UTAH BIG GAME RANGE TREND STUDIES

2007 Volume 1

Central Region

PUBLICATION NUMBER 08-24
REPORT FOR FEDERAL AID PROJECT W-82-R-52

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

UTAH BIG GAME
RANGE TREND STUDIES
2007 Volume 1

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UTAH DEPARTMENT OF NATURAL RESOURCES
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* indicates study was not read in 2007, because it was suspended, replaced by another study, or was not accessible. Maps, discussions, and tables for these studies are available at http://www.wildlife.utah.gov/range/.

PROGRAM NARRATIVE

State: UTAH Project Number: W-82-R

Grant Title: Wildlife Habitat Research and Monitoring

Project Title: Wildlife Habitat Monitoring/Range Trend Studies

Need:

The ability to detect changes in vegetation composition (range trend) on big game winter ranges is an important part of the Division's big game management program. The health and vigor of big game populations are closely correlated to the quality and quantity of forage in key areas. The majority of the permanent range trend studies will be located on deer and elk winter ranges, however on certain management units, studies will be located on spring and/or summer ranges, if vegetation composition on these ranges is the limiting factor for big game populations. Range trend data are used by wildlife biologists for habitat improvement planning purposes, reviewing BLM and USFS allotment management plans, and as one of several sources of information for revising deer and elk herd unit management plans.

Objective:

Monitor, evaluate, and report range trend at designated key areas throughout the state, and inform Division biologists, public land managers and private landowners of significant changes in plant community composition in these areas.

Expected Results or Benefits:

Range trend studies in each region will be reread every five years, and vegetation condition and trend assessments will be made for key areas. DWR biologists, land management personnel from the USFS and BLM, and private landowners will use the range trend database to evaluate the impact of land management programs on big game habitat. Annual reports will be readily available on the Division's website, on CDs, and in hard copies located in DWR regional offices, BLM and USFS offices, and public libraries. Special studies (habitat project monitoring and big game/livestock forage utilization studies) will give DWR biologists and public land managers additional information to address local resource management problems.

REMARKS

The work completed during the 2007 field season and reported in this publication involves the reading of interagency range trend studies in the DWR Central Region. Trend studies surveyed in these management units were established in 1983, 1984, 2002, and 2007, with rereads in 1989, 1990, 1996, 1997, 1999, 2002, and 2007.

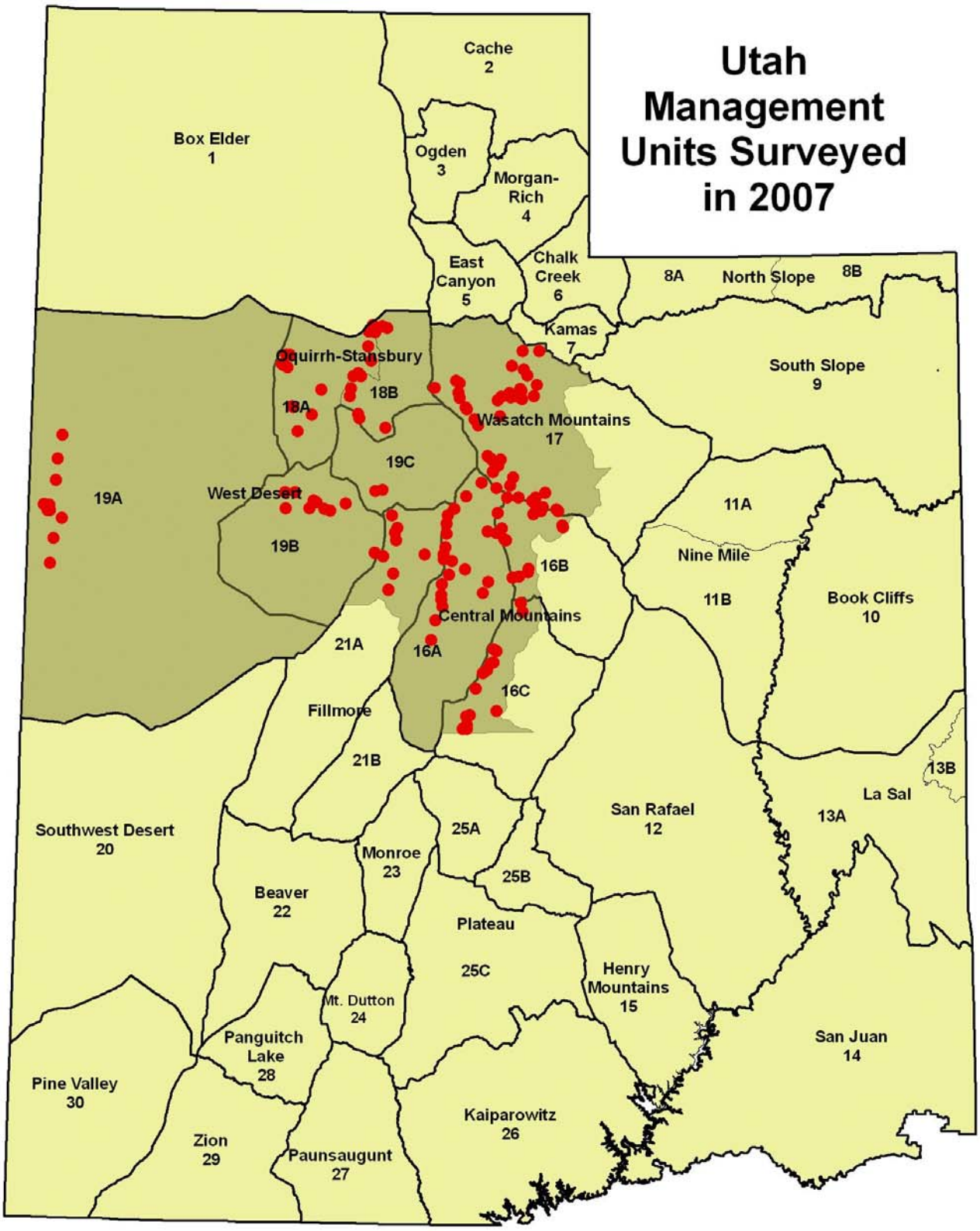
The following Bureau of Land Management and U.S. Forest Service offices provided information and/or assistance in completion of the trend studies which add to the value of this interagency report:

Bureau of Land Management Salt Lake Field Office

Uinta National Forest
- Pleasant Grove Ranger District
- Spanish Fork Ranger District

Manti-La Sal National Forest
- Sanpete Ranger District

Private landowners were cooperative in allowing access to study sites located on their land.


Utah
Management
Units Surveyed
in 2007
Box Elder
1
Cache
2
Ogden
3
Morgan-
Rich
4
East
Canyon
5
Chalk
Creek
6
Kamas
7
8A
North Slope
8B
South Slope
9
Oquirrh-Stansbury
18B
18A
Wasatch Mountains
17
19C
19A
West Desert
19B
11A
Nine Mile
11B
16B
Book Cliffs
10
Central Mountains
16A
21A
16C
Fillmore
21B
13B
La Sal
13A
San Rafael
12
Southwest Desert
20
25A
Monroe
23
25B
Beaver
22
Plateau
25C
Henry
Mountains
15
Mt. Dutton
24
San Juan
14
Panguitch
Lake
28
Pine Valley
30
Kaiparowitz
26
Zion
29
Paunsaugunt
27

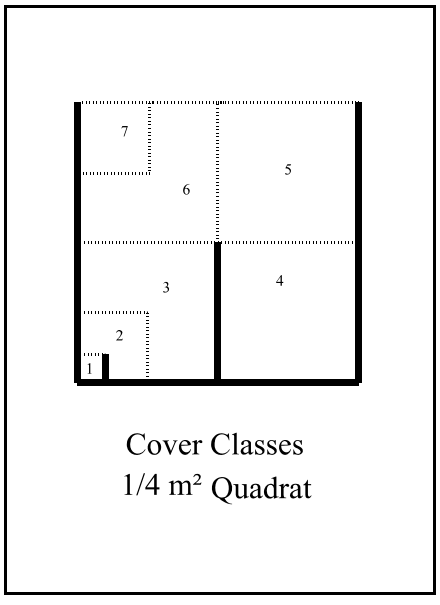
RANGE TREND STUDY METHODS

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.

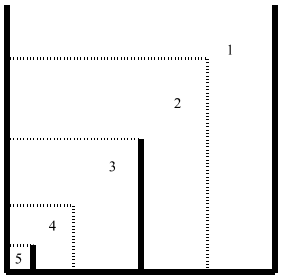
Cover is determined using an ocular cover estimation procedure using 7 cover classes (Bailey and Poulton, 1968, Daubenmire 1969). The seven cover classes are: 1) .01-1%, 2) 1.1-5%, 3) 5.1-25%, 4) 25.1-50%, 5) 50.1-75%, 6) 75.1-95%, and 7) 95.1-100%. For example, to estimate vegetative cover with this 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.



Cover Classes
1/4 m^2 Quadrat

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.



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 and composition through time. Nested frequency has been found to be a more sensitive measurement for changes taking place within plant communities than quadrat frequency (Smith et al. 1987, Smith et al. 1986, Mosley et al. 1986). Plant cover and density values are not reliable indicators of trend for herbaceous species and can fluctuate greatly with precipitation and time of season sampled. Therefore, plant cover and density values can be misleading if used 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 or high densities. Therefore, beginning in mid-1992, each 1/100th acre shrub strip is divided into 20, five foot segments. To give a more accurate measure of shrub frequency, presence or absence of shrub species is determined within these strip segments, and this measurement is termed strip frequency. For example, if a species was rooted in 25 of the 100 shrub strips, strip frequency for this species would be 25%. This larger sample will better reflect changing trends in shrub populations. This data along with shrub cover is recorded in the "Browse Trends" table.

TREND DETERMINATION

The methods described above rely on relative and absolute measurements of plant composition as determined from the frequency, cover, and density data. In addition, estimates of plant vigor, average height and crown diameter, form class, and age class are utilized to characterize shrub populations. 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 more accurately estimate canopy cover of trees and shrubs, the line-intercept method is used along each 100 foot belt. This data is reported in the "Canopy Cover, Line Intercept" table. For example, 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		Average diameter (in)	
	'98	'03	'98	'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, 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:

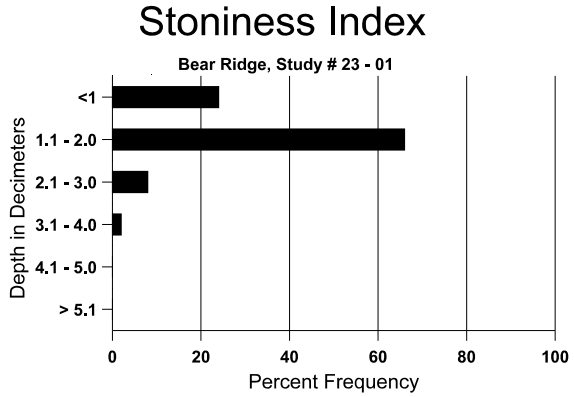
Ultra acid	< 3.5
Extremely acid	3.5-4.4
Very strongly acid	4.5-5.0
Strongly acid	5.1-5.5
Moderately acid	5.6-6.0
Slightly acid	6.1-6.5
Neutral	6.6-7.3
Slightly alkaline	7.4-7.8
Moderately alkaline	7.9-8.4
Strongly alkaline	8.5-9.0
Very strongly alkaline	> 9.1

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.



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 has 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 deer 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).

<u>Desirable Components Index Ratings</u>

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).

<u>Desirable Components Index Scoring</u>

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.

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REPORT FORMAT

An introductory segment at the beginning of each wildlife management unit categorizes the trend studies and provide references to further information on winter range limits, land ownership patterns, livestock management practices, and management unit objectives.

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

A discussion of the study site includes descriptions of the site's physical characteristics (elevation, slope, aspect), soil, ground cover, vegetative community, and species composition. The trend assessment is based upon the comparison of the recent year and the previous years data. Additional assessment is made by comparing photographs from year to year.

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

Summaries and evaluations at the end of each management unit address range trends in these key areas. This report will serve to identify and verify changes that are occurring on key areas for big game.

WILDLIFE MANAGEMENT UNIT - 16 - MANTI-NEBO

Boundary Description

Utah, Carbon, Emery, Juab, Sevier and Sanpete counties - Boundary begins at the junction of US-6 and I-15 in Spanish Fork; southeast on US-6 to Price and SR-10; south on SR-10 to I-70; west on I-70 to US-89; north on US-89 to SR-28 at Gunnison; north on SR-28 to I-15 at Nephi; north on I-15 to US-6 in Spanish Fork and beginning point.

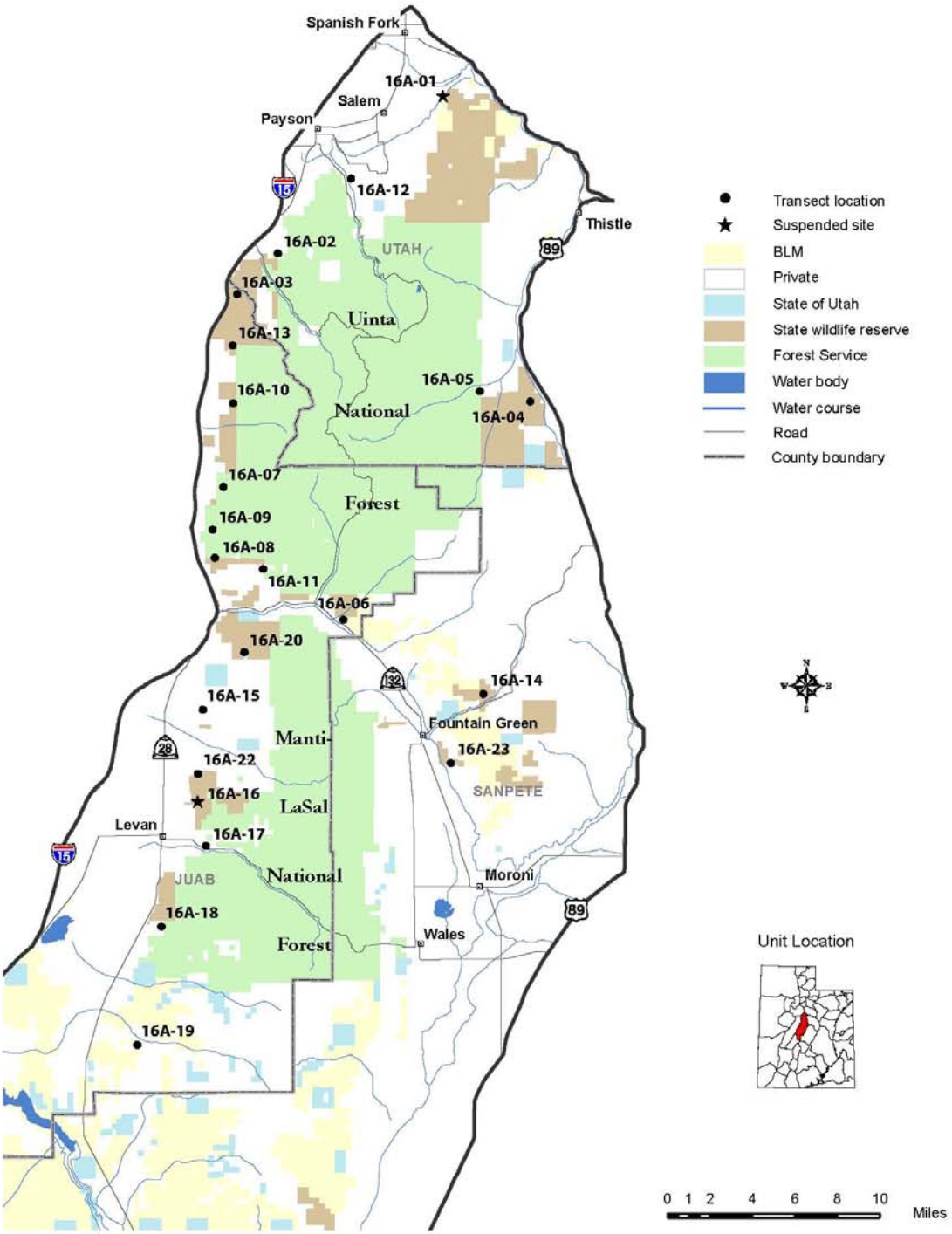
The Manti-Nebo wildlife management unit incorporates a total area of almost 2,250,000 acres. For deer, 47% is winter range, 46% summer range, and 7% is considered year-long range. The majority of the summer range is on U.S. Forest lands (72%), while as much as 35% of the winter range is on private lands. For elk, 36% is winter range, 40% summer range, and 24% is classified as year-long range. Again, the majority of the summer range is on U.S. Forest lands (78%), while as much as 28% of the winter range is on private lands. The one aspect of elk range that could emerge as a problem is that 64% of the year-long range is on private property.

This unit has been subdivided into 3 subunits, 16A - Nebo, 16B - Manti North, and 16C - Manti South. Each subunit will be discussed separately in this report. Due to logistic problems, the portion of subunits 16B and 16C that lie west of the Wasatch Plateau are read with the Central Region, while the portions east of the Wasatch Plateau are read with the Southeast Region.

Big Game Management

Unit management goals for deer are to achieve a target population size of 60,600 deer; 38,000 wintering deer on the Wasatch Plateau or Manti Mountain portion of the unit, and 22,600 on the Nebo portion (Hersey and McLaughlin 2006). The management objective for post season buck to doe ratio is 15 to 100 with 30% of these bucks being three point or better. The target winter herd size for elk on the unit is 1,450 for the North Nebo area and 12,000 for the Wasatch Plateau. Management objectives for the herd composition are to attain a minimum bull to cow ratio of 8 bulls to 100 cows with a minimum of 4 mature bulls to 100 cows.

Management Unit 16A



MANAGEMENT SUBUNIT 16A - NEBO

Subunit Boundary Description

Utah, Juab, and Sanpete Counties - Boundary begins at the junction of I-15 and US-6 in Spanish Fork; southeast on US-6 to US-89 at Thistle Junction; south on US-89 to Gunnison and SR-28; north along SR-28 to I-15 at Nephi; north along I-15 to US-6 in Spanish Fork.

Range Trend Studies

Fifteen studies were originally established in the subunit in 1983. Six studies were added in 1989, and two were added in 2007. Three have been suspended over the years. A total of 21 sites were sampled in 2007.

Management Unit Description

This management subunit incorporates most of the old North and South Nebo deer herd units. The old North Nebo deer herd unit included about 490,240 acres (198,400 ha). Physiographically, the unit was dominated by high mountains such as Santaquin Peak, Bald Mountain, and Mount Nebo. Mount Nebo represents the southernmost extension of the Wasatch Range. These mountains constitute the heart of a diverse and productive summer range, making up about 29% of the unit. Normal winter range constitutes approximately 32% of the area. The Mount Nebo summer range has a long history of high hunting success and depredation problems, a growing elk herd, and limited winter range.

The principal limiting factor and management concern in the old North Nebo unit is the lack of good-condition winter range, especially severe winter range on the west side of the unit. In this area, from Spanish Fork Canyon south to Nephi, the normal winter range averages 2 miles (3.2 km) or less in width. Severe winter range is even more narrow, ranging from as narrow as a few hundred yards, up to 1.5 miles (2.4 km). Total severe winter range accounts for only about 12% of the area. However, the winter range on the east and south sides of the unit is more expansive, and not nearly as critical. Some of the major problems related to the limited winter range on the unit, especially low elevation severe winter range, include: restricted access to traditional wintering areas west of I-15, predominately private ownership of critical ranges (63% of normal winter range), and agricultural depredation. To remedy the situation, the Utah Division of Wildlife Resources (UDWR) has acquired approximately 12,800 acres (5,180 ha) of winter range in the unit (7% of winter range) and has attempted treatments and rehabilitation in these critical areas. This unit remains one of the top deer herd units requiring winter habitat revegetation action. The available winter range, especially critical areas on the west side of the unit, remains threatened by development, mismanagement, and a high fire hazard from cheatgrass.

The key areas identified and sampled with 12 trend studies in 1983 are still priority areas. Three new studies were added in 1989. The majority of the studies are on UDWR land. However, much of the critical range is under private ownership and was not sampled due to restricted access and limited management opportunities. The 15 permanently-marked trend studies originally sampled in early August 1983 were resampled in mid-July of the drier year of 1989, and in late May of 1997, 2002, and 2007. All sample big game winter range areas, although many sites had some evidence of summer deer occupancy. The studies range in elevation from approximately 5,400 feet (1,646 m) to 6,500 feet (1,981 m). The prominent winter range vegetation types that were sampled include: mixed oak/big sagebrush, sagebrush/grass, mountain brush, bitterbrush, and cliffrose.

The San Pitch Mountains make up the majority of the old South Nebo herd unit. This low mountain range contains all of the summer range on the unit and 40% of the area. The surrounding foothills and western slopes provide winter range that makes up the remaining 60% of the range. The upper limit of the winter range is approximately 7,000 feet (2,134 m) in elevation, but extends to 8,000 feet (2,438 m) on the south exposures in canyons on the west side of the unit. Twenty-five percent of the winter range was classified as severe winter range in the 1976 range inventory. The upper limit of severe winter range is 6,000 feet (1,829 m), while the lower limit (5,200 feet or 1,585 m) of the winter range is restricted by highways, reservoirs,

agriculture, and small communities.

The Division has acquired several parcels of land totaling 7,200 acres (2,914 m), or 5% of the winter range. Further habitat acquisition and rehabilitation are necessary to adequately maintain the winter range. This unit has been one of the most important deer herd units for future winter range land purchases.

In 1983, four of the permanent range trend studies were established on severe winter range in the old South Nebo unit. Their elevation ranged from 5,520 feet (1,682 m) to 6,000 feet (1,829 m). Two chained areas were also sampled. One study is in a cliffrose type, the other in a mountain brush community. These studies were initially read in mid-August 1983. They were reread in mid-July 1989, then again in late May and early June of 1997, 2002, and 2007. Three studies were established in 1989 and reread in 1997, 2002, and 2007. Two new studies were established in June and July of 2007.

Trend Study 16A-2-07

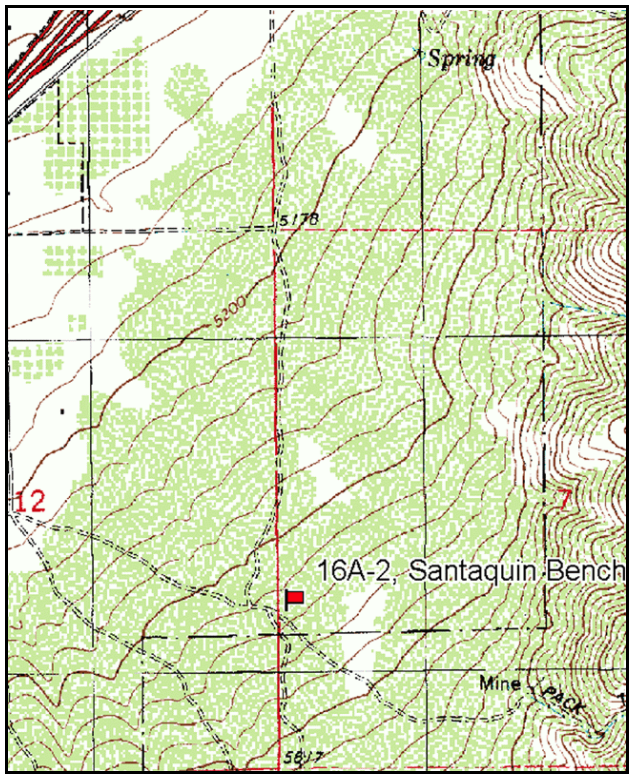
Study site name: Santaquin Bench . Vegetation type: Mixed Oak-Sage .

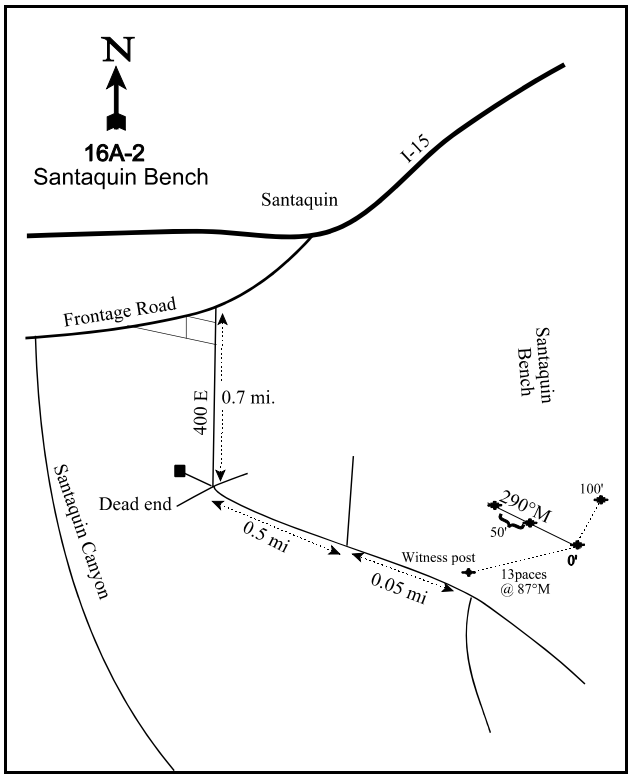
Compass bearing: frequency baseline 28 degrees magnetic (lines 2-3 @ 290°M).

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

LOCATION DESCRIPTION

From the I-15 interchange on the east side of Santaquin, proceed southwest on the frontage road (Highland Drive) for a short distance to where there are several forks. Turn left on 400 East which turns due south and passes through some orchards and home sites. Travel 0.7 miles to where the road forks at the end of a maintained road. Turn immediately to the left (east) and travel 0.50 miles to a fork in the road. Stop just beyond the fork at the witness post on the left. The 0-foot baseline stake is located 13 paces from the witness post at an azimuth of 87°M. The study markers are green steel fenceposts approximately 12 to 18 inches in height. The 0-foot baseline stake is marked by browse tag #3929. The last baseline is only 50 feet long.





Map Name: Santaquin

Township 10S , Range 2E , Section 7

Diagrammatic Sketch

GPS: NAD 83, UTM 12S 434518 E 4423386 N

DISCUSSION

Santaquin Bench - Trend Study No. 16A-2

Study Information

This study is located on deer and elk winter range on the Santaquin Bench within the Uinta National Forest [elevation: 5,480 feet (1,670 m), slope: 7%, aspect: northwest]. The entire area burned in 2001 as part of the Molly fire. Prior to 2001, the dominant overstory consisted of Gambel oak (*Quercus gambelii*) and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), with scattered Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), antelope bitterbrush (*Purshia tridentata*), and Utah juniper (*Juniperus osteosperma*). Deer and elk pellet groups were common in 1983, but few were found in 1997 and 2002. A pellet group transect read in 2002 estimated only 1 deer day use/acre (3 ddu/ha). Use increased in 2007 to 9 deer days use/acre (22 ddu/ha) and 17 elk days use/acre (41 edu/ha).

Soil

The soil is classified within the Dry Creek series (USDA-NRCS 2007). The soils in this series formed in alluvium and colluvium from sedimentary rocks, and are deep and well-drained. The soil texture is a cobbly loam in the surface horizons and is slightly acidic (pH 6.0). Prior to 2001, the soil surface was well-protected by abundant litter under the oak clones and by grass and litter cover in the openings. Relative bare ground cover increased from 2% in 1997 to 50% in 2002 following the fire, but decreased to 3% by 2007. The soil erosion condition was classified as stable in 2002 and 2007.

Browse

Before the study burned, the preferred browse species was sagebrush, although Gambel oak accounted for half of the shrub cover. The oak formed relatively dense clumps of variable height, and some of the forage was physically unavailable due to height and/or density. The age structure was indicative of an expanding population with many young plants, especially near the edges of the clones. Vigor had been depressed in the past due to worm infestations, which severely defoliated the oak. Forty-one percent of the oak sampled in 1997 was impacted by these insects. All of the oak was burned in the 2001 fire. Burned stems were left standing with abundant young shoots sprouting. Density of resprouting oak was estimated at 7,960 stems/acre (19,669 stems/ha) in 2002 and 13,560 stems/acre (33,506 stems/ha) in 2007. The population was mostly mature in 2007 with good vigor, although the plants were noted to have a substantial amount of galls. Use has been light throughout the study.

The mountain big sagebrush population occupied the oak interspaces. Between 1983 and 1989, sagebrush density declined from 1,266 plants/acre (3,127 plants/ha) to 799 plants/acre (1,974 plants/ha). Decadence increased from 26% to 42% of the population, and reproduction and recruitment were limited. Use remained mostly light during these years, so the decline was most likely due to oak competition combined with drought in 1989 (Utah Climate Summaries 2007). When the study area was lengthened in 1997, the extended baseline was placed in more open areas to better sample the sagebrush population. As a result, density estimates were significantly larger compared to previous years. In 1997, sagebrush accounted for 47% of the shrub cover with a density of 2,540 plants/acre (6,276 plants/ha). Seventy-four percent of the population was mature, and decadence was relatively low at 16%. The fire in 2001 eliminated all of the sagebrush plants. Only one seedling was sampled in 2002. In 2007, sagebrush density was estimated at 80 plants/acre (198 plants/ha), and all of the sampled plants were mature. Vigor was good and 75% of these plants exhibited heavy use.

Herbaceous Understory

In 1997, total grass cover was nearly 20%. Abundance and composition varied greatly between the oakbrush and sagebrush dominated openings. Under the oak canopy, Kentucky bluegrass (*Poa pratensis*) was the most abundant herbaceous plant. In contrast, bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass (*Poa secunda*) were dominant under sagebrush. Annual grasses accounted for only 2% of the herbaceous

understory. After the fire, grass cover decreased to 5% in 2002, then increased to 34% in 2007 after a seeding treatment. Four perennial grasses that were not present before the fire were sampled in 2007, including intermediate wheatgrass (*Agropyron intermedium*), smooth brome (*Bromus inermis*), and Great Basin wildrye (*Elymus cinereus*), which were seeded. In 2007, bulbous bluegrass (*Poa bulbosa*) provided the majority of the grass cover, followed by intermediate wheatgrass and bluebunch wheatgrass. Cheatgrass (*Bromus tectorum*) provided 2% cover in 2007. Jointed goatgrass (*Aegilops cylindrica*), a noxious weed, was also sampled in 2007.

Forbs provided 16% cover in 1997. Bedstraw (*Galium aparine*) and Bonneville pea (*Lathyrus brachycalyx*) provided the majority of the forb cover. In 2002, total forb cover decreased to 10%, although the number of species sampled remained stable. Forbs increased to 13% cover by 2007, with bedstraw and Bonneville pea continuing to be the dominant species. Use of the herbaceous understory appeared light.

1989 TREND ASSESSMENT

The trend for browse is down. The sagebrush openings appeared to be becoming smaller and the plants on the edges were declining in vigor due to shading and competition. The density of oak increased from 4,866 plants/acre (12,024 plants/ha) to 11,799 plants/acre (29,155 plants/ha). Sagebrush density decreased from 1,266 plants/acre (3,128 plants/ha) to 799 plants/acre (1,974 plants/ha). Only mature and decadent plants were sampled, and decadence increased from 26% to 42% of the population. The plants appeared to be lightly hedged. The trend for grass is up. The sum of nested frequency for perennial grasses increased by 20%. Kentucky bluegrass, an increaser, increased significantly in nested frequency, while Sandberg bluegrass decreased significantly. The trend for forbs is up. The sum of nested frequency for perennial forbs doubled, due to a large increase in the nested frequency of Bonneville pea.

browse - down (-2) grass - up (+2) forb - up (+2)

1997 TREND ASSESSMENT

The trend for browse is slightly up. Sagebrush density increased from 799 plants/acre (1,974 plants/ha) to 2,540 plants/acre (6,274 plants/ha), but the increase in sampling area was likely responsible for this change. Decadence declined from 42% to 16% of the population, and 10% of the sampled plants were young. Vigor slightly improved and use increased to light-moderate. The trend for grass is stable. The sum of nested frequency for perennial grasses changed very little. Kentucky bluegrass continued to increase in nested frequency, while Sandberg bluegrass continued to decrease. The trend for forbs is up. The sum of nested frequency for perennial forbs increased 33%. Eight perennial species that were not present in 1989 were sampled in 1997. The Desirable Components Index (DCI) was rated as excellent due to favorable browse and perennial herbaceous cover, and low annual grass cover.

winter range condition (DCI) - excellent (88) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is down. The study burned in the summer of 2001, eliminating the sagebrush population and reducing the total browse cover from 23% to 3%. One seedling sagebrush plant was sampled in 2002. Oak resprouted at a density of 7,960 plants/acre (19,669 plants/ha), and the entire population was made up of young, vigorous plants. However, oak is less desirable for wintering big game than sagebrush. The trend for grass is down. The sum of nested frequency for perennial grasses decreased by 51%, with significant decreases in Kentucky bluegrass and bluebunch wheatgrass nested frequency. Total grass cover declined from 20% to 5%. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased 19%. Total forb cover decreased from 16% to 10% and several species declined significantly in nested frequency. However, the majority of the species that were sampled in 1997 returned after the fire. The DCI was rated as very poor, due to the loss of preferred browse and herbaceous cover following the fire.

winter range condition (DCI) - very poor (22) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - slightly down (-1)

2007 TREND ASSESSMENT

The trend for browse is stable, although the sagebrush population did not recover from the fire as quickly as the less-preferred oak. Only 80 sagebrush plants/acre (198 plants/ha) were sampled in 2007, and all were mature and vigorous. Most of the plants displayed heavy use. Oak density continued to increase from 7,960 plants/acre (19,669 plants/ha) to 13,560 plants/acre (33,506 plants/ha). The population was largely mature, with no decadent plants sampled. The trend for grass is slightly up. Four perennial grass species were sampled for the first time, and there was a significant increase in the nested frequency of bluebunch wheatgrass. However, two undesirable species, cheatgrass and bulbous bluegrass, also increased significantly. Additionally, jointed goatgrass, a noxious weed, was sampled in two quadrats. Total grass cover increased from 5% to 34%. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little. Total forb cover increased from 10% to 13%, and the species composition remained similar to that before the fire. The DCI rating improved to good due to the resprouting of the oak population and the recovering understory of perennial grasses and forbs, despite increasing annual grass cover and the presence of a noxious weed.

winter range condition (DCI) - good (73) Mid-level potential scale
browse - stable (0) grass - slightly up (+1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 2

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Aegilops cylindrica (a)	-	-	-	-	7	-	-	.06
G	Agropyron intermedium	-	-	-	-	170	-	-	6.56
G	Agropyron spicatum	ab89	bc126	c136	a86	bc119	6.75	2.00	5.78
G	Bromus brizaeformis (a)	-	-	-	-	5	-	-	.01
G	Bromus inermis	-	-	-	-	28	-	-	.63
G	Bromus japonicus (a)	-	-	-	-	208	-	-	3.39
G	Bromus tectorum (a)	-	-	a50	a56	b162	.30	.23	2.32
G	Elymus cinereus	-	-	-	-	2	-	-	.15
G	Festuca myuros (a)	-	-	a3	a1	-	.00	.00	-
G	Poa bulbosa	-	-	a30	a21	b193	.96	.32	13.27
G	Poa fendleriana	-	-	a6	-	a1	.18	-	.00
G	Poa pratensis	a52	b124	c202	a71	a39	10.03	2.16	.95
G	Poa secunda	c167	b127	a63	a43	a43	1.23	.43	.90
G	Sitanion hystrix	a26	a24	-	-	-	-	-	-
G	Unknown grass - annual (a)	-	-	47	-	-	.39	-	-
Total for Annual Grasses		0	0	100	57	382	0.69	0.23	5.78
Total for Perennial Grasses		334	401	437	221	595	19.16	4.91	28.26
Total for Grasses		334	401	537	278	977	19.86	5.15	34.05

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Alyssum alyssoides (a)	-	-	a46	a32	b147	.12	.09	.79
F	Allium sp.	ab22	b46	c81	c90	a12	.30	.30	.03
F	Antennaria sp.	-	a3	a2	a1	-	.00	.00	-
F	Arabis sp.	-	-	4	-	-	.01	-	-
F	Astragalus cibarius	-	-	-	-	10	-	-	.31
F	Aster sp.	-	-	4	-	-	.01	-	-
F	Astragalus sp.	-	-	a6	-	a3	.07	-	.00
F	Cirsium sp.	a1	a2	a8	a6	a-	.23	.01	.15
F	Collomia linearis (a)	4	-	-	-	-	-	-	-
F	Collinsia parviflora (a)	-	-	a103	b158	a84	.35	1.15	.26
F	Cymopterus sp.	a7	a5	b30	a5	a7	.12	.04	.04
F	Descurainia pinnata (a)	-	-	a3	a1	a-	.00	.00	.00
F	Draba sp. (a)	-	-	a16	-	b30	.03	-	.10
F	Epilobium brachycarpum (a)	-	-	c84	a3	b38	.30	.01	.17
F	Erodium cicutarium (a)	-	-	-	-	5	-	-	.04
F	Eriogonum racemosum	ab15	b20	a6	a3	ab7	.01	.01	.10
F	Eriogonum umbellatum	b22	a2	a8	a-	-	.04	-	-
F	Galium aparine (a)	-	-	b192	a87	a83	5.72	.89	3.71
F	Geranium sp.	-	-	2	-	-	.00	-	-
F	Holosteum umbellatum (a)	-	-	a7	a4	b134	.02	.01	.51
F	Hymenoxys acaulis	-	-	-	8	-	-	.45	-
F	Hydrophyllum capitatum	-	a1	-	-	a4	-	-	.03
F	Lathyrus brachycalyx	a43	cd157	d153	bc120	b104	7.55	6.11	3.86
F	Lappula occidentalis (a)	-	-	-	a2	a5	-	.03	.15
F	Lactuca serriola	-	-	a3	a1	a8	.00	.00	.02
F	Medicago sativa	-	-	-	-	2	-	-	.21
F	Microsteris gracilis (a)	-	-	b29	a6	b31	.11	.04	.09
F	Montia perfoliata (a)	-	-	-	-	40	-	-	1.22
F	Phlox longifolia	a9	a19	a25	ab25	b50	.13	.15	.24
F	Polygonum douglasii (a)	-	-	a18	b83	a36	.03	.31	.10
F	Ranunculus testiculatus (a)	-	-	a56	a38	a47	.19	.11	.10
F	Sisymbrium altissimum (a)	-	-	-	-	3	-	-	.00
F	Solidago sp.	-	-	-	13	-	-	.02	-
F	Taraxacum officinale	-	-	-	-	-	-	.00	-
F	Tragopogon dubius	-	a3	a12	a7	b39	.67	.04	.70
F	Trifolium sp.	-	-	-	1	1	-	.00	.03

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Unknown forb-annual (a)	-	-	63	-	-	.31	-	-
F	Viola sp.	-	-	-	-	2	-	-	.00
F	Wyethia amplexicaulis	-	-	-	-	3	-	-	.03
F	Zigadenus paniculatus	$_a$2	$_a$4	$_a$5	$_a$3	$_a$4	.06	.06	.03
Total for Annual Forbs		4	0	617	414	683	7.21	2.66	7.29
Total for Perennial Forbs		121	262	349	283	256	9.25	7.25	5.82
Total for Forbs		125	262	966	697	939	16.46	9.92	13.11

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

BROWSE TRENDS --
Management unit 16A, Study no: 2

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	71	0	4	10.86	.01	-
B	Gutierrezia sarothrae	3	0	0	.56	-	-
B	Quercus gambelii	48	52	52	11.56	2.68	21.59
Total for Browse		122	52	56	22.99	2.69	21.59

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 2

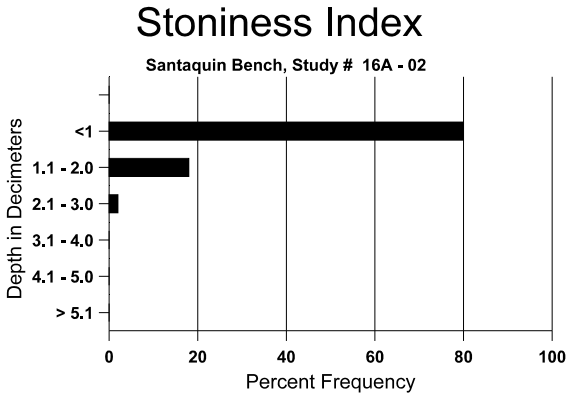
Species	Percent Cover	
	'02	'07
Quercus gambelii	-	35.70

BASIC COVER --
Management unit 16A, Study no: 2

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	1.25	3.25	54.34	18.60	67.33
Rock	2.25	3.75	3.68	4.94	2.91
Pavement	.25	2.00	1.83	12.90	.81
Litter	91.75	81.75	67.93	19.62	49.53
Cryptogams	.25	2.25	.23	.03	.19
Bare Ground	4.25	7.00	2.00	55.59	3.16

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 02, Santaquin Bench

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.5	46.5 (16.7)	6.0	46.4	29.1	24.6	3.9	20.2	211.2	.7



PELLET GROUP DATA --
Management unit 16A, Study no: 2

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	-	11
Elk	1	1	2
Deer	7	2	3

Days use per acre (ha)	
'02	'07
-	-
-	17 (41)
1 (3)	9 (22)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 vaseyana												
83	**1266**	-	133	800	333	-	26	5	26	-	21	21/21
89	**799**	66	-	466	333	-	8	0	42	17	17	22/28
97	**2540**	-	260	1880	400	860	28	4	16	11	11	27/39
02	**0**	20	-	-	-	320	0	0	0	-	0	-/-
07	**80**	-	-	80	-	-	0	75	0	-	0	12/14

		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												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**133**	-	-	133	-	-	0	0	0	-	0	7/9
97	**80**	-	20	40	20	-	0	0	25	25	25	9/12
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	-/-
Quercus gambelii												
83	**4866**	1866	1800	3000	66	-	3	0	1	-	1	66/39
89	**11799**	1466	8800	2666	333	-	0	0	3	.16	.56	120/39
97	**5100**	280	1660	3400	40	520	5	2	1	-	0	69/46
02	**7960**	-	7960	-	-	200	0	3	0	-	0	7/9
07	**13560**	340	800	12760	-	160	0	0	0	-	0	45/26

Trend Study 16A-3-07

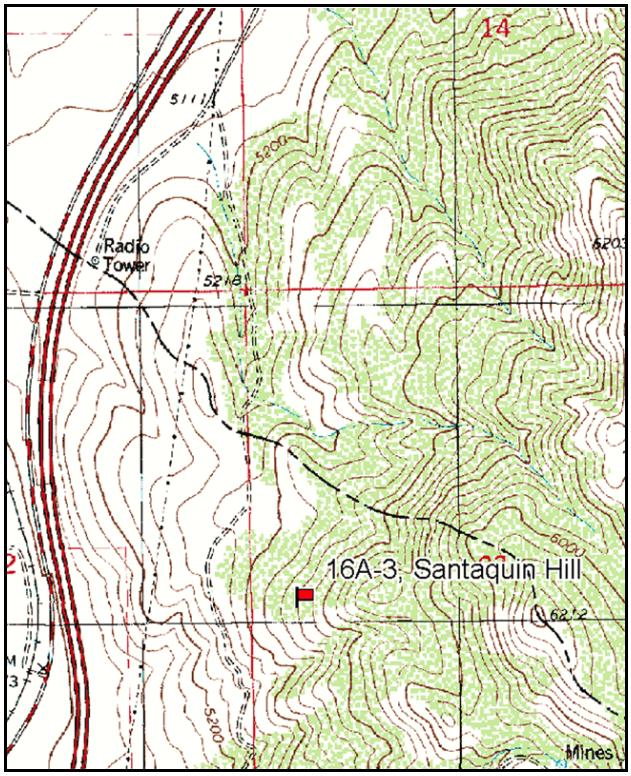
Study site name: Santaquin Hill . Vegetation type: Mixed Oak-Sage .

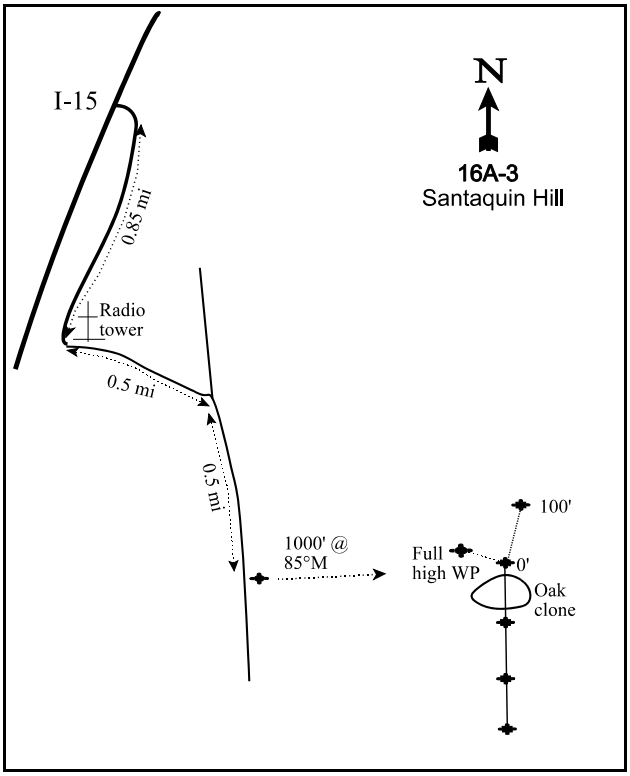
Compass bearing: frequency baseline 350 degrees magnetic (lines 2-4 @ 143°M).

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

LOCATION DESCRIPTION

From the south Santaquin exit on I-15, proceed easterly under the overpass and then southerly onto the frontage road for 0.85 miles to the radio tower. Proceed over the ridge to the east of the radio tower on a faint road for 0.5 miles to an intersection with a dirt road. Proceed south for 0.5 miles to a half high witness post on the east side of the road. From the witness post, walk 1,000 feet at 85 degrees magnetic up the ridge to a full high witness post. The 0-foot baseline stake is 20 feet south of the witness post. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height. A red browse tag, #3967, is attached to the 0-foot baseline stake.





Map Name: Santaquin

Diagrammatic Sketch

Township 10S , Range 1E , Section 22

GPS: NAD 83, UTM 12S 431422 E 4420247 N

DISCUSSION

Santaquin Hill - Trend Study No. 16A-3

Study Information

This study is located on critical deer and elk winter range on UDWR property. It is close to the boundary between Juab and Utah Counties near the top of Santaquin Hill [elevation: 5,500 feet (1,676 m), slope: 25%, aspect: west]. The plant community is a mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) grassland with interspersed Gambel oak (*Quercus gambelii*). Considerable evidence of deer and elk use in the form of pellet groups, antler drops, and forage use was apparent in 1983. Pellet group data from 1997, 2002, and 2007 estimated increasing deer use with quadrat frequencies of 22%, 33%, and 52%, respectively. Transect data estimated 112 deer days use/acre (276 ddu/ha) in 2002 and 139 deer days use/acre (342 ddu/ha) in 2007. Several deer were observed as the site was read in 2007. Most pellets were from the winter, but some were noted from spring and fall use.

Soil

The soil is classified within the Reebok series (USDA-NRCS 2007). The soils in this series are shallow and well-drained. They formed in alluvium and colluvium weathered from latite, andesite and rhyolite, quartzite, and limestone. The soil texture is a clay loam with a neutral pH (6.8). There is also a thick lime hardpan beginning approximately 13 inches (33 cm) below the surface. Protective ground cover appeared adequate to prevent serious erosion. The erosion condition classification was determined to be stable in 2002 and 2007.

Browse

The browse component consists mainly of mountain big sagebrush and Gambel oak. Sagebrush accounts for the majority of the shrub cover. Density has been relatively stable since 1983 between 2,732 plants/acre (6,748 plants/ha) and 3,199 plants/acre (7,902 plants/ha), and the population has consisted of mostly mature and decadent plants. Approximately 25% of the population was classified as dying in 2002 and 2007, and 26% of the population displayed poor vigor. Use was mostly light-moderate until 2002 and 2007, when the majority of the plants showed moderate-heavy use. Annual leader growth averaged 1.7 inches (4.3 cm) in 2002 and 2.2 inches (5.6 cm) in 2007.

Oak has provided between 35% and 42% of the total browse cover since 1997. The density increased from 3,140 plants/acre (7,759 plants/ha) in 1997 to 6,860 plants/acre (16,951 plants/ha) in 2002, then decreased to 5,020 plants/acre (12,404 plants/ha) by 2007. The population is mostly mature, with low decadence. Young recruitment has fluctuated between 2% and 90% of the population since 1983. Less than 10% of the population has shown poor vigor since 1983. Use was mostly moderate-heavy in 1997, but has decreased to mostly light in 2002 and 2007. The oak plants are low-growing, averaging 27 to 34 inches (69 to 86 cm) in height.

Herbaceous Understory

The herbaceous understory is relatively depleted. Bluebunch wheatgrass (*Agropyron spicatum*) provides approximately 10% cover and the majority of the total grass cover, but cheatgrass (*Bromus tectorum*) has steadily increased from 1% to 5% cover since 1997. Forb cover has also increased since 1997. The forb species composition is diverse. Annual forbs provided 86%-92% of the total forb cover from 1997 to 2007. Pale alyssum (*Alyssum alyssoides*) is the dominant forb, and comprised 64% to 84% of the total forb cover between 1997 and 2007. Field bindweed (*Convolvulus arvensis*), a noxious weed, was sampled in one quadrat in 2007.

1989 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from 3,199 plants/acre (7,902 plants/ha) to 2,732 plants/acre (6,748 plants/ha). Decadence increased from 25% to 63% of the population. Recruitment

was low, with young plants comprising only 5% of the population. Twenty percent of the plants sampled displayed poor vigor, and use decreased from mostly moderate to mostly light. The trend for grass is up. The sum of nested frequency for perennial grasses increased 54%. Bluebunch wheatgrass and Sandberg wheatgrass (*Poa secunda*) both increased significantly in nested frequency. The trend for forbs is up. The sum of nested frequency for forbs increased two-fold.

browse - slightly down (-1) grass - up (+2) forb - up (+2)

1997 TREND ASSESSMENT

The trend for browse is stable. The density of sagebrush changed little, and decadence declined from 63% to 27%. Recruitment increased from 5% to 19% of the population. Use was mostly light-moderate, and 12% of the plants showed heavy use. Plants displaying poor vigor remained stable at approximately 20% of the population. The trend for grass is slightly down. The sum of nested frequency for perennial grasses decreased by 18%. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little. The Desirable Components Index (DCI) was rated as fair-good due to an adequate browse population with high recruitment, good perennial grass cover, and low perennial forb cover.

winter range condition (DCI) - fair-good (66) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - stable (0)

2002 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density increased very slightly, from 2,780 plants/acre (6,869 plants/ha) to 2,940 plants/acre (7,264 plants/ha). However, recruitment was low, with only 5% of the population consisting of young plants, and seedlings were rare. Plants classified as decadent and dying increased to 39% and 26% of the population, respectively. Approximately one-third of the population displayed light use, one-third showed moderate use, and one-third was browsed heavily. The trend for grass is stable. The sum of nested frequency for perennial grasses did not change. However, the frequency of annual grasses decreased by approximately 50%. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased, but total forb cover did not change. Annual species remained dominant. The DCI rating decreased to poor due to increased browse decadence, decreased recruitment of preferred browse, and a decrease in perennial forb cover.

winter range condition (DCI) - poor (48) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - slightly down (-1)

2007 TREND ASSESSMENT

The trend for browse remains stable. Sagebrush density decreased very slightly to 2,820 plants/acre (6,968 plants/ha), but cover increased from 9% to 12%. Recruitment remained low, while decadence increased slightly to 43% of the population. Plants classified as dying remained stable at 24% of the population. Plants displaying poor vigor remained stable at 26% of the population, and use was mostly heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses did not change. However, cheatgrass increased significantly in nested frequency, and its cover increased from 2% to 5%. The trend for forbs is stable. Forb cover increased from 4% to 11%, however this increase is largely attributed to annual species. Several annual forbs increased significantly in nested frequency. These species included pale alyssum, blue-eyed Mary (*Collinsia parviflora*), bedstraw (*Galium aparine*), and slender phlox (*Microsteris gracilis*). Additionally, bindweed, a noxious weed, was sampled in one quadrat. The DCI increased only slightly to a poor-fair rating due to an increase in preferred browse cover, despite an increase in annual grass cover and the presence of a noxious weed.

winter range condition (DCI) - poor-fair (51) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 3

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	a181	b246	b230	b253	b235	10.56	10.89	8.18
G	Bromus japonicus (a)	-	-	b129	-	a6	1.89	-	.04
G	Bromus tectorum (a)	-	-	a117	a125	b187	.76	1.83	5.26
G	Poa pratensis	a8	a7	-	a3	-	-	.03	-
G	Poa secunda	a74	b153	a102	a85	a101	.85	.50	.87
Total for Annual Grasses		0	0	246	125	193	2.66	1.83	5.30
Total for Perennial Grasses		263	406	332	341	336	11.42	11.42	9.04
Total for Grasses		263	406	578	466	529	14.09	13.26	14.35
F	Alyssum alyssoides (a)	-	-	a293	a302	b349	2.36	3.38	9.56
F	Antennaria rosea	-	-	a1	a2	-	.00	.00	-
F	Arabis sp.	a2	a10	a7	-	-	.02	-	-
F	Astragalus beckwithii	-	-	a2	a1	a10	.05	.00	.65
F	Astragalus cibarius	a11	a5	a11	-	-	.21	-	-
F	Astragalus eurekensis	a1	a3	-	a2	a-	-	.01	.00
F	Castilleja linariaefolia	-	-	a-	a1	-	.00	.00	-
F	Calochortus nuttallii	a5	a23	a12	a18	a12	.03	.07	.03
F	Chaenactis douglasii	a6	a5	a7	-	-	.04	-	-
F	Cirsium undulatum	-	-	-	a-	a5	-	.00	.06
F	Convolvulus arvensis	-	-	-	-	1	-	-	.00
F	Comandra pallida	-	-	-	4	-	-	.01	-
F	Collinsia parviflora (a)	-	-	a21	a17	b52	.05	.07	.17
F	Crepis acuminata	-	a2	a4	a2	-	.00	.00	-
F	Draba sp. (a)	-	-	3	-	-	.00	-	-
F	Epilobium brachycarpum (a)	-	-	a36	a20	-	.08	.05	-
F	Eriogonum brevicaule	-	-	-	1	-	-	.00	-
F	Erodium cicutarium (a)	-	-	-	-	4	-	-	.00
F	Erigeron pumilus	-	-	1	-	-	.00	-	-
F	Galium aparine (a)	-	-	a43	a40	b70	.48	.14	.34
F	Helianthus annuus (a)	-	-	3	-	-	.00	-	-
F	Holosteum umbellatum (a)	-	-	a5	a7	-	.01	.01	-
F	Lactuca serriola	-	-	a9	a1	a8	.02	.00	.01
F	Microsteris gracilis (a)	-	-	a30	a27	b58	.06	.07	.12
F	Petradoria pumila	-	-	a1	a3	a-	.03	.15	.15
F	Phlox longifolia	a8	b30	ab28	ab24	ab22	.05	.05	.08
F	Ranunculus testiculatus (a)	-	-	a50	a67	a61	.13	.25	.14

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Streptanthus cordatus	$_a$1	$_a$3	-	-	-	-	-	-
F	Taraxacum officinale	-	-	-	1	-	-	.00	-
F	Tragopogon dubius	$_a$8	-	$_a$2	$_a$5	$_a$2	.03	.01	.03
Total for Annual Forbs		0	0	484	480	594	3.19	4.00	10.36
Total for Perennial Forbs		42	81	85	65	60	0.52	0.35	1.04
Total for Forbs		42	81	569	545	654	3.71	4.35	11.40

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

BROWSE TRENDS --
Management unit 16A, Study no: 3

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	70	72	70	10.42	8.92	11.68
B	Chrysothamnus nauseosus albicaulis	7	3	4	.66	.16	.78
B	Gutierrezia sarothrae	23	10	7	.81	.03	-
B	Quercus gambelii	30	33	35	8.67	4.98	6.70
Total for Browse		130	118	116	20.58	14.10	19.16

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 3

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	12.94
Chrysothamnus nauseosus albicaulis	-	1.20
Quercus gambelii	-	8.46

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 3

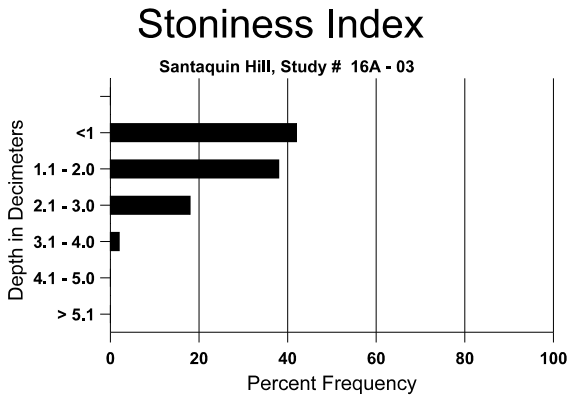
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.7	2.2

BASIC COVER --
Management unit 16A, Study no: 3

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	0	7.50	35.97	33.26	43.40
Rock	17.00	15.00	23.06	25.70	25.57
Pavement	4.00	14.00	3.11	4.19	2.93
Litter	61.50	55.25	47.94	47.63	38.72
Cryptogams	0	1.25	.57	.31	.37
Bare Ground	17.50	7.00	7.12	5.78	7.44

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 03, Santaquin Hill

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
15.3	54.8 (16.0)	6.8	40.4	29.1	30.6	3.2	16.3	204.8	.6



PELLET GROUP DATA --
Management unit 16A, Study no: 3

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	11	15	21
Elk	2	2	1
Deer	20	33	52

Days use per acre (ha)	
'02	'07
-	-
-	-
112 (276)	139 (342)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 vaseyana												
83	**3199**	-	133	2266	800	-	71	10	25	-	0	18/21
89	**2732**	-	133	866	1733	-	20	0	63	5	20	17/22
97	**2780**	100	520	1500	760	1140	43	12	27	19	19	17/25
02	**2940**	20	160	1620	1160	1700	38	28	39	26	26	20/31
07	**2820**	20	120	1500	1200	1420	29	45	43	24	26	26/35
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**140**	-	-	140	-	-	14	14	0	-	0	27/35
02	**80**	-	-	60	20	60	0	0	25	25	25	29/47
07	**80**	-	-	-	80	-	0	25	100	75	75	29/42
Gutierrezia sarothrae												
83	**533**	-	-	533	-	-	0	0	0	-	0	16/10
89	**2666**	-	800	1600	266	-	0	0	10	-	0	9/12
97	**740**	20	60	660	20	-	0	0	3	-	0	8/7
02	**260**	-	20	200	40	240	0	0	15	15	15	6/7
07	**160**	20	60	100	-	20	0	0	0	-	13	9/12
Quercus gambelii												
83	**7132**	733	1866	5000	266	-	85	0	4	-	0	27/18
89	**9332**	1266	8400	866	66	-	23	0	1	-	0	33/21
97	**3140**	100	840	2220	80	80	26	43	3	.63	.63	30/29
02	**6860**	-	160	6700	-	140	.58	16	0	-	8	32/20
07	**5020**	100	2200	2540	280	600	7	0	6	2	2	34/28

Trend Study 16A-4-07

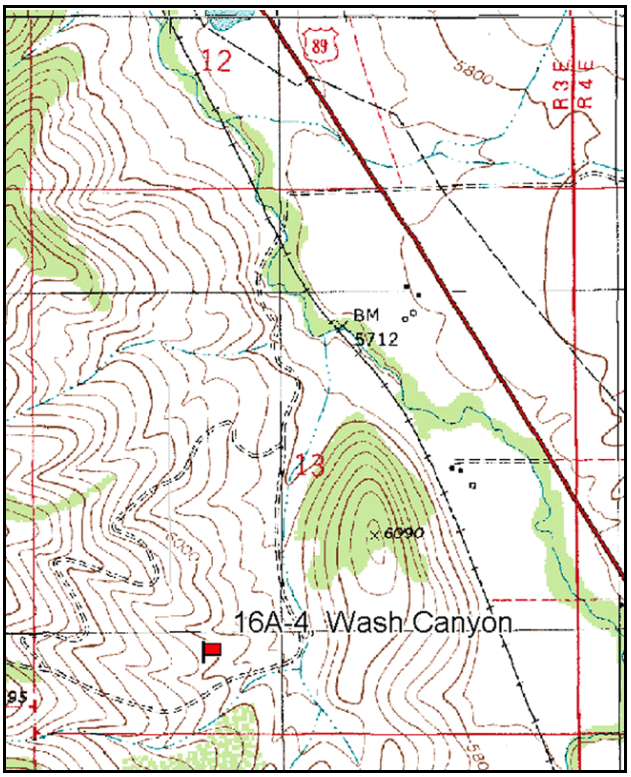
Study site name: Wash Canyon . Vegetation type: Mountain Brush .

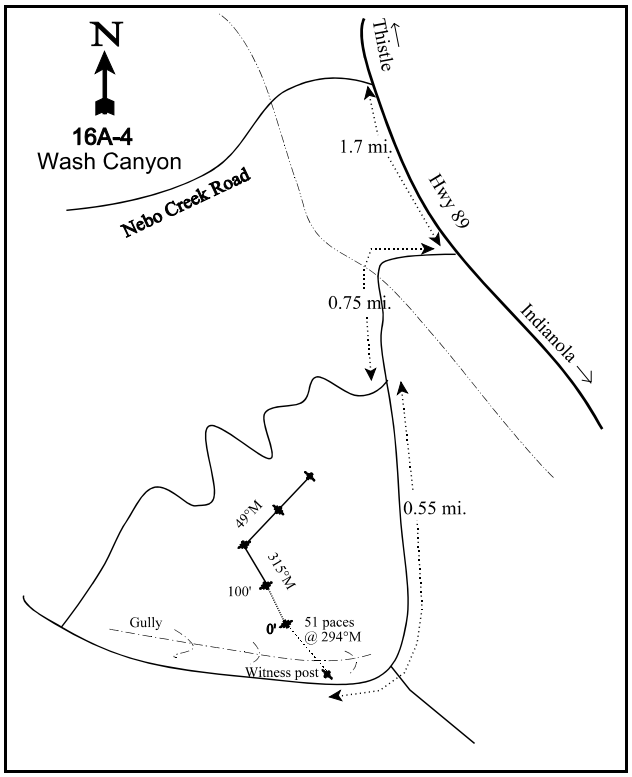
Compass bearing: frequency baseline 315 degrees magnetic (lines 3-4 @ 49°M).

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

LOCATION DESCRIPTION

From the intersection of the Nebo Creek Road and U.S. 89, proceed south on U.S. 89 for 1.7 miles (0.6 miles south of mile marker 302) to a road to the west. Turn right and proceed westerly for 0.75 miles, crossing a stream at 0.25 miles and an old railroad bed at 0.30 miles in route to a faint fork in the road. Take the left fork and proceed 0.55 miles to a half high witness post on the north side of the road. From the witness post, walk 51 paces at an azimuth of 295 degrees magnetic to the 0-foot baseline stake (the baseline stake is 17 paces away from lone juniper at an azimuth of 56 degree TRUE). The 0-foot baseline stake is a green post located just north of a clump of oak.





Map Name: Spencer Canyon

Diagrammatic Sketch

Township 11S , Range 3E , Section 13

GPS: NAD 83, UTM 12S 453707 E 4412101 N

DISCUSSION

Wash Canyon - Trend Study No. 16A-4

Study Information

This study samples winter range located in Lower Wash Canyon. It is on UDWR property surrounded by privately owned land [elevation: 6,000 feet (1,829 m), slope: 21%, aspect: northeast]. The vegetation type is mountain brush, with a moderate density of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) intermixed with low densities of Utah serviceberry (*Amelanchier utahensis*), true mountain mahogany (*Cercocarpus montanus*), and bitterbrush (*Purshia tridentata*). Antler drops and winter killed deer were noted during the 1983 reading. Deer and elk pellet groups were abundant in 1997 with quadrat frequencies of 58% and 21%, respectively. Some cattle use and sign were also evident in 1997. Pellet group transect data estimated deer use at 80 days use/acre (198 ddu/ha) in 1997, 169 days use/acre (417 ddu/ha) in 2002, and 92 days use/acre (228 ddu/ha) in 2007. Elk use was estimated at 64 days use/acre (159 edu/ha) in 1997, 12 days use/acre (30 edu/ha) in 2002, and 9 days use/acre (23 edu/ha) in 2007. Cattle use was estimated at 22 days use/acre (54 cdu/ha) in 1997, 1 day use/acre (2 cdu/ha) in 2002, and 9 days use/acre (23 cdu/ha) in 2007.

Soil

The soil is classified within the Lizzant series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in alluvium and colluvium derived from sedimentary rocks. The soil texture is a clay loam with a neutral pH (6.8). The parent material appears to be limestone. Relative bare ground cover increased from 13% in 1997 to 27% in 2002 and 24% in 2007. However, protective ground cover still appears adequate to limit erosion. The erosion condition was classified as stable in 2002 and 2007.

