combined cover. Field bindweed (*Convolvulus arvensis*), a noxious weed, was one of the most abundant forbs, providing 7% cover. Storksbill (*Erodium cicutarium*), bur buttercup (*Ranunculus testiculatus*), and pale alyssum (*Alyssum alyssoides*) were also common.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. There was almost no preferred browse on the study. The understory composition was poor, and was made up mostly of cheatgrass and weedy species. Field bindweed, a noxious weed, was the most common forb species, and storksbill and bur buttercup both prevent the establishment of native species (Buchanan et al. 1978, Kimball and Schiffman 2003).

winter range condition (DCI) - very poor (-20) Low potential scale

Table 1. Seed mix applied to the DC Plateau project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Crested Wheatgrass "Douglas"	24	18
Intermediate Wheatgrass	24	18
Bluebunch Wheatgrass "Anatone"	6	4
Orchardgrass "Paiute"	6	4
Siberian Wheatgrass "Vavilov"	6	4
Indian Ricegrass "Rimrock"	6	4
Canby Bluegrass "Canbar"	6	4
Western Yarrow	3	2
Yellow Sweetclover	3	2
Alfalfa "Spredor 4"	12	9
Sainfoin "Eski"	12	9
Small Burnet "Delar"	24	18
Fourwing Saltbush	6	4
Total	138	100

HERBACEOUS TRENDS --
Management unit 16R, Study no: 27

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron cristatum	2	.45
G	Agropyron smithii	10	.18
G	Bromus tectorum (a)	471	27.43
G	Carex sp.	10	.18
G	Poa bulbosa	7	.22
G	Poa secunda	5	.06
Total for Annual Grasses		471	27.43
Total for Perennial Grasses		34	1.08
Total for Grasses		505	28.52
F	Alyssum alyssoides (a)	360	2.13
F	Alyssum desertorum (a)	3	.00
F	Camelina microcarpa (a)	19	.11
F	Chorispora tenella (a)	7	.07
F	Convolvulus arvensis	269	6.84
F	Descurainia pinnata (a)	4	.00
F	Erodium cicutarium (a)	216	4.75
F	Ranunculus testiculatus (a)	352	2.72
F	Sphaeralcea coccinea	10	.07
F	Tragopogon dubius	5	.04

Type	Species	Nested Frequency '07	Average Cover % '07
Total for Annual Forbs		961	9.81
Total for Perennial Forbs		284	6.96
Total for Forbs		1245	16.78

BROWSE TRENDS --
Management unit 16R, Study no: 27

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	0	-
B	Gutierrezia sarothrae	4	.00
Total for Browse		4	0.00

CANOPY COVER, LINE INTERCEPT --
Management unit 16R, Study no: 27

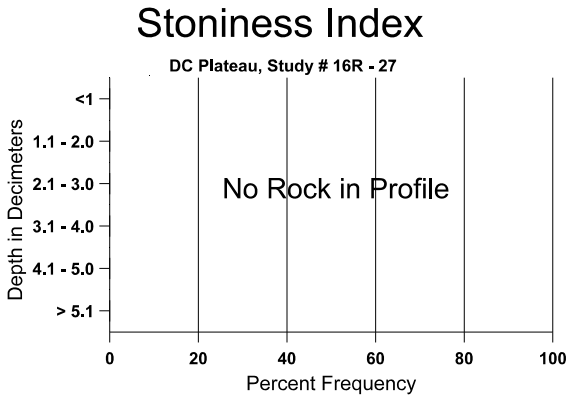
Species	Percent Cover '07
Gutierrezia sarothrae	.18

BASIC COVER --
Management unit 16R, Study no: 27

Cover Type	Average Cover % '07
Vegetation	45.79
Rock	.05
Pavement	.32
Litter	48.39
Cryptogams	1.16
Bare Ground	15.68

SOIL ANALYSIS DATA --
Herd Unit 16R, Study no: 27, Study Name: DC Plateau

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
14.1	-	7.0	28.2	37.0	34.8	1.4	11.4	246.4	0.7



PELLET GROUP DATA --
Management unit 16R, Study no: 27

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	24	-
Elk	-	2 (5)
Deer	11	15 (38)

BROWSE CHARACTERISTICS --
Management unit 16R, Study no: 27

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**0**	-	-	-	-	-	0	0	-	-	0	20/21
Gutierrezia sarothrae												
07	**80**	-	-	80	-	-	0	0	-	-	0	11/13

Trend Study 16R-30-07

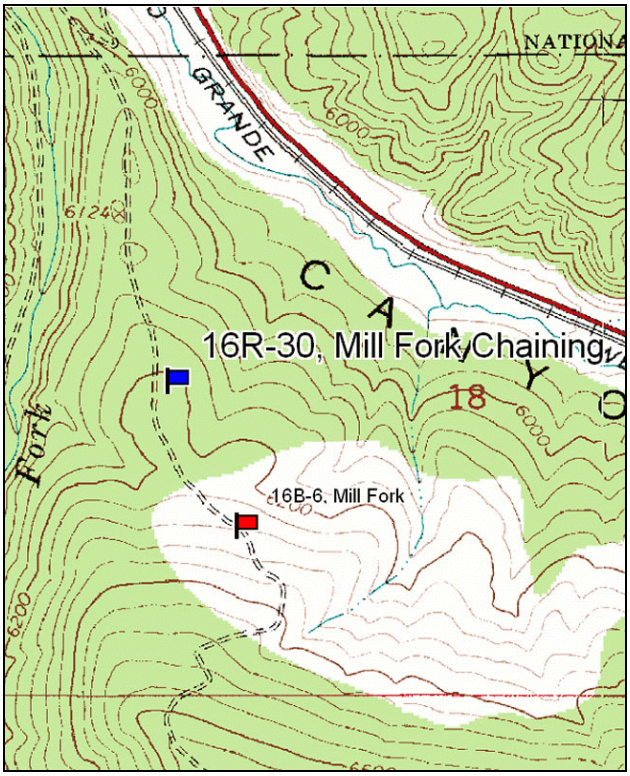
Study site name: Mill Fork Chaining . Vegetation type: Pinyon-Juniper .

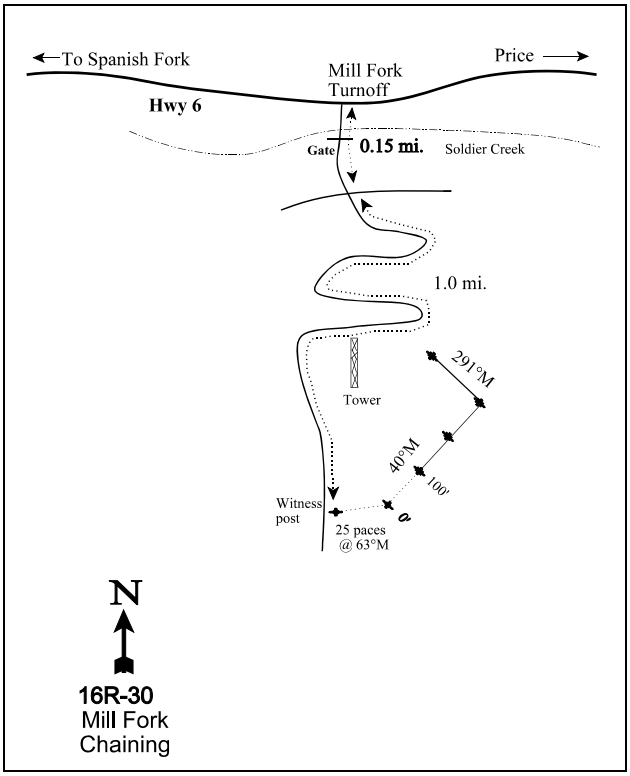
Compass bearing: frequency baseline 360 degrees magnetic.

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

LOCATION DESCRIPTION

From the Sheep Creek Café 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

DISCUSSION

Mill Fork Chaining - Trend Study No. 16R-30

Study Information

This study was established in 2007 to monitor a big game winter range improvement project in Spanish Fork Canyon, 0.4 miles (0.7 km) southwest of US-6 and 0.2 miles (0.4 km) northwest of the permanent Mill Fork study (16B-6) [elevation: 6,200 feet (1,890 m), slope: 3%-5%, aspect: north]. A large portion of the sagebrush habitats in the canyon have become decadent or have been invaded by pinyon-juniper. 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. In fall 2006, Spike® herbicide was aerially applied to 105 acres (42 ha) to thin sagebrush. In October 2007, 350 acres (142 ha) of thick sagebrush and pinyon-juniper woodland were chained one-way with an Ely chain. Grass and forb seed was aerially applied to 462 acres (187 ha), including most of the area that was treated with Spike® and gullies and islands that were not chained (Table 1). A second chaining pass was done with a smooth chain. Dribblers were used on the second pass to seed bitterbrush and fourwing saltbush (Table 2). Improving this property will prevent wintering deer and elk from crossing US-6 and therefore reduce vehicle collisions. Winter and fall wildlife use was estimated at 5 deer days use/acre (12 ddu/ha) and 3 elk days use/acre (7 edu/ha).

Soil

Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 6.9). The soil phosphorus was moderate at 8.9 ppm, and potassium was high at 179.2 ppm (Tiedemann and Lopez 2004). Relative litter cover was 43%, and relative vegetative cover was 13%. Relative combined rock and pavement cover was 20%. Cryptogams provided 10% relative cover, and relative bare ground cover was 14%. The soil erosion condition was classified as slight due to evidence of surface litter and rock movement, and the formation of flow patterns and rills around the juniper trees.

Browse

The preferred browse component consisted of a few mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) plants scattered throughout the study. Dead sagebrush plants were sampled at a density of 100 plants/acre (247 plants/ha). Utah juniper (*Juniperus osteosperma*) provided 39% canopy cover. From the point-centered quarter data, juniper density was estimated at 272 trees/acre (672 trees/ha). Average trunk diameter was 5.5 inches (14 cm). Forty-five percent of the sampled trees were greater than 12 feet (3.7 m), and 30% were seedlings.

Herbaceous Understory

The herbaceous understory was sparse, and diversity was low. Grasses provided 7% cover. The most abundant grasses were cheatgrass (*Bromus tectorum*), Sandberg bluegrass (*Poa secunda*), and bottlebrush squirreltail (*Sitanion hystrix*). Kentucky bluegrass (*Poa pratensis*) and Indian ricegrass (*Oryzopsis hymenoides*) were also sampled in lower frequencies. Total forb cover was 1%. Thirteen forb species were sampled, eight of which were perennials. Mat penstemon (*Penstemon caespitosus*) and longleaf phlox (*Phlox longifolia*) were the most common perennial forbs. Bur buttercup (*Ranunculus testiculatus*) and tansymustard (*Descurainia pinnata*) were the most abundant annual forbs.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. There was almost no preferred or key browse available. Herbaceous groundcover was also very low and provided very little forage. Cheatgrass was the most frequently sampled grass species. Bur buttercup, the most common forb, is allelopathic and prevents the establishment of native species (Buchanan et al. 1978).

winter range condition (DCI) - very poor (8) Mid-level potential scale

Table 1. Aerial seed mix applied to the Mill Fork project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	300	5
Alfalfa "Ranger"	300	5
Alfalfa "Spredor 4"	300	5
Bluebunch Wheatgrass "Anatone"	450	7
Canby Bluegrass "Canbar"	200	3
Cicer Milkvetch "Lutana"	250	4
Crested Wheatgrass "Douglas"	250	4
Crested Wheatgrass "Ephraim"	250	4
Crested Wheatgrass "Hycrest"	200	3
Great Basin Wildrye "Trailhead"	250	4
Indian Ricegrass "Rimrock"	450	7
Intermediate Wheatgrass	450	7
Mountain Brome	400	6
Orchardgrass "Paiute"	200	3
Sainfoin "Eski"	900	13
Siberian Wheatgrass "Vavilov"	400	6
Small Burnet "Delar"	883	13
Western Yarrow	48	1
Total	6481	100

Table 2. Dribbler seed mix applied to the Mill Fork project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Bitterbrush	100	50
Fourwing Saltbush	100	50
Total	200	100

HERBACEOUS TRENDS --
Management unit 16R, Study no: 30

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bromus tectorum (a)	226	2.45
G	Oryzopsis hymenoides	5	.05
G	Poa pratensis	5	.03
G	Poa secunda	130	2.71
G	Sitanion hystrix	117	1.37
Total for Annual Grasses		226	2.45
Total for Perennial Grasses		257	4.16
Total for Grasses		483	6.61
F	Alyssum alyssoides (a)	25	.09
F	Antennaria rosea	12	.04

Type	Species	Nested Frequency '07	Average Cover % '07
F	Astragalus convallarius	1	.03
F	Astragalus utahensis	4	.04
F	Chaenactis douglasii	2	.00
F	Collinsia parviflora (a)	13	.02
F	Descurainia pinnata (a)	86	.23
F	Microsteris gracilis (a)	28	.05
F	Penstemon caespitosus	25	.23
F	Phlox longifolia	28	.13
F	Ranunculus testiculatus (a)	148	.51
F	Senecio multilobatus	6	.01
F	Streptanthus cordatus	1	.00
Total for Annual Forbs		300	0.90
Total for Perennial Forbs		79	0.50
Total for Forbs		379	1.40

BROWSE TRENDS --
Management unit 16R, Study no: 30

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata vaseyana	0	-
B	Gutierrezia sarothrae	2	.03
B	Juniperus osteosperma	16	7.01
B	Leptodactylon pungens	1	-
B	Opuntia fragilis	30	1.15
Total for Browse		49	8.20

CANOPY COVER, LINE INTERCEPT --
Management unit 16R, Study no: 30

Species	Percent Cover '07
Gutierrezia sarothrae	.11
Juniperus osteosperma	39.18
Opuntia fragilis	.86

POINT-QUARTER TREE DATA --
Management unit 16R, Study no: 30

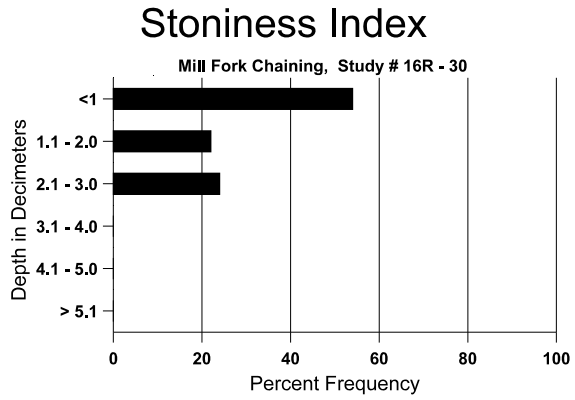
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	272	5.5

BASIC COVER --
Management unit 16R, Study no: 30

Cover Type	Average Cover % '07
Vegetation	15.61
Rock	5.48
Pavement	17.96
Litter	50.14
Cryptogams	11.75
Bare Ground	16.05

SOIL ANALYSIS DATA --
Herd Unit 16R, Study no: 30, Study Name: Mill Fork Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
11.0	-	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 '07	Days use per acre (ha) '07
Rabbit	23	-
Elk	2	3 (7)
Deer	6	5 (12)

BROWSE CHARACTERISTICS --
Management unit 16R, Study no: 30

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata vaseyana												
07	**0**	-	-	-	-	100	0	0	-	-	0	10/10
Gutierrezia sarothrae												
07	**40**	-	-	40	-	-	0	0	-	-	0	9/12
Juniperus osteosperma												
07	**340**	40	20	260	60	-	0	0	18	-	0	-/-
Leptodactylon pungens												
07	**20**	-	20	-	-	-	0	0	-	-	0	-/-
Opuntia fragilis												
07	**1060**	-	160	840	60	-	0	0	6	-	2	3/14

Trend Study 17R-26-07

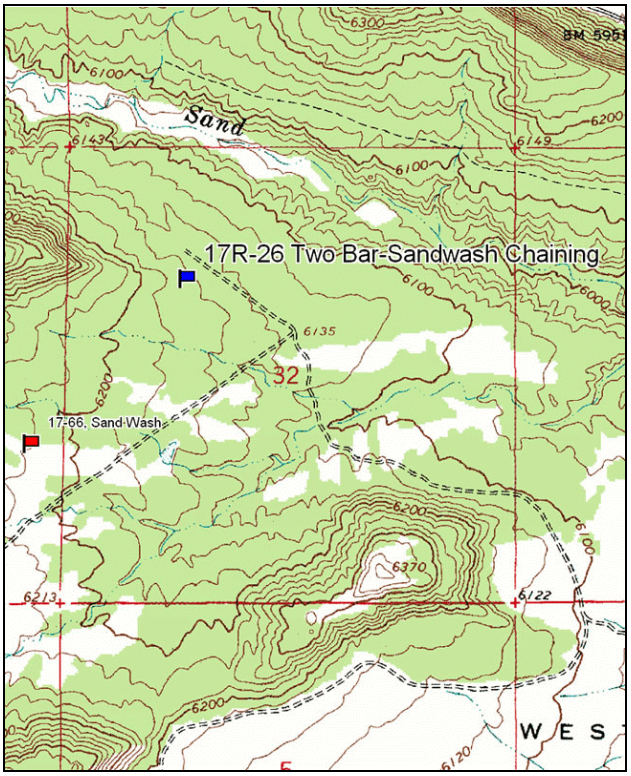
Study site name: Two Bar-Sand Wash Chaining . Vegetation type: Pinyon-Juniper .

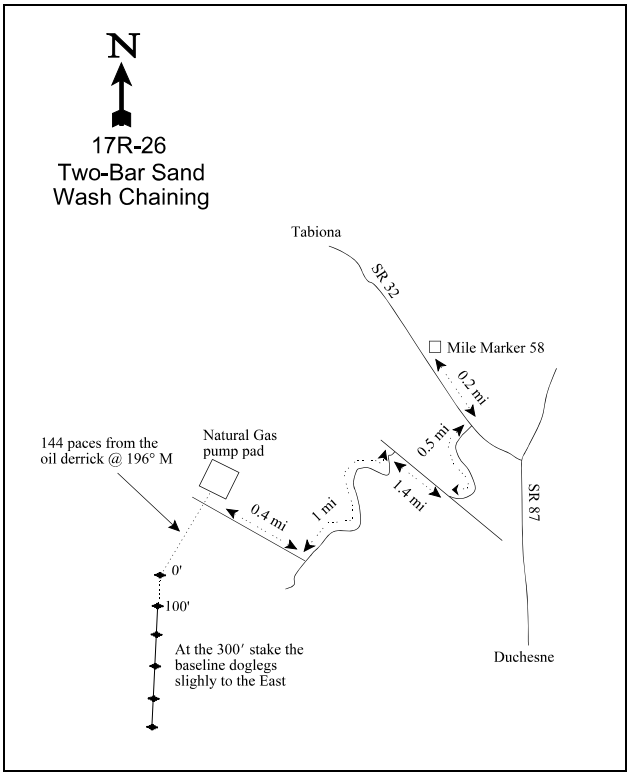
Compass bearing: frequency baseline 194 degrees magnetic.

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

LOCATION DESCRIPTION

From Tabiona, travel southeast on State Road 32 to mile marker 58, continuing 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. Turn left and travel 1 mile to a fork. Turn right and travel 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

Diagrammatic Sketch

Township 2S , Range 5W , Section 32

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

DISCUSSION

Two Bar-Sand Wash Chaining - Trend Study No. 17R-26

Study Information

This study was established in 2007 to monitor a pinyon-juniper thinning project on the Tabby Mountain Wildlife Management Area. It is located approximately 1 mile (1.6 km) south of SR-32/35 and 14 miles (22.5 km) southeast of the community of Tabiona [elevation: 6,160 feet (1,878 m), slope: 5%, aspect: northeast]. The area serves as critical deer and elk wintering habitat, but pinyon-juniper encroachment has eliminated much of the sagebrush habitat. The trees were removed from approximately 1,000 acres (405 ha) with two passes of an anchor chain, and shrubs were seeded with a dribbler (Table 1). Grass and forb seed was also applied aerially after the second pass (Table 2). Big game use was estimated at 36 deer days use/acre (89 ddu/ha) and 5 elk days use/acre (13 edu/ha), and pellet groups were from winter/spring use.