Browse

The browse composition is diverse, but the most abundant preferred species is big sagebrush, which appears to be a hybrid of mountain big sagebrush and basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). Sagebrush cover has ranged between 7% and 10% since 1997, while density has remained relatively stable between 1,760 plants/acre (4,349 plants/ha) and 1,980 plants/acre (4,893 plants/ha). Use was mostly light in 1983 and 1997, and moderate-heavy in 1989, 2002 and 2007. Sagebrush vigor has decreased since the study was established. Almost all of the plants were vigorous in 1983, and by 2007, 32% of the plants showed poor vigor. In 2007, it was noted that nearly half of the plants were infected by the sagebrush defoliator moth (*Aroga websteri*), and damage to the plants ranged from mild to severe. Annual leader growth averaged 1.3 inches (3.3 cm) in 2002 and 1.6 inches (4.1 cm) in 2007.

Several other species of preferred browse have been sampled infrequently. These species include serviceberry, mountain mahogany, and bitterbrush. Due to their low densities and high palatability, use of all three species has been heavy. Mahogany and bitterbrush plants have a short growth form as a result of the high browsing pressure. All of these species, except mahogany, have fluctuated in vigor since 1997.

Stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) and broom snakeweed (*Gutierrezia sarothrae*), both of which are undesirable increasers, are abundant. Rabbitbrush density has ranged from 6,140 plants/acre (15,172 plants/ha) to 7,520 plants/acre (18,582 plants/ha) since 1997. Decadence decreased from 34% of the population in 2002 to 9% in 2007. Broom snakeweed density decreased from 6,420 plants/acre (15,864 plants/ha) in 1997 to 1,600 plants/acre (3,954 plants/ha) in 2002, then increased to 7,420 plants/acre (18,335 plants/ha) in 2007. The majority of the population was mature in 1997 and 2007, but 84% of the population was decadent in 2002.

Utah juniper (*Juniperus osteosperma*) trees are also scattered throughout the site. Point-centered quarter data estimated juniper density at 39 trees/acre (96 trees/ha) in 2002 and 25 trees/acre (62 trees/ha) in 2007. Tree size increased from an average trunk diameter of 2.6 inches (6.6 cm) in 2002 to 5.4 inches (13.7 cm) in 2007.

Herbaceous Understory

The herbaceous understory is diverse. It provided 19% cover in 1997, decreased to 15% cover in 2002, and increased to 23% cover in 2007. Cheatgrass (*Bromus tectorum*) was the most abundant grass sampled in 1997, providing 40% of the total grass cover. In 2002, cheatgrass cover decreased significantly due to drought conditions, and the majority of the grass cover was provided by perennials such as bluebunch wheatgrass (*Agropyron spicatum*), Indian ricegrass (*Oryzopsis hymenoides*), and needle-and-thread (*Stipa comata*). Cheatgrass cover increased in 2007, but perennial grasses remained dominant. Forb species richness was high in 1997, with 33 species sampled. Perennials such as Lewis flax (*Linum lewisii*) and scarlet globemallow (*Sphaeralcea coccinea*) were abundant. Drought conditions in 2002 caused a decrease in perennial forb cover. By 2007, perennial forbs had recovered, but annual forbs were dominant. The most abundant species sampled in 2007 were pale alyssum (*Alyssum alyssoides*) and bur buttercup (*Ranunculus testiculatus*), which is allelopathic (Buchanan et al. 1978).

1989 TREND ASSESSMENT

The trend for browse is slightly up. Sagebrush density increased from 1,665 plants/acre (4,113 plants/ha) to 2,466 plants acre (6,091 plants/ha). The majority of the plants were young, and decadence increased from 4% of the population to 14%. Vigor was good, with only 8% of the population displaying poor vigor. Use of this species increased from light to mostly moderate-heavy. Bitterbrush density increased by 40%, however, decadence also increased. All of the plants sampled were classified as either young or decadent. Vigor greatly improved, from 80% of the population showing poor vigor to only 14%. Use remained mostly heavy. The trend for grass is slightly up. The sum of nested frequency of perennial grasses increased by almost 20%. Kentucky bluegrass (*Poa pratensis*) and needle-and-thread increased significantly in nested frequency, while bottlebrush squirreltail (*Sitanion hystrix*) decreased significantly. The trend for forbs is stable. The sum of nested frequency for perennial forbs remained unchanged.

browse - slightly up (+1) grass - slightly up (+1) forb - stable (0)

1997 TREND ASSESSMENT

The trend for browse is slightly down. The density of sagebrush decreased from 2,466 plants/acre (6,093 plants/ha) to 1,800 plants/acre (4,448 plants/ha). Decadence doubled and recruitment decreased from 57% to 20% of the population. Plants displaying poor vigor increased from 8% to 17% of the population. Use decreased to mostly light. Bitterbrush density decreased from 233 plants/acre (551 plants/ha) to 140 plants/acre (346 plants/ha), recruitment also decreased. All of the sampled plants were vigorous, use decreased to mostly moderate, and decadence also decreased. Two serviceberry and two mountain mahogany plants were also sampled, and half of these plants showed heavy use. The trend for grass is slightly up. The sum of nested frequency for perennial grasses increased 16%. Sandberg bluegrass (*Poa secunda)* and bottlebrush squirreltail increased significantly in nested frequency, while needle-and-thread decreased significantly. The trend for forbs is down. The sum of nested frequency for perennial species decreased almost 40%. The Desirable Components Index (DCI) was rated as poor due to low preferred browse and perennial grass cover, and high cheatgrass cover.

winter range condition (DCI) - poor (48) Mid-level potential scale
browse - slightly down (-1) grass - slightly up (+1) forb - down (-2)

2002 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density increased 10%, and decadence decreased. Seventy-eight percent of the population was classified as mature. Plants displaying poor vigor decreased from 17% to 11% of the population. Use increased from mostly light to moderate-heavy. Bitterbrush density decreased by 14%, and the age structure of the population shifted from mature to mostly decadent. One-third of the plants sampled displayed poor vigor, and use increased to mostly heavy. Serviceberry and mountain mahogany densities remained very low. The trend for grass is stable. Bluebunch wheatgrass increased significantly in

nested frequency, while cheatgrass decreased significantly. Cheatgrass cover declined from 6% to less than 1%. Bulbous bluegrass (*Poa bulbosa*) was sampled for the first time, but at a low frequency. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased by 50%, while that for annual forbs increased by 50%. The DCI rating increased to fair due to increased preferred browse and perennial grass cover and decreased annual grass cover, but decreased perennial forb cover.

winter range condition (DCI) - fair (54) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from 1,980 plants/acre (4,893 plants/ha) to 1,760 plants/acre (4,349 plants/ha), however, young recruitment increased from 4% of the population to 17%. Decadence increased slightly from 18% to 22% of the population. Plants showing poor vigor increased from 11% to 32% of the population, and use continued to be moderate-heavy. Bitterbrush density increased very slightly from 120 plants/acre (297 plants/ha) to 140 plants/acre (346 plants/ha). Most of the sampled plants were mature and all were vigorous. Young recruitment increased from 0% of the population to 14%. Seventy-one percent of the bitterbrush plants were used heavily. Two moderately hedged serviceberry and two heavily hedged mahogany plants were sampled, and all of these plants were vigorous. The trend for grass is stable. The sum of nested frequency for perennial grasses increased 4%, but cover decreased from 12% to 9%. Sandberg bluegrass increased significantly in nested frequency. However, cheatgrass, bulbous bluegrass, and Japanese brome (*Bromus japonicus*) also increased significantly. The trend for forbs is up. The sum of nested frequency for perennial species increased 100%, and longleaf phlox (*Phlox longifolia*), Bonneville pea (*Lathyrus brachycalyx*), and rose pussytoes (*Antennaria rosea*) increased significantly in nested frequency. Total forb cover increased from 3% to 10%, however, annuals provided the majority of the forb cover. Pale alyssum and bur buttercup both increased significantly in nested frequency and cover. The DCI rating declined slightly to poor-fair due to a decrease in preferred browse and perennial grass cover.

winter range condition (DCI) - poor-fair (52) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 4

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	a19	a31	a76	b113	b151	2.19	4.51	5.01
G	Bromus japonicus (a)	-	-	-	a4	b28	-	.01	.15
G	Bromus tectorum (a)	-	-	b270	a157	b263	6.14	.70	3.40
G	Dactylis glomerata	-	-	1	-	-	.00	-	-
G	Melica bulbosa	-	-	-	2	-	-	.15	-
G	Oryzopsis hymenoides	d145	cd128	bc86	b87	a29	1.75	3.75	.53
G	Poa bulbosa	-	-	-	a11	b46	-	.09	.87
G	Poa fendleriana	-	-	a4	-	a2	.15	-	.03
G	Poa pratensis	a43	b74	a77	a25	-	3.04	.22	-
G	Poa secunda	a3	a3	b47	b38	c81	.86	.46	1.39
G	Sitanion hystrix	b35	a4	b49	b34	b45	.58	.84	.60
G	Stipa comata	a19	b75	a25	a22	a25	.61	1.52	1.00
Total for Annual Grasses		0	0	270	161	291	6.14	0.70	3.55
Total for Perennial Grasses		264	315	365	332	379	9.19	11.58	9.46
Total for Grasses		264	315	635	493	670	15.34	12.29	13.02
F	Agoseris glauca	-	-	a4	a8	a16	.01	.04	.18
F	Alyssum alyssoides (a)	-	-	a107	b185	c307	.29	.80	2.55
F	Allium sp.	a6	a1	a13	-	a10	.03	-	.02
F	Antennaria rosea	-	-	a1	a1	b13	.03	.00	.19
F	Aster chilensis	-	-	a1	a4	a3	.00	.01	.01
F	Astragalus cibarius	-	-	-	-	8	-	-	.07
F	Astragalus convallarius	b30	b35	a9	a1	a6	.07	.03	.10
F	Aster sp.	-	-	-	-	2	-	-	.03
F	Astragalus sp.	-	-	-	a2	a3	-	.00	.00
F	Astragalus utahensis	-	-	a1	-	a2	.03	-	.01
F	Balsamorhiza sagittata	-	-	-	-	-	-	-	.00
F	Castilleja chromosa	a5	-	-	-	a3	-	-	.06
F	Camelina microcarpa (a)	-	-	-	-	3	-	-	.01
F	Calochortus nuttallii	a4	a1	a5	-	-	.01	-	-
F	Chaenactis douglasii	b29	a4	a1	-	2	.00	-	.00
F	Chenopodium sp. (a)	-	-	3	-	-	.00	-	-
F	Cirsium sp.	b84	b56	a18	a15	a10	.17	.24	.22
F	Collomia linearis (a)	-	-	a9	a1	a1	.02	.00	.00
F	Comandra pallida	a3	a3	a2	-	a5	.00	-	.09
F	Collinsia parviflora (a)	-	-	a3	b84	b116	.00	.23	.31

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Crepis acuminata	$_{a}$2	$_{a}$4	$_{a}$3	-	$_{a}$10	.00	-	.04
F	Cryptantha sp.	$_{a}$12	$_{a}$28	$_{a}$13	$_{a}$11	$_{a}$10	.10	.08	.11
F	Descurainia pinnata (a)	-	-	$_{b}$39	$_{a}$1	$_{a}$4	.11	.00	.02
F	Epilobium brachycarpum (a)	-	-	$_{b}$11	$_{ab}$2	$_{a}$2	.05	.01	.00
F	Erigeron divergens	-	$_{b}$5	$_{a}$1	-	-	.00	-	-
F	Erigeron pumilus	6	-	-	-	-	-	-	-
F	Eriogonum racemosum	-	-	$_{a}$-	$_{ab}$3	$_{b}$11	.00	.06	.13
F	Eriogonum umbellatum	$_{bc}$9	$_{c}$14	$_{ab}$2	$_{a}$1	-	.03	.00	-
F	Hackelia patens	$_{a}$36	$_{a}$21	$_{a}$37	$_{a}$36	$_{a}$28	.36	.33	.29
F	Lathyrus brachycalyx	$_{a}$21	$_{b}$55	$_{a}$3	$_{a}$8	$_{b}$66	.01	.01	.58
F	Lappula occidentalis (a)	-	-	$_{a}$5	-	$_{a}$6	.01	-	.01
F	Linum lewisii	$_{c}$125	$_{b}$98	$_{b}$81	-	$_{a}$8	.72	-	.11
F	Lithospermum ruderale	$_{a}$1	$_{b}$10	-	$_{a}$1	$_{a}$1	-	.03	.19
F	Lithophragma sp.	-	-	6	-	-	.30	-	-
F	Lomatium sp.	-	$_{a}$4	-	-	$_{a}$7	-	-	.03
F	Machaeranthera canescens	$_{a}$3	-	$_{a}$3	-	-	.00	-	-
F	Microsteris gracilis (a)	-	-	-	2	-	-	.00	-
F	Oenothera sp.	$_{a}$2	-	$_{a}$2	-	-	.03	-	-
F	Orobanche fasciculata	-	-	3	-	-	.00	-	-
F	Phlox longifolia	$_{a}$6	$_{c}$67	$_{a}$3	$_{a}$5	$_{b}$35	.00	.02	.21
F	Polygonum douglasii (a)	-	-	$_{b}$19	$_{a}$1	-	.06	.00	-
F	Ranunculus testiculatus (a)	-	-	-	$_{a}$16	$_{b}$240	-	.05	3.06
F	Schoencrambe linifolia	-	-	-	7	-	-	.02	-
F	Senecio multilobatus	-	2	-	-	-	-	-	-
F	Sphaeralcea coccinea	$_{b}$137	$_{b}$168	$_{a}$88	$_{a}$77	$_{a}$96	1.04	.98	.95
F	Streptanthus cordatus	-	-	-	-	3	-	-	.00
F	Taraxacum officinale	$_{a}$2	-	$_{a}$1	-	-	.00	-	-
F	Tragopogon dubius	$_{bc}$49	$_{ab}$28	$_{c}$67	$_{a}$4	$_{a}$9	.44	.04	.02
Total for Annual Forbs		0	0	196	292	679	0.56	1.11	6.00
Total for Perennial Forbs		572	604	368	184	367	3.47	1.95	3.70
Total for Forbs		572	604	564	476	1046	4.03	3.06	9.70

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

BROWSE TRENDS --
Management unit 16A, Study no: 4

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	2	3	2	-	.15	-
B	Artemisia tridentata vaseyana	56	57	57	7.28	9.81	8.82
B	Cercocarpus montanus	2	1	2	.15	.15	.15
B	Chrysothamnus nauseosus albicaulis	1	2	2	-	-	-
B	Chrysothamnus viscidiflorus viscidiflorus	90	86	79	8.12	6.80	4.78
B	Gutierrezia sarothrae	71	31	72	2.68	.58	2.55
B	Opuntia sp.	27	30	23	.73	1.15	.65
B	Pinus edulis	1	1	1	-	.15	.15
B	Purshia tridentata	7	6	7	.56	.42	.56
B	Quercus gambelii	3	3	2	-	1.00	.78
B	Ribes sp.	1	0	0	-	-	-
Total for Browse		261	220	247	19.54	20.22	18.46

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 4

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	.15	.13
Artemisia tridentata vaseyana	7.25	9.98
Cercocarpus montanus	-	.13
Chrysothamnus nauseosus albicaulis	.25	.51
Chrysothamnus viscidiflorus viscidiflorus	4.00	4.40
Gutierrezia sarothrae	.70	2.46
Opuntia sp.	.31	.46
Pinus edulis	.36	.40
Purshia tridentata	.50	.35
Quercus gambelii	.18	.26

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 4

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.3	1.6
Cercocarpus montanus	-	0.9
Purshia tridentata	-	1.3

POINT-QUARTER TREE DATA --
Management unit 16A, Study no: 4

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	39	25

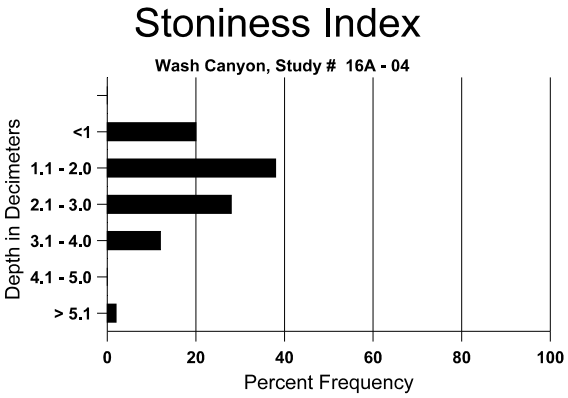
Average diameter (in)	
'02	'07
2.6	5.4

BASIC COVER --
Management unit 16A, Study no: 4

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	4.25	8.75	44.12	32.27	41.40
Rock	4.00	8.25	5.81	5.52	5.47
Pavement	8.00	15.50	9.30	6.17	6.27
Litter	45.25	37.75	40.90	40.87	30.93
Cryptogams	0	.25	.38	.00	.04
Bare Ground	38.50	29.50	14.36	31.73	25.87

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 04, Wash Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
15.4	58.2 (16.6)	6.8	35.0	31.2	33.8	3.4	13.5	99.2	.6



PELLET GROUP DATA --
Management unit 16A, Study no: 4

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	2	14	22
Elk	21	12	17
Deer	58	68	48
Cattle	2	1	1

Days use per acre (ha)	
'02	'07
-	-
12 (30)	9 (23)
169 (417)	92 (228)
1 (2)	9 (23)

BROWSE CHARACTERISTICS --
Management unit 16A, 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												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**40**	-	-	20	20	-	0	50	50	50	50	-/-
02	**60**	-	20	-	40	-	0	33	67	-	0	9/17
07	**40**	-	20	20	-	-	100	0	0	-	0	14/23
Artemisia tridentata vaseyana												
83	**1665**	-	533	1066	66	-	0	0	4	-	2	27/24
89	**2466**	-	1400	733	333	-	39	19	14	-	8	29/32
97	**1800**	-	360	940	500	400	14	0	28	17	17	31/38
02	**1980**	-	80	1540	360	360	39	35	18	9	11	25/32
07	**1760**	420	300	1080	380	220	50	8	22	10	32	27/38
Cercocarpus montanus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	20	20	-	-	0	50	-	-	0	11/56
02	**20**	-	-	20	-	-	0	100	-	-	0	18/23
07	**40**	-	-	40	-	-	0	100	-	-	0	16/26
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	0	0	0	-	0	-/-
02	**40**	-	-	40	-	-	100	0	0	-	0	25/25
07	**40**	-	-	20	20	-	0	0	50	-	0	38/35

		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)
Chrysothamnus viscidiflorus viscidiflorus												
83	**4300**	-	-	4200	100	-	0	0	2	-	0	13/19
89	**10632**	-	1766	7266	1600	-	0	0	15	.56	27	11/16
97	**7280**	-	920	5940	420	40	0	0	6	2	2	9/14
02	**7520**	-	140	4860	2520	580	1	0	34	16	16	9/13
07	**6140**	420	220	5360	560	40	0	0	9	2	3	8/12
Gutierrezia sarothrae												
83	**2666**	-	400	2266	-	-	0	0	0	-	0	13/12
89	**7532**	-	1666	5366	500	-	0	0	7	.53	2	11/12
97	**6420**	360	940	5440	40	-	0	0	1	.31	.62	10/13
02	**1600**	-	-	260	1340	2640	0	3	84	76	76	7/7
07	**7420**	20	880	6360	180	-	0	0	2	.53	.53	8/7
Juniperus osteosperma												
83	**66**	-	33	33	-	-	0	0	-	-	0	47/30
89	**66**	-	33	33	-	-	0	50	-	-	0	71/35
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Opuntia sp.												
83	**466**	-	-	466	-	-	0	0	0	-	0	8/17
89	**1866**	33	300	1566	-	-	0	0	0	-	0	8/10
97	**920**	20	100	800	20	20	0	0	2	2	2	5/12
02	**1240**	-	40	960	240	-	0	0	19	6	6	5/10
07	**780**	20	40	680	60	20	0	0	8	3	21	6/11
Pinus edulis												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	-	0	0	-	-	0	-/-
02	**20**	-	20	-	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Purshia tridentata												
83	**166**	-	33	133	-	-	0	80	0	-	80	23/37
89	**233**	33	100	-	133	-	14	71	57	14	14	-/-
97	**140**	-	-	140	-	-	71	29	0	-	0	8/39
02	**120**	-	-	40	80	60	0	83	67	33	33	9/13
07	**140**	-	20	120	-	-	14	71	0	-	0	8/15

		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)
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**60**	-	40	20	-	-	33	0	0	-	0	-/-
02	**100**	-	60	20	20	-	20	20	20	20	80	28/56
07	**300**	-	-	300	-	-	0	0	0	-	0	49/35
Ribes sp.												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	40	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16A-5-07

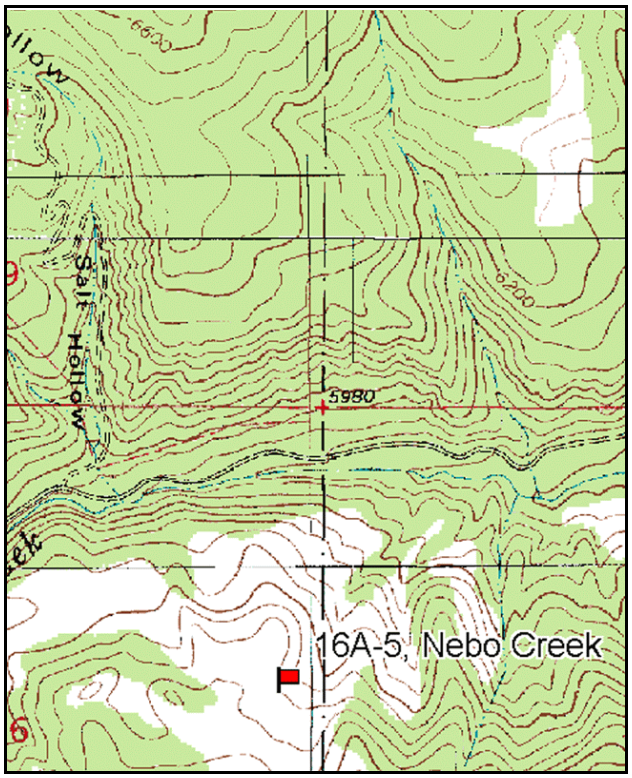
Study site name: Nebo Creek . Vegetation type: Mixed Oak-Sage .

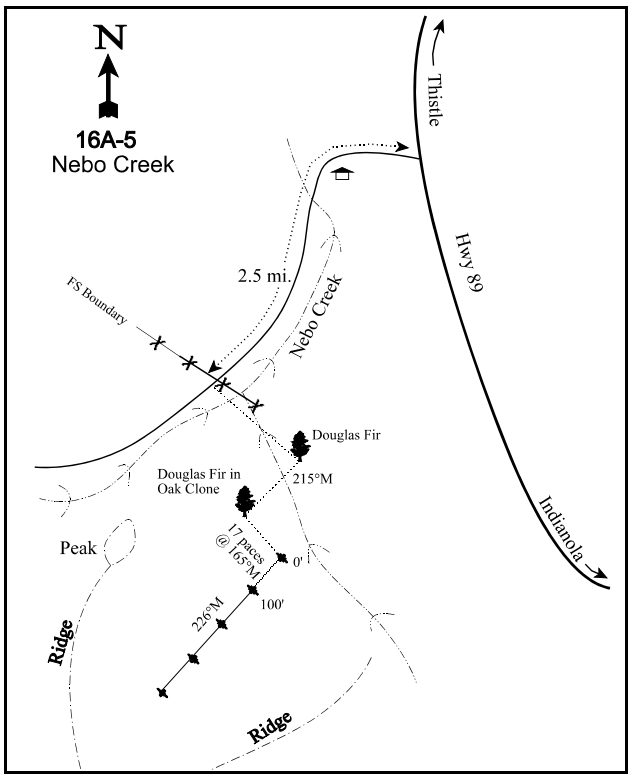
Compass bearing: frequency baseline 226 degrees magnetic.

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

LOCATION DESCRIPTION

Beginning at the intersection of Highway US-89 and the Nebo Creek Road, proceed 2.5 miles westerly up Nebo Creek to the USFS boundary sign or the cattle guard. Park here. Take an azimuth of 185 degrees magnetic to the top of a lone Douglas fir. Proceed across Nebo Creek and uphill to the Douglas fir tree. From here walk at an azimuth of 215 degrees magnetic up a drainage to a fence line. From the fence line, walk 124 paces at the same azimuth to a second but smaller Douglas fir within a clump of oak brush. From this tree, the 0-foot baseline stake is 17 paces away at an azimuth of 165 degree magnetic. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height.





Map Name: Spencer Canyon

Diagrammatic sketch

Township 11S , Range 3E , Section 16

GPS: NAD 83, UTM 12S 449858E 4412882 N

DISCUSSION

Nebo Creek - Trend Study No. 16A-5

Study Information

This study is located on National Forest land in the Nebo Creek drainage [elevation: 6,320 feet (1,926 m), slope: 10%, aspect: northeast]. When the study began in 1983, the preferred browse was Gambel oak (*Quercus gambelii*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), and basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). The entire area burned in the Nebo Creek fire of 2001. The fire eliminated all of the sagebrush, and the only shrubs sampled in 2002 were a small number of stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) and threadleaf rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *consimilis*). The area serves as year-round range for deer and elk, and is grazed by livestock in the summer. During the 1983 reading, numerous fresh deer and elk pellet groups, as well as three live deer were observed. The carcasses of two deer and an elk were observed, along with two separate antler drops. Deer were also observed during the 2007 reading. Pellet group quadrat frequency indicated light use by deer, elk, and cattle in 1997. Deer use was estimated at 7 days use/acre (17 ddu/ha) in 2002 and 1 day use/acre (2 ddu/ha) in 2007. Elk use was estimated at 3 days use/acre (7 edu/ha) in 2002 and 23 days use/acre (57 edu/ha) in 2007. Cattle use estimates were 1 day use/acre (2 cdu/ha) in 2002 and 29 days use/acre (72 cdu/ha) in 2007. Sheep use was estimated at 1 day use/acre (3 sdu/ha) in 2002. Due to the difficulty of identifying the differences between elk and sheep pellets, it is likely that some of the elk use in 2007 was actually sheep use.

Soil

The soil is classified within the Lizzant series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in alluvium and colluvium derived from sedimentary rocks. The soil texture is a clay loam with a moderately acidic pH (6.0). There is some large rock cobble on the surface and throughout the profile. Vegetation and litter were abundant prior to 2001, and signs of erosion were minimal. After the fire, relative vegetation cover had declined from 47% to 17%, and litter cover dropped from 43% to 7%. Relative bare ground cover increased from 7% in 1997 to 61% in 2002. By 2007, relative vegetation cover increased to 57%, and bare ground only accounted for 17% relative cover. The erosion condition was classified as slight in 2002 due to the presence of rills, pedestalling, gullies, and some soil and surface litter movement. The classification was stable in 2007.

Browse

The original study sampled an oak clone in the middle of a sagebrush-grass basin. It was a mixed-age stand that varied in height from a few inches to a treelike stature up to 15 feet (4.6 m) in height. The plants were mostly mature and 23% of the population was young. The degree of hedging in 1983 was variable, with young plants showing only light use and available portions of mature individuals heavily utilized. The majority of the population consisted of young plants in 1989. The stand was vigorous, and use was light. In 1997, the baseline was lengthened and moved entirely into the sagebrush-grass type, and as a result, little oak was sampled. The fire burned the entire stand in 2001. It was resprouting in 2002, and one mature plant was sampled in 2007.

Basin big sagebrush and mountain big sagebrush provided approximately 7% cover in 1997 when the baseline was relocated. Basin big sagebrush density was the higher of the two species at 1,080 plants/acre (2,669 plants/ha), while mountain big sagebrush density was 400 plants/acre (988 plants/ha). Both populations were mostly mature, with good recruitment. Use was mostly light, and mountain big sagebrush was used slightly more than basin big sagebrush. All of the sampled plants were vigorous. Sagebrush was eliminated in the fire of 2001, and although no plants were sampled in 2002 or 2007, it was noted that sagebrush was beginning to reestablish.

Prior to the fire, the most common shrub was stickyleaf low rabbitbrush. This species made up 53% of the shrub cover in 1997, with a density of 3,540 plants/acre (8,747 plants/ha). The population was mature and vigorous. Other shrubs included threadleaf rubber rabbitbrush and a few heavily hedged Utah serviceberry (*Amelanchier utahensis*) plants. After the fire, low rabbitbrush resprouted to 720 plants/acre (1,779 plants/ha) in 2002 and 2,800 plants/acre (6,919 plants/ha) in 2007. A few resprouting rubber rabbitbrush were also sampled after the fire, but serviceberry was not.

Herbaceous Understory

The herbaceous understory was diverse and abundant in 1997, and provided 57% total cover. Perennial species dominated the understory, and perennial grasses provided 23% cover. The most abundant grasses were Sandberg bluegrass (*Poa secunda*) and Kentucky bluegrass (*Poa pratensis*), which together provided 17% cover. Cheatgrass (*Bromus tectorum*) was sampled in almost half of the quadrats, but only provided 3% cover. Following the fire, cheatgrass became the dominant grass species. Between 2002 and 2007, this species increased from less than 1% to 24% cover, and from a quadrat frequency of 16% to 95%. Perennial grass cover also increased from 10% in 2002 to 15% in 2007. Sandberg bluegrass remained abundant in 2007, but only provided 22% of the total grass cover.

Bonneville pea (*Lathyrus brachycalyx*), American vetch (*Vicia americana*), blue-eyed Mary (*Collinsia parviflora*), stickseed (*Hackelia patens*), western aster (*Aster chilensis*), and Beckwith milkvetch (*Astragalus beckwithii*) provided the most forb cover in 1997. Common houndstongue (*Cynoglossum officinale*), a noxious weed, was sampled in five quadrats. Total forb cover was 31% in 1997, but cover only reached 8% in 2002 and 11% in 2007 following the fire, due to a sharp decline in perennial cover from 26% in 1997 to 7% in 2002 and 2007. Bonneville pea, aster, slender phlox (*Microsteris gracilis*), tumblemustard (*Sisymbrium altissimum*), and pale alyssum (*Alyssum alyssoides*) provided the most forb cover in 2007.

1989 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush was not divided into two different species in the 1983 report, and the combined density decreased 14%, from 1,932 plants/acre (4,774 plants/ha) to 1,664 plants/acre (4,112 plants/ha). Decadence increased to 54% of the basin big sagebrush population and 50% of the mountain big sagebrush population. Recruitment of basin big sagebrush was high at 38% of the population. Vigor declined, and 15% of the population displayed poor vigor. Thirty-one percent of the basin big sagebrush individuals showed moderate-heavy use, while 42% of the mountain big sagebrush population showed moderate use. The trend for grass is up. The sum of nested frequency for perennial grass increased two-fold, and Kentucky bluegrass, mutton bluegrass (*Poa fendleriana*), and mountain brome (*Bromus carinatus*) increased significantly in nested frequency. The trend for forbs is up. The sum of nested frequency for perennial forbs increased almost 60%, and American vetch, dandelion (*Taraxacum officinale*), and onion (*Allium campanulatum*) increased significantly in nested frequency. Houndstongue was sampled in three quadrats.

browse - slightly down (-1) grass - up (+2) forb - up (+2)

1997 TREND ASSESSMENT

The trend for browse is stable. It is difficult to determine the trend for 1997 because the baseline was moved out of the oak and entirely into the sagebrush, so the sample areas are completely different. Basin big sagebrush, the most abundant species, increased in density from 865 plants/acre (2,137 plants/ha) to 1,080 plants/acre (2,669 plants/ha). Decadence decreased to 0% of the population, and the plants were mostly mature with good recruitment. Vigor was good and use was light. Mountain big sagebrush density decreased by 50%, but decadence also decreased from 50% of the population to 10%. All of the plants were vigorous and use decreased to only 5% of the individuals showing moderate use. Additionally, one vigorous, heavily hedged serviceberry plant was sampled. The trend for grass is up. The sum of nested frequency for perennial grasses continued to increase substantially, with significant increases in Kentucky bluegrass, Sandberg

bluegrass, bluebunch wheatgrass (*Agropyron spicatum*), and oniongrass (*Melica bulbosa*). However, some of these changes might be a product of moving the baseline in 1997. The trend for forbs is up. The sum of nested frequency for perennial forbs increased by almost 80%. These species provided 26% cover. American vetch and lambstongue groundsel (*Senecio integerrimus*) increased significantly in nested frequency. Houndstongue was still present, but provided very little cover. The Desirable Components Index (DCI) was rated as good due to excellent perennial herbaceous cover, low annual grass cover, and low decadence of preferred browse, despite low browse cover and the presence of a noxious weed.

winter range condition (DCI) - good (69) Mid-level potential scale
browse - stable (0) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is down. Both sagebrush subspecies were eliminated by the fire, and only low densities of rabbitbrush and Gambel oak resprouted. The trend for grass is down. The sum of nested frequency for perennial grasses decreased 46%. Average grass cover decreased from 25% to 11%. Cheatgrass decreased significantly in nested frequency. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 59%, and forb cover decreased from 31% to 8%. Houndstongue was not sampled. The DCI was rated as very poor due to losses in browse and understory cover from the fire.

winter range condition (DCI) - very poor (30) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is stable, since preferred browse was not sampled since the fire. It was noted that sagebrush was beginning to return in 2007, but it was not sampled in the density measurements. Low rabbitbrush became the dominant shrub, with a density of 2,800 plants/acre (6,919 plants/ha). Additionally, one moderately hedged rubber rabbitbrush plant and one oak plant were sampled. The trend for grass is down. Although the sum of nested frequency for perennial grasses increased 25%, average cheatgrass cover increased from less than 1% to 24%. Cheatgrass dominated the study and could prevent the establishment of desirable species. The nested frequency of cheatgrass increased nine-fold. There was, however, a significant increase in the nested frequency of Sandberg bluegrass. The trend for forbs is up. The sum of nested frequency for perennial species increased 22%, and total forb cover increased from 8% to 11%. Houndstongue was sampled at a similar nested frequency and cover as in 1997. The DCI rating continued to be very poor due to the absence of preferred browse and high annual grass cover.

winter range condition (DCI) - very poor (20) Mid-level potential scale
browse - stable (0) grass - down (-2) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 5

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	-	-	2	-	-	.15	-	-
G	Agropyron spicatum	$_{a}$9	$_{ab}$36	$_{c}$78	$_{ab}$28	$_{bc}$57	3.05	.91	3.37
G	Bromus carinatus	$_{a}$16	$_{b}$27	-	-	-	-	-	-
G	Bromus japonicus (a)	-	-	-	-	1	-	-	.00

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Bromus tectorum (a)	-	-	$_{b}$131	$_{a}$34	$_{c}$313	2.50	.53	24.47
G	Elymus cinereus	$_{a}$1	-	$_{a}$5	$_{a}$2	$_{a}$8	.97	.15	1.25
G	Elymus junceus	-	-	-	6	-	-	1.41	-
G	Melica bulbosa	$_{a}$10	$_{a}$3	$_{c}$78	$_{bc}$52	$_{b}$43	2.05	1.68	.44
G	Oryzopsis hymenoides	-	-	1	-	-	.03	-	-
G	Phleum pratense	-	-	-	-	4	-	-	.15
G	Poa bulbosa	-	-	-	-	15	-	-	.36
G	Poa fendleriana	$_{a}$22	$_{b}$57	-	$_{a}$7	$_{a}$3	-	.01	.03
G	Poa pratensis	$_{a}$6	$_{b}$56	$_{c}$173	$_{ab}$24	$_{ab}$33	8.10	.35	.73
G	Poa secunda	$_{a}$34	$_{a}$26	$_{b}$154	$_{b}$146	$_{c}$191	8.42	5.62	8.91
G	Sitanion hystrix	-	$_{a}$1	-	$_{a}$3	-	-	.03	-
G	Stipa columbiana	-	-	5	-	-	.01	-	-
G	Stipa lettermani	-	-	$_{a}$4	$_{a}$4	$_{a}$1	.03	.03	.03
Total for Annual Grasses		0	0	131	34	314	2.50	0.53	24.48
Total for Perennial Grasses		98	206	500	272	355	22.83	10.20	15.29
Total for Grasses		98	206	631	306	669	25.34	10.74	39.77
F	Achillea millefolium	$_{b}$21	$_{ab}$20	$_{ab}$17	$_{a}$2	-	.88	.00	-
F	Agoseris glauca	$_{a}$10	-	$_{b}$67	$_{b}$59	$_{b}$58	.84	.39	.37
F	Alyssum alyssoides (a)	-	-	$_{a}$6	$_{a}$24	$_{b}$106	.04	.22	1.01
F	Allium campanulatum	$_{a}$8	$_{b}$47	$_{b}$62	$_{a}$10	$_{a}$2	.33	.13	.01
F	Antennaria rosea	-	-	-	3	-	-	.00	-
F	Arabis sp.	-	3	-	-	-	-	-	-
F	Artemisia ludoviciana	$_{a}$7	$_{a}$7	$_{a}$3	-	$_{a}$7	.15	-	.76
F	Astragalus beckwithii	-	-	$_{b}$49	$_{a}$13	-	1.82	.21	-
F	Aster chilensis	$_{b}$35	$_{bc}$43	$_{c}$76	$_{a}$1	$_{bc}$67	1.86	.03	1.60
F	Astragalus convallarius	-	-	-	1	-	-	.03	-
F	Balsamorhiza sagittata	$_{a}$6	$_{a}$7	$_{a}$8	$_{a}$12	$_{a}$5	.73	1.23	.16
F	Camelina microcarpa (a)	-	-	$_{a}$36	-	$_{b}$60	.13	-	.16
F	Calochortus nuttallii	-	-	$_{a}$6	$_{a}$7	$_{a}$2	.01	.01	.00
F	Chenopodium album (a)	-	-	3	-	-	.00	-	-
F	Cirsium sp.	-	$_{a}$14	$_{a}$13	-	-	.07	-	-
F	Collomia linearis (a)	-	-	$_{b}$119	-	$_{a}$3	.68	-	.00
F	Comandra pallida	37	-	-	-	-	-	-	-
F	Collinsia parviflora (a)	-	-	$_{c}$258	$_{b}$123	$_{a}$53	3.96	.63	.12
F	Crepis acuminata	$_{a}$3	$_{ab}$16	$_{c}$56	$_{c}$55	$_{bc}$36	.82	1.85	.75
F	Cymopterus longipes	$_{a}$3	$_{a}$2	$_{a}$7	-	-	.04	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Cymopterus sp.	-	5	-	-	-	-	-	-
F	Cynoglossum officinale	-	$_{a}$6	$_{a}$12	-	$_{a}$12	.17	-	.07
F	Delphinium nuttallianum	-	-	$_{a}$5	$_{a}$1	-	.04	.00	-
F	Descurainia pinnata (a)	-	-	$_{a}$10	$_{a}$14	$_{b}$34	.06	.16	.10
F	Epilobium brachycarpum (a)	-	-	$_{a}$16	-	$_{a}$8	.11	-	.02
F	Eriogonum racemosum	$_{a}$6	$_{a}$1	$_{a}$3	$_{a}$4	$_{a}$1	.03	.00	.03
F	Hackelia patens	$_{ab}$16	$_{b}$41	$_{c}$72	$_{a}$5	$_{ab}$21	2.07	.09	.34
F	Holosteum umbellatum (a)	-	-	-	3	-	-	.00	-
F	Hymenoxys acaulis	-	-	2	-	-	.30	-	-
F	Lathyrus brachycalyx	$_{a}$97	$_{a}$54	$_{b}$172	$_{b}$164	$_{b}$154	9.14	2.15	1.55
F	Lappula occidentalis (a)	-	-	-	-	60	-	-	.32
F	Lactuca serriola	-	$_{ab}$13	$_{ab}$18	$_{a}$1	$_{b}$29	.38	.33	.11
F	Lithospermum ruderale	$_{a}$1	$_{a}$6	$_{a}$10	$_{a}$1	$_{a}$1	.48	.01	.03
F	Lupinus argenteus	$_{a}$8	$_{a}$5	$_{a}$4	$_{a}$4	$_{a}$9	.06	.16	.19
F	Machaeranthera canescens	-	2	-	-	-	-	-	-
F	Microsteris gracilis (a)	-	-	-	$_{a}$23	$_{b}$160	-	.28	1.22
F	Penstemon sp.	-	-	-	-	1	-	-	.00
F	Phlox longifolia	-	$_{b}$88	$_{a}$17	$_{a}$1	$_{a}$18	.08	.00	.09
F	Polygonum douglasii (a)	-	-	$_{b}$17	$_{ab}$5	$_{a}$1	.06	.01	.00
F	Ranunculus testiculatus (a)	-	-	$_{a}$28	$_{a}$20	$_{a}$38	.15	.06	.32
F	Senecio integerrimus	-	$_{a}$1	$_{b}$36	-	$_{a}$4	1.08	-	.06
F	Sisymbrium altissimum (a)	-	-	-	-	109	-	-	1.00
F	Sphaeralcea coccinea	-	3	-	-	-	-	-	-
F	Taraxacum officinale	$_{a}$12	$_{b}$40	$_{b}$46	$_{a}$6	-	.38	.03	-
F	Tragopogon dubius	$_{a}$26	$_{a}$14	$_{a}$16	-	$_{a}$24	.15	-	.31
F	Veronica biloba (a)	-	-	17	-	-	.27	-	-
F	Vicia americana	$_{a}$10	$_{b}$52	$_{c}$106	$_{a}$6	$_{a}$3	3.71	.18	.06
F	Viguiera multiflora	-	$_{a}$3	$_{a}$-	$_{a}$5	-	.03	.01	-
Total for Annual Forbs		0	0	510	212	632	5.48	1.38	4.30
Total for Perennial Forbs		306	493	883	361	454	25.70	6.90	6.55
Total for Forbs		306	493	1393	573	1086	31.18	8.28	10.85

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

BROWSE TRENDS --
Management unit 16A, Study no: 5

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	1	0	0	.03	-	-
B	Artemisia tridentata tridentata	37	0	0	3.98	-	-
B	Artemisia tridentata vaseyana	15	0	0	2.98	-	-
B	Chrysothamnus nauseosus consimilis	1	1	1	.15	.03	.15
B	Chrysothamnus viscidiflorus viscidiflorus	72	20	63	8.75	.35	8.12
B	Gutierrezia sarothrae	0	0	0	.00	-	-
B	Opuntia sp.	3	0	1	.06	-	-
B	Quercus gambelii	1	0	1	.63	-	.15
Total for Browse		130	21	66	16.59	0.38	8.42

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 5

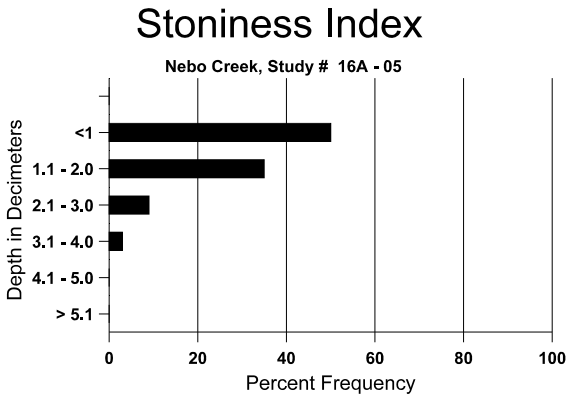
Species	Percent Cover	
	'02	'07
Chrysothamnus nauseosus consimilis	-	.03
Chrysothamnus viscidiflorus viscidiflorus	.38	12.39

BASIC COVER --
Management unit 16A, Study no: 5

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	0	3.00	61.17	18.42	62.62
Rock	.50	1.50	1.88	5.83	2.13
Pavement	.25	2.00	1.65	10.49	1.46
Litter	88.00	84.75	55.32	7.27	24.93
Cryptogams	0	.25	.54	0	.00
Bare Ground	11.25	8.50	8.40	64.55	18.93

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 05, Nebo Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
15.2	41.0 (13.3)	6.0	34.7	34.7	30.6	3.5	39.6	320.0	.5



PELLET GROUP DATA --
Management unit 16A, Study no: 5

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	2	-
Elk	4	1	9
Deer	7	1	6
Cattle	5	-	3

Days use per acre (ha)	
'02	'07
1 (3)	-
3 (7)	23 (58)
7 (17)	1 (2)
1 (2)	29 (72)

BROWSE CHARACTERISTICS --
Management unit 16A, 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)
Amelanchier utahensis												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	100	-	-	0	29/43
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Artemisia tridentata tridentata												
83	**1932**	-	66	1266	600	-	28	0	31	-	0	28/38
89	**865**	133	333	66	466	-	23	8	54	8	15	22/21
97	**1080**	20	180	900	-	480	0	0	0	-	0	40/47
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	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)
Artemisia tridentata vaseyana												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**799**	200	66	333	400	-	42	0	50	-	0	49/34
97	**400**	-	100	260	40	100	5	0	10	-	0	27/39
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	16/18
Chrysothamnus nauseosus consimilis												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	37/41
02	**20**	-	-	20	-	-	0	0	-	-	0	9/8
07	**20**	-	-	20	-	-	100	0	-	-	0	31/55
Chrysothamnus viscidiflorus viscidiflorus												
83	**1666**	-	66	1600	-	-	0	0	0	-	0	16/18
89	**1932**	-	266	1200	466	-	0	0	24	3	41	15/19
97	**3540**	-	20	3460	60	20	0	0	2	2	2	17/23
02	**720**	-	440	280	-	-	0	0	0	-	3	6/7
07	**2800**	-	20	2740	40	20	1	0	1	-	0	16/24
Juniperus osteosperma												
83	**66**	-	-	66	-	-	0	0	-	-	0	67/79
89	**66**	-	-	66	-	-	0	100	-	-	0	128/87
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Opuntia sp.												
83	**533**	-	-	533	-	-	0	0	-	-	0	6/6
89	**1199**	-	533	666	-	-	0	0	-	-	0	5/8
97	**80**	-	-	80	-	-	0	0	-	-	0	5/12
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	5/8
Quercus gambelii												
83	**6799**	466	1533	5200	66	-	18	60	1	-	0	43/18
89	**8866**	533	6133	2533	200	-	15	0	2	-	0	85/36
97	**60**	-	-	60	-	-	0	0	0	-	0	21/12
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**20**	-	-	20	-	-	0	0	0	-	0	28/17

		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)
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	66	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16A-6-07

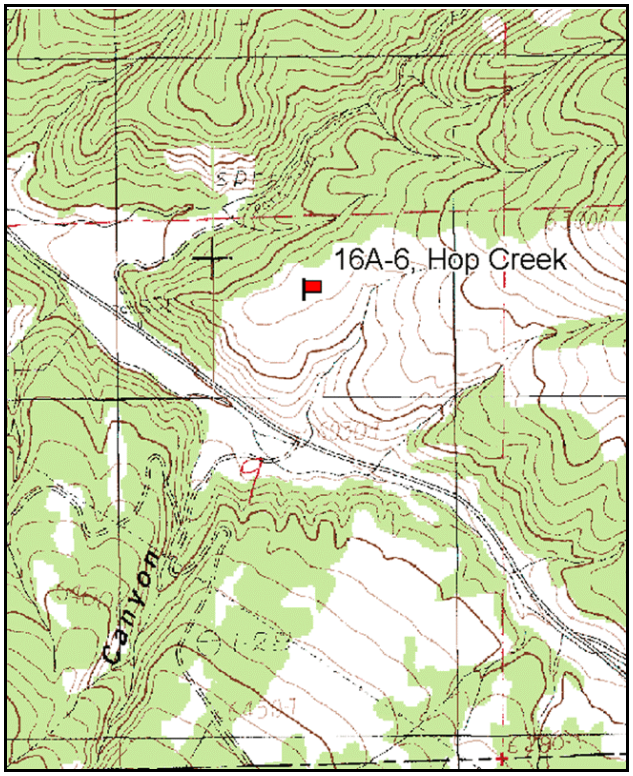
Study site name: Hop Creek Browse . Vegetation type: Antelope Bitterbrush .

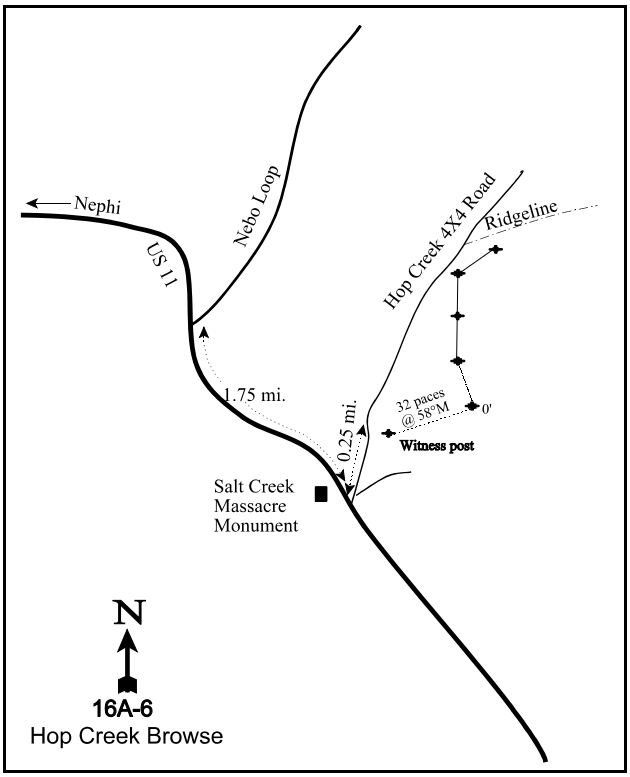
Compass bearing: frequency baseline 163 degrees magnetic (line 2-3 @ 1°M, line 4 @ 45°M).

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

LOCATION DESCRIPTION

From the intersection of Highway 132 and the Nebo Loop Road, proceed south on Highway 132 for 1.75 miles. Just past the Salt Creek Massacre Monument, stop at a turnoff on the north side of the road. Drive up the left fork of a four-wheel drive road 0.25 miles to a witness post. From the witness post walk 32 paces at 58°M to the 0-foot stake. The 0-foot baseline stake is located 2 paces to the east of an antelope bitterbrush plant with a browse tag, number E1318, attached. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height.





Map Name: Fountain Green North

Diagrammatic Sketch

Township 13S , Range 2E , Section 9

GPS: NAD 83, UTM 12S 439487 E 4395492 N

DISCUSSION

Hop Creek - Trend Study No. 16A-6

Study Information

This study is located adjacent to the Hop Creek bitterbrush browse transect, and is found on a broad ridge just north of Salt Creek Canyon [elevation: 6,300 feet (1,920 m), slope: 5%, aspect: southeast]. The vegetative composition is dominated by a mixed stand of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*) in association with a moderately diverse and vigorous herbaceous understory. This area is an important wintering area for deer and elk. Abundant evidence of big game use in the form of pellet groups and antler drops was found in 1983. Quadrat frequency from 1997 indicated moderate amounts of both deer and elk pellet groups at 34% and 24%, respectively. Pellet group transect data estimated high deer use at 146 deer days use/acre (360 ddu/ha) in 2002 and 147 deer days use (364 ddu/ha) in 2007. Elk use was estimated at 23 days use/acre (58 edu/ha) in 2002 and 2007. Most of the big game use appeared to be from the winter. Cattle use was estimated at 2 days use/acre (5 cdu/ha) in 2002 and 9 days use/acre (22 cdu/ha) in 2007.

Soil

The soil is classified within the Sheep Creek series (USDA-NRCS 2007). The soils in this series are moderately deep and well-drained. They are formed in residuum and colluvium derived from calcareous sandstone, limestone, and quartzite. The soil texture is a clay loam with a neutral pH (6.9). There is a caliche layer at a depth of approximately 10 to 12 inches (25 to 30 cm). The majority of the soil is covered by vegetation and litter. There are localized areas of bare ground that show signs of soil movement. However, the erosion condition was classified as stable in 2002 and 2007.

Browse

The majority of the browse is composed of mountain big sagebrush, which accounted for 63% to 71% of the total browse cover since 1997. Sagebrush density has fluctuated between an estimated 2,260 plants/acre (5,584 plants/ha) and 3,132 plants/acre (7,739 plants/ha) since the study began. Decadence increased from 12% of the population in 1997 to 34% in 2007. Recruitment was high each year the site was sampled until 2007, when it dropped from 33% of the population to 3%. Since 1983, plants showing poor vigor have steady increased to 22% of the population in 2007. Use has been mostly low-moderate, with occasional heavy use. Annual leader growth averaged 2.1 inches (5.3 cm) in 2002 and 1.5 inches (3.8 cm) in 2007.

Bitterbrush has accounted for 16% to 22% of the total browse cover since 1997. Its density is lower than that of sagebrush, and has been estimated between 399 plants/acre (986 plants/ha) and 540 plants/acre (1,334 plants/ha) since 1983. The age structure of the population shifted from 89% mature and 7% decadent in 1997 to 50% mature and 42% decadent in 2007. Recruitment has been low throughout the study. The majority of the plants are large and vigorous, and use is mostly heavy. Annual leader growth averaged 1 inch (2.5 cm) in 2002 and 1.2 inches (3.1 cm) in 2007. A few moderate-heavily used serviceberry (*Amelanchier alnifolia*) plants have also been sampled since 1997.

Utah juniper (*Juniperus osteosperma*) trees are also scattered throughout the site. Juniper density was 24 trees/acre (59 trees/ha) in 2002 and increased to 38 trees/acre (94 trees/ha) in 2007. Average trunk diameter was 8.5 inches (21.6 cm) in 2002 and 7.8 inches (19.8 cm) in 2007.

Herbaceous Understory

The herbaceous understory is diverse and productive. Total grass cover has averaged between 18% and 32% since 1997. The large majority of the grass cover is composed of perennial species. Perennial grasses provided 20% cover in 1997, 17% in 2002, and 26% in 2007. The most abundant perennial grasses are bluebunch wheatgrass (*Agropyron spicatum*), Sandberg bluegrass (*Poa secunda*), western wheatgrass

(*Agropyron smithii*), and Kentucky bluegrass (*Poa pratensis*). Cheatgrass (*Bromus tectorum*) nested frequency was low in 1997 and 2002, but increased significantly in 2007. This species provided less than 1% cover in 1997 and 2002, but approximately 7% cover and 20% of the total grass cover in 2007.

Forb cover increased from 8% in 1997 to 15% in 2007, and is rich in diversity. The cover of annual species has increased from 31% of the total forb cover in 1997 to 51% in 2007. Common species include pale alyssum (*Alyssum alyssoides*), tapertip hawksbeard (*Crepis acuminata*), draba (*Draba* sp.), western aster (*Aster chilensis*), bastard toadflax (*Comandra pallida*), Lewis flax (*Linum lewisii*), blue-eyed Mary (*Collinsia parviflora*), and bur buttercup (*Ranunculus testiculatus*).

1989 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from 3,132 plants/acre (7,739 plants/ha) to 2,598 plants/acre (6,420 plants/ha). Decadence increased from 13% to 33% of the population. Recruitment remained high, with 26% of the population composed of young plants. Plants displaying poor vigor increased from 0% to 8% of the population. Use also increased to light-moderate, with 5% of the plants showing heavy use. Bitterbrush density declined from 533 plants/acre (1,317 plants/ha) to 399 plants/acre (986 plants/ha). Decadence increased from 25% to 33% of the population, and no young plants were sampled. All of the sampled plants were vigorous, which is an improvement from 88% of the plants displaying poor vigor in 1983. Use was moderate-heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses did not change. However, mutton bluegrass (*Poa fendleriana*) and oniongrass (*Melica bulbosa*) both increased significantly in nested frequency. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased by 22%. However, most of the decrease was attributed to significant decreases in sego lily (*Calochortus nuttallii*) and bastard toadflax, neither of which are important forage species.

browse - slightly down (-1) grass - stable (0) forb - slightly down (-1)

1997 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density decreased 12% while bitterbrush density increased 35%, but these changes were partly caused by the lengthening of the baseline in 1997. Decadence decreased to 12% of the sagebrush population and 7% of the bitterbrush population, while the percentage of young plants sampled increased in both species. Eight percent of the sagebrush and 11% of the bitterbrush plants displayed poor vigor. Use remained light-moderate on sagebrush, and was mostly heavy on bitterbrush. Additionally, serviceberry was sampled for the first time at an estimated density of 100 plants/acre (247 plants/ha). These plants were mostly mature, with good recruitment and relatively low decadence. Eighty percent of the plants showed moderate use. The trend for grass is slightly up. The sum of nested frequency for perennial grasses increased 18%, with significant increases in bluebunch wheatgrass and Kentucky bluegrass. The trend for forbs is up. The sum of nested frequency for perennial forbs increased substantially, and several individual species increased significantly in nested frequency. The Desirable Components Index (DCI) was rated as good-excellent due to favorable browse cover with low decadence and high recruitment, and an understory dominated by perennial grasses and forbs.

winter range condition (DCI) - good-excellent (80) Mid-level potential scale
browse - stable (0) grass - slightly up (+1) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is slightly up. Sagebrush density increased from 2,300 plants/acre (5,681 plants/ha) to 3,120 plants/acre (7,706 plants/ha), all of which was due to increases in young and decadent plants. Decadence increased from 12% to 31% of the population. Plants displaying poor vigor increased slightly from 8% to 13% of the population, and use remained light-moderate. Bitterbrush density decreased slightly from 540 plants/acre (1,334 plants/ha) to 480 plants/acre (1,186 plants/ha). Decadence increased from 7% to 29%

of the population, and vigor was good. Ninety-two percent of the plants showed heavy use. Serviceberry density declined from 100 plants/acre (247 plants/ha) to 60 plants/acre (148 plants/ha), and all of the plants were mature and vigorous. Use increased to mostly moderate-heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. Kentucky bluegrass and mutton bluegrass decreased significantly in nested frequency while oniongrass increased significantly in nested frequency. However, perennial species continued to dominate the understory. Cheatgrass did not change significantly in nested frequency and continued to provide less than 1% cover. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 22%, while that for annual forbs increased 6%. Total forb cover remained relatively stable at 9%. The DCI rating declined to good due to increased decadence of preferred browse and a decrease in perennial forb cover.

winter range condition (DCI) - good (75) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased 28%, and decadence slightly increased from 31% to 34% of the population. Recruitment decreased from young plants comprising 33% of the population to only 3%. The majority of the loss in population is due to the loss of young plants. Plants displaying poor vigor increased from 13% to 22% of the population, and use remained light-moderate. Bitterbrush density increased 8%, and recruitment remained stable at 8% of the population. Decadence increased from 29% of the population to 42%, and 23% of the plants displayed poor vigor. Use remained mostly heavy. Serviceberry density was unchanged, but one-third of the sampled plants was young. Vigor remained good, and use shifted from moderate-heavy to mostly heavy. The trend for grass is slightly down. The sum of nested frequency for perennial grasses remained stable, and Sandberg bluegrass increased significantly in nested frequency. However, cheatgrass also increased significantly in nested frequency, and its average cover increased from 1% to 7%. The trend for forbs is up. The sum of nested frequency for perennial forbs increased 42%, with significant increases in desirable species such as tapertip hawksbeard, Lewis flax, and longleaf phlox (*Phlox longifolia*). Total forb cover increased from 9% to 15%. The DCI rating declined to fair due to increased decadence and decreased recruitment of preferred browse, and an increase in annual grass cover.

winter range condition (DCI) - fair (58) Mid-level potential scale
browse - slightly down (-1) grass - slightly down (-1) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 6

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron smithii	$_{b}$194	$_{b}$205	$_{a}$123	$_{a}$131	$_{a}$140	1.57	3.15	2.44
G	Agropyron spicatum	$_{a}$135	$_{a}$92	$_{b}$173	$_{b}$171	$_{b}$163	5.03	5.05	12.25
G	Bromus tectorum (a)	-	-	$_{a}$65	$_{a}$82	$_{b}$218	.67	.84	6.56
G	Festuca ovina	-	-	$_{a}$1	$_{a}$3	-	.03	.03	-
G	Melica bulbosa	$_{ab}$15	$_{c}$36	$_{a}$9	$_{bc}$33	$_{a}$3	.21	1.22	.06
G	Oryzopsis hymenoides	-	-	-	$_{a}$3	$_{a}$2	-	.15	.15
G	Poa bulbosa	-	-	-	-	3	-	-	.03
G	Poa fendleriana	$_{ab}$50	$_{c}$94	$_{bc}$71	$_{a}$27	$_{a}$34	1.61	.88	.60

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Poa pratensis	$_{a}$74	$_{a}$50	$_{b}$172	$_{a}$80	$_{a}$57	7.65	2.23	2.24
G	Poa secunda	$_{a}$35	$_{ab}$39	$_{bc}$84	$_{c}$115	$_{d}$181	2.47	2.80	7.68
G	Stipa comata	$_{b}$59	$_{b}$53	$_{ab}$36	$_{ab}$41	$_{a}$18	1.04	1.17	.35
Total for Annual Grasses		0	0	65	82	218	0.67	0.83	6.56
Total for Perennial Grasses		562	569	669	604	601	19.64	16.70	25.81
Total for Grasses		562	569	734	686	819	20.32	17.54	32.38
F	Achillea millefolium	-	1	-	-	-	-	-	-
F	Agoseris glauca	-	-	$_{a}$22	$_{a}$33	$_{a}$33	.11	.35	.18
F	Alyssum alyssoides (a)	-	-	$_{a}$120	$_{b}$162	$_{c}$297	.51	.83	4.46
F	Allium sp.	-	$_{a}$2	$_{a}$-	$_{a}$1	-	.00	.00	-
F	Antennaria rosea	$_{a}$1	$_{a}$7	$_{a}$5	$_{a}$7	$_{a}$7	.03	.04	.18
F	Arabis sp.	-	-	1	-	-	.00	-	-
F	Aster chilensis	$_{a}$2	$_{ab}$13	$_{bc}$25	$_{bc}$28	$_{c}$35	1.18	.90	1.14
F	Astragalus convallarius	$_{ab}$23	$_{c}$55	$_{a}$9	$_{a}$7	$_{bc}$34	.10	.02	.47
F	Astragalus sp.	-	-	$_{a}$1	$_{a}$2	-	.03	.00	-
F	Castilleja linariaefolia	$_{a}$4	-	$_{b}$31	$_{a}$8	$_{a}$9	.56	.08	.09
F	Camelina microcarpa (a)	-	-	$_{a}$8	-	$_{a}$6	.02	-	.01
F	Calochortus nuttallii	$_{c}$35	$_{a}$3	$_{a}$10	$_{bc}$36	$_{ab}$16	.03	.11	.04
F	Chenopodium album (a)	-	-	-	3	-	-	.00	-
F	Chaenactis douglasii	-	-	2	-	-	.01	-	-
F	Chorispora tenella (a)	-	-	-	2	-	-	.15	-
F	Cirsium undulatum	$_{a}$3	$_{a}$3	$_{a}$18	$_{a}$16	$_{a}$13	.23	.33	.30
F	Collomia linearis (a)	-	-	$_{b}$45	$_{b}$26	$_{a}$7	.12	.06	.01
F	Conringia orientalis (a)	1	-	-	-	-	-	-	-
F	Comandra pallida	$_{d}$123	$_{ab}$51	$_{cd}$91	$_{a}$30	$_{bc}$83	.91	.18	.73
F	Collinsia parviflora (a)	-	-	$_{b}$171	$_{b}$183	$_{a}$119	1.26	2.20	.43
F	Crepis acuminata	$_{a}$1	$_{a}$5	$_{b}$45	$_{b}$69	$_{c}$107	.48	1.25	1.58
F	Cymopterus longipes	-	$_{a}$6	$_{b}$50	$_{b}$42	-	.35	.49	-
F	Descurainia pinnata (a)	-	-	$_{a}$3	$_{a}$6	$_{a}$6	.00	.01	.01
F	Draba sp. (a)	-	-	$_{a}$3	-	$_{b}$72	.00	-	1.39
F	Epilobium brachycarpum (a)	-	-	$_{a}$38	$_{a}$24	$_{a}$27	.07	.08	.11
F	Eriogonum racemosum	$_{a}$5	$_{a}$3	$_{a}$1	$_{a}$4	$_{a}$1	.00	.06	.01
F	Eriogonum umbellatum	-	$_{a}$3	$_{a}$3	$_{a}$3	$_{a}$3	.06	.00	.15
F	Erysimum sp.	-	-	1	-	-	.00	-	-
F	Galium sp.	-	-	-	1	-	-	.00	-
F	Lappula occidentalis (a)	-	-	-	2	-	-	.00	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Lactuca serriola	-	$_{a}$4	$_{a}$3	-	$_{a}$5	.00	-	.01
F	Linum lewisii	$_{a}$25	$_{a}$3	$_{b}$91	$_{a}$21	$_{b}$61	.62	.11	.69
F	Lomatium sp.	-	-	-	-	46	-	-	.52
F	Lupinus argenteus	-	-	$_{a}$2	$_{a}$1	$_{a}$2	.38	.00	.15
F	Machaeranthera canescens	-	-	-	1	-	-	.00	-
F	Microsteris gracilis (a)	-	-	$_{a}$8	$_{b}$39	$_{b}$44	.01	.11	.15
F	Phlox longifolia	-	$_{a}$11	$_{bc}$38	$_{ab}$27	$_{c}$46	.07	.19	.32
F	Polygonum douglasii (a)	-	-	$_{a}$3	$_{a}$4	$_{a}$4	.01	.01	.01
F	Ranunculus testiculatus (a)	-	-	$_{ab}$74	$_{a}$48	$_{b}$91	.52	.48	.88
F	Sphaeralcea coccinea	-	$_{a}$7	$_{a}$3	$_{a}$1	-	.00	.00	-
F	Tragopogon dubius	$_{a}$13	$_{a}$10	$_{a}$16	$_{a}$15	$_{a}$13	.10	.13	.25
F	Zigadenus paniculatus	$_{a}$5	-	$_{ab}$24	$_{b}$32	$_{b}$33	.22	.26	.26
Total for Annual Forbs		1	0	473	499	673	2.55	3.96	7.48
Total for Perennial Forbs		240	187	492	385	547	5.57	4.57	7.13
Total for Forbs		241	187	965	884	1220	8.13	8.54	14.61

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

BROWSE TRENDS --
Management unit 16A, Study no: 6

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier alnifolia	4	3	3	.15	.38	.53
B	Artemisia tridentata vaseyana	56	72	67	9.17	9.92	9.13
B	Chrysothamnus viscidiflorus viscidiflorus	10	16	14	.18	.34	.09
B	Gutierrezia sarothrae	14	23	13	.07	1.24	.06
B	Juniperus osteosperma	0	0	0	.85	.78	.78
B	Purshia tridentata	22	19	22	2.97	2.51	1.98
B	Tetradymia canescens	3	9	9	.03	.48	.18
Total for Browse		109	142	128	13.44	15.67	12.77

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 6

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	-	.16
Artemisia tridentata vaseyana	-	13.63
Chrysothamnus viscidiflorus viscidiflorus	-	.55
Gutierrezia sarothrae	-	.26
Juniperus osteosperma	.01	3.90
Purshia tridentata	-	2.29
Tetradymia canescens	-	.13

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 6

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.1	1.5
Purshia tridentata	1.0	1.2

POINT-QUARTER TREE DATA --
Management unit 16A, Study no: 6

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	24	38

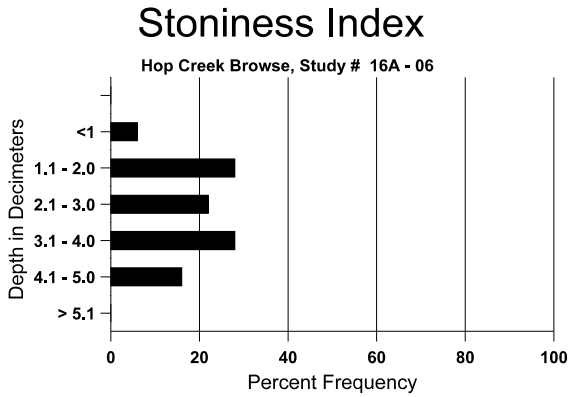
Average diameter (in)	
'02	'07
8.5	7.8

BASIC COVER --
Management unit 16A, Study no: 6

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	4.75	11.75	44.00	43.48	57.77
Rock	.25	.25	.19	.15	.05
Pavement	.50	0	1.93	1.25	1.25
Litter	71.25	69.75	51.30	51.80	41.67
Cryptogams	1.25	1.50	4.62	2.62	3.05
Bare Ground	22.00	16.75	17.71	17.85	14.58

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 06, Hop Creek Browse

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
20.2	44.0 (17.6)	6.9	42.4	27.1	30.6	3.2	9.6	67.2	.6



PELLET GROUP DATA --
Management unit 16A, Study no: 6

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	4	18	44
Elk	24	17	19
Deer	34	43	64
Cattle	-	1	-

Days use per acre (ha)	
'02	'07
-	-
23 (56)	23 (58)
146 (360)	142 (364)
2 (5)	9 (22)

BROWSE CHARACTERISTICS --
Management unit 16A, 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)
Amelanchier alnifolia												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**100**	-	20	60	20	20	80	0	20	20	20	30/31
02	**60**	-	-	60	-	-	33	33	0	-	0	31/32
07	**60**	-	20	40	-	-	0	67	0	-	0	41/41

		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												
83	**3132**	200	666	2066	400	-	11	0	13	-	0	31/36
89	**2598**	-	666	1066	866	-	23	5	33	-	8	29/33
97	**2300**	40	760	1260	280	620	29	4	12	8	8	33/45
02	**3120**	20	1020	1120	980	740	27	5	31	13	13	30/39
07	**2260**	200	60	1440	760	540	27	9	34	18	22	30/37
Chrysothamnus nauseosus consimilis												
83	**66**	-	66	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Chrysothamnus viscidiflorus viscidiflorus												
83	**66**	-	-	66	-	-	0	0	0	-	0	8/10
89	**66**	-	-	66	-	-	0	0	0	-	0	10/14
97	**300**	-	-	300	-	-	0	0	0	-	0	13/22
02	**740**	-	100	560	80	-	0	3	11	8	8	11/18
07	**640**	-	160	420	60	20	13	9	9	6	6	14/19
Gutierrezia sarothrae												
83	**66**	-	-	66	-	-	0	0	0	-	0	11/19
89	**866**	-	200	600	66	-	0	0	8	-	0	8/6
97	**840**	20	300	500	40	-	0	0	5	5	5	7/7
02	**1780**	-	100	1440	240	60	0	0	13	1	1	6/11
07	**480**	-	60	380	40	-	4	0	8	4	33	9/12
Juniperus osteosperma												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	20	-	-	-	-	0	0	-	-	0	-/-
Purshia tridentata												
83	**533**	-	-	400	133	-	0	100	25	-	88	44/38
89	**399**	-	-	266	133	-	50	50	33	-	0	38/44
97	**540**	40	20	480	40	80	15	70	7	7	11	38/54
02	**480**	-	40	300	140	140	4	92	29	4	4	41/48
07	**520**	20	40	260	220	80	15	85	42	23	23	45/52

		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)
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	16/24
Tetradymia canescens												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**133**	-	133	-	-	-	0	0	0	-	0	-/-
97	**80**	-	-	80	-	-	0	0	0	-	0	14/11
02	**260**	-	40	220	-	-	0	8	0	-	0	11/16
07	**220**	-	-	200	20	-	27	9	9	-	9	10/17

Trend Study 16A-7-07

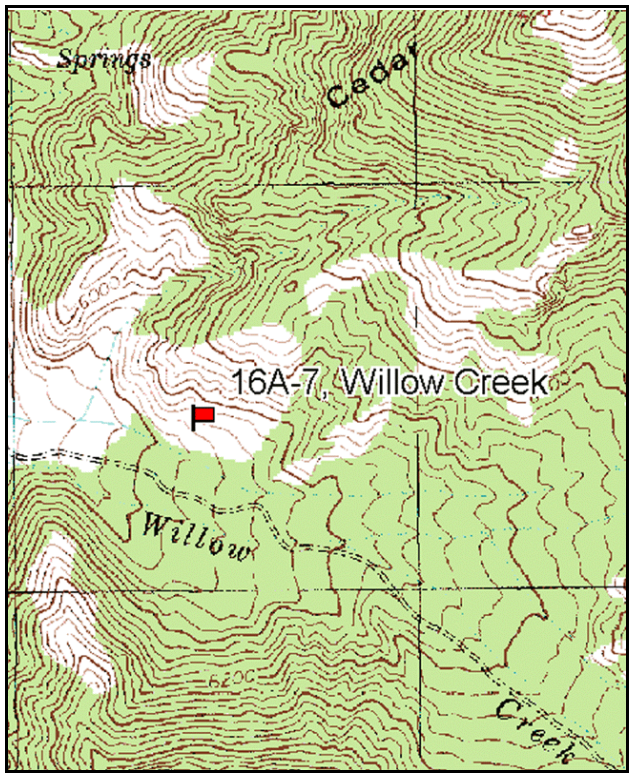
Study site name: Willow Creek . Vegetation type: Stansbury Cliffrose .