Soil

The soil is a reddish sandy clay loam with a neutral reaction (pH 7.0). Soil phosphorus and potassium were both marginal at 9.5 ppm and 115.2 ppm, respectively (Tiedemann and Lopez 2004). Approximately 50% of the soil was bare. Relative litter cover was 31%, and relative vegetative cover was 13%. Cryptogams provided 5% of the relative ground cover. The erosion condition was classified as critical due to evidence of surface litter and soil movement, pedestalling around plants, flow patterns, and the formation of rills and gullies.

Browse

Browse species provided 13% of the total ground cover in 2007. Preferred species comprised 30% of the total browse cover. Black sagebrush (*Artemisia nova*) density was 2,420 plants/acre (5,980 plants/ha). Decadence was high at 62% of the population, while 36% of the plants were mature. Dead plants were sampled at a density of 1,260 plants/acre (3,113 plants/ha), and 36% of the live plants sampled were classified as dying. Another 12% of the population displayed poor vigor. Use was moderate-heavy. Annual leader growth on black sagebrush was 0.9 inches (2.4 cm). True mountain mahogany (*Cercocarpus montanus*) and Mormon tea (*Ephedra viridis*) were also present in low densities. Approximately half of the mountain mahogany population was decadent, and some of the plants were unavailable due to heavy browsing. Average annual leader growth on mountain mahogany was 2.7 inches (6.8 cm).

Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) provided 22% combined canopy cover. From the point-centered quarter data, pinyon density was 137 trees/acre (339 trees/ha). Average trunk diameter was 6.5 inches (16.5 cm), and the sampled trees varied evenly among height classes. Juniper density was 160 trees/acre (395 trees/ha), and average trunk diameter was 15.1 inches (38.4 cm). The majority of the sampled juniper trees were 4-12 feet (1.2-3.7 m) in height.

Herbaceous Understory

The understory was very sparse and provided almost no cover. Four grass species were sampled, all of which were perennials. Species included bluebunch wheatgrass (*Agropyron spicatum*), Indian ricegrass (*Oryzopsis hymenoides*), galleta (*Hilaria jamesii*), and bottlebrush squirreltail (*Sitanion hystrix*). Eight forb species were sampled, six of which were perennials. Rockcress (*Arabis* sp.), thickstem wildcabbage (*Caulanthus crassicaulis*), tansymustard (*Descurainia pinnata*) and nodding eriogonum (*Eriogonum cernuum*) were sampled most frequently.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Preferred browse cover was very low, and pinyon-juniper comprised the majority of the browse cover. The understory was very depleted and provided very little cover. Herbaceous composition was favorable, with mostly perennial species sampled, however, diversity was low. Cheatgrass and noxious weeds were not present.

winter range condition (DCI) - very poor (5) Low potential scale

Table 1. Dribbler seed mix applied to the Two Bar-Sand Wash project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Sagebrush	960	70
Bitterbrush	150	11
Fourwing Saltbush	200	15
True Mountain Mahogany	50	4
Total	1360	100

Table 2. Aerial seed mix applied to the Two Bar-Sand Wash project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	200	6
Alfalfa "Ranger"	200	6
Blue Flax "Appar"	100	3
Canby Bluegrass "Canbar"	100	3
Crested Wheatgrass "Douglas"	200	6
Crested Wheatgrass "Hycrest"	200	6
Indian Ricegrass "Rimrock"	400	12
Pubescent Wheatgrass	200	6
Russian Wildrye	300	9
Sand Dropseed	20	1
Small Burnet "Delar"	800	24
Snake River Wheatgrass "Secar"	200	6
Thickspike Wheatgrass "Critana"	400	12
Total	3320	100

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

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron spicatum	15	.11
G	Hilaria jamesii	4	.01
G	Oryzopsis hymenoides	11	.05
G	Sitanion hystrix	2	.00
Total for Annual Grasses		0	0
Total for Perennial Grasses		32	0.17
Total for Grasses		32	0.17
F	Arabis sp.	6	.01
F	Caulanthus crassicaulis	3	.01
F	Cryptantha sp.	3	.00

Type	Species	Nested Frequency '07	Average Cover % '07
F	Cymopterus sp.	3	.00
F	Descurainia pinnata (a)	15	.03
F	Eriogonum cernuum (a)	8	.03
F	Ipomopsis congesta	3	.00
F	Streptanthus cordatus	1	.00
Total for Annual Forbs		23	0.06
Total for Perennial Forbs		19	0.03
Total for Forbs		42	0.10

BROWSE TRENDS --
Management unit 17R, Study no: 26

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia nova	55	3.41
B	Cercocarpus montanus	2	.41
B	Ephedra viridis	0	-
B	Gutierrezia sarothrae	1	-
B	Juniperus osteosperma	5	3.62
B	Leptodactylon pungens	3	.00
B	Opuntia sp.	40	2.29
B	Pinus edulis	10	2.80
Total for Browse		116	12.55

CANOPY COVER, LINE INTERCEPT --
Management unit 17R, Study no: 26

Species	Percent Cover '07
Artemisia nova	2.66
Cercocarpus montanus	.65
Juniperus osteosperma	10.14
Opuntia sp.	1.61
Pinus edulis	11.88

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17R, Study no: 26

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

POINT-QUARTER TREE DATA --
Management unit 17R, Study no: 26

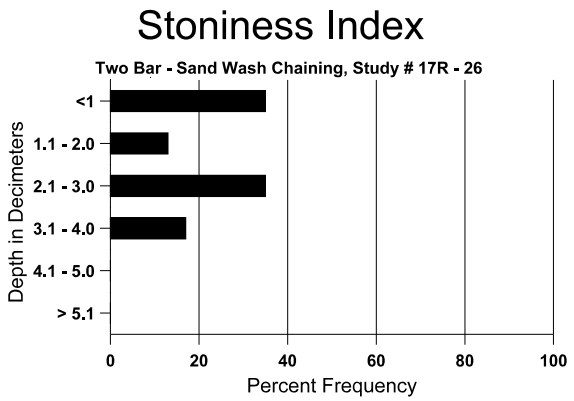
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	160	15.1
Pinus edulis	137	6.5

BASIC COVER --
Management unit 17R, Study no: 26

Cover Type	Average Cover % '07
Vegetation	13.84
Rock	1.29
Pavement	.03
Litter	34.72
Cryptogams	5.44
Bare Ground	55.03

SOIL ANALYSIS DATA --
Herd Unit 17R, Study no: 26, Study Name: Two Bar-Sand Wash Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
12.3	-	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 '07	Days use per acre (ha) '07
Rabbit	51	-
Elk	11	5 (13)
Deer	18	36 (89)
Cattle	-	1 (2)

BROWSE CHARACTERISTICS --
Management unit 17R, Study no: 26

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia nova												
07	**2420**	60	40	880	1500	1260	26	38	62	36	48	6/17
Cercocarpus montanus												
07	**40**	20	20	20	-	20	0	0	-	-	50	51/70
Ephedra viridis												
07	**0**	-	-	-	-	-	0	0	-	-	0	25/32
Gutierrezia sarothrae												
07	**20**	-	20	-	-	-	0	0	-	-	0	4/2
Juniperus osteosperma												
07	**120**	-	-	100	20	80	0	0	17	-	0	-/-
Leptodactylon pungens												
07	**140**	-	-	60	80	20	0	0	57	-	0	2/4
Opuntia sp.												
07	**3080**	-	-	2880	200	-	23	0	6	.64	5	3/12

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Pinus edulis												
07	**220**	-	140	80	-	60	0	0	-	-	0	-/-

Trend Study 17R-27-07

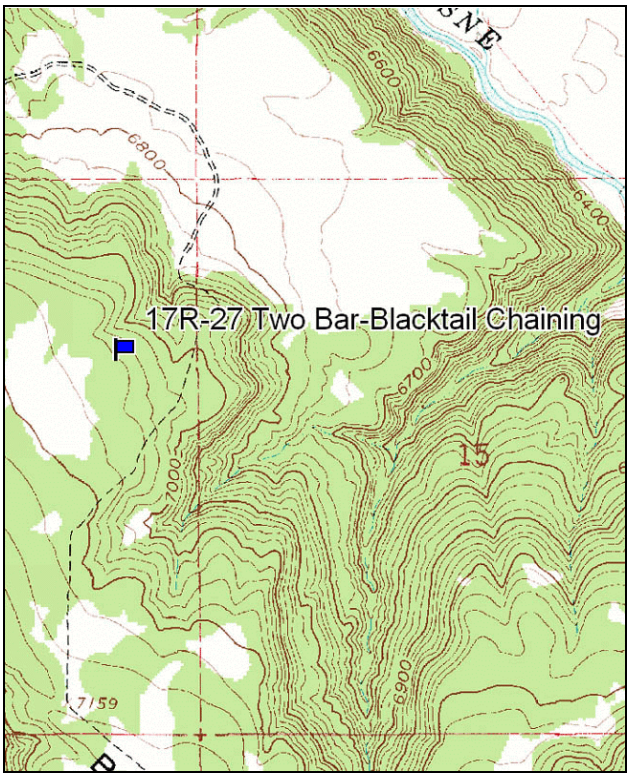
Study site name: Two Bar-Blacktail Chaining . Vegetation type: Pinyon-Juniper .

Compass bearing: frequency baseline 179 degrees magnetic.

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

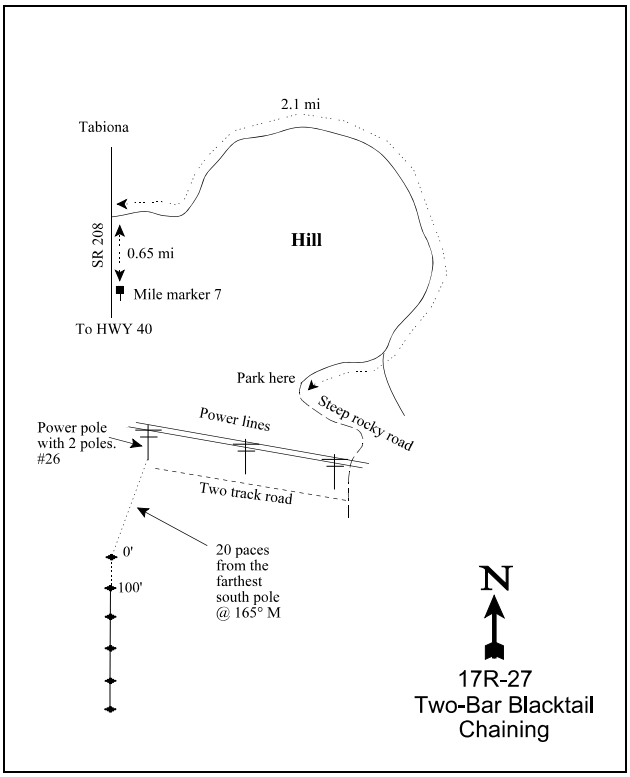
LOCATION DESCRIPTION

From US 40, turn north on Highway 208 and travel to mile marker 7. From here, go 0.65 miles to a road coming in from the right. Turn east here and go 2.1 miles around a hill to a parking area at the bottom of the hill. From the parking area hike up the road, turn left at the T in the road, then turn right (west) and walk up the 2-track below the power lines. Walk to the power line with 2 poles (#26). From here the 0-foot stake is 20 paces at 165 degrees magnetic, and is marked with browse tag #137.



Map Name: Tabiona

Township 6S , Range 11E , Section 11



Diagrammatic Sketch

GPS: NAD 83, UTM 12T 527706 E 4462075 N

DISCUSSION

Two Bar-Blacktail Chaining - Trend Study No. 17R-27

Study Information

This study was established in 2007 to monitor a pinyon-juniper thinning project on the Tabby Mountain Wildlife Management Area. It is located approximately 1.5 miles (2.4 km) south of the junction of SR-208 and SR-32/35 and 4 miles (6.4 km) southeast of the community of Tabiona [elevation: 7,060 feet (2,152 m), slope: 11%, aspect: northeast]. It is approximately 11 miles (17.7 km) northwest of the Two Bar-Sand Wash Chaining study (17R-26). The area serves as critical deer and elk wintering habitat, but pinyon-juniper encroachment has eliminated much of the sagebrush habitat. The trees were removed from approximately 1,000 acres (405 ha) with two passes of an anchor chain, and shrubs were seeded with a dribbler (Table 1). Grass and forb seed was applied aerially shortly before completion of the first chain pass (Table 2). Big game use was estimated at 42 elk days use/acre (104 edu/ha) and 25 deer days use/acre (63 ddu/ha).

Soil

Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 7.0). The soil phosphorus and potassium are both marginal at 9.1 ppm and 67.2 ppm, respectively (Tiedemann and Lopez 2004). Litter comprised 53% of the relative ground cover. Relative bare ground cover was 22%, and relative vegetative cover was 12%. Cryptogams provided 10% relative cover. The soil erosion condition was classified as moderate-critical due to surface litter and soil movement, pedestalling around plants, flow patterns, and the formation of rills and gullies.

Browse

Browse species provided 7% of the total ground cover. Preferred species, including black sagebrush (*Artemisia nova*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), dwarf rabbitbrush (*Chrysothamnus depressus*), and true mountain mahogany (*Cercocarpus montanus*) comprised 29% of the total browse cover. Black sagebrush density was 1,400 plants/acre (3,459 plants/ha). Forty percent of the population was decadent, and young plants comprised 21% of the population. Dead plants were sampled at a density of 600 plants/acre (1,483 plants/ha), and seedling density was 220 plants/acre (544 plants/ha). Twenty-one percent of the live plants sampled were classified as dying. Approximately half of the population showed light use, and half showed moderate-heavy use. Average annual leader growth was 0.7 inches (1.9 cm).

Wyoming big sagebrush density was 180 plants/acre (445 plants/ha). One-third of the population was mature, and two-thirds were decadent. Dead plants were sampled at a density of 240 plants/acre (593 plants/ha). Fifty-six percent of the live plants were classified as dying. Use was heavy on 56% of the population. Dwarf rabbitbrush density was 900 plants/acre (2,224 plants/ha). The population was largely mature, with 16% decadence. Seedlings were sampled at a density of 440 plants/acre (1,087 plants/ha). The majority of the plants were vigorous, and use was moderate-heavy. True mountain mahogany plants were also present at a low density.

Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) provided 25% canopy cover. From the point-centered quarter data, pinyon density was 185 trees/acre (457 trees/ha). Average trunk diameter was 5.3 inches (13.5 cm), and the majority of the sampled trees were greater than 4 feet (1.2 m) in height. Juniper density was 34 trees/acre (84 trees/ha), and the average trunk diameter was 11.6 inches (29.5 cm). Most of the sampled trees were greater than 12 feet (3.7 m) in height.

Herbaceous Understory

The herbaceous component provided 6% total cover. The majority of the herbaceous cover was composed of perennial grasses. Eight perennial grass species were sampled, and common species included bluebunch wheatgrass (*Agropyron spicatum*), Sandberg bluegrass (*Poa secunda*), and Indian ricegrass (*Oryzopsis*

hymenoides). No annual grasses were sampled. Eight forb species were sampled, five of which were perennials. The most abundant forbs were Hood's phlox (*Phlox hoodii*), low penstemon (*Penstemon humilis*), and annual stickseed (*Lappula occidentalis*).

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. Preferred browse cover was very low, and pinyon-juniper comprised the majority of the browse cover. The understory was very depleted and provided very little cover. Herbaceous composition was favorable, with mostly perennial species sampled, however, diversity was low. Cheatgrass and noxious weeds were not present.

winter range condition (DCI) - poor (15) Low potential scale

Table 1. Dribbler seed mix applied to the Two Bar-Blacktail project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Sagebrush	960	70
Bitterbrush	150	11
Fourwing Saltbush	200	15
True Mountain Mahogany	50	4
Total	1360	100

Table 2. Aerial seed mix applied to the Two Bar-Blacktail project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Blue Flax "Appar"	150	2
Blue Grama	300	5
Canby Bluegrass "Canbar"	150	2
Crested Wheatgrass "Douglas"	300	5
Crested Wheatgrass "Ephraim"	300	5
Great Basin Wildrye "Trailhead"	300	5
Orchardgrass "Paiute"	300	5
Russian Wildrye	450	8
Sandberg Bluegrass	150	2
Sainfoin "Eski"	1500	25
Small Burnet "Delar"	1200	20
Snake River Wheatgrass "Secar"	300	5
Thickspike Wheatgrass "Bannock"	600	10
Total	6000	100

HERBACEOUS TRENDS --
Management unit 17R, Study no: 27

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron smithii	19	.09
G	Agropyron spicatum	101	3.00
G	Carex sp.	5	.03
G	Oryzopsis hymenoides	23	.36
G	Poa fendleriana	4	.38
G	Poa secunda	115	1.18
G	Sitanion hystrix	4	.04
G	Stipa comata	5	.03
Total for Annual Grasses		0	0
Total for Perennial Grasses		276	5.13
Total for Grasses		276	5.13
F	Arabis sp.	9	.03
F	Chaenactis douglasii	3	.00
F	Chenopodium fremontii (a)	3	.00
F	Cymopterus sp.	15	.03
F	Descurainia pinnata (a)	1	.00
F	Lappula occidentalis (a)	31	.09
F	Penstemon humilis	23	.18
F	Phlox hoodii	24	.58
Total for Annual Forbs		35	0.09
Total for Perennial Forbs		74	0.83
Total for Forbs		109	0.93

BROWSE TRENDS --
Management unit 17R, Study no: 27

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia nova	38	1.49
B	Artemisia tridentata wyomingensis	7	.18
B	Cercocarpus montanus	1	-
B	Chrysothamnus depressus	19	.38
B	Chrysothamnus viscidiflorus viscidiflorus	0	-
B	Leptodactylon pungens	3	-
B	Opuntia fragilis	13	.01
B	Opuntia sp.	8	.03
B	Pediocactus simpsonii	1	-
B	Pinus edulis	7	4.91
Total for Browse		97	7.02

CANOPY COVER, LINE INTERCEPT --
Management unit 17R, Study no: 27

Species	Percent Cover '07
Artemisia nova	2.26
Artemisia tridentata wyomingensis	.05
Chrysothamnus depressus	.18
Juniperus osteosperma	3.29
Opuntia sp.	.01
Pinus edulis	21.41

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17R, Study no: 27

Species	Average leader growth (in) '07
Artemisia nova	0.7

POINT-QUARTER TREE DATA --
Management unit 17R, Study no: 27

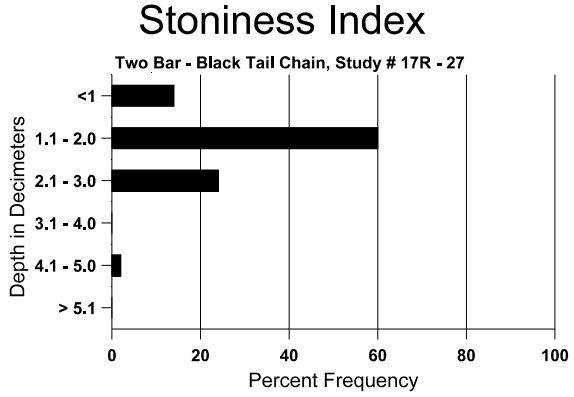
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	34	11.6
Pinus edulis	185	5.3

BASIC COVER --
Management unit 17R, Study no: 27

Cover Type	Average Cover % '07
Vegetation	12.70
Rock	3.20
Pavement	1.17
Litter	58.04
Cryptogams	10.44
Bare Ground	23.95

SOIL ANALYSIS DATA --
Herd Unit 17R, Study no: 27, Study Name: Two Bar-Blacktail Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
9.1	-	7.0	41.4	44.0	14.6	1.6	9.1	67.2	0.6



PELLET GROUP DATA --
Management unit 17R, Study no: 27

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	38	-
Elk	31	42 (104)
Deer	35	25 (63)

BROWSE CHARACTERISTICS --
Management unit 17R, Study no: 27

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia nova												
07	**1400**	220	300	540	560	600	9	39	40	21	21	10/19
Artemisia tridentata wyomingensis												
07	**180**	-	-	60	120	240	0	56	67	56	56	17/26
Cercocarpus montanus												
07	**20**	-	-	-	20	-	0	100	100	100	100	19/22
Chrysothamnus depressus												
07	**900**	440	-	760	140	60	40	49	16	7	7	3/9
Chrysothamnus viscidiflorus viscidiflorus												
07	**0**	-	-	-	-	-	0	0	-	-	0	8/10
Leptodactylon pungens												
07	**100**	-	-	-	100	-	0	0	100	100	100	-/-
Opuntia fragilis												
07	**320**	-	60	260	-	-	0	0	-	-	0	2/6
Opuntia sp.												
07	**260**	-	20	160	80	-	0	0	31	8	8	5/13
Pediocactus simpsonii												
07	**20**	-	-	20	-	-	0	0	-	-	0	½
Pinus edulis												
07	**140**	20	60	80	-	-	0	0	-	-	0	-/-

Trend Study 18R-5-07

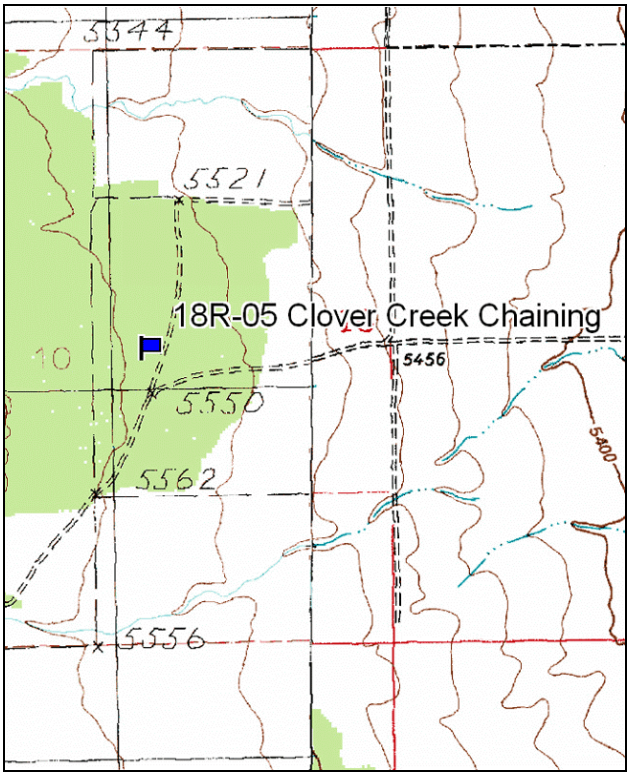
Study site name: Clover Creek Chaining . Vegetation type: P-J & Wyoming Big Sagebrush.