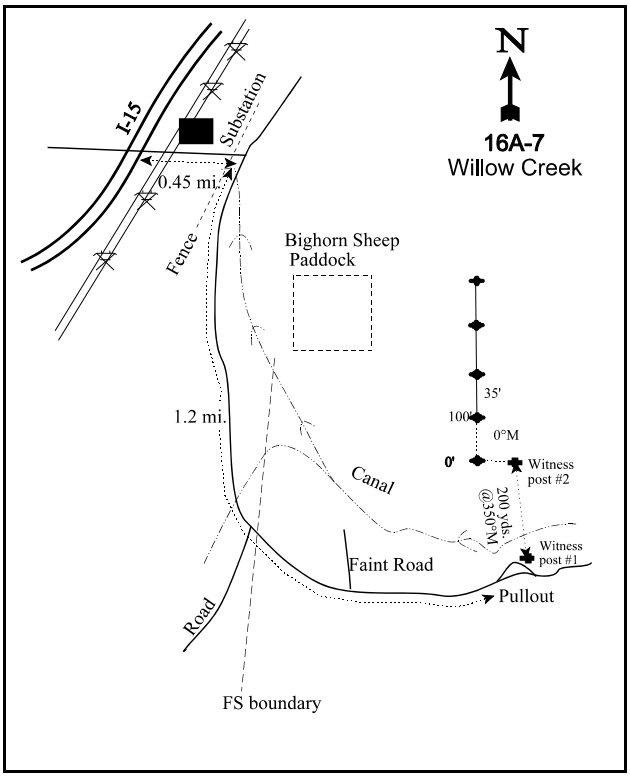
Compass bearing: frequency baseline 0 degrees magnetic.

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

LOCATION DESCRIPTION

Beginning at the east side of the underpass where Cemetery Road passes over I-15 southeast of Mona, proceed east for 0.45 miles to an intersection. Take the right fork and proceed 1.2 miles to the witness post staying on the main road. From this point, walk 200 yards at 350 degrees magnetic to the witness post (you will need to cross the irrigation canal). The 0-foot baseline stake is 3 paces west of the witness post. It is a green fencepost with a red browse tag, number 3958, attached. The baseline runs at an azimuth of 0 degrees magnetic.





Map Name: Mona

Diagrammatic Sketch

Township 12S , Range 1E , Section 3

GPS: NAD 83, UTM 12S 430382 E 4405594 N

DISCUSSION

Willow Creek - Trend Study No. 16A-7

Study Information

This study is located at the mouth of Willow Creek Canyon, within the Uinta National Forest [elevation: 5,900 feet (1,798 m), slope: 42%, aspect: southwest]. Unfenced, private land lies immediately to the west. The study samples a Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) community that is considered critical deer and elk winter range. A fire burned approximately 0.5 miles (0.8 km) to the south in 2001. In 1997, quadrat frequency of elk pellet groups was moderately high at 32%, and deer pellet frequency was lower at 11%. Deer use was estimated at 88 days use/acre (217 ddu/ha) in 2002 and 122 days use/acre (301 ddu/ha) in 2007. Elk use was estimated at 36 days use/acre (89 edu/ha) in 2002 and 13 days use/acre (33 edu/ha) in 2007. Most of the deer pellet groups appeared to be from winter use, while most of the elk use was late winter to early spring.

Soil

The soil is classified as the Yeates Hollow series (USDA-NRCS 2007). The soils in this series are deep and well-drained to moderately well-drained. They formed in alluvium, colluvium, and residuum from conglomerate, sandstone, and quartzite. The soil texture is a sandy loam with a neutral pH (7.0). Organic matter is limited at only 1.8%. Soil phosphorus is also moderately low at 6.4 ppm. When the study was established, the soil surface appeared highly eroded, with 21% bare ground and 12% pavement cover. By 2007, relative vegetative cover was 36%, with 10% bare ground and 15% pavement relative cover. Pedestalling was common, but erosion appeared localized. The erosion condition was classified as slight in 2002 and 2007.

Browse

Stansbury cliffrose is the preferred browse species, and has provided 85% to 92% of the total browse cover since the baseline was lengthened in 1997. Density steadily increased from 580 plants/acre (1,433 plants/ha) in 1997 to 1,040 plants/acre (2,570 plants/ha) in 2007. The population was largely mature until 2007, when 46% of the plants were classified as decadent. Recruitment has been low throughout the study. Vigor has been good on most individuals, with 16% and 10% of the population showing poor vigor in 2002 and 2007, respectively. Use was moderate-heavy in 1983 and 1989, and over 90% of the plants have displayed heavy use since 1997. Annual leader growth averaged 1.1 inches (2.8 cm) in 2002 and 2007. Other browse species, such as mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), bitterbrush (*Purshia tridentata*), fourwing saltbush (*Atriplex canescens*), and white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), are found in low densities and have displayed moderate-heavy use.

Herbaceous Understory

The herbaceous understory is dominated by cheatgrass (*Bromus tectorum*), which comprised 46% to 62% of the total herbaceous cover between 1997 and 2007. It provided 17% cover in 1997, 15% in 2002, and 16% in 2007. Perennial grasses have increased from 6% cover in 1997 to 7% in 2002 and 12% in 2007. The most abundant perennial grass is bluebunch wheatgrass (*Agropyron spicatum*), which composed 25% of the total grass cover in 2002 and 26% in 2007. Bulbous bluegrass (*Poa bulbosa*), a low-value perennial, is also fairly abundant. It has increased in average cover from 1% to 4% since 1997.

The forb composition is poor and is dominated by annuals. The most abundant forb species are pale alyssum (*Alyssum alyssoides*) and storksbill (*Erodium cicutarium*), which has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003). Scarlet globemallow (*Sphaeralcea coccinea*) and heath aster (*Leucelene ericoides*) are the most abundant perennial species, but occur infrequently.

1989 TREND ASSESSMENT

The trend for browse is stable. Cliffrose density increased slightly from 965 plants/acre (2,384 plants/ha) to 1,033 plants/acre (2,552 plants/ha). Decadence increased from 7% of the population to 39%. Young plants composed 10% of the population, which increased from 3%. All of the plants were vigorous and use was moderate-heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. Bulbous bluegrass and Sandberg bluegrass (*Poa secunda*) were sampled for the first time, but in low frequencies. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little. Forbs were sampled infrequently and provided little forage.

browse - stable (0) grass - stable (0) forb - stable (0)

1997 TREND ASSESSMENT

The trend for browse is slightly down. Cliffrose density decreased 44%, however, this change partly reflects the increase in sampling area. Decadence decreased from 39% in 1989 to 3% in 1997, and no young plants were sampled. Vigor remained excellent, and 93% of the plants displayed heavy use. The trend for grass is down. The sum of nested frequency for perennial grasses, excluding bulbous bluegrass, decreased 22%. Bluebunch wheatgrass decreased significantly in nested frequency. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little. The Desirable Components Index (DCI) was rated as very poor-poor due to high annual grass cover, low perennial understory cover, and low recruitment of preferred browse.

winter range condition (DCI) - very poor-poor (37) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - stable (0)

2002 TREND ASSESSMENT

The trend for browse is slightly up. Cliffrose density increased from 580 plants/acre (1,433 plants/ha) to 880 plants/acre (2,174 plants/ha). Decadence increased from 3% to 23%, and plants displaying poor vigor increased from 0% to 16% of the population. Use remained heavy. Sagebrush, bitterbrush, and fourwing saltbush were sampled in low densities and also showed some heavy use. The trend for grass is slightly down. The sum of nested frequency for perennial grasses decreased 13%. Cheatgrass remained the dominant grass species and bulbous bluegrass increased significantly in nested frequency. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little. Although pale alyssum decreased significantly in nested frequency, it remained the most abundant forb. Storksbill increased significantly in nested frequency. The DCI continued to be rated as very poor-poor.

winter range condition (DCI) - very poor-poor (35) Mid-level potential scale
browse - slightly up (+1) grass - slightly down (-1) forb - stable (0)

2007 TREND ASSESSMENT

The trend for browse is stable. Cliffrose density increased 18%, while cover decreased from 15% to 11%. Decadence doubled to 46% of the population. Recruitment remained low, with only 6% of the population consisting of young plants. Plants displaying poor vigor decreased slightly from 16% to 10% of the population. Use remained heavy. The sagebrush density remained stable, and half of sampled plants displayed heavy use. The trend for grass is stable. The sum of nested frequency for perennial grasses increased 9%. However, cheatgrass cover increased from 14% to 16%. Bulbous bluegrass cover increased almost three-fold since 2002. The trend for forbs is stable. The sum of nested frequency for perennial forbs did not change, while storksbill increased significantly in nested frequency. The DCI rating declined to very poor due to a decrease in cover and increase in decadence of preferred browse.

winter range condition (DCI) - very poor (26) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 7

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{b}$198	$_{b}$191	$_{a}$132	$_{a}$121	$_{a}$135	4.17	5.55	7.18
G	Bromus japonicus (a)	-	-	-	19	-	-	.39	-
G	Bromus tectorum (a)	-	-	$_{b}$354	$_{ab}$336	$_{a}$335	17.42	14.48	15.65
G	Festuca myuros (a)	-	-	$_{a}$6	-	$_{a}$4	.03	-	.00
G	Poa bulbosa	-	$_{a}$10	$_{a}$32	$_{b}$58	$_{b}$85	1.23	1.50	4.28
G	Poa secunda	-	$_{a}$12	$_{a}$27	$_{a}$17	$_{a}$16	.13	.11	.26
Total for Annual Grasses		0	0	360	355	339	17.45	14.87	15.66
Total for Perennial Grasses		198	213	191	196	236	5.53	7.17	11.73
Total for Grasses		198	213	551	551	575	22.99	22.04	27.39
F	Agoseris glauca	-	-	-	1	-	-	.00	-
F	Alyssum alyssoides (a)	-	-	$_{b}$291	$_{a}$212	$_{a}$217	3.07	.82	2.46
F	Artemisia ludoviciana	$_{a}$5	$_{a}$6	$_{a}$6	$_{a}$3	-	.06	.03	-
F	Astragalus cibarius	-	-	-	-	3	-	-	.03
F	Asclepias sp.	-	-	-	5	-	-	.18	-
F	Astragalus utahensis	$_{a}$2	$_{a}$5	$_{a}$11	$_{a}$-	$_{a}$2	.24	.00	.03
F	Camelina microcarpa (a)	-	-	3	-	-	.00	-	-
F	Calochortus nuttallii	1	-	-	-	-	-	-	-
F	Cerastium sp.	-	3	-	-	-	-	-	-
F	Cirsium vulgare	$_{a}$1	$_{a}$6	-	-	-	-	-	-
F	Cryptantha sp.	$_{a}$4	$_{a}$2	-	-	-	-	-	-
F	Descurainia pinnata (a)	-	-	$_{a}$8	$_{a}$2	$_{a}$8	.03	.01	.05
F	Draba sp. (a)	-	-	-	-	4	-	-	.01
F	Eriogonum brevicaule	$_{a}$3	$_{a}$4	$_{a}$7	-	-	.06	-	-
F	Erodium cicutarium (a)	-	-	$_{a}$35	$_{b}$93	$_{c}$141	.18	1.67	2.69
F	Erigeron pumilus	$_{a}$34	$_{a}$47	-	-	-	-	-	-
F	Eriogonum umbellatum	-	-	-	-	1	-	-	.03
F	Galium aparine (a)	-	-	$_{a}$8	-	$_{a}$1	.01	-	.00
F	Haplopappus acaulis	-	-	-	-	-	-	-	.03
F	Hackelia patens	-	-	6	-	-	.02	-	-
F	Holosteum umbellatum (a)	-	-	-	$_{a}$3	$_{a}$5	-	.00	.01
F	Lappula occidentalis (a)	-	-	-	$_{a}$1	$_{b}$17	-	.00	.05
F	Lactuca serriola	-	-	$_{a}$1	$_{a}$2	$_{a}$8	.00	.00	.02
F	Leucelene ericoides	-	-	$_{a}$14	$_{a}$18	$_{a}$18	.26	.19	.39
F	Lygodesmia grandiflora	$_{a}$9	-	-	-	$_{a}$5	-	-	.06
F	Oenothera sp.	-	-	1	-	-	.03	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Penstemon sp.	-	-	-	1	-	-	.03	-
F	Phlox longifolia	-	$_{a}$4	$_{a}$3	$_{a}$3	$_{a}$1	.01	.15	.03
F	Sphaeralcea coccinea	$_{a}$8	$_{a}$14	$_{ab}$26	$_{b}$31	$_{ab}$22	.98	.59	.42
F	Taraxacum officinale	-	-	3	-	-	.00	-	-
F	Tragopogon dubius	-	-	-	-	3	-	-	.00
Total for Annual Forbs		0	0	345	311	393	3.30	2.51	5.28
Total for Perennial Forbs		67	91	78	64	63	1.68	1.19	1.06
Total for Forbs		67	91	423	375	456	4.98	3.70	6.34

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

BROWSE TRENDS --
Management unit 16A, Study no: 7

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	2	2	2	.53	.91	.38
B	Atriplex canescens	0	1	0	-	-	-
B	Chrysothamnus nauseosus albicaulis	13	3	3	1.04	.53	.30
B	Cowania mexicana stansburiana	21	33	26	14.32	14.97	10.62
B	Gutierrezia sarothrae	27	16	17	.39	1.25	.24
B	Purshia tridentata	0	1	0	-	-	-
Total for Browse		63	56	48	16.29	17.66	11.55

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 7

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	.86
Chrysothamnus nauseosus	-	.18
Chrysothamnus nauseosus albicaulis	-	1.25
Cowania mexicana stansburiana	.33	23.03
Gutierrezia sarothrae	-	.08

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 7

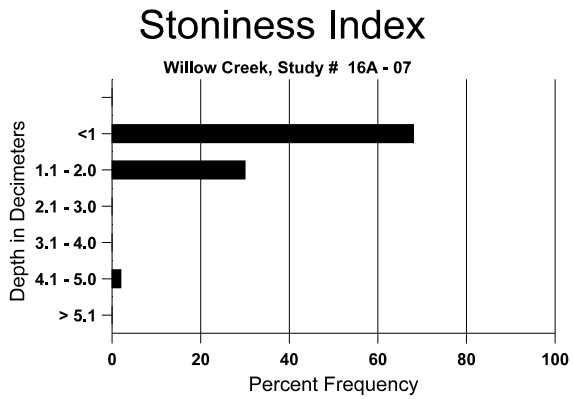
Species	Average leader growth (in)	
	'02	'07
Cowania mexicana stansburiana	1.1	1.1

BASIC COVER --
Management unit 16A, Study no: 7

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	1.25	8.75	40.62	40.11	41.18
Rock	4.00	8.00	7.40	7.74	9.30
Pavement	11.50	29.75	15.57	16.68	17.24
Litter	62.25	44.75	40.29	36.85	35.05
Cryptogams	0	0	.14	0	.07
Bare Ground	21.00	8.75	12.06	18.06	11.79

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 07, Willow Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
17.4	54.8 (14.6)	7.0	58.4	25.1	16.6	1.8	6.4	38.4	.6



PELLET GROUP DATA --
Management unit 16A, Study no: 7

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	-	2
Elk	32	19	6
Deer	11	30	35

Days use per acre (ha)	
'02	'07
-	-
36 (89)	13 (33)
88 (217)	122 (301)

BROWSE CHARACTERISTICS --
Management unit 16A, Study no: 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)
Artemisia tridentata vaseyana												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**40**	-	-	40	-	480	50	0	0	-	0	28/50
02	**40**	-	-	20	20	40	0	50	50	-	0	32/54
07	**40**	-	-	20	20	20	0	50	50	-	50	25/43
Atriplex canescens												
83	**33**	-	-	-	33	-	0	0	100	-	100	-/-
89	**33**	-	-	33	-	-	0	0	0	-	0	43/39
97	**0**	-	-	-	-	-	0	0	0	-	0	59/46
02	**20**	-	-	20	-	-	0	100	0	-	0	48/69
07	**0**	-	-	-	-	-	0	0	0	-	0	78/65
Brickellia sp.												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**666**	-	100	566	-	-	0	0	-	-	0	6/5
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Chrysothamnus nauseosus albicaulis												
83	**66**	-	-	66	-	-	0	0	0	-	0	31/51
89	**66**	-	-	33	33	-	0	0	50	-	0	41/31
97	**320**	-	40	280	-	20	31	44	0	-	0	29/51
02	**60**	-	-	-	60	-	67	0	100	33	33	24/38
07	**60**	-	-	20	40	80	0	0	67	-	0	31/45
Chrysothamnus viscidiflorus viscidiflorus												
83	**33**	-	-	33	-	-	0	0	-	-	0	14/17
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	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)
Cowania mexicana stansburiana												
83	**965**	-	33	866	66	-	21	38	7	-	3	52/53
89	**1033**	-	100	533	400	-	39	32	39	-	0	81/84
97	**580**	20	-	560	20	100	7	93	3	-	0	56/66
02	**880**	-	20	660	200	100	0	95	23	16	16	64/67
07	**1040**	-	60	500	480	60	4	94	46	2	10	68/70
Gutierrezia sarothrae												
83	**266**	-	-	266	-	-	0	0	0	-	0	13/14
89	**566**	-	-	533	33	-	0	0	6	6	12	8/10
97	**1780**	20	880	880	20	20	0	0	1	-	0	11/11
02	**520**	-	20	260	240	320	0	0	46	38	38	7/10
07	**680**	-	260	420	-	-	0	0	0	-	0	11/17
Purshia tridentata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	78/194
02	**20**	-	20	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	29/45
02	**0**	-	-	-	-	-	0	0	-	-	0	72/57
07	**0**	-	-	-	-	-	0	0	-	-	0	76/53
Rhus trilobata												
83	**166**	-	100	66	-	-	0	0	0	-	0	24/24
89	**133**	-	-	33	100	-	0	0	75	-	75	28/30
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**0**	-	-	-	-	-	0	0	0	-	0	53/114
07	**0**	-	-	-	-	-	0	0	0	-	0	-/-

Trend Study 16A-8-07

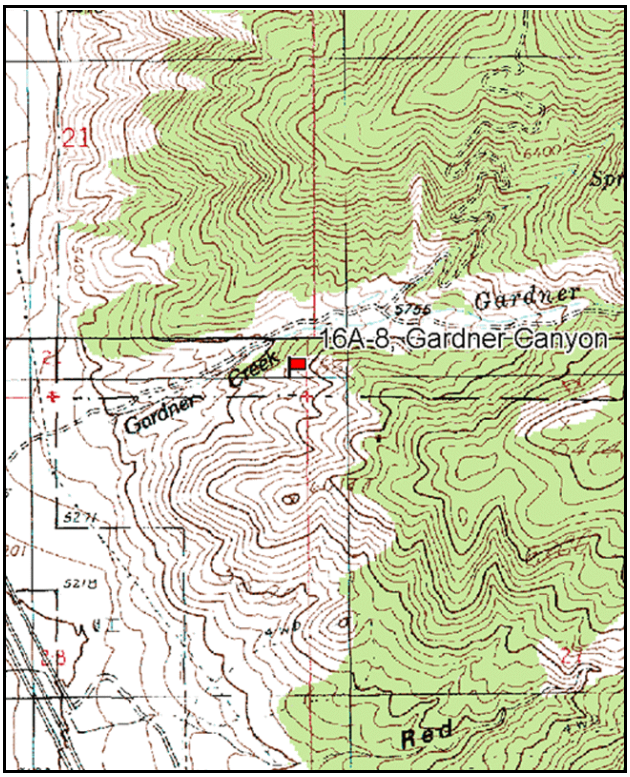
Study site name: Gardner Canyon . Vegetation type: Stansbury Cliffrose .

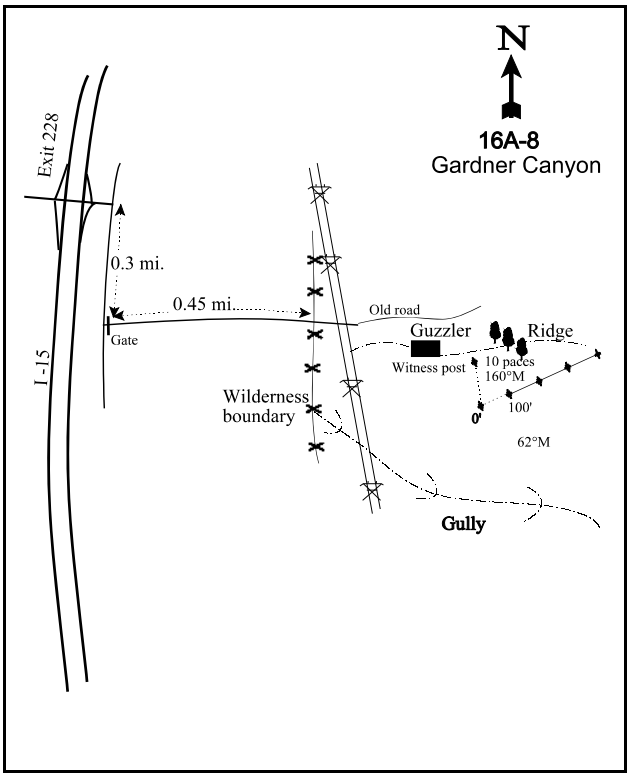
Compass bearing: frequency baseline 62 degrees magnetic.

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

LOCATION DESCRIPTION

From exit #228 off of I-15, turn south on the frontage road and drive 0.3 miles to an intersection with a gate. Turn left at the intersection and drive 0.45 miles to the wilderness boundary fence. Walk up the old road under some powerlines. To the south, and perpendicular to the road, is a steep slope with a Gambel oak and cliffrose community. Walk up the slope to a guzzler on the ridgetop. The witness post lies 75 yards up the ridge from the guzzler. From the witness post, the 0-foot stake is 10 paces at an azimuth of 160 degrees magnetic. The study is marked by green steel "T" fenceposts 12 to 13 inches in height. The 0-foot stake has a red browse tag, number 3964, attached.





Map Name: Nephi

Diagrammatic Sketch

Township 12S , Range 1E , Section 28

GPS: NAD 83, UTM 12S 429752 E 4400202 N

DISCUSSION

Gardner Canyon - Trend Study No. 16A-8

Study Information

This study is located on critical winter range between I-15 and Mt. Nebo. It lies on UDWR land, near the guzzler in Gardner Canyon [elevation: 5,700 feet (1,737 m), slope: 45%, aspect: west]. To the northeast of the study is U.S. Forest Service wilderness area. These foothills are heavily used by deer and elk, and carcasses were found in the area during the 1989 and 2007 readings. Deer and elk pellet groups were moderately abundant in 1997 with quadrat frequencies of 21% and 20%, respectively. Pellet group transect data estimated 70 deer days use/acre (172 ddu/ha) in 2002 and 101 deer days use/acre (250 ddu/ha) in 2007. Elk use was estimated at 24 elk days use/acre (60 edu/ha) in 2002 and 19 elk days use/acre (48 edu/ha) in 2007.

Soil

The soil is classified within the Lundy series (USDA-NRCS 2007). The soils in this series are shallow and well-drained. They formed in residuum and colluvium from limestone and shale. There is an abundance of large and small rocks on the surface. The soil texture is a loam with a neutral pH (7.0). Organic matter is limited at only 1.6%, and phosphorus is also low at 4.4 ppm. Values less than 6 ppm may be limiting to plant growth and development (Tiedemann and Lopez 2004). The majority of the soil is covered by vegetation and litter, however, relative bare ground cover has been moderate at 16% in 1997, 23% in 2002, and 15% in 2007. Some erosion is occurring due to the steep slope. The erosion condition was classified as slight in 2002 and 2007 due to pedestalling, flow patterns, gullies, and apparent soil movement.

Browse

The preferred browse species are Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) and true mountain mahogany (*Cercocarpus montanus*). A few moderately-heavily hedged mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) plants were sampled from 1983 to 1997, but by 2002, these plants had died.

Cliffrose has provided 36% to 54% of the total browse cover since 1997. After the baseline was lengthened in 1997, its density has steadily declined from 600 plants/acre (1,482 plants/ha) to 440 plants/acre (1,087 plants/ha). The population has been mostly mature, with relatively high decadence and low reproduction and recruitment. Plants displaying poor vigor increased from less than 10% of the population in 1997 and 2002 to 23% in 2007. The average height of mature plants is approximately 4 feet (1.2 m), making most plants available for wildlife use. Use has been mostly heavy since the study began in 1983. Annual leader growth averaged 1.5 inches (3.8 cm) in 2002 and 1.6 inches (4.1 cm) in 2007.

Mountain mahogany has provided 27% to 41% of the total browse cover since 1997. Its density is lower than that of cliffrose, having fluctuated between 200 plants/acre (494 plants/ha) and 300 plants/acre (741 plants/ha) in the past 10 years. Most plants have been mature. Decadence was low in 1997, but increased to 33% in 2002, and remained stable in 2007. No seedlings have been sampled since 1983, and young plants were sampled in low densities only in 1989 and 1997. The population was vigorous throughout the study until 2007, when 20% of the plants displayed poor vigor. The average height of mature plants in 2007 was 5.5 feet (1.7 m). Use of the available portions of the plants has been moderate-heavy. Annual leader growth averaged 1.6 inches (4.1 cm) in 2002 and 2.1 inches (5.3 cm) in 2007.

Herbaceous Understory

The understory composition is dominated by annuals, biennials, and low-value perennials. Total grass cover was 19% in 1997, 18% in 2002, and 21% in 2007. Cheatgrass (*Bromus tectorum*) is the dominant grass species, and has provided 9%-12% cover since 1997. The most abundant perennial grass is bluebunch wheatgrass (*Agropyron spicatum*), which provided 43% of the total grass cover in 2002 and 41% in 2007.

Forbs provided 5%-7% cover from 1997 to 2007. Pale alyssum (*Alyssum alyssoides*) and storksbill (*Erodium cicutarium*) together have provided 57%-86% of the total forb cover since 1997. Storksbill is an introduced species that outcompetes and prevents the establishment of native species (Buchanan et al. 1978). Scarlet globemallow (*Sphaeralcea coccinea*) is the most abundant perennial forb, and has provided less than 2% cover since 1997.

1989 TREND ASSESSMENT

The trend for browse is stable. Cliffrose density remained at 966 plants/acre (2,386 plants/ha), but decadence increased from 21% of the population to 52%. Recruitment also increased, with 24% of the population composed of young plants. Twenty-four percent of the sampled plants displayed poor vigor. The density of mahogany increased from 333 plants/acre (823 plants/ha) to 466 plants/acre (1,151 plants/ha). Recruitment increased to 21% of the population consisting of young plants, and no decadent plants were sampled. All of the sampled plants were vigorous. Sagebrush was sampled at a density of 66 plants/acre (163 plants/ha), and all of the plants were decadent and showed poor vigor. Cliffrose, mahogany, and sagebrush were all moderately-heavily hedged. The trend for grass is stable. The only perennial grass sampled in 1989 was bluebunch wheatgrass, which remained stable in nested frequency. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little, but the number of forb species sampled decreased from 10 to only five.

browse - stable (0) grass - stable (0) forb - stable (0)

1997 TREND ASSESSMENT

The trend for browse is stable. Preferred browse density decreased, but this change was partly attributed to the increase in sampling area. Cliffrose decadence decreased from 52% of the population to 23%. Recruitment also decreased, but was still good, with 10% of the population consisting of young plants. The majority of the mahogany population was mature, with 8% consisting of young plants and 8% decadence. The cliffrose and mahogany populations were vigorous, and use was mostly heavy. Forty decadent sagebrush plants/acre (99 plants/ha) were sampled, and were classified as dying. The trend for grass is stable. The sum of nested frequency for perennial grass changed very little, and was composed primarily of bluebunch wheatgrass. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased 16%. The Desirable Components Index (DCI) was rated as very poor-poor due to low preferred browse cover and an understory dominated by annual species.

winter range condition (DCI) - very poor-poor (35) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - slightly down (-1)

2002 TREND ASSESSMENT

The trend for browse is stable. Cliffrose density decreased from 600 plants/acre (1,482 plants/ha) to 500 plants/acre (1,235 plants/ha), while young recruitment decreased from 10% to 4% of the population. Decadence remained relatively stable at 20% of the population. Vigor was good and use was mostly heavy. Mahogany density increased from 240 plants/acre (593 plants/ha) to 300 plants/acre (741 plants/ha), but decadence also increased from 8% to 33% of the population. No young mahogany plants were sampled. Only 7% of the sampled plants displayed poor vigor, and use was moderate-heavy. No living sagebrush plants were sampled. The trend for grass is slightly down. The sum of nested frequency for perennial grasses decreased 15%, and bluebunch wheatgrass decreased significantly in nested frequency. However, cheatgrass nested frequency also decreased significantly. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased 15%, while the frequency of annual species increased 10%. The DCI rating remained very poor-poor.

winter range condition (DCI) - very poor-poor (36) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - slightly down (-1)

2007 TREND ASSESSMENT

The trend for browse is slightly down. Cliffrose and mahogany densities decreased by 12% and 33%, respectively. Cliffrose decadence increased from 20% to 32%. There was no young recruitment in the cliffrose and mahogany populations, although one young sagebrush plant was sampled. Plants showing poor vigor increased to approximately 20% of the preferred browse, and use was mostly heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. The total grass cover increased slightly from 18% to 21%, however, most of this increase was attributed to an increase in cheatgrass. The trend for forbs is slightly up. The sum of nested frequency for perennial forbs increased 36%. The majority of this increase was attributed to a significant increase in the nested frequency of scarlet globemallow. However, forb composition remained poor. The DCI rating declined to very poor due to high decadence and low recruitment of preferred browse.

winter range condition (DC Index) - very poor (31) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 8

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	ab234	b231	b227	a187	a176	7.66	7.83	8.78
G	Bromus japonicus (a)	-	-	-	-	3	-	-	.00
G	Bromus tectorum (a)	-	-	b344	a296	a320	11.33	9.32	11.89
G	Festuca myuros (a)	-	-	a3	a6	a9	.00	.18	.07
G	Poa bulbosa	-	-	a1	ab5	13	.00	.64	.48
G	Poa pratensis	2	-	-	-	-	-	-	-
G	Poa secunda	a1	-	-	a6	a-	-	.04	.00
Total for Annual Grasses		0	0	347	302	332	11.34	9.50	11.97
Total for Perennial Grasses		237	231	228	198	189	7.67	8.51	9.27
Total for Grasses		237	231	575	500	521	19.01	18.02	21.24
F	Alyssum alyssoides (a)	-	-	b350	a303	a312	5.48	1.82	3.84
F	Asclepias sp.	-	-	-	-	-	-	.03	-
F	Astragalus sp.	-	2	-	-	-	-	-	-
F	Calochortus nuttallii	a3	-	a6	-	a3	.01	-	.00
F	Cirsium undulatum	a1	-	-	-	a2	-	-	.01
F	Comandra pallida	3	-	-	-	-	-	-	-
F	Descurainia pinnata (a)	-	-	6	-	-	.01	-	-
F	Draba sp. (a)	-	-	-	-	1	-	-	.00
F	Eriogonum brevicaule	3	-	-	-	-	-	-	-
F	Erodium cicutarium (a)	-	-	a12	b86	b116	.05	1.31	1.59
F	Erigeron pumilus	a14	a21	-	-	-	-	-	-
F	Galium aparine (a)	-	-	2	-	-	.03	-	-
F	Hackelia patens	-	-	4	-	-	.00	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Helianthus annuus (a)	-	-	-	3	-	-	.01	-
F	Hedysarum boreale	17	-	-	-	-	-	-	-
F	Holosteum umbellatum (a)	-	-	-	-	6	-	-	.01
F	Lappula occidentalis (a)	-	-	-	$_{a}$16	$_{b}$42	-	.18	.45
F	Leucelene ericoides	-	-	$_{a}$15	$_{a}$8	$_{a}$17	.27	.21	.10
F	Lygodesmia grandiflora	$_{a}$12	$_{a}$3	$_{a}$5	$_{a}$16	$_{a}$10	.03	.14	.06
F	Phlox longifolia	-	-	-	-	1	-	-	.00
F	Sphaeralcea coccinea	$_{ab}$90	$_{b}$117	$_{ab}$80	$_{a}$80	$_{b}$108	.50	1.77	1.29
F	Streptanthus cordatus	$_{a}$8	$_{a}$3	$_{a}$7	-	-	.04	-	-
F	Tragopogon dubius	$_{a}$4	-	$_{a}$4	-	-	.01	-	-
F	Trifolium sp.	-	-	1	-	-	.00	-	-
Total for Annual Forbs		0	0	370	408	477	5.57	3.32	5.92
Total for Perennial Forbs		155	146	122	104	141	0.88	2.16	1.49
Total for Forbs		155	146	492	512	618	6.46	5.48	7.41

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

BROWSE TRENDS --
Management unit 16A, Study no: 8

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	1	0	0	-	-	.00
B	Cercocarpus montanus	11	13	9	2.78	3.31	4.39
B	Chrysothamnus nauseosus albicaulis	1	1	0	.38	.30	.15
B	Chrysothamnus viscidiflorus stenophyllus	15	13	15	.21	.46	.81
B	Cowania mexicana stansburiana	22	21	22	4.65	5.33	3.94
B	Gutierrezia sarothrae	26	45	34	.50	2.07	1.33
B	Rhus trilobata	0	0	0	-	.76	.18
Total for Browse		76	93	80	8.54	12.25	10.82

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 8

Species	Percent Cover	
	'02	'07
Cercocarpus montanus	-	7.38
Chrysothamnus viscidiflorus stenophyllus	-	.85
Cowania mexicana stansburiana	-	5.41
Gutierrezia sarothrae	-	1.73

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 8

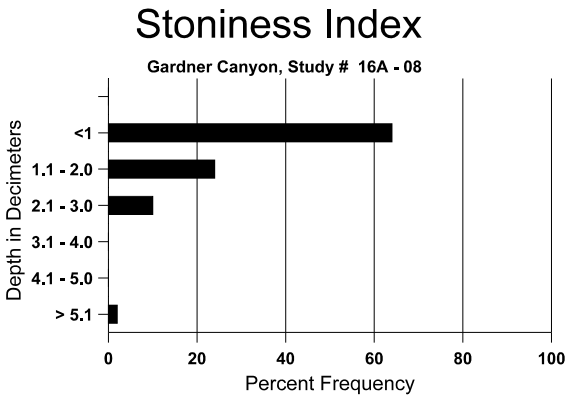
Species	Average leader growth (in)	
	'02	'07
Cercocarpus montanus	1.6	2.1
Cowania mexicana stansburiana	1.5	1.6

BASIC COVER --
Management unit 16A, Study no: 8

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	0	10.25	33.54	33.40	38.12
Rock	17.00	20.00	18.29	18.00	18.54
Pavement	2.00	12.75	7.86	5.28	4.10
Litter	50.50	31.00	30.88	30.60	38.04
Cryptogams	.25	0	.99	.75	.74
Bare Ground	30.25	26.00	17.82	26.45	17.23

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 08, Gardner Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
10.1	55.4 (13.8)	7.0	38.7	40.7	20.6	1.6	4.4	57.6	.5



PELLET GROUP DATA --
Management unit 16A, Study no: 8

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	5	2	11
Elk	20	20	15
Deer	21	26	51

Days use per acre (ha)	
'02	'07
-	-
24 (60)	19 (48)
70 (172)	101 (250)

BROWSE CHARACTERISTICS --
Management unit 16A, Study no: 8

		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												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	21/37
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Artemisia tridentata vaseyana												
83	**66**	-	-	66	-	-	50	50	0	-	0	25/19
89	**66**	-	-	-	66	-	50	50	100	50	50	-/-
97	**40**	-	-	-	40	60	100	0	100	100	100	21/35
02	**0**	-	-	-	-	60	0	0	0	-	0	22/37
07	**0**	20	-	-	-	-	0	0	0	-	0	23/27

		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)
Cercocarpus montanus												
83	**333**	-	-	333	-	-	70	30	0	-	0	52/55
89	**466**	-	100	366	-	-	36	64	0	-	0	62/51
97	**240**	-	20	200	20	-	25	75	8	-	0	63/79
02	**300**	-	-	200	100	-	27	67	33	7	7	67/75
07	**200**	-	-	140	60	-	10	70	30	10	20	66/80
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	100	0	0	-	0	28/71
02	**20**	-	-	-	20	-	0	0	100	-	0	25/51
07	**0**	-	-	-	-	-	0	0	0	-	0	21/47
Chrysothamnus viscidiflorus stenophyllus												
83	**633**	-	33	600	-	-	0	0	0	-	0	10/13
89	**798**	-	266	466	66	-	29	0	8	4	8	10/14
97	**440**	-	-	400	40	20	0	0	9	5	5	13/25
02	**360**	-	-	280	80	40	6	0	22	-	0	14/25
07	**420**	-	-	420	-	-	29	0	0	-	0	15/29
Cowania mexicana stansburiana												
83	**966**	-	-	766	200	-	38	62	21	-	0	32/30
89	**966**	-	233	233	500	-	31	69	52	24	24	25/29
97	**600**	-	60	400	140	180	3	80	23	7	7	46/48
02	**500**	-	20	380	100	120	0	80	20	8	8	38/43
07	**440**	-	-	300	140	160	0	95	32	23	23	49/49
Eriogonum heracleoides												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	15/30
Gutierrezia sarothrae												
83	**1933**	-	-	1933	-	-	0	0	0	-	0	11/9
89	**832**	-	33	266	533	-	0	0	64	28	32	9/8
97	**1280**	60	580	660	40	40	0	0	3	2	2	7/10
02	**2280**	-	20	1920	340	300	0	0	15	5	5	7/12
07	**2060**	160	1080	900	80	-	0	.97	4	3	3	8/12

		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)
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	78/81
02	**0**	-	-	-	-	-	0	0	-	-	0	36/26
07	**0**	-	-	-	-	-	0	0	-	-	0	57/42
Rhus trilobata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	57/188
07	**0**	-	-	-	-	-	0	0	-	-	0	68/125

Trend Study 16A-9-07

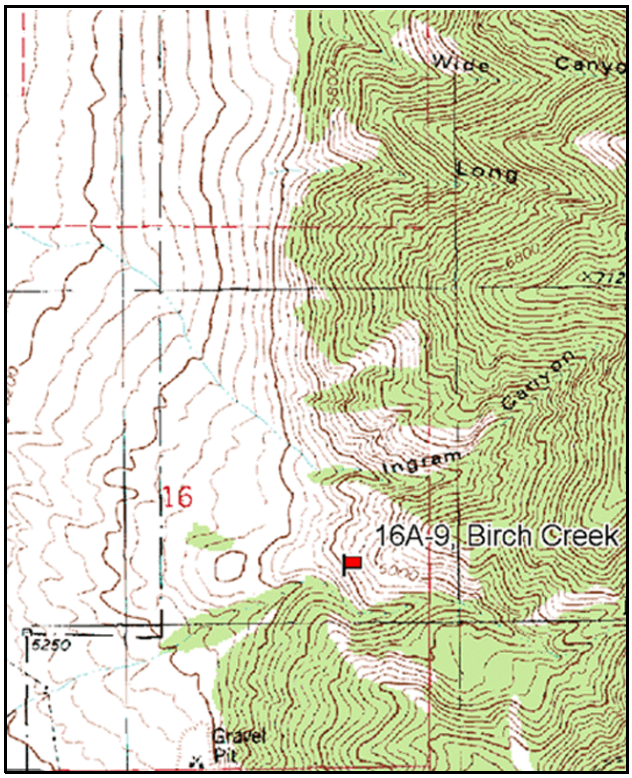
Study site name: Birch Creek . Vegetation type: Mountain Brush .

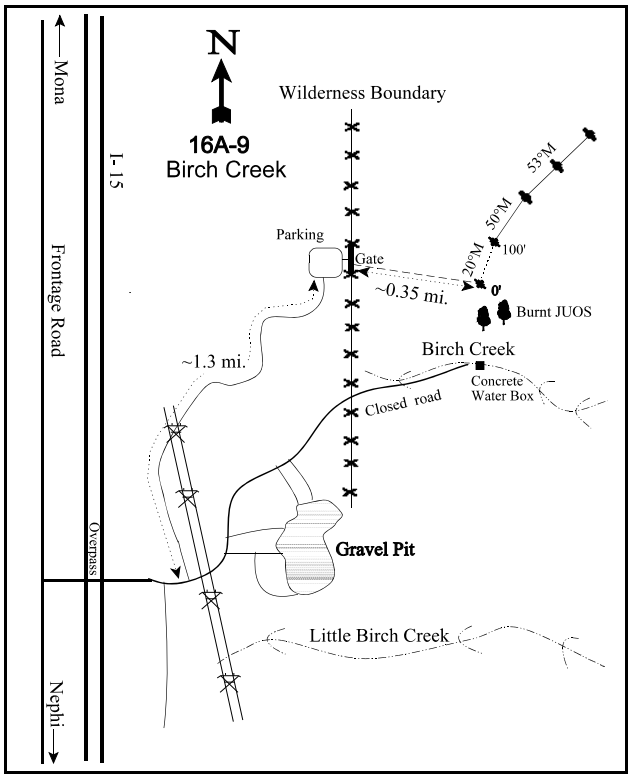
Compass bearing: frequency baseline 20 degrees magnetic (line 2 @ 50°M, line 3-4 @ 53°M).

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

LOCATION DESCRIPTION

Beginning at the overpass where the road to Little Birch Canyon passes over I-15 (north of the northernmost Nephi exit), take the first left just before the powerlines cross the road. Proceed about 1.3 miles east-northeast to a parking lot. From the wilderness boundary, walk east for about 0.35 miles to the 0-foot stake. The 0-foot baseline stake is near a cliffrose bush on a small trail running parallel along the bench. Browse tag #197 marks the 0-foot baseline stake.





Map Name: Mona

Diagrammatic Sketch

Township 12S , Range 1E , Section 16

GPS: NAD 83, UTM 12S 429592 E 4402342 N

DISCUSSION

Birch Creek - Trend Study No. 16A-9

Study Information

This study is located at the mouth of Little Birch Creek [elevation: 5,780 feet (1,762 m), slope: 55%, aspect: southwest]. The range type is a sparse mixture of Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), Utah serviceberry (*Amelanchier utahensis*), and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Water is available in Birch Creek approximately 150 yards (137 m) downslope from the baseline. A fire burned the majority of the study in 2001, although the end of the baseline was spared, leaving some healthy browse intact. The area is considered critical deer and elk winter range. Deer and elk pellet groups were sampled at quadrat frequencies of 30% and 15% in 1997, respectively. Deer use was estimated at 44 days use/acre (109 ddu/ha) in 2002 and 39 days use/acre (96 ddu/ha) in 2007. Elk use was estimated at 20 days use (50 edu/ha) in 2002 and 38 days use/acre (94 edu/ha) in 2007.

Soil

The soil was formed in colluvium derived from limestone (USDA-NRCS 2007). It is shallow and extremely rocky, and there are numerous rock outcrops. The soil texture is a sandy loam with a neutral pH (7.1). The organic matter content is 3.1%. Some erosion has occurred due to the steep slope. There are microterraces on the downslope side of the vegetation. The erosion condition was classified as slight in 2002 due to pedestalling and surface litter and rock movement, but was classified as stable in 2007.

Browse

The main browse species are serviceberry, cliffrose, and mountain big sagebrush. Serviceberry has been sampled at the highest density of the three species. In 1997, the density was estimated at 640 plants/acre (1,581 plants/ha). Most of the serviceberry burned in the fire, but had resprouted by 2002, with a density of 1,300 plants/acre (3,212 plants/ha). By 2007, the density was 920 plants/acre (2,272 plants/ha). Ninety-three percent of the plants were either young or had reached maturity, and were vigorous in 2007. Before the fire, use of serviceberry was mostly moderate-heavy. In 2007, use was mostly light, with some moderate and heavy use. Annual leader growth averaged 1.1 inches (2.8 cm) in 2007.

Cliffrose density was estimated at 180 plants/acre (445 plants/ha) in 1997. The majority of the population consisted of large, mature plants with an average height of 5.4 feet (1.6 m). The fire burned most of the cliffrose, but left a few plants unburned upslope at the end of the baseline. Only an estimated 40 plants/acre (99 plants/ha), 20 young and 20 mature, were sampled in 2007, all of which displayed good vigor. Use of the available cliffrose has been consistently moderate-heavy throughout the study. Annual leader growth averaged 1.3 inches (3.2 cm) in 2007.

Mountain big sagebrush density was 360 plants/acre (889 plants/ha) in 1997. The population consisted of mostly mature plants, with high recruitment. All of the plants were vigorous, and use was moderate-heavy. The fire eliminated most of the sagebrush. In 2002, the few plants that were sampled were mostly decadent and classified as dying, and no plants were sampled in 2007. Other preferred browse, including black sagebrush (*Artemisia nova*), true mountain mahogany (*Cercocarpus montanus*), and fourwing saltbush (*Atriplex canescens*), were sampled in very low densities.

Herbaceous Understory

The grass component of the understory is not very diverse, and the majority of the grass cover has been provided by bluebunch wheatgrass (*Agropyron spicatum*) and cheatgrass (*Bromus tectorum*) since 1997. Sandberg bluegrass (*Poa secunda*) also occurs in low frequency. Grass cover has increased since the fire, from 13% in 1997 to 15% in 2002 and 29% in 2007. Cheatgrass provided 46% of the total grass cover in 1997, 63% in 2002, and 59% in 2007. Bluebunch wheatgrass provided 53% of the total grass cover in 1997, 32% in 2002,

and 38% in 2007.

Forbs are relatively diverse, but provide little quality forage. Total forb cover has ranged from 4% to 7% since 1997. The majority of the perennial forb cover is provided by northern sweetvetch (*Hedysarum boreale*) and shortstem wild buckwheat (*Eriogonum brevicaule*). Annual species dominate the forb component of the understory. The most common annuals are storksbill (*Erodium cicutarium*), which outcompetes native species (Buchanan et al. 1978), and pale alyssum (*Alyssum alyssoides*).

1989 TREND ASSESSMENT

The trend for browse is slightly down. Serviceberry density decreased from 700 plants/acre (1,729 plants/ha) to 265 plants/acre (655 plants/ha), although it is believed that serviceberry density was underestimated in 1989. The population remained mostly mature, however, recruitment decreased and decadence increased. All of the sampled plants were vigorous. Mountain big sagebrush density decreased from 732 plants/acre (1,808 plants/ha) to 466 plants/acre (1,151 plants/ha). The age structure indicated a stable population, with approximately 30% young plants and 30% decadence. Plants displaying poor vigor increased from 9% to 14% of the population. Cliffrose density was low, but increased from 66 plants/acre (163 plants/ha) to 99 plants/acre (245 plants/ha). Decadence also increased, and no young plants were sampled, but vigor was good. All of the preferred browse species showed moderate use. The trend for grass is up. The sum of nested frequency for perennial grasses increased 74%. Both bluebunch wheatgrass and Sandberg bluegrass increased significantly in nested frequency. The trend for forbs is up. The sum of nested frequency for perennial forbs increased nearly two-fold. Although the frequencies of grasses and forbs increased, diversity was low.

browse - slightly down (-1) grass - up (+2) forb - up (+2)

1997 TREND ASSESSMENT

The trend for browse is slightly up. The total density of preferred browse species increased, although this increase was partly attributed to the lengthening of the baseline. Serviceberry density increased substantially. Decadence decreased, while young recruitment increased from 12% to 41% of the population. Mountain big sagebrush density decreased 23%, and all of the sampled plants were young or mature and displayed good vigor. Cliffrose increased in density by 82%. Decadence decreased from 33% to 22%, but there continued to be no reproduction or recruitment of this species. Plants displaying poor vigor increased to 11% of the population. Mountain mahogany, black sagebrush, and fourwing saltbush were sampled in low frequencies. All of the preferred browse species displayed moderate-heavy use. The trend for grass is down. The sum of nested frequency for perennial grasses decreased almost 30%, and Sandberg bluegrass decreased significantly in nested frequency. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased 26%. The Desirable Components Index (DCI) was rated as poor due to low preferred browse cover and an understory dominated by annual species.

winter range condition (DCI) - poor (42) Mid-level potential scale
browse - slightly up (+1) grass - down (-2) forb - slightly down (-1)

2002 TREND ASSESSMENT

The trend for browse is stable. The fire that burned in 2001 eliminated the majority of the shrubs. Sagebrush density was estimated at only 80 plants/acre (198 plants/ha). Seventy-five percent of the sampled plants were decadent, and 50% were classified as dying. Half of the plants displayed poor vigor and heavy use. Cliffrose density decreased to 60 plants/acre (148 plants/ha), with 33% decadence. All of the plants were vigorous and heavily hedged. Serviceberry resprouted at a density of 1,300 plants/acre (3,211 plants/ha). Ninety-five percent of these plants were young and vigorous, and use was mostly light. This increase in the recruitment of serviceberry helped to improve the sustainability of the winter range on the study. The trend for grass is slightly down. The sum of nested frequency for perennial grasses decreased 18%. Bluebunch wheatgrass decreased significantly in nested frequency. Cheatgrass cover increased from 6% to 10%. The trend for forbs

is slightly up. The sum of nested frequency for perennial forbs increased 53%, but these species were still rare. Pale alyssum decreased significantly in nested frequency. The DCI rating declined to very poor, mainly due to the decrease in preferred browse cover caused by the fire.

winter range condition (DCI) - very poor (10) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - slightly up (+1)

2007 TREND ASSESSMENT

The trend for browse is down. Serviceberry density decreased 29%, and the majority of the population was young, with 35% mature plants. Most individuals were vigorous, and 37% of the sampled plants showed moderate-heavy use. Mountain big sagebrush was not sampled. Cliffrose, mahogany, and black sagebrush were sampled in low densities. Despite the low densities of preferred browse species, serviceberry, mahogany, and cliffrose all increased slightly in cover. Black sagebrush was mostly decadent and displayed poor vigor, while cliffrose and mahogany were vigorous and showed moderate-heavy use. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. Perennial grass cover increased from 6% to 12%, which was attributed to an increase in bluebunch wheatgrass cover. However, cheatgrass increased significantly in nested frequency, and increased in average cover from 10% to 17%. The trend for forbs is stable. The sum of nested frequency for perennial forbs did not change substantially. The DCI rating increased to poor-fair due to the increase in preferred browse and perennial grass cover.

winter range condition (DCI) - poor-fair (52) Mid-level potential scale
browse - down (-2) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 9

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{bc}$188	$_{d}$259	$_{cd}$215	$_{a}$141	$_{ab}$173	7.00	4.87	11.01
G	Bromus japonicus (a)	-	-	-	$_{b}$45	$_{a}$3	-	.15	.00
G	Bromus tectorum (a)	-	-	$_{a}$292	$_{a}$276	$_{b}$315	6.13	9.72	17.10
G	Poa secunda	$_{a}$4	$_{c}$75	$_{ab}$23	$_{bc}$54	$_{a}$25	.14	.63	.52
G	Vulpia octoflora (a)	-	-	-	-	7	-	-	.18
Total for Annual Grasses		0	0	292	321	325	6.13	9.88	17.28
Total for Perennial Grasses		192	334	238	195	198	7.14	5.50	11.53
Total for Grasses		192	334	530	516	523	13.27	15.39	28.82
F	Alyssum alyssoides (a)	-	-	$_{b}$237	$_{a}$190	$_{a}$193	2.66	1.20	1.30
F	Allium sp.	-	-	-	3	-	-	.03	-
F	Arabis sp.	-	-	1	-	-	.00	-	-
F	Artemisia ludoviciana	$_{a}$2	-	$_{a}$3	$_{a}$3	$_{a}$3	.03	.03	.03
F	Castilleja linariaefolia	-	-	3	-	-	.00	-	-
F	Camelina microcarpa (a)	-	-	-	$_{a}$3	$_{a}$10	-	.00	.02
F	Calochortus nuttallii	$_{a}$3	-	$_{a}$2	$_{a}$1	-	.00	.00	-
F	Cirsium sp.	-	-	6	-	-	.01	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Comandra pallida	-	7	-	-	-	-	-	-
F	Collinsia parviflora (a)	-	-	-	$_{a}$3	$_{a}$4	-	.00	.03
F	Descurainia pinnata (a)	-	-	$_{a}$9	$_{a}$20	$_{a}$24	.02	.10	.51
F	Epilobium brachycarpum (a)	-	-	-	1	-	-	.00	-
F	Eriogonum brevicaule	-	$_{a}$2	$_{a}$8	$_{a}$10	$_{a}$6	.73	.48	.39
F	Erodium cicutarium (a)	-	-	$_{a}$23	$_{a}$42	$_{b}$91	.09	1.39	2.64
F	Galium aparine (a)	-	-	$_{a}$57	$_{a}$57	$_{a}$32	.83	.22	.38
F	Gilia sp. (a)	-	-	$_{a}$9	$_{b}$19	$_{a}$-	.01	.11	.00
F	Hackelia patens	$_{a}$2	$_{a}$6	-	-	-	-	-	-
F	Hedysarum boreale	$_{c}$27	$_{c}$31	$_{bc}$21	$_{a}$2	$_{ab}$8	.77	.18	.59
F	Holosteum umbellatum (a)	-	-	-	$_{a}$9	$_{b}$55	-	.02	.21
F	Lappula occidentalis (a)	-	-	$_{a}$6	$_{a}$7	$_{a}$6	.01	.04	.01
F	Lactuca serriola	-	-	-	$_{a}$2	$_{b}$43	-	.03	.34
F	Lygodesmia grandiflora	$_{a}$7	$_{a}$18	-	-	-	-	-	-
F	Machaeranthera canescens	-	$_{a}$9	$_{a}$10	-	$_{a}$4	.04	-	.06
F	Phacelia linearis	-	-	-	$_{b}$68	$_{a}$8	-	.52	.01
F	Phlox longifolia	-	$_{a}$11	$_{a}$2	$_{a}$5	$_{a}$10	.00	.06	.03
F	Ranunculus testiculatus (a)	-	-	-	5	-	-	.01	-
F	Sisymbrium altissimum (a)	-	-	-	-	4	-	-	.22
F	Streptanthus cordatus	-	-	$_{a}$5	$_{a}$1	$_{a}$3	.15	.00	.03
F	Tragopogon dubius	$_{a}$2	-	$_{a}$1	-	$_{a}$8	.00	-	.10
F	Unknown forb-annual (a)	-	-	33	-	-	.08	-	-
Total for Annual Forbs		0	0	374	356	419	3.73	3.14	5.35
Total for Perennial Forbs		43	84	62	95	93	1.78	1.35	1.61
Total for Forbs		43	84	436	451	512	5.51	4.49	6.96

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

BROWSE TRENDS --
Management unit 16A, Study no: 9

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	16	16	16	1.91	1.05	1.65
B	Artemisia nova	5	0	4	-	-	-
B	Artemisia tridentata vaseyana	15	4	0	.89	.03	-
B	Atriplex canescens	1	0	0	-	-	-
B	Brickellia californica	2	0	1	.85	-	-
B	Cercocarpus montanus	2	1	2	1.00	.15	1.03
B	Chrysothamnus viscidiflorus stenophyllus	3	3	3	.00	.03	.18
B	Cowania mexicana stansburiana	8	3	2	3.01	1.06	2.16
B	Gutierrezia sarothrae	7	2	4	-	-	.18
B	Juniperus osteosperma	2	0	0	2.89	-	-
B	Rhus glabra cismontana	0	2	2	-	-	1.64
Total for Browse		61	31	34	10.57	2.32	6.85

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 9

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	-	2.90
Brickellia californica	-	.18
Cercocarpus montanus	-	1.43
Chrysothamnus viscidiflorus stenophyllus	-	1.20
Cowania mexicana stansburiana	-	1.78
Gutierrezia sarothrae	-	.11
Rhus glabra cismontana	-	2.00

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 9

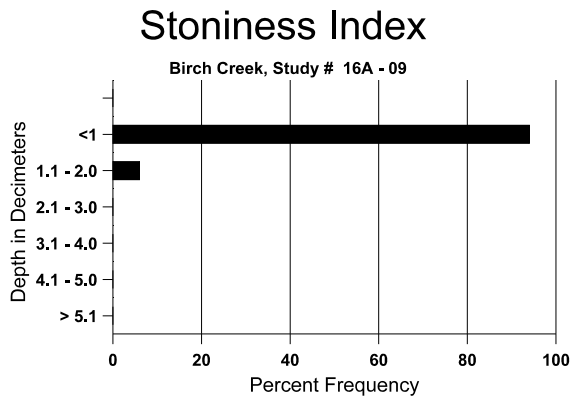
Species	Average leader growth (in)	
	'02	'07
Amelanchier utahensis	-	1.1
Cercocarpus montanus	-	1.2
Cowania mexicana stansburiana	-	1.3

BASIC COVER --
Management unit 16A, Study no: 9

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	2.00	8.50	26.68	22.07	43.54
Rock	26.25	41.25	48.14	51.06	37.57
Pavement	25.50	3.25	9.28	9.39	6.91
Litter	44.50	42.25	26.36	19.13	21.97
Cryptogams	.25	1.50	.88	.00	.01
Bare Ground	1.50	3.25	7.58	13.19	5.55

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 09, Birch Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.8	55.5 (12.9)	7.1	54.4	30.1	15.6	3.1	9.7	80.0	.7



PELLET GROUP DATA --
Management unit 16A, Study no: 9

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	-	1
Elk	30	12	8
Deer	15	25	14

Days use per acre (ha)	
'02	'07
-	-
20 (50)	38 (94)
44 (109)	39 (96)

BROWSE CHARACTERISTICS --
Management unit 16A, Study no: 9

		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												
83	**700**	-	200	500	-	-	81	0	0	-	10	34/37
89	**265**	-	33	166	66	-	63	13	25	-	0	46/31
97	**640**	160	260	360	20	20	50	34	3	-	0	52/62
02	**1300**	-	1240	40	20	660	0	5	2	-	0	42/53
07	**920**	100	540	320	60	-	17	20	7	4	4	26/35
Artemisia nova												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**120**	-	-	100	20	-	50	17	17	17	17	15/27
02	**0**	-	-	-	-	60	0	0	0	-	0	6/28
07	**80**	-	-	20	60	40	25	0	75	75	75	9/20
Artemisia tridentata vaseyana												
83	**732**	-	66	400	266	-	59	0	36	-	9	22/25
89	**466**	-	133	200	133	-	50	7	29	7	14	17/29
97	**360**	-	60	300	-	20	50	33	0	-	0	27/47
02	**80**	-	-	20	60	60	0	50	75	50	50	19/30
07	**0**	-	-	-	-	-	0	0	0	-	0	18/30
Atriplex canescens												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	100	-	-	0	22/37
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	42/59
Brickellia californica												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**100**	-	-	100	-	20	0	0	-	-	0	21/28
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**40**	-	-	40	-	-	0	0	-	-	0	14/25

		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)
Cercocarpus montanus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	-	0	100	-	-	0	55/50
02	**20**	20	-	20	-	-	0	100	-	-	0	71/56
07	**40**	-	-	40	-	-	100	0	-	-	0	58/57
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	60/94
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	35/52
Chrysothamnus viscidiflorus stenophyllus												
83	**133**	-	-	133	-	-	0	0	0	-	0	19/33
89	**199**	-	-	166	33	-	0	0	17	-	0	15/27
97	**60**	20	-	60	-	-	0	0	0	-	0	16/33
02	**60**	-	20	20	20	-	0	0	33	-	0	11/18
07	**80**	-	-	60	20	-	0	0	25	-	0	12/26
Cowania mexicana stansburiana												
83	**66**	33	-	66	-	-	50	50	0	-	50	67/69
89	**99**	-	-	66	33	-	100	0	33	-	0	75/45
97	**180**	-	-	140	40	-	44	44	22	11	11	65/77
02	**60**	-	-	40	20	160	0	100	33	-	0	44/64
07	**40**	-	20	20	-	20	50	50	0	-	0	55/57
Gutierrezia sarothrae												
83	**66**	-	-	66	-	-	0	0	0	-	0	11/10
89	**33**	-	-	-	33	-	0	0	100	-	0	-/-
97	**160**	20	60	100	-	20	0	0	0	-	0	8/12
02	**60**	-	-	40	20	40	0	0	33	33	33	6/10
07	**140**	20	60	80	-	-	0	0	0	-	0	7/12
Juniperus osteosperma												
83	**33**	-	-	33	-	-	0	0	-	-	0	67/81
89	**33**	-	-	33	-	-	0	0	-	-	0	108/79
97	**40**	-	-	40	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	40	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	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)
Rhus glabra cismontana												
83	**33**	-	33	-	-	-	0	0	-	-	0	-/-
89	**300**	-	-	300	-	-	33	0	-	-	0	39/35
97	**0**	-	-	-	-	-	0	0	-	-	0	35/17
02	**40**	-	40	-	-	40	0	0	-	-	0	-/-
07	**60**	20	-	60	-	-	0	0	-	-	0	39/50
Rhus trilobata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	74/154

Trend Study 16A-10-07

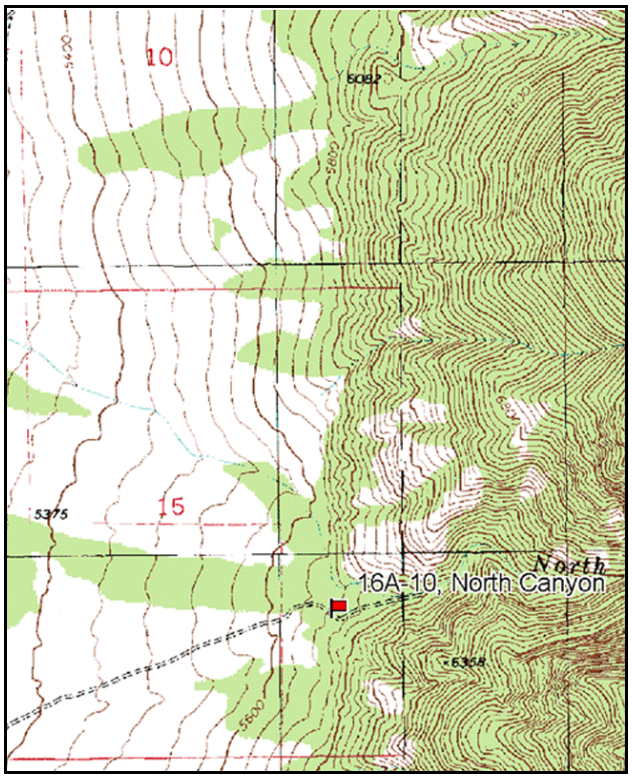
Study site name: North Canyon . Vegetation type: Big Sagebrush-Grass .

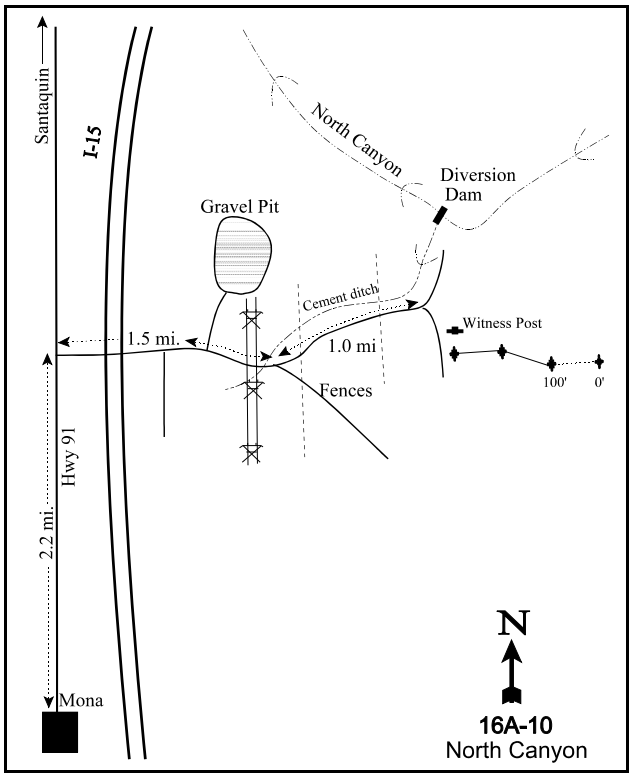
Compass bearing: frequency baseline 267 degrees magnetic (line 2 @ 277°M).

Frequency belt placement: line 1 (11 & 71ft), line 2 [belt 3] (41ft), line 3 (34 ft centered on 40, & 95ft).
Rebar: belt 4 on 2 ft, belt 2 on 1 ft.

LOCATION DESCRIPTION

Beginning at the intersection of 200 North and Main Street in Mona, go north on Main Street for 2.2 miles to an improved gravel road on the east side. Take this road east for 1.5 miles (passing beneath the freeway) to where the road forks after crossing an irrigation ditch. Stay left at this fork and continue another mile to where the road faintly forks again. From here, walk down the right fork for 22 paces. At this point, the witness post is on the left, next to the 300-foot stake. A red browse tag, number 3957, is attached to the 0-foot baseline stake.





Map Name: Mona

Diagrammatic Sketch

Township 11S , Range 1E , Section 15

GPS: NAD 83, UTM 12S 431120 E 4411976 N

DISCUSSION

North Canyon - Trend Study No. 16A-10

Study Information

This study is located on UDWR land near the mouth of North Canyon on an alluvial fan dissected by gullies [elevation: 5,700 feet (1,737 m), slope: 15%, aspect: west]. It supports a mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and grass community, with lower densities of Gambel oak (*Quercus gambelii*). There is a creek approximately 650 feet (200 m) north of the study. The area serves as winter range, mainly for deer. Quadrat frequency for deer pellets was low at 6% in 1997. Elk pellet quadrat frequency was 1% in 2002. Pellet group transect data estimated use at 21 deer days use/acre (53 ddu/ha) in 2002 and 54 deer days use/acre (132 ddu/ha) in 2007. A few cattle were observed during the 2007 reading, and use was estimated at 1 day use/acre (2 cdu/ha).

Soil

The soil is classified within the Lizzant series (USDA-NRCS 2007). The soils in this series are deep and well-drained, and formed in alluvium and colluvium derived from sedimentary rocks. The parent material was identified as limestone and quartzite. The soil texture is a sandy loam with a neutral pH (7.1). Soil phosphorus is marginal at 8.2 ppm, and potassium is low at 51.2 ppm (Tiedemann and Lopez 2004). The soil surface is covered with rocks ranging in size from cobble to boulders. The majority of the soil is covered by vegetation and litter. The soil erosion condition was classified as stable in 2002 and 2007.

Browse

The preferred browse species is mountain big sagebrush, which has comprised 66%-80% of the total browse cover since 1997. It provided 20% cover in 1997, 18% in 2002, and 14% in 2007. Sagebrush density has decreased steadily since the study began. When the baseline was lengthened in 1997, the density was estimated at 3,880 plants/acre (9,584 plants/ha), which steadily declined to 2,900 plants/acre (7,163 plants/ha) by 2007. The population has been largely mature, however, decadence was high in 2002 and 2007 at 42% and 39%, respectively. Recruitment has declined from 21% of the population consisting of young plants in 1983 to only 2% in 2007. Very few seedlings have been sampled since 1983. The percent of the population displaying poor vigor increased from 5% to 24% between 1997 and 2007. Sagebrush use has been mostly moderate-heavy, but was mostly light in 2002. Annual leader growth averaged 2.1 inches (5.2 cm) in 2002 and 2.2 inches (5.6 cm) in 2007. Other shrubs that have shown wildlife use include small densities of Gambel oak, curlleaf mountain mahogany (*Cercocarpus ledifolius*), and white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*).

Herbaceous Understory

The understory is diverse, but provides little forage. Ten grass species were sampled in 1997, 14 in 2002, and 15 in 2007. Although the grass cover was dominated by annual species in 1997, perennials comprised 77% of the total grass cover in 2007. Perennial grass cover increased from 4% in 1997 to 14% in 2002 and 21% in 2007, while annual grass cover has remained stable at 6%. Approximately half of the grass species sampled since 1983 have been natives, and half have been introduced. Bulbous bluegrass (*Poa bulbosa*), Sandberg bluegrass (*Poa secunda*), and intermediate wheatgrass (*Agropyron intermedium*) provided the majority of the perennial grass cover in 2007, while cheatgrass (*Bromus tectorum*) was the most abundant annual. Jointed goatgrass (*Aegilops cylindrica*), a noxious weed, was sampled in one quadrat in 2007.

Forb cover has increased from 4% in 1997 to 8% in 2007, but shifted from mostly perennial cover to mostly annual cover. Common houndstongue (*Cynoglossum officinale*), a noxious weed, was sampled in one quadrat in both 1989 and 1997. Redroot eriogonum (*Eriogonum racemosum*) provided 55% of the total forb cover in 1997, but declined to 8% by 2007. The majority of the forb cover was composed of blue-eyed Mary (*Collinsia parviflora*) and bedstraw (*Galium aparine*) in 2007.

1989 TREND ASSESSMENT

The trend for browse is down. Sagebrush density decreased from 6,333 plants/acre (15,643 plants/ha) to 4,865 plants/acre (12,017 plants/ha). Decadence increased slightly to 26% of the population. Recruitment decreased, but remained relatively high with 14% of the population consisting of young plants. Plants showing poor vigor decreased from 20% to 7% of the population, and use increased to mostly moderate-heavy. The trend for grass is up. The sum of nested frequency for perennial grasses increased 30%, however, species diversity was low. The trend for forbs is stable. The sum of nested frequency for perennial forbs did not change substantially. Common houndstongue was sampled, but only in one quadrat.

browse - down (-2) grass - up (+2) forb - stable (0)

1997 TREND ASSESSMENT

The trend for browse is stable. Density of sagebrush decreased 20%, however, the decrease was partly attributed to the change in sampling area. The population remained mostly mature, and decadence decreased to 11% of the population. Recruitment was good, with 10% of the population consisting of young plants. Only 5% of the population displayed poor vigor, and use remained moderate-heavy. The trend for grass is up. The sum of nested frequency for perennial grass increased 32% and Sandberg bluegrass increased significantly in nested frequency. The trend for forbs is up. The sum of nested frequency of perennial forbs increased substantially. However, the total forb cover was low at less than 4%. Common houndstongue was sampled again, but did not increase in quadrat frequency. The Desirable Components Index (DCI) was rated as fair due to favorable browse cover with low decadence, but minimal perennial herbaceous cover, and the presence of a noxious weed.

winter range condition (DCI) - fair (52) Mid-level potential scale
browse - stable (0) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is down. Sagebrush density decreased from 3,880 plants/acre (9,584 plants/ha) to 3,460 plants/acre (8,546 plants/ha). Decadence greatly increased to 42%. Twenty percent of the population was classified as dying. Recruitment decreased from 10% of the population to 3%, and no seedlings were sampled. Plants displaying poor vigor increased from 5% to 21% of the population, and use decreased to mostly light. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. Total perennial grass cover increased from 4% to 14%, although part of this increase was attributed to an increase in bulbous bluegrass, an undesirable species. Bulbous bluegrass increased significantly in nested frequency, while cheatgrass cover did not increase. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased 21%. Although total forb cover did not change, the composition shifted from mostly perennial cover to mostly annual cover. Blue-eyed Mary and pale alyssum (*Alyssum alyssoides*), both annuals, increased significantly in nested frequency. However, common houndstongue was not sampled. The DCI rating remained fair.

winter range condition (DCI) - fair (55) Mid-level potential scale
browse - down (-2) grass - stable (0) forb - slightly down (-1)

2007 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased 16%, and average cover also decreased from 18% to 14%. Decadence remained high at 39% of the population, and reproduction and recruitment remained very low. Twenty-four percent of the population displayed poor vigor, and 22% was classified as dying. Use increased to mostly moderate-heavy. The trend for grass is slightly up. The sum of nested frequency for perennial and annual grasses increased by 20% and 28%, respectively. Perennial grass cover increased from 14% to 21%, however, the majority of this increase was due to the spread of bulbous bluegrass. Jointed goatgrass was sampled, but only in one quadrat. The trend for forbs is slightly up. The sum of nested

frequency for perennial forbs increased 13%, while that for annual forbs changed little. Average cover for annual species increased from 2% to 6%, mainly due to large increases in blue-eyed Mary and bedstraw cover. Pale alyssum and bur buttercup, an allelopathic annual (Buchanan et al. 1978), decreased significantly in nested frequency. The DCI rating remained fair.

winter range condition (DCI) - fair (59) Mid-level potential scale
browse - slightly down (-1) grass - slightly up (+1) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 10

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Aegilops cylindrica (a)	-	-	-	-	1	-	-	.00
G	Agropyron cristatum	a8	a22	a7	a6	a11	.04	.57	.34
G	Agropyron intermedium	ab40	ab48	a24	a25	b51	.61	2.76	4.15
G	Agropyron spicatum	-	-	-	-	1	-	-	.00
G	Aristida purpurea	a8	ab7	ab18	ab20	b23	.80	.76	.82
G	Bromus carinatus	a1	-	-	a6	-	-	.68	-
G	Bromus japonicus (a)	-	-	-	a3	a10	-	.03	.02
G	Bromus tectorum (a)	-	-	a274	a284	a274	5.69	5.55	5.60
G	Festuca myuros (a)	-	-	a29	a4	b75	.30	.01	.31
G	Festuca ovina	-	-	a6	ab18	b20	.53	1.01	1.19
G	Poa bulbosa	-	-	a15	b60	c161	.24	2.91	7.85
G	Poa pratensis	-	-	-	a2	b11	-	.03	.10
G	Poa secunda	a75	ab114	c166	bc165	c174	1.37	4.28	4.67
G	Sitanion hystrix	-	-	a7	a2	a3	.01	.06	.09
G	Sporobolus cryptandrus	a15	-	a24	a23	a27	.41	.46	1.40
G	Vulpia octoflora (a)	-	-	-	a7	a21	-	.04	.06
Total for Annual Grasses		0	0	303	298	381	5.99	5.63	6.00
Total for Perennial Grasses		147	191	267	327	482	4.03	13.56	20.65
Total for Grasses		147	191	570	625	863	10.02	19.20	26.66
F	Alyssum alyssoides (a)	-	-	a86	c178	b130	.27	.43	.64
F	Allium sp.	-	-	8	-	-	.01	-	-
F	Antennaria rosea	-	-	-	a4	a3	-	.03	.00
F	Aster chilensis	-	-	-	-	3	-	-	.00
F	Astragalus eurekensis	-	-	-	a14	a8	-	.15	.02
F	Astragalus utahensis	-	-	b27	a8	ab15	.33	.09	.30
F	Castilleja linariaefolia	-	-	-	2	-	-	.03	-
F	Calochortus nuttallii	-	-	a18	a25	a13	.04	.08	.05
F	Cirsium vulgare	ab3	-	b7	a-	ab2	.02	.00	.04

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Collinsia parviflora (a)	-	-	$_{a}$19	$_{b}$78	$_{c}$126	.06	.27	2.87
F	Cruciferae	-	2	-	-	-	-	-	-
F	Cryptantha sp.	-	-	$_{a}$4	-	$_{a}$1	.03	-	.00
F	Cynoglossum officinale	-	$_{a}$2	$_{a}$3	-	-	.00	-	-
F	Draba sp. (a)	-	-	-	$_{a}$14	$_{b}$81	-	.04	.19
F	Epilobium brachycarpum (a)	-	-	$_{a}$10	$_{a}$6	$_{a}$1	.02	.02	.00
F	Erigeron pumilus	$_{a}$5	$_{a}$2	$_{a}$8	$_{a}$1	-	.09	.00	-
F	Eriogonum racemosum	$_{a}$43	$_{a}$52	$_{a}$73	$_{a}$47	$_{a}$58	2.09	.80	.66
F	Galium aparine (a)	-	-	$_{a}$100	$_{a}$79	$_{a}$97	.42	.62	2.36
F	Helianthus annuus (a)	$_{a}$4	$_{a}$15	-	$_{a}$8	-	-	.01	-
F	Holosteum umbellatum (a)	-	-	$_{a}$29	$_{b}$82	$_{ab}$48	.05	.19	.13
F	Lactuca serriola	-	-	-	-	6	-	-	.01
F	Leucelene ericoides	-	-	$_{a}$6	$_{ab}$14	$_{b}$19	.03	.36	.40
F	Lithospermum incisum	-	-	$_{a}$4	$_{a}$6	$_{a}$3	.03	.04	.04
F	Machaeranthera canescens	$_{a}$6	$_{a}$3	$_{a}$8	-	$_{a}$3	.04	-	.15
F	Medicago sativa	$_{a}$1	$_{a}$3	$_{a}$2	-	-	.03	-	-
F	Microsteris gracilis (a)	-	-	-	$_{a}$13	$_{a}$7	-	.03	.01
F	Oenothera pallida	-	-	-	$_{a}$3	$_{a}$3	-	.03	.06
F	Phlox longifolia	-	-	$_{a}$3	$_{ab}$9	$_{b}$8	.00	.02	.05
F	Ranunculus testiculatus (a)	-	-	$_{ab}$74	$_{b}$93	$_{a}$40	.18	.55	.12
F	Tragopogon dubius	-	-	-	1	-	-	.00	-
F	Unknown forb-annual (a)	-	-	2	-	-	.01	-	-
F	Unknown forb-perennial	3	-	-	-	-	-	-	-
F	Verbascum thapsus	-	-	-	-	3	-	-	.15
F	Wyethia amplexicaulis	-	-	-	-	2	-	-	.15
F	Zigadenus paniculatus	-	-	$_{a}$4	$_{a}$2	$_{a}$3	.01	.03	.03
Total for Annual Forbs		4	15	320	551	530	1.02	2.18	6.34
Total for Perennial Forbs		61	64	175	136	153	2.80	1.69	2.13
Total for Forbs		65	79	495	687	683	3.82	3.88	8.47

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

BROWSE TRENDS --
Management unit 16A, Study no: 10

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	88	74	71	19.99	18.17	13.61
B	Cercocarpus ledifolius	1	1	2	.00	-	-
B	Chrysothamnus nauseosus albicaulis	2	6	5	1.39	3.15	.96
B	Chrysothamnus viscidiflorus viscidiflorus	1	0	0	.38	-	-
B	Gutierrezia sarothrae	24	31	33	2.14	.36	.94
B	Opuntia sp.	3	0	0	.00	-	-
B	Pediocactus simpsonii	0	1	2	-	.00	.15
B	Quercus gambelii	7	9	11	1.06	2.40	4.21
B	Rhus trilobata	0	0	1	-	.38	.66
Total for Browse		126	122	125	24.98	24.47	20.53

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 10

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	18.11
Cercocarpus ledifolius	-	.11
Chrysothamnus nauseosus albicaulis	-	2.34
Gutierrezia sarothrae	-	.60
Quercus gambelii	-	4.71
Rhus trilobata	-	.45

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 10

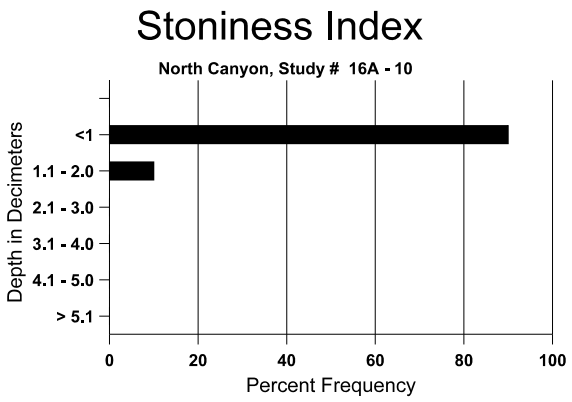
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.1	2.2

BASIC COVER --
Management unit 16A, Study no: 10

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	1.00	3.75	34.09	48.70	50.06
Rock	20.50	25.25	18.35	20.88	16.87
Pavement	7.00	10.00	15.76	16.25	14.11
Litter	66.75	56.75	43.20	43.88	39.07
Cryptogams	0	0	1.19	1.19	.53
Bare Ground	4.75	4.25	4.25	.91	2.50

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 10, North Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
10.3	55.5 (14.3)	7.1	56.4	28.1	15.6	3.2	8.2	51.2	.8



PELLET GROUP DATA --
Management unit 16A, Study no: 10

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	4	3
Elk	-	1	-
Deer	6	16	26
Cattle	-	-	-

Days use per acre (ha)	
'02	'07
-	-
-	-
21 (53)	54 (132)
-	1 (2)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 tridentata vaseyana												
83	**6333**	-	1333	3800	1200	-	17	24	19	-	20	21/24
89	**4865**	-	666	2933	1266	-	49	40	26	3	7	19/28
97	**3880**	40	380	3060	440	880	49	17	11	5	5	24/40
02	**3460**	-	100	1900	1460	1660	14	.57	42	20	21	23/33
07	**2900**	20	60	1720	1120	1240	46	14	39	22	24	26/34
Cercocarpus ledifolius												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	20	-	-	-	0	0	0	-	0	-/-
02	**20**	-	-	-	20	-	0	100	100	-	0	3/4
07	**40**	-	20	20	-	-	0	100	0	-	0	9/10
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**40**	-	-	40	-	-	50	0	0	-	0	32/33
02	**220**	-	-	20	200	20	9	0	91	-	0	37/31
07	**100**	-	-	60	40	40	0	0	40	20	20	28/33
Chrysothamnus viscidiflorus viscidiflorus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	34/38
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
83	**1066**	-	400	666	-	-	0	0	0	-	0	9/8
89	**1733**	-	733	400	600	-	0	0	35	1	4	8/5
97	**2020**	80	560	1420	40	-	0	0	2	-	0	7/8
02	**1700**	-	80	1500	120	40	0	0	7	7	7	6/6
07	**2660**	100	1600	960	100	-	0	0	4	2	2	11/17

		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)
Opuntia sp.												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**80**	-	-	80	-	-	0	0	-	-	0	5/7
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Pediocactus simpsonii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	-	40	-	-	0	0	-	-	0	7/7
07	**60**	-	40	20	-	20	0	0	-	-	0	6/6
Prunus virginiana												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	72/142
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Quercus gambelii												
83	**199**	66	133	66	-	-	0	0	-	-	0	20/31
89	**200**	-	200	-	-	-	100	0	-	-	0	-/-
97	**140**	-	60	80	-	-	57	0	-	-	0	65/48
02	**420**	-	160	260	-	-	0	0	-	-	38	48/35
07	**620**	-	240	380	-	-	0	0	-	-	0	71/51
Rhus trilobata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	62/113
07	**20**	-	20	-	-	-	0	0	-	-	0	78/143

Trend Study 16A-11-07

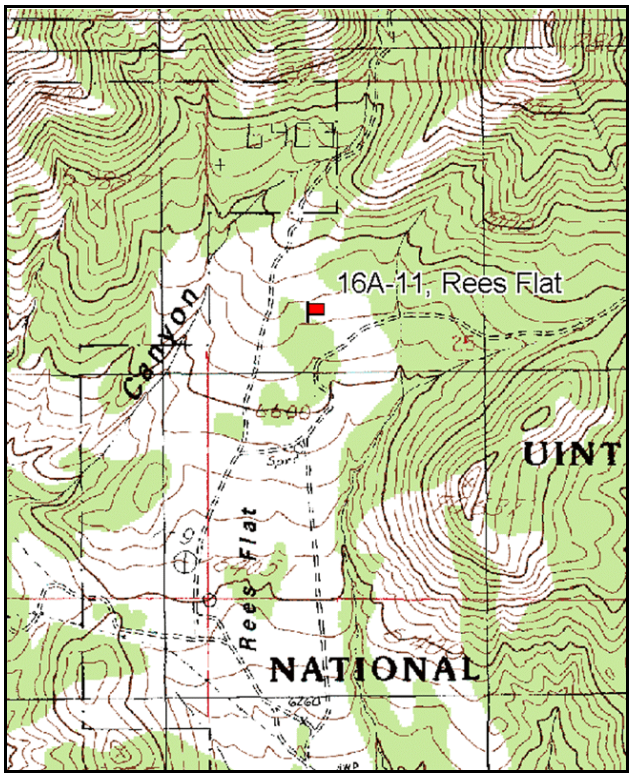
Study site name: Rees Flat . Vegetation type: Mixed Oak-Sage .

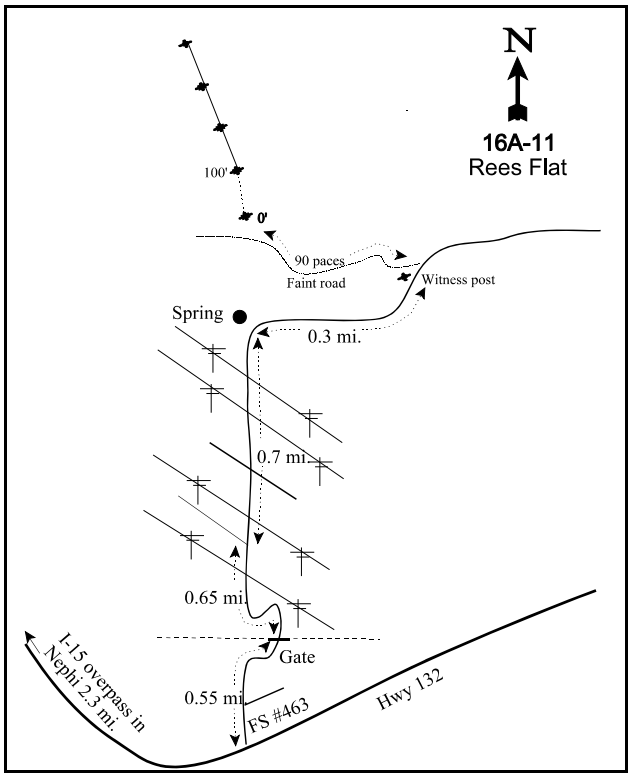
Compass bearing: frequency baseline 344 degrees magnetic (lines 2-4 @ 333°M).

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

LOCATION DESCRIPTION

Beginning at the overpass where Highway 132 crosses beneath I-15 in Nephi, take Highway 132 east for 2.3 miles. Turn north onto Forest Service Road #463 and go 0.2 miles to a fork in the road. Stay left and go another 0.35 miles to a gate. From the gate, go 0.65 miles to another fork. Stay right on the main road for 0.7 miles passing through a 4-way intersection beneath the powerlines until you come to a spring on the left. Continue 0.3 miles farther along to a 3-foot tall witness post 6 paces northwest of the road near some oak brush. Stop here and walk 90 paces west on a faint road. The 0-foot baseline stake is 9 paces north of the faint road. It is a 12 inch high red post marked by browse tag #3956.





Map Name: Nephi

Diagrammatic Sketch

Township 12S , Range 1E , Section 25

GPS: NAD 83, UTM 12S 433389 E 4399358 N

DISCUSSION

Rees Flat - Trend Study No. 16A-11

Study Information

This study is located on a mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and Gambel oak (*Quercus gambelii*) mixed range that was burned and seeded before the study was established [elevation: 6,700 feet (2,042 m), slope: 17%, aspect: south]. It is used primarily by deer as high-elevation winter range, however, elk have also used it fairly consistently. A moderate number of deer and elk pellet groups, as well as two deer antler drops, were noted in 1983 when the study was established. Pellet group quadrat frequency was 26% for deer and 38% for elk in 1997. Deer use was estimated at 56 days use/acre (137 ddu/ha) in 2002 and 25 days use/acre (61 ddu/ha) in 2007. Elk use was estimated at 27 days use/acre (66 edu/ha) in 2002 and 22 days use/acre (55 edu/acre) in 2007. Most deer and elk pellets were from fall, winter, and early spring use. Cattle and horses also graze the area in the summer. Cattle use was estimated at 9 days use/acre (22 cdu/ha) in 2002 and 2 days use (4 cdu/ha) 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. They formed in alluvium, colluvium, and residuum from conglomerate, sandstone, and quartzite. The soil texture is a loam, and it is moderately acidic (pH 5.9). The majority of the soil surface is covered by vegetation and litter, with smaller percentages of rock and pavement cover. The erosion condition was classified as stable in 2002 and 2007.

Browse

The preferred browse species are mountain big sagebrush and antelope bitterbrush (*Purshia tridentata*). Sagebrush is the dominant species, and has fluctuated in density between 1,900 plants/acre (4,693 plants/ha) and 3,460 plants/acre (8,546 plants/ha) since the baseline was lengthened in 1997. Average cover has steadily increased from 4% in 1997 to 13% in 2007. The age structure of the population has shifted from 72% young to 91% mature since 1997, with low decadence. Vigor has been good on most plants since 1983 and use has been mostly light, with some moderate and heavy hedging. Some of the plants were noted to have an insect infestation, most likely the sagebrush defoliator moth (*Aroga websteri*), in 2007. Annual leader growth averaged 2.6 inches (6.6 cm) in 2002 and 1.7 inches (4.4 cm) in 2007.

Bitterbrush was sampled at a density of 200 plants/acre (494 plants/ha) in 1997 and 420 plants/acre (1,037 plants/ha) in 2002 and 2007. This population has consisted of mostly mature individuals since 1983. No decadent plants have been sampled, and recruitment has been high since 1989. The plants are vigorous, and use has been moderate-heavy. These plants were infested with tent caterpillars during the 2007 reading, but did not seem to be adversely impacted. Annual leader growth averaged 1.4 inches (3.6 cm) in 2002 and 1.6 inches (4 cm) in 2007.

Gambel oak is also present in scattered clones, with an average height that has ranged from 4 to 7 feet (1.2 to 2.1 m) since 1983. Average cover has remained stable between 3% and 5% since 1997, and density has ranged between 1,640 plants/acre (4,051 plants/ha) and 2,480 plants/acre (6,126 plants/ha). Plants showing poor vigor increased dramatically from 0% of the population in 1997 to 99% in 2007. The leaves of this species were stunted in 2002 due to a late frost and also showed some frost damage and silkworm infestation in 2007. There was some moderate and heavy use on individuals in 1997 and 2002, but use was light in 2007.

Herbaceous Understory

Average grass cover has been high and has increased from 37% to 46% between 1997 and 2007. However, species diversity is low. The majority of the total grass cover has been comprised of bulbous bluegrass (*Poa bulbosa*), an undesirable perennial, and smooth brome (*Bromus inermis*) since 1997. Bulbous bluegrass

provided 27% cover in 1997 and 2007 and 32% in 2002, while smooth brome cover increased from 5% in 1997 to 19% in 2007. Cheatgrass (*Bromus tectorum*) was the only annual grass present and was only sampled in 1997. Average forb cover has decreased from approximately 2% in 1997 to less than 1% in 2002 and 2007. Forbs are relatively diverse, but occur infrequently. Silky milkvetch (*Astragalus cibarius*) and longleaf phlox (*Phlox longifolia*) had the highest nested frequencies of the forbs in 2007.

1989 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from approximately 500 plants/acre (1,235 plants/ha) to 200 plants/acre (494 plants/ha), and decadence increased by 10%. However, recruitment also increased to 33% of the population consisting of young plants. The percent of plants showing poor vigor increased from 0% of the population to 17%, and 34% of the sampled plants displayed moderate-heavy use. Bitterbrush density increased from 166 plants/acre (410 plants/ha) to approximately 300 plants/acre (741 plants/ha). Recruitment increased to 22% of the population, and all of the plants were vigorous. Eighty-nine percent of the sampled plants showed moderate-heavy use. The trend for grass is down. The sum of nested frequency for perennial species, excluding bulbous bluegrass, decreased by 51%. Bulbous bluegrass increased significantly in nested frequency, while Sandberg bluegrass and crested wheatgrass (*Agropyron cristatum*) decreased significantly in nested frequency. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little.

browse - slightly down (-1) grass - down (-2) forb - stable (0)

1997 TREND ASSESSMENT

The trend for browse is slightly up. Sagebrush density greatly increased from 199 plants/acre (492 plants/ha) to 1,900 plants/acre (4,693 plants/ha), however, some of this increase was attributed to the lengthening of the baseline. This species provided approximately 40% of the total shrub cover. Decadence decreased from 17% of the population to 3%. Young plants comprised 72% of the population, and vigor was good. Use was mostly light, with some moderate-heavy use. Fourteen percent of the total shrub cover was composed of bitterbrush. Its density decreased by 33% with the extended baseline. Young recruitment remained high, and all of the plants were vigorous. Use was mostly moderate, with some heavy hedging. The trend for grass is stable. The sum of nested frequency for perennial grasses, excluding bulbous bluegrass, changed very little. Bulbous bluegrass and smooth brome increased significantly in nested frequency. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little, and forbs only provided approximately 2% cover. The Desirable Components Index (DCI) was rated as fair due to low desirable perennial grass and forb cover, and moderate preferred browse cover.

winter range condition (DCI) - fair (58) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - stable (0)

2002 TREND ASSESSMENT

The trend for browse is up. Sagebrush cover increased from 4% to 10%, and density increased from 1,900 plants/acre (4,693 plants/ha) to 3,460 plants/acre (8,546 plants/ha). Decadence remained low, and although recruitment decreased, it was high with 48% of the population consisting of young plants. Vigor was good, and use was mostly light, with some moderate-heavy browsing. Bitterbrush density also increased from 200 plants/acre (494 plants/ha) to 420 plants/acre (1,037 plants/ha), and cover almost tripled. The population was mostly mature, with 14% composed of young plants. Vigor was good on all plants, and use was heavy. The trend for grass is stable. The sum of nested frequency for desirable perennial grasses changed little. Smooth brome increased significantly in nested frequency , while crested wheatgrass (*Agropyron cristatum*) decreased significantly. Cheatgrass was not sampled. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 54%. The number of individual species sampled decreased from 17 to 10. Total forb cover declined below 1%. The DCI rating increased to good, mostly due to the increase in preferred browse cover.

winter range condition (DCI) - good (73) Mid-level potential scale
browse - up (+2) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density decreased 16%, but cover increased from 10% to 13%. Ninety-one percent of the population was mature, with low decadence and recruitment. Most of the sampled plants were vigorous, and use was mostly light. Bitterbrush density remained stable. This population was also mostly mature, and 10% of the sampled plants were young. Vigor was good, and use remained mostly moderate-heavy. The trend for grass is slightly up. The sum of nested frequency for perennial grasses increased 19% since 1997. Although its nested frequency did not change significantly, smooth brome cover increased from 8% to 19%. Bulbous bluegrass cover decreased from 32% to 26%. The trend for forbs is stable. Although the sum of nested frequency for forbs increased, average cover remained below 1%. The DCI rating remained good.

winter range condition (DCI) - good (77) Mid-level potential scale
browse - stable (0) grass - slightly up (+1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 11

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	c159	b117	b94	a33	a43	2.14	.42	.64
G	Agropyron spicatum	b24	ab11	-	a4	a-	-	.03	.00
G	Bromus inermis	a88	a118	b170	c245	c272	5.09	8.34	18.73
G	Bromus tectorum (a)	-	-	48	-	-	2.26	-	-
G	Dactylis glomerata	a6	a2	-	-	-	-	-	-
G	Poa bulbosa	a3	b282	d352	cd335	c318	26.80	31.76	26.46
G	Poa fendleriana	-	a3	-	-	b13	-	-	.09
G	Poa pratensis	a14	a14	-	a3	a7	-	.38	.18
G	Poa secunda	b290	a18	a25	a29	a8	.37	.51	.04
Total for Annual Grasses		0	0	48	0	0	2.26	0	0
Total for Perennial Grasses		584	565	641	649	661	34.42	41.44	46.15
Total for Grasses		584	565	689	649	661	36.69	41.44	46.15
F	Agoseris glauca	a3	-	a7	a1	-	.19	.03	-
F	Artemisia ludoviciana	a4	a3	-	-	-	-	-	-
F	Astragalus beckwithii	-	-	-	14	-	-	.16	-
F	Aster chilensis	-	10	-	-	-	-	-	-
F	Astragalus cibarius	-	-	-	-	21	-	-	.40
F	Astragalus convallarius	-	-	2	-	-	.03	-	-
F	Astragalus sp.	-	-	15	-	-	.43	-	-
F	Calochortus nuttallii	a3	-	a7	-	a2	.02	-	.00
F	Cirsium sp.	a5	a6	a4	a5	a2	.04	.18	.15

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Collomia sp. (a)	-	-	$_{a}$1	-	$_{a}$5	.00	-	.02
F	Comandra pallida	$_{bc}$23	$_{c}$29	$_{ab}$10	$_{a}$5	$_{a}$8	.48	.03	.04
F	Collinsia parviflora (a)	-	-	-	-	3	-	-	.01
F	Cymopterus longipes	$_{a}$10	-	$_{a}$5	$_{a}$6	$_{a}$7	.04	.04	.01
F	Draba sp. (a)	-	-	-	-	10	-	-	.05
F	Epilobium brachycarpum (a)	-	-	$_{b}$19	$_{a}$3	-	.04	.00	-
F	Erigeron divergens	-	-	2	-	-	.15	-	-
F	Lathyrus brachycalyx	2	-	-	-	-	-	-	-
F	Lactuca serriola	-	-	$_{a}$1	-	$_{a}$1	.00	-	.00
F	Lomatium sp.	-	$_{a}$3	$_{a}$9	-	-	.05	-	-
F	Machaeranthera canescens	-	$_{a}$9	$_{a}$2	-	-	.00	-	-
F	Phlox longifolia	$_{a}$16	$_{a}$15	$_{a}$26	$_{a}$11	$_{a}$31	.05	.40	.14
F	Polygonum douglasii (a)	-	-	-	3	-	-	.00	-
F	Solidago sparsiflora	2	-	-	-	-	-	-	-
F	Stellaria sp.	5	-	-	-	-	-	-	-
F	Tragopogon dubius	$_{b}$14	$_{ab}$6	$_{ab}$6	$_{a}$3	-	.01	.00	-
F	Unknown forb-annual (a)	-	-	2	-	-	.00	-	-
F	Viguiera multiflora	9	-	-	-	-	-	-	-
F	Zigadenus paniculatus	-	-	$_{a}$3	$_{a}$1	$_{a}$3	.03	.03	.00
Total for Annual Forbs		0	0	22	6	18	0.04	0.00	0.08
Total for Perennial Forbs		96	81	99	46	75	1.54	0.89	0.77
Total for Forbs		96	81	121	52	93	1.59	0.90	0.86

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

BROWSE TRENDS --
Management unit 16A, Study no: 11

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	45	55	57	4.21	9.89	12.74
B	Chrysothamnus nauseosus albicaulis	1	1	1	.15	.03	.03
B	Chrysothamnus viscidiflorus viscidiflorus	0	2	0	-	-	-
B	Gutierrezia sarothrae	18	37	23	.52	1.52	.24
B	Purshia tridentata	7	15	17	1.54	4.21	5.19
B	Quercus gambelii	14	16	16	4.35	4.57	3.32
Total for Browse		85	126	114	10.79	20.23	21.52

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 11

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	16.43
Chrysothamnus nauseosus albicaulis	-	.05
Gutierrezia sarothrae	-	.30
Purshia tridentata	-	5.56
Quercus gambelii	.10	6.46

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 11

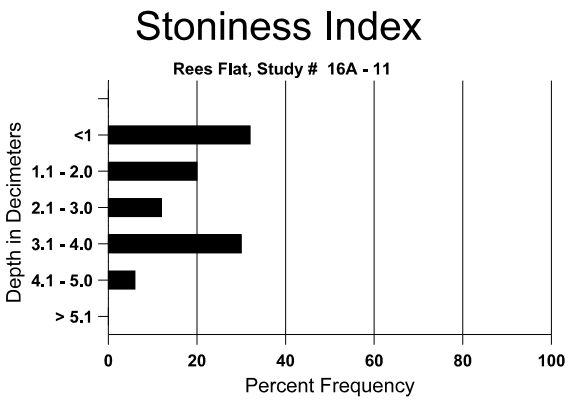
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.6	1.7
Purshia tridentata	1.4	1.6

BASIC COVER --
Management unit 16A, Study no: 11

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	.25	8.25	50.06	57.61	63.02
Rock	7.50	7.75	2.80	3.06	2.80
Pavement	3.50	8.25	5.17	2.70	4.69
Litter	54.50	50.00	33.86	38.47	33.59
Cryptogams	.50	3.00	8.60	4.12	1.22
Bare Ground	33.75	22.75	7.52	11.90	11.02

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 11, Rees Flat

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
15.4	48.0 (17.0)	5.9	40.4	33.1	26.6	2.4	29.8	179.2	.4



PELLET GROUP DATA --
Management unit 16A, Study no: 11

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	2	3	5
Elk	38	13	9
Deer	26	29	33
Cattle	2	4	1

Days use per acre (ha)	
'02	'07
-	-
27 (66)	22 (55)
56 (137)	25 (61)
9 (22)	2 (4)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 vaseyana												
83	**499**	-	-	466	33	-	13	0	7	-	0	18/26
89	**199**	-	66	100	33	-	17	17	17	-	17	17/13
97	**1900**	560	1360	480	60	140	6	4	3	3	3	24/44
02	**3460**	360	1660	1580	220	80	18	5	6	2	6	18/36
07	**2900**	-	200	2640	60	40	14	.68	2	1	1	22/36
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	100	0	0	-	0	9/13
02	**20**	-	-	-	20	-	100	0	100	100	100	19/37
07	**80**	-	-	80	-	-	0	0	0	-	0	19/18
Chrysothamnus viscidiflorus viscidiflorus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	10/28
02	**40**	-	20	20	-	-	0	0	-	-	0	9/22
07	**0**	-	-	-	-	-	0	0	-	-	0	7/14
Grayia spinosa												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	20	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
83	**2199**	733	1466	700	33	-	0	0	2	-	0	8/6
89	**1600**	-	100	1300	200	-	0	0	13	-	0	9/7
97	**1500**	380	500	900	100	20	0	0	7	7	7	5/8
02	**2600**	-	120	1880	600	200	0	0	23	8	8	4/7
07	**2140**	80	1380	580	180	-	10	0	8	.93	.93	7/8

		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)
Purshia tridentata												
83	**166**	-	-	166	-	-	80	0	-	-	0	16/28
89	**299**	66	66	233	-	-	78	11	-	-	0	23/39
97	**200**	40	40	160	-	-	60	10	-	-	0	27/81
02	**420**	-	60	360	-	-	10	81	-	-	0	27/72
07	**420**	-	40	380	-	-	19	52	-	-	0	30/66
Quercus gambelii												
83	**4900**	133	200	4700	-	-	0	0	0	-	0	46/24
89	**3966**	1033	1233	2033	700	-	.84	0	18	.50	3	77/36
97	**1740**	40	660	1080	-	120	1	0	0	-	0	86/76
02	**2480**	-	100	2220	160	300	0	14	6	2	31	62/32
07	**1640**	20	160	1300	180	520	0	0	11	-	99	68/47

Trend Study 16A-12-07

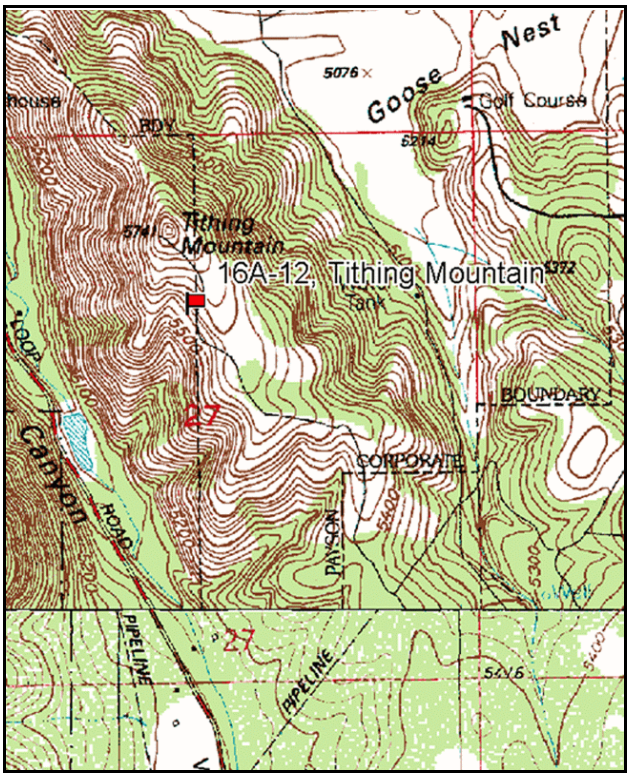
Study site name: Tithing Mountain . Vegetation type: Stansbury Cliffrose .

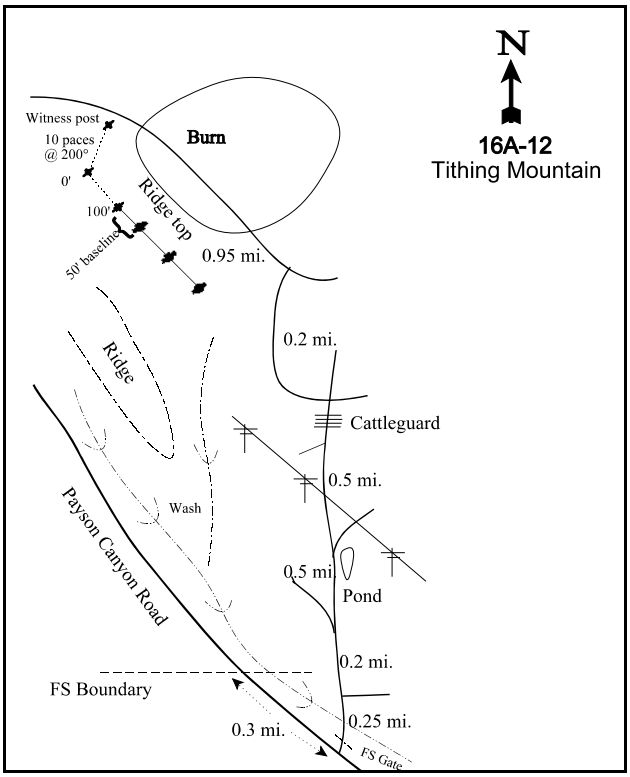
Compass bearing: frequency baseline 140 degrees magnetic.

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

LOCATION DESCRIPTION

[A key is needed to get in the gate]. From the old Peteetneet school at 100 North and 600 East in Payson, head south on 600 East which turns into the Payson Canyon Road. Go 2.9 miles to a flood control basin and a wide spot in the road. Either park here, cross the creek, follow the pipeline south to the first draw, then walk approximately 1/2 mile northwest up this draw to the burn, the road and the transect; **OR** continue driving up the Payson Canyon Road another 1.6 miles to the Forest Service boundary. Go another 0.3 miles and take a rough dirt road on the left (north). Go another 0.25 miles to a side road. Stay straight (left) 0.1 miles further until you cross a cattle guard. Go 0.1 miles beyond the cattle guard until you come to an intersection. At the intersection, go straight for 0.5 miles passing a pond (where you stay left) and crossing beneath the powerlines to another fork in the road. Go straight (north) for another 0.5 miles to a 4-way intersection. Stay left (west) and go 0.2 miles to a 3-way intersection where you will turn right (west). Go 0.95 miles to a witness post/rock pile on the left side of the road. From here, the 0-foot baseline stake (marked by browse tag #9083) is 10 paces away at 200 degrees magnetic.





Map Name: Spanish Fork

Diagrammatic Sketch

Township 9S , Range 2E , Section 27

GPS: NAD 83, UTM 12S 440081 E 4429054 N

DISCUSSION

Tithing Mountain - Trend Study No. 16A-12

Study Information

This study was established in 1989 on private land to monitor critical big game winter range southeast of Payson [elevation: 5,700 feet (1,737 m), slope: 17%, aspect: southeast]. The ridge is occupied by a stand of cliffrose (*Cowania mexicana* ssp. *stansburiana*) intermixed with mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and Gambel oak (*Quercus gambelii*). The area has been used in the past by wintering deer and elk, as well as domestic sheep and cattle. Deer use was light in 1997 with a pellet group frequency of 7%, which increased to 21% in 2002 and 31% in 2007. Deer use was estimated at 68 days use/acre (167 ddu/ha) in 2002 and 93 days use/acre (230 ddu/ha) in 2007. Elk use was estimated at 3 days use/acre (8 edu/ha) in 2002 and 25 days use/acre (63 edu/ha) in 2007. Cattle use was estimated at 1 day use/acre (2 cdu/ha) in 2007. Sheep use was estimated at 3 days use/acre (7 sdu/ha) in 2002. Three deer were observed during the 2007 reading, and deer bedding areas were noted on and around the site.

Soil

The soil is classified as an association of the Henefer and Rake series (USDA-NRCS 2007). Soils in the Henefer series are very deep and well-drained, and formed in alluvium and colluvium from quartzite and sandstone. The Rake series consists of shallow to lime-cemented hardpan soils that formed in colluvium and local alluvium derived from limestone and minor amounts of quartz. The soil on the site is well-drained and moderately shallow. The texture is a clay loam, and is slightly acidic (pH 6.3). Cobble-sized rocks are common throughout the soil profile. The majority of the ground is covered by vegetation and litter, with very little bare soil exposed. The soil erosion condition was classified as stable in 2002 and 2007.

Browse

The preferred browse is Stansbury cliffrose, which has provided between 76% and 96% of the total browse cover since 1997. Cliffrose density increased from 466 plants/acre (1,151 plants/ha) in 1989 to 760 plants/acre (1,878 plants/ha) when the baseline was extended in 1997, then remained stable at 580 plants/acre (1,433 plants/ha) in 2002 and 2007. The population has remained mostly mature, with decadent plants composing less 21% of the population. Young recruitment was high at 21% in 1989, but no young plants have been sampled since. The population has been generally vigorous, although during the initial sampling in 1989 it was noted that the older, taller cliffrose had large branches broken down. Mature plants have been measured up to 8.1 feet (2.5 m) in height. Over 50% of the sampled plants have shown moderate-heavy use in all sample years. Annual leader growth averaged 0.8 inches (2.1 cm) in 2002 and 2.7 inches (6.9 cm) in 2007.

Average sagebrush cover has decreased from 3% in 1997 to less than 1% in 2002 and 2007. Density was 666 plants/acre (1,646 plants/ha) in 1989, and has steadily decreased to 100 plants/acre (247 plants/ha) by 2007. The age structure of the population was stable in 1989, with 40% of the population consisting of young plants. Mature plants increased from 58% of the population in 1997 to 83% in 2002. By 2007, all of the sagebrush plants sampled were decadent, and 60% were classified as dying. Vigor was good until 2007, and use was mostly light, with some moderate and heavy hedging. Annual leader growth averaged 2.7 inches (6.9 cm) in 2007.

Herbaceous Understory

The herbaceous understory is abundant, but in poor condition. It is dominated by annuals and low-value perennial weeds. Annual grasses provided 29% cover in 1997, 15% in 2002, and 41% in 2007. Perennial grasses provided only 2% cover in 1997, 6% in 2002, and 12% in 2007. Cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), and bulbous bluegrass (*Poa bulbosa*) comprised 97% of the total grass cover in 1997. Cheatgrass and bulbous bluegrass continued to increase in cover, while Japanese brome decreased. In 2007, cheatgrass and bulbous bluegrass combined provided 48% cover, which was 91% of the

total grass cover. Perennial grasses such as bluebunch wheatgrass (*Agropyron spicatum*), Kentucky bluegrass (*Poa pratensis*), and Sandberg bluegrass (*Poa secunda*), were sampled in low frequencies in 1989 and 1997, but diminished in 2002 and 2007 with the substantial increase in bulbous bluegrass.

Forbs are diverse, and have provided 26% to 35% cover since 1997. However, composition is extremely poor. Whitetop (*Cardaria draba*), a noxious weed, has been sampled since 1989, and provided the majority of the perennial forb cover in 2002 and 2007. Other common perennial species include prickly lettuce (*Lactuca serriola*) and dandelion (*Taraxacum officinale*). Storksbill (*Erodium cicutarium*) has steadily increased in nested frequency and cover since 1997. It comprised 50% of the total forb cover in 2007. Storksbill is an introduced annual, and has been shown to outcompete and prevent the establishment of native species (Buchanan et al. 1978). Bedstraw *(Galium aparine*), another annual, made up 22% of the total forb cover in 1997 and 2002, but decreased to 5% in 2007.

1997 TREND ASSESSMENT

The trend for browse is stable. Cliffrose density increased from 466 plants/acre (1,151 plants/ha) to 760 plants/acre (1,878 plants/ha), however, this increase was partly attributed to the increase in sampling area. The plants were mostly mature, and decadence decreased from 21% to 13% of the population. Young recruitment also decreased from 21% to 0%. Plants showing poor vigor increased from 0% to 8% of the population, and use remained moderate-heavy. Sagebrush density remained stable at 620 plants/acre (1,532 plants/ha). Decadence decreased from 30% to 13% of the population. Recruitment also decreased, but was still high, with 29% of the population composed of young plants. Vigor improved from 15% of the plants displaying poor vigor to only 3%, and use decreased to mostly light. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little, but 97% of the total grass cover was composed of undesirable species. The trend for forbs is up. The sum of nested frequency for perennial forbs, excluding whitetop, increased almost 70%. Prickly lettuce, dandelion, and yellow salsify (*Tragopogon dubius*), all of which are used by big game, increased significantly in nested frequency. However, whitetop also increased significantly in nested frequency. The Desirable Components Index (DCI) was rated as very poor due to low recruitment of preferred browse species, sparse perennial grass cover, high annual grass cover, and the presence of a noxious weed.

winter range condition (DCI) - very poor (29) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is down. Cliffrose density decreased from 760 plants/acre (1,878 plants/ha) to 580 plants/acre (1,433 plants/ha), although average cover remained stable at 14%. Decadence increased from 13% to 17% of the population, and no young plants were sampled. Plants displaying poor vigor increased from 8% to 14% of the population, and use remained moderate-heavy. Sagebrush density decreased from 620 plants/acre (1,532 plants/ha) to 240 plants/acre (593 plants/ha), and decadence increased from 13% to 17% of the population. Young recruitment declined from 29% to 0% of the population. All of the sampled plants were vigorous, and half of the population showed moderate-heavy use. The trend for grass is down. The sum of nested frequency for perennial grasses, excluding bulbous bluegrass, decreased 84%, and Sandberg bluegrass decreased significantly in nested frequency. Bulbous bluegrass increased significantly in nested frequency, and its average cover increased from 1% to 6%. Cheatgrass cover also slightly increased from 13% to 15%. The trend for forbs is down. The sum of nested frequency for perennial forbs, excluding whitetop, decreased 17%. Prickly lettuce decreased significantly in nested frequency, while whitetop and storksbill increased significantly in nested frequency. Total forb cover increased from 27% to 35%, but this change was attributed to a large increase in weedy annual forb cover. The DCI rating remained very poor.

winter range condition (DCI) - very poor (30) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is stable. Cliffrose density did not change, although its average cover decreased from 14% to 9%. The age structure of the population remained stable and vigor slightly improved, with 10% of the population displaying poor vigor. Use remained moderate-heavy. Sagebrush density continued to decrease from 240 plants/acre (593 plants/ha) to 100 plants/acre (247 plants/ha). All of the plants sampled were decadent, and 60% were classified as dying. Vigor was poor, and 40% of the plants showed heavy use. The trend for grass is down. The sum of nested frequency for perennial grasses, excluding bulbous bluegrass, decreased 83%. Cheatgrass increased significantly in nested frequency, and its average cover increased from 15% to 36%. Bulbous bluegrass also increased significantly in nested frequency, and its average cover doubled from 6% to 12%. Bluebunch wheatgrass was the only grass species sampled that benefits big game, and was sampled in only one quadrat. The trend for forbs is down. The sum of nested frequency for perennial forbs, excluding whitetop, decreased almost 40%, and dandelion decreased significantly in nested frequency. Storksbill increased significantly in nested frequency, and its average cover increased from 10% to 13%. The majority of forb species, including those of benefit to big game, are weedy exotics. The DCI rating remained very poor, however, the score declined due to the decrease in preferred browse and perennial forb cover, and the increase in noxious weed species sampled.

winter range condition (DCI) - very poor (3) Mid-level potential scale
browse - stable (0) grass - down (-2) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 12

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Aegilops cylindrica (a)	-	-	-	2	-	-	.03
G	Agropyron spicatum	a10	a3	-	a1	.03	-	.00
G	Bromus brizaeformis (a)	-	-	-	12	-	-	.05
G	Bromus japonicus (a)	-	b297	-	a44	15.63	-	.10
G	Bromus tectorum (a)	-	a300	a267	b375	12.92	15.48	35.83
G	Festuca myuros (a)	-	a47	-	b156	.18	-	4.50
G	Poa bulbosa	-	a15	b104	c167	1.45	5.55	11.68
G	Poa pratensis	a5	a5	a3	-	.03	.00	-
G	Poa secunda	ab28	b30	a3	-	.74	.04	-
Total for Annual Grasses		0	644	267	589	28.74	15.48	40.53
Total for Perennial Grasses		43	53	110	168	2.26	5.59	11.69
Total for Grasses		43	697	377	757	31.01	21.08	52.22
F	Agoseris glauca	-	-	-	3	-	-	.00
F	Alyssum alyssoides (a)	-	b98	a16	b67	.56	.05	.18
F	Allium sp.	a6	-	a2	-	-	.00	-
F	Asclepias asperula	3	-	-	-	-	-	-
F	Boraginaceae (a)	-	-	-	86	-	-	2.43
F	Cardaria draba	a49	b112	c188	c176	4.88	7.82	6.57
F	Camelina microcarpa (a)	-	a9	a9	a20	.04	.02	.38

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Calochortus nuttallii	-	$_{a}$-	$_{a}$2	-	.00	.00	-
F	Collinsia parviflora (a)	-	$_{b}$61	$_{b}$70	$_{a}$11	.30	.49	.05
F	Cymopterus longipes	$_{a}$7	$_{a}$15	$_{a}$15	$_{a}$8	.11	.10	.04
F	Epilobium brachycarpum (a)	-	$_{b}$59	$_{a}$9	$_{b}$48	.91	.04	.20
F	Eriogonum brevicaule	-	-	11	-	-	.02	-
F	Erodium cicutarium (a)	-	$_{a}$197	$_{b}$229	$_{c}$292	4.78	10.46	12.71
F	Erigeron divergens	-	-	3	-	-	.15	-
F	Eriogonum ovalifolium	-	-	2	-	-	.03	-
F	Galium aparine (a)	$_{b}$104	$_{bc}$140	$_{c}$179	$_{a}$52	6.00	7.63	1.32
F	Helianthus annuus (a)	9	-	-	-	-	-	-
F	Holosteum umbellatum (a)	-	$_{b}$67	$_{a}$19	$_{a}$17	.28	.05	.04
F	Lappula occidentalis (a)	-	-	-	4	-	-	.01
F	Lactuca serriola	$_{b}$148	$_{c}$204	$_{a}$89	$_{a}$81	5.83	.86	.42
F	Lomatium sp.	-	-	6	-	-	.06	-
F	Medicago sativa	-	2	-	-	.00	-	-
F	Microsteris gracilis (a)	-	$_{a}$9	-	$_{a}$1	.01	-	.00
F	Montia perfoliata (a)	-	-	33	-	-	.22	-
F	Phlox longifolia	2	-	-	-	-	-	-
F	Polygonum douglasii (a)	-	$_{a}$3	$_{a}$5	$_{a}$9	.00	.01	.02
F	Ranunculus sp.	-	-	37	-	-	.41	-
F	Ranunculus testiculatus (a)	-	$_{a}$22	$_{a}$29	-	.09	.09	-
F	Taraxacum officinale	$_{a}$3	$_{bc}$39	$_{c}$61	$_{ab}$20	1.21	2.37	.22
F	Tragopogon dubius	$_{a}$25	$_{b}$62	$_{ab}$41	$_{b}$53	.62	.46	.29
F	Unknown forb-annual (a)	-	$_{a}$19	$_{b}$56	-	.38	3.12	-
F	Unknown forb-perennial	-	4	-	-	.38	-	-
F	Veronica biloba (a)	-	$_{a}$37	$_{a}$46	$_{a}$32	.57	.66	.59
F	Zigadenus paniculatus	$_{a}$1	$_{a}$3	$_{a}$3	$_{a}$2	.00	.00	.00
Total for Annual Forbs		113	721	700	639	13.96	22.86	17.95
Total for Perennial Forbs		244	441	460	343	13.05	12.32	7.57
Total for Forbs		357	1162	1160	982	27.02	35.18	25.53

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

BROWSE TRENDS --
Management unit 16A, Study no: 12

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	28	12	5	2.54	.66	.00
B	Chrysothamnus viscidiflorus viscidiflorus	0	0	1	-	-	-
B	Cowania mexicana stansburiana	32	26	26	13.96	14.17	9.32
B	Opuntia sp.	0	1	1	.03	.15	.00
B	Purshia tridentata	1	0	0	-	-	-
B	Quercus gambelii	1	2	2	1.82	.53	.41
Total for Browse		62	41	35	18.37	15.51	9.75

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 12

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	.06	.13
Cowania mexicana stansburiana	1.48	21.16
Quercus gambelii	-	.30
Rosa woodsii	-	.26

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 12

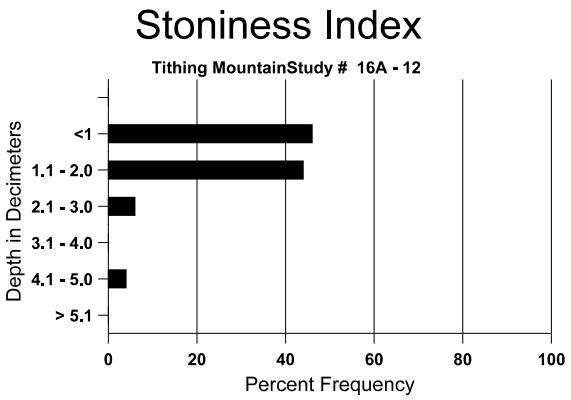
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	-	2.7
Cowania mexicana stansburiana	0.8	2.7

BASIC COVER --
Management unit 16A, Study no: 12

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	2.50	59.62	64.40	73.30
Rock	5.25	9.61	7.72	9.42
Pavement	.25	3.13	1.05	.20
Litter	84.25	61.15	40.52	32.36
Cryptogams	.75	.06	0	.09
Bare Ground	7.00	3.39	6.54	.83

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 12, Tithing Mountain

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
9.4	53.6 (12.4)	6.3	38.4	29.1	32.6	3.4	22.0	92.8	.6



PELLET GROUP DATA --
Management unit 16A, Study no: 12

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	2	4
Elk	-	-	6
Deer	7	21	31
Cattle	-	-	-
Sheep	-	-	-

Days use per acre (ha)	
'02	'07
-	-
3 (8)	25 (63)
68 (167)	93 (230)
-	1 (2)
3 (8)	-

BROWSE CHARACTERISTICS --
Management unit 16A, 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 vaseyana												
89	**666**	-	266	200	200	-	30	20	30	5	15	20/38
97	**620**	-	180	360	80	180	3	16	13	3	3	24/37
02	**240**	-	-	200	40	120	25	25	17	-	0	24/31
07	**100**	-	-	-	100	220	0	40	100	60	60	26/35
Chrysothamnus viscidiflorus viscidiflorus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Cowania mexicana stansburiana												
89	**466**	-	100	266	100	-	50	29	21	-	0	56/58
97	**760**	-	-	660	100	80	26	61	13	8	8	97/105
02	**580**	-	-	480	100	20	10	48	17	10	14	87/89
07	**580**	-	-	480	100	20	17	34	17	10	10	97/97
Grayia spinosa												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	103/72
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	3/7
07	**20**	-	-	20	-	-	0	0	-	-	0	6/22
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	100	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Quercus gambelii												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**80**	-	-	80	-	-	0	0	0	-	0	37/39
02	**140**	-	120	-	20	40	0	0	14	-	14	72/56
07	**60**	-	-	60	-	40	0	0	0	-	0	35/27

		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)
Rosa woodsii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	73/91
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16A-13-07

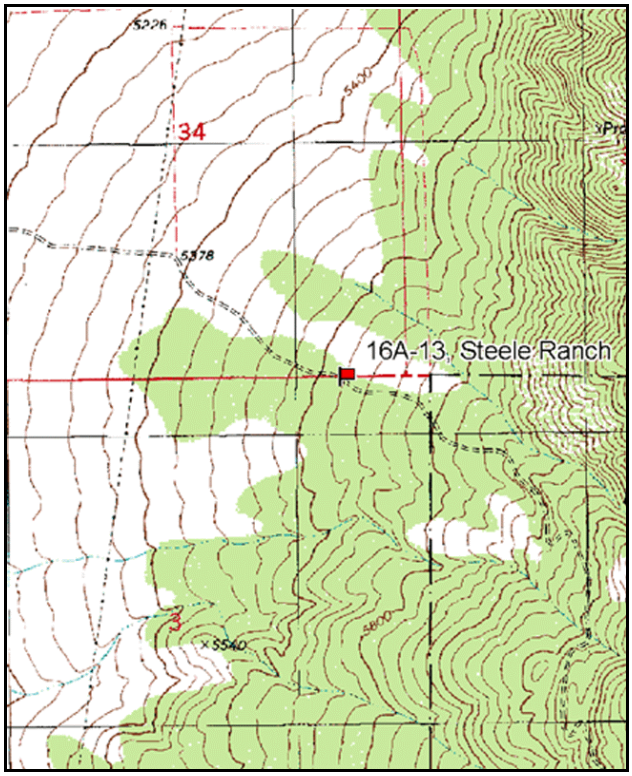
Study site name: Steele Ranch . Vegetation type: Mixed Oak-Sage .