Compass bearing: frequency baseline 250 degrees magnetic.

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

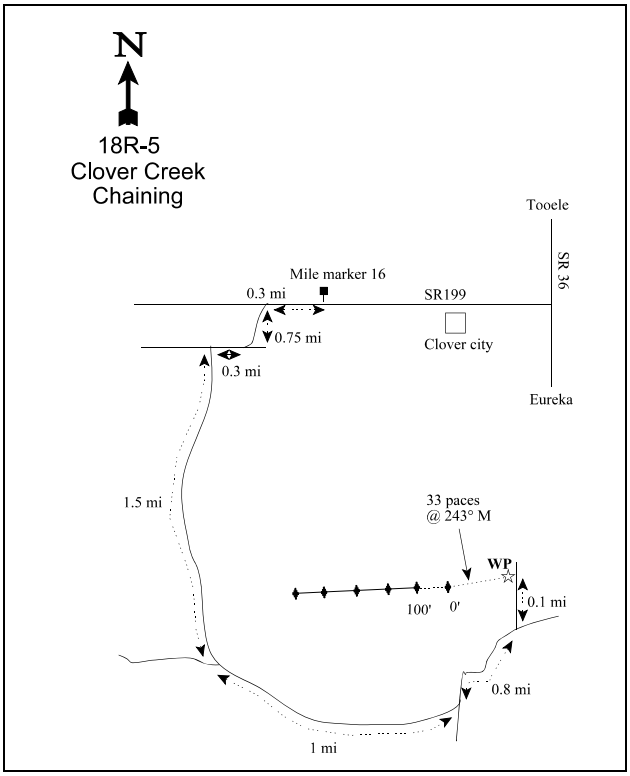
LOCATION DESCRIPTION

From Lehi, drive west on SR 73 (Main St) to the junction of SR 36. Turn left (south) and drive 3.7 miles to 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 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. 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, and is marked with browse tag #114.



Map Name: Johnson Pass

Township 6S , Range 6W , Section 10



Diagrammatic Sketch

GPS: NAD 83, UTM 12T 372018 E 4463281 N

DISCUSSION

Clover Creek Chaining - Trend Study No. 18R-5

Study Information

This study was established in 2007 to monitor a pinyon-juniper thinning project approximately 4 miles southwest of the town of Rush Valley in the Clover Creek watershed [elevation: 5,550 feet (1,692 m), slope: 1%, aspect: east]. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) have invaded and dominated the flats and low foothills surrounding Clover Creek. An old dryland farm in this area is dominated by thick, decadent Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) with a depleted understory. Additionally, the riparian corridor surrounding Clover Creek is in poor condition and is dominated by rabbitbrush (*Chrysothamnus* sp.), big sagebrush, and weeds, including whitetop (*Cardaria draba*), a noxious weed. An improvement project was proposed to enhance upland sagebrush and lowland riparian habitats. The area currently supports deer and wild turkeys, and historically served as sage-grouse habitat. Thick pinyon-juniper and big sagebrush dominated areas were treated with an anchor chain and a Dixie harrow in a mosaic pattern. The riparian corridor was also treated mechanically or burned to decrease rabbitbrush stands, and noxious weeds were sprayed. The entire treated area was reseeded and will be rested from livestock grazing for two growing seasons (Table 1). This study lies within an area that was chained, and is approximately 0.5 miles (0.8 km) from a stock pond. Deer use was estimated at 8 days use/acre (20 ddu/ha), and rabbit pellet quadrat frequency was 67%. An old cow carcass was found on the study.

Soil

The soil is classified within the Borvant series (USDA-NRCS 2007). This type of soil is well-drained and shallow over a petrocalcic horizon, and formed in alluvium or colluvium derived from limestone and sandstone. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 7.0). The soil phosphorus is marginal at 8.0 ppm, and potassium is high at 220.8 ppm, respectively (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 47%, and relative bare ground cover was 37%. Cryptogams provided 15% of the relative ground cover. The soil erosion condition was classified as moderate due to evidence of surface litter, rock, and soil movement, pedestalling around plants, and the formation of flow patterns and rills. Microterracing was occurring around cryptogams and grass roots, and animal trails were becoming flow patterns.

Browse

Total browse cover was 16%, however, Wyoming big sagebrush was the only preferred species and comprised 2% of the browse cover. Sagebrush density was 460 plants/acre (1,137 plants/ha), and all of the sampled plants were decadent. Ninety-six percent of the population was classified as dying. Dead plants were sampled at a density of 920 plants/acre (2,273 plants/ha). Use was mostly heavy, and average annual leader growth was 1 inch (2.6 cm).

Juniper provided 27% canopy cover. From the point-centered quarter data, juniper density was estimated at 236 trees/acre (583 trees/ha). The average trunk diameter was 8.7 inches (22.1 cm). All of the sampled trees were greater than 1 foot (0.3 m) in height, and varied evenly among height classes.

Herbaceous Understory

The understory was depleted and dominated by perennial grasses, which provided 8% cover. Five perennial grass species were sampled, and Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Agropyron spicatum*) were dominant. Cheatgrass (*Bromus tectorum*) was sampled in 9% of the quadrats, but provided less than 1% cover. Six forb species were sampled, and provided almost no cover. No forb species were particularly abundant, but the annual species bur buttercup (*Ranunculus testiculatus*) and pale alyssum (*Alyssum alyssoides*) were the most common. Longleaf phlox (*Phlox longifolia*) and desert phlox (*Phlox austromontana*) were the most frequently sampled perennial forbs.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. The preferred browse was limited to a small density of decadent sagebrush plants. The dense juniper canopy caused the understory to become very sparse. Perennial grass cover was moderate, but perennial forbs provided very little cover. Cheatgrass cover was low, and no noxious weeds were sampled.

winter range condition (DCI) - poor (17) Low potential scale

Table 1. Seed mix applied to the Clover Creek project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	100	3
Alfalfa "Ranger"	100	3
Alfalfa "Spredor 4"	100	3
Blue Flax "Appar"	100	3
Bluebunch Wheatgrass "Anatone"	250	6
Canby Bluegrass "Canbar"	150	4
Crested Wheatgrass "Douglas"	150	4
Crested Wheatgrass "Ephraim"	150	4
Crested Wheatgrass "Hycrest"	200	5
Indian Ricegrass "Rimrock"	150	4
Intermediate Wheatgrass	500	13
Orchardgrass "Paiute"	200	5
Siberian Wheatgrass "Vavilov"	450	11
Sainfoin "Eski"	500	13
Small Burnet "Delar"	500	13
Western Yarrow	25	1
Yellow Sweetclover	200	5
Total	3825	100

HERBACEOUS TRENDS --
Management unit 18R, Study no: 5

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron smithii	42	.76
G	Agropyron spicatum	55	2.25
G	Bromus tectorum (a)	19	.14
G	Oryzopsis hymenoides	5	.07
G	Poa secunda	241	4.67
G	Sitanion hystrix	29	.36
Total for Annual Grasses		19	0.14
Total for Perennial Grasses		372	8.11
Total for Grasses		391	8.26
F	Alyssum alyssoides (a)	46	.08
F	Arabis sp.	3	.00

Type	Species	Nested Frequency '07	Average Cover % '07
F	Descurainia pinnata (a)	5	.00
F	Phlox austromontana	6	.07
F	Phlox longifolia	8	.02
F	Ranunculus testiculatus (a)	56	.16
Total for Annual Forbs		107	0.25
Total for Perennial Forbs		17	0.09
Total for Forbs		124	0.34

BROWSE TRENDS --
Management unit 18R, Study no: 5

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	18	.36
B	Gutierrezia sarothrae	1	-
B	Juniperus osteosperma	9	15.88
B	Opuntia sp.	1	.15
Total for Browse		29	16.40

CANOPY COVER, LINE INTERCEPT --
Management unit 18R, Study no: 5

Species	Percent Cover '07
Artemisia tridentata wyomingensis	.66
Juniperus osteosperma	26.88
Opuntia sp.	.10

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 18R, Study no: 5

Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	1.0

POINT-QUARTER TREE DATA --
Management unit 18R, Study no: 5

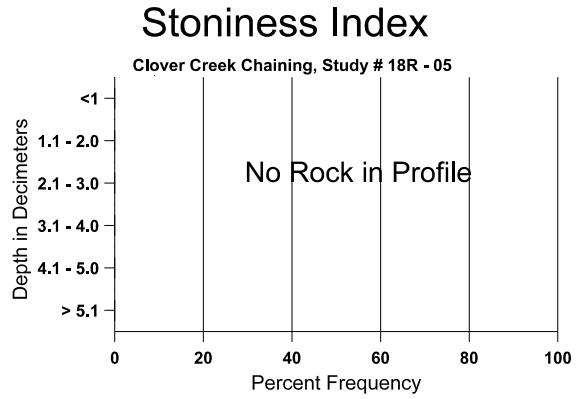
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	236	8.7

BASIC COVER --
Management unit 18R, Study no: 5

Cover Type	Average Cover % '07
Vegetation	22.61
Rock	.06
Pavement	1.40
Litter	33.09
Cryptogams	17.11
Bare Ground	43.29

SOIL ANALYSIS DATA --
Herd Unit 18R, Study no: 5, Study Name: Clover Creek Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
12.6	-	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 '07	Days use per acre (ha) '07
Rabbit	67	-
Deer	-	8 (20)

BROWSE CHARACTERISTICS --
Management unit 18R, Study no: 5

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**460**	-	-	-	460	920	9	74	100	96	100	15/21
Gutierrezia sarothrae												
07	**20**	-	20	-	-	-	0	0	-	-	0	5/5
Juniperus osteosperma												
07	**200**	40	20	180	-	-	0	0	-	-	0	-/-
Opuntia sp.												
07	**20**	-	-	20	-	-	0	0	-	-	0	6/18

Trend Study 18R-6-07

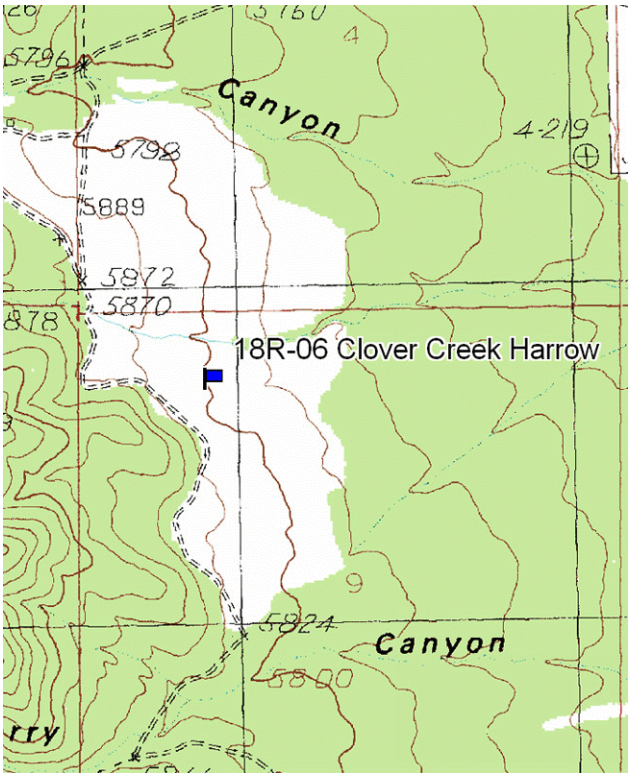
Study site name: Clover Creek Harrow. Vegetation type: P-J & Wyoming Big Sagebrush .

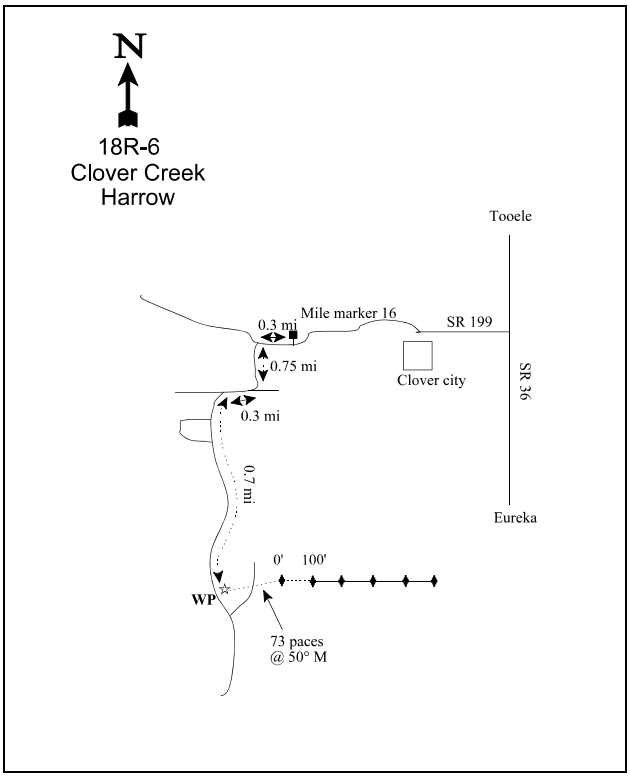
Compass bearing: frequency baseline 94 degrees magnetic.

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

LOCATION DESCRIPTION

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 to a witness post on the left side of the road. The 0-foot stake is 73 paces at 50 degrees magnetic, and is marked with browse tag #115.





Map Name: Johnson Pass

Township 6S , Range 6W , Section 9

Diagrammatic Sketch

GPS: NAD 83, UTM 12T 369837 E 4463898 N

DISCUSSION

Clover Creek Harrow - Trend Study No. 18R-6

Study Information

This study was established in 2007 to monitor a pinyon-juniper thinning project approximately 5 miles southwest of the town of Rush Valley in the Clover Creek watershed [elevation: 5,800 feet (1,768 m), slope: 6%, aspect: northeast]. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) have invaded and dominated the flats and low foothills surrounding Clover Creek. An old dryland farm in this area is dominated by thick, decadent Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) with a depleted understory. Additionally, the riparian corridor surrounding Clover Creek is in poor condition and is dominated by rabbitbrush (*Chrysothamnus* sp.), big sagebrush, and weeds, including whitetop (*Cardaria draba*), a noxious weed. An improvement project was proposed to enhance upland sagebrush and lowland riparian habitats. The area currently supports deer and wild turkeys, and historically served as sage-grouse habitat. Thick pinyon-juniper and big sagebrush dominated areas were treated with an anchor chain and a Dixie harrow in a mosaic pattern. The riparian corridor was also treated mechanically or burned to decrease rabbitbrush stands, and noxious weeds were sprayed. The entire treated area was reseeded and will be rested from livestock grazing for two growing seasons (Table 1). This study lies within an area that was harrowed, approximately 1.5 miles (2.4 km) west of the Clover Creek Chaining study (18R-5). It appeared to have been chained or pushed a year before the 2007 sampling. Animal use was estimated at 5 deer days use/acre (13 ddu/ha) and 2 sheep days use/acre (5 sdu/ha). Rabbit pellet quadrat frequency was 29%, and rabbit bones were found on the study.

Soil

The soil is classified within the Kapod series (USDA-NRCS 2007). The soils in this series were alluvially deposited, derived mainly from sandstone and limestone. They are very deep and well-drained. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 7.0). The soil phosphorus and potassium were both high at 19.6 ppm and 444.8 ppm, respectively (Tiedemann and Lopez 2004). Approximately 76% of the ground was covered by litter or was bare. Relative vegetation cover was 19%, and relative combined rock and pavement cover was 3%. The soil erosion condition was classified as slight due to some pedestalling around plants and the formation of flow patterns. Some areas of the soil were compacted by a tractor.

Browse

Total browse cover was 13%, most of which was provided by Wyoming big sagebrush. Sagebrush density was 4,320 plants/acre (10,675 plants/ha). Sixty-eight percent of the population was decadent, and 31% was mature. Seedlings were sampled at a density of 1,580 plants/acre (3,904 plants/ha), and the density of dead plants was 2,040 plants/acre (5,041 plants/ha). Vigor was poor on most plants due to the previous treatment, and 6% of the population was classified as dying. Use was mostly light, with 27% of the plants showing moderate-heavy hedging. Annual leader growth averaged 1.5 inches (3.9 cm).

Antelope bitterbrush (*Purshia tridentata*) was also sampled at a density of 60 plants/acre (148 plants/ha). Two-thirds of the sampled plants were decadent, and one-third was young. The decadent plants displayed poor vigor due to being knocked over during the treatment. Most of the plants were small, with an average height of 14 inches (35.6 cm) and average crown width of 26 inches (66 cm). Use on bitterbrush was heavy.

From the point-centered quarter data, juniper density was estimated at 58 trees/acre (143 trees/ha). Average trunk diameter was 3.1 inches (7.9 cm), and the majority of the sampled trees were 1-8 feet (0.3-2.4 m) in height. Some of the adult trees were knocked over during the treatment.