Compass bearing: frequency baseline 185 degrees magnetic.

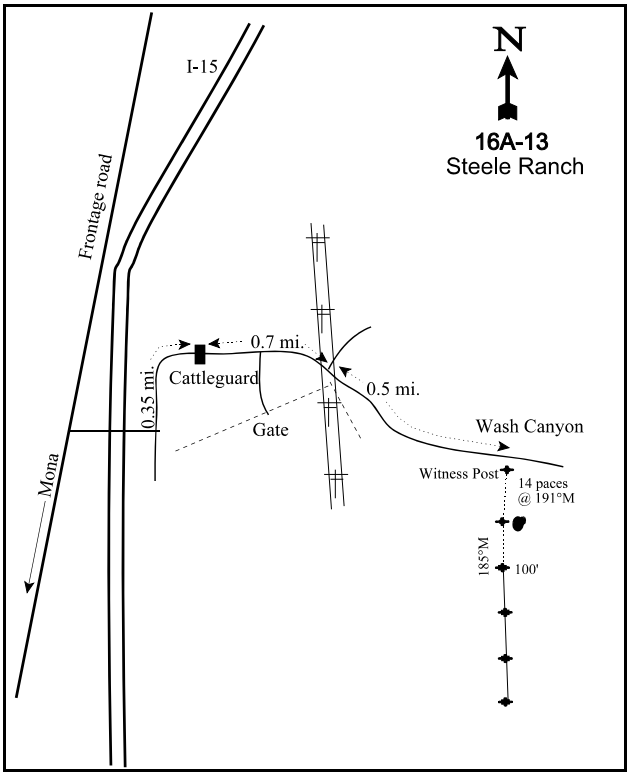
Frequency belt placement: line 1 (11 & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft).

LOCATION DESCRIPTION

From 200 North Main Street in Mona, take the frontage road north towards Santaquin. Go 5.35 miles and turn east onto a gravel road that goes beneath the I-15 overpass. After passing beneath I-15, the road comes to a "T", go left 0.35 miles to a cattle guard. Continue up the road 0.7 miles to a fence corner and a fork in the road. Stay to the right (south) for 0.5 miles to the witness post on the south side of the road. From the witness post the 0-foot baseline stake is 14 paces away at 187 degrees magnetic. The 0-foot stake is marked with browse tag #182.



Map Name: Santaquin



Diagrammatic Sketch

Township 11S , Range 1E , Section 3

GPS: NAD 83, UTM 12S 431085 E 4416365 N

DISCUSSION

Steele Ranch - Trend Study No. 16A-13

Study Information

This study is on UDWR property and is typical of the mixed oak-big sagebrush vegetation type along the foothills of the Wasatch Front [elevation: 5,620 feet (1,713 m), slope: 15%, aspect: west]. Much of this type has been converted to agriculture or has been heavily grazed by domestic livestock. However, the study is representative of the remaining native winter range along the mountain front. Depending on the severity of the winter, the area receives moderate-heavy use by deer and light use from elk. Pellet group data from 1997 estimated little deer use with a quadrat frequency of 7%. Deer use was estimated at 62 days use/acre (154 ddu/ha) in 2002 and 90 days use (223 ddu/ha) in 2007.

Soil

The soil is classified within the Lizzant series (USDA-NRCS 2007). Soils in this series are very deep and well-drained, and formed in alluvium and colluvium derived from sedimentary rocks. The soil texture is a loam with a neutral pH of 7.2. Rocks are common on the surface and within the profile. Soil phosphorus is marginal at 9.1 ppm. Vegetation and litter have provided at least 80% relative ground cover since 1997, which has prevented erosion. The erosion condition was classified as stable in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) density has fluctuated between 2,480 plants/acre (6,128 plants/ha) and 3,340 plants/acre (8,253 plants/ha) since 1989. Average cover was 13% to 14% between 1997 and 2007. When the study was established, the sagebrush population was mostly decadent, but young recruitment was good at 11% of the population. In 1997, the age structure improved and was largely mature, although recruitment was almost nonexistent. Decadence increased from 19% in 1997 to 60% in 2002 and 53% in 2007, while recruitment remained low. Plants displaying poor vigor greatly increased from 7% of the population in 1997 to 39% by 2007. Use was moderate in 1989, moderate-heavy in 1997 and 2002, and mostly light with some moderate-heavy use in 2007. Annual leader growth averaged 1.8 inches (4.6 cm) in 2002 and 0.9 inches (2.3 cm) in 2007.

Gambel oak (*Quercus gambelii*) is patchy in its distribution, but has provided 50% to 64% of the browse cover since 1997. Its density increased from 9,532 plants/acre (23,553 plants/ha) in 1989 to 15,940 plants/acre (39,387 plants/ha) by 2002, then decreased to 10,560 plants/acre (26,093 plants/ha) in 2007. The age structure has been indicative of a stable population, with mostly mature plants and high young recruitment. The plants have been generally vigorous, except in 2002 when 25% of the sampled plants displayed poor vigor due to frost damage. The oak height is variable, with some clones growing to 10 feet (3 m) while others are less than two feet (0.6 m). Use is mostly light on the lower-growing plants, with some moderate-heavy hedging.

Herbaceous Understory

Perennial grasses have provided 3% cover in 1997, 5% in 2002, and 6% in 2007. Sandberg bluegrass (*Poa secunda*) is the most abundant grass, and has comprised 75% to 88% of the total grass cover since 1997. Other perennial grasses, such as bluebunch wheatgrass (*Agropyron spicatum*), mutton bluegrass (*Poa fendleriana*), and sheep fescue (*Festuca ovina*), were sampled only occasionally. Cheatgrass (*Bromus tectorum*) is present, but has provided less than 1% average cover since 1997.

Forbs are diverse, but provide little quality forage. Pale alyssum (*Alyssum alyssoides*), bedstraw (*Galium aparine*), holosteum (*Holosteum umbellatum*), and bur buttercup (*Ranunculus testiculatus*) were the most abundant forb species in 2002 and 2007. Forb cover was 3% in 1997 and 4% in 2002, but greatly increased to 9% in 2007. Most of the increase was attributed to annual species.

1997 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from 3,132 plants/acre (7,739 plants/ha) to 2,480 plants/acre (6,128 plants/ha), and decadence also decreased from 55% of the population to 19%. Some of the change in density is likely due to the increase in sample area. Young recruitment declined from 11% of the population to only 1%. Vigor remained good, and use slightly increased to moderate-heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. The trend for forbs is up. The sum of nested frequency for perennial forbs increased substantially. Beckwith milkvetch (*Astragalus beckwithii*) and desert parsley (*Lomatium* sp.) increased significantly in nested frequency. The Desirable Components Index (DCI) was rated as fair due to high preferred browse cover, but low browse recruitment and limited perennial herbaceous cover.

winter range condition (DCI) - fair (56) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is slightly up. Sagebrush density increased from 2,480 plants/acre (6,128 plants/ha) to 3,340 plants/acre (8,253 plants/ha), and young recruitment slightly improved from 1% of the population to 7%. However, decadence greatly increased from 19% of the population to 60%, and 35% of the sampled plants displayed poor vigor and were classified as dying. Use remained moderate-heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little, however, average perennial grass cover increased from 3% to 5%. Cheatgrass increased significantly in nested frequency, but its average cover remained below 1%. The trend for forbs is up. The sum of nested frequency for perennial forbs increased 28%. Sego lily (*Calochortus nuttallii*) increased significantly in nested frequency, while pale alyssum decreased significantly in nested frequency. Average forb cover increased from 3% to 4%. Although diverse, the forb component has relatively few species beneficial to big game. The DCI rating declined to poor-fair due to the increase in preferred browse decadence.

winter range condition (DCI) - poor-fair (52) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - up (+2)

2007 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from 3,340 plants/acre (8,253 plants/ha) to 2,680 plants/acre (6,622 plants/ha). Decadence remained high at 53% of the population, and recruitment slightly decreased from 7% of the population to 4%. Plants displaying poor vigor slightly increased from 35% to 39% of the population, and use decreased to mostly light, with some moderate-heavy hedging. Gambel oak cover increased from 14% to 23%, and the population structure shifted from 94% mature to 55% mature and 40% young. The trend for grass is stable. The sum of nested frequency for perennial grasses remained relatively unchanged, however, bluebunch wheatgrass increased significantly in nested frequency. Cheatgrass nested frequency changed little, and its average cover remained less than 1%. The trend for forbs is up. The sum of nested frequency for perennial forbs increased 54%, and numerous forbs increased significantly in nested frequency. Average forb cover increased from 4% to 9%, however, the majority of the increase was attributed to annual species. The DCI rating increased to good, mainly due to the increase in oak recruitment.

winter range condition (DCI) - good (67) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 13

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	-	-	a8	b19	-	.09	.53
G	Bromus tectorum (a)	-	a100	b131	ab120	.29	.65	.90
G	Festuca myuros (a)	-	a30	-	a48	.06	-	.12
G	Festuca ovina	-	-	-	3	-	-	.02
G	Poa fendleriana	a1	ab16	b26	b17	.08	.61	.31
G	Poa secunda	a235	a233	a218	a207	3.29	4.68	5.60
G	Sitanion hystrix	-	-	2	-	-	.03	-
Total for Annual Grasses		0	130	131	168	0.35	0.64	1.02
Total for Perennial Grasses		236	249	254	246	3.37	5.42	6.46
Total for Grasses		236	379	385	414	3.73	6.07	7.49
F	Agoseris glauca	-	a8	a5	a12	.02	.04	.05
F	Alyssum alyssoides (a)	-	b234	a163	b255	.51	.83	3.74
F	Allium sp.	-	2	-	-	.00	-	-
F	Antennaria rosea	-	-	1	-	-	.00	-
F	Arabis sp.	a5	a1	a2	a6	.00	.00	.01
F	Astragalus beckwithii	a3	b11	-	-	.08	-	-
F	Astragalus eurekensis	-	-	b30	a14	-	.18	.04
F	Astragalus utahensis	-	2	-	-	.03	-	-
F	Castilleja linariaefolia	-	a6	a6	a6	.04	.06	.10
F	Calochortus nuttallii	a21	a34	b77	b67	.08	.23	.18
F	Castilleja sp.	a6	a3	-	-	.01	-	-
F	Cirsium undulatum	-	-	-	6	-	-	.01
F	Comandra pallida	-	-	a4	b12	-	.03	.09
F	Collinsia parviflora (a)	-	a6	a21	a10	.01	.04	.02
F	Crepis acuminata	-	-	a5	a8	-	.07	.21
F	Cryptantha sp.	-	a3	-	a1	.00	-	.00
F	Draba sp. (a)	-	-	a1	b121	-	.00	.48
F	Epilobium brachycarpum (a)	-	a12	a6	a7	.03	.02	.02
F	Erigeron pumilus	-	-	-	-	-	.00	-
F	Eriogonum racemosum	a3	a2	-	a9	.00	-	.01
F	Galium aparine (a)	-	a77	a58	b108	.96	.23	1.70
F	Helianthus annuus (a)	-	-	-	4	-	-	.06
F	Helianthella uniflora	-	-	-	4	-	-	.03
F	Holosteum umbellatum (a)	-	a51	a32	b157	.13	.06	.97
F	Lactuca serriola	-	-	a3	b23	-	.00	.06

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Lomatium sp.	$_{a}$5	$_{b}$33	$_{b}$23	$_{b}$46	.48	.36	.37
F	Microsteris gracilis (a)	-	-	$_{a}$6	$_{b}$51	-	.01	.13
F	Montia perfoliata (a)	-	-	-	7	-	-	.04
F	Petradoria pumila	$_{a}$3	-	$_{a}$1	$_{a}$2	-	.00	.06
F	Phlox longifolia	$_{a}$20	$_{ab}$35	$_{ab}$24	$_{b}$38	.10	.11	.14
F	Ranunculus testiculatus (a)	-	$_{a}$116	$_{a}$147	$_{a}$116	.47	1.95	.57
F	Sanguisorba minor	-	-	-	3	-	-	.00
F	Tragopogon dubius	$_{a}$3	$_{a}$4	$_{a}$1	$_{b}$32	.01	.01	.23
F	Unknown forb-annual (a)	-	6	-	-	.01	-	-
F	Veronica biloba (a)	-	$_{a}$2	$_{a}$6	$_{a}$7	.00	.01	.07
F	Viola sp.	-	$_{a}$3	$_{a}$5	-	.01	.01	-
F	Zigadenus paniculatus	-	$_{a}$-	$_{a}$1	-	.01	.01	-
Total for Annual Forbs		0	504	440	843	2.15	3.18	7.84
Total for Perennial Forbs		69	147	188	289	0.91	1.17	1.65
Total for Forbs		69	651	628	1132	3.07	4.35	9.49

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BROWSE TRENDS --
Management unit 16A, Study no: 13

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	75	75	72	13.34	13.93	12.58
B	Gutierrezia sarothrae	2	5	5	.06	.19	.01
B	Quercus gambelii	55	58	62	18.79	13.64	22.78
Total for Browse		132	138	139	32.20	27.76	35.38

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 13

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	16.26
Gutierrezia sarothrae	-	.23
Quercus gambelii	1.39	42.70

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 13

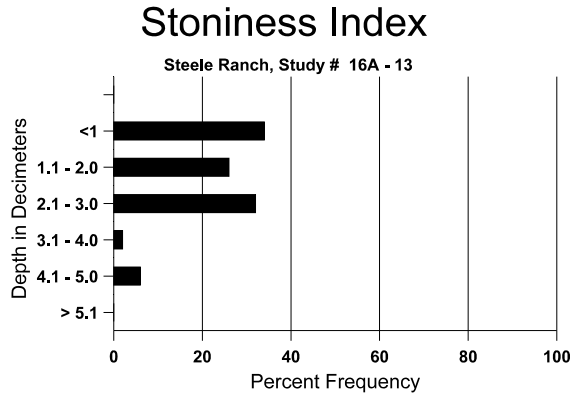
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.8	0.9

BASIC COVER --
Management unit 16A, Study no: 13

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	3.00	38.51	36.13	47.69
Rock	3.75	5.61	5.34	5.85
Pavement	26.75	9.78	8.90	7.96
Litter	56.75	58.58	60.54	52.81
Cryptogams	5.75	3.87	4.72	5.41
Bare Ground	4.00	4.83	6.14	3.49

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 13, Steele Ranch

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
10.6	47.6 (13.1)	7.2	37.1	41.1	21.8	4.0	9.1	86.4	.7



PELLET GROUP DATA --
Management unit 16A, Study no: 13

Type	Quadrat Frequency			
	'89	'97	'02	'07
Rabbit	-	5	3	8
Deer	-	7	15	19

Days use per acre (ha)	
'02	'07
-	-
62 (154)	90 (223)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 vaseyana												
89	**3132**	66	333	1066	1733	-	55	0	55	-	9	22/23
97	**2480**	80	20	2000	460	460	44	22	19	7	7	26/40
02	**3340**	40	240	1080	2020	820	29	37	60	35	35	25/36
07	**2680**	180	120	1140	1420	580	28	17	53	28	39	23/33
Gutierrezia sarothrae												
89	**532**	200	400	66	66	-	0	0	12	-	0	4/2
97	**80**	-	-	80	-	-	0	0	0	-	0	6/9
02	**120**	-	-	100	20	20	0	0	17	-	0	4/5
07	**360**	1160	140	200	20	-	0	0	6	-	0	9/11
Quercus gambelii												
89	**9532**	733	7200	1266	1066	-	22	.69	11	-	.69	33/24
97	**10320**	260	1700	8380	240	920	0	0	2	.19	.19	54/40
02	**15940**	20	1020	14920	-	320	4	11	0	-	25	44/27
07	**10560**	920	4200	5860	500	900	2	1	5	2	2	42/28

Trend Study 16A-14-07

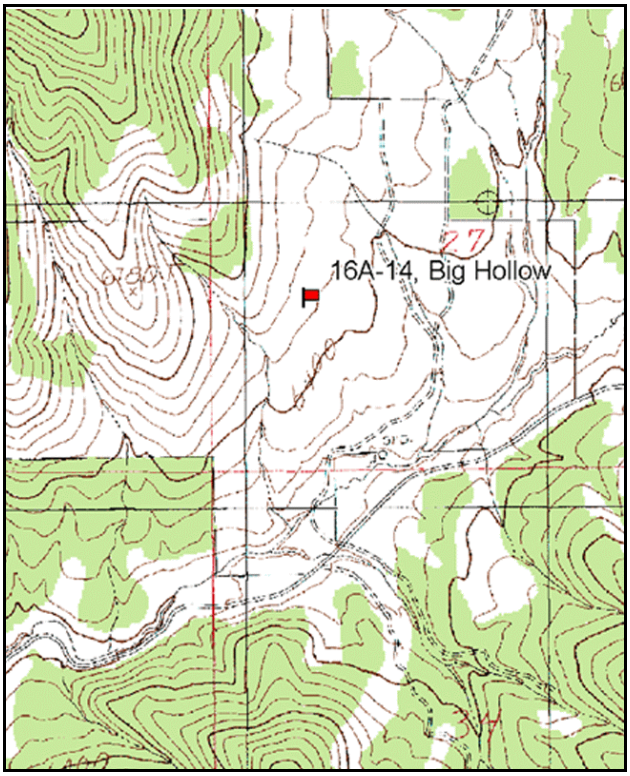
Study site name: Big Hollow . Vegetation type: Big Sagebrush .

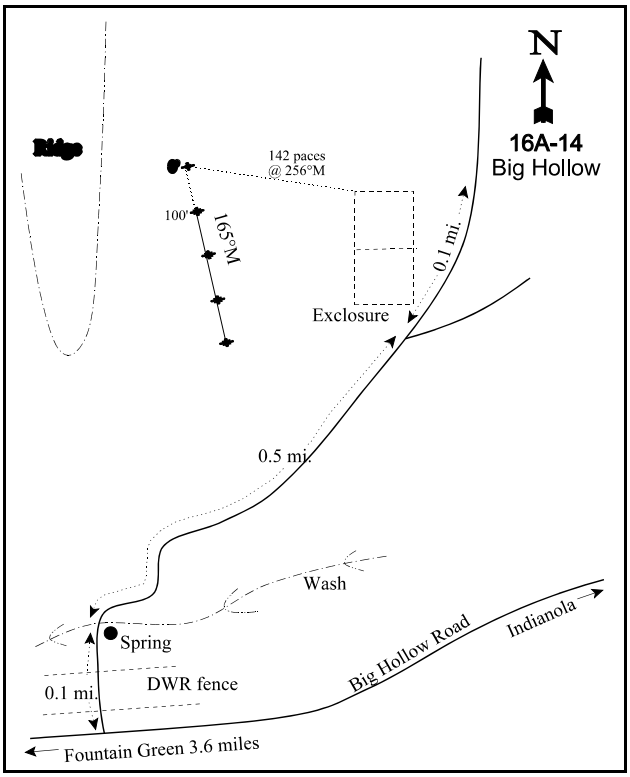
Compass bearing: frequency baseline 165 degrees magnetic.

Frequency belt placement: line 1 (11 & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft). Rebar: no rebar placed on site.

LOCATION DESCRIPTION

At the intersection of State Street and 100 North in Fountain Green, go east on 100 North for 0.3 miles to the old dump. Continue up Big Hollow for 3.3 miles to a gate parallel to the road onto DWR land. Turn left through the gates and go 0.1 miles to a spring in a wash. Continue on this road for 0.5 miles to a fork. Stay left and go 0.1 miles to the north end of an exclosure. Park here. From the northwest corner of the exclosure, walk 142 paces at a bearing of 256 degrees M to a tall fencepost in the sagebrush. This 4-foot tall green fencepost is the 0-foot baseline stake.





Map Name: Big Hollow

Diagrammatic Sketch

Township 13S , Range 3E , Section 27

GPS: NAD 83, UTM 12S 450137 E 4389862 N

DISCUSSION

Big Hollow - Trend Study No. 16A-14

Study Information

This study is located on UDWR property east of Fountain Green on a large area that was chained in 1964 [elevation: 6,450 feet (1,966 m), slope: 17%, aspect: southeast]. However, there is little evidence of the treatment. It does not appear that dense trees were ever present, and no seeded species have been sampled. Other areas of the chaining were apparently more heavily seeded. The dominant vegetation is basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) interspersed with a smaller density of antelope bitterbrush (*Purshia tridentata*). There is a perennial spring 200 yards (183 m) to the southeast. Due to the availability of water during the dry year of 1989, deer were using the area during the summer. However, the majority of big game use usually occurs in winter and spring. One recent winter-killed fawn was found in 1989, and an antler drop was noted in 2007. Deer use was estimated at 31 days use/acre (78 ddu/ha) in 1997, 62 days use/acre (154 ddu/ha) in 2002, and 58 days use/acre (144 ddu/ha) in 2007. Elk use was estimated at 2 days use/acre (5 edu/ha) in 1997, 1 day use/acre (2 edu/ha) in 2002, and 5 days use/acre (12 edu/ha) in 2007. Cattle use was estimated at 6 days use/acre (14 cdu/ha) in 1997, 8 days use/acre (20 cdu/ha) in 2002, and 8 days use/acre (20 cdu/ha) in 2007. Rabbit pellets had a quadrat frequency of 26% in 1997, 73% in 2002, and 50% in 2007.

Soil

The soil is classified within the Deer Creek series (USDA-NRCS 2007). The soils in this series are deep and well-drained, and formed from alluvial and colluvial materials. The soil texture is a sandy clay loam. A substantial amount of small rocks are concentrated in the upper 8 inches (20 cm) of the profile, and on the soil surface as pavement. Relative rock and pavement cover was 30% in 1989, and steadily decreased to 14% in 2007. The soil erosion condition was classified as stable in 2002 and 2007.

Browse

Basin big sagebrush density was 2,599 plants/acre (6,422 plants/ha) in 1989, and has remained relatively stable between 1,580 plants/acre (3,904 plants/ha) and 1,880 plants/acre (4,645 plants/ha) since the baseline was lengthened in 1997. Its average cover was 15% in 1997 and 2002, then decreased to 10% in 2007. The population has been mostly mature, however, decadence is high and has steadily increased from 27% of the population in 1997 to 46% in 2007. Young recruitment has steadily decreased from 13% of the population in 1989 to only 1% in 2007. Plants displaying poor vigor have increased from 3% of the population in 1989 to 29% in 2007. Sagebrush use has been mostly light, with some moderate-heavy browsing. Annual leader growth averaged 1.7 inches (4.3 cm) in 2002 and 2007.

Bitterbrush density was 599 plants/acre (1,480 plants/ha) in 1989, and decreased to 280 plants/acre (692 plants/ha) with the increased sample area in 1997. The density remained relatively stable in 2002 and 2007, at 320 plants/acre (791 plants/ha) and 260 plants/acre (642 plants/ha), respectively. Average bitterbrush cover remained at 2% from 1997 to 2007. The age structure of the population was stable in 1989 and 1997, with mostly mature plants and high young recruitment. However, 63% of the population in 2002 and 77% in 2007 were classified as decadent, and there was no young recruitment. Vigor was excellent in 1989, but decreased in 1997 and 2002, when 21% and 25% of the population showed poor vigor, respectively. Only 8% of the population displayed poor vigor in 2007. Use on the available portions of the plants was moderate-heavy in 1989 and 1997 and mostly heavy in 2002 and 2007. The bitterbrush plants were tall in 2002 and 2007, with an average height of 5 to 6 feet (1.5 to 1.8 m). Annual leader growth averaged 0.5 inches (1.3 cm) in 2002 and 1.6 inches (4 cm) in 2007.

Broom snakeweed (*Gutierrezia sarothrae*), an undesirable invader and increaser, dramatically increased in density between 1989 and 1997, from 799 plants/acre (1,974 plants/ha) to 22,560 plants/acre (55,745 plants/ha). Strip frequency was 79% in 1997, indicating that it was widely distributed. The age distribution of

the population indicated an expanding population. Most likely due to drought conditions, snakeweed declined to only 160 plants/acre (395 plants/ha) in 2002, but increased to 9,400 plants/acre (23,227 plants/ha) in 2007.

Point-centered quarter data estimated Utah juniper (*Juniperus osteosperma*) density at 24 trees/acre (59 trees/ha) in 2002 and 34 trees/acre (84 trees/ha) in 2007. Average trunk diameter was 6 inches (15.2 cm) in 2002 and 6.5 inches (16.5 cm) in 2007. The trees averaged 6 to 10 feet (1.8 to 3 m) in height in 2002, but in 2007, 50% of the sampled trees were over 12 feet (3.7 m) tall.

Herbaceous Understory

The herbaceous understory is diverse, but not particularly productive. Total grass cover was 9% in 1997, 14% in 2002, and 22% in 2007. Cheatgrass (*Bromus tectorum*) has been the most abundant grass since 1997, and provided 42%, 34%, and 61% of the total grass cover in 1997, 2002, and 2007, respectively. This species comprised 28% of the total herbaceous cover in 2002, and 42% in 2007. Common perennial species include bluebunch wheatgrass (*Agropyron spicatum*), needle-and-thread (*Stipa comata*), sedge (*Carex* sp.), and Indian ricegrass (*Oryzopsis hymenoides*). The forb composition is made up of mostly annual and few desirable perennial species. Total forb cover was 2% in 1997, 3% in 2002, and 10% in 2007. Pale alyssum (*Alyssum alyssoides*) has been the most abundant forb since 1997, and provided 64% and 86% of the total forb cover in 2002 and 2007, respectively.

1997 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from 2,599 plants/acre (6,422 plants/ha) to 1,780 plants/acre (4,398 plants/ha). Young recruitment slightly decreased to 10% of the population. Decadence slightly decreased from 33% of the population to 27%, but plants displaying poor vigor increased slightly from 3% of the population to 9%. Use remained mostly light. Bitterbrush density also decreased, from 599 plants/acre (1,480 plants/ha) to 280 plants/acre (692 plants/ha). Young recruitment increased from 22% of the population to 29%. Decadence decreased from 33% of the population to 21%, and plants displaying poor vigor greatly increased from 0% of the population to 21%. Use remained moderate-heavy, although there was more heavy use than in 1989. The trend for grass is up. The sum of nested frequency for perennial grasses increased 27%. Needle-and-thread increased significantly in nested frequency, while squirreltail (*Sitanion hystrix*) decreased significantly in nested frequency. The trend for forbs is slightly up. The sum of nested frequency for perennial forbs increased 19%, and douglas chaenactis (*Chaenactis douglasii*) increased significantly in nested frequency. The Desirable Components Index (DCI) was rated as poor due to favorable preferred browse cover, but high browse decadence and low perennial ground cover.

winter range condition (DCI) - poor (45) Mid-level potential scale
browse - slightly down (-1) grass - up (+2) forb - slightly up (+1)

2002 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density increased slightly from 1,780 plants/acre (4,398 plants/ha) to 1,880 plants/acre (4,645 plants/ha). Decadence increased from 27% of the population to 35%, and young recruitment continued to decrease from 10% of the population to 7%. Vigor declined, with 19% of the population showing poor vigor. Use remained mostly light, but there was some moderate-heavy hedging. Bitterbrush density increased slightly from 280 plants/acre (692 plants/ha) to 320 plants/acre (791 plants/ha). However, decadence greatly increased from 21% of the population to 63%, and no young plants were sampled. Plants displaying poor vigor remained high at 25% of the population, and use was heavy. The trend for grass is up. The sum of nested frequency for perennial grasses increased 20%. Sedge and squirreltail increased significantly in nested frequency. Perennial grass cover increased from 5% to 9%, while cheatgrass cover increased from 4% to 5%. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased 13%. Pale alyssum increased significantly in nested frequency, however, this species does not provide quality forage. The DCI rating remained poor.

winter range condition (DCI) - poor (46) Mid-level potential scale
browse - stable (0) grass - up (+2) forb - slightly down (-1)

2007 TREND ASSESSMENT

The trend for browse is slightly down. The density of sagebrush decreased from 1,880 plants/acre (4,645 plants/ha) to 1,580 plants/acre (3,904 plants/ha), and its average cover decreased from 15% to 10%. Decadence increased from 35% of the population to 46%, while young recruitment declined to only 1% of the population. Twenty-nine percent of the sampled plants were classified as dying. Use was light-moderate. Bitterbrush density decreased from 320 plants/acre (791 plants/ha) to 260 plants/acre (642 plants/ha), and decadence continued to increase to 77% of the population. No young plants were sampled. Plants showing poor vigor decreased from 25% of the population to 8%, and use was mostly heavy. The trend for grass is down. The sum of nested frequency for perennial grasses decreased 18%. Squirreltail decreased significantly in nested frequency, while thickspike wheatgrass (*Agropyron dasystachyum*) increased in nested frequency. Cheatgrass increased significantly in nested frequency, and its average cover increased from 5% to 13%. The trend for forbs is stable. The sum of nested frequency for perennial forbs did not change. Pale alyssum increased significantly in nested frequency, and its cover increased from 2% to 8%. The DCI rating declined to very poor due to the decreased cover and increased decadence of preferred browse, and the increase in annual grass cover.

winter range condition (DCI) - very poor (24) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 14

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron dasystachyum	-	-	a5	b31	-	.04	.96
G	Agropyron spicatum	a11	ab39	b38	b35	.70	2.45	2.25
G	Bromus japonicus (a)	-	-	21	-	-	.09	-
G	Bromus tectorum (a)	-	a238	a242	b337	3.74	4.85	13.36
G	Carex sp.	-	a41	b61	b57	.74	2.33	1.46
G	Oryzopsis hymenoides	a74	a67	a45	a42	1.85	1.14	1.36
G	Poa secunda	-	3	-	-	.00	-	-
G	Sitanion hystrix	b89	a40	b79	a26	.86	2.18	1.09
G	Stipa comata	a12	b46	b54	b41	1.05	1.00	1.54
Total for Annual Grasses		0	238	263	337	3.74	4.95	13.36
Total for Perennial Grasses		186	236	282	232	5.21	9.17	8.67
Total for Grasses		186	474	545	569	8.96	14.12	22.03
F	Alyssum alyssoides (a)	-	a148	b241	c338	1.02	2.07	8.43
F	Arabis sp.	-	-	-	6	-	-	.02
F	Astragalus sp.	a1	-	a3	-	-	.00	-
F	Calochortus nuttallii	-	a2	a5	a14	.01	.01	.04
F	Chenopodium album (a)	-	-	-	1	-	-	.00

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Chaenactis douglasii	$_{a}$12	$_{b}$21	$_{a}$5	$_{a}$6	.11	.02	.04
F	Chenopodium sp. (a)	-	2	-	-	.00	-	-
F	Cirsium sp.	$_{a}$8	$_{a}$17	$_{a}$17	-	.04	.31	-
F	Collinsia parviflora (a)	-	-	$_{a}$4	$_{a}$11	-	.00	.02
F	Cryptantha sp.	-	-	-	3	-	-	.00
F	Descurainia pinnata (a)	-	-	$_{a}$1	$_{b}$45	-	.00	.32
F	Draba sp. (a)	-	-	-	3	-	-	.00
F	Eriogonum cernuum (a)	-	-	$_{a}$3	$_{a}$1	-	.00	.00
F	Erodium cicutarium (a)	-	-	$_{a}$4	$_{a}$9	-	.00	.04
F	Eriogonum sp.	$_{a}$1	$_{a}$2	-	-	.00	-	-
F	Gilia sp. (a)	-	$_{a}$1	-	$_{a}$6	.00	-	.01
F	Hackelia patens	-	4	-	-	.03	-	-
F	Lappula occidentalis (a)	-	-	-	37	-	-	.15
F	Lactuca serriola	-	$_{a}$1	-	$_{a}$6	.00	-	.01
F	Microsteris gracilis (a)	-	-	11	-	-	.03	-
F	Orobanche fasciculata	-	1	-	-	.00	-	-
F	Penstemon sp.	-	-	1	-	-	.00	-
F	Polygonum douglasii (a)	-	$_{a}$15	$_{a}$2	-	.05	.01	-
F	Ranunculus testiculatus (a)	-	-	$_{a}$30	$_{a}$37	-	.08	.12
F	Sisymbrium altissimum (a)	-	-	-	3	-	-	.00
F	Sphaeralcea coccinea	$_{a}$42	$_{a}$35	$_{a}$43	$_{a}$38	.47	.64	.60
F	Tragopogon dubius	$_{a}$8	$_{a}$3	$_{a}$1	$_{a}$3	.01	.00	.01
Total for Annual Forbs		0	166	296	491	1.09	2.21	9.12
Total for Perennial Forbs		72	86	75	76	0.69	1.01	0.73
Total for Forbs		72	252	371	567	1.78	3.22	9.86

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

BROWSE TRENDS --
Management unit 16A, Study no: 14

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata tridentata	61	57	52	14.77	14.69	9.95
B	Artemisia tridentata vaseyana	1	1	0	.30	.78	-
B	Gutierrezia sarothrae	79	8	74	5.73	.01	7.35
B	Juniperus osteosperma	0	1	0	-	.00	.15
B	Opuntia sp.	5	2	3	.18	-	.15
B	Purshia tridentata	12	13	10	2.27	2.38	1.76
Total for Browse		158	82	139	23.27	17.87	19.37

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 14

Species	Percent Cover	
	'02	'07
Artemisia tridentata tridentata	-	13.53
Gutierrezia sarothrae	-	7.09
Juniperus osteosperma	-	.10
Opuntia sp.	-	.05
Purshia tridentata	.03	2.00

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 14

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata tridentata	1.7	1.7
Purshia tridentata	0.5	1.6

POINT-QUARTER TREE DATA --
Management unit 16A, Study no: 14

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	24	34

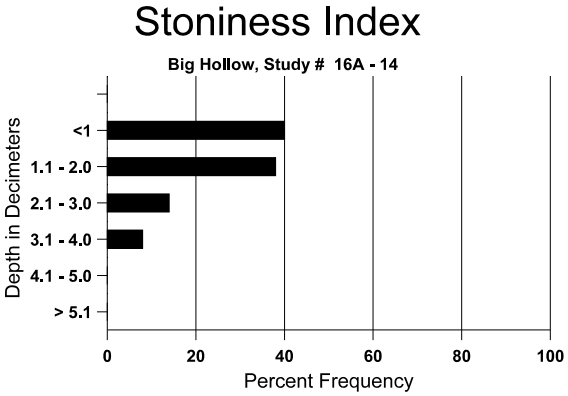
Average diameter (in)	
'02	'07
6.0	6.5

BASIC COVER --
Management unit 16A, Study no: 14

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	3.25	33.79	35.76	48.65
Rock	3.75	5.09	4.71	4.12
Pavement	26.25	17.61	15.09	13.10
Litter	49.00	44.18	38.18	35.58
Cryptogams	.50	1.59	5.34	4.57
Bare Ground	17.25	11.16	20.92	13.19

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 14, Big Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
11.7	63.4 (13.2)	6.8	48.0	27.1	24.9	2.9	13.3	166.4	.5



PELLET GROUP DATA --
Management unit 16A, Study no: 14

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	26	73	50
Elk	2	1	3
Deer	32	14	9
Cattle	1	3	3

Days use per acre (ha)		
'97	'02	'07
-	-	-
2 (5)	1 (2)	5 (12)
31 (78)	62 (154)	58 (144)
6 (14)	8 (20)	8 (20)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 tridentata												
89	**2599**	200	333	1400	866	-	18	0	33	3	3	31/33
97	**1780**	80	180	1120	480	340	3	0	27	9	9	29/41
02	**1880**	180	140	1080	660	560	18	6	35	16	19	44/51
07	**1580**	20	20	840	720	520	22	1	46	29	29	35/44
Artemisia tridentata vaseyana												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	25/31
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Cowania mexicana stansburiana												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	65/94
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
89	**799**	-	66	733	-	-	0	0	0	-	0	6/4
97	**22560**	20	6680	15860	20	180	.44	0	0	.08	.08	9/13
02	**160**	20	160	-	-	140	0	0	0	-	0	-/-
07	**9400**	1120	120	9240	40	20	0	0	0	.42	11	9/12
Juniperus osteosperma												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	100	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**160**	-	20	140	-	80	0	0	0	-	0	-/-
02	**60**	-	-	40	20	-	67	0	33	-	0	5/10
07	**60**	-	-	60	-	-	0	0	0	-	0	6/14
Purshia tridentata												
89	**599**	-	133	266	200	-	67	11	33	-	0	24/38
97	**280**	-	80	140	60	-	36	29	21	21	21	46/76
02	**320**	-	-	120	200	40	6	94	63	25	25	68/59
07	**260**	-	-	60	200	60	8	69	77	8	8	59/61

		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)
Tetradymia canescens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	8/14

Trend Study 16A-15-07

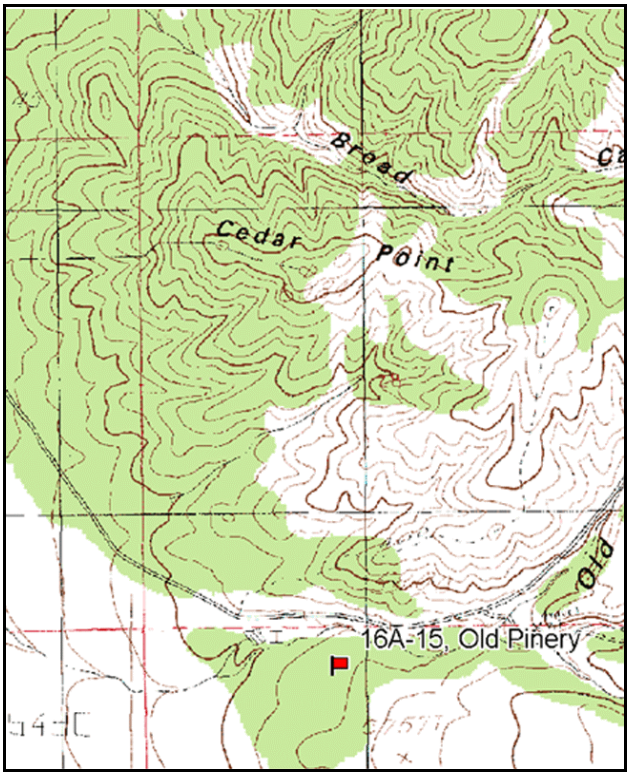
Study site name: Old Pinery . Vegetation type: Chained, Seeded P-J .

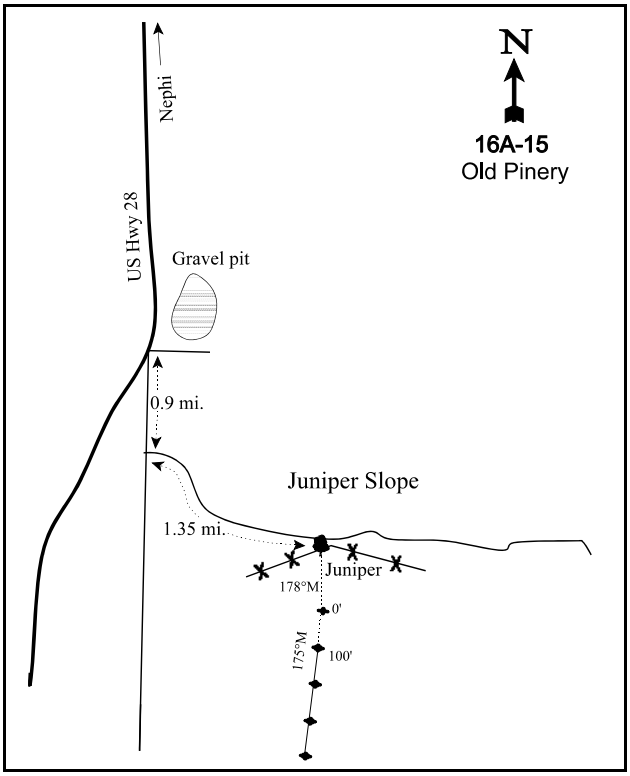
Compass bearing: frequency baseline 175 degrees magnetic.

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

LOCATION DESCRIPTION

From Nephi, proceed south on U.S. 28 to a dirt road just past a gravel pit. Turn left on the dirt road, and proceed south 0.9 miles to another intersection. Turn left at the intersection and proceed southeast for 1.35 miles toward Old Pinery Canyon. Stop at the corner of the fenceline. From the easternmost of the two middle fenceposts, the 0-foot marker of the baseline is located 130 paces away at an azimuth of 178 degrees magnetic. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height. A red browse tag, number 3960, is attached to the 0-foot baseline stake.





Map Name: Nephi

Diagrammatic Sketch

Township 13S , Range 1E , Section 33

GPS: NAD 83, UTM 12S 428825 E 4388666 N

DISCUSSION

Old Pinery - Trend Study No. 16A-15

Study Information

This study is located on privately-owned rangeland south of Old Pinery Creek [elevation: 5,650 feet (1,722 m), slope: 3%, aspect: west]. The area was dominated by pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*), but was chained and seeded prior to study establishment in 1983. Animal use was very low in 1983 due to lack of cover and forage. However, deer pellet groups were common in 1997 with a quadrat frequency of 41%, and use was estimated at 94 deer days use/acre (233 ddu/ha) in 2002 and 90 days use/acre (222 ddu/ha) in 2007. Cattle sign was also noted in 1997 with a quadrat frequency of 18%, and use was estimated at 22 days use/acre (54 cdu/ha) in 2002 and 12 days use/acre (29 cdu/ha) in 2007. All of the cattle use appeared to be from previous years, but most deer pellet groups were from winter use. A dead deer and cow were noted on the study in 2007.

Soil

The soil is classified within the Borvant series (USDA-NRCS 2007). The soils in this series are shallow and well-drained, with possible petrocalcic horizons. They formed in alluvium or colluvium derived from limestone and sandstone. The soil texture is a loam, and it is slightly acidic (pH 6.2). Few rocks are found on the surface and in the profile. Vegetation and litter have accounted for at least 75% of the relative ground cover since 1997. Abundant cover and the gentle slope prevent most erosion. The erosion condition was classified as stable in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the main browse species, and comprised 83% of the total browse cover in 1997, 86% in 2002, and 93% in 2007. It provided only 6% cover in 1997, then increased to 10% in 2002 and 13% in 2007. Sagebrush density has varied greatly. It increased from 1,332 plants/acre (3,291 plants/ha) in 1983 to 4,532 plants/acre (11,198 plants/ha) in 1989, and ranged between 2,040 plants/acre (5,041 plants/ha) and 3,340 plants/acre (8,253 plants/ha) from 1997 to 2007. The population was made up of 95% mature plants in 1983, and in 1989, 76% of the population was young. Recruitment slowly declined but remained high until 2007, when 92% of the sampled plants were mature. Decadence has remained at 5% of the population or less since 1983. Vigor has been excellent in all sample years. Use was light from 1983 to 2002 with some moderate and heavy use in 1997 and 2002, and was moderate-heavy in 2007. Annual leader growth averaged 2.8 inches (7.1 cm) in 2002 and 1.7 inches (4.2 cm) in 2007.

Antelope bitterbrush (*Purshia tridentata*) has also been sampled since 1997. Density was estimated at 60 plants/acre (148 plants/ha) in 1997, 80 plants/acre (198 plants/ha) in 2002, and 100 plants/acre (247 plants/ha) in 2007. All of the sampled plants have been mature, vigorous, and heavily used.

The chaining appears to have been relatively successful, with a juniper density of only 12 trees/acre (30 trees/ha) in 1997, 21 trees/acre (52 trees/ha) in 2002, and 23 trees/acre (57 trees/ha) in 2007. A few of the sampled trees were tipped over, but still growing. Average trunk diameter was 3.2 inches (8.1 cm) in 1997, 6.8 inches (17.3 cm) in 2002, and 9.7 inches (24.6 cm) in 2007. Most of the sampled trees were 8-10 feet (2.4-3 m) tall in 2002 and over 12 feet (3.7 m) tall in 2007.

Herbaceous Understory

The herbaceous understory was dominated by cheatgrass (*Bromus tectorum*) in 1983, and it appeared that the seeding was not successful. Seeded and native perennial grasses were rare. By 1989, the sum of nested frequency for perennial grasses had increased nearly three-fold. Total grass cover was 23% in 1997, 35% in 2002, and 44% in 2007. Cheatgrass accounted for 10% of the total grass cover in 1997, 9% in 2002, and 21% in 2007. Perennial grass cover greatly increased between 1997 and 2007, however, the majority of this

increase was attributed to bulbous bluegrass (*Poa bulbosa*). Bulbous bluegrass provided 4% of the total grass cover in 1997, 43% in 2002, and 67% in 2007. It also accounted for 40% of the total herbaceous cover in 2002 and 57% in 2007. Other common perennial grass species include crested wheatgrass (*Agropyron cristatum*), bluebunch wheatgrass (*Agropyron spicatum*), western wheatgrass (*Agropyron smithii*), and Sandberg bluegrass (*Poa secunda*).

Total forb cover was 7% in 1997, 3% in 2002, and returned to 7% in 2007. However, the majority of the forb cover is provided by annual species. Pale alyssum (*Alyssum alyssoides*), bur buttercup (*Ranunculus testiculatus*), blue-eyed Mary (*Collinsia parviflora*), and storksbill (*Erodium cicutarium*) are the most abundant forbs. Storksbill has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003). Field bindweed (*Convolvulus arvensis*), a noxious weed, was sampled at low nested and quadrat frequencies in 1997 and 2007.

1989 TREND ASSESSMENT

The trend for browse is up. Sagebrush density increased from 1,332 plants/acre (3,291 plants/ha) to 4,532 plants/acre (11,198 plants/ha). Young recruitment greatly increased from 0% of the population to 76%, and reproduction also increased from 0 seedlings/acre to 8,166 seedlings/acre (20,178 seedlings/ha). Decadence remained low at 4% of the population. Vigor was good, and use remained light. The trend for grass is up. The sum of nested frequency for perennial grasses almost tripled. Crested wheatgrass, western wheatgrass, and Sandberg bluegrass increased significantly in nested frequency. The trend for forbs is up. Seven perennial forb species were sampled, which was an improvement from 1983 when no forbs were sampled.

browse - up (+2) grass - up (+2) forb - up (+2)

1997 TREND ASSESSMENT

The trend for browse is stable. The density decreased from 4,532 plants/acre (11,198 plants/ha) to 2,040 plants/acre (5,041 plants/ha). However, this decrease was attributed to the increase in sampling area, and may have also been due to self-thinning, since so many young plants were sampled in 1989. Young recruitment remained very high, but slightly decreased from 76% of the population to 69%. Decadence remained low at only 1% of the population. All of the sampled plants were vigorous, and use increased, with 21% of the plants showing moderate-heavy hedging. Bitterbrush was also sampled for the first time, at a density of 60 plants/acre (148 plants/ha). All of these plants were mature, vigorous, and heavily browsed. The trend for grass is up. The sum of nested frequency for perennial grasses increased almost 30%. Western wheatgrass, bluebunch wheatgrass, and Sandberg bluegrass increased significantly in nested frequency. The trend for forbs is up. The sum of nested frequency for perennial forbs increased almost 50%. The number of sampled perennial species doubled from seven to 14. However, bindweed was sampled in one quadrat. The Desirable Components Index (DCI) was rated as fair due to high perennial grass cover, high preferred browse recruitment, and low browse decadence. However, low browse and perennial forb cover, as well as the presence of a noxious weed, prevented the score from being higher.

winter range condition (DCI) - fair (59) Mid-level potential scale
browse - stable (0) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is up. Sagebrush density increased from 2,040 plants/acre (5,041 plants/ha) to 3,340 plants/acre (8,253 plants/ha), and average cover increased from 6% to 10%. Young recruitment decreased from 69% of the population to 35%, and decadence slightly increased from 1% of the population to 5%. Vigor remained good, and plants showing moderate-heavy use increased from 21% of the population to 31%. Bitterbrush density slightly increased from 60 plants/acre (148 plants/ha) to 80 plants/acre (198 plants/ha). Vigor remained good, and use remained heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses, excluding bulbous bluegrass, decreased only 9%. Sandberg bluegrass decreased

significantly in nested frequency, while bulbous bluegrass increased significantly in nested frequency. Bulbous bluegrass average cover increased from less than 1% to 15%. Cheatgrass cover also increased from 2% to 3%. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 62%, and total forb cover decreased from 7% to 3%. Numerous species decreased significantly in nested frequency. Bindweed was not sampled. The DCI rating increased to good due to the increase in preferred browse cover and the absence of noxious weeds.

winter range condition (DCI) - good (69) Mid-level potential scale
browse - up (+2) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from 3,340 plants/acre (8,253 plants/ha) to 2,700 plants/acre (6,672 plants/ha), however, average cover increased from 10% to 13%. Young recruitment decreased from 35% of the population to 4%, but decadence remained low at 4%. Vigor remained good, with only 3% of the sampled plants displaying poor vigor. Use increased to moderate-heavy. Bitterbrush density slightly increased from 80 plants/acre (198 plants/ha) to 100 plants/acre (247 plants/ha). Use continued to be heavy on these plants, and vigor was good. The trend for grass is down. The sum of nested frequency for perennial grasses, excluding bulbous bluegrass, decreased 34%. Sandberg bluegrass continued to decrease significantly in nested frequency, while cheatgrass and bulbous bluegrass increased significantly in nested frequency. Average cheatgrass cover increased from 3% to 9%, and average bulbous bluegrass cover almost doubled from 15% to 29%. The trend for forbs is slightly up. The sum of nested frequency for perennial forbs increased 20%. However, storksbill increased significantly in nested frequency, and its average cover increased from less than 1% to 5%. Average perennial forb cover did not change, while annual forb cover increased from 3% to 7%. Additionally, bindweed was sampled in one quadrat. The DCI rating declined to very poor due to decreases in young recruitment for preferred browse and valuable perennial grass cover, an increase in annual grass cover, and the presence of a noxious weed.

winter range condition (DCI) - very poor (32) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 15

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	a35	b121	b110	b107	b87	5.19	6.10	1.00
G	Agropyron smithii	a23	b148	c163	bc144	bc131	3.49	3.78	1.63
G	Agropyron spicatum	ab23	a7	bc36	c60	bc37	1.39	3.37	1.23
G	Bromus japonicus (a)	-	-	-	a18	a10	-	.04	.05
G	Bromus tectorum (a)	-	-	a259	a259	b317	2.30	3.27	9.00
G	Festuca myuros (a)	-	-	b277	a81	a105	5.50	.20	1.08
G	Poa bulbosa	-	-	a64	b246	c346	.89	14.90	29.20
G	Poa pratensis	b55	-	-	a4	-	-	.15	-
G	Poa secunda	a4	c104	d190	c138	b45	3.79	2.79	.59

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Sitanion hystrix	-	$_{a}$8	-	$_{a}$3	-	-	.03	-
Total for Annual Grasses		0	0	536	358	432	7.80	3.52	10.14
Total for Perennial Grasses		140	388	563	702	646	14.77	31.14	33.66
Total for Grasses		140	388	1099	1060	1078	22.58	34.68	43.81
F	Agoseris glauca	-	-	$_{a}$7	$_{a}$4	$_{a}$5	.01	.01	.01
F	Alyssum alyssoides (a)	-	-	$_{c}$281	$_{b}$127	$_{a}$47	.91	.31	.27
F	Allium sp.	-	$_{b}$57	$_{b}$47	$_{a}$4	-	.13	.01	-
F	Astragalus sp.	-	-	$_{a}$9	$_{a}$4	$_{a}$1	.10	.03	.00
F	Astragalus utahensis	-	-	$_{a}$2	$_{a}$3	$_{a}$3	.15	.00	.00
F	Calochortus nuttallii	-	-	$_{a}$11	$_{a}$3	$_{a}$1	.02	.00	.00
F	Cerastium sp.	-	16	-	-	-	-	-	-
F	Cirsium sp.	-	-	$_{a}$9	$_{a}$3	$_{a}$1	.05	.06	.03
F	Convolvulus arvensis	-	-	$_{a}$2	-	$_{a}$1	.00	-	.00
F	Collinsia parviflora (a)	-	-	$_{b}$196	$_{a}$103	$_{a}$106	.78	.57	.59
F	Cymopterus longipes	-	$_{a}$3	$_{a}$17	$_{a}$7	$_{a}$10	.21	.06	.02
F	Descurainia pinnata (a)	-	3	-	-	-	-	-	-
F	Draba sp. (a)	-	-	-	$_{a}$5	$_{b}$132	-	.01	.72
F	Epilobium brachycarpum (a)	-	-	$_{b}$75	$_{a}$7	-	.14	.01	-
F	Erodium cicutarium (a)	-	-	$_{b}$158	$_{a}$31	$_{c}$236	1.72	.57	4.87
F	Erigeron sp.	-	-	2	-	-	.00	-	-
F	Eriogonum racemosum	-	-	$_{a}$6	$_{a}$5	$_{a}$1	.04	.01	.00
F	Galium aparine (a)	-	-	-	-	1	-	-	.00
F	Grindelia squarrosa	-	-	3	-	-	.00	-	-
F	Holosteum umbellatum (a)	-	-	-	$_{a}$6	$_{b}$65	-	.01	.14
F	Lactuca serriola	-	$_{b}$26	$_{a}$11	-	$_{a}$3	.02	-	.01
F	Microsteris gracilis (a)	-	-	$_{b}$58	$_{a}$5	$_{a}$12	.16	.01	.03
F	Phlox longifolia	-	$_{a}$9	$_{ab}$32	$_{ab}$24	$_{b}$41	.09	.08	.22
F	Polygonum douglasii (a)	-	-	$_{b}$23	$_{a}$1	$_{a}$1	.05	.00	.00
F	Ranunculus testiculatus (a)	-	-	$_{c}$287	$_{b}$163	$_{a}$33	2.15	1.01	.10
F	Sphaeralcea coccinea	-	$_{a}$3	-	-	$_{a}$1	-	-	.00
F	Tragopogon dubius	-	$_{a}$3	$_{b}$9	-	$_{a}$3	.05	-	.00
F	Vicia americana	-	-	$_{a}$9	$_{a}$9	$_{a}$9	.06	.12	.12
Total for Annual Forbs		0	3	1078	448	633	5.93	2.52	6.74
Total for Perennial Forbs		0	117	176	66	80	0.96	0.40	0.46
Total for Forbs		0	120	1254	514	713	6.89	2.92	7.20

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

BROWSE TRENDS --
Management unit 16A, Study no: 15

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	46	66	64	5.53	10.01	12.58
B	Gutierrezia sarothrae	19	17	25	.53	.83	.06
B	Juniperus osteosperma	1	1	1	.15	.76	.76
B	Purshia tridentata	3	4	5	.42	.07	.06
Total for Browse		69	88	95	6.63	11.67	13.47

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 15

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	14.93
Gutierrezia sarothrae	-	.10
Juniperus osteosperma	.05	1.58

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 15

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.8	1.6

POINT-QUARTER TREE DATA --
Management unit 16A, Study no: 15

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	21	23

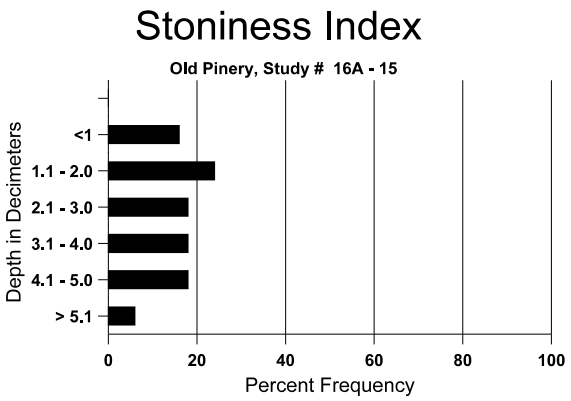
Average diameter (in)	
'02	'07
6.8	9.7

BASIC COVER --
Management unit 16A, Study no: 15

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	3.00	9.50	43.06	53.96	61.49
Rock	2.25	.25	4.32	1.16	.98
Pavement	0	.50	.67	1.03	1.56
Litter	75.00	63.00	36.01	38.60	35.81
Cryptogams	1.50	0	5.95	1.58	3.71
Bare Ground	18.25	26.75	14.39	16.45	11.89

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 15, Old Pinery

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
19.1	44.8 (16.9)	6.2	37.4	39.7	22.8	1.8	19.2	208.0	.4



PELLET GROUP DATA --
Management unit 16A, Study no: 15

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	12	12	77
Elk	-	1	4
Deer	41	58	67
Cattle	18	9	7

Days use per acre (ha)	
'02	'07
-	-
-	-
94 (233)	90 (222)
22 (54)	12 (29)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 vaseyana												
83	**1332**	-	-	1266	66	-	0	0	5	-	3	13/13
89	**4532**	8166	3433	933	166	-	1	0	4	1	.73	15/16
97	**2040**	920	1400	620	20	-	11	10	1	-	0	22/41
02	**3340**	140	1160	2000	180	-	23	8	5	1	1	18/27
07	**2700**	40	100	2480	120	80	35	17	4	3	3	24/35
Gutierrezia sarothrae												
83	**633**	-	-	633	-	-	0	0	0	-	0	11/13
89	**8565**	-	3966	4133	466	-	0	0	5	-	0	11/9
97	**1560**	140	280	1280	-	-	0	0	0	-	0	7/8
02	**900**	-	-	680	220	200	0	0	24	4	4	7/8
07	**1100**	60	260	800	40	40	0	0	4	-	0	8/8
Juniperus osteosperma												
83	**33**	-	33	-	-	-	0	0	-	-	0	-/-
89	**33**	-	33	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	60	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Purshia tridentata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**60**	-	-	60	-	-	0	100	-	-	0	11/43
02	**80**	-	-	80	-	20	0	100	-	-	0	16/49
07	**100**	-	-	100	-	-	0	100	-	-	0	17/51

Trend Study 16A-16-07

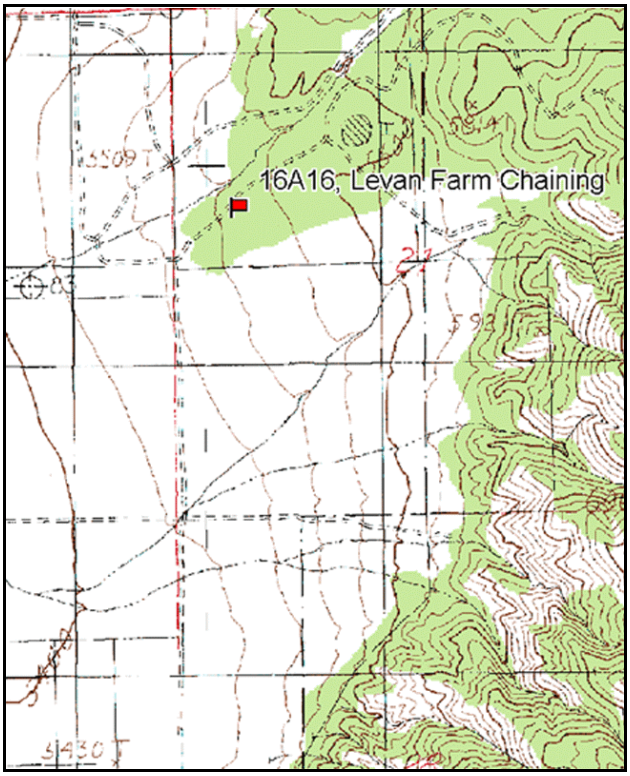
Study site name: Levan Farm Chaining . Vegetation type: Chained, Seeded P-J .

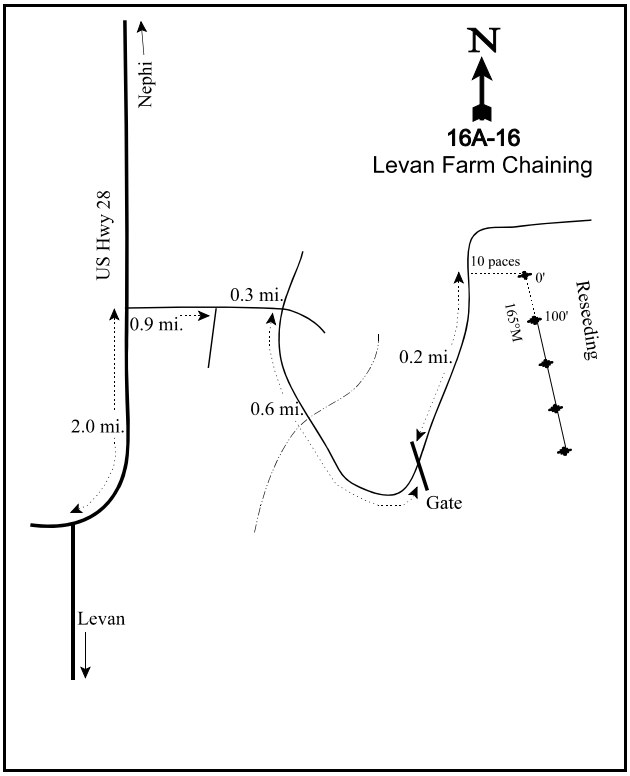
Compass bearing: frequency baseline 165 degrees magnetic.

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

LOCATION DESCRIPTION

From the junction of Highway U.S. 78 and Highway 28 in Levan, proceed north towards Nephi for 2.0 miles to a dirt road to the east. Turn right and proceed east for 0.90 miles to a fork. Continue straight ahead for 0.30 miles to a 3-way fork. Take the right (southernmost) fork for 0.60 miles through a gate to another fork. Take the left fork for 0.20 miles to a chained-reseeded area, and stop. The baseline is located 10 paces to the east between two windrows of slash. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height. A red browse tag, number 3965, is attached to the 0-foot stake of the baseline.





Map Name: Levan

Diagrammatic Sketch

Township 14S , Range 1E , Section 21

GPS: NAD 83, UTM 12S 428453 E 4381673 N

DISCUSSION

Levan Farm Chaining - Trend Study No. 16A-16

Study Information

This study is located on a chained pinyon-juniper treatment northeast of Levan [elevation: 5,530 feet (1,686 m), slope: 1%, aspect: west]. Since it is used by deer and elk during severe winters, the land was purchased by the UDWR shortly after the chaining was completed. The area was not seeded, and therefore has little perennial ground cover. This study is similar to the Old Pinery study (16A-15), except the juniper slash was windrowed. Wildlife use has been relatively light since 1983 due to the lack of forage. Deer pellet quadrat frequency was 16% in 1997, and use was estimated at 50 deer days use/acre (122 ddu/ha) in 2002 and 17 days use/acre (41 ddu/ha) in 2007. Cow pat frequency was 4% in 1997, and use was estimated at 2 days use/acre (4 cdu/ha) in 2007. Cattle were present during the 2007 reading. Rabbit use has steadily increased from a pellet quadrat frequency of 7% in 1997 to 65% in 2007.

Soil

The soil is classified within the Borvant series (USDA-NRCS 2007). The soils in this series are shallow and well-drained, with possible petrocalcic horizons. They formed in alluvium or colluvium derived from limestone and sandstone. The soil texture is a clay loam, and the pH is neutral (7.1). Soil phosphorus is relatively low at 7.7 ppm. When the study was established in 1983, bare ground cover was high at 35%, and erosion was reported to be occurring. Relative bare ground cover steadily decreased from 19% in 2002 to 12% in 2007, while relative vegetative cover increased from 24% in 2002 to 44% in 2007. The erosion condition was classified as stable in 2002 and 2007.

Browse

Valuable browse forage is limited and consists entirely of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). Some sagebrush plants were apparently transplanted after the chaining, and the initial reading estimated density at 100 plants/acre (247 plants/ha), but no plants were sampled in 1989. Sagebrush density increased from 660 plants/acre (1,631 plants/ha) in 1997 to 1,540 plants/acre (3,805 plants/ha) in 2002, then slightly decreased to 1,320 plants/acre (3,262 plants/ha) in 2007. Sagebrush has increased from 3% to 7% cover from 1997 to 2007. The population was made up entirely of young and mature plants in 1997, and the age structure shifted to mostly mature in 2002 and 2007. Decadence increased from 0% of the population in 1997 to 10% in 2002 and 21% in 2007. All of the sampled plants were vigorous until 2002 and 2007, when 3% and 9% of the population, respectively, displayed poor vigor. Use was mostly light from 1983 to 2002 and moderate-heavy in 2007. Insect galls were found on some of the plants in 2007. Annual leader growth averaged 2.2 inches (5.6 cm) in 2002 and 2.3 inches (5.8 cm) in 2007.

The only other common browse species is broom snakeweed (*Gutierrezia sarothrae*), which increased in density from 3,066 plants/acre (7,576 plants/ha) in 1983 to 23,060 plants/acre (56,980 plants/ha) in 1997 when the baseline was lengthened. Density decreased to 3,780 plants/acre (9,340 plants/ha) in 2002 and 2,980 plants/acre (7,363 plants/ha). The majority of the sampled plants in 2002 were decadent and displayed poor vigor, but vigor improved greatly by 2007, and most plants were mature.

Utah juniper (*Juniperus osteosperma*) trees are also present. Point-centered quarter data estimated 18 trees/acre (44 trees/ha) in 2002 and 34 trees/acre (84 trees/ha) in 2007. Average trunk diameter was 5.4 inches (13.7 cm) in 2002 and 9.8 inches (24.2 plants/ha) in 2007. The majority of the sampled trees were 8 to 12 feet (2.4 to 3.7 m) tall in 2007.

Herbaceous Understory

The herbaceous understory is very poor and dominated by annuals and biennial weeds. Total grass cover was 5% in 1997, 16% in 2002, and 27% in 2007. Cheatgrass (*Bromus tectorum*) has provided 80%-93% of the total

grass cover since 1997. Japanese brome (*Bromus japonicus*), squirreltail (*Sitanion hystrix*), and Indian ricegrass (*Oryzopsis hymenoides*) are also relatively abundant.

Perennial forbs are rare. Bur buttercup (*Ranunculus testiculatus*), pale alyssum (*Alyssum alyssoides*), and storksbill (*Erodium cicutarium*) have accounted for the majority of the forb cover since 1997. Bur buttercup and storksbill have both been shown to prevent the establishment of other species (Buchanan et al. 1978, Kimball and Schiffman 2003). Bindweed (*Convolvulus arvensis*) and blue lettuce (*Lactuca pulchella*), both noxious weeds, have also been sampled.

1989 TREND ASSESSMENT

The trend for browse is slightly down. No sagebrush plants were sampled within the density plots, however, some of the transplanted sagebrush survived and were approximately 5 feet (1.5 m) tall. The plants were vigorous with high seed production, and were surrounded by seedlings. The trend for grass is slightly up. The sum of nested frequency for perennial grasses increased, and the number of grass species sampled increased from one to three. However, the total quadrat frequency for perennial grasses was only 8%. The trend for forbs is up. The sum of nested frequency for perennial forbs, with the exception of blue lettuce, increased substantially. Blue lettuce decreased significantly in nested frequency. The number of sampled forb species doubled from four to eight, and common sunflower (*Helianthus annuus*) increased significantly in nested frequency.

browse - slightly down (-1) grass - slightly up (+1) forb - up (+2)

1997 TREND ASSESSMENT

The trend for browse is slightly up. Sagebrush density increased from 0 plants/acre to 660 plants/acre (1,631 plants/ha), although this increase was partly attributed to the larger sampling area. Young recruitment was high at 52% of the population, and no decadent plants were sampled. All of the plants were vigorous, and use was light. The trend for grass is up. The sum of nested frequency for perennial grasses increased substantially, and bluebunch wheatgrass (*Agropyron spicatum*) was sampled for the first time. The trend for forbs is slightly up. Although the sum of nested frequency for perennial forbs increased 23%, two noxious weeds, blue lettuce and field bindweed, were sampled. Sunflower decreased significantly in nested frequency. The Desirable Components Index (DCI) was rated as very poor due to low browse and perennial herbaceous cover and the presence of two noxious weeds.

winter range condition (DCI) - very poor (0) Mid-level potential scale
browse - slightly up (+1) grass - up (+2) forb - slightly up (+1)

2002 TREND ASSESSMENT

The trend for browse is up. Sagebrush density increased from 660 plants/acre (1,631 plants/ha) to 1,540 plants/acre (3,805 plants/ha), and average cover increased from 3% to 6%. Vigor remained good on most plants, and use increased, with 23% of the population showing moderate-heavy use. Young recruitment decreased from 52% of the population to 3%, while decadence increased from 0% to 10% of the population. The trend for grass is stable. The sum of nested frequency for perennial grasses increased 43%, and squirreltail increased significantly in nested frequency. However, cheatgrass also increased significantly in nested frequency, and its average cover increased from 4% to 15%. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 60%. Bur buttercup and sunflower also decreased significantly in nested frequency. Blue lettuce and field bindweed were not sampled. The DCI rating remained very poor.

winter range condition (DCI) - very poor (12) Mid-level potential scale
browse - up (+2) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased 14%, from 1,540 plants/acre (3,805 plants/ha) to 1,320 plants/acre (3,262 plants/ha). Plants displaying poor vigor increased from 3% of the population to 9%, and use increased to mostly moderate-heavy. Young recruitment remained stable at 3% of the population, while decadence increased from 10% of the population to 21%. The trend for grass is stable. The sum of nested frequency for perennial grasses increased 40%, however, Japanese brome increased significantly in nested frequency. Quadrat frequency for Japanese brome increased from 8% to 80%, and its cover increased from nearly 0% to 2%. Cheatgrass nested frequency remained stable, although its average cover increased from 15% to 22%. The trend for forbs is slightly up. The sum of nested frequency for perennial forbs increased 60%. However, field bindweed and blue lettuce both re-emerged. Storksbill and pale alyssum increased significantly in nested frequency, while bur buttercup decreased significantly in nested frequency. The DCI rating remained very poor.

winter range condition (DCI) - very poor (3) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 16

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron intermedium	-	a4	a2	a4	-	.00	.00	-
G	Agropyron spicatum	-	-	a10	a4	a6	.22	.19	.21
G	Bromus japonicus (a)	-	-	-	a18	b219	-	.06	2.26
G	Bromus tectorum (a)	-	-	a269	b346	b353	4.20	14.61	22.20
G	Oryzopsis hymenoides	-	-	a8	a8	a23	.36	.25	.85
G	Poa secunda	a6	a9	a17	a8	a17	.38	.09	.41
G	Sitanion hystrix	-	a3	a7	b39	b41	.06	.55	1.25
G	Stipa thurberiana	-	-	-	-	1	-	-	.15
Total for Annual Grasses		0	0	269	364	572	4.20	14.67	24.47
Total for Perennial Grasses		6	16	44	63	88	1.04	1.10	2.88
Total for Grasses		6	16	313	427	660	5.24	15.77	27.35
F	Agoseris glauca	-	-	6	-	-	.03	-	-
F	Alyssum alyssoides (a)	-	-	ab281	a266	b313	3.72	.94	6.13
F	Astragalus eurekensis	-	3	-	-	-	-	-	-
F	Asclepias speciosa	-	1	-	-	-	-	-	-
F	Astragalus sp.	-	-	-	2	-	-	.03	-
F	Camelina microcarpa (a)	-	-	9	-	-	.07	-	-
F	Calochortus nuttallii	a3	-	a4	-	-	.03	-	-
F	Chorispora tenella (a)	-	-	a5	a1	a1	.03	.00	.00
F	Cirsium sp.	-	a14	a1	a7	a10	.03	.06	.01
F	Convolvulus arvensis	-	-	a10	-	a18	.39	-	.40
F	Comandra pallida	-	-	-	2	-	-	.00	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Collinsia parviflora (a)	-	-	-	$_{a}$7	$_{a}$3	-	.04	.00
F	Crepis acuminata	-	-	3	-	-	.00	-	-
F	Draba sp. (a)	-	-	-	-	1	-	-	.00
F	Epilobium brachycarpum (a)	-	-	13	-	-	.07	-	-
F	Erodium cicutarium (a)	-	-	$_{a}$54	$_{a}$52	$_{b}$178	.41	.87	10.10
F	Gilia sp. (a)	-	-	$_{a}$1	$_{a}$3	-	.00	.00	-
F	Helianthus annuus (a)	$_{a}$3	$_{d}$240	$_{c}$166	$_{b}$56	$_{a}$-	.41	.13	.00
F	Holosteum umbellatum (a)	-	-	-	-	4	-	-	.01
F	Lactuca pulchella	$_{b}$226	$_{a}$13	$_{a}$12	-	$_{a}$10	.03	-	.05
F	Leucelene ericoides	-	-	-	$_{a}$3	$_{a}$3	-	.00	.15
F	Marrubium vulgare	1	-	-	-	-	-	-	-
F	Microsteris gracilis (a)	-	-	-	9	1	-	.01	.00
F	Ranunculus testiculatus (a)	-	-	$_{c}$264	$_{b}$202	$_{a}$166	4.43	.95	.84
F	Sisymbrium altissimum (a)	-	-	$_{a}$7	$_{a}$-	$_{a}$13	.04	.00	.05
F	Sphaeralcea coccinea	-	$_{a}$3	$_{a}$2	-	-	.15	-	-
F	Streptanthus cordatus	-	$_{a}$4	$_{a}$3	$_{a}$1	-	.01	.03	-
F	Taraxacum officinale	-	-	4	-	-	.15	-	-
F	Tragopogon dubius	-	$_{a}$5	$_{a}$14	$_{a}$-	$_{a}$11	.03	.00	.05
Total for Annual Forbs		3	240	800	596	680	9.20	2.97	17.15
Total for Perennial Forbs		230	43	59	15	52	0.87	0.14	0.66
Total for Forbs		233	283	859	611	732	10.07	3.11	17.81

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

BROWSE TRENDS --
Management unit 16A, Study no: 16

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata tridentata	24	31	33	2.83	5.95	6.90
B	Chrysothamnus nauseosus albicaulis	0	1	0	.85	.00	-
B	Chrysothamnus viscidiflorus stenophyllus	0	1	0	-	.03	-
B	Gutierrezia sarothrae	93	62	63	9.29	2.20	1.16
B	Juniperus osteosperma	1	0	0	.38	-	1.00
Total for Browse		118	95	96	13.35	8.19	9.07

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

Species	Percent Cover	
	'02	'07
Artemisia tridentata tridentata	-	9.03
Gutierrezia sarothrae	-	.88
Juniperus osteosperma	.06	1.20

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

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata tridentata	2.2	2.3

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

Species	Trees per Acre		
	'97	'02	'07
Juniperus osteosperma	-	.80	34

Average diameter (in)		
'97	'02	'07
3.4	5.4	9.8

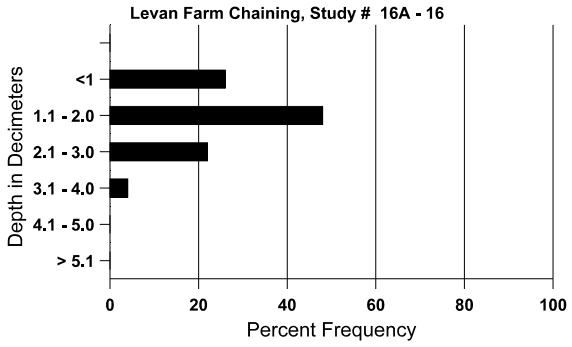
BASIC COVER --
Management unit 16A, Study no: 16

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	0	1.75	31.58	28.32	48.98
Rock	3.00	3.00	2.70	2.68	2.40
Pavement	3.75	18.00	13.90	3.82	4.27
Litter	58.25	47.50	29.85	52.71	36.84
Cryptogams	0	0	2.36	6.25	6.46
Bare Ground	35.00	29.75	23.82	21.95	12.87

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 16, Levan Farm Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.9	50.6 (16.9)	7.1	41.1	29.1	29.8	2.6	7.7	92.8	.5

Stoniness Index



PELLET GROUP DATA --
Management unit 16A, Study no: 16

Type	Quadrat Frequency				
	'83	'89	'97	'02	'07
Rabbit	-	-	7	22	65
Elk	-	-	-	-	1
Deer	-	-	16	25	19
Cattle	-	-	4	-	1

Days use per acre (ha)	
'02	'07
-	-
-	-
50 (122)	17 (41)
-	2 (4)

BROWSE CHARACTERISTICS --
Management unit 16A, Study no: 16

		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												
83	**100**	-	-	100	-	-	0	0	0	-	0	16/24
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**660**	60	340	320	-	-	0	0	0	-	0	32/41
02	**1540**	-	40	1340	160	80	22	1	10	1	3	30/32
07	**1320**	-	40	1000	280	100	8	50	21	5	9	42/44
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**66**	-	66	-	-	-	0	0	0	-	0	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**20**	-	-	-	20	-	0	0	100	100	100	24/34
07	**0**	-	-	-	-	-	0	0	0	-	0	24/29

		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)
Chrysothamnus viscidiflorus stenophyllus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	-	40	-	-	100	0	-	-	0	3/7
07	**0**	-	-	-	-	-	0	0	-	-	0	9/22
Gutierrezia sarothrae												
83	**3066**	-	100	2900	66	-	0	0	2	-	0	9/9
89	**3765**	10066	366	2866	533	-	0	0	14	1	2	9/10
97	**23060**	3900	5300	17540	220	500	0	0	1	.43	.43	7/9
02	**3780**	-	-	1460	2320	7880	.52	0	61	32	59	6/8
07	**2980**	300	360	2380	240	80	3	1	8	3	4	8/9
Juniperus osteosperma												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	40	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	20	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Rhus trilobata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	71/148
07	**0**	-	-	-	-	-	0	0	-	-	0	87/162
Ribes sp.												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	4/12
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16A-17-07

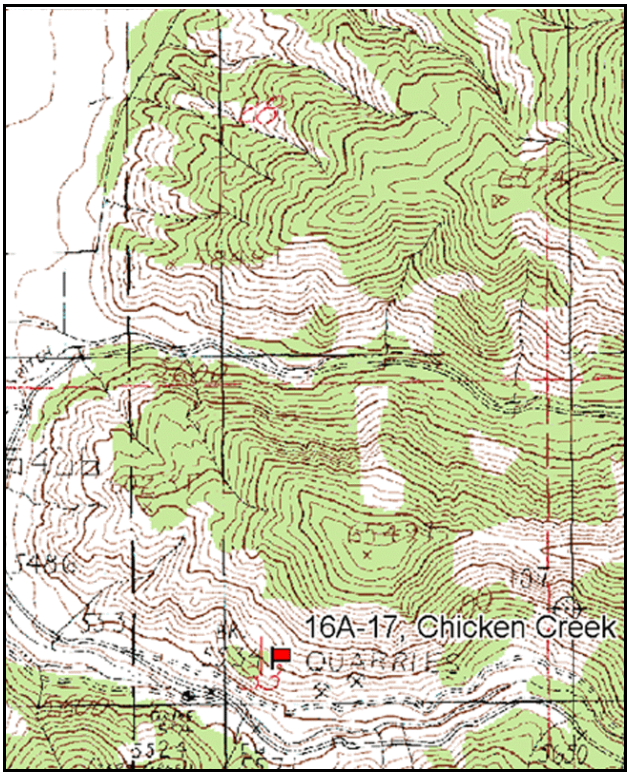
Study site name: Chicken Creek . Vegetation type: Stansbury Cliffrose .

Compass bearing: frequency baseline 280 degrees magnetic (line 2 @ 298°M, lines 3 and 4 @ 357°M).

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

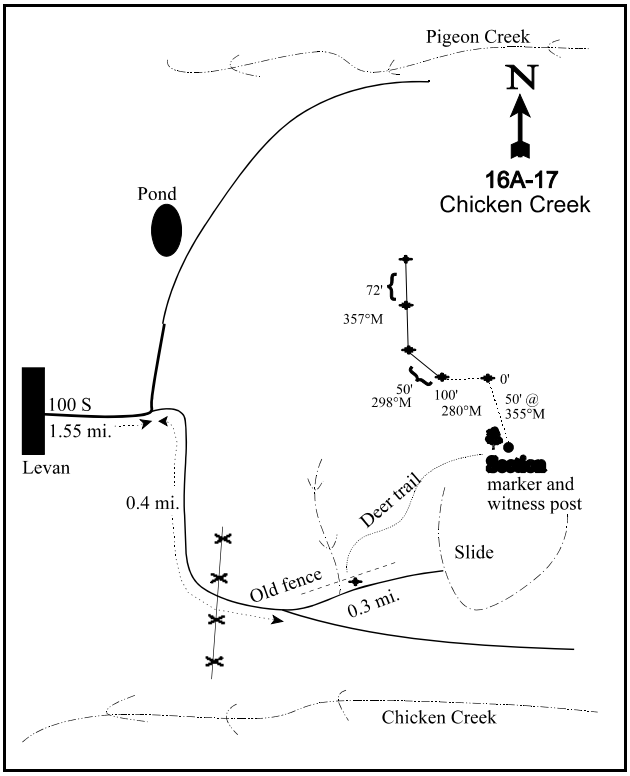
LOCATION DESCRIPTION

From the intersection of 100 South and Main Street in Levan, proceed east on 100 South for 1.55 miles to a fork. Turn right (south) and proceed 0.40 miles towards Chicken Creek to a road to the left. Turn left and proceed east for 0.30 miles to a green steel "T" fencepost on the north side of the road (fencepost may no longer exist). From the fencepost, walk up slope at an azimuth of 344 degrees true to the eastern most juniper on the ridge. There is a section marker and witness post next to the juniper. The 0-foot baseline stake is located 50 feet away at an azimuth 355 degrees magnetic. The study is marked by green, steel “T” fenceposts approximately 12 to 18 inches in height.



Map Name: Levan

Township 14S , Range 1E , Section 33



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 429073 E 4378304 N

DISCUSSION

Chicken Creek - Trend Study No. 16A-17

Study Information

This study is located on deer winter range near the mouth of Chicken Creek Canyon [elevation: 5,800 feet (1,768 m), slope: 10-60%, aspect: south]. It samples Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) intermixed with Utah serviceberry (*Amelanchier utahensis*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), Utah juniper (*Juniperus osteosperma*), and Gambel oak (*Quercus gambelii*). Pellet groups were abundant in 1983. Quadrat frequency of deer pellet groups was moderately high at 39% in 1997, and use was estimated at 74 days use/acre (182 ddu/ha) in 2002 and 52 days use/acre (129 ddu/ha) in 2007. Elk pellet quadrat frequency was low at 2% in 1997 and 3% in 2007, and use was estimated at 2 days use/acre (5 edu/ha) in 2002. Most of the deer pellet groups appeared to be from winter and spring use, and most were sampled on the downslope end of the baseline where there was more vegetation. Three live and two dead deer were noted during the 2007 sampling.

Soil

The soil is derived from limestone, with many gravel-sized fragments covering the surface. Large rock outcrops are also present. The soil texture is a clay loam, and it has a neutral pH (6.9). Pedestalling is common, and several large cracks in the ground surface were noted in 1983, which are indicative of high potential for slippage or landslides. Bare ground has accounted for less than 10% of the relative ground cover since 1983. The soil erosion condition was classified as slight in 2002 and 2007 due to surface rock and litter movement and flow patterns.

Browse

The preferred browse species are Stansbury cliffrose and serviceberry, although both occur in low densities. Cliffrose density has ranged from 199 plants/acre (492 plants/ha) to 460 plants/acre (1,137 plants/ha) since 1983. Over half of the population has been classified as decadent every sample year except 1997, when 33% of the sampled plants were decadent. No young plants have been sampled. Dead plants were sampled at a density of 100 plants/acre (247 plants/ha) in 1997 and 80 plants/acre (198 plants/ha) in 2002 and 2007. Plants showing poor vigor made up 42% of the population in 1983, decreased to 17% by 1997, then increased to 38% by 2007. Use has been mostly moderate-heavy, although many of the mature plants are tall and partly unavailable for browsing. Annual leader growth averaged 3.8 inches (9.7 cm) in 2002 and 1.6 inches (4.1 cm) in 2007.

Serviceberry occurs less frequently than cliffrose. Its density was 166 plants/acre (410 plants/ha) in 1983, and has ranged from 60 plants/acre (148 plants/ha) to 80 plants/acre (198 plants/ha) since 1989. The majority of the plants have been either young or decadent in each sample year. Vigor has been good on all plants, and use has been moderate-heavy.

Scattered Gambel oak clones have increased in density from 2,060 plants/acre (5,090 plants/ha) in 1997 to 2,900 plants/acre (7,166 plants/ha) in 2007. Most plants were young in 1997 and 2002, and most were mature in 2007. All of the sampled plants have been vigorous, and use is light. Other shrubs that provide additional forage but occur infrequently are mountain big sagebrush, true mountain mahogany (*Cercocarpus montanus*), white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), and chokecherry (*Prunus virginiana*).

Herbaceous Understory

The herbaceous understory is sparse and of poor quality. Total grass cover was 23% in 1997 and 2007, and 20% in 2002. Bluebunch wheatgrass (*Agropyron spicatum*) has provided between 54% and 57% of the total grass cover and between 44% and 49% of the total herbaceous cover since 1997. Cheatgrass is also abundant, and has provided 42%-45% of the total grass cover since 1997. However, this species is concentrated mostly under the crowns of juniper trees. The forb component of the understory is diverse, but few forbs are

particularly abundant. Total forb cover has been 3%-5% since 1997. Bedstraw (*Galium aparine*) has made up 29%-40% of the total forb cover since 1997.

1989 TREND ASSESSMENT

The trend for browse is down. Cliffrose density decreased from 399 plants/acre (986 plants/ha) to 199 plants/acre (492 plants/ha), and decadence remained high at 83% of the population. Plants displaying poor vigor decreased slightly, but still made up one-third of the population. Use remained moderate-heavy. Serviceberry density decreased from 166 plants/acre (410 plants/ha) to 66 plants/acre (163 plants/ha). Decadence increased from 60% of the sampled plants to 100%, and use increased to heavy. The trend for grass is up. The sum of nested frequency for perennial grasses increased 40%, and Sandberg bluegrass (*Poa secunda*) was sampled for the first time. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased almost 30%, and the number of species important to big game remained low.

browse - down (-2) grass - up (+2) forb - slightly down (-1)

1997 TREND ASSESSMENT

The trend for browse is slightly up. Cliffrose density increased 21%, from 199 plants/acre (492 plants/ha) to 240 plants/acre (593 plants/ha). However, this increase was partly attributed to the increase in sampling area. Decadence decreased from 83% to 33% of the population. Vigor improved from 33% of the plants displaying poor vigor to only 17%. Use remained moderate-heavy. Serviceberry density also increased slightly from 66 plants/acre (163 plants/ha) to 80 plants/acre (198 plants/ha). There were no decadent plants, and 75% of the sampled plants were young. Use decreased to mostly moderate, with some heavy use. The trend for grass is down. The sum of nested frequency for perennial forbs decreased 25%. The trend for forbs is up. The sum of nested frequency for perennial forbs increased substantially. Bonneville pea (*Lathyrus brachycalyx*), longleaf phlox (*Phlox longifolia*), and heartleaf twistflower (*Streptanthus cordatus*) increased significantly in nested frequency. The Desirable Components Index (DCI) was rated as fair due to low preferred browse cover and high cheatgrass cover, but good recruitment of preferred browse and high perennial grass cover.

winter range condition (DCI) - fair (54) Mid-level potential scale
browse - slightly up (+1) grass - down (-2) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is stable. Cliffrose density increased from 240 plants/acre (593 plants/ha) to 460 plants/acre (1,137 plants/ha). However, decadence increased from 33% of the population to 61%, and 22% of the sampled plants were classified as dying. Plants displaying poor vigor increased slightly from 17% of the population to 22%. Use remained moderate-heavy. Serviceberry density decreased slightly from 80 plants/acre (198 plants/ha) to 60 plants/acre (148 plants/ha), and all of the sampled plants were decadent and heavily hedged. The trend for grass is slightly down. The sum of nested frequency for perennial grasses decreased 14%. Cheatgrass nested frequency did not change. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 52%. Bonneville pea, longleaf phlox, stickseed (*Hackelia patens*), and thistle (*Cirsium* sp.) decreased significantly in nested frequency, while bur buttercup (*Ranunculus testiculatus*), an allelopathic annual (Buchanan et al. 1978), increased significantly in nested frequency. Total forb cover decreased from 5% to 3%. The DCI rating declined to very poor-poor due to an increase in decadence and decrease in recruitment of preferred browse.

winter range condition (DCI) - very poor-poor (36) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is slightly down. Cliffrose density decreased 30%, from 460 plants/acre (1,137 plants/ha) to 320 plants/acre (791 plants/ha). Plants showing poor vigor increased to 38% of the population, and use

increased to mostly heavy. Decadence slightly decreased from 61% of the population to 50%, and plants classified as dying slightly decreased from 22% of the population to 19%. Serviceberry density increased slightly from 60 plants/acre (148 plants/ha) to 80 plants/acre (198 plants/ha), and decadence decreased from 100% of the sampled plants to 50%. Use decreased to moderate-heavy. The trend for grass is up. The sum of nested frequency for perennial grasses increased 28%, while cheatgrass nested frequency did not change. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little, while that for annual forbs decreased 15%. Total forb cover slightly increased from 3% to 4%. The DCI rating declined slightly to very poor because total preferred browse cover dropped below 5%.

winter range condition (DCI) - very poor (27) Mid-level potential scale
browse - slightly down (-1) grass - up (+2) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 17

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	ab150	b185	ab139	a121	ab146	12.44	11.67	12.23
G	Bromus japonicus (a)	-	-	-	7	-	-	.04	-
G	Bromus tectorum (a)	-	-	a260	a253	a253	10.29	8.61	10.41
G	Poa secunda	-	a25	a19	a15	a28	.38	.13	.65
Total for Annual Grasses		0	0	260	260	253	10.29	8.65	10.41
Total for Perennial Grasses		150	210	158	136	174	12.82	11.80	12.88
Total for Grasses		150	210	418	396	427	23.11	20.46	23.29
F	Alyssum alyssoides (a)	-	-	-	-	15	-	-	.05
F	Allium sp.	-	-	-	a1	a1	-	.00	.03
F	Artemisia ludoviciana	-	-	-	-	3	-	-	.15
F	Camelina microcarpa (a)	-	-	b23	ab12	a6	.06	.07	.04
F	Chorispora tenella (a)	-	-	a7	a14	a8	.01	.07	.08
F	Cirsium sp.	-	-	b17	a3	a1	.53	.45	.33
F	Collinsia parviflora (a)	-	-	-	2	-	-	.00	-
F	Cryptantha flavoculata	-	5	-	-	-	-	-	-
F	Cruciferae	-	-	12	-	-	.54	-	-
F	Cryptantha sp.(a)	-	-	-	-	2	-	-	.00
F	Cryptantha sp.	a14	a6	-	a2	a3	-	.01	.00
F	Cymopterus sp.	-	-	-	1	-	-	.01	-
F	Descurainia pinnata (a)	-	-	a21	a7	a8	.12	.02	.02
F	Eriogonum brevicaule	a9	a14	a11	a5	a6	.52	.09	.10
F	Erodium cicutarium (a)	-	-	a13	a25	a19	.07	.33	.12
F	Erigeron pumilus	-	-	-	-	2	-	-	.03
F	Galium aparine (a)	-	-	a62	a55	a45	2.00	.94	1.60
F	Gilia sp. (a)	-	-	-	a5	a3	-	.04	.00

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Hackelia patens	$_{a}$2	-	$_{b}$19	$_{a}$3	$_{ab}$14	.44	.42	.80
F	Holosteum umbellatum (a)	-	-	-	-	8	-	-	.04
F	Lathyrus brachycalyx	$_{a}$2	$_{a}$2	$_{b}$25	$_{a}$7	$_{ab}$12	.31	.04	.40
F	Lappula occidentalis (a)	-	-	$_{a}$8	$_{a}$22	$_{a}$16	.02	.24	.18
F	Lactuca serriola	$_{b}$27	-	$_{a}$6	$_{a}$7	$_{a}$3	.02	.02	.03
F	Lithospermum ruderale	-	-	-	4	-	-	.06	-
F	Machaeranthera canescens	$_{a}$4	-	$_{a}$1	-	-	.00	-	-
F	Phacelia sp.	-	-	-	9	-	-	.04	-
F	Physalis hederaefolia	-	$_{a}$7	$_{a}$2	-	-	.00	-	-
F	Phlox longifolia	-	$_{a}$3	$_{b}$21	$_{a}$6	$_{ab}$9	.07	.04	.07
F	Ranunculus testiculatus (a)	-	-	$_{a}$6	$_{b}$14	$_{ab}$8	.01	.10	.02
F	Sisymbrium altissimum (a)	-	-	$_{b}$35	$_{a}$12	$_{a}$6	.18	.12	.07
F	Streptanthus cordatus	$_{a}$3	$_{a}$8	$_{b}$23	$_{ab}$18	$_{ab}$18	.06	.06	.08
F	Tragopogon dubius	2	-	-	-	-	.00	-	.00
F	Unknown forb-annual (a)	-	-	5	-	-	.03	-	-
F	Veronica biloba (a)	-	-	-	$_{a}$5	$_{a}$3	-	.03	.01
Total for Annual Forbs		0	0	180	173	147	2.52	1.99	2.26
Total for Perennial Forbs		63	45	137	66	72	2.53	1.27	2.05
Total for Forbs		63	45	317	239	219	5.05	3.27	4.32

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

BROWSE TRENDS --
Management unit 16A, Study no: 17

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	3	1	3	.41	-	.38
B	Cercocarpus montanus	1	1	0	-	.38	-
B	Chrysothamnus nauseosus albicaulis	6	5	4	.90	.71	.53
B	Cowania mexicana stansburiana	12	13	16	3.00	3.21	1.52
B	Gutierrezia sarothrae	5	4	2	.01	.15	-
B	Juniperus osteosperma	0	1	1	-	1.00	2.11
B	Mahonia repens	20	21	23	.07	.31	1.02
B	Prunus virginiana	6	2	3	.00	-	-
B	Quercus gambelii	9	6	7	1.58	.83	1.33
B	Rhus glabra cismontana	0	0	0	.03	-	-
Total for Browse		62	54	59	6.03	6.60	6.92

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 17

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	-	.50
Cercocarpus montanus	-	.01
Chrysothamnus nauseosus albicaulis	-	1.46
Cowania mexicana stansburiana	-	2.01
Gutierrezia sarothrae	-	.16
Juniperus osteosperma	.21	4.71
Mahonia repens	-	.76
Quercus gambelii	.75	8.18

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 17

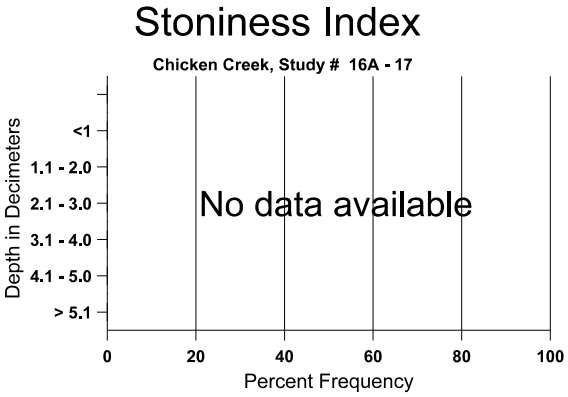
Species	Average leader growth (in)	
	'02	'07
Cowania mexicana stansburiana	3.8	1.6

BASIC COVER --
Management unit 16A, Study no: 17

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	2.25	7.00	29.85	29.54	31.93
Rock	4.75	4.25	13.62	22.55	20.35
Pavement	52.00	57.25	26.51	26.07	22.63
Litter	33.50	29.75	27.93	30.74	32.72
Cryptogams	0	0	.26	.15	.05
Bare Ground	7.50	1.75	8.96	5.48	2.97

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 17, Chicken Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
21.7	48.0 (13.0)	6.9	39.4	30.7	29.8	2.8	11.6	192.0	1.2



PELLET GROUP DATA --
Management unit 16A, Study no: 17

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	2	11
Elk	2	-	3
Deer	39	36	26

Days use per acre (ha)	
'02	'07
-	-
2 (5)	-
74 (181)	52 (129)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 utahensis												
83	**166**	-	33	33	100	-	40	40	60	-	0	18/8
89	**66**	-	-	-	66	-	0	100	100	-	0	-/-
97	**80**	-	60	20	-	-	75	25	0	-	0	49/69
02	**60**	-	-	-	60	-	0	100	100	-	0	51/64
07	**80**	-	40	-	40	-	25	50	50	-	0	38/54
Artemisia tridentata vaseyana												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	20	0	0	-	-	0	34/30
02	**0**	-	-	-	-	40	0	0	-	-	0	25/36
07	**0**	-	-	-	-	-	0	0	-	-	0	30/28
Cercocarpus montanus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	40	100	0	-	-	0	88/86
02	**20**	-	-	20	-	-	0	100	-	-	0	61/82
07	**0**	-	-	-	-	-	0	0	-	-	0	89/105
Chrysothamnus nauseosus albicaulis												
83	**100**	-	-	100	-	-	0	0	0	-	0	27/33
89	**233**	-	133	100	-	-	0	0	0	-	0	28/34
97	**120**	-	20	60	40	-	33	0	33	17	17	26/40
02	**100**	-	-	40	60	-	0	40	60	-	0	26/34
07	**80**	-	-	20	60	20	25	0	75	50	50	31/43
Cowania mexicana stansburiana												
83	**399**	-	-	66	333	-	25	75	83	-	42	43/72
89	**199**	-	-	33	166	-	33	50	83	33	33	114/126
97	**240**	20	-	160	80	100	25	50	33	17	17	50/48
02	**460**	-	-	180	280	80	4	57	61	22	22	55/60
07	**320**	-	-	160	160	80	6	75	50	19	38	63/65

		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												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**180**	-	40	140	-	40	0	0	0	-	0	9/15
02	**140**	-	-	80	60	40	0	0	43	14	14	5/11
07	**40**	-	20	20	-	-	0	0	0	-	0	16/27
Juniperus osteosperma												
83	**33**	-	-	33	-	-	0	0	-	-	0	67/118
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	116/145
02	**20**	-	-	20	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Mahonia repens												
83	**4933**	-	1333	3600	-	-	0	0	0	-	0	5/4
89	**4166**	-	2900	1266	-	-	10	0	0	-	0	4/5
97	**2740**	-	460	2280	-	-	0	0	0	-	0	3/4
02	**4840**	-	460	4220	160	40	0	0	3	.41	.41	2/4
07	**7300**	-	480	6820	-	-	0	0	0	-	0	3/5
Prunus virginiana												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**300**	80	220	60	20	-	20	13	7	-	0	15/15
02	**40**	-	-	20	20	20	50	50	50	50	50	6/8
07	**60**	-	60	-	-	-	0	100	0	-	0	8/12
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**2060**	280	1700	360	-	100	0	0	0	-	0	113/140
02	**2180**	-	2080	100	-	100	0	0	0	-	0	104/65
07	**2900**	-	-	2860	40	100	0	0	1	-	0	20/15
Rhus glabra cismontana												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	88/128
07	**0**	-	-	-	-	-	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)
Rhus trilobata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	102/142

Trend Study 16A-18-07

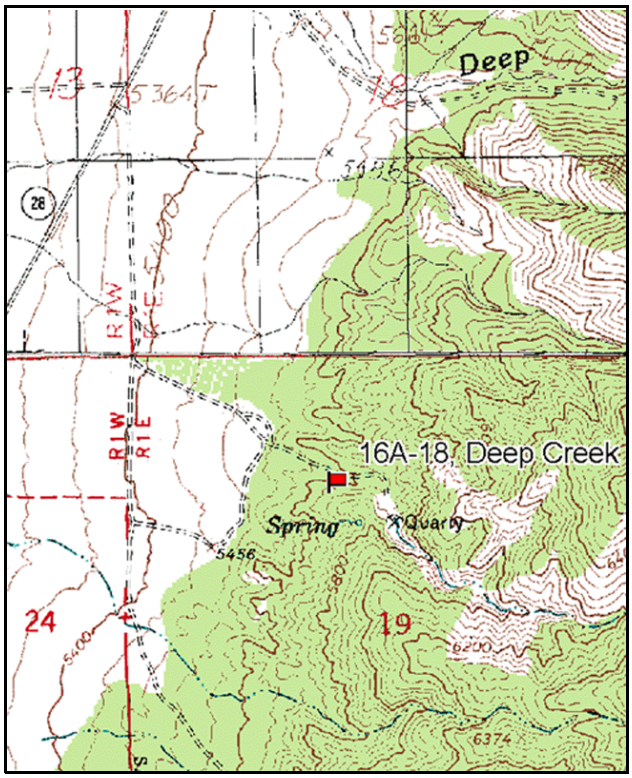
Study site name: Deep Creek . Vegetation type: True Mountain Mahogany .

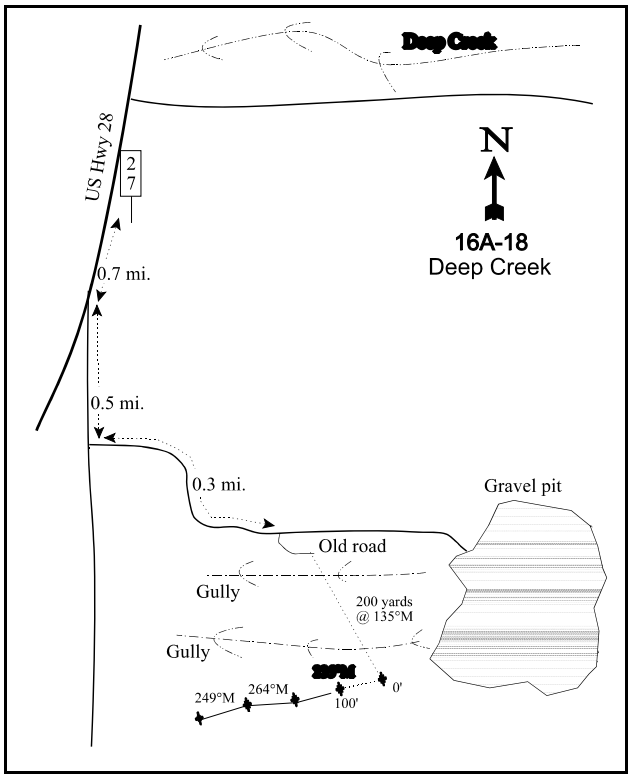
Compass bearing: frequency baseline 235 degrees magnetic (line 3 @ 264°M, line 4 @ 249°M).

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

LOCATION DESCRIPTION

From the post office in Levan (75 N. Main St.) go south on US-28 for 3.8 miles. Turn left 0.7 miles past mile marker 27 (east then south) and go 0.5 miles to a fork in the road. Take a left (east) and go 0.3 miles to another fork. Take the old road to the right and park when it ends. From here, the 0-foot baseline stake is 200 yards at an azimuth of 135 degrees magnetic. There are some large boulders around the 100-foot baseline stake.





Map Name: Chriss Canyon Diagrammatic Sketch

Township 15S , Range 1E , Section 19 GPS: NAD 83, UTM 12S 425691 E 4372189 N

DISCUSSION

Deep Creek - Trend Study No. 16A-18

Study Information

This study monitors critical deer winter range located just south of Deep Creek. It is placed along a narrow ridge running east to west [elevation: 5,670 feet (1,728 m), slope: 15%-20%, aspect: northwest and southeast]. The vegetative composition is typical of the west-facing foothills from Levan south to the unit boundary. It supports a sparse pinyon-juniper stand associated with an understory mixture of browse species. Deer use of the area was reported moderate-heavy in 1983 and 1989, and several deer carcasses were found in 1989. Pellet group quadrat frequency for deer was fairly low at 16% in 1997, and use was estimated at 9 days use/acre (23 ddu/ha) in 2002 and 7 days use/acre (17 ddu/ha) in 2007. Elk pellet quadrat frequency was only 2% in 1997 and 1% in 2002. Sheep use was heavy during the springs of 2002 and 2007, with 56 days use/acre (137 sdu/ha) and 48 days use/acre (117 sdu/ha), respectively.

Soil

The soil texture is a clay, and the pH is neutral (7.2). Soil phosphorus is relatively low at only 6.6 ppm (Tiedemann and Lopez 2004). Organic matter is also low at 1.2%. The soil has poor structure, and erosion is apparent. Relative bare ground cover was 23% in 1997, 40% in 2002, and 41% in 2007, with only 26%, 20%, and 23% relative vegetation cover, respectively. The erosion condition was classified as slight in 2002 and 2007, due to soil, litter, and rock movement, as well as pedestalling. The steep slope increases erosion potential on the study.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), true mountain mahogany (*Cercocarpus montanus*), and green ephedra (*Ephedra viridis*) provide preferred browse. Mahogany density increased from 433 plants/acre (1,070 plants/ha) in 1983 to 1,040 plants/acre (2,570 plants/ha) in 2002, then decreased to 740 plants/acre (1,829 plants/ha) in 2007. Average cover has ranged between 3% and 6% since 1997. Decadence has slowly increased from 0% of the population in 1983 to 68% in 2007, while recruitment has decreased from 31% in 1983 to 0% in 2007. Most of the population was vigorous until 2007, when 59% displayed poor vigor. Use was moderate-heavy in all sample years. Annual leader growth averaged 2.5 inches (6.4 cm) in 2002 and 2.6 inches (6.6 cm) in 2007.

Sagebrush density has steadily declined from 533 plants/acre (1,317 plants/ha) in 1983 to 160 plants/acre (395 plants/ha) in 2007. It provided 1% average cover from 1997 to 2007. Decadence has been high, and has fluctuated between 25% and 60% of the population since 1983. The density of dead plants was higher than the density of live plants in 1997 and 2002 at 340 plants/acre (840 plants/ha) and 360 plants/acre (890 plants/ha), respectively, then decreased to 100 plants/acre (247 plants/ha) in 2007. Recruitment has been nonexistent, except in 1997 when 7% of the population was young. Plants showing poor vigor increased from 0% of the population in 1983 to 33% in 1989, decreased to 8% by 2002, then slightly increased to 13% in 2007. Use was moderate-heavy in 1983, 1989, and 2007, light in 1997, and moderate in 2002.

Ephedra density increased slowly from 299 plants/acre (739 plants/ha) in 1983 to 700 plants/acre (1,730 plants/ha) in 2002, then decreased to 460 plants/acre (1,137 plants/ha) by 2007. Young recruitment was good in 1983 at 11% of the population, but young plants were not sampled again until 2002 and 2007, when 6% and 17% of the population was made up of young plants, respectively. Decadence increased from 22% of the population to 60% between 1983 and 1989, decreased to 14% in 1997, then increased to approximately 30% in 2002 and 2007. The sampled plants have been mostly vigorous, and use has been light-moderate, with some heavy use in 2007.

Some Utah juniper (*Juniperus osteosperma*) and pinyon pine (*Pinus edulis*) trees are also present. Point-centered quarter data estimated juniper density at 63 trees/acre (156 trees/ha) in 2002 and 56 trees/acre (138 trees/ha) in 2007. Average trunk diameter was 11 inches (27.2 cm) in 2002 and 13.9 inches (34.3 cm) in 2007. Most of the juniper trees sampled were between 4 feet (1.2 m) and 12 feet (3.7 m) tall. Pinyon density was 19 trees/acre (47 trees/ha) in 2002 and 21 trees/acre (52 trees/ha) in 2007, with an average trunk diameter of approximately 4 inches (10.2 cm) both years.

Herbaceous Understory

The herbaceous understory is sparsely distributed, and most shrub and tree interspaces lack vegetative cover. Total grass cover was 9% in 1997, 4% in 2002, and 11% in 2007. Bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass (*Poa secunda*) are the most abundant perennial grasses, and occur most often near the base of shrubs. Cheatgrass has provided 8% to 31% of the total grass cover since 1997, and is found mostly under the crowns of juniper trees. Forbs are diverse, but provide poor forage value. The most abundant forbs have included tapertip hawksbeard (*Crepis acuminata*), Hood's phlox (*Phlox hoodii*), and bur buttercup (*Ranunculus testiculatus*).

1989 TREND ASSESSMENT

The trend for browse is stable. Mahogany density increased slightly from 433 plants/acre (1,070 plants/ha) to 465 plants/acre (1,149 plants/ha), and young recruitment remained high at approximately 30% of the population. Decadence and plants displaying poor vigor increased, however, from 0% of the population to 14%. Sagebrush density slightly decreased from 533 plants/acre (1,317 plants/ha) to 500 plants/acre (1,235 plants/ha). Decadence remained high, and increased from 44% of the population to 60%, while no young plants were sampled. Vigor decreased, with one-third of the sampled sagebrush plants displaying poor vigor. Ephedra density increased from 299 plants/acre (739 plants/ha) to 333 plants/acre (823 plants/ha). Decadence greatly increased, from 22% of the population to 60%, and young recruitment also decreased from 11% of the population to 0%. Vigor remained good on all plants. Use remained moderate-heavy on mahogany and sagebrush, and light on ephedra. The trend for grass is up. The sum of nested frequency for perennial grasses increased 64%, and bluebunch wheatgrass increased significantly in nested frequency. The trend for forbs is stable. The sum of nested frequency for perennial forbs did not change substantially. Hood's phlox increased significantly in nested frequency, while cryptantha (*Cryptantha* sp.) and fleabane (*Erigeron* sp.) decreased significantly in nested frequency.

browse - stable (0) grass - up (+2) forb - stable (0)

1997 TREND ASSESSMENT

The trend for browse is stable. The density of mahogany increased from 465 plants/acre (1,149 plants/ha) to 860 plants/acre (2,125 plants/ha), however, some of this increase may be attributed to the increase in sampling area. Decadence remained stable at 14% of the population, while young recruitment continued to decrease from 29% of the population to 14%. Plants displaying poor vigor decreased from 14% of the population to 2%, and use remained moderate-heavy. Sagebrush density decreased from 500 plants/acre (1,235 plants/ha) to 300 plants/acre (741 plants/ha), but decadence also decreased from 60% of the population to 33%. Young recruitment increased to 7% of the population. Vigor improved, with only 13% of the sampled plants displaying poor vigor, and use decreased to mostly light. Ephedra density increased from 333 plants/acre (823 plants/ha) to 440 plants/acre (1,087 plants/ha) and no young plants were sampled, but decadence greatly decreased from 60% of the population to only 14%. Vigor remained good on most plants, and use increased to light-moderate. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. The trend for forbs is slightly up. The sum of nested frequency for perennial forbs increased 17%. Hawksbeard increased significantly in nested frequency, while Hood's phlox decreased significantly in nested frequency. The Desirable Components Index (DCI) was rated as poor-fair due to low browse recruitment and cover, but also low browse decadence and high perennial forb cover.

winter range condition (DCI) - poor-fair (50) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - slightly up (+1)

2002 TREND ASSESSMENT

The trend for browse is slightly up. Mahogany density increased from 860 plants/acre (2,125 plants/ha) to 1,040 plants/acre (2,570 plants/ha). However, decadence increased to 35% of the population, and young recruitment decreased to 4%. Plants displaying poor vigor increased from 2% of the population to 10%, and use remained moderate-heavy. Sagebrush density continued to decrease from 300 plants/acre (741 plants/ha) to 240 plants/acre (593 plants/ha), and decadence increased from one-third to half of the population. Young recruitment decreased to 0% of the population. Plants displaying poor vigor decreased slightly to 8% of the population, and use increased to moderate. Ephedra density increased from 440 plants/acre (1,087 plants/ha) to 700 plants/acre (1,730 plants/ha). Decadence increased to 29% of the population, but young recruitment increased to 6%. Vigor remained good, and use remained light. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little, however, perennial grass cover decreased from 8% to 3%. Cheatgrass decreased significantly in nested frequency. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 32%, and total forb cover declined from 9% to 4%. Hawksbeard and bur buttercup decreased significantly in nested frequency. The DCI rating declined to very poor-poor due to the increase in preferred browse decadence, and decreases in preferred browse recruitment and perennial herbaceous ground cover.

winter range condition (DCI) - very poor-poor (33) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is down. Mahogany density decreased from 1,040 plants/acre (2,570 plants/ha) to 740 plants/acre (1,829 plants/ha), and decadence almost doubled from 35% of the population to 68%. Forty-six percent of the sampled plants were classified as dying, which increased from 10%. No young plants were sampled, although reproduction increased with a density of 80 seedlings/acre (198 seedlings/ha). Vigor was poor on almost 60% of the sampled plants, and use increased to heavy. Sagebrush density decreased from 240 plants/acre (593 plants/ha) to 160 plants/acre (395 plants/ha). Decadence decreased from 50% to 25% of the population, but no young plants were sampled. Plants displaying poor vigor increased to 13% of the population, and use increased to moderate-heavy. Ephedra density decreased 34%, from 700 plants/acre (1,730 plants/ha) to 460 plants/acre (1,137 plants/ha). Decadence was stable at 30%, while young recruitment increased to 17% of the population. Plants showing poor vigor slightly increased from 6% of the population to 9%, and use was mostly light, with some moderate-heavy hedging. The trend for grass is slightly up. The sum of nested frequency for perennial grasses increased 20%, and perennial grass cover increased from 3% to 8%. However, cheatgrass increased significantly in nested frequency, and its average cover increased from less than 1% to 3%. The trend for forbs is stable. The sum of nested frequency for perennial forbs decreased 7%, while that for annual species increased substantially. Bur buttercup, an allelopathic annual (Buchanan et al. 1978), increased significantly in nested frequency. Total forb cover increased from 4% to 7%, however, perennial forb cover did not change. The DCI rating continued to decline to very poor due to the loss of preferred browse cover, and increases in browse decadence and annual grass cover.

winter range condition (DCI) - very poor (32) Mid-level potential scale
browse - down (-2) grass - slightly up (+1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 18

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	a79	b141	b127	b120	b123	6.26	3.11	6.06
G	Bromus japonicus (a)	-	-	-	-	4	-	-	.03
G	Bromus tectorum (a)	-	-	b105	a33	c163	1.05	.28	3.36
G	Oryzopsis hymenoides	a2	-	-	-	a4	-	-	.01
G	Poa fendleriana	-	a2	-	-	a4	-	-	.15
G	Poa secunda	a25	ab31	bc62	c66	c91	1.37	.33	1.37
G	Sitanion hystrix	-	-	-	-	2	-	-	.00
Total for Annual Grasses		0	0	105	33	167	1.05	0.28	3.40
Total for Perennial Grasses		106	174	189	186	224	7.64	3.44	7.60
Total for Grasses		106	174	294	219	391	8.69	3.72	11.01
F	Agoseris glauca	-	-	-	a4	a3	-	.01	.04
F	Alyssum alyssoides (a)	-	-	a5	-	b98	.01	-	.39
F	Arabis sp.	a1	-	a5	a6	a6	.01	.02	.07
F	Astragalus sp.	-	-	-	a1	a7	-	.00	.01
F	Camelina microcarpa (a)	-	-	-	-	1	-	-	.00
F	Calochortus nuttallii	a9	a3	a10	a7	a8	.02	.02	.02
F	Chaenactis douglasii	a3	-	-	a2	-	-	.00	-
F	Chorispora tenella (a)	-	-	-	-	27	-	-	.06
F	Collinsia parviflora (a)	-	-	a4	a1	b26	.00	.00	.06
F	Crepis acuminata	a14	a17	b53	a16	a13	2.03	.08	.06
F	Cruciferae	-	-	43	-	-	.12	-	-
F	Cryptantha sp.	b78	a30	a27	a11	a13	.12	.02	.09
F	Descurainia pinnata (a)	-	-	ab18	a12	b31	.03	.02	.07
F	Draba sp. (a)	-	-	-	-	3	-	-	.01
F	Eriogonum brevicaule	a3	a7	a7	a7	a2	.01	.04	.00
F	Erigeron sp.	b19	a3	a2	-	-	.00	-	-
F	Galium aparine (a)	-	-	a16	a5	a10	.20	.01	.05
F	Gilia sp. (a)	-	-	a12	a29	a15	.02	.05	.04
F	Haplopappus acaulis	-	-	a4	-	a3	.15	-	.15
F	Hackelia patens	a5	a9	-	a10	-	-	.03	-
F	Lactuca serriola	-	-	-	a2	a3	-	.00	.00
F	Leucelene ericoides	-	-	b16	ab11	a7	.24	.04	.09
F	Machaeranthera canescens	-	1	-	-	-	-	-	-
F	Microsteris gracilis (a)	-	-	-	-	4	-	-	.01
F	Penstemon sp.	-	-	6	-	-	.01	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Physaria australis	$_{a}$4	-	-	-	$_{a}$5	-	-	.01
F	Physalis hederaefolia	-	-	1	-	-	.00	-	-
F	Phlox hoodii	$_{a}$112	$_{b}$155	$_{a}$89	$_{a}$102	$_{a}$84	1.88	2.34	2.09
F	Phlox longifolia	$_{a}$26	$_{ab}$30	$_{b}$56	$_{ab}$40	$_{b}$49	.20	.09	.22
F	Ranunculus testiculatus (a)	-	-	$_{c}$275	$_{a}$139	$_{b}$197	3.50	.85	2.95
F	Stanleya pinnata	$_{a}$7	$_{a}$17	-	-	-	-	-	-
F	Unknown forb-annual (a)	-	-	8	-	-	.10	-	-
F	Veronica biloba (a)	-	-	-	-	17	-	-	.06
F	Zigadenus paniculatus	-	$_{a}$1	$_{a}$1	-	-	.00	-	-
Total for Annual Forbs		0	0	338	186	429	3.87	0.93	3.71
Total for Perennial Forbs		281	273	320	219	203	4.82	2.73	2.87
Total for Forbs		281	273	658	405	632	8.70	3.67	6.59

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

BROWSE TRENDS --
Management unit 16A, Study no: 18

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	13	10	8	.74	1.02	1.14
B	Cercocarpus montanus	26	29	24	4.73	5.89	3.26
B	Chrysothamnus viscidiflorus stenophyllus	5	8	6	.36	.21	.21
B	Ephedra viridis	18	20	17	2.62	3.43	2.49
B	Juniperus osteosperma	3	2	2	3.95	2.48	4.56
B	Pinus edulis	0	2	1	-	.66	.03
B	Quercus gambelii	0	0	0	-	.00	.00
Total for Browse		65	71	58	12.42	13.70	11.73

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 18

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	.41
Cercocarpus montanus	-	3.95
Chrysothamnus viscidiflorus stenophyllus	-	.50
Ephedra viridis	-	5.05
Juniperus osteosperma	.21	6.00
Pinus edulis	.03	-

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 18

Species	Average leader growth (in)	
	'02	'07
Cercocarpus montanus	2.5	2.6

POINT-QUARTER TREE DATA --
Management unit 16A, Study no: 18

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	63	56
Pinus edulis	-	21

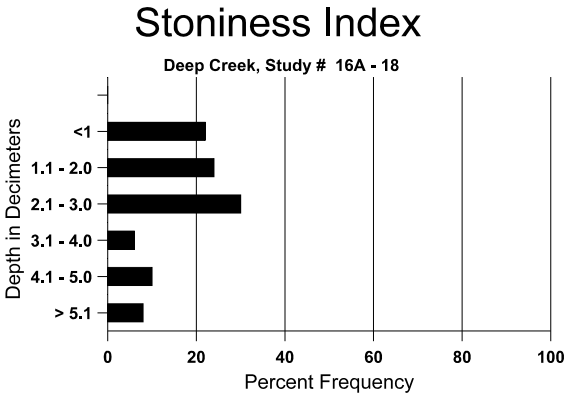
Average diameter (in)	
'02	'07
11.0	13.9
-	4.1

BASIC COVER --
Management unit 16A, Study no: 18

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	2.50	9.75	27.87	23.49	26.98
Rock	2.25	5.25	8.19	7.31	7.28
Pavement	6.75	20.50	20.05	10.19	13.63
Litter	46.50	33.75	25.98	27.82	19.12
Cryptogams	2.00	0	.67	.88	1.11
Bare Ground	40.00	30.75	25.02	47.01	47.02

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 18, Deep Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
18.3	49.0 (17.0)	7.2	28.7	19.4	51.8	1.2	6.6	124.8	.4



PELLET GROUP DATA --
Management unit 16A, Study no: 18

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	12	23
Rabbit	9	15	36
Elk	2	1	-
Deer	16	1	10

Days use per acre (ha)	
'02	'07
56 (137)	48 (117)
-	-
-	-
9 (23)	7 (17)

BROWSE CHARACTERISTICS --
Management unit 16A, Study no: 18

		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												
83	**533**	-	-	300	233	-	50	38	44	-	0	28/34
89	**500**	-	-	200	300	-	47	40	60	33	33	21/19
97	**300**	-	20	180	100	340	13	0	33	13	13	26/30
02	**240**	-	-	120	120	360	58	0	50	-	8	24/25
07	**160**	-	-	120	40	100	38	13	25	13	13	24/33
Cercocarpus montanus												
83	**433**	-	133	300	-	-	77	15	0	-	0	35/36
89	**465**	-	133	266	66	-	79	21	14	14	14	40/41
97	**860**	-	120	620	120	-	63	35	14	2	2	39/48
02	**1040**	-	40	640	360	20	42	27	35	10	10	42/50
07	**740**	80	-	240	500	100	14	81	68	46	59	48/61

		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)
Chrysothamnus viscidiflorus stenophyllus												
83	**100**	-	-	100	-	-	0	0	0	-	0	11/14
89	**133**	-	-	133	-	-	25	0	0	-	0	10/13
97	**100**	-	-	80	20	-	0	0	20	-	0	10/16
02	**200**	-	-	140	60	-	20	20	30	-	0	10/20
07	**140**	-	-	80	60	-	43	57	43	-	0	11/17
Cowania mexicana stansburiana												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**66**	-	-	66	-	-	100	0	-	-	0	26/35
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	18/18
07	**0**	-	-	-	-	-	0	0	-	-	0	67/47
Ephedra viridis												
83	**299**	-	33	200	66	-	11	0	22	-	0	40/48
89	**333**	-	-	133	200	-	0	0	60	-	0	35/24
97	**440**	-	-	380	60	-	27	0	14	-	5	41/56
02	**700**	-	40	460	200	120	14	0	29	6	6	42/53
07	**460**	-	80	240	140	20	13	13	30	9	9	43/66
Juniperus osteosperma												
83	**66**	-	-	66	-	-	0	0	-	-	0	67/207
89	**66**	-	-	66	-	-	0	0	-	-	0	165/136
97	**60**	-	-	60	-	40	0	33	-	-	0	-/-
02	**60**	-	-	60	-	40	0	0	-	-	0	-/-
07	**40**	-	-	40	-	20	0	0	-	-	0	-/-
Pinus edulis												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	-	40	-	-	0	0	-	-	0	-/-
07	**20**	-	20	-	-	-	0	0	-	-	0	-/-
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	20	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16A-19-07

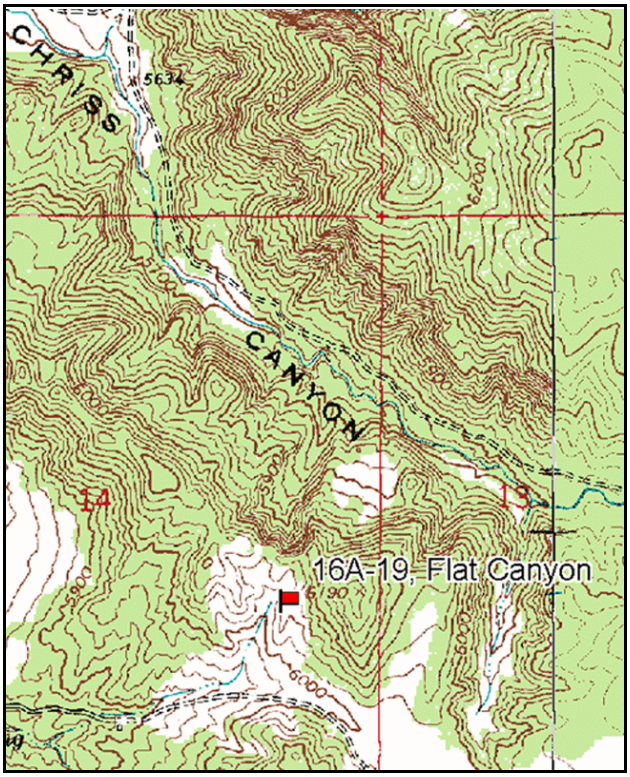
Study site name: Flat Canyon . Vegetation type: Bitterbrush - Sagebrush .

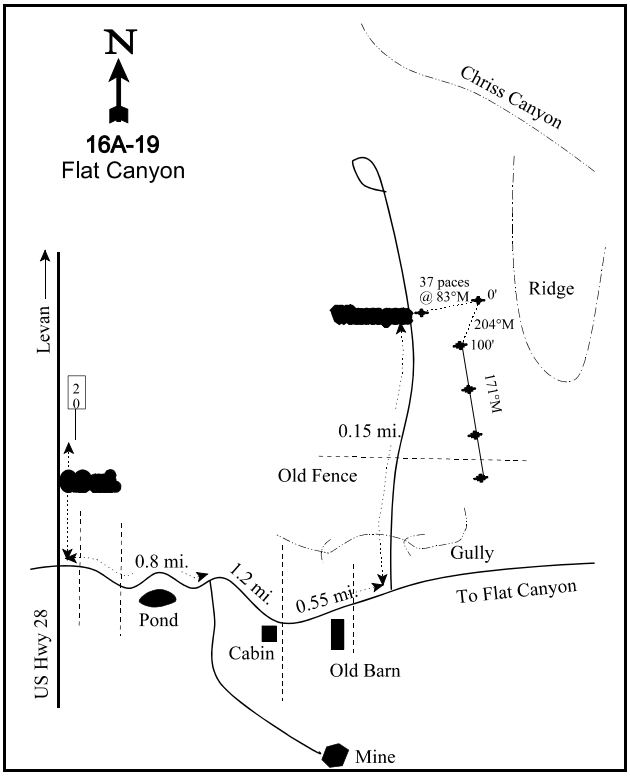
Compass bearing: frequency baseline 204 degrees magnetic (line 2-4 @ 171°M).

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

LOCATION DESCRIPTION

From Levan, go south on Highway 28 to 0.2 miles south of mile marker #20. Turn left here (east) and go 0.8 miles to a fork, keep left. Continue 1.2 miles to an old fence by an old cabin where the road makes a 90° turn to the east. Continue up the main road for 0.55 miles to a faint road which turns off to the left down into the sagebrush. Follow this road for 0.15 miles to a witness post on the right side of the road. From here walk up the hill about 37 paces bearing 83degrees magnetic to the 0 foot baseline stake which is marked with browse tag #9084.





Map Name: Skinner Peaks Diagrammatic Sketch

Township 16S , Range 1W , Section 14 GPS: NAD 83, UTM 12S 423840 E 4363157 N

DISCUSSION

Flat Canyon - Trend Study No. 16A-19

Study Information

This study was established in 1989 on the critical winter range in the hills around Flat and Chriss Canyons, north of Gunnison. Most of the surrounding land is privately-owned. It is located on a small ridge. The original baseline sampled the steeper side of the ridge, while the extended baseline samples the ridge top [elevation: 6,050 feet (1,844 m), slope: 3-5% on ridge top, 30% on ridge side, aspect: southwest]. The vegetation is typical of the higher elevation range in the area and is composed of a moderate density of Utah juniper (*Juniperus osteosperma*) and pinyon pine (*Pinus edulis*), with a shrub understory of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and bitterbrush (*Purshia tridentata*). Big game use was reportedly heavy in 1989. Pellet group quadrat frequency for deer was moderately high at 28% in 1997, and use was estimated at 44 days use/acre (109 ddu/ha) in 2002 and 15 days use/acre (36 ddu/ha) in 2007. Most of the deer pellet groups appeared to be from late winter or early spring use in 2002. Summer cattle use was estimated at 2 days use/acre (5 cdu/ha) in 2002 and 2007. Elk and sheep use were estimated at 3 days use/acre (7 edu/ha) and 2 days use/acre (5 sdu/ha) in 2007, respectively.