Herbaceous Understory

The understory provided 8% cover, approximately half of which was comprised of grasses. Kentucky bluegrass (*Poa pratensis*), cheatgrass (*Bromus tectorum*), and Japanese brome (*Bromus japonicus*) were the dominant grass species, and each provided 1%-2% cover. The forb component was dominated by annual species. Pale alyssum (*Alyssum alyssoides*) was the most abundant forb; it was sampled in 96% of the quadrats and provided 3% cover. Bur buttercup (*Ranunculus testiculatus*) and tall annual willowherb (*Epilobium brachycarpum*) were also fairly common. Munro globemallow (*Sphaeralcea munroana*) was the most abundant perennial forb, and most were seedlings that had recently germinated. Gooseberryleaf globemallow (*Sphaeralcea grossulariaefolia*) and Lewis flax (*Linum lewisii*) had been seeded and were present, although neither was sampled in any quadrats.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor-poor. Preferred browse cover was relatively low, and decadence was high. There was little young recruitment in the community, although many sagebrush seedlings were sampled. The understory was depleted and dominated by annuals. Cheatgrass provided little cover, but was sampled in 70% of the quadrats. Bur buttercup, one of the more common forb species, is allelopathic and may prevent the establishment of native species (Buchanan et al. 1978). No noxious weeds were sampled.

winter range condition (DCI) - very poor-poor (10) Low potential scale

Table 1. Seed mix applied to the Clover Creek project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	100	3
Alfalfa "Ranger"	100	3
Alfalfa "Spredor 4"	100	3
Blue Flax "Appar"	100	3
Bluebunch Wheatgrass "Anatone"	250	6
Canby Bluegrass "Canbar"	150	4
Crested Wheatgrass "Douglas"	150	4
Crested Wheatgrass "Ephraim"	150	4
Crested Wheatgrass "Hycrest"	200	5
Indian Ricegrass "Rimrock"	150	4
Intermediate Wheatgrass	500	13
Orchardgrass "Paiute"	200	5
Siberian Wheatgrass "Vavilov"	450	11
Sainfoin "Eski"	500	13
Small Burnet "Delar"	500	13
Western Yarrow	25	1
Yellow Sweetclover	200	5
Total	3825	100

HERBACEOUS TRENDS --
Management unit 18R, Study no: 6

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron spicatum	1	.00
G	Bromus japonicus (a)	141	1.18
G	Bromus tectorum (a)	222	1.66
G	Poa bulbosa	1	.00
G	Poa pratensis	61	1.45
G	Poa secunda	4	.15
Total for Annual Grasses		363	2.84
Total for Perennial Grasses		67	1.62
Total for Grasses		430	4.46
F	Agoseris glauca	1	.00
F	Alyssum alyssoides (a)	360	2.50
F	Arabis sp.	3	.02
F	Astragalus convallarius	2	.15
F	Cirsium sp.	-	.03
F	Epilobium brachycarpum (a)	25	.42
F	Helianthus annuus (a)	7	.23
F	Lappula occidentalis (a)	1	.00
F	Lactuca serriola	4	.02
F	Ranunculus testiculatus (a)	62	.39
F	Sphaeralcea munroana	37	.12
Total for Annual Forbs		455	3.56
Total for Perennial Forbs		47	0.34
Total for Forbs		502	3.90

BROWSE TRENDS --
Management unit 18R, Study no: 6

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	86	10.30
B	Chrysothamnus nauseosus	1	-
B	Gutierrezia sarothrae	72	1.71
B	Juniperus osteosperma	4	1.23
B	Purshia tridentata	3	.21
Total for Browse		166	13.46

CANOPY COVER, LINE INTERCEPT –
Management unit 18R, Study no: 6

Species	Percent Cover '07
Artemisia tridentata wyomingensis	11.36
Gutierrezia sarothrae	2.25
Juniperus osteosperma	.23
Purshia tridentata	1.33

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 18R, Study no: 6

Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	1.5

POINT-QUARTER TREE DATA --
Management unit 18R, Study no: 6

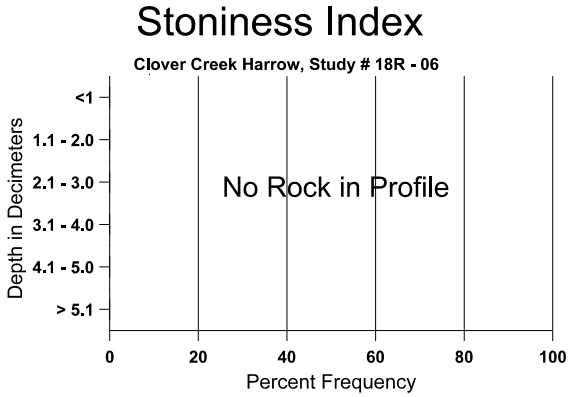
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	58	3.1

BASIC COVER --
Management unit 18R, Study no: 6

Cover Type	Average Cover % '07
Vegetation	21.67
Rock	.30
Pavement	3.80
Litter	53.14
Cryptogams	1.37
Bare Ground	34.26

SOIL ANALYSIS DATA --
Herd Unit 18R, Study no: 6, Study Name: Clover Creek Harrow

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
8.9	-	7.0	31.4	44	24.6	2.2	19.6	444.8	0.5



PELLET GROUP DATA --
Management unit 18R, Study no: 6

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	29	-
Deer	9	5 (13)
Sheep	-	2 (5)

BROWSE CHARACTERISTICS --
Management unit 18R, Study no: 6

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**4320**	1580	40	1360	2920	2040	14	13	68	6	88	20/25
Chrysothamnus nauseosus												
07	**20**	-	20	-	-	-	0	0	-	-	0	19/20
Gutierrezia sarothrae												
07	**5880**	6080	2160	3580	140	100	0	0	2	2	2	7/7
Juniperus osteosperma												
07	**80**	20	60	20	-	-	0	0	-	-	50	-/-
Purshia tridentata												
07	**60**	-	20	-	40	-	0	100	67	-	67	14/26

Trend Study 19R-20-07

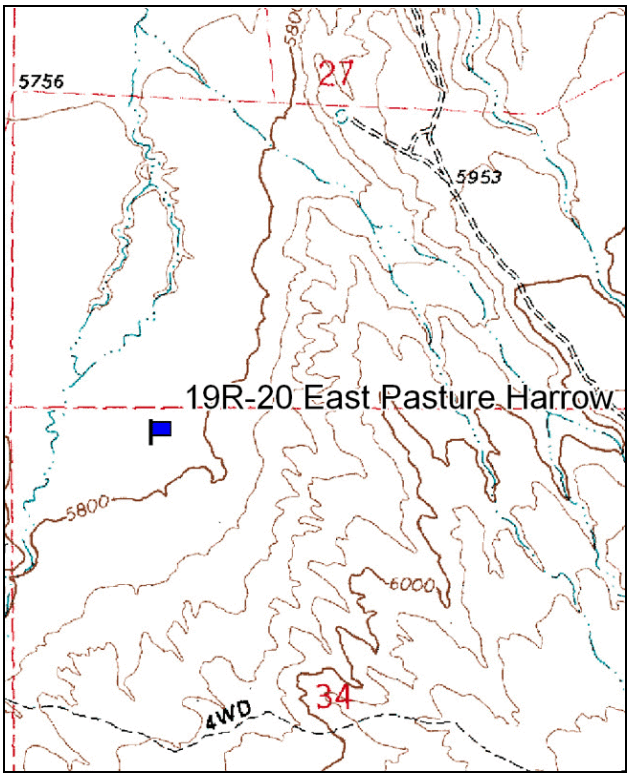
Study site name: East Pasture Harrow . Vegetation type: Wyoming Big Sagebrush .

Compass bearing: frequency baseline 15 degrees magnetic.

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

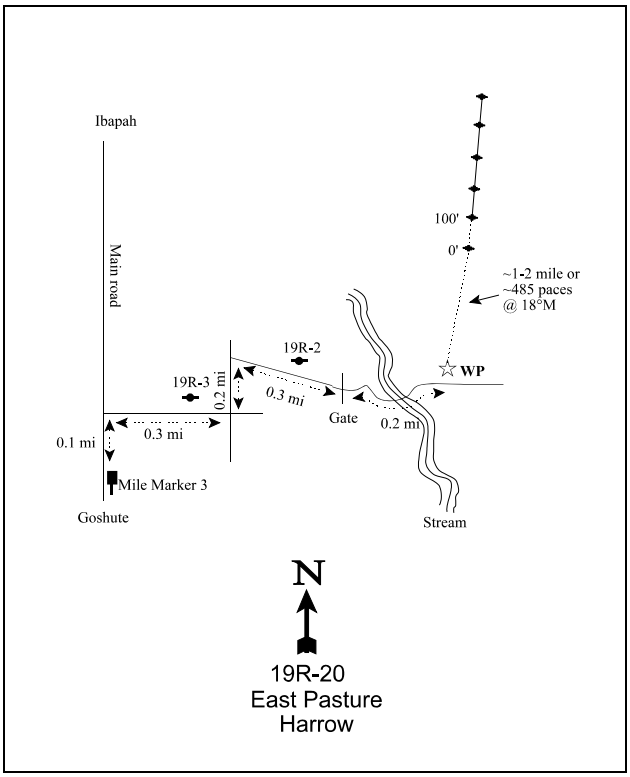
LOCATION DESCRIPTION

Drive north of Goshute toward Ibapah to mile marker 3. Drive north of the mile marker 0.1 miles to a 2-track road on the right (east) side of the road. Turn right and drive 0.3 miles to a four-way intersection. Turn left at the intersection and drive 0.2 miles to a road on the right. Turn right and drive 0.1 miles to the witness post on the left (north) side of the road for the Deep Creek Aerator study site (19R-2). Continues on for 0.2 miles to a gate. From the gate travel 0.2 miles to a witness post on the left side of the road. From the witness post the 0-foot stake is 0.5 mile (485 paces) at 18 degrees magnetic, and is marked with browse tag # 192.



Map Name: Goshute

Township 10S , Range 19W , Section 34



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 245351 E 4423091 N

DISCUSSION

East Pasture Harrow - Trend Study No. 19R-20

Study Information

This study was established in 2007 to monitor a habitat improvement project approximately 8 miles (12.9 km) southeast of Ibapah [elevation: 5,800 feet (1,768 m), slope: 2%, aspect: west]. The sagebrush habitat on the western slope of the Deep Creek Mountains has become old and decadent. The native vegetation is being invaded by juniper in some areas, and cheatgrass (*Bromus tectorum*) has become dominant after wildfire events. Additionally, continuous stands of decadent sagebrush create a wildfire hazard which may ultimately eliminate the sagebrush component. The Salt Lake Field Office of the BLM administered the thinning of 150 acres (61 ha) of thick, decadent sagebrush in a mosaic pattern using a 15-foot pipe harrow pulled behind a large tractor. A broadcast seeder was mounted on the tractor and seed was applied after the first pass in the two-way harrow treatments and prior to the first pass in the one-way harrow treatments (Table 1). This project will decrease the threat of catastrophic fire, reduce the spread of cheatgrass, and improve habitat for sage-grouse and wintering big game. Animal use was estimated at 2 deer days use/acre (5 ddu/ha) and 12 cattle days use/acre (29 cdu/ha). Rabbit pellet quadrat frequency was 18%. Coyote scat was also noted.

Soil

The soil is classified within the Medburn series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in alluvium or lacustrine sediments derived dominantly from igneous and sedimentary rock. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 6.8). The soil phosphorus is marginal at 9.8 ppm, and potassium is high at 380.8 ppm (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 54%, and relative bare ground cover was 33%. Relative pavement cover was 8%, while cryptogams provided 5% of the relative ground cover. The soil erosion condition was classified as slight due to pedestalling around plants, the formation of flow patterns and rills, and evidence of soil movement.

Browse

Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) was the dominant browse species, and provided 17% of the total ground cover and 21% canopy cover. Sagebrush density was 6,140 plants/acre (15,172 plants/ha). Approximately half of the population was decadent, with 4% young recruitment. Seedlings were sampled at a density of 2,320 plants/acre (5,733 plants/ha), and dead plant density was 1,540 plants/acre (3,805 plants/ha). Twenty percent of the population was classified as dying. Use was light-moderate, with 7% of the sampled plants showing heavy hedging. Average annual leader growth was 0.8 inches (2.1 cm), and it was noted that the sagebrush leaves were very small. Curl-leaf mountain mahogany (*Cercocarpus ledifolius*) was also present at a density of 60 plants/acre (148 plants/ha), and all of the sampled plants were decadent.

Herbaceous Understory

The understory provided 13% cover, most of which was composed of grasses. Sandberg bluegrass (*Poa secunda*) was dominant, comprising 71% of the total herbaceous cover. Other perennial grass species included bottlebrush squirreltail (*Sitanion hystrix*), crested wheatgrass (*Agropyron cristatum*), and Indian ricegrass (*Oryzopsis hymenoides*). Crested wheatgrass and Indian ricegrass were grazed heavily. Cheatgrass was sampled in 91% of the quadrats and provided 2% cover. Six forb species were sampled, but provided almost no cover. The most commonly sampled species were prairie groundsmoke (*Gayophytum ramosissimum*), bur buttercup (*Ranunculus testiculatus*), and rockcress (*Arabis* sp.).

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is fair. Preferred browse cover was moderate, however, half of the sagebrush population was decadent. The grass component was

favorable, with several perennial species sampled. Perennial grasses were dominant, and cheatgrass cover was low. The forb component was depleted, however, no noxious weeds were sampled.

winter range condition (DCI) - fair (42) Low potential scale

Table 1. Seed mix applied to the East Pasture project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	100	4
Alfalfa "Ranger"	100	4
Alfalfa "Spredor 4"	100	4
Blue Flax "Appar"	50	2
Canby Bluegrass "Canbar"	50	2
Crested Wheatgrass "Douglas"	150	7
Crested Wheatgrass "Hycrest"	150	7
Great Basin Wildrye "Trailhead"	150	7
Indian Ricegrass "Rimrock"	150	7
Pubescent Wheatgrass	300	14
Russian Wildrye	150	7
Sainfoin "Eski"	300	14
Small Burnet "Delar"	300	14
Western Wheatgrass "Arriba"	150	7
Western Yarrow	13	<1
Total	2213	100

HERBACEOUS TRENDS --
Management unit 19R, Study no: 20

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron cristatum	8	.09
G	Bromus tectorum (a)	313	2.05
G	Oryzopsis hymenoides	-	.03
G	Poa secunda	309	9.19
G	Sitanion hystrix	27	.52
G	Stipa comata	3	.30
G	Stipa lettermani	4	.38
G	Vulpia octoflora (a)	56	.16
Total for Annual Grasses		369	2.22
Total for Perennial Grasses		351	10.52
Total for Grasses		720	12.74
F	Arabis sp.	5	.01
F	Delphinium nuttallianum	2	.06
F	Draba sp. (a)	3	.00

Type	Species	Nested Frequency '07	Average Cover % '07
F	Gayophytum ramosissimum(a)	19	.06
F	Microsteris gracilis (a)	5	.01
F	Ranunculus testiculatus (a)	6	.02
Total for Annual Forbs		33	0.09
Total for Perennial Forbs		7	0.07
Total for Forbs		40	0.17

BROWSE TRENDS --
Management unit 19R, Study no: 20

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	96	17.42
B	Cercocarpus ledifolius	1	-
B	Chrysothamnus viscidiflorus	0	-
B	Gutierrezia sarothrae	2	.00
B	Leptodactylon pungens	1	-
B	Opuntia sp.	1	.03
Total for Browse		101	17.45

CANOPY COVER, LINE INTERCEPT --
Management unit 19R, Study no: 20

Species	Percent Cover '07
Artemisia tridentata wyomingensis	20.93

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 19R, Study no: 20

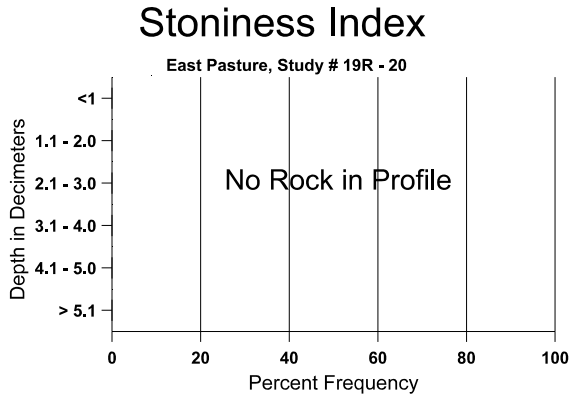
Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	0.8

BASIC COVER --
Management unit 19R, Study no: 20

Cover Type	Average Cover % '07
Vegetation	33.08
Pavement	8.72
Litter	25.56
Cryptogams	5.18
Bare Ground	36.35

SOIL ANALYSIS DATA --
Herd Unit 19R, Study no: 20, Study Name: East Pasture Harrow

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
16.2	-	6.8	33.4	46.0	20.6	1.0	9.8	380.8	0.5



PELLET GROUP DATA --
Management unit 19R, Study no: 20

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	18	-
Deer	2	2 (5)
Cattle	1	12 (29)

BROWSE CHARACTERISTICS --
Management unit 19R, Study no: 20

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**6140**	2320	260	2540	3340	1540	32	7	54	20	23	21/33
Cercocarpus ledifolius												
07	**60**	100	-	-	60	-	100	0	100	-	0	-/-
Chrysothamnus viscidiflorus												
07	**0**	-	-	-	-	-	0	0	-	-	0	10/7
Gutierrezia sarothrae												
07	**40**	-	-	40	-	-	50	0	-	-	50	5/7
Leptodactylon pungens												
07	**20**	-	-	20	-	-	0	0	-	-	0	8/6
Opuntia sp.												
07	**20**	-	-	20	-	-	0	0	-	-	0	3/5

Trend Study 21R-6-07

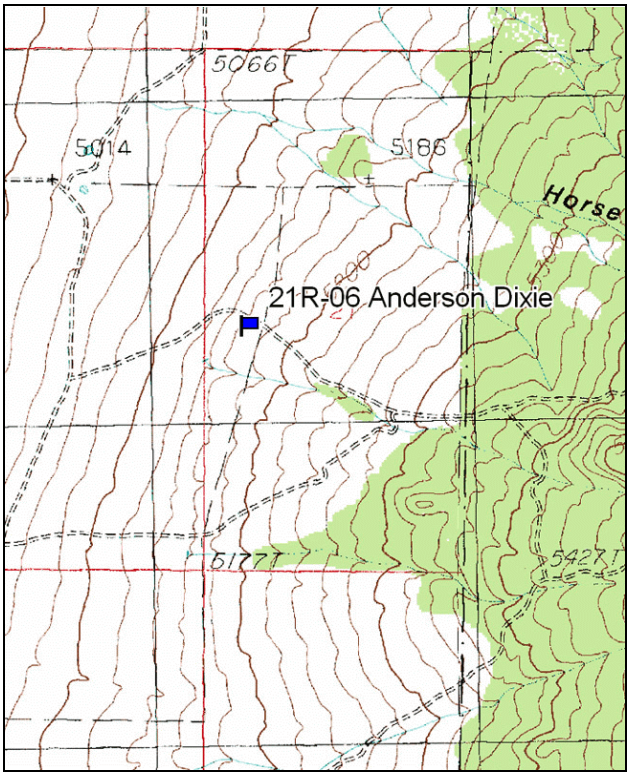
Study site name: Anderson Dixie . Vegetation type: Wyoming Big Sagebrush .

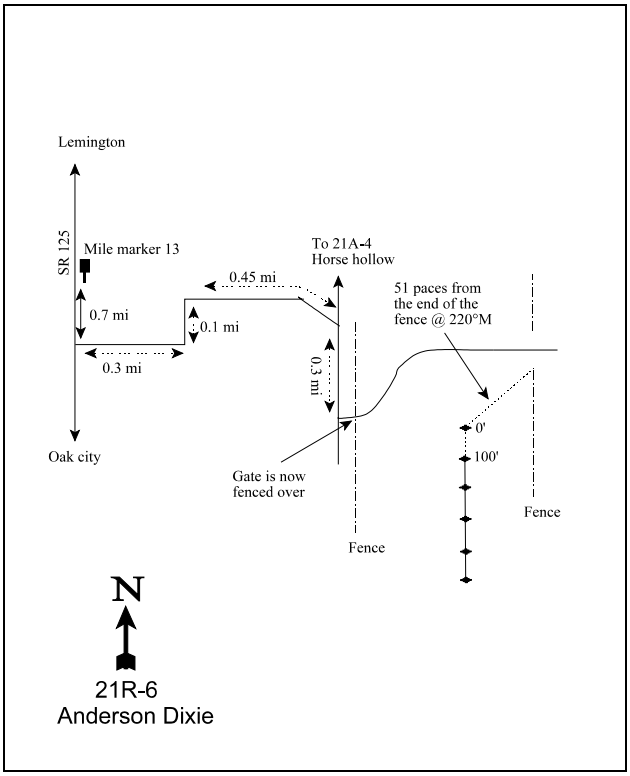
Compass bearing: frequency baseline 185 degrees magnetic.