Soil

The soil is classified within the Saxby series (USDA-NRCS 2007). The soils in this series are shallow and well-drained. They formed in colluvium, residuum, and alluvium from basalt mixed with alluvium from lacustrine sediments, with some areas having loess deposits. The soil texture is a sandy loam, and it has a neutral pH (7.2). Organic matter is limited at only 1.6%, and soil phosphorus is also low at 4.4 ppm. Phosphorus levels below 6 ppm may be limiting to plant growth and development (Tiedemann and Lopez 2004). There appears to be a caliche layer in places that varies in depth. Large and small gravel sized rocks are common on the surface and throughout the profile. Rocks found at approximately 12 inches (30.5 cm) in depth have a calcium carbonate coating. The soil erosion condition was classified as stable in 2002 and slight in 2007, due to some gullies and indication of soil movement.

Browse

The preferred browse cover is composed mostly of mountain big sagebrush and bitterbrush, with a very low density of ephedra (*Ephedra viridis*). Sagebrush density decreased from 2,532 plants/acre (6,256 plants/ha) in 1989 to 1,220 plants/acre (3,015 plants/ha) with the extended baseline in 1997, then steadily increased to 1,340 plants/acre (3,311 plants/ha) by 2007. Its average cover increased from 9% in 1997 to 11% in 2002, then declined to 7% in 2007. The population has been mostly mature, with young recruitment steadily decreasing from 24% of the population in 1989 to only 3% by 2007. Decadence decreased from 26% of the population in 1989 to 15% in 1997, then increased to 42% by 2007. Plants showing poor vigor and classified as dying also increased between 1997 and 2007, from 2% of the population to 21%. Use was mostly light-moderate in all years, with some heavy use in 1989, 2002, and 2007. Annual leader growth averaged 2.1 inches (5.3 cm) in 2002 and 2007.

Bitterbrush density increased from 533 plants/acre (1,317 plants/ha) in 1989 to 620 plants/acre (1,532 plants/ha) in 2002, and remained stable in 2007. Cover increased from 3% to 5% between 1997 and 2007. Young recruitment increased from 0% of the population in 1989 to 17% in 1997, then declined to 3% in 2002 and 2007. Decadence has steadily increased from 0% of the population in 1989 to 19% in 2007. Vigor has been good on most plants, and 10% and 13% of the sampled plants displayed poor vigor in 2002 and 2007, respectively. The growth form varies from prostrate, layering shrubs to eight foot tall, open tree-like forms. Use on the low-growing plants has been especially heavy, while the taller plants have also been heavily browsed, but some of the forage is unavailable due to height. Annual leader growth averaged 1.7 inches (4.2 cm) in 2002 and 2.6 inches (6.7 cm) in 2007.

Point-centered quarter data estimated juniper density at 45 trees/acre (111 trees/ha) in 2002 and 41 trees/acre (101 trees/ha) in 2007. Average trunk diameter was 7.5 inches (19.1 cm) in 2002 and 8.8 inches (22.4 cm) in 2007. The majority of the trees were over 8 feet (2.4 m) tall in 2007. Pinyon density was 10 trees/acre (25 trees/ha) in 2002 and 19 trees/acre (47 trees/ha) in 2007, with an average trunk diameter of 4.6 inches (11.7 cm) and 7.9 inches (20.1 cm), respectively.

Herbaceous Understory

Grasses provided 12% cover in 1997, 11% in 2002, and 22% in 2007. Perennial bunchgrasses are fairly common, but widely spaced. The most common perennial grass is bluebunch wheatgrass (*Agropyron spicatum*), which provided 59% of the total grass cover in 2002 and 26% in 2007. Sandberg bluegrass (*Poa secunda*) and needle-and-thread (*Stipa comata*) are also common. Cheatgrass (*Bromus tectorum*) is found primarily under the canopies of shrubs and trees. It accounted for 48% of the total grass cover in 1997, 11% in 2002, and 57% in 2007. Forbs are diverse, but few have been abundant, especially with dry conditions in 2002. Gilia (*Gilia* sp.) was abundant in 1997, and pale alyssum (*Alyssum alyssoides*) was abundant in 2007.

1997 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density decreased 52%, from 2,532 plants/acre (6,256 plants/ha) to 1,220 plants/acre (3,015 plants/ha), most of which was likely due to the increase in sample area. Decadence decreased from 26% of the population to 15%, and young recruitment also decreased from 24% of the population to 13%. The density of dead plants was high at 1,020 plants/acre (2,520 plants/ha). Some of the dead sagebrush appeared to have died recently, but not due to excessive use. Seedlings were sampled at a density of 120 seedlings/acre (297 seedlings/ha). Plants displaying poor vigor decreased from 21% of the population to 2%, and use decreased to light. Bitterbrush density increased slightly from 533 plants/acre (1,317 plants/ha) to 600 plants/acre (1,483 plants/ha). Decadence remained low at only 3% of the population, while recruitment increased from 0% of the population to 17%. All of the sampled plants were vigorous, and use remained moderate-heavy. The trend for grass is slightly down. The sum of nested frequency for perennial grasses decreased 11%. Bluebunch wheatgrass decreased significantly in nested frequency, while Sandberg bluegrass increased significantly in nested frequency. The trend for forbs is up. The sum of nested frequency for perennial species increased substantially. The Desirable Components Index (DCI) was rated as poor due to low preferred browse and perennial understory cover.

winter range condition (DCI) - poor (46) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density increased slightly from 1,220 plants/acre (3,015 plants/ha) to 1,280 plants/acre (3,163 plants/ha). Young recruitment decreased from 13% of the population to 6%, and decadence increased from 15% of the population to 22%. Plants displaying poor vigor and classified as dying increased from 2% of the population to 11%, and use increased from light to approximately one-third of the sampled plants showing moderate-heavy use. Bitterbrush density remained relatively stable at 620 plants/acre (1,532 plants/ha). Decadence increased from 3% of the population to 13%, and young recruitment decreased from 17% of the population to 3%. Plants displaying poor vigor and classified as dying increased from 0% to 10% of the population, and use remained moderate-heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses increased only 7%, but average perennial grass cover increased from 6% to 10%. Cheatgrass decreased significantly in nested frequency, and its cover also decreased from 6% to 1%. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 63%, while that for annual forbs decreased 12%. Several species, including sego lily (*Calochortus nuttallii*), Douglas chaenactis (*Chaenactis douglasii*), and gilia, decreased significantly in nested frequency. The DCI rating increased slightly to poor-fair due to increased preferred browse and perennial grass cover, and decreased annual grass cover.

winter range condition (DCI) - poor-fair (52) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density slightly increased from 1,280 plants/acre (3,163 plants/ha) to 1,340 plants/acre (3,311 plants/ha). However, decadence almost doubled from 22% of the population to 42%, and young recruitment continued to decline from 6% of the population to 3%. Plants displaying poor vigor and classified as dying increased from 11% of the population to 21%, and 44% of the sampled plants showed moderate-heavy use. Bitterbrush density remained stable at 620 plants/acre (1,532 plants/ha). Decadence continued to increase to 19% of the population. Plants classified as dying increased from 10% of the population to 13%, and use remained heavy. The trend for grass is stable. The sum of nested frequency for perennial grasses did not change substantially since 2002, but increased 12% since 1997. The sum of nested frequency for annual grasses increased 52%. Cheatgrass cover increased from 1% to 12%. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little. Pale alyssum increased significantly in nested frequency. The DCI rating decreased to very poor due to an increase in decadence and decrease in recruitment for preferred browse, and an increase in cheatgrass cover.

winter range condition (DCI) - very poor (33) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 19

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{b}$171	$_{a}$122	$_{ab}$150	$_{a}$121	3.44	6.67	5.55
G	Bromus japonicus (a)	-	-	20	-	-	.06	-
G	Bromus tectorum (a)	-	$_{b}$275	$_{a}$211	$_{c}$350	5.80	1.19	12.38
G	Oryzopsis hymenoides	$_{b}$27	$_{ab}$11	$_{a}$-	$_{b}$16	.10	.01	.52
G	Poa secunda	$_{a}$20	$_{b}$65	$_{b}$55	$_{b}$72	1.22	1.53	1.27
G	Sitanion hystrix	$_{a}$2	$_{a}$6	-	$_{a}$10	.15	-	.09
G	Stipa comata	$_{a}$38	$_{a}$26	$_{a}$41	$_{a}$39	1.33	1.82	1.81
Total for Annual Grasses		0	275	231	350	5.80	1.26	12.38
Total for Perennial Grasses		258	230	246	258	6.25	10.05	9.25
Total for Grasses		258	505	477	608	12.05	11.31	21.64
F	Agoseris glauca	-	$_{b}$20	$_{ab}$11	$_{a}$8	.27	.05	.04
F	Alyssum alyssoides (a)	-	$_{a}$1	$_{a}$25	$_{b}$166	.00	.04	1.15
F	Allium sp.	-	-	2	-	-	.00	-
F	Arabis sp.	-	-	1	-	-	.00	-
F	Astragalus agrestis	-	$_{a}$4	$_{a}$5	$_{a}$6	.07	.04	.16
F	Astragalus eurekensis	-	-	$_{a}$6	$_{a}$6	-	.04	.04
F	Castilleja linariaefolia	-	2	-	-	.06	-	-
F	Camelina microcarpa (a)	-	-	-	2	-	-	.00
F	Calochortus nuttallii	-	$_{b}$41	$_{a}$15	$_{a}$6	.16	.05	.03

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Chaenactis douglasii	-	$_{b}$25	$_{a}$2	-	.69	.00	-
F	Chorispora tenella (a)	-	$_{a}$4	$_{a}$3	-	.03	.00	-
F	Cirsium sp.	-	5	-	-	.04	-	-
F	Collinsia parviflora (a)	-	-	$_{a}$3	$_{a}$2	-	.00	.00
F	Crepis acuminata	-	-	$_{a}$-	$_{a}$-	-	.00	.00
F	Cryptantha sp.	$_{a}$6	$_{a}$16	-	$_{a}$9	.11	-	.02
F	Descurainia pinnata (a)	-	-	$_{a}$7	$_{a}$14	-	.01	.03
F	Draba sp. (a)	-	-	-	1	-	-	.00
F	Epilobium brachycarpum (a)	-	$_{a}$3	$_{a}$7	$_{a}$2	.00	.02	.00
F	Erodium cicutarium (a)	-	$_{a}$2	$_{a}$3	$_{a}$10	.00	.00	.07
F	Eriogonum racemosum	-	-	2	-	-	.03	-
F	Galium aparine (a)	-	-	$_{a}$1	$_{a}$2	-	.00	.01
F	Gilia sp. (a)	-	$_{b}$61	$_{a}$11	$_{a}$18	2.15	.03	.05
F	Lappula occidentalis (a)	-	-	-	13	-	-	.06
F	Lactuca serriola	-	$_{a}$4	-	$_{a}$2	.00	-	.00
F	Machaeranthera canescens	$_{a}$3	$_{a}$-	-	-	.00	-	-
F	Microsteris gracilis (a)	-	-	$_{a}$3	$_{a}$1	-	.01	.00
F	Phlox austromontana	-	$_{a}$6	-	$_{a}$3	.18	-	.15
F	Phlox longifolia	$_{a}$9	$_{a}$9	$_{a}$6	$_{a}$6	.04	.02	.01
F	Polygonum douglasii (a)	-	3	-	-	.00	-	-
F	Ranunculus testiculatus (a)	-	-	-	8	-	-	.01
F	Streptanthus cordatus	$_{a}$3	$_{a}$5	$_{a}$1	$_{a}$2	.04	.00	.00
F	Tragopogon dubius	-	$_{a}$9	-	$_{a}$2	.10	-	.06
F	Veronica biloba (a)	-	-	$_{a}$2	$_{a}$2	-	.00	.00
F	Zigadenus paniculatus	-	-	3	-	-	.03	-
Total for Annual Forbs		0	74	65	241	2.20	0.15	1.42
Total for Perennial Forbs		21	146	54	50	1.80	0.28	0.54
Total for Forbs		21	220	119	291	4.00	0.43	1.96

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

BROWSE TRENDS --
Management unit 16A, Study no: 19

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	43	44	44	8.83	10.96	7.23
B	Chrysothamnus viscidiflorus viscidiflorus	4	4	4	.15	.06	-
B	Ephedra viridis	0	0	0	-	.00	.03
B	Gutierrezia sarothrae	7	4	4	.35	.30	.00
B	Juniperus osteosperma	1	4	5	2.96	6.56	6.59
B	Opuntia sp.	3	0	4	.03	-	-
B	Purshia tridentata	14	18	15	3.04	4.09	4.55
B	Quercus gambelii	0	1	1	-	-	.00
Total for Browse		72	75	77	15.37	21.99	18.42

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 19

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	6.09
Chrysothamnus viscidiflorus viscidiflorus	-	.05
Juniperus osteosperma	.81	16.85
Purshia tridentata	-	4.36

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 19

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.1	2.1
Purshia tridentata	1.7	2.7

POINT-QUARTER TREE DATA --
Management unit 16A, Study no: 19

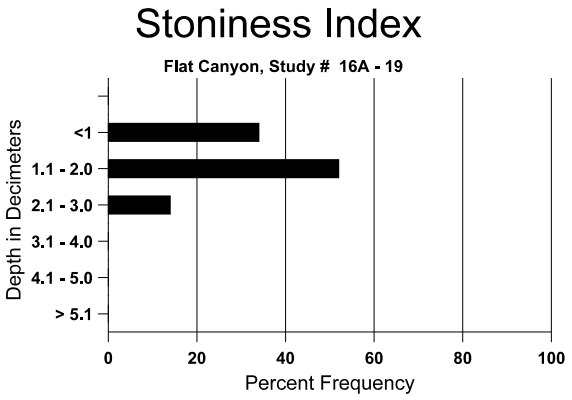
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Juniperus osteosperma	45	41	7.5	8.8
Pinus edulis	10	19	4.6	7.9

BASIC COVER --
Management unit 16A, Study no: 19

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	4.75	26.96	31.86	37.45
Rock	8.75	7.50	9.19	7.91
Pavement	21.00	15.75	11.90	14.13
Litter	42.25	32.46	35.46	33.34
Cryptogams	1.25	.92	.76	.30
Bare Ground	22.00	28.46	30.32	23.53

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 19, Flat Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
17.2	50.8 (17.1)	7.2	70.4	15.8	13.8	1.6	4.4	153.6	.5



PELLET GROUP DATA --
Management unit 16A, Study no: 19

Type	Quadrat Frequency			Days use per acre (ha)	
	'97	'02	'07	'02	'07
Sheep	-	-	2	-	2 (5)
Rabbit	2	23	59	-	-
Horse	-	1	-	-	-
Elk	1	-	1	-	3 (7)
Deer	28	29	12	44 (109)	15 (36)
Cattle	-	2	2	2 (5)	2 (5)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 vaseyana												
89	**2532**	66	600	1266	666	-	39	8	26	3	21	20/24
97	**1220**	120	160	880	180	1020	10	0	15	2	2	22/35
02	**1280**	-	80	920	280	580	33	2	22	11	11	19/29
07	**1340**	-	40	740	560	440	31	13	42	21	21	27/34
Chrysothamnus nauseosus albicaulis												
89	**132**	-	66	66	-	-	0	50	-	-	0	20/13
97	**0**	-	-	-	-	-	0	0	-	-	0	28/33
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Chrysothamnus viscidiflorus viscidiflorus												
89	**465**	-	66	333	66	-	14	14	14	-	14	12/13
97	**140**	-	40	100	-	-	0	0	0	-	0	13/19
02	**120**	-	20	60	40	-	0	0	33	-	0	11/15
07	**120**	-	-	80	40	-	0	0	33	17	17	10/11
Ephedra viridis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	18/13
02	**0**	-	-	-	-	-	0	0	-	-	0	16/13
07	**0**	-	-	-	-	-	0	0	-	-	0	43/54
Gutierrezia sarothrae												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**1400**	180	1160	240	-	20	0	0	0	-	0	10/14
02	**400**	-	-	100	300	300	0	0	75	75	75	4/6
07	**80**	20	40	40	-	-	0	0	0	-	0	12/11
Juniperus osteosperma												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	-/-
02	**80**	-	-	80	-	-	0	0	-	-	0	-/-
07	**100**	20	20	80	-	-	0	0	-	-	0	-/-
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**80**	-	-	80	-	-	0	0	-	-	0	3/10
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**100**	-	20	80	-	-	0	0	-	-	0	3/7

		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)
Purshia tridentata												
89	**533**	-	-	533	-	-	63	38	0	-	0	15/32
97	**600**	-	100	480	20	20	67	27	3	-	0	57/46
02	**620**	-	20	520	80	100	23	45	13	10	10	21/56
07	**620**	-	20	480	120	100	23	71	19	13	13	25/60
Quercus gambelii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	-/-
07	**20**	-	20	-	-	-	0	0	-	-	0	-/-

Trend Study 16A-20-07

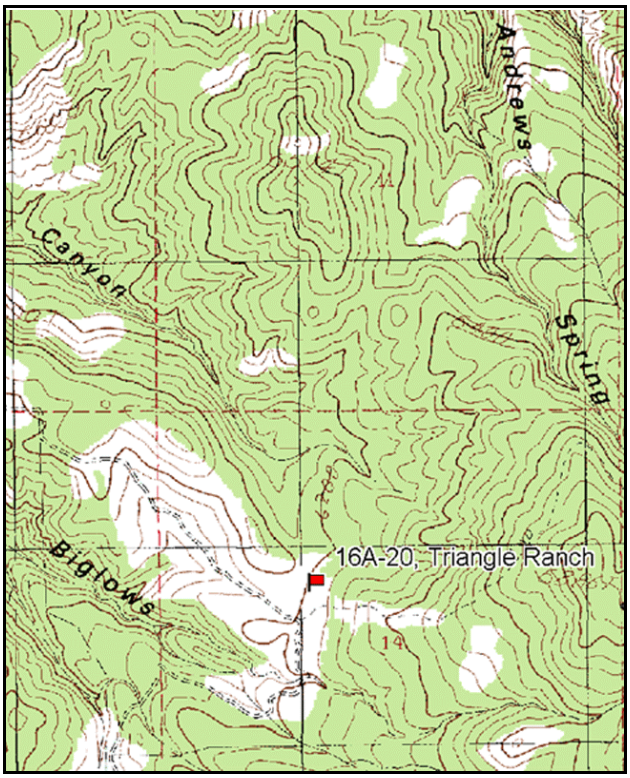
Study site name: Triangle Ranch . Vegetation type: Chained, Seeded P-J .

Compass bearing: frequency baseline 256 degrees magnetic.

Frequency belt placement: line 1 (11 & 95ft), line 2 (34ft) 50' baseline, line 3 (59ft), line 4 (71ft). Rebar: belt 5 on 4ft.

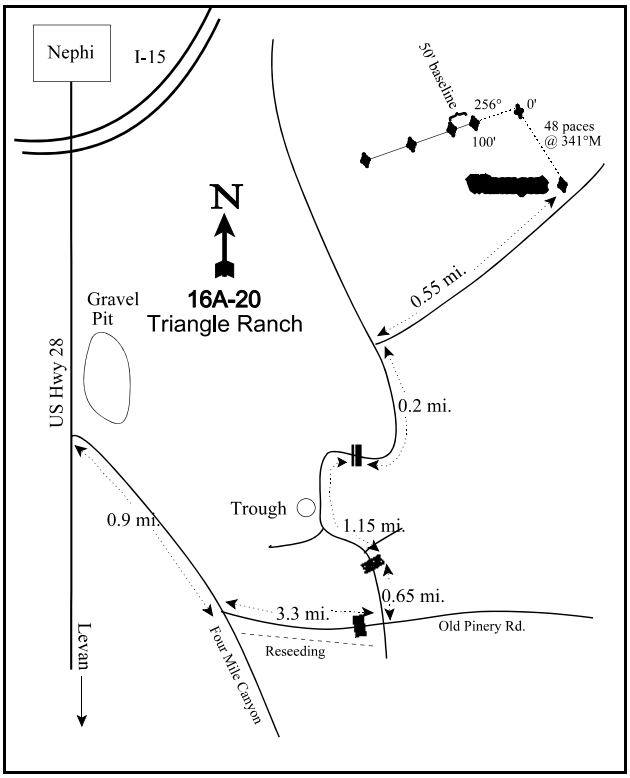
LOCATION DESCRIPTION

Just south of Nephi on Highway 28, turn south past the gravel pit onto a graded road. Go 0.9 miles to a fork. Bear left on the Old Pinery Road. Go 3.0 miles to a cattle guard. Continue 0.3 miles to an intersection. Turn left here and go 0.65 miles to a cattle guard at the top of the hill, then drive through Little Valley 1.1 miles to a gate at the north end of the valley and 0.05 more to a cattle guard. Proceed up the jeep trail 0.2 miles to a fork and bear right. Go 0.55 miles to another fork in a chaining. Take the right fork 0.05 miles to the witness post. From the witness post, go 48 paces at 341 degrees magnetic to the 0-foot baseline stake.



Map Name: Nephi

Township 13S , Range 1E , Section 14



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 431971 E 4393046 N

DISCUSSION

Triangle Ranch - Trend Study No. 16A-20

Study Information

This study was established in 1989 within a chaining treatment on the UDWR Triangle Ranch property. It is in a valley between the low hills south of Nephi [elevation: 6,200 feet (1,890 m), slope: 15%, aspect: west]. The area provides a variety and abundance of browse and herbaceous forage. There is an excellent stand of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and perennial grass, although Gambel oak (*Quercus gambelii*) and Utah juniper (*Juniperus osteosperma*) have reestablished since the treatment. In 1989, there was sign of moderate use by deer and elk, mainly from spring and fall as the area often receives significant snow cover. No deer pellets were sampled in 1997, but use was estimated at 35 deer days use/acre (88 ddu/ha) in 2002 and 40 days use/acre (99 ddu/ha) in 2007. Summer cattle use was estimated at 4 days use/acre (11 cdu/ha) in 2002 and 2007.

Soil

The soil is classified within the Lizzant series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in alluvium and colluvium derived from sedimentary rocks. The soil texture is a loam. There are few rocks on the surface or in the soil profile, and organic matter is fairly low at 1.9%. Vegetation and litter have accounted for over 80% of the relative ground cover since 1989. The soil erosion condition was classified as stable in 2002 and 2007.

Browse

The preferred browse includes mostly mountain big sagebrush, with a low density of antelope bitterbrush (*Purshia tridentata*). Sagebrush density has slowly declined from 3,333 plants/acre (8,236 plants/ha) in 1989 to 2,320 plants/acre (5,733 plants/ha) in 2007. Decadence was high at 60% of the population in 1989, decreased to only 8% in 1997, then increased to 29% and 35% in 2002 and 2007, respectively. Young recruitment increased from 12% of the population in 1989 to 28% in 1997, then decreased to 10% and 6% in 2002 and 2007. All of the sampled plants were vigorous in 1989, and by 2007, 28% of the plants displayed poor vigor. Use was moderate in 1989, light-moderate in 1997 and 2002, and moderate-heavy in 2007. Annual leader growth averaged 1.5 inches (3.7 cm) in 2002 and 1.6 inches (4.1 cm) in 2007.

Gambel oak and juniper have reestablished since the treatment. Oak density was 300 plants/acre (741 plants/ha) in 2002 and 220 plants/acre (544 plants/ha) in 2007. Point-centered quarter data estimated juniper density at 72 trees/acre (178 trees/ha) in 1989, 97 trees/acre (240 trees/ha) in 1997, 110 trees/acre (272 trees/ha) in 2002, and 117 trees/acre (289 trees/ha) in 2007. Most trees were 10 feet (3 m) to 15 feet (4.6 m) tall in 2002, and in 2007, the sampled trees averaged approximately 8 feet (2.4 m) in height. Average trunk diameter has been approximately 4.2 inches (10.7 cm) since 1997.

Herbaceous Understory

The herbaceous understory is diverse. Perennial grasses provided 26% cover in 1997, 30% in 2002, and 46% in 2007. Bulbous bluegrass (*Poa bulbosa*) was the most abundant grass in 2002 and 2007, and accounted for approximately 30% of the total grass cover both years. Other abundant grass species include sheep fescue (*Festuca ovina*), orchardgrass (*Dactylis glomerata*), intermediate wheatgrass (*Agropyron intermedium*), and Kentucky bluegrass (*Poa pratensis*). Cheatgrass (*Bromus tectorum*) is present, but at a low frequency. Few forbs are particularly abundant. Total forb cover has been 5%-6% since 1997. Beckwith milkvetch (*Astragalus beckwithii*) provided 32% of the total forb cover in 1997, 42% in 2002, and 43% in 2007.

1997 TREND ASSESSMENT

The trend for browse is stable. Sagebrush density decreased slightly from 3,333 plants/acre (8,236 plants/ha) to 3,180 plants/acre (7,858 plants/ha), but decadence decreased from 60% of the population to only 8%.

Young recruitment was high, and increased from 12% of the population to 28%. Most plants remained vigorous. Use decreased from moderate to mostly light, although approximately 20% of the sampled plants showed moderate-heavy hedging. The trend for grass is stable. The sum of nested frequency for perennial grasses, not including bulbous bluegrass, changed little. Orchardgrass, sheep fescue, and Kentucky bluegrass increased significantly in nested frequency, while crested wheatgrass (*Agropyron cristatum*) and western wheatgrass (*Agropyron smithii*) decreased significantly in nested frequency. The trend for forbs is up. The sum of nested frequency for perennial forbs increased almost 90%. The Desirable Components Index (DCI) was rated as good-excellent due to a favorable preferred browse component and ample perennial herbaceous cover.

winter range condition (DCI) - good-excellent (79) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is slightly down. Sagebrush density decreased from 3,180 plants/acre (7,858 plants/ha) to 2,900 plants/acre (7,166 plants/ha), and decadence increased from 8% of the population to 29%. Young recruitment decreased to 10% of the population. Plants displaying poor vigor increased from 5% of the population to 11%, and 10% of the sampled plants were classified as dying. Use remained light-moderate. The trend for grass is down. The sum of nested frequency for perennial grasses, with the exception of bulbous bluegrass, decreased 23%. Western wheatgrass and Kentucky bluegrass both decreased in nested frequency, while bulbous bluegrass increased significantly in nested frequency. Average bulbous bluegrass cover increased from 2% to 8%. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 22%. Several individual species, including false dandelion (*Agoseris glauca*), Lewis flax (*Linum lewisii*), and yellow salsify (*Tragopogon dubius*), decreased significantly in nested frequency. The DCI rating declined to good due to an increase in decadence and decrease in recruitment of preferred browse.

winter range condition (DCI) - good (67) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - down (-2)

2007 TREND ASSESSMENT

The trend for browse is down. Sagebrush density continued to decrease to 2,320 plants/acre (5,733 plants/ha), and its average cover also decreased from 14% to 9%. Decadence increased from 29% of the population to 35%, and young recruitment decreased from 10% of the population to 6%. Plants displaying poor vigor increased from 11% of the population to 28%, while those classified as dying increased from 10% to 17%. Use increased to moderate-heavy. The trend for grass is slightly down. The sum of nested frequency for perennial grasses, not including bulbous bluegrass, decreased 10%. Kentucky bluegrass decreased significantly in nested frequency, while sheep fescue increased significantly in nested frequency. Bulbous bluegrass continued to spread. Its nested frequency increased significantly, and its average cover increased from 8% to 14%. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 22%. However, perennial forb cover remained stable at approximately 4%. The DCI rating continued to decline to fair, mainly due to the decrease in preferred browse cover.

winter range condition (DCI) - fair (58) Mid-level potential scale
browse - down (-2) grass - slightly down (-1) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16A, Study no: 20

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{b}$40	$_{a}$17	$_{a}$13	$_{a}$11	.78	.36	.37
G	Agropyron intermedium	$_{a}$62	$_{a}$109	$_{a}$122	$_{a}$96	4.19	3.47	6.07
G	Agropyron smithii	$_{c}$330	$_{b}$140	$_{a}$71	$_{a}$74	1.06	.81	.81
G	Agropyron spicatum	$_{a}$4	-	-	$_{a}$1	-	-	.03
G	Bromus inermis	$_{a}$13	$_{ab}$37	$_{b}$47	$_{b}$51	1.17	2.71	3.95
G	Bromus japonicus (a)	-	-	-	24	-	-	.22
G	Bromus tectorum (a)	-	$_{a}$71	$_{a}$51	$_{a}$52	.39	.12	.62
G	Dactylis glomerata	$_{a}$28	$_{b}$83	$_{ab}$60	$_{b}$73	2.34	3.06	6.34
G	Elymus cinereus	-	$_{a}$1	$_{a}$3	$_{a}$6	.00	.78	.53
G	Elymus salina	-	$_{a}$5	-	$_{a}$2	.76	-	.03
G	Festuca ovina	$_{a}$30	$_{b}$89	$_{b}$85	$_{c}$114	4.06	6.15	11.03
G	Poa bulbosa	-	$_{a}$64	$_{b}$189	$_{c}$252	2.33	7.94	13.91
G	Poa fendleriana	-	1	-	-	.03	-	-
G	Poa pratensis	$_{b}$74	$_{c}$182	$_{b}$112	$_{a}$44	8.13	3.63	1.81
G	Poa secunda	$_{b}$82	$_{ab}$59	$_{ab}$47	$_{a}$34	1.19	.84	.78
Total for Annual Grasses		0	71	51	76	0.39	0.12	0.84
Total for Perennial Grasses		663	787	749	758	26.09	29.79	45.68
Total for Grasses		663	858	800	834	26.48	29.92	46.52
F	Agoseris glauca	$_{a}$5	$_{c}$90	$_{b}$58	$_{ab}$28	.80	.32	.15
F	Alyssum alyssoides (a)	-	$_{a}$39	$_{b}$85	$_{b}$70	.08	.25	.18
F	Antennaria rosea	-	6	-	-	.01	-	-
F	Arabis sp.	$_{a}$10	$_{a}$10	$_{a}$2	-	.02	.00	-
F	Astragalus beckwithii	-	$_{a}$60	$_{a}$76	$_{a}$66	1.83	2.09	2.37
F	Aster chilensis	-	-	$_{a}$3	$_{a}$4	-	.15	.18
F	Astragalus convallarius	$_{b}$25	$_{a}$6	$_{a}$2	$_{a}$-	.06	.18	.03
F	Balsamorhiza sagittata	-	$_{a}$3	$_{a}$3	-	.00	.00	-
F	Camelina microcarpa (a)	-	-	-	2	-	-	.00
F	Calochortus nuttallii	-	$_{a}$9	$_{a}$14	$_{a}$10	.02	.04	.02
F	Cerastium sp.	4	-	-	-	-	-	-
F	Cirsium sp.	-	-	-	-	.03	-	-
F	Collomia linearis (a)	-	$_{a}$7	$_{a}$9	-	.05	.02	-
F	Collinsia parviflora (a)	-	$_{b}$198	$_{b}$165	$_{a}$65	.63	.64	.16
F	Crepis acuminata	$_{a}$14	$_{a}$12	$_{b}$31	$_{ab}$30	.13	.69	.80
F	Cymopterus sp.	$_{a}$8	$_{a}$4	$_{a}$8	$_{a}$6	.03	.02	.01
F	Draba sp. (a)	-	$_{a}$3	-	$_{a}$2	.00	-	.00

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Epilobium brachycarpum (a)	-	$_{b}$66	$_{a}$20	$_{a}$26	.17	.05	.07
F	Eriogonum racemosum	$_{a}$5	$_{a}$3	$_{a}$1	$_{a}$5	.00	.00	.01
F	Eriogonum umbellatum	$_{a}$6	$_{a}$6	$_{a}$6	$_{a}$6	.06	.03	.06
F	Galium aparine (a)	-	$_{a}$25	-	$_{a}$25	.50	-	.81
F	Holosteum umbellatum (a)	-	-	-	1	-	-	.00
F	Lappula occidentalis (a)	-	12	-	-	.02	-	-
F	Lactuca serriola	$_{a}$5	$_{a}$2	-	$_{a}$1	.00	-	.00
F	Linum lewisii	$_{ab}$13	$_{b}$19	$_{a}$6	$_{a}$-	.15	.04	.07
F	Medicago sativa	-	-	-	1	-	-	.00
F	Microsteris gracilis (a)	-	-	$_{b}$21	$_{a}$5	-	.04	.02
F	Penstemon sp.	-	-	2	-	-	.00	-
F	Phlox longifolia	$_{a}$18	$_{a}$21	$_{a}$20	$_{a}$22	.04	.04	.09
F	Polygonum douglasii (a)	-	$_{a}$8	$_{a}$3	-	.01	.00	-
F	Ranunculus testiculatus (a)	-	$_{b}$101	$_{a}$44	$_{a}$27	.26	.14	.14
F	Sanguisorba minor	1	-	-	-	-	-	-
F	Sphaeralcea coccinea	$_{b}$12	$_{ab}$9	$_{a}$3	$_{ab}$5	.02	.01	.01
F	Taraxacum officinale	-	1	-	-	.00	-	-
F	Tragopogon dubius	$_{b}$45	$_{b}$53	$_{a}$12	$_{a}$6	.57	.08	.04
F	Unknown forb-annual (a)	-	22	-	-	.05	-	-
F	Vicia americana	-	-	-	3	-	-	.15
F	Viola sp.	-	$_{b}$5	$_{a}$1	$_{a}$-	.02	.00	.00
F	Zigadenus paniculatus	$_{a}$1	$_{a}$6	$_{a}$7	$_{a}$5	.04	.07	.06
Total for Annual Forbs		0	481	347	223	1.81	1.16	1.40
Total for Perennial Forbs		172	325	255	198	3.89	3.81	4.11
Total for Forbs		172	806	602	421	5.71	4.97	5.51

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

BROWSE TRENDS --
Management unit 16A, Study no: 20

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	62	64	58	12.08	13.80	9.26
B	Chrysothamnus nauseosus albicaulis	6	6	4	.06	.68	.18
B	Gutierrezia sarothrae	6	28	16	.02	.26	.45
B	Juniperus osteosperma	2	8	8	1.14	3.04	4.75
B	Purshia tridentata	2	1	0	.15	-	-
B	Quercus gambelii	0	2	3	.63	.63	.85
Total for Browse		78	109	89	14.09	18.43	15.51

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 20

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	7.76
Chrysothamnus nauseosus albicaulis	-	.28
Gutierrezia sarothrae	-	.05
Juniperus osteosperma	.21	.68
Quercus gambelii	.16	-

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 20

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.5	1.6

POINT-QUARTER TREE DATA --
Management unit 16A, Study no: 20

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	110	117

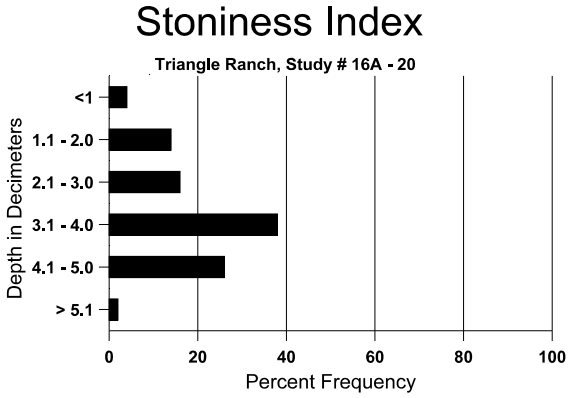
Average diameter (in)	
'02	'07
4.0	4.2

BASIC COVER --
Management unit 16A, Study no: 20

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	6.50	48.11	55.36	60.52
Rock	1.00	.22	.22	.13
Pavement	.50	1.14	1.77	2.41
Litter	79.75	51.00	42.92	40.18
Cryptogams	1.25	.07	.15	.18
Bare Ground	11.00	12.95	19.10	12.50

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 20, Triangle Ranch

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
21.3	43.8 (17.7)	6.2	42.0	31.4	26.6	1.9	17.7	185.6	.4



PELLET GROUP DATA --
Management unit 16A, Study no: 20

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	2	8	13
Elk	-	-	1
Deer	-	9	11
Cattle	7	5	2

Days use per acre (ha)	
'02	'07
-	-
-	-
35 (88)	40 (99)
4 (11)	4 (11)

BROWSE CHARACTERISTICS --
Management unit 16A, 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												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	32/30
02	**0**	-	-	-	-	-	0	0	-	-	0	44/42
07	**0**	-	-	-	-	-	0	0	-	-	0	32/33
Artemisia tridentata vaseyana												
89	**3333**	66	400	933	2000	-	54	0	60	-	0	22/24
97	**3180**	140	880	2060	240	180	16	3	8	4	5	26/38
02	**2900**	20	280	1780	840	180	26	0	29	10	11	25/37
07	**2320**	-	140	1360	820	120	27	28	35	17	28	26/39
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**140**	-	40	80	20	-	0	0	14	14	14	34/29
02	**140**	-	-	60	80	20	71	0	57	-	0	29/31
07	**80**	-	-	-	80	-	50	25	100	75	75	32/32
Chrysothamnus viscidiflorus viscidiflorus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	11/15
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
89	**3199**	-	533	2400	266	-	0	0	8	2	6	7/8
97	**240**	20	100	140	-	40	0	0	0	-	0	5/3
02	**1320**	-	280	960	80	-	0	0	6	5	5	4/7
07	**520**	20	20	400	100	-	0	0	19	4	4	7/8
Juniperus osteosperma												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	40	-	-	80	0	0	-	-	0	-/-
02	**160**	-	-	160	-	-	0	0	-	-	0	71/43
07	**160**	-	40	120	-	20	0	0	-	-	0	-/-
Peraphyllum ramosissimum												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	51/64
07	**0**	-	-	-	-	-	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)
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	-	0	100	-	-	0	23/32
02	**20**	-	-	20	-	-	0	100	-	-	0	19/51
07	**0**	-	-	-	-	-	0	0	-	-	0	30/39
Quercus gambelii												
89	**200**	66	200	-	-	-	0	0	0	-	0	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**300**	-	-	300	-	-	53	0	0	-	0	64/36
07	**220**	-	20	160	40	20	0	0	18	18	27	-/-
Symphoricarpos oreophilus												
89	**132**	-	-	66	66	-	0	100	50	-	0	40/34
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	-/-

Trend Study 16A-22-07

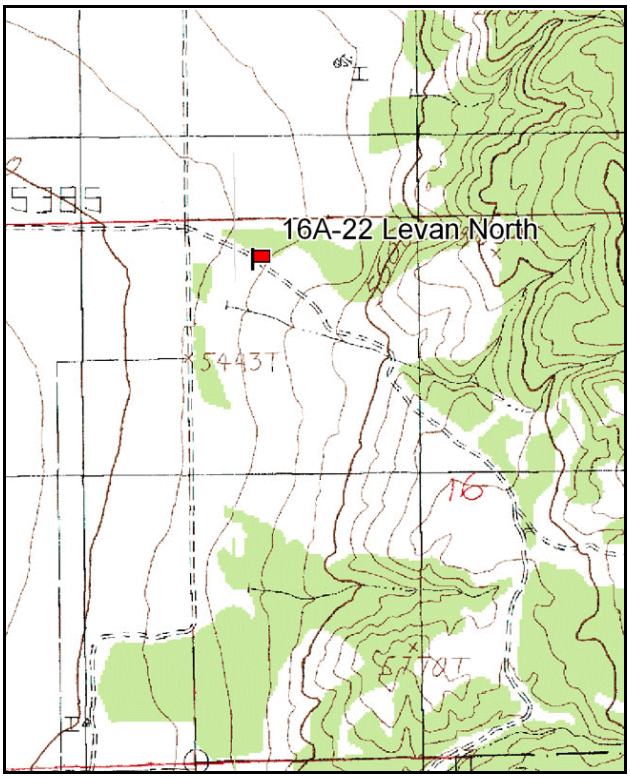
Study site name: Levan North . Vegetation type: P-J/Wyoming Big Sagebrush.

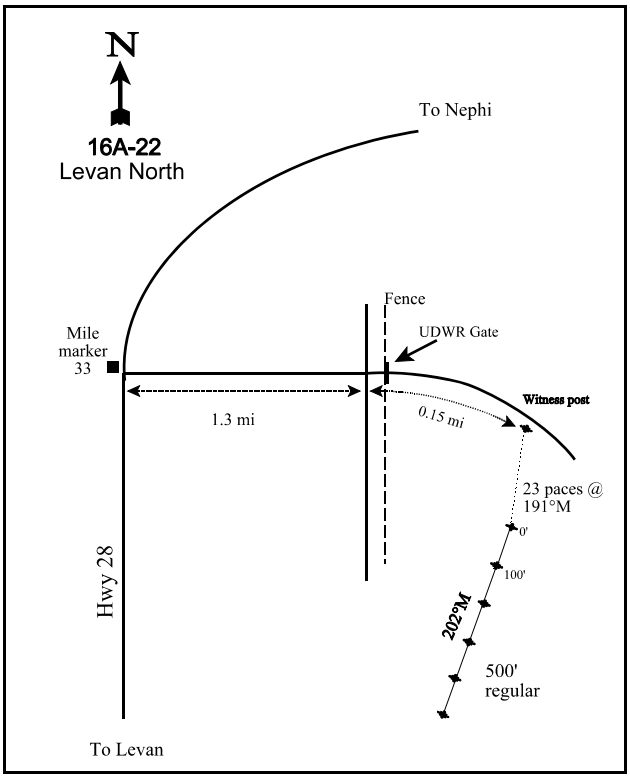
Compass bearing: frequency baseline 202 degrees magnetic.

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

LOCATION DESCRIPTION

From Nephi travel south on Highway 28 and turn left at mile marker 33. Travel east for 1.3 miles; cross a road and a UDWR fence that is immediately after the road. Continue east for 0.15 miles to a witness post on the right. From the witness post the 0-foot baseline stake is 23 paces at 191 degrees magnetic. The 0-stake is marked by browse tag #184.





Map Name: Levan Diagrammatic Sketch

Township 13S , Range 1E , Section 14 GPS: NAD 83, UTM 12S 428445 E 4383802 N

DISCUSSION

Levan North - Trend Study No. 16A-22

Study Information

This study lies 3.4 miles (5.5 km) northeast of Levan within the South Nebo WMA, Levan/Deep Creek Unit. It was established in 2007 to monitor a lop and scatter juniper treatment that took place in the summer of 2007 on an old chaining [elevation: 5,480 feet (1,670 m), slope: 8%, aspect: northwest]. This study was also established to replace the Levan Farm Chaining (16A-16) study. The vegetative composition consists of a mostly decadent stand of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) intermixed with mature Utah juniper (*Juniperus osteosperma*) trees. The area is used by big game as winter range, and grazed by cattle in the summer. Use was estimated at 38 deer days use/acre (93 ddu/ha), 1 elk day use/acre (3 edu/ha), and 12 cattle days use/acre (30 cdu/ha).

Soil

The soil is classified within the Hupp series (USDA-NRCS 2007). The soils in this series are very deep and well-drained, and formed in alluvium from limestone and quartzite. The soil texture is a sandy loam, and the pH is neutral (6.9). Soil phosphorus and potassium are high at 11.9 ppm and 227 ppm, respectively (Tiedemann and Lopez 2004), and soil organic matter is 2.9%. Eighty-three percent of the relative ground cover in 2007 was vegetation and litter, and the soil erosion condition was classified as stable.

Browse

Wyoming big sagebrush provides the majority of the preferred browse. Sagebrush density was 480 plants/acre (1,186 plants/ha), with a canopy cover of only 2%. Eighty-three percent of the sampled plants were decadent, and 75% were classified as dying. The density of dead plants was greater than that of live plants at 1,320 plants/acre (3,262 plants/ha). No young plants were sampled. Almost 80% of the population showed poor vigor, and use was moderate-heavy. Annual leader growth averaged 2.4 inches (6.1 cm).

Antelope bitterbrush (*Purshia tridentata*) and Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) are also present at very low densities. Annual leader growth averaged 3.3 inches (8.3 cm) on bitterbrush and 3 inches (7.6 cm) on cliffrose. Point-centered quarter data estimated juniper density at 38 trees/acre (94 trees/ha). The majority of the sampled trees were over 8 feet (2.4 m) tall, and the average trunk diameter was 8.7 inches (22.1 cm).

Herbaceous Understory

Grasses provided 74% of the total vegetative cover. Total grass cover was 32%. Crested wheatgrass (*Agropyron cristatum*) was the dominant grass and provided 15% cover. Other abundant perennial grasses included bluebunch wheatgrass (*Agropyron spicatum*), Sandberg bluegrass (*Poa secunda*), and bulbous bluegrass (*Poa bulbosa*). Cheatgrass (*Bromus tectorum*) provided almost 30% of the total grass cover.

The forb component of the understory provided little forage, and was dominated by annual species. Total forb cover was 4%. Pale alyssum (*Alyssum alyssoides*) was the most abundant species. Field bindweed (*Convolvulus arvensis*), a noxious weed, was sampled in 9 quadrats and provided 10% of the total forb 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 the majority of the sagebrush plants were decadent and classified as dying. Reproduction was not evident. There was also a high density of dead plants, and most of the live plants that were sampled displayed poor vigor. Perennial grass cover was high, but annual grasses, particularly cheatgrass, provided over 10% average cover. Perennial forb cover was very low at less than 1%, and it was provided mostly by a noxious weed.

winter range condition (DCI) - poor (22) Low potential scale

HERBACEOUS TRENDS --
Management unit 16A, Study no: 22

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron cristatum	276	15.13
G	Agropyron intermedium	14	.25
G	Agropyron spicatum	80	2.43
G	Bromus inermis	1	.03
G	Bromus japonicus (a)	45	.18
G	Bromus tectorum (a)	352	9.49
G	Dactylis glomerata	5	.23
G	Festuca myuros (a)	79	.66
G	Poa bulbosa	54	1.24
G	Poa secunda	109	2.59
Total for Annual Grasses		476	10.34
Total for Perennial Grasses		539	21.93
Total for Grasses		1015	32.27
F	Alyssum alyssoides (a)	302	1.42
F	Astragalus eurekensis	7	.01
F	Camelina microcarpa (a)	4	.00
F	Convolvulus arvensis	29	.39
F	Collinsia parviflora (a)	37	.08
F	Draba sp. (a)	14	.05
F	Erodium cicutarium (a)	58	.42
F	Eriogonum racemosum	1	.00
F	Holosteum umbellatum (a)	140	.83
F	Lactuca serriola	6	.01
F	Leucelene ericoides	9	.07
F	Microsteris gracilis (a)	13	.02
F	Phlox longifolia	2	.00
F	Ranunculus testiculatus (a)	64	.22

Type	Species	Nested Frequency '07	Average Cover % '07
F	Sisymbrium altissimum (a)	1	.00
F	Sphaeralcea coccinea	17	.16
F	Tragopogon dubius	6	.01
Total for Annual Forbs		633	3.06
Total for Perennial Forbs		77	0.67
Total for Forbs		710	3.73

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

BROWSE TRENDS --
Management unit 16A, Study no: 22

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata wyomingensis	20	1.00
B	Chrysothamnus viscidiflorus viscidiflorus	0	-
B	Cowania mexicana stansburiana	0	-
B	Gutierrezia sarothrae	4	.03
B	Juniperus osteosperma	4	6.55
B	Purshia tridentata	1	-
Total for Browse		29	7.59

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 22

Species	Percent Cover '07
Artemisia tridentata wyomingensis	1.79
Gutierrezia sarothrae	.16
Juniperus osteosperma	9.66
Purshia tridentata	.15

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 22

Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	2.4
Cowania mexicana stansburiana	3
Purshia tridentata	3.2

POINT-QUARTER TREE DATA --
Management unit 16A, Study no: 22

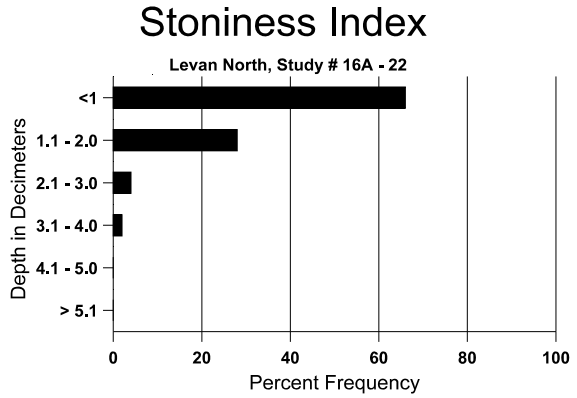
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	38	8.7

BASIC COVER --
Management unit 16A, Study no: 22

Cover Type	Average Cover % '07
Vegetation	45.96
Rock	3.72
Pavement	4.16
Litter	47.31
Cryptogams	2.67
Bare Ground	9.20

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 22, Levan North

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
-	-	6.9	67.2	15.5	17.3	2.9	11.9	227.2	.9



PELLET GROUP DATA --
Management unit 16A, Study no: 22

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	52	-
Elk	5	1 (3)
Deer	23	38 (93)
Cattle	6	12 (30)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 wyomingensis												
07	**480**	-	-	80	400	1320	21	54	83	75	79	26/33
Chrysothamnus viscidiflorus viscidiflorus												
07	**0**	-	-	-	-	-	0	0	-	-	0	9/19
Cowania mexicana stansburiana												
07	**0**	-	-	-	-	-	0	0	-	-	0	63/46
Gutierrezia sarothrae												
07	**80**	-	40	40	-	-	0	0	-	-	0	8/11
Juniperus osteosperma												
07	**80**	-	20	60	-	-	0	0	-	-	0	-/-
Purshia tridentata												
07	**20**	-	-	20	-	-	0	0	-	-	0	27/49

Trend Study 16A-23-07

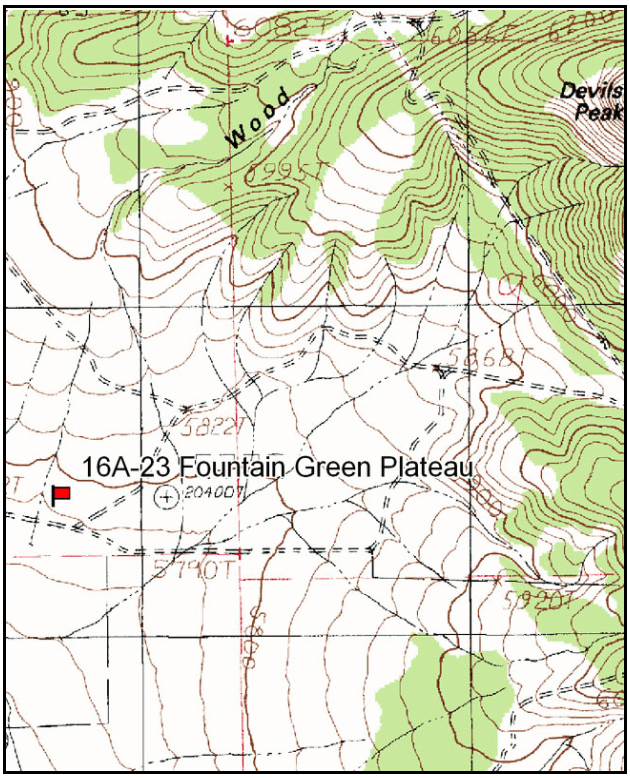
Study site name: Fountain Green Plateau . Vegetation type: Wyoming Big Sagebrush.

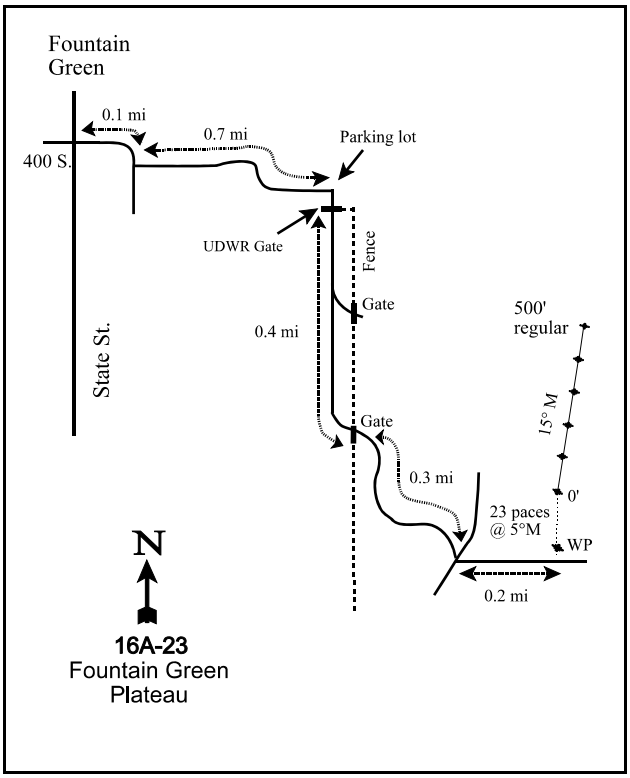
Compass bearing: frequency baseline 15 degrees magnetic.

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

LOCATION DESCRIPTION

From Fountain Green travel south on State St. Turn left on 400 South and travel 0.1 mile to an intersection. Take the left fork and go 0.7 mile to a parking lot in front of a DWR gate. Turning right, go through the gate and travel 0.4 miles to another gate, passing a gate on the side on your way. Go through the gate and go 0.3 mile to an intersection. Turn left and continue east 0.2 mile to a witness post on the left side of the road. From the witness post, the 0-foot baseline stake is 23 paces at 5 degrees magnetic. The 0-stake is marked by browse tag #193.





Map Name: Moroni Diagrammatic Sketch

Township 13S , Range 1E , Section 14 GPS: NAD 83, UTM 12S 447673 E 4384595 N

DISCUSSION

Fountain Green Plateau - Trend Study No. 16A-23

Study Information

This study is located approximately 1.9 miles (3.1 km) southeast of Fountain Green within the North Nebo WMA, Fountain Green Unit [elevation: 5,800 feet (1,768 m), slope: 5%, aspect: southwest]. It was established in 2007 to monitor a Plateau® treatment to eliminate cheatgrass (*Bromus tectorum*). The vegetative cover consists of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) intermixed with a smaller density of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), and a cheatgrass understory. The area is used by deer and elk as wintering habitat, and grazed by sheep in the summer. Use was estimated at 22 deer days use/acre (55 ddu/ha), 1 elk day use/acre (3 edu/ha), and 65 sheep days use/acre (160 sdu/ha). Two deer carcasses were also found.

Soil

The soil is classified within the Snake Hollow series (USDA-NRCS 2007). The soils in this series are very deep, and formed in alluvium from coarse-grained acid and intermediate igneous rocks. The soil texture is a sandy loam, and the pH is neutral (7.0). Soil phosphorus and potassium are high at 12 ppm and 486 ppm, respectively. Soil organic matter is 1.6%. Bare ground is relatively high at 18%, while vegetation and litter provide 78% cover. The soil erosion condition was classified as stable.

Browse

Wyoming big sagebrush is the preferred browse species, and appears to be hybridizing with the few basin big sagebrush plants that are present. Wyoming big sagebrush density was 1,180 plants/acre (2,916 plants/ha). Decadence was high at 68% of the population, and almost half of the sampled plants were classified as dying. The density of dead plants was 1,020 plants/acre (2,520 plants/ha). No young plants were sampled. Fifty-six percent of the population displayed poor vigor, and use was mostly heavy. Annual leader growth averaged 0.9 inches (2.3 cm).

Herbaceous Understory

The understory is dominated by grasses, mostly cheatgrass. This species accounted for 93% of the total grass cover and 80% of the total herbaceous cover. Total grass cover was 29%. Western wheatgrass (*Agropyron smithii*) was also fairly abundant, with a quadrat frequency of 70%.

Total forb cover averaged 5%, but was dominated by annual species. The majority of the forb cover was provided by pale alyssum (*Alyssum alyssoides*) and storksbill (*Erodium cicutarium*). Storksbill has been shown to outcompete and prevent the establishment of native species (Kimball and Schiffman 2003).

2007 PRE-TREATMENT ASSESSMENT

The winter range condition, determined by the Desirable Components Index (DCI), is very poor. Preferred browse cover was low, and the majority of the population was decadent. Approximately half of the sampled plants were classified as dying, and there was a large density of dead plants. There was no indication of sagebrush reproduction. Vigor was poor on most plants, and use was heavy. The average cover of perennial grasses and forbs was low, and the understory was largely dominated by cheatgrass. It appears as though the cheatgrass is preventing the establishment of sagebrush seedlings.

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

HERBACEOUS TRENDS --
Management unit 16A, Study no: 23

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron smithii	202	1.19
G	Agropyron spicatum	10	.27
G	Bromus tectorum (a)	475	27.20
G	Poa secunda	4	.06
G	Secale cereale (a)	11	.09
G	Sitanion hystrix	8	.09
G	Stipa comata	10	.27
G	Vulpia octoflora (a)	3	.00
Total for Annual Grasses		489	27.30
Total for Perennial Grasses		234	1.89
Total for Grasses		723	29.20
F	Alyssum alyssoides (a)	376	2.01
F	Erodium cicutarium (a)	103	1.70
F	Lappula occidentalis (a)	1	.00
F	Ranunculus testiculatus (a)	160	.49
F	Sisymbrium altissimum (a)	2	.03
F	Sphaeralcea coccinea	77	.37
Total for Annual Forbs		642	4.25
Total for Perennial Forbs		77	0.36
Total for Forbs		719	4.61

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

BROWSE TRENDS --
Management unit 16A, Study no: 23

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia tridentata tridentata	1	-
B	Artemisia tridentata wyomingensis	45	3.45
B	Chrysothamnus viscidiflorus	0	-
B	Opuntia sp.	15	1.11
Total for Browse		61	4.55

CANOPY COVER, LINE INTERCEPT --
Management unit 16A, Study no: 23

Species	Percent Cover '07
Artemisia tridentata tridentata	.60
Artemisia tridentata wyomingensis	3.09
Opuntia sp.	.78

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16A, Study no: 23

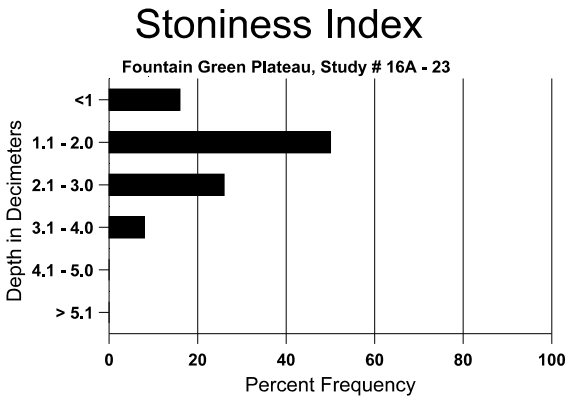
Species	Average leader growth (in) '07
Artemisia tridentata wyomingensis	0.9

BASIC COVER --
Management unit 16A, Study no: 23

Cover Type	Average Cover % '07
Vegetation	42.00
Rock	2.22
Pavement	.47
Litter	44.88
Cryptogams	1.80
Bare Ground	19.69

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 23, Fountain Green Plateau

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
-	-	7.0	56.2	19.8	24	1.6	12.3	486.4	.6



PELLET GROUP DATA --
Management unit 16A, Study no: 23

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Sheep	31	65 (160)
Rabbit	60	-
Elk	5	1 (3)
Deer	26	22 (55)

BROWSE CHARACTERISTICS --
Management unit 16A, 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 tridentata												
07	**20**	-	-	-	20	-	0	100	100	-	0	55/60
Artemisia tridentata wyomingensis												
07	**1180**	-	-	380	800	1020	12	86	68	49	56	28/39
Chrysothamnus viscidiflorus												
07	**0**	-	-	-	-	-	0	0	-	-	0	21/49
Opuntia sp.												
07	**440**	-	-	400	40	-	0	0	9	-	0	8/20

SUMMARY

WILDLIFE MANAGEMENT SUBUNIT 16A - NEBO

Community Types

Nineteen studies were resampled and two studies were established in 2007. Five studies were dominated by mixed oak and sagebrush, three by Stansbury cliffrose, three by pinyon-juniper, two by mountain brush, two by mountain big sagebrush, two by basin big sagebrush, two by Wyoming big sagebrush, one by bitterbrush, and one by true mountain mahogany.

Precipitation

Vegetation trends are dependent upon annual and spring precipitation patterns. Precipitation data for this subunit were compiled from the Nephi, Levan, and Santaquin weather stations (Figures 1 and 2). The subunit annual precipitation average was below normal in 1987-1989, 1991, 1992, 1999, and 2001-2004, and was below 75% of normal (drought conditions) in 1989 and 2002 (Figure 1). Spring precipitation was below normal in 1985, 1987, 1989, 1990, 1992, 1994, 1997, 2000-2004, and 2007, and was near or below 75% of normal in 1989, 1992, 2002, 2004, and 2007 (Figure 2). Spring precipitation is essential for the recruitment of browse seedlings and the establishment of native perennial grasses and forbs. Fall precipitation was below 50% of normal in 1995 and 1999 (Figure 2).

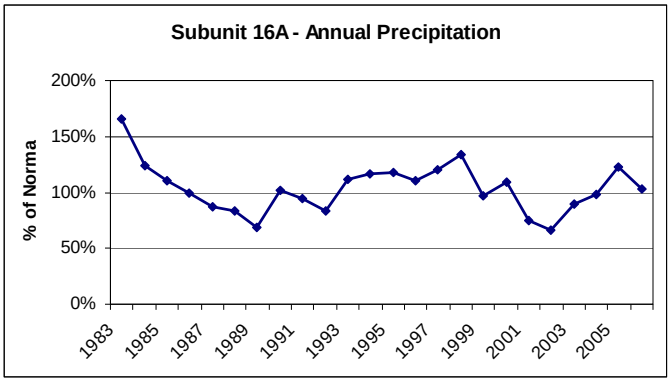


Figure 1. Annual Precipitation for subunit 16A. Precipitation data were collected at the Nephi, Levan, and Santaquin weather stations (Utah Climate Summaries 2007).

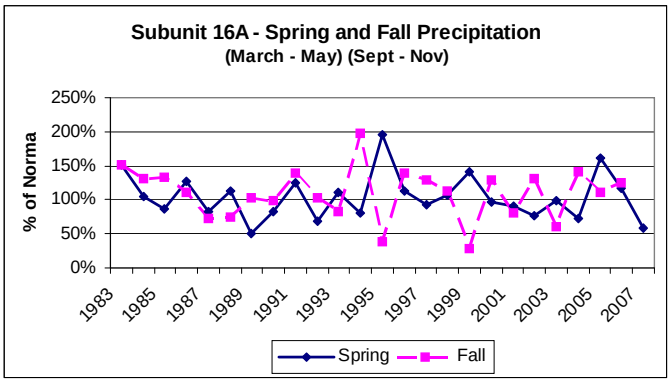


Figure 2. Spring and fall precipitation for subunit 16A. Precipitation data were collected at the Nephi, Levan, and Santaquin weather stations (Utah Climate Summaries 2007).

Browse

The average browse trend decreased from 1983 to 1989, remained relatively stable between 1989 and 2002, and decreased from 2002 to 2007 (Figure 3). Mountain big sagebrush was sampled on most studies, while basin big sagebrush was only sampled on Nebo Creek (16A-5), Big Hollow (16A-14), and Levan Farm Chaining (16A-16). The densities of both these species remained relatively stable from 1997 to 2002, then declined from 2002 to 2007 (Figure 4). Black sagebrush was only sampled on one study, Birch Creek (16A-9), and decreased from 1997 to 2002, then increased from 2002 to 2007. Wyoming big sagebrush was only sampled in 2007 on Levan North (16A-22) and Fountain Green Plateau (16A-23). Mountain big sagebrush cover remained relatively stable from 1997 to 2007, however, basin big sagebrush remained stable between 1997 and 2002, then declined from 2002 to 2007 (Figure 5). Black sagebrush was sampled only in density strips and not quadrats, and therefore cover could not be estimated. Decadence increased between 1997 and 2007 for

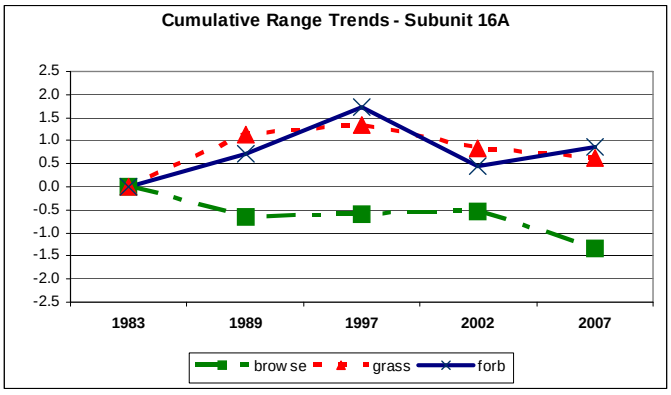


Figure 3. Cumulative range trends for subunit 16A.

mountain big and basin big sagebrush (Figure 6). Black sagebrush decadence was relatively low in 1997, was not sampled in 2002, and was high in 2007. Wyoming big sagebrush decadence was high in 2007 on both studies where it was sampled.