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

LOCATION DESCRIPTION

Heading south on Highway 125 between Lemmington and Oak City, go to mile marker 13 and continue south 0.7 miles to a road coming in from the left. Turn left (east) and go 0.3 miles where the road will turn left (north) for 0.1 miles then right (east) again for 0.45 miles to a T in the road. (The left going to Horse Hollow (21A-4)). Go right 0.3 miles. Here there is a faint dirt road to the left that now is fenced in. Park here, and walk up the road (east) to another fence. From the end fence post on the south side of the road, the 0-foot stake is 51 paces at 220 degrees magnetic, and is marked with browse tag #139.





Map Name: Oak City North

Diagrammatic Sketch

Township 16S , Range 4W , Section 21

GPS: NAD 83, UTM 12S 387222 E 4363473 N

DISCUSSION

Anderson Dixie - Trend Study No. 21R-6

Study Information

This study was established in 2007 to monitor a fire rehabilitation project on private land 3 miles (4.8 km) north of Oak City [elevation: 5,170 feet (1,576 m), slope: 5%, aspect: west]. Large fires surrounding Oak City in the summer of 2006 destroyed a large portion of the winter and transitional ranges for deer in the area. This project was proposed to increase winter forage for deer and also forage for livestock. A Dixie harrow was used to treat 250 acres (101 ha) and broadcast grass, forb, and shrub seed (Table 1). Seeded areas will be excluded from cattle grazing for two growing seasons. Animal use was estimated at 23 deer days use/acre (56.8 ddu/ha), 2 elk days use/acre (5 edu/ha), and 6 cattle days use/acre (14 cdu/ha).

Soil

The soil is classified within the Pober series (USDA-NRCS 2007). The soils in this series are moderately deep over a petrocalcic horizon, and are well-drained. They formed in alluvium derived mainly from sedimentary rocks. Textural and chemical analyses identified the soil as a medium loam with mildly alkaline reaction (pH 7.4). The soil potassium was high at 182.4 ppm, and phosphorus was low-marginal at 6.3 ppm. Soil phosphorus values less than 6 ppm may limit normal plant growth and development (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 63%, and relative combined rock and pavement cover was 12%. Relative bare ground cover was 20%, and cryptogams provided the remaining 5% relative ground cover. The soil erosion condition was classified as stable, although there was a large gully and some flow patterns on the study.

Browse

Total browse cover was 13%, and Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) provided 90% of the browse cover. Sagebrush density was 2,380 plants/acre (5,881 plants/ha). Sixty-one percent of the population was mature, and the other 39% was decadent. Dead plants were sampled at a density of 520 plants/acre (1,285 plants/ha), and no seedlings were sampled. Nineteen percent of the live plants sampled were classified as dying. Use was mostly light, with 16% of the sampled plants showing moderate-heavy hedging. Annual leader growth was 1.4 inches (3.5 cm). Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), antelope bitterbrush (*Purshia tridentata*), and ephedra (*Ephedra* sp.) were also scattered throughout the study. Ephedra showed heavy use.

Utah juniper (*Juniperus osteosperma*) provided 2% canopy cover. From the point-centered quarter data, juniper density was 26 trees/acre (64 trees/ha). The average trunk diameter was 5.9 inches (15 cm), and the majority of the sampled trees were in the 4-8 foot (1.2-2.4 m) height class.

Herbaceous Understory

The understory provided 25% total cover, the majority of which was composed of grasses. Cheatgrass (*Bromus tectorum*) was the most abundant grass and was sampled in 99% of the quadrats. Average cheatgrass cover was 16%. The perennial grass component consisted of Sandberg bluegrass (*Poa secunda*) and bottlebrush squirreltail (*Sitanion hystrix*), which provided 8% combined cover. Nine forb species were sampled and provided approximately 1% cover. Annuals, particularly bur buttercup (*Ranunculus testiculatus*), were dominant. The most common perennial forb was longleaf phlox (*Phlox longifolia*).

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. Preferred browse cover was moderate, however, of the sagebrush population was largely decadent. The understory was depleted, and diversity was low. Cheatgrass was dominant, and the most abundant forb, bur buttercup, is allelopathic and therefore undesirable (Buchanan et al. 1978). No noxious weeds were sampled.

winter range condition (DCI) - poor (23) Low potential scale

Table 1. Seed mix applied to the Anderson Dixie harrow project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	100	4
Alfalfa "Ranger"	100	4
Alfalfa "Spredor 4"	50	2
Canby Bluegrass "Canbar"	50	2
Crested Wheatgrass "Douglas"	100	4
Crested Wheatgrass "Ephraim"	72	3
Crested Wheatgrass "Hycrest"	100	4
Intermediate Wheatgrass	250	9
Sainfoin "Eski"	550	21
Small Burnet "Delar"	750	28
Snake River Wheatgrass "Secar"	300	11
Western Yarrow	13	<1
Forage Kochia	125	5
Wyoming Big Sagebrush	100	4
Total	2660	100

HERBACEOUS TRENDS --
Management unit 21R, Study no: 6

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bromus tectorum (a)	423	15.80
G	Poa secunda	260	7.93
G	Sitanion hystrix	10	.09
Total for Annual Grasses		423	15.80
Total for Perennial Grasses		270	8.03
Total for Grasses		693	23.83
F	Calochortus nuttallii	-	.00
F	Cymopterus sp.	2	.03
F	Descurainia pinnata (a)	17	.06
F	Draba sp. (a)	21	.03
F	Erodium cicutarium (a)	3	.00
F	Gilia sp. (a)	6	.01
F	Phlox longifolia	22	.08
F	Ranunculus testiculatus (a)	138	.58
F	Zigadenus paniculatus	1	.03
Total for Annual Forbs		185	0.70
Total for Perennial Forbs		25	0.15
Total for Forbs		210	0.86

BROWSE TRENDS --
Management unit 21R, Study no: 6

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	65	11.78
B	Chrysothamnus viscidiflorus stenophyllus	8	.22
B	Cowania mexicana stansburiana	0	.01
B	Gutierrezia sarothrae	14	.25
B	Juniperus osteosperma	1	.81
B	Purshia tridentata	1	-
Total for Browse		89	13.07

CANOPY COVER, LINE INTERCEPT --
Management unit 21R, Study no: 6

Species	Percent Cover '07
Artemisia tridentata wyomingensis	14.88
Chrysothamnus viscidiflorus stenophyllus	.40
Gutierrezia sarothrae	.08
Juniperus osteosperma	1.60
Purshia tridentata	.40

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 21R, Study no: 6

Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	1.4

POINT-QUARTER TREE DATA --
Management unit 21R, Study no: 6

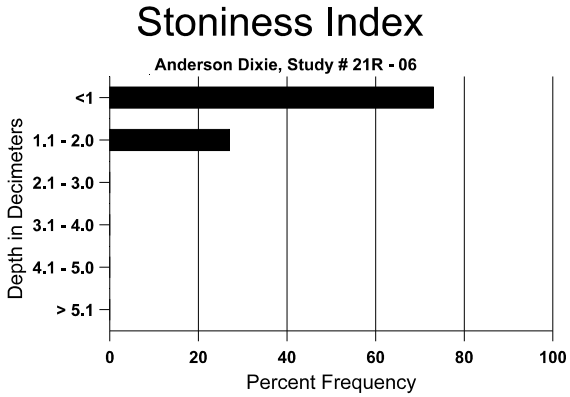
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	26	5.9

BASIC COVER --
Management unit 21R, Study no: 6

Cover Type	Average Cover % '07
Vegetation	38.81
Rock	6.66
Pavement	6.64
Litter	33.65
Cryptogams	5.59
Bare Ground	22.38

SOIL ANALYSIS DATA --
Herd Unit 21R, Study no: 6, Study Name: Anderson Dixie

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
4.6	-	7.4	45.4	34.0	20.6	2.0	6.3	182.4	0.5



PELLET GROUP DATA --
Management unit 21R, Study no: 6

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	59	-
Elk	-	2 (5)
Deer	5	23 (56)
Cattle	5	6 (14)

BROWSE CHARACTERISTICS --
Management unit 21R, Study no: 6

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**2380**	-	-	1440	940	520	11	5	39	19	22	31/40
Chrysothamnus viscidiflorus stenophyllus												
07	**220**	-	-	200	20	40	0	27	9	-	0	12/15
Cowania mexicana stansburiana												
07	**0**	-	-	-	-	-	0	0	-	-	0	72/73
Gutierrezia sarothrae												
07	**680**	80	20	640	20	60	0	0	3	-	12	8/10
Juniperus osteosperma												
07	**20**	-	-	20	-	20	0	0	-	-	0	-/-
Purshia tridentata												
07	**20**	-	-	20	-	-	0	0	-	-	0	49/59

Trend Study 22R-11-07

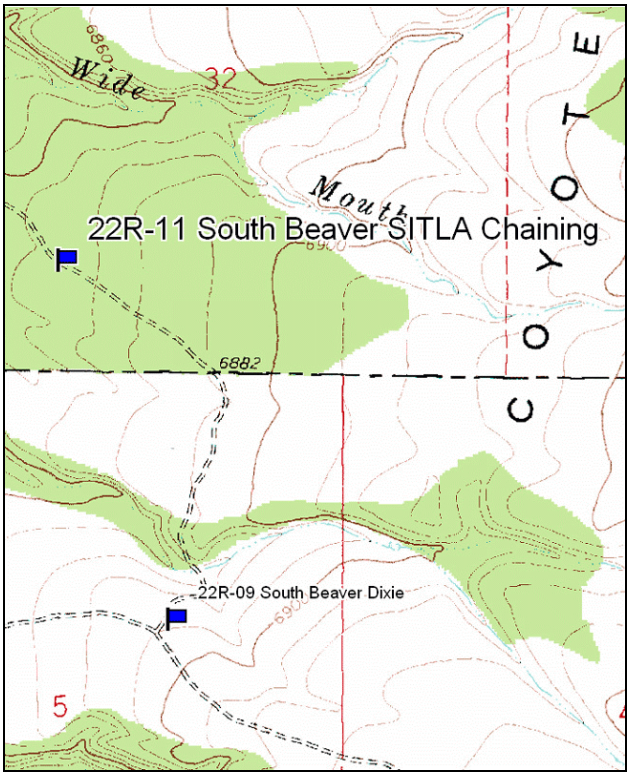
Study site name: South Beaver SITLA Chaining . Vegetation type: P-J - Wyoming Big Sagebrush .

Compass bearing: frequency baseline 124 degrees magnetic.

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

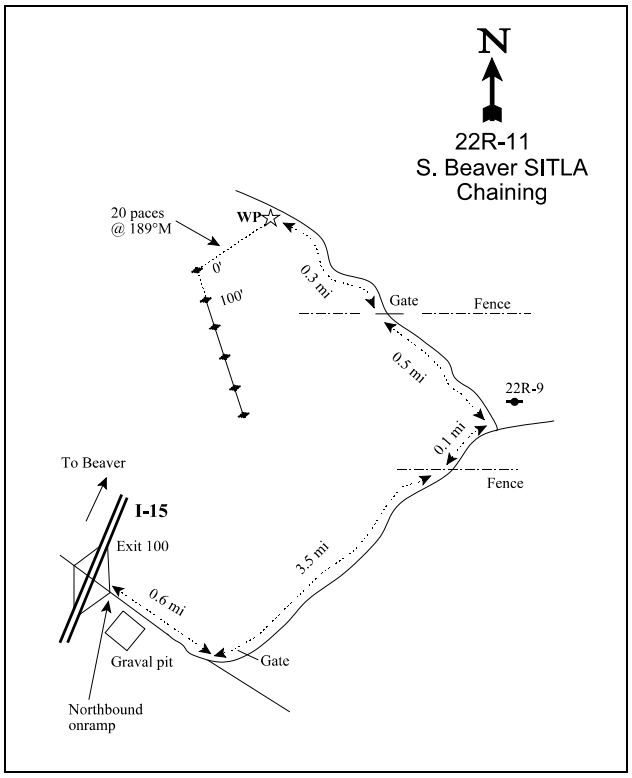
LOCATION DESCRIPTION

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, and 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, and is marked with browse tag #187.



Map name: Kane Canyon

Township 30S , Range 6W , Section 32



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 363188 E 4223621 N

DISCUSSION

South Beaver SITLA Chaining - Trend Study No. 22R-11

Study Information

This study was established in 2007 to monitor a proposed pinyon-juniper removal project on SITLA land approximately 10 miles southeast of Beaver [elevation: 6,830 feet (2,082 m), slope: 2%, aspect: northwest]. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) 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. Riparian systems supporting Bonneville cutthroat trout have also suffered from the encroachment, with a decline in water quantity and quality. The objective of this project is to restore the sagebrush semi-desert ecosystem by removing pinyon and juniper trees and seeding desirable grasses, forbs, and shrubs. 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. To attain these goals, pinyon and juniper trees will be thinned on 700 acres (283 ha) using a chain, and the treated area will be seeded. Deer use was estimated at 8 days use/acre (20 ddu/ha), and rabbit pellet quadrat frequency was 52%.

Soil

The soil is classified within the Pavant series (USDA-NRCS 2007). The soils in this series are well-drained, and are shallow over a calcium carbonate cemented hardpan. Textural and chemical analyses identified the soil as a medium loam with a neutral reaction (pH 7.3). The soil phosphorus was marginal at 8.7 ppm, and soil potassium was high at 156.8 ppm (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 48%, and relative combined rock and pavement cover was 30%. Relative bare ground cover was 21%. The soil erosion condition was classified as slight due to evidence of surface litter and soil movement, pedestalling around plants, and the formation of some small flow patterns and rills.

Browse

Browse provided 15% of the total ground cover in 2007. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) was the most abundant preferred browse species, but provided only 1% cover. Sagebrush density was 1,540 plants/acre (3,805 plants/ha). Forty-six percent of the population was mature, and 53% was decadent. Reproduction and young recruitment were very low. Dead plants were sampled at a density of 900 plants/acre (2,224 plants/ha), and 25% of the live plants sampled were classified as dying. Sixteen percent of the population was infested with the sagebrush defoliator moth (*Aroga websteri*). Approximately half of the population displayed light use, and half were moderately-heavily hedged. Average annual leader growth on sagebrush was 1.5 inches (3.8 cm). Antelope bitterbrush (*Purshia tridentata*) was also present, but its density was very low. Average annual leader growth on bitterbrush was 1.5 inches (3.9 cm).

Pinyon and juniper trees provided 27% canopy cover. From the point-centered quarter data, pinyon density was 168 trees/acre (415 trees/ha). The average trunk diameter was 5.3 inches (13.5 cm), and the majority of the sampled trees were 1-12 feet (0.3-3.7 m) tall. Juniper density was 259 trees/acre (640 trees/ha), and average trunk diameter was 5.3 inches (13.5 cm). The majority of the sampled trees were less than 4 feet (1.2 m) tall.

Herbaceous Understory

The understory provided 8% total cover, approximately half of which was composed of grasses. Bluebunch wheatgrass (*Agropyron spicatum*) was the dominant grass, providing 3% cover. Indian ricegrass (*Oryzopsis hymenoides*), needle-and-thread (*Stipa comata*), and bottlebrush squirreltail (*Sitanion hystrix*) were also sampled in low frequencies. Cheatgrass (*Bromus tectorum*) was sampled in 12% of the quadrats, but provided almost no cover.

Thirteen forb species were sampled, nine of which were perennials. Desert phlox (*Phlox austromontana*) was the dominant forb, providing 3% cover. The annual species bur buttercup (*Ranunculus testiculatus*), gilia (*Gilia* sp.), and slender phlox (*Microsteris gracilis*) were also common, but provided little cover.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. Preferred browse cover was very low, and decadence was high. Perennial grasses and forbs provided little cover. Cheatgrass was sampled, but provided almost no cover. No noxious weeds were sampled.

winter range condition (DCI) - poor (16) Low potential scale

HERBACEOUS TRENDS --
Management unit 22R, Study no: 11

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron spicatum	127	3.13
G	Bromus tectorum (a)	27	.06
G	Oryzopsis hymenoides	36	.39
G	Sitanion hystrix	1	.00
G	Stipa comata	6	.03
Total for Annual Grasses		27	0.06
Total for Perennial Grasses		170	3.56
Total for Grasses		197	3.62
F	Antennaria rosea	3	.00
F	Arabis sp.	11	.02
F	Astragalus sp.	9	.03
F	Chaenactis douglasii	6	.01
F	Collinsia parviflora (a)	1	.00
F	Eriogonum umbellatum	5	.33
F	Gilia sp. (a)	65	.13
F	Hymenoxys acaulis	17	.09
F	Lesquerella sp.	6	.02
F	Lygodesmia spinosa	3	.03
F	Microsteris gracilis (a)	54	.14
F	Phlox austromontana	96	3.06
F	Ranunculus testiculatus (a)	82	.18
Total for Annual Forbs		202	0.45
Total for Perennial Forbs		156	3.61
Total for Forbs		358	4.06

BROWSE TRENDS --
Management unit 22R, Study no: 11

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	53	1.14
B	Chrysothamnus viscidiflorus stenophyllus	11	.04
B	Gutierrezia sarothrae	10	.21
B	Juniperus osteosperma	6	4.17
B	Leptodactylon pungens	13	.36
B	Opuntia sp.	1	-
B	Pinus edulis	15	8.91
B	Purshia tridentata	0	-
Total for Browse		109	14.85

CANOPY COVER, LINE INTERCEPT --
Management unit 22R, Study no: 11

Species	Percent Cover '07
Artemisia tridentata wyomingensis	2.26
Chrysothamnus viscidiflorus stenophyllus	-
Gutierrezia sarothrae	.18
Juniperus osteosperma	10.44
Leptodactylon pungens	.36
Pinus edulis	16.78

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 22R, Study no: 11

Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	1.5
Purshia tridentata	1.5

POINT-QUARTER TREE DATA --
Management unit 22R, Study no: 11

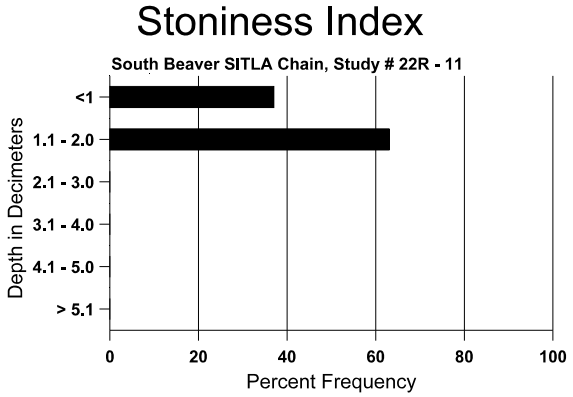
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	259	5.3
Pinus edulis	168	5.3

BASIC COVER --
Management unit 22R, Study no: 11

Cover Type	Average Cover % '07
Vegetation	22.86
Rock	15.13
Pavement	20.00
Litter	34.03
Cryptogams	1.59
Bare Ground	24.18

SOIL ANALYSIS DATA --
Herd Unit 22R, Study no: 11, Study Name: South Beaver SITLA Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
6.2	-	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 '07	Days use per acre (ha) '07
Rabbit	52	-
Deer	-	8 (20)

BROWSE CHARACTERISTICS --
Management unit 22R, Study no: 11

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**1540**	20	20	700	820	900	12	39	53	25	25	16/22
Chrysothamnus viscidiflorus stenophyllus												
07	**240**	-	-	200	40	-	25	58	17	8	8	6/7
Gutierrezia sarothrae												
07	**240**	-	20	220	-	-	0	0	-	-	0	7/5
Juniperus osteosperma												
07	**120**	100	20	100	-	20	0	0	-	-	0	-/-
Leptodactylon pungens												
07	**820**	20	-	800	20	-	0	0	2	2	2	5/8
Opuntia sp.												
07	**20**	-	-	20	-	-	0	0	-	-	0	4/8
Pinus edulis												
07	**300**	100	140	160	-	-	0	0	-	-	0	-/-
Purshia tridentata												
07	**0**	-	-	-	-	-	0	0	-	-	0	28/48

Trend Study 22R-12-07

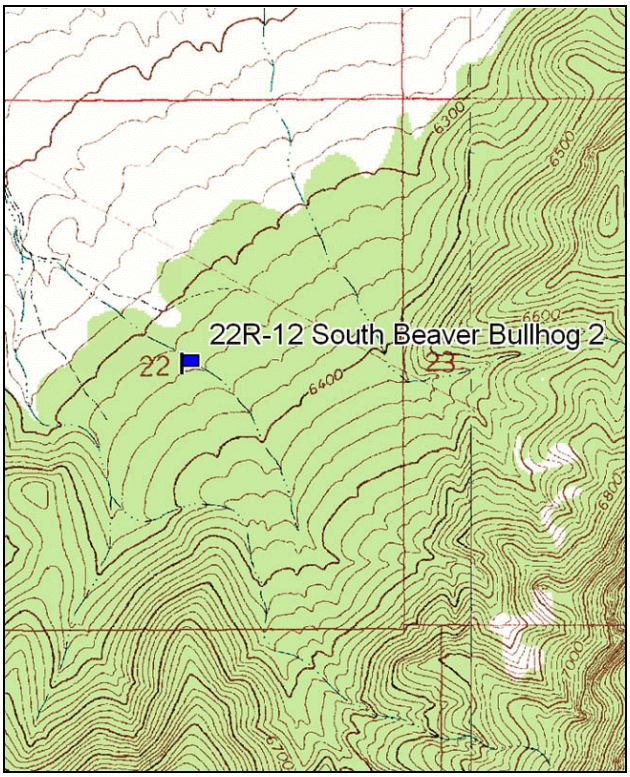
Study site name: South Beaver Bullhog 2 . Vegetation type: Pinyon-Juniper .

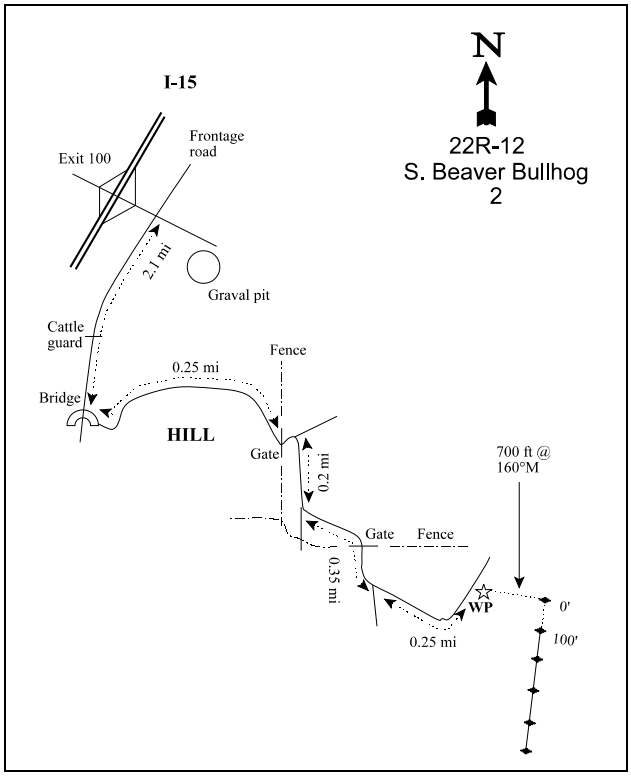
Compass bearing: frequency baseline 243 degrees magnetic.

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

LOCATION DESCRIPTION

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) and travel 0.25 miles around a hill and 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 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, and is marked by browse tag #113.





Map name: Buckhorn Flat

Township 31S , Range 7W , Section 22

Diagrammatic Sketch

GPS: NAD 83, UTM 12S 356563 E 4217544 N

DISCUSSION

South Beaver Bullhog 2 - Trend Study No. 22R-12

Study Information

This study was established in 2007 to aid in monitoring a large scale pinyon-juniper removal project south of Beaver [elevation: 6,350 feet (1,935 m), slope: 6%, aspect: west]. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) 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. Riparian systems supporting Bonneville cutthroat trout have also suffered from the encroachment, with a decline in water quantity and quality. The objective of this project was to restore the sagebrush semi-desert ecosystem by removing pinyon and juniper trees and seeding desirable grasses, forbs, and shrubs. 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. To attain these goals, pinyon and juniper trees were thinned on 12,000 acres (283 ha) over a 5-year timespan using bullhog, Dixie harrow, and lop and scatter techniques where appropriate. Areas with little or no understory were seeded (Table 1). This study monitors an area that was treated with a bullhog machine. Deer use was estimated at 1 day use/acre (2 ddu/ha), and rabbit pellet quadrat frequency was 82%. A deer and rabbit skull, as well as a deer backbone were found on the study.

Soil

The soil is classified within the Manderfield series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in mixed alluvium. Textural and chemical analyses identified the soil as a sandy clay loam with a neutral reaction (pH 6.7). The soil phosphorus and potassium are both high at 11.3 ppm and 256 ppm, respectively (Tiedemann and Lopez 2004). Relative combined rock and pavement cover was 38%. Relative litter cover was 46%, and relative vegetative cover was 6%. Cryptogams provided 7% of the relative ground cover, and relative bare ground cover was 3%. The soil erosion condition was classified as moderate due to evidence of soil movement and the formation of flow patterns, rills, and gullies.

Browse

The preferred browse on the study was very limited. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) density was 40 plants/acre (99 plants/ha), and all of the sampled plants were decadent and classified as dying. Dead plants were sampled at a density of 60 plants/acre (148 plants/ha). Use on sagebrush was heavy. Slenderbush eriogonum (*Eriogonum microthecum*) was also sampled at a density of 20 plants/acre (49 plants/ha), and use was light.

Pinyon and juniper provided 40% combined canopy cover. From the point-centered quarter data, pinyon density was 171 trees/acre (423 trees/ha). The average trunk diameter was 6.3 inches (16 cm), and the majority of the sampled trees were greater than 8 feet (2.4 m) tall. Juniper density was 76 trees/acre (188 trees/ha), and average trunk diameter was 10 inches (25.4 cm). Most of the sampled trees were greater than 12 feet (3.7 m) tall.

Herbaceous Understory

The understory was very sparse and provided 2% cover. No species were particularly abundant. Blue grama (*Bouteloua gracilis*) and bottlebrush squirreltail (*Sitanion hystrix*) were the only perennial grasses sampled. Cheatgrass (*Bromus tectorum*) was the most abundant grass and was sampled in 36% of the quadrats. Sixteen forb species were sampled. The annual species Douglas knotweed (*Polygonum douglasii*) and slender phlox (*Microsteris gracilis*) were the most common forbs. Sulfur eriogonum (*Eriogonum umbellatum*) and heartleaf twistflower (*Streptanthus cordatus*) were the most abundant perennial forbs.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Pinyon and juniper trees comprised the majority of the vegetative cover. Preferred browse density was very low, and sagebrush decadence was high. There was almost no herbaceous cover.

winter range condition (DCI) - very poor (0) Low potential scale

Table 1. Seed mix applied to the South Beaver project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	200	5
Alfalfa "Ranger"	200	5
Bitterbrush	50	1
Blue Flax "Appar"	150	4
Bluebunch Wheatgrass "Anatone"	300	8
Crested Wheatgrass "Hycrest"	300	8
Orchardgrass "Paiute"	150	4
Pubescent Wheatgrass	600	15
Sainfoin "Eski"	650	16
Sandberg Bluegrass	100	2
Siberian Wheatgrass "Vavilov"	200	5
Small Burnet "Delar"	600	15
Snake River Wheatgrass "Secar"	450	11
Yellow Sweetclover	50	1
Total	4000	100

HERBACEOUS TRENDS --

Management unit 22R, Study no: 12

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bouteloua gracilis	2	.00
G	Bromus tectorum (a)	116	.86
G	Sitanion hystrix	22	.10
Total for Annual Grasses		116	0.86
Total for Perennial Grasses		24	0.11
Total for Grasses		140	0.97
F	Arabis sp.	6	.01
F	Astragalus calycosus	2	.00
F	Astragalus sp.	1	.00
F	Cryptantha sp.	5	.01
F	Descurainia pinnata (a)	41	.07
F	Eriogonum cernuum (a)	6	.01
F	Eriogonum umbellatum	7	.08
F	Euphorbia sp.	3	.00

Type	Species	Nested Frequency '07	Average Cover % '07
F	Gayophytum ramosissimum(a)	1	.00
F	Gilia sp. (a)	31	.06
F	Ipomopsis aggregata	11	.02
F	Lotus sp. (a)	9	.02
F	Microsteris gracilis (a)	57	.12
F	Polygonum douglasii (a)	108	.24
F	Ranunculus testiculatus (a)	10	.02
F	Streptanthus cordatus	9	.02
Total for Annual Forbs		263	0.56
Total for Perennial Forbs		44	0.15
Total for Forbs		307	0.71

BROWSE TRENDS --
Management unit 22R, Study no: 12

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	2	-
B	Eriogonum microthecum	1	-
B	Juniperus osteosperma	5	2.24
B	Opuntia sp.	0	-
B	Pinus edulis	11	3.07
Total for Browse		19	5.31

CANOPY COVER, LINE INTERCEPT --
Management unit 22R, Study no: 12

Species	Percent Cover '07
Artemisia tridentata wyomingensis	.23
Juniperus osteosperma	15.26
Pinus edulis	24.88

POINT-QUARTER TREE DATA --
Management unit 22R, Study no: 12

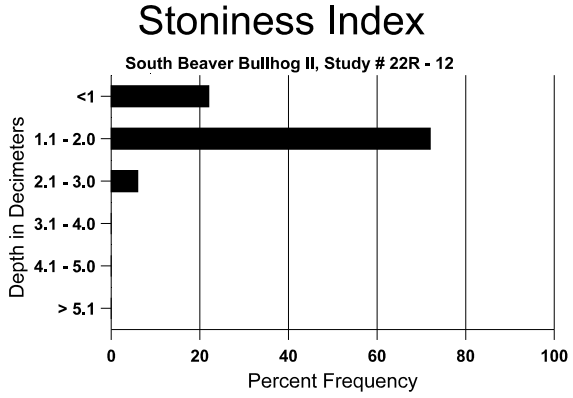
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	76	10.0
Pinus edulis	171	6.3

BASIC COVER --
Management unit 22R, Study no: 12

Cover Type	Average Cover % '07
Vegetation	6.78
Rock	16.91
Pavement	25.74
Litter	52.07
Cryptogams	7.55
Bare Ground	3.97

SOIL ANALYSIS DATA --
Herd Unit 22R, Study no: 12, Study Name: South Beaver Bullhog 2

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
7.4	-	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 '07	Days use per acre (ha) '07
Rabbit	82	-
Deer	3	1 (2)

BROWSE CHARACTERISTICS --
Management unit 22R, Study no: 12

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**40**	-	-	-	40	60	0	100	100	100	100	39/55
Eriogonum microthecum												
07	**20**	-	-	20	-	-	0	0	-	-	0	6/6
Juniperus osteosperma												
07	**100**	-	20	80	-	20	0	0	-	-	0	-/-
Opuntia sp.												
07	**0**	-	-	-	-	-	0	0	-	-	0	6/15
Pinus edulis												
07	**420**	100	120	280	20	40	0	0	5	-	0	-/-

Trend Study 22R-13-07

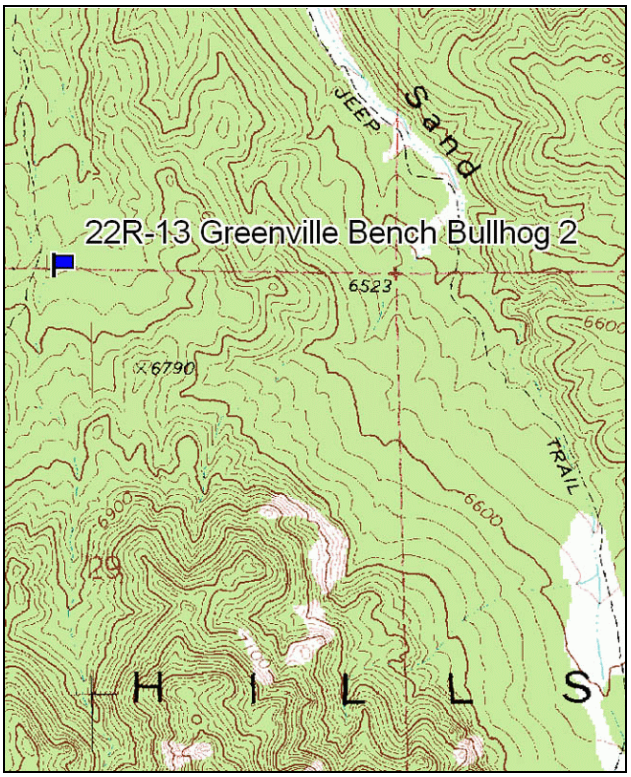
Study site name: Greenville Bench Bullhog 2 . Vegetation type: Pinyon-Juniper.

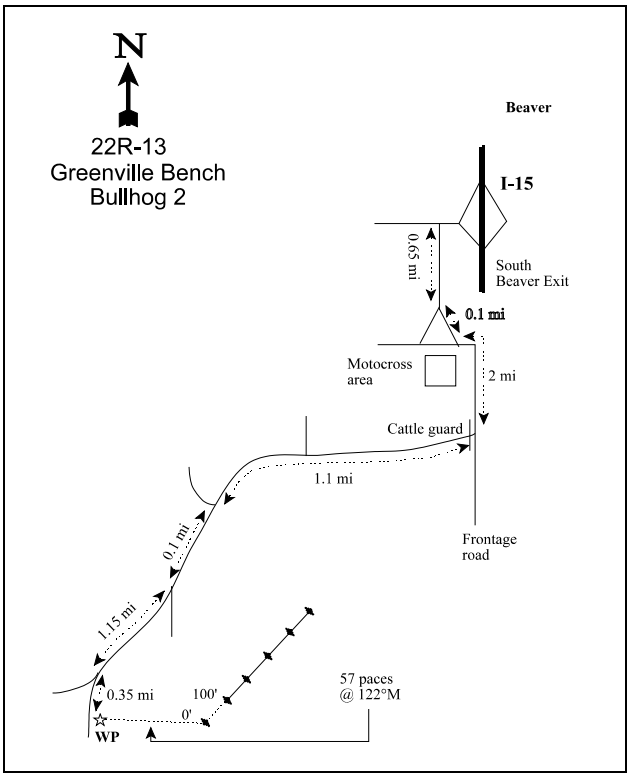
Compass bearing: frequency baseline 73 degrees magnetic.

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

LOCATION DESCRIPTION

Take Exit 109 off of I-15 and go west on the overpass toward a Chevron Station. From the Chevron Station, head south on 600 West for 0.7 miles. Turn left before the motor-cross area. Stay on the left most road to where the road turns more south. From here travel 2.0 miles to a road coming in on the right. Turn onto this road and travel 1.1 miles to a fork. Stay left and travel 0.1 miles to another fork. Go right 1.15 miles to another fork. Go left 0.5 miles on a small 2-track in the bottom of a drainage to a witness post. The 0-foot stake is 57 paces from the witness post at 122 degrees magnetic, and is marked with browse tag #112.





Map name: Greenville Bench

Diagrammatic Sketch

Township 30S , Range 7W , Section 29

GPS: NAD 83, UTM 12S 353847 E 4226732 N

DISCUSSION

Greenville Bench Bullhog 2 - Trend Study No. 22R-13

Study Information

This study monitors a bullhog treatment approximately 7 miles (11.3 km) south of Beaver [elevation: 6,670 feet (2,033 m), slope: 3%, aspect: north]. In November of 2004, 1,500 acres were treated with a bullhog machine, then drill seeded with a rangeland drill. Later, a mix of browse seed was aerially applied to the treated area. In 2007, this project was expanded to include more acreage. Two seed mixes were applied to the project; one on 10,860 acres (4,395 ha) and one on 4,030 acres (1,631 ha). The mixes were very similar. The first mix is outlined in Table 1, since it was applied to a larger acreage and has the higher likelihood of being applied to the study. Big game use was estimated at 11 deer days use/acre (28 ddu/ha) and 1 elk day use/acre (3 edu/ha). Rabbit pellet quadrat frequency was 43%.

Soil

The soil is classified within the Red Butte series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in alluvium and colluvium derived from sedimentary and igneous rocks. Textural and chemical analyses identified the soil as a sandy loam with a neutral reaction (pH 6.8). The soil potassium is high at 124.8 ppm, and phosphorus is low-marginal at 6.6 ppm. Soil phosphorus values less than 6 ppm may limit normal plant growth and development (Tiedemann and Lopez 2004). Relative vegetative cover was 9%, and relative litter cover was 51%. Relative combined rock and pavement cover was 25%, and relative bare ground cover was 14%. The soil erosion condition was classified as slight due to pedestalling around plants and the presence of flow patterns.

Browse

Total browse cover was 10% in 2007, however, preferred species provided only 2% cover. Antelope bitterbrush (*Purshia tridentata*) was sampled at a density of 180 plants/acre (445 plants/ha). The majority of the population was mature, with 11% decadence and 11% young recruitment. Vigor was good on most plants, and use was moderate-heavy. Average leader growth was 2.7 inches (6.8 cm).

Gambel oak (*Quercus gambelii*) density was 460 plants/acre (1,137 plants/ha). Most of the sampled plants were mature, with 4% decadence and 13% young recruitment. The population was vigorous, and use was light. Squaw-apple (*Peraphyllum ramosissimum*) was sampled at a density of 120 plants/acre (297 plants/ha). Mature plants comprised 33% of the population, with 50% decadence and 17% young recruitment. One-third of the population was classified as dying. Use was light on half of the plants, and the other half showed moderate-heavy use. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and curl-leaf mountain mahogany (*Cercocarpus ledifolius*) were also present in low densities.

Pinyon and juniper trees provided 43% combined canopy cover. From the point-centered quarter data, pinyon density was estimated at 245 plants/acre (605 plants/ha). Average trunk diameter was 2.1 inches (5.3 cm), and the majority of the sampled plants were less than 4 feet (1.2 m) tall. Juniper density was 143 plants/acre (353 plants/ha), and average trunk diameter was 7.6 inches (19.3 cm). Most of the sampled trees were greater than 12 feet (3.7 m) in height.

Herbaceous Understory

The understory was very sparse and provided less than 1% cover. No species were particularly abundant. Indian ricegrass (*Oryzopsis hymenoides*) and bottlebrush squirreltail (*Sitanion hystrix*) were the only perennial grasses sampled. Cheatgrass (*Bromus tectorum*) was present but was sampled in only 4% of the quadrats. Eleven forb species were sampled. The annual species Douglas knotweed (*Polygonum douglasii*) and nodding eriogonum (*Eriogonum cernuum*) were the most common forbs. Lobeleaf groundsel (*Senecio multilobatus*) and heartleaf twistflower (*Streptanthus cordatus*) were the most abundant perennial forbs.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index, is very poor. Preferred browse cover was very low. Pinyon and juniper trees composed the majority of the vegetative cover. There was almost no herbaceous cover.

winter range condition (DCI) - very poor (2) Low potential scale

Table 1. Seed mix applied to the Greenville Bench project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	12300	13
Antelope Bitterbrush	450	<1
Blue Flax	250	<1
Bluebunch Wheatgrass "P7"	6750	7
Bottlebrush Squirreltail	200	<1
Canby Bluegrass "Canbar"	1100	1
Crested Wheatgrass "Nordan"	11000	11
Fourwing Saltbush	600	<1
Gooseberryleaf Globemallow	100	<1
Indian Ricegrass	3750	4
Indian Ricegrass "Rimrock"	2000	2
Intermediate Wheatgrass "Rush"	4200	4
Orchardgrass "Paiute"	2100	2
Palmer Penstemon	390	<1
Pubescent Wheatgrass	7000	7
Pubescent Wheatgrass "Luna"	7150	7
Russian Wildrye	450	<1
Sand Dropseed	150	<1
SITLA Mix	1600	2
Small Burnet	3450	4
Thickspike Wheatgrass "Bannock"	6750	7
Western Wheatgrass "Arriba"	10750	11
Western Yarrow	300	<1
Yellow Sweetclover	15150	15
Total	97940	100

HERBACEOUS TRENDS --

Management unit 22R, Study no: 13

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bromus tectorum (a)	8	.04
G	Oryzopsis hymenoides	1	.03
G	Sitanion hystrix	13	.06
Total for Annual Grasses		8	0.04
Total for Perennial Grasses		14	0.09
Total for Grasses		22	0.13

Type	Species	Nested Frequency '07	Average Cover % '07
F	Arabis sp.	4	.00
F	Descurainia pinnata (a)	27	.07
F	Eriogonum cernuum (a)	32	.29
F	Eriogonum sp.	3	.06
F	Gayophytum ramosissimum(a)	1	.00
F	Microsteris gracilis (a)	24	.06
F	Penstemon sp.	3	.00
F	Phlox longifolia	1	.00
F	Polygonum douglasii (a)	41	.19
F	Senecio multilobatus	8	.02
F	Streptanthus cordatus	6	.01
Total for Annual Forbs		125	0.62
Total for Perennial Forbs		25	0.10
Total for Forbs		150	0.73

BROWSE TRENDS --
Management unit 22R, Study no: 13

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	2	-
B	Cercocarpus ledifolius	1	-
B	Gutierrezia sarothrae	2	.03
B	Juniperus osteosperma	6	.89
B	Opuntia fragilis	0	.00
B	Opuntia sp.	1	-
B	Peraphyllum ramosissimum	5	.15
B	Pinus edulis	13	7.31
B	Purshia tridentata	8	.75
B	Quercus gambelii	2	.77
Total for Browse		40	9.90

CANOPY COVER, LINE INTERCEPT --
Management unit 22R, Study no: 13

Species	Percent Cover '07
Gutierrezia sarothrae	.05
Juniperus osteosperma	8.83
Peraphyllum ramosissimum	.91
Pinus edulis	34.54
Purshia tridentata	.76
Quercus gambelii	2.45

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 22R, Study no: 13

Species	Average leader growth (in) '07
Purshia tridentata	2.7

POINT-QUARTER TREE DATA --
Management unit 22R, Study no: 13

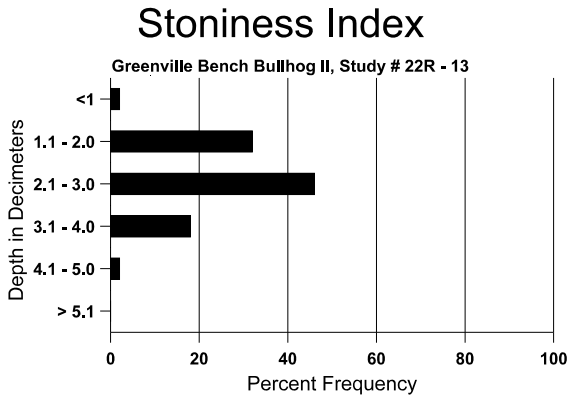
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	143	7.6
Pinus edulis	245	2.1

BASIC COVER --
Management unit 22R, Study no: 13

Cover Type	Average Cover % '07
Vegetation	10.39
Rock	3.84
Pavement	24.20
Litter	56.94
Cryptogams	1.61
Bare Ground	15.89

SOIL ANALYSIS DATA --
Herd Unit 22R, Study # 13, Study Name: Greenville Bench Bullhog 2

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
11.2	-	6.8	63.4	20.0	16.6	1.6	6.6	124.8	0.5



PELLET GROUP DATA --
Management unit 22R, Study no: 13

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	43	-
Elk	1	1 (3)
Deer	13	11 (28)

BROWSE CHARACTERISTICS --
Management unit 22R, Study no: 13

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia tridentata wyomingensis												
07	**40**	-	-	-	40	200	0	50	100	100	100	-/-
Cercocarpus ledifolius												
07	**20**	-	-	20	-	-	0	100	-	-	0	24/29
Gutierrezia sarothrae												
07	**80**	-	-	80	-	80	0	0	-	-	0	9/8
Juniperus osteosperma												
07	**120**	-	40	80	-	40	0	0	-	-	0	-/-
Opuntia fragilis												
07	**0**	40	-	-	-	-	0	0	-	-	0	-/-

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Opuntia sp.												
07	**40**	-	-	40	-	-	0	0	-	-	0	4/8
Peraphyllum ramosissimum												
07	**120**	-	20	40	60	-	17	33	50	33	50	42/53
Pinus edulis												
07	**300**	160	160	140	-	-	0	0	-	-	0	-/-
Purshia tridentata												
07	**180**	20	20	140	20	20	22	44	11	-	11	26/45
Quercus gambelii												
07	**460**	40	60	380	20	60	0	0	4	-	0	52/39

Trend Study 25R-6-07

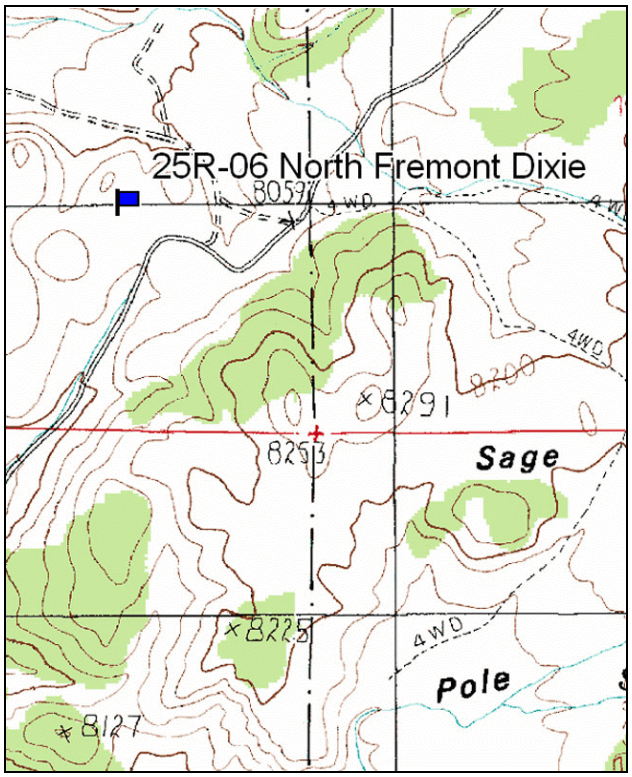
Study site name: North Fremont Dixie . Vegetation type: Wyoming Big Sagebrush & Low Sagebrush.

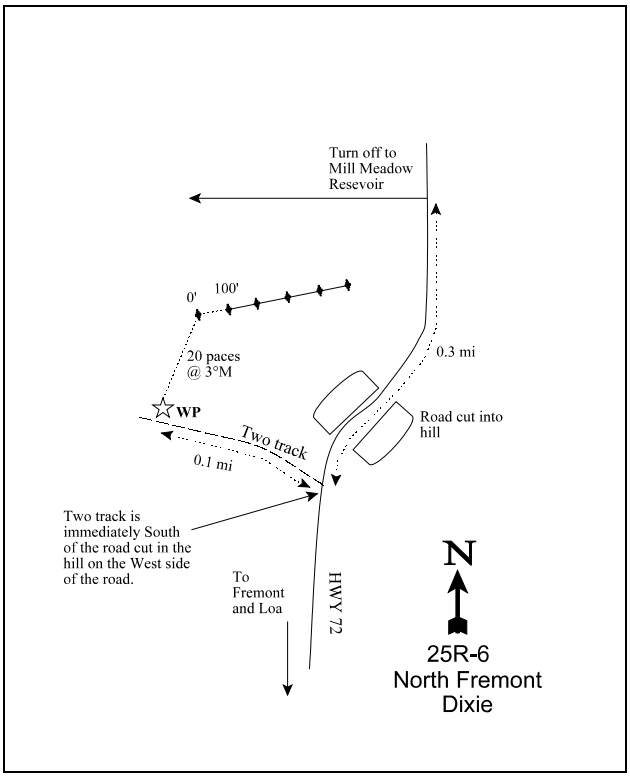
Compass bearing: frequency baseline 86 degrees magnetic.

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

LOCATION DESCRIPTION

From Highway 72 and the turn-off to Mill Meadow Reservoir, drive south towards Fremont and Loa on Highway 72 0.3 miles to a faint 2-track on the right side of the road. Turn right on the 2-track and go 0.1 mile to a witness post. The 0-foot stake is 20 paces from the witness post at 3 degrees magnetic, and is marked with browse tag #190.





Map name: Lyman

Diagrammatic Sketch

Township 27S , Range 3E , Section 2

GPS: NAD 83 UTM 12S 452263 E 4260172 N

DISCUSSION

North Fremont Dixie - Trend Study No. 25R-6

Study Information

This study was established in 2007 to monitor a habitat rejuvenation project on BLM land approximately 7.5 miles (12.1 km) northeast of Loa [elevation: 8,070 feet (2,460 m), slope: 7%, aspect: southeast]. Mill Meadow reservoir lies approximately 1 mile (1.6 km) northwest of the study. The area is considered crucial winter and spring range for big game, and supports 200-400 deer and 100-200 elk in the winter (UDWR 1985-2007). A Dixie harrow and seeding treatment was implemented to thin and rejuvenate the Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) stand, reduce encroaching pinyon-juniper, and improve the understory (Table 1). Animal use was estimated at 34 deer days use/acre (84 ddu/ha), 6 elk days use/acre (12 edu/ha), and 7 cattle days use/acre (18 cdu/ha) in 2007. The big game pellet groups were from year-long use. Rabbit pellet quadrat frequency was 65%, and coyote scat was also noted near the study.

Soil

The soil is a tan-reddish sandy clay loam with a neutral reaction (pH 7.0). The soil potassium is marginal at 80 ppm, and phosphorus is low at 5.7 ppm. Soil phosphorus values less than 6 ppm may limit normal plant growth and development (Tiedemann and Lopez 2004). Relative combined vegetation and litter cover was 46%, and relative bare ground cover was 37%. Relative pavement cover was 14%, and relative rock cover was 1%. The rocks present on the soil seemed to be of volcanic origin. Cryptogams were also present and provided 2% of the relative ground cover. The soil erosion condition was classified as slight due to relocation of surface litter, pedestalling around some plants, and the formation of flow patterns in the vegetation interspaces.

Browse

Total browse cover was 22% in 2007. Wyoming big sagebrush and low sagebrush (*Artemisia arbuscula*) comprised the preferred browse component. Wyoming big sagebrush provided 18% cover, and its density was 7,740 plants/acre (19,125 plants/ha). The population was mostly mature, with 32% decadence and 7% young recruitment. Seedlings were sampled at a density of 1,000 plants/acre (2,471 plants/ha), and dead plant density was 1,620 plants/acre (4,003 plants/ha). Twelve percent of the population was classified as dying. Use was moderate-heavy, and some of the plants had webbing on their branches, possibly from a sagebrush defoliator moth (*Aroga websteri*) infestation. Annual leader growth averaged 1.5 inches (3.7 cm).

Average low sagebrush cover was 3%, and its density was 3,140 plants/acre (7,759 plants/ha). The population was 85% mature and 15% decadent. Seedlings were abundant, with a density of 4,100 plants/acre (10,131 plants/ha). Dead plants were sampled at a density of 240 plants/acre (593 plants/ha), and 2% of the live plants were classified as dying. Use was moderate-heavy, and average annual leader growth was 1.4 inches (3.6 cm). The broom snakeweed (*Gutierrezia sarothrae*) and low rabbitbrush (*Chrysothamnus viscidiflorus*) populations also showed some hedging, probably from rabbits.

Herbaceous Understory

The understory component was sparse, and diversity was low. No annual herbaceous species were sampled. Almost the entire understory was composed of grasses, which provided 8% cover. The most abundant species was blue grama (*Bouteloua gracilis*), although many of the plants were dead. Bottlebrush squirreltail (*Sitanion hystrix*) was common underneath sagebrush plants. Sedge (*Carex* sp.), Indian ricegrass (*Oryzopsis hymenoides*), and western wheatgrass (*Agropyron smithii*) were also present. Forbs provided almost no cover. Cryptantha (*Cryptantha* sp.), pingue hymenoxys (*Hymenoxys richardsonii*), and longleaf phlox (*Phlox longifolia*) were the only species sampled.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is good. Preferred browse cover was favorable, however, decadence was high and young recruitment was low. Reproduction was good for both Wyoming big sagebrush and low sagebrush. The understory was sparse, and although perennial grass cover was moderate, forbs provided very little cover.

winter range condition (DCI) - good (52) Low potential scale

Table 1. Seed mix applied to the North Fremont Dixie project in 2007.

Seed Species	Bulk lbs in Mix	Percent of Mix
Alfalfa "Ladak"	400	2
Alfalfa "Spredor 4"	392	2
Annual Sunflower	400	2
Big Bluegrass "Sherman"	500	3
Blue Flax "Appar"	589	3
Bottlebrush Squirreltail "Toe Jam"	400	2
Canby Bluegrass "Canbar"	800	4
Crested Wheatgrass "Douglas"	1600	9
Crested Wheatgrass "Hycrest"	1600	9
Indian Ricegrass "Rimrock"	1600	9
Intermediate Wheatgrass	600	3
Palmer Penstemon	200	1
Pubescent Wheatgrass	600	3
Rocky Mountain Beeplant	400	2
Russian Wildrye	1600	9
Wyoming Big Sagebrush	800	4
Sandberg Bluegrass	300	2
Sheep Fescue	400	2
Small Burnet "Delar"	3400	18
Yellow Sweetclover	1424	8
Forage Kochia "Immigrant"	117	<1
Forage Kochia	483	3
Total	18605	100

HERBACEOUS TRENDS --

Management unit 25R, Study no: 6

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron smithii	4	.01
G	Bouteloua gracilis	179	6.03
G	Carex sp.	80	.96
G	Oryzopsis hymenoides	8	.04
G	Sitanion hystrix	85	1.14
Total for Annual Grasses		0	0
Total for Perennial Grasses		356	8.19
Total for Grasses		356	8.19

Type	Species	Nested Frequency '07	Average Cover % '07
F	Cryptantha sp.	8	.02
F	Hymenoxys richardsonii	3	.00
F	Phlox longifolia	3	.00
Total for Annual Forbs		0	0
Total for Perennial Forbs		14	0.02
Total for Forbs		14	0.02

BROWSE TRENDS --
Management unit 25R, Study no: 6

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia arbuscula	19	3.39
B	Artemisia tridentata wyomingensis	91	17.78
B	Chrysothamnus viscidiflorus stenophyllus	11	.21
B	Chrysothamnus viscidiflorus viscidiflorus	15	.10
B	Gutierrezia sarothrae	43	.30
B	Opuntia fragilis	13	.10
B	Opuntia sp.	2	-
B	Pediocactus simpsonii	1	-
B	Pinus edulis	1	-
Total for Browse		196	21.90

CANOPY COVER, LINE INTERCEPT --
Management unit 25R, Study no: 6

Species	Percent Cover '07
Artemisia arbuscula	3.73
Artemisia tridentata wyomingensis	21.14
Chrysothamnus viscidiflorus stenophyllus	.30
Chrysothamnus viscidiflorus viscidiflorus	.18
Gutierrezia sarothrae	.35
Opuntia fragilis	.10

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 25R, Study no: 6

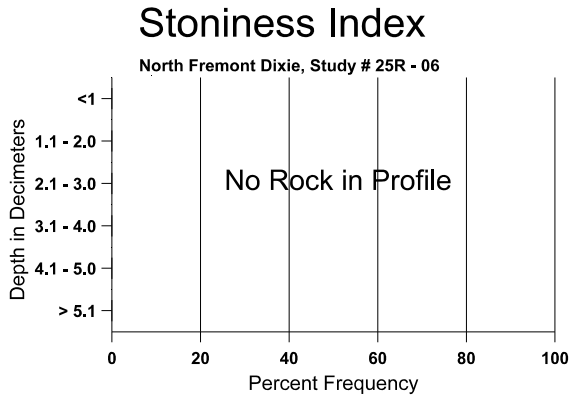
Species	Average leader growth (in) '07
Artemisia arbuscula	1.4
Artemisia tridentata wyomingensis	1.5

BASIC COVER --
Management unit 25R, Study no: 6

Cover Type	Average Cover % '07
Vegetation	30.47
Rock	1.35
Pavement	16.11
Litter	23.52
Cryptogams	2.03
Bare Ground	42.16

SOIL ANALYSIS DATA --
Herd Unit 25R, Study no: 6, Study Name: North Fremont Dixie

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
13.8	-	7.0	51.4	26.0	22.6	1.4	5.7	80.0	0.5



PELLET GROUP DATA --
Management unit 25R, Study no: 6

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	65	-
Elk	11	5 (12)
Deer	51	34 (84)
Cattle	1	7 (18)

BROWSE CHARACTERISTICS --
Management unit 25R, Study no: 6

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia arbuscula												
07	**3140**	4100	-	2680	460	240	88	11	15	2	2	4/12
Artemisia tridentata wyomingensis												
07	**7740**	1000	540	4740	2460	1620	32	56	32	12	12	17/24
Chrysothamnus viscidiflorus stenophyllus												
07	**500**	-	40	440	20	-	8	80	4	-	0	5/6
Chrysothamnus viscidiflorus viscidiflorus												
07	**1000**	40	160	800	40	80	22	10	4	4	4	5/6
Gutierrezia sarothrae												
07	**1760**	20	180	1560	20	-	27	19	1	1	2	5/5
Opuntia fragilis												
07	**280**	80	100	180	-	-	0	0	-	-	0	2/6
Opuntia sp.												
07	**40**	-	-	40	-	-	0	0	-	-	0	2/7

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Pediocactus simpsonii												
07	**20**	-	-	20	-	-	0	0	-	-	0	½
Pinus edulis												
07	**20**	20	20	-	-	-	0	0	-	-	0	-/-

Trend Study 27R-19-07

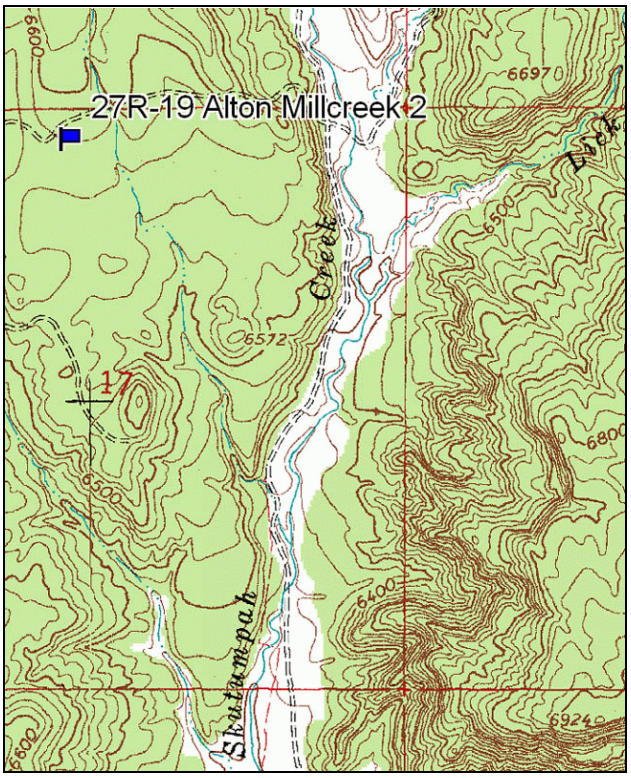
Study site name: Alton-Millcreek 2 . Vegetation type: Pinyon-Juniper-Black Sagebrush .

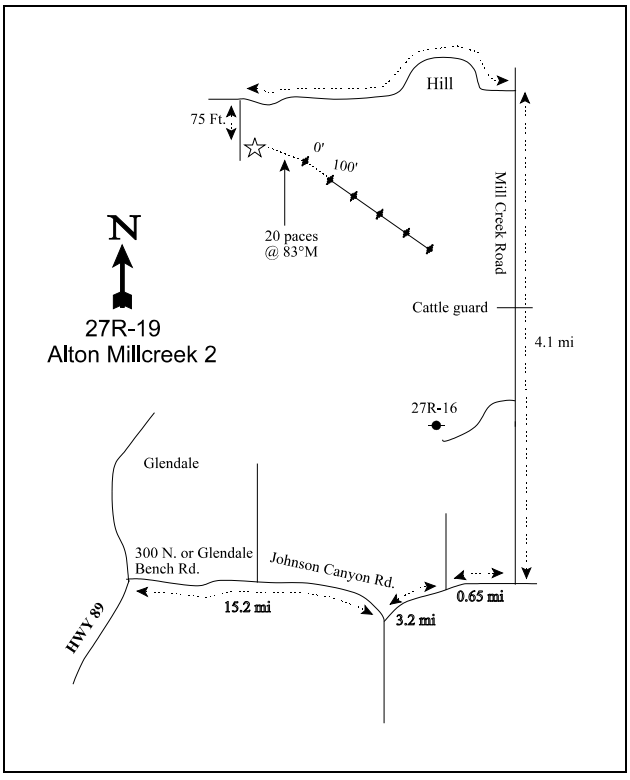
Compass bearing: frequency baseline 129 degrees magnetic.

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

LOCATION DESCRIPTION

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 reads "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, going through a gate, and travel 0.5 miles to a 2-track to the left. The witness post is 75 feet down the 2-track on the left side. From the witness post the 0-foot stake is 20 paces at 83 degrees magnetic, and is marked with browse tag #183.





Map name: Skutumpah Creek

Diagrammatic Sketch

Township 40S , Range 4.5W , Section 17

GPS: NAD 83, UTM 12S 381746 E 4133373 N

DISCUSSION

Alton-Millcreek 2 - Trend Study No. 27R-19

Study Information

This study was established in 2007 to monitor a pinyon-juniper removal project on BLM land approximately 10 miles (16.1 km) southeast of Alton [elevation: 6,580 feet (2,006 m), slope: 2%, aspect: southeast]. The total project area encompasses 3,400 acres (1,376 ha) of historical sage-grouse habitat, and is 3 miles (4.8 km) from the Ford Pasture historic lek. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees were thinned with a lop and scatter treatment before the study was sampled in summer 2007, and a bullhog machine will also be used on the treated area. The area will also be aerially seeded. Wildlife use was estimated at 7 deer days use/acre (18 ddu/ha) and 1 elk day use/acre (3 edu/ha). There were many prints left by the animals, and a dead elk was also noted on the study.

Soil

The soil was identified as a medium loam, and was a layer of fine sand on the surface. The soil reaction was neutral (pH 6.7). The soil phosphorus was marginal at 9 ppm, and potassium was high at 182.4 ppm (Tiedemann and Lopez 2004). Relative bare ground cover was 47% and relative litter cover was 43%, while relative vegetation cover was 7%. Cryptogams provided 3% of the relative cover. The soil erosion condition was classified as slight due to evidence of soil movement, pedestalling around plants, and the formation of flow patterns and rills.

Browse

Total browse cover was 5% in 2007. Preferred species provided approximately one-quarter of the browse cover. Black sagebrush (*Artemisia nova*) was the most abundant preferred browse species, with a density of 860 plants/acre (2,125 plants/ha). The population was composed of 35% mature plants and 65% decadent plants. Dead plants were sampled at a density of 500 plants/acre (1,235 plants/ha), and 23% of the live plants sampled were classified as dying. No seedlings or young plants were sampled. Use on black sagebrush was moderate-heavy, and the average annual leader growth was 1.5 inches (3.9 cm).

Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) was also present at a density of 140 plants/acre (346 plants/ha). Fifty-seven percent of the sampled plants were decadent, and 43% were classified as dying. Wyoming big sagebrush showed heavy use. The two sagebrush species appeared to be hybridizing. Antelope bitterbrush (*Purshia tridentata*) and Gambel oak (*Quercus gambelii*) were also scattered throughout the study, but were not sampled in the density strips.

Pinyon and juniper provided 19% canopy cover in 2007, and some of the sampled trees had been affected by the lop and scatter treatment. From the point-centered quarter data, juniper density was 237 trees/acre (586 trees/ha). The average trunk diameter was 6.5 inches (16.5 cm), and the majority of the sampled trees were 1-8 feet (0.3-2.4 m) tall. The density of trees that were killed in the treatment was 80 trees/acre (198 trees/ha). Pinyon density was 29 trees/acre (72 trees/ha). Average trunk diameter was 2.7 inches (6.9 cm), and most of the sampled trees were 1-8 feet (0.3-2.4 m) tall. Approximately 20% of the live pinyon and juniper trees sampled had been cut in the treatment.

Herbaceous Understory

Total herbaceous cover was 1%, and almost no cover was provided by grasses. Bottlebrush squirreltail (*Sitanion hystrix*), cheatgrass (*Bromus tectorum*), and sixweeks fescue (*Vulpia octoflora*) were the only grasses sampled. Nine forb species were sampled, six of which were perennials. Low penstemon (*Penstemon humilis*) was the most common forb and was sampled in 35% of the quadrats.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. The area was dominated by pinyon-juniper, and the preferred browse component provided very little cover. The herbaceous understory was very sparse. Cheatgrass was sampled, but provided almost no cover. No noxious weeds were sampled.

winter range condition (DCI) - very poor (4) Low potential scale

HERBACEOUS TRENDS --
Management unit 27R, Study no: 19

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bromus tectorum (a)	33	.10
G	Sitanion hystrix	8	.01
G	Vulpia octoflora (a)	9	.01
Total for Annual Grasses		42	0.11
Total for Perennial Grasses		8	0.01
Total for Grasses		50	0.12
F	Caulanthus crassicaulis	2	.00
F	Chaenactis douglasii	3	.03
F	Descurainia pinnata (a)	10	.05
F	Eriogonum umbellatum	1	.00
F	Gilia sp. (a)	4	.01
F	Microsteris gracilis (a)	2	.00
F	Penstemon humilis	99	.91
F	Phlox longifolia	2	.00
F	Trifolium sp.	3	.01
Total for Annual Forbs		16	0.07
Total for Perennial Forbs		110	0.97
Total for Forbs		126	1.04

BROWSE TRENDS --
Management unit 27R, Study no: 19

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia nova	20	1.25
B	Artemisia tridentata wyomingensis	6	.01
B	Juniperus osteosperma	18	3.86
B	Pinus edulis	3	.33
B	Purshia tridentata	0	-
B	Quercus gambelii	0	-
Total for Browse		47	5.46

CANOPY COVER, LINE INTERCEPT --
Management unit 27R, Study no: 19

Species	Percent Cover '07
Artemisia nova	1.56
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
Artemisia nova	1.5

POINT-QUARTER TREE DATA --
Management unit 27R, Study no: 19

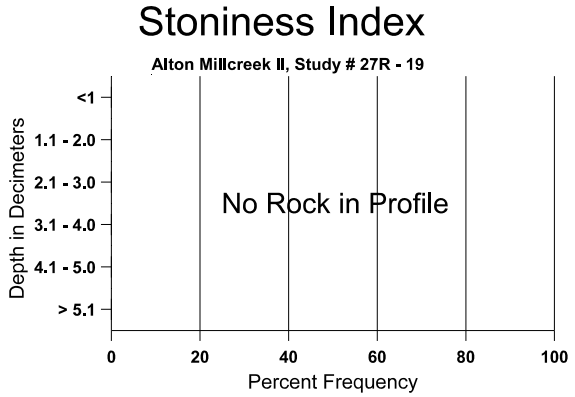
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	237	6.5
Pinus edulis	29	2.7

BASIC COVER --
Management unit 27R, Study no: 19

Cover Type	Average Cover % '07
Vegetation	6.96
Rock	.28
Pavement	.41
Litter	45.48
Cryptogams	3.01
Bare Ground	48.80

SOIL ANALYSIS DATA --
Herd Unit 27R, Study no: 19, Study Name: Alton-Millcreek 2

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
9.6	-	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 '07	Days use per acre (ha) '07
Rabbit	53	-
Elk	1	1 (3)
Deer	2	7 (18)

BROWSE CHARACTERISTICS --
Management unit 27R, Study no: 19

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia nova												
07	**860**	-	-	300	560	500	35	65	65	23	40	11/19
Artemisia tridentata wyomingensis												
07	**140**	-	20	40	80	-	14	86	57	43	43	17/18
Juniperus osteosperma												
07	**460**	80	100	240	120	80	0	26	26	9	30	-/-
Pinus edulis												
07	**60**	40	20	40	-	-	0	0	-	-	33	-/-
Purshia tridentata												
07	**0**	-	-	-	-	-	0	0	-	-	0	15/35
Quercus gambelii												
07	**0**	-	-	-	-	-	0	0	-	-	0	36/31

Trend Study 28R-12-07

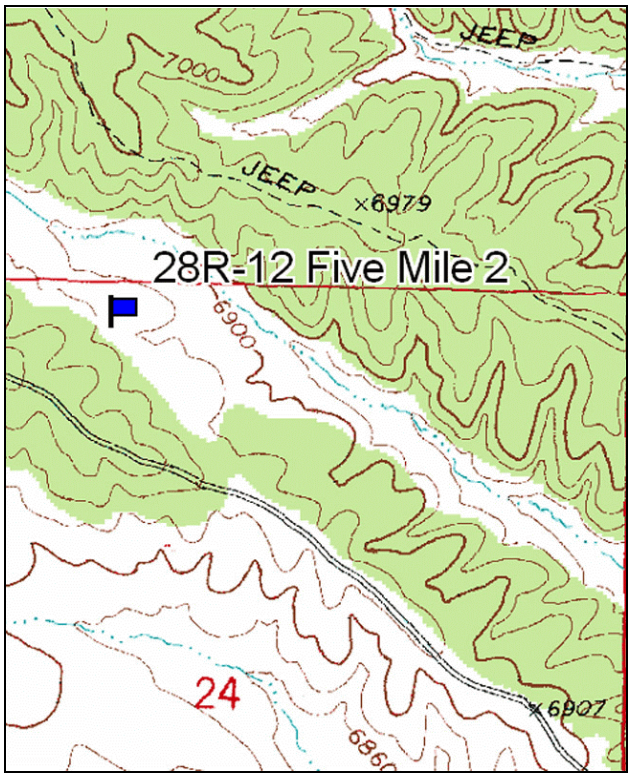
Study site name: Five Mile 2 . Vegetation type: Pinyon-Juniper-Black Sagebrush .

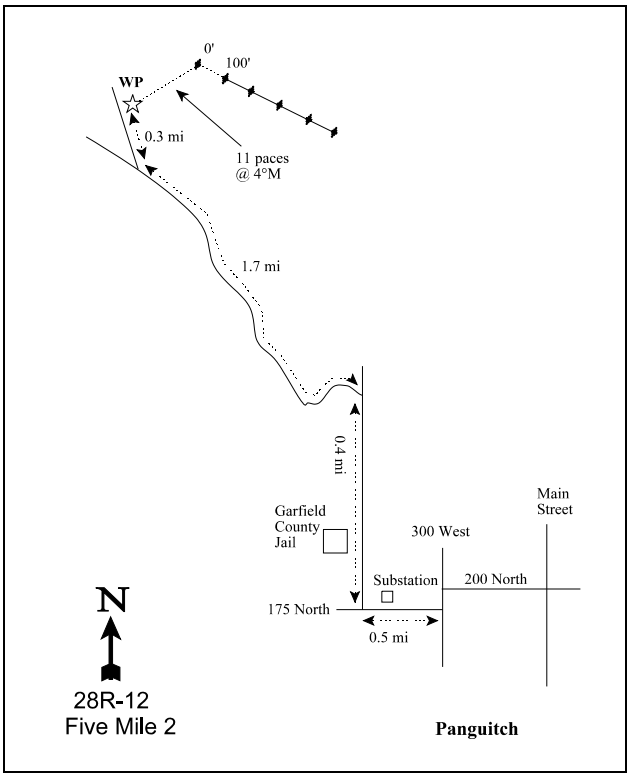
Compass bearing: frequency baseline 97 degrees magnetic.

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

LOCATION DESCRIPTION

From 200 North and Main St. in Panguitch, drive east on 200 North to 300 West. Turn left, heading south to 175 North. Go right (east) 0.5 miles, passing a substation on the right. Go right (north) 0.4 miles, passing the Garfield county jail, to a road to the left. Go left here for 1.7 miles to a fork. Take the right and drive 0.3 miles to a witness post. From the witness post the 0-foot stake is 11 paces at 4 degrees magnetic, and is marked with browse tag #186.





Map name: Panguitch

Diagrammatic Sketch

Township 34S , Range 6W , Section 24

GPS: NAD 83, UTM 12S 369739 E 4189766 N

DISCUSSION

Five Mile 2 - Trend Study No. 28R-12

Study Information

This study was established in 2007 to monitor a pinyon-juniper removal project on BLM land approximately 3 miles (4.8 km) northwest of Panguitch [elevation: 6,940 feet (2,115 m), slope: 4%, aspect: east]. The total project area encompasses 6,700 acres (2,711 ha) of sage-grouse brood-rearing and wintering habitat, as well as critical deer winter range. Encroaching pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees were thinned with a lop and scatter treatment and a bullhog machine. Wildlife use was estimated at 34 deer days use/acre (84 ddu/ha) and 2 elk day use/acre (5 edu/ha). Rabbit pellet quadrat frequency was 86%.

Soil

The soil is classified within the Ipson series (USDA-NRCS 2007). The soils in this series are deep and well-drained, and formed in colluvium and alluvium derived from basic and intermediate igneous rocks. Textural and chemical analyses identified the soil as a sandy clay loam with a slightly acidic reaction (pH 6.5). The soil phosphorus and potassium are both high at 12.5 ppm and 156.8 ppm, respectively (Tiedemann and Lopez 2004). Relative bare ground cover was 31%. Relative vegetation cover was 18%, and relative litter cover was 34%. Relative combined rock and pavement cover was 12%, and cryptogams provided 5% of the relative ground cover. The soil erosion condition was classified as slight due to evidence of soil and litter movement, pedestalling around plants, and the formation of flow patterns and rills.

Browse

Total browse cover was 14% in 2007. The preferred browse component comprised 45% of the total browse cover, and consisted of black sagebrush (*Artemisia nova*) and basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). There appeared to be some hybridization between the two sagebrush species. Black sagebrush density was 2,780 plants/acre (6,869 plants/ha). The population consisted of 2% young plants, 39% mature plants, and 59% decadent plants. Seedlings were sampled at a density of 500 plants/acre (1,235 plants/ha), and the density of dead plants was 1,300 plants/acre (3,212 plants/ha). Forty-two percent of the live plants sampled were classified as dying. Most, if not all, of the plants were infested with the sagebrush defoliator moth (*Aroga websteri*). Approximately half of the population showed light use, and half showed moderate-heavy use. Annual leader growth averaged 2 inches (5.1 cm).

Basin big sagebrush density was 540 plants/acre (1,334 plants/ha). The population was 56% mature, with 41% decadence and 3% young recruitment. Seedling density was 100 plants/acre (247 plants/ha), and the density of dead plants was 680 plants/acre (1,680 plants/ha). Seven percent of the population was classified as dying. Use was light-moderate, and average annual leader growth was 2.4 inches (6 cm).

Pinyon pine provided 17% canopy cover. From the point-centered quarter data, pinyon density was 101 trees/acre (250 trees/ha). Average trunk diameter was 7.4 inches (18.8 cm), and the majority of the sampled trees were greater than 4 feet (1.2 m) in height.

Herbaceous Understory

The understory provided 5% cover, the majority of which was composed of grasses. Blue grama (*Bouteloua gracilis*) was the most abundant grass. Indian ricegrass (*Oryzopsis hymenoides*), bottlebrush squirreltail (*Sitanion hystrix*), and galleta (*Hilaria jamesii*). No annual grasses were sampled. Forbs were very sparse, and provided almost no cover. Tansymustard (*Descurainia pinnata*) and nodding eriogonum (*Eriogonum cernuum*) were the most common forb species.

2007 Pre-treatment Assessment

The winter range condition, determined by the Desirable Components Index (DCI), is poor. The preferred browse component provided little cover. Decadence was high, and young recruitment was low. The understory was sparse and diversity was low. No cheatgrass or noxious weeds were sampled.

winter range condition (DCI) - poor (18) Low potential scale

HERBACEOUS TRENDS --
Management unit 28R, Study no: 12

Type	Species	Nested Frequency '07	Average Cover % '07
G	Bouteloua gracilis	153	5.07
G	Hilaria jamesii	4	.00
G	Oryzopsis hymenoides	7	.07
G	Sitanion hystrix	10	.02
Total for Annual Grasses		0	0
Total for Perennial Grasses		174	5.17
Total for Grasses		174	5.17
F	Descurainia pinnata (a)	16	.04
F	Eriogonum cernuum (a)	9	.02
F	Gayophytum ramosissimum(a)	5	.01
F	Lactuca serriola	2	.00
Total for Annual Forbs		30	0.07
Total for Perennial Forbs		2	0.00
Total for Forbs		32	0.08

BROWSE TRENDS --
Management unit 28R, Study no: 12

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia nova	67	4.70
B	Artemisia tridentata tridentata	20	1.75
B	Gutierrezia sarothrae	8	.04
B	Juniperus osteosperma	1	-
B	Opuntia sp.	1	.00
B	Pinus edulis	9	7.99
Total for Browse		106	14.49

CANOPY COVER, LINE INTERCEPT --
Management unit 28R, Study no: 12

Species	Percent Cover '07
Artemisia nova	4.46
Artemisia tridentata tridentata	1.78
Gutierrezia sarothrae	.06
Pinus edulis	17.29

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 28R, Study no: 12

Species	Average leader growth (in) '07
Artemisia nova	2.0
Artemisia tridentata tridentata	2.4

POINT-QUARTER TREE DATA --
Management unit 28R, Study no: 12

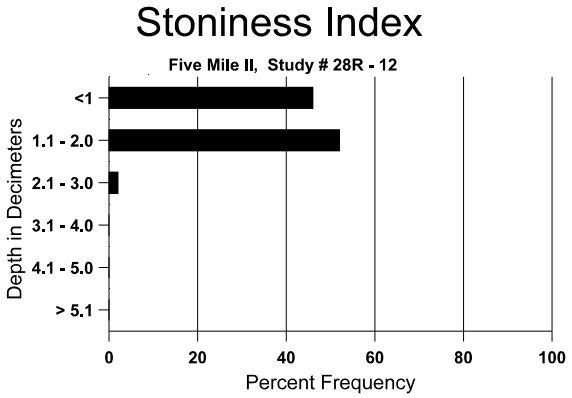
Species	Trees per Acre '07	Average diameter (in) '07
Pinus edulis	101	7.4

BASIC COVER --
Management unit 28R, Study no: 12

Cover Type	Average Cover % '07
Vegetation	20.93
Rock	1.75
Pavement	11.42
Litter	39.67
Cryptogams	5.34
Bare Ground	36.38

SOIL ANALYSIS DATA --
Herd Unit 28R, Study no: 12, Study Name: Five Mile 2

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	ppm P	ppm K	dS/m
6.2	-	6.5	53.4	25.0	21.6	1.7	12.5	156.8	0.4



PELLET GROUP DATA --
Management unit 28R, Study no: 12

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	86	-
Elk	-	2 (5)
Deer	16	34 (84)

BROWSE CHARACTERISTICS --
Management unit 28R, Study no: 12

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
Artemisia nova												
07	**2780**	500	60	1080	1640	1300	22	26	59	42	47	12/19
Artemisia tridentata tridentata												
07	**540**	100	20	300	220	680	26	0	41	7	7	39/43
Gutierrezia sarothrae												
07	**360**	280	280	80	-	-	0	0	-	-	0	3/3
Juniperus osteosperma												
07	**20**	-	20	-	-	-	0	0	-	-	100	-/-
Opuntia sp.												
07	**20**	20	20	-	-	-	0	0	-	-	0	4/10
Pinus edulis												
07	**180**	40	40	140	-	20	0	0	-	-	0	-/-

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