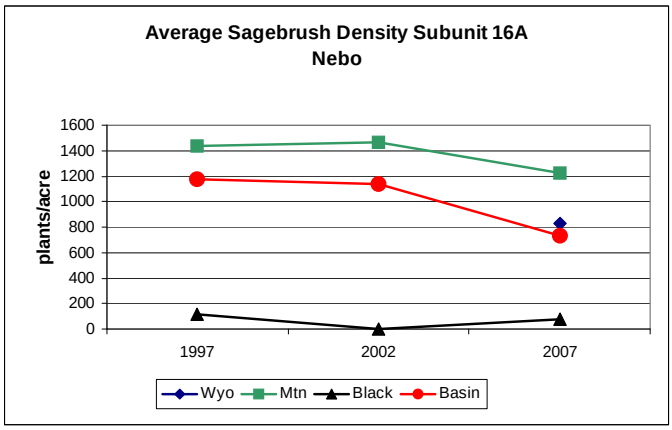


Figure 4. Average Wyoming big, mountain big, basin big, and black sagebrush density for subunit 16A.

Grass

The grass trend increased from 1983 to 1989, remained relatively stable in 1997, decreased from 1997 to 2002, and remained stable in 2007 (Figure 3). Average perennial grass cover slightly decreased from 1997 to 2002, then increased from 2002 to 2007 (Figure 7). However, average cheatgrass cover increased from 5% to 11% between 2002 and 2007. Bulbous bluegrass has been sampled at 12 sites, and its average cover has steadily increased from 2% to 5% since 1997. The average nested frequency of perennial grasses decreased from 1997 to 2002, then slightly increased from 2002 to 2007 (Figure 8). Cheatgrass nested frequency decreased slightly from 1997 to 2002, then increased substantially between 2002 and 2007. The average nested frequency of bulbous bluegrass has steadily increased from 1997 to 2007. Additionally, jointed goatgrass (*Aegilops cylindrica*), a noxious weed, was sampled on three sites.

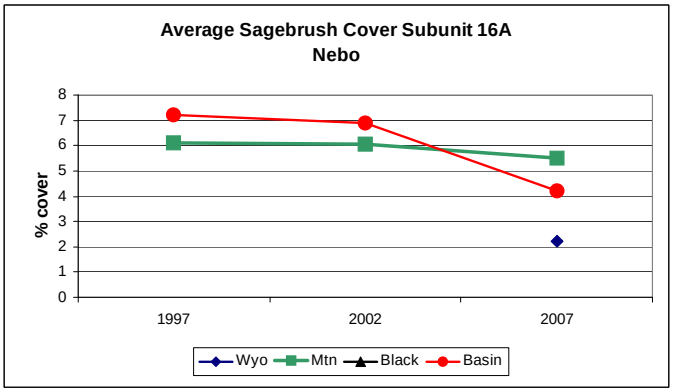


Figure 5. Average Wyoming big, mountain big, and basin big sagebrush cover for subunit 16A.

Forb

The forb trend steadily increased from 1983 to 1997, declined in 2002, and slightly increased in 2007 (Figure 3). The decline of the trend in 2002 may be attributed to drought conditions (Figures 1 and 2). The forb trend was slightly down or down on approximately 90% of the studies in 2002. Average perennial forb cover decreased between 1997 and 2002, then remained relatively stable in 2007 (Figure 7). The average nested frequency of perennial forbs followed the same pattern (Figure 8). Bur buttercup (*Ranunculus testiculatus*) and storksbill (*Erodium cicutarium*), two species that prevent the growth of other species (Buchanan et al. 1978, Kimball and Schiffman 2003), were sampled on 18 and 13 sites, respectively. Additionally, noxious weeds, including field bindweed (*Convolvulus arvensis*), houndstongue (*Cynoglossum officinale*), whitetop (*Cardaria draba*), and blue lettuce (*Lactuca pulchella*), were sampled on seven sites.

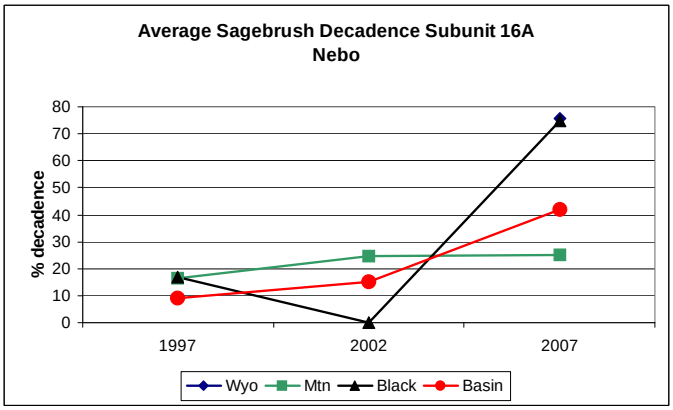


Figure 6. Average Wyoming big, mountain big, basin big, and black sagebrush decadence for subunit 16A.

Desirable Components Index

The subunit Desirable Components Index (DCI) average for mid-level potential studies declined from fair in 1997 to poor in 2002 and 2007 (Figure 9). The decline of the DCI ratings was mainly due to decreases in preferred browse and perennial forb cover, increases in browse decadence and cheatgrass cover, and the

presence of noxious weeds. Low potential studies were only sampled in 2007, but the average DCI rating for these two sites was very poor due to low sagebrush cover with high decadence, high annual grass cover, and the presence of a noxious weed on the Levan North site (16A-22).

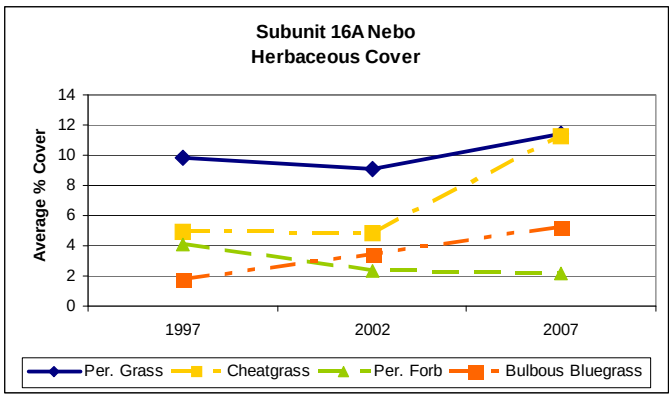


Figure 7. Average herbaceous cover for subunit 16A.

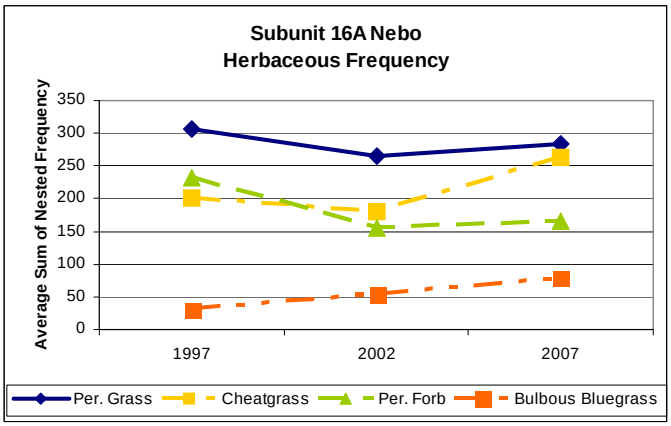


Figure 8. Average herbaceous nested frequency for subunit 16A.

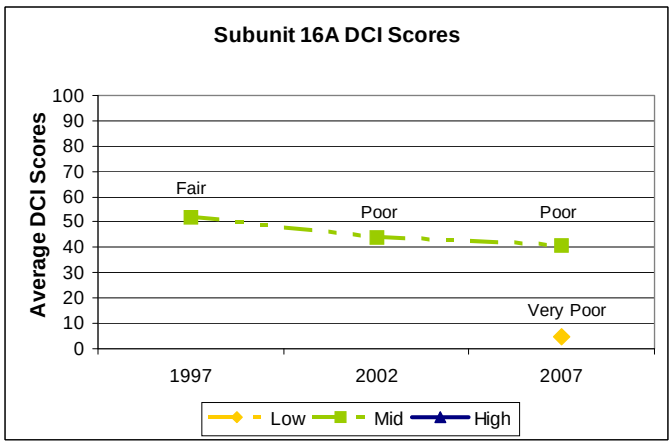
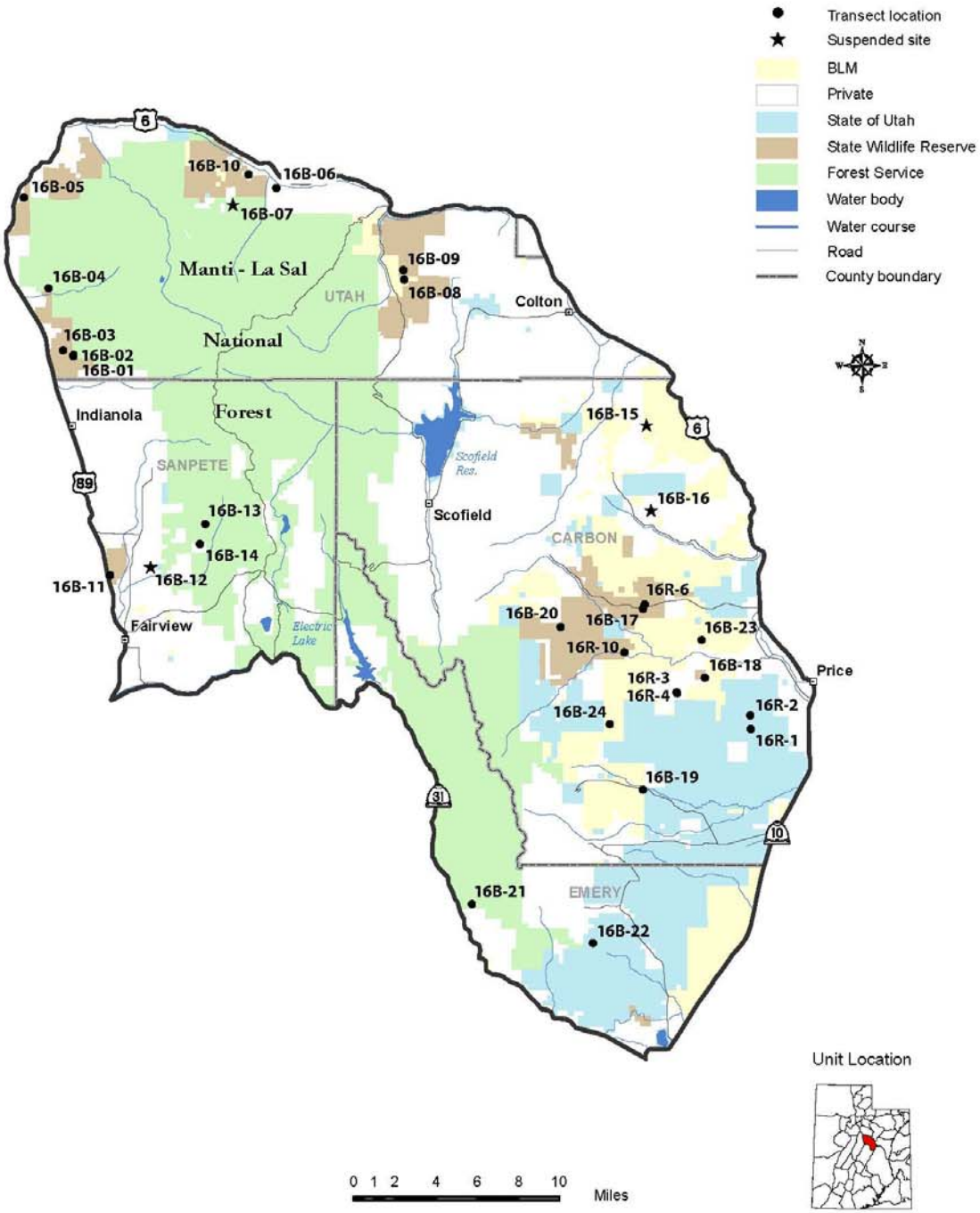


Figure 9. Subunit 16A average Desirable Components Index (DCI) scores by year. The DCI scores are divided into three categories based on ecological potentials, which include low, mid-level, and high.

Management Unit 16B



WILDLIFE MANAGEMENT UNIT 16 - CENTRAL MOUNTAINS

SUBUNIT 16B - CENTRAL MOUNTAINS, MANTI NORTH

Subunit 16B Boundary Description

Utah, Sanpete, Emery, and Carbon counties - Boundary begins at the junction of SR-10 and SR-31 in Huntington; north on SR-10 to US-6; northwest on US-6 to US-89; south on US-89 to SR-31; southeast on SR-31 to Huntington.

Subunit Description

Management Subunit 16B covers both the east and west slopes of the Wasatch Plateau that lie within the above listed subunit boundaries. The western portion of this subunit was monitored in 2007, which includes the area from Soldier Summit west to US-89 and south to Fairview. The east side of this management subunit is monitored as part of the Southeastern Region rotation, last sampled in 2004, and will be sampled again in 2009. The range trend studies in this subunit were established in 1989 and all but two were sampled again in 1997, 2002, and 2007. The exceptions (Starvation Mahogany, 186B-8 and Starvation Mountain Brush, 16B-9) were re-sampled for the first time in 1999 and then again in 2002 and 2007. Studies were selected based on recommendations of local interagency personnel and some were placed on old 1978 line-intercept (LI) studies. The majority monitor winter ranges along US-89 from Spanish Fork Canyon to Fairview and on the southern side of US-6 in Spanish Fork Canyon. Two monitor transitional and summer ranges along Skyline Drive on top of the Wasatch Plateau. Elk are an increasingly important factor in this subunit and thus several studies were established in consideration of the importance of monitoring critical elk habitat.

Winter range availability, condition, and productivity have always been an issue on this important deer herd unit in central Utah. Due to location and access, a large number of hunters use this unit and they continue to contribute an important portion of the yearly statewide deer harvest. The majority of the critical winter range in subunit 16B is found along highway corridors and adjacent to agricultural areas. As a result, two issues facing wildlife managers in this unit are highway mortality and crop depredation. Nearly all of the Division of Wildlife Resources-owned lands in this unit were purchased to try to minimize the effects of these two factors. Habitat management objectives for this unit include working with federal agencies, local governments, and private landowners to achieve long term habitat protection and preservation.

Big Game Management Objectives

The current management objective is to maintain a herd of 38,000 wintering deer for management units 16B and 16C. The estimated herd size has grown from 26,000 deer in 2002 to 32,700 in 2005. The buck:doe ratio has averaged 11.3:100 during the three year period from 2003 to 2005, slightly below the objective of 15 to 20 bucks per 100 does (Hersey and McLaughlin 2006). From 1999 to 2005 the fawn:doe ratio has averaged 66:100.

The current elk management objective is to maintain a winter herd population of 12,000. From 2002 to 2005 the estimated population has ranged from 8,800 to 11,100 (Hersey and McLaughlin 2006).

Trend Study Description

A total of 14 studies were established in the subunit in 1989 and were reread in either 1997 or 1999, 2002 and 2007. Two studies have been suspended since 1989. In 2007, 12 were sampled.

Trend Study 16B-1-07

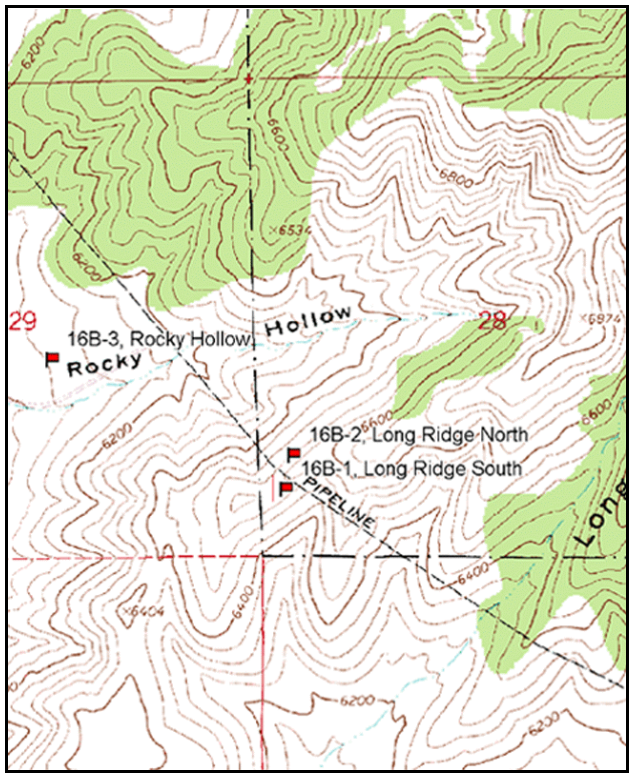
Study site name: Long Ridge South . Vegetation type: Mountain Brush .

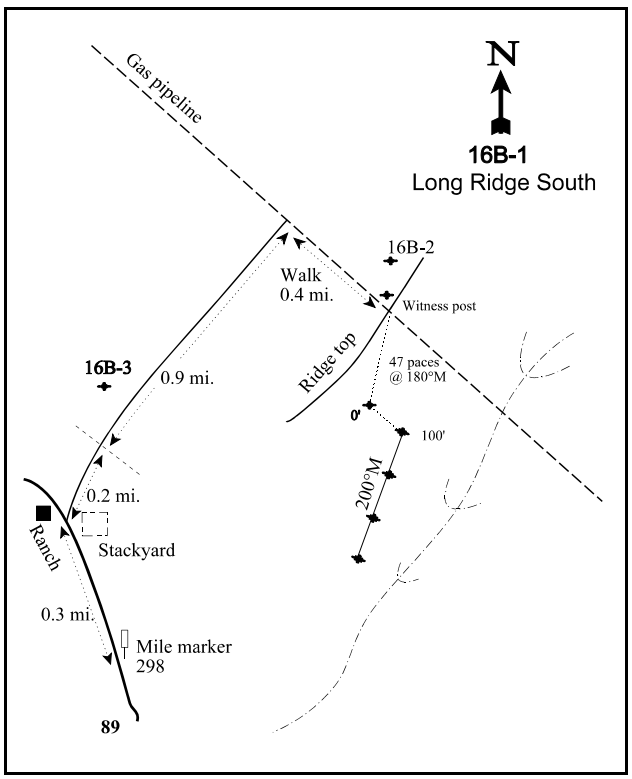
Compass bearing: frequency baseline 120 degrees magnetic (line 2-4 @ 200°M).

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

LOCATION DESCRIPTION

Go north from Fairview on U.S. 89 for approximately 15 miles to a ranch house and stackyard (0.3 miles north of mile marker 298). Turn right, go through a DWR gate into Lassen Draw Property. Go 0.2 miles to another gate/fence. Continue up the road, past transect 16B-3, for about 0.9 miles to a pipeline intersection at the upper end of the valley. Walk 0.4 miles up the steep hill following the pipeline to the top of the first ridge. Stop here at an intersection/witness post. From the southwest corner of the intersection, walk 47 paces at a bearing of 180 degrees magnetic to the 0-foot baseline stake, marked by browse tag #9090.





Map name: Indianola

Diagrammatic Sketch

Township 11S , Range 4E , Section 28

GPS: NAD 83, UTM 12S 458213 E 4408848 N

DISCUSSION

Long Ridge South - Trend Study No. 16B-1

Study Information

This study, along with its companion study, Long Ridge North (16B-2), is located on Division of Wildlife Resources property north of Indianola [elevation: 6,480 feet (1,975 m), slope: 35%-40%, aspect: south]. Both studies are on mountain brush-covered hillsides that are important wintering areas for deer and elk. Thistle Creek is located about 1.5 miles (2.4 km) to the west of the study. An underground natural gas pipeline runs between this study and the Long Ridge North study. From the pellet group transect data, deer use was estimated at 106 days use/acre (261 ddu/ha) in 2002 and decreased to 49 days use/acre (121 ddu/ha) in 2007. Elk use was estimated at 17 days use/acre (41 edu/ha) in 2002 and increased to 29 days use/acre (73 edu/ha). Additionly, cattle use was estimated at 1 day use/acre (2 cdu/ha) in 2007.

Soil

The soil is relatively shallow and very rocky on the surface and throughout the profile. Soil texture is a sandy clay loam with a slightly acidic pH (6.2). The soil is very well drained, but does have moderate erosion and runoff hazard. Erosion is minimized due to the low bare soil cover (less than 5% since 1997) and high vegetation and litter cover. However, the majority of vegetation and litter cover are comprised of annual grasses. The erosion condition was classified as stable in 2002 and 2007.

Browse

This study supports a fair diversity of preferred browse species, including Utah serviceberry (*Amelanchier utahensis*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), and antelope bitterbrush (*Purshia tridentata*). Serviceberry density decreased from 432 plants/acre (1,069 plants/ha) in 1989 to 260 plants/acre (644 plants/ha) by 2002 and 2007. Canopy cover of serviceberry increased from less than 1% in 2002 to 3% in 2007. Prior to 2007, the population was skewed towards mature and decadent plants. The age class distribution shifted in 2007 to a more normal distribution of young, mature, and decadent plants. Decadence has fluctuated during all sample years from a low of 15% in 1989 and 2002, to a high of 47% in 1997. In 2007, decadent plants comprised 23% of the population. The percent of serviceberry plants exhibiting poor vigor was low from 1989 through 2002, but increased to 23% in 2007. Serviceberry were also observed to have smaller live crowns in 2007, although there was dead crown material remaining from previous years. This dead material seems to offer some protection from browsing. Annual leader growth increased from 1.5 inches (3.8 cm) in 2002 to 2.5 inches (6.3 cm) in 2007. Browse use has been to moderate-heavy since 1989, though there was a shift in 2007 to more moderate-light use.

The sampled big sagebrush was classified as mountain big sagebrush. However, some plants exhibit characteristics of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and it appears that the two species have hybridized. Canopy cover was estimated at 2% in 2007. Density was estimated at approximately 800 plants/acre (1,980 plants/ha) in 1989, and has steadily decreased to 480 plants/acre (1,190 plants/ha) in 2007. The largest decrease in density occurred between 2002 and 2007. The proportion of the population that is decadent has steadily increased from 6% in 1997 to 42% in 2007. An increasing percentage of the population has been classified as dying since 1997. Plants with poor vigor increased from 4% in 1989 to 25% in 2007, and the largest increase occurred between 2002 and 2007. The cause for the decrease in plant vigor may be drought stress, understory competition with cheatgrass (*Bromus tectorum*), or damage from the sagebrush defoliator moth (*Aroga websteri*). In 2007, 17% of the sampled sagebrush plants were infested with this moth. Annual growth on sagebrush averaged 1.4 inches (3.5 cm) in 2002 and increased to 2.0 inches (5 cm) in 2007. The plants with moderate-heavy browse use has ranged from a low of 40% of the population in 1997 to 71% in 2007. The individuals displaying the heaviest use are those with the characteristics of mountain big sagebrush.

Canopy cover of antelope bitterbrush was 1% in 2007. It occurs at a low density and has decreased from an estimated 232 plants/acre (574 plants/ha) in 1989 to 120 plants per acre (298 plants/ha) in 2007. Seedling and young plants have never been sampled, which may explain the continually decreasing density. Decadence has fluctuated and was lowest at 27% in 1997 and highest at 86% in 2002. On average, 34% of the bitterbrush have been classified as dying. Bitterbrush displaying poor vigor increased from 27% in 1997 to 43% in 2002, then decreased to 33% in 2007. Mature plants exhibit a tall growth-form that has averaged approximately 4 feet (1.2 m) in height since 1997. Browse use was very heavy in both 1997 and 2002 and was less heavy in 2007.

Stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) provided about 44% of the canoy cover in 2007. It had an estimated density of 2,460 plants/acre (6,090 plants/ha) in 1997, and had decreased to 1,820 plants/acre (4,505 plants/ha) by 2007.

Herbaceous Understory

The herbaceous understory is abundant, but dominated by cheatgrass. Since 1997, cheatgrass has comprised an average of 66% of the total herbaceous cover and has had a quadrat frequency of 100%. Cheatgrass cover increased from approximately 25% in 1997 and 2002 to 33% in 2007. The only common perennial grass is bluebunch wheatgrass (*Agropyron spicatum*). Most of the bluebunch wheatgrass individuals were found either underneath or in close proximity to shrubs and had a moderate amount of seed production. Other perennial species have been sampled, but in low frequencies.

The forb composition is diverse, yet nearly half of the forb cover comes from annual species. Since 1997, both perennial and annual species have comprised an average 3% of the total ground cover. Pale alyssum (*Alyssum alyssoides*) and storksbill (*Erodium cicutarium*) are the most common annual species. The most common perennial species include cudweed sagewort (*Artemisia ludoviciana*), spreading fleabane (*Erigeron divergens*), redroot eriogonum (*Eriogonum racemosum*) and scarlet globemallow (*Sphaeralcea coccinea*).

1997 TREND ASSESSMENT

The browse trend is slightly down. Mountain big sagebrush density declined by 12%, but decadency decreased from 25% to 6% of the population. Serviceberry declined in density and increased in decadence. Bitterbrush was very heavily utilized and had reduced vigor on nearly one-third of the population. Reproduction and recruitment for the preferred browse species were either nonexistent or had decreased. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased 23%. Although bluebunch wheatgrass increased significantly in nested frequency, cheatgrass dominated the understory. Approximately 61% of the herbaceous understory cover was cheatgrass. The forb trend is up. The sum of nested frequency of perennial forbs increased 74%. There was an increase in desirable forbs, including pale agoseris (*Agoseris glauca*), Beckwith milkvetch (*Astragalus beckwithii*), and scarlet globemallow (*Sphaeralcea coccinea*). There was also an abundance of weedy annual forbs. The Desirable Components Index (DCI) score was very poor due to the abundance of annual grasses, moderate preferred browse cover, and elevated shrub decadence.

winter range condition (DCI) - very poor (27) Mid-level potential scale
browse - slightly down (-1) grass - slightly up (+1) forb -up (+2)

2002 TREND ASSESSMENT

The browse trend is slightly down. Utah serviceberry and antelope bitterbrush density decreased 24% and 36%, respectively. Mountain big sagebrush density remained stable. Recruitment was poor or nonexistent for all three preferred browse species, and was likely the result of cheatgrass competition and drought. Decadency and poor vigor increased for both bitterbrush and sagebrush. Trend for the grasses is slightly down. The sum of nested frequency of perennial grasses, specifically bluebunch wheatgrass, changed little. In addition, the nested frequency for cheatgrass increased significantly and Japanese chess (*Bromus japonicus*) was measured

on the study for the first time. The forb trend is down. The sum of nested frequency of perennial forbs decreased 53%, and the number of species decreased from 32 to 18. The DCI score remained very poor.

winter range condition (DCI) - very poor (16) Mid-level potential scale
browse - slightly down (-1) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is slightly down. Average cover declined in all preferred browse species. Plant density declined for mountain big sagebrush and remained nearly stable for antelope bitterbrush and Utah serviceberry. The percentage of plants exhibiting poor vigor increased for sagebrush and serviceberry, but decreased for bitterbrush. Competition from cheatgrass and dry conditions are likely to have increased the susceptibility of sagebrush to the sagebrush defoliator moth. The grass trend is down. The sum of nested frequency of perennial grasses decreased by 20%, including a significant decrease in the nested frequency of bluebunch wheatgrass. Cheatgrass cover increased to 32%, while that of bluebunch wheatgrass decreased to 6%. The forb trend is up. The sum of nested frequency of perennial forbs increased 59%, and account for more cover than annual forbs. Nested frequency of storksbill also increased significantly, and may be out-competing and preventing the establishment of native species (Kimball and Schiffman 2003). The DCI score continued to be very poor.

winter range condition (DCI) - very poor (16) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 1

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{a}$138	$_{bc}$197	$_{c}$226	$_{ab}$182	5.51	8.96	5.85
G	Bromus brizaeformis (a)	-	-	-	4	-	-	.03
G	Bromus japonicus (a)	-	-	$_{b}$62	$_{a}$8	-	.27	.09
G	Bromus tectorum (a)	-	$_{a}$347	$_{b}$377	$_{b}$379	23.89	24.84	33.20
G	Carex sp.	4	-	-	-	-	-	-
G	Poa fendleriana	$_{b}$22	$_{ab}$6	$_{a}$1	$_{a}$2	.09	.00	.00
G	Poa secunda	$_{a}$4	$_{a}$3	$_{a}$5	$_{a}$2	.03	.01	.03
G	Sitanion hystrix	-	4	-	-	.00	-	-
G	Sporobolus cryptandrus	-	1	-	-	.03	-	-
G	Stipa comata	$_{a}$5	$_{a}$1	-	-	.03	-	-
Total for Annual Grasses		0	347	439	391	23.89	25.11	33.34
Total for Perennial Grasses		173	212	232	186	5.70	8.98	5.89
Total for Grasses		173	559	671	577	29.60	34.10	39.23
F	Agoseris glauca	-	$_{a}$16	$_{a}$8	-	.12	.02	-
F	Alyssum alyssoides (a)	-	$_{a}$171	$_{b}$236	$_{b}$207	.88	1.32	1.05
F	Antennaria rosea	-	-	-	3	-	-	.00
F	Artemisia ludoviciana	$_{b}$74	$_{a}$34	$_{a}$44	$_{a}$31	.92	.36	.59

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Astragalus beckwithii	-	$_{a}$24	$_{a}$9	-	.38	.08	-
F	Astragalus convallarius	-	-	-	4	-	-	.06
F	Astragalus utahensis	-	5	-	-	.04	-	-
F	Balsamorhiza sagittata	$_{a}$15	$_{a}$4	$_{a}$6	$_{a}$7	.04	.31	.21
F	Camelina microcarpa (a)	-	$_{b}$52	$_{b}$42	$_{a}$6	1.78	.15	.03
F	Calochortus nuttallii	$_{a}$5	$_{a}$1	$_{a}$1	-	.01	.00	-
F	Cirsium sp.	$_{a}$6	$_{a}$5	-	-	.06	-	-
F	Collomia linearis (a)	-	$_{b}$40	$_{a}$2	-	.26	.00	-
F	Collinsia parviflora (a)	-	$_{a}$8	$_{a}$6	$_{a}$3	.04	.01	.00
F	Crepis acuminata	-	$_{a}$6	$_{a}$2	-	.02	.00	-
F	Cryptantha sp.	-	$_{a}$2	-	$_{a}$5	.03	-	.01
F	Cymopterus sp.	-	2	-	-	.00	-	-
F	Cynoglossum officinale	-	2	-	-	.03	-	-
F	Descurainia pinnata (a)	-	$_{a}$7	$_{a}$2	-	.04	.00	-
F	Draba sp. (a)	-	-	-	4	-	-	.01
F	Epilobium brachycarpum (a)	-	6	-	-	.02	-	-
F	Erodium cicutarium (a)	-	$_{b}$146	$_{a}$76	$_{b}$151	1.39	1.03	1.94
F	Erigeron divergens	-	$_{b}$75	-	$_{a}$47	1.75	-	.96
F	Eriogonum racemosum	$_{a}$10	$_{a}$6	$_{a}$4	$_{b}$54	.03	.01	1.30
F	Haplopappus acaulis	-	4	-	-	.30	-	-
F	Lappula occidentalis (a)	-	6	-	-	.01	-	-
F	Lactuca serriola	-	4	-	-	.02	-	-
F	Lithospermum ruderale	$_{a}$10	$_{a}$11	$_{a}$1	-	.22	.00	-
F	Lomatium dissectum	$_{a}$4	$_{a}$-	-	-	.00	-	-
F	Microsteris gracilis (a)	-	$_{a}$1	$_{a}$6	-	.00	.01	-
F	Phlox longifolia	$_{a}$6	$_{a}$4	$_{a}$4	$_{a}$4	.01	.01	.04
F	Polygonum douglasii (a)	-	3	-	-	.01	-	-
F	Ranunculus testiculatus (a)	-	3	-	-	.00	-	-
F	Sisymbrium altissimum (a)	-	$_{a}$1	-	$_{a}$6	.00	-	.01
F	Sphaeralcea coccinea	$_{a}$14	$_{b}$42	$_{b}$38	$_{ab}$31	.79	.25	.46
F	Tragopogon dubius	-	2	-	-	.00	-	-
F	Viguiera multiflora	-	1	-	-	.01	-	-
Total for Annual Forbs		0	444	370	377	4.46	2.53	3.06
Total for Perennial Forbs		144	250	117	186	4.84	1.07	3.66
Total for Forbs		144	694	487	563	9.30	3.61	6.73

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

BROWSE TRENDS --
Management unit 16B, Study no: 1

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	16	12	13	4.17	2.87	1.86
B	Artemisia tridentata vaseyana	27	23	20	1.82	2.09	.95
B	Chrysothamnus nauseosus albicaulis	1	2	1	-	.00	.38
B	Chrysothamnus viscidiflorus viscidiflorus	46	53	44	7.42	5.16	2.07
B	Gutierrezia sarothrae	12	2	5	.51	-	.00
B	Opuntia sp.	16	16	23	1.27	.86	1.66
B	Purshia tridentata	11	7	6	3.71	2.17	1.22
B	Tetradymia canescens	4	4	4	.03	.31	.21
Total for Browse		133	119	116	18.95	13.49	8.36

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 1

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	.13	2.58
Artemisia tridentata vaseyana	-	2.33
Chrysothamnus nauseosus albicaulis	-	.13
Chrysothamnus viscidiflorus viscidiflorus	-	6.13
Opuntia sp.	-	1.76
Purshia tridentata	-	.93
Tetradymia canescens	-	.18

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 1

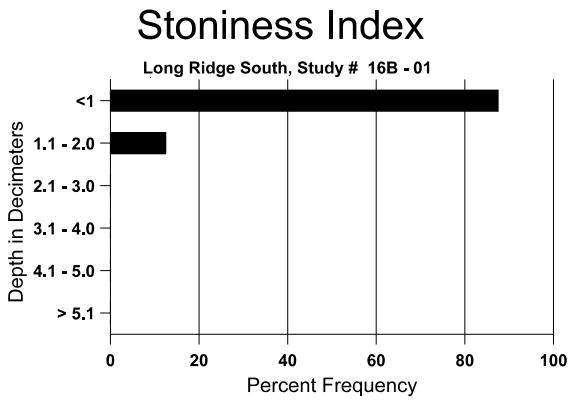
Species	Average leader growth (in)	
	'02	'07
Amelanchier utahensis	1.5	2.5
Artemisia tridentata vaseyana	1.4	2.0

BASIC COVER --
Management unit 16B, Study no: 1

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	6.75	49.93	54.82	52.74
Rock	18.00	15.18	13.60	13.30
Pavement	14.50	2.49	3.69	.66
Litter	52.00	52.19	40.37	46.25
Cryptogams	.25	.40	.03	.05
Bare Ground	8.50	2.52	4.48	2.05

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 01, Long Ridge South

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy Clay Loam			%0M	PPM P	PPM K	dS/m
			%sand	%silt	%clay				
10.2	55.6 (13.1)	6.2	60.7	18.7	20.6	2.7	21.3	217.6	.5



PELLET GROUP DATA --
Management unit 16B, Study no: 1

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	3	11
Elk	19	1	17
Deer	46	30	38
Cattle	-	-	-

Days use per acre (ha)	
'02	'07
-	-
17 (41)	29 (73)
106 (261)	49 (121)
-	1 (2)

BROWSE CHARACTERISTICS --
Management unit 16B, 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)
Amelanchier utahensis												
89	**432**	66	-	366	66	-	0	92	15	-	8	89/45
97	**340**	-	20	160	160	80	18	65	47	6	6	52/46
02	**260**	-	-	220	40	40	8	92	15	8	8	61/53
07	**260**	-	60	140	60	100	46	23	23	23	23	45/44
Artemisia tridentata vaseyana												
89	**799**	-	466	133	200	-	46	17	25	4	4	34/52
97	**700**	-	200	460	40	60	29	11	6	3	3	24/31
02	**680**	100	20	560	100	80	24	38	15	9	9	23/38
07	**480**	-	20	260	200	220	42	29	42	25	25	25/34
Chrysothamnus nauseosus albicaulis												
89	**33**	-	-	33	-	-	0	0	0	-	0	22/19
97	**20**	-	-	20	-	20	0	0	0	-	0	26/32
02	**40**	-	-	20	20	-	100	0	50	-	0	24/24
07	**20**	-	-	20	-	-	0	0	0	-	0	31/36
Chrysothamnus viscidiflorus viscidiflorus												
89	**1199**	-	-	1033	166	-	0	0	14	3	81	12/20
97	**2460**	-	260	2200	-	-	.81	.81	0	-	0	13/24
02	**2240**	-	-	1900	340	20	0	0	15	3	3	11/21
07	**1820**	-	100	1360	360	20	3	3	20	1	4	12/20
Echinocereus sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	7/16
Ephedra nevadensis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	21/26
Gutierrezia sarothrae												
89	**2066**	-	-	1866	200	-	0	0	10	.96	2	11/8
97	**480**	-	-	480	-	20	0	0	0	-	0	10/11
02	**40**	-	-	20	20	160	0	0	50	50	50	4/7
07	**100**	-	20	80	-	-	0	0	0	-	0	10/13

		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)
Opuntia sp.												
89	**799**	-	33	733	33	-	0	0	4	-	4	6/14
97	**440**	-	-	420	20	20	0	0	5	-	0	7/18
02	**520**	-	20	500	-	-	0	0	0	-	0	6/20
07	**1700**	-	20	1680	-	-	0	0	0	-	0	7/21
Pediocactus simpsonii												
89	**33**	-	-	33	-	-	0	0	-	-	0	4/6
97	**0**	-	-	-	-	-	0	0	-	-	0	6/13
02	**0**	-	-	-	-	-	0	0	-	-	0	6/15
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**232**	-	-	166	66	-	57	43	28	-	0	26/43
97	**220**	-	-	160	60	20	9	91	27	27	27	42/63
02	**140**	-	-	20	120	20	0	100	86	43	43	52/65
07	**120**	-	-	60	60	60	33	33	50	33	33	46/53
Tetradymia canescens												
89	**166**	-	-	-	166	-	100	0	100	100	100	-/-
97	**80**	-	20	60	-	-	50	0	0	-	0	12/24
02	**120**	20	-	80	40	20	0	0	33	33	33	10/23
07	**80**	3160	20	60	-	-	0	0	0	-	0	11/24

Trend Study 16B-2-07

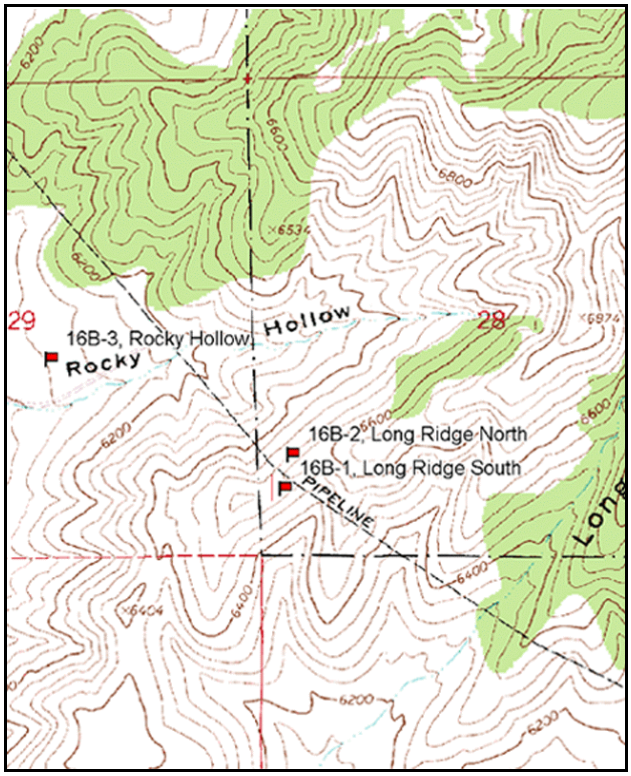
Study site name: Long Ridge North . Vegetation type: Big Sagebrush-Grass .

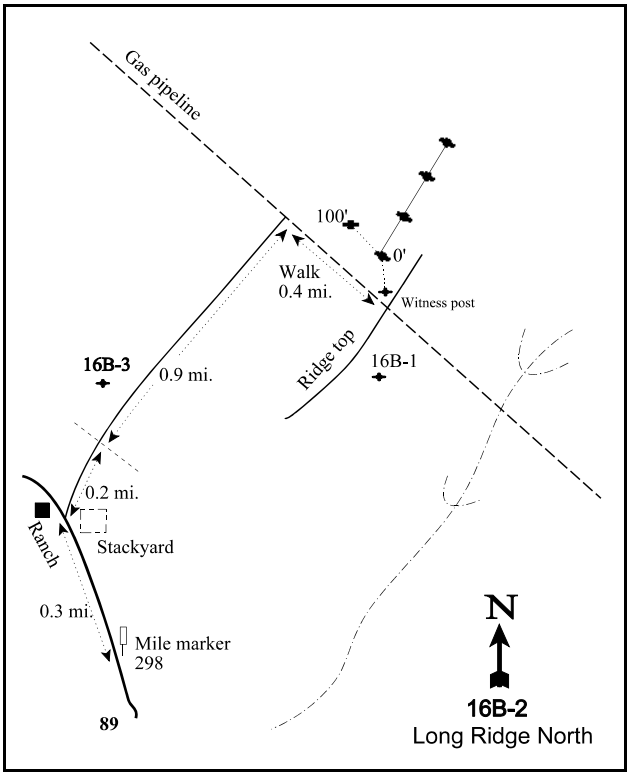
Compass bearing: frequency baseline 310 degrees magnetic (line 2 @ 440°M).

Frequency belt placement: line 1 (11 & 95ft), line 2 (59ft), line 3 (34ft), line 4 (71ft). Rebar: belt 1 on 2 ft, belt 5 on 10 ft, and belt 3 on 1 ft.

LOCATION DESCRIPTION

Go north from Fairview on U.S. 89 for approximately 15 miles to a ranch house and stackyard (0.3 miles north of mile marker 298). Turn right and go through a DWR gate into Lassen Draw property. Go 0.2 miles to another gate/fence. Continue up the road, past transect 16B-3, for about 0.9 miles to a pipeline intersection at the upper end of the valley. Walk 0.4 miles up the steep hill following the pipeline to the top of the first ridge. Stop here at an intersection/witness post. From the witness post, walk 21 paces at 5 degrees magnetic to the 0-foot baseline stake, marked by browse tag #173.





Map Name: Indianola

Diagrammatic Sketch

Township 11S , Range 4E , Section 28

GPS: NAD 83, UTM 12S 458241 E 4408965 N

DISCUSSION

Long Ridge North - Trend Study No. 16B-2

Study Information

This study is on the opposite side of the ridge from Long Ridge South (16B-1) and is on Division of Wildlife Resources land [elevation: 6,500 feet (1,980 m), slope: 25%-35%, aspect: northwest]. The vegetation is characterized as sagebrush/grass type with a few scattered serviceberry. This slope is designated as key big game winter range. Thistle Creek is located about 1.5 miles (2.4 km) to the west. An underground natural gas pipeline runs between this study and Long Ridge South. Both deer and elk use this study, and deer were observed in the area during the 1997 sampling. From the pellet group transect, deer use was estimated at 80 days use/acre (197 ddu/ha) in 2002 and 35 days use/acre (86 ddu/ha) in 2007. Elk use was estimated at 9 days use/acre (23 edu/ha) in 2002 and 19 days use/acre (46 edu/ha) in 2007.

Soil

The soil is similar to those on the nearby Long Ridge South study. Rock and pavement are common on the surface and throughout the profile. The parent material is a mixture of igneous rock and sandstone. Texture is sandy clay loam and pH is neutral (6.9). Organic matter is moderate at 2.8%. There are some microterraces and pedestals present, suggesting that soil movement has occurred. The erosion condition was classified as slight in 2002 and 2007.

Browse

The north side of the ridge supports the same key browse species that are found at Long Ridge South. Utah serviceberry *(Amelanchier utahensis)* and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) are the most common while a small number of antelope bitterbrush (*Purshia tridentata*) seedlings were sampled in 1997 and 2007. The estimated Utah serviceberry density decreased from 666 plants/acre (1,650 plants/ha) in 1989 to 520 plants/acre (1,287 plants/ha) in 1997. In 2002 and 2007, the density was estimated at approximately 400 plants/acre (990 plants/ha). Serviceberry is a small component of the browse community, providing less than 1% of the canopy cover in 2007. Even though seedlings have not been sampled, the population has had good recruitment; young plants have comprised between 24% and 40% of the population. Decadent plants have decreased from 70% of the population in 1989 to 0% in 2007. Concurrently, plants exhibiting poor vigor have decreased from 50% to 0% of the population. The decreases in decadency and poor vigor have occurred along with an increase in moderate-heavy browse use and suggest that some factor other than browsing is causing the decline in density. Mature plants are relatively small averaging only 16 inches in height. Annual leader growth averaged 2.4 inches (6.1 cm) on serviceberry in 2002 and 2.9 inches (7.4 cm) in 2007.

Mountain big sagebrush is much more abundant on this study than on Long Ridge South. In 1989, sagebrush density was estimated at 4,665 plants/acre (11,545 plants/ha). Since 1997, the density has increased from 2,220 plants/acre (5,495 plants/ha) to 2,480 plants/acre (6,138 plants/ha) in 2002, and decreased to 2,100 plants/acre (5,200 plants/ha) in 2007. The decrease in density in 1997 and subsequent years likely resulted from the increased sample area. Decadence declined from a high of 70% of the population in 1989 to 31% in 2002, and increased to 44% in 2007. Recruitment of young plants was poor in both 1989 and 1997, but improved to approximately 10% of the population in 2002 and 2007. Poor vigor was estimated at 18% or less of the population in all years, despite moderate-heavy use. However, since 1997, all plants with poor vigor were classified as dying. Average annual growth on sagebrush grew from 1.9 inches (4.8 cm) in 2002 to 2.1 inches (5.3 cm) in 2007.

Herbaceous Understory

The understory is diverse and is dominated by perennial grasses. Bluebunch wheatgrass (*Agropyron spicatum*), Sandberg bluegrass (*Poa secunda*), and muttongrass (*Poa fendleriana*) are the most abundant

species. Despite drought conditions in 2002 (Utah Climate Summaries 2007), bluebunch wheatgrass remained stable. However, Sandberg bluegrass and muttongrass significantly declined in nested frequency and then rebounded in 2007. Use on perennial grasses has been light each sample year. Cheatgrass (*Bromus tectorum*), although present, has accounted for less than 1% of the total ground cover.

Forb diversity is high and several preferred species are present. The most abundant species are longstalk springparsley (*Cymopterus longipes*), silvery lupine (*Lupinus argenteus*), and the annual forb, pale alyssum (*Alyssum alyssoides*). The drought in 2002 is suspected to be the cause of a large decline in total forb abundance. Sum of nested frequency for total forbs decreased by 45% between 1997 and 2002. Bur buttercup (*Ranunculus testiculatus*) quadrat frequency has steadily increased since 1997 and may have a negative impact on germination and growth of other herbaceous species (Buchanan et al. 1978).

1997 TREND ASSESSMENT

The browse trend is stable. Density decreased for Utah serviceberry and mountain big sagebrush by 22% and 52%, respectively. However, the decrease in density was likely from the change in sample area. There was a decrease in percent decadence for both species. The proportion of plants exhibiting poor vigor decreased for serviceberry and remained nearly stable for sagebrush. It was also noted that the average height and crown measurements nearly doubled, suggesting that the stand consisted of fewer, larger plants. The grass trend is stable. The sum of nested frequency for perennial grasses increased 4%. There was a significant increase in the nested frequency for Sandberg bluegrass and a significant decrease in that of needle-and-thread grass (*Stipa comata*). The forb trend is up. The sum of nested frequency for perennial forbs increased 30% due to a significant increase in the nested frequency of segolily (*Calochortus nuttallii*) and longstalk springparsley. The Desirable Components Index (DCI) score was categorized as fair due to the high perennial grass and forb cover and moderate shrub cover.

winter range condition (DCI) - fair (59) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is stable. Mountain big sagebrush density increased by 12% and recruitment of young plants improved. Percent decadence in the sagebrush population also decreased from 38% to 31%. However, the number of plants exhibiting poor vigor increased from 8% to 15%, and browse use shifted from predominantly light-moderate to moderate-heavy. Utah serviceberry density decreased by 23%, but remained stable in percent decadence and vigor. The trend for grass is down. The sum of nested frequency for perennial grasses declined by 32%, with significant decreases in nested frequencies for muttongrass and Sandberg bluegrass. However, bluebunch wheatgrass cover increased from 7% to 18% and perennial grass cover increased from 14% to 21%. The forb trend is down. Nested frequency for perennial forbs declined by 57%, including a significant decrease in the nested frequencies of five perennial species. The loss of herbaceous species was likely the result of drought. The DCI score remained fair, although there was an increase in shrub recruitment and perennial grass cover.

winter range condition (DCI) - fair-good (63) Mid-level potential scale
browse - stable (0) grass - down (-2) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is slightly down. The density of mountain big sagebrush decreased by 15%, and decadent plants increased from 31% to 44% of the population. The percentage of sagebrush plants with poor vigor remained stable, and those with moderate and heavy use declined. Few flowering heads were observed on sagebrush. Utah serviceberry density increased by 5%, and none of the serviceberry plants sampled were decadent or had poor vigor. The trend for grass is up. The sum of nested frequency for perennial grasses increased by 37%. Sandberg bluegrass, muttongrass, needle-and-thread grass, and cheatgrass all increased

significantly in nested frequency. Although annual grasses increased in nested frequency, they still only account for 1% of the total ground cover. Perennial grasses had moderate seed head production in 2007. The forb trend is slightly up. The nested frequency of several perennial forbs increased significantly, and the sum of nested frequency increased 67%. The sum of nested frequency of annual forbs increased two-fold, but most of the increase was in ecologically neutral species with little forage value. There was also a significant increase in the nested frequency of bur buttercup (*Ranunculus testiculatus*), but it still only accounts for less than 1% of the vegetative cover. Bur buttercup is an allelopathic annual and may limit the germination and seedling growth of desirable plants in the future (Buchanan et al. 1978). Forbs were noted to have good vigor and flower production. The DCI score remained fair due. There was a decrease in shrub cover and an increase in shrub decadence.

winter range condition (DCI) - fair (55) Mid-level potential scale
browse - slightly down (-1) grass - up (+2) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 2

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{ab}$295	$_{ab}$270	$_{b}$281	$_{a}$260	7.18	17.81	11.55
G	Bromus brizaeformis (a)	-	-	-	10	-	-	.02
G	Bromus japonicus (a)	-	-	-	19	-	-	.21
G	Bromus tectorum (a)	-	$_{a}$57	$_{a}$61	$_{b}$142	.46	.17	.86
G	Poa fendleriana	$_{bc}$164	$_{c}$177	$_{a}$68	$_{b}$137	3.37	1.69	4.91
G	Poa secunda	$_{a}$140	$_{c}$192	$_{b}$104	$_{c}$195	3.75	1.10	4.23
G	Sitanion hystrix	-	3	-	-	.00	-	-
G	Stipa comata	$_{c}$49	$_{ab}$29	$_{a}$5	$_{bc}$37	.16	.06	.98
Total for Annual Grasses		0	57	61	171	0.46	0.17	1.10
Total for Perennial Grasses		648	671	458	629	14.47	20.67	21.68
Total for Grasses		648	728	519	800	14.94	20.84	22.78
F	Agoseris glauca	-	$_{b}$49	$_{b}$34	$_{a}$14	.15	.22	.14
F	Alyssum alyssoides (a)	-	$_{a}$29	$_{b}$69	$_{c}$207	.05	.44	1.37
F	Allium sp.	-	3	-	-	.01	-	-
F	Antennaria rosea	$_{a}$20	$_{b}$55	$_{a}$23	$_{a}$22	.70	.59	.30
F	Arabis sp.	$_{c}$51	$_{a}$6	$_{a}$1	$_{b}$28	.01	.00	.14
F	Artemisia ludoviciana	$_{a}$3	$_{a}$3	$_{b}$13	$_{ab}$12	.15	.34	.21
F	Astragalus beckwithii	$_{b}$58	$_{b}$60	$_{a}$4	$_{a}$10	1.51	.03	.07
F	Astragalus convallarius	-	-	-	9	-	-	.24
F	Astragalus utahensis	-	$_{b}$21	$_{ab}$11	$_{a}$10	.51	.22	.08
F	Balsamorhiza sagittata	$_{a}$5	$_{a}$10	$_{a}$1	$_{a}$5	.36	.15	.36
F	Castilleja chromosa	$_{b}$31	$_{a}$8	$_{a}$5	$_{a}$5	.02	.04	.16
F	Calochortus nuttallii	$_{a}$6	$_{b}$101	$_{a}$5	$_{a}$10	.22	.01	.02

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Chaenactis douglasii	$_{a}$2	-	-	$_{a}$3	-	-	.06
F	Cirsium sp.	$_{a}$1	$_{b}$5	-	-	.33	-	-
F	Collomia linearis (a)	-	$_{a}$46	$_{a}$26	$_{a}$37	.10	.06	.09
F	Comandra pallida	-	-	-	10	-	-	.10
F	Collinsia parviflora (a)	-	$_{a}$36	$_{a}$14	$_{b}$62	.27	.03	.38
F	Crepis acuminata	$_{a}$20	$_{a}$24	$_{a}$11	$_{a}$21	.05	.28	.41
F	Cryptantha sp.	$_{b}$47	$_{ab}$22	$_{a}$7	$_{ab}$26	.22	.22	.28
F	Cymopterus longipes	$_{ab}$67	$_{c}$117	$_{a}$56	$_{bc}$91	.75	.15	.42
F	Descurainia pinnata (a)	-	-	-	5	-	-	.01
F	Epilobium brachycarpum (a)	-	$_{a}$1	-	$_{a}$1	.00	-	.00
F	Eriogonum racemosum	$_{b}$64	$_{a}$31	$_{a}$36	$_{ab}$41	.23	.70	.35
F	Eriogonum umbellatum	$_{a}$29	$_{a}$18	$_{a}$29	$_{a}$32	.09	.27	.45
F	Lappula occidentalis (a)	-	$_{a}$5	-	$_{a}$5	.01	-	.01
F	Linum lewisii	$_{a}$1	$_{a}$3	$_{a}$4	$_{a}$5	.01	.01	.01
F	Lithospermum ruderale	$_{a}$8	$_{a}$17	$_{a}$9	$_{a}$13	.42	.26	.40
F	Lupinus argenteus	$_{b}$40	$_{bc}$47	$_{a}$12	$_{c}$67	2.43	.22	1.51
F	Microsteris gracilis (a)	-	$_{a}$12	$_{a}$7	$_{a}$21	.02	.02	.06
F	Phlox longifolia	$_{a}$24	$_{a}$12	$_{a}$10	$_{a}$16	.03	.03	.14
F	Ranunculus testiculatus (a)	-	$_{a}$8	$_{a}$33	$_{b}$170	.02	.06	.89
F	Sphaeralcea coccinea	$_{a}$13	$_{a}$9	$_{a}$7	$_{a}$8	.01	.04	.04
F	Taraxacum officinale	3	-	-	-	-	-	-
F	Tragopogon dubius	-	$_{b}$20	-	$_{a}$5	.04	-	.04
Total for Annual Forbs		0	137	149	508	0.50	0.62	2.82
Total for Perennial Forbs		493	641	278	463	8.31	3.87	5.97
Total for Forbs		493	778	427	971	8.81	4.49	8.80

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

BROWSE TRENDS --
Management unit 16B, Study no: 2

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	18	19	19	.63	.57	.52
B	Artemisia tridentata vaseyana	76	69	71	9.75	9.54	5.90
B	Chrysothamnus viscidiflorus viscidiflorus	41	40	49	2.69	1.49	2.32
B	Gutierrezia sarothrae	19	6	26	.07	.01	.67
B	Mahonia repens	3	3	3	.06	.15	.18
B	Opuntia sp.	15	19	23	.25	.41	.75
B	Purshia tridentata	0	0	0	.00	-	.00
B	Rosa woodsii	1	0	0	-	-	-
B	Symphoricarpos oreophilus	4	0	0	-	-	-
B	Tetradymia canescens	25	21	27	.52	.69	.61
Total for Browse		202	177	218	13.99	12.87	10.98

BROWSE TRENDS--
CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 2

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	-	.15
Artemisia tridentata vaseyana	-	12.66
Chrysothamnus viscidiflorus viscidiflorus	-	3.09
Gutierrezia sarothrae	-	.65
Mahonia repens	-	.13
Opuntia sp.	-	.11
Tetradymia canescens	-	1.03

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 2

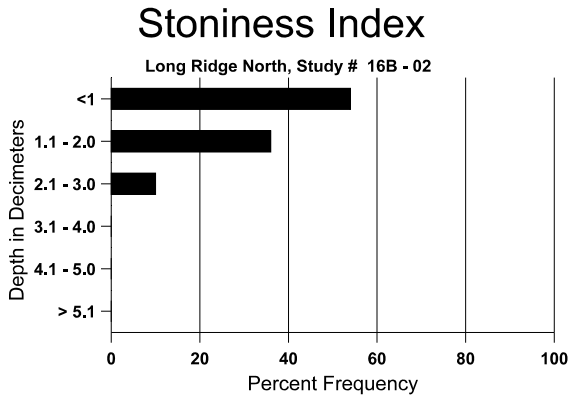
Species	Average leader growth (in)	
	'02	'07
Amelanchier utahensis	2.4	2.9
Artemisia tridentata vaseyana	1.9	2.1

BASIC COVER --
Management unit 16B, Study no: 2

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	13.50	35.95	40.50	43.85
Rock	12.00	9.81	12.97	10.96
Pavement	31.75	10.85	17.20	15.61
Litter	35.75	33.23	26.77	27.77
Cryptogams	.50	.40	.06	.08
Bare Ground	6.50	17.84	10.21	13.31

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 02, Long Ridge North

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.5	50.4 (14.0)	6.9	54.7	19.7	25.6	2.8	13.6	294.4	.6



PELLET GROUP DATA --
Management unit 16B, Study no: 2

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	3	1	10
Elk	29	2	21
Deer	41	30	46

Days use per acre (ha)	
'02	'07
-	-
10 (23)	19 (46)
80 (197)	35 (86)

BROWSE CHARACTERISTICS --
Management unit 16B, 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 utahensis												
89	**666**	-	200	-	466	-	30	30	70	33	50	-/-
97	**520**	-	160	300	60	40	8	31	12	4	4	15/22
02	**400**	-	160	200	40	-	20	25	10	5	5	16/19
07	**420**	-	100	320	-	-	19	48	0	-	0	18/22
Artemisia tridentata vaseyana												
89	**4665**	66	133	1266	3266	-	46	29	70	6	6	15/16
97	**2220**	20	80	1300	840	580	53	14	38	8	8	26/33
02	**2480**	60	280	1440	760	440	27	54	31	15	15	24/31
07	**2100**	120	180	1000	920	760	30	42	44	18	18	22/33
Chrysothamnus viscidiflorus viscidiflorus												
89	**399**	-	133	66	200	-	33	0	50	17	33	7/4
97	**1420**	-	40	1360	20	-	0	0	1	-	0	9/13
02	**1560**	-	120	1320	120	100	0	0	8	3	3	9/14
07	**1860**	-	100	1620	140	20	0	0	8	-	0	10/14
Echinocereus sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	2/4
Gutierrezia sarothrae												
89	**732**	-	-	666	66	-	0	0	9	9	9	10/6
97	**500**	-	-	500	-	-	0	0	0	-	0	6/6
02	**120**	-	20	40	60	140	0	0	50	17	17	6/4
07	**1280**	20	180	940	160	-	0	0	13	3	5	9/10
Mahonia repens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**520**	-	20	500	-	-	0	0	-	-	0	4/4
02	**320**	-	-	320	-	-	0	0	-	-	0	2/2
07	**580**	-	20	560	-	-	0	0	-	-	0	3/6
Opuntia sp.												
89	**399**	200	66	333	-	-	0	0	0	-	0	4/7
97	**380**	-	20	340	20	-	0	0	5	-	0	4/8
02	**400**	20	20	340	40	-	0	0	10	10	10	5/9
07	**540**	-	20	460	60	-	0	0	11	7	7	5/10

		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)
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	20	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	60	-	-	-	-	0	0	-	-	0	-/-
Rosa woodsii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	8/7
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Symphoricarpos oreophilus												
89	**66**	-	66	-	-	-	100	0	-	-	100	-/-
97	**80**	-	20	60	-	-	25	0	-	-	0	3/8
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Tetradymia canescens												
89	**132**	-	66	66	-	-	0	0	0	-	0	6/4
97	**740**	-	80	580	80	-	0	0	11	-	0	9/16
02	**640**	-	80	520	40	-	0	0	6	-	0	8/12
07	**700**	-	120	460	120	-	0	0	17	3	3	9/14

Trend Study 16B-3-07

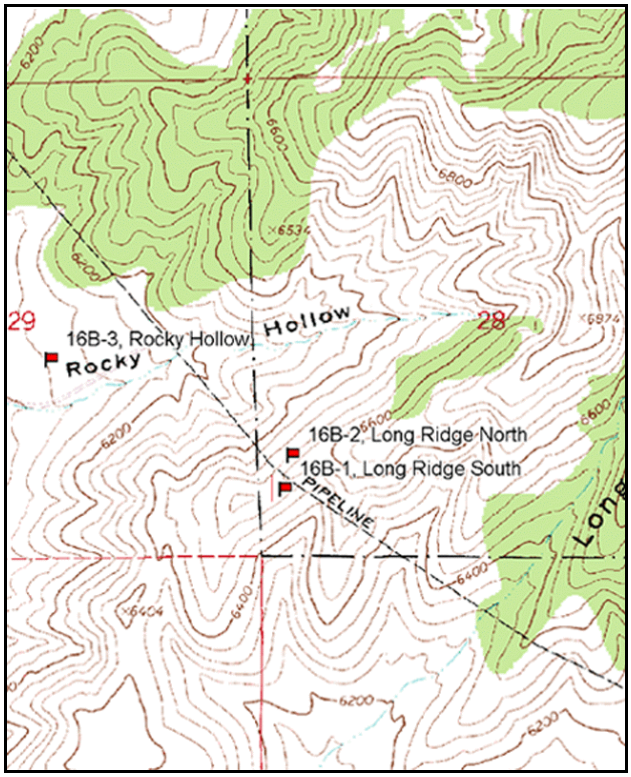
Study site name: Rocky Hollow . Vegetation type: Big Sagebrush-Grass .

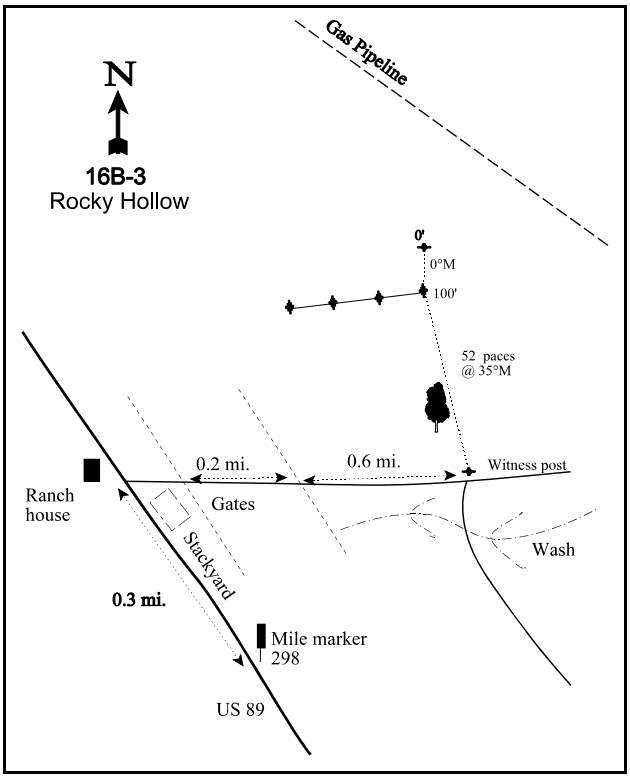
Compass bearing: frequency baseline 180 degrees magnetic (lines 2-4 @ 260°M).

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

LOCATION DESCRIPTION

Go north from Fairview on U.S. 89 for approximately 15 miles to a ranch house and stackyard (0.3 miles north of mile marker 298). Turn right, go through a DWR gate into Lassen Draw property. Go 0.2 miles to another gate/fence. Continue up road another 0.6 miles to a green and white witness post on the left (north) just 3 paces off the road. From the witness post, walk 52 paces at 350 degrees magnetic to the 100-foot baseline stake. The 0-foot stake is marked by browse tag #180.





Map Name: Indianola

Diagrammatic Sketch

Township 11S , Range 4E , Section 29

GPS: NAD 83, UTM 12S 457412 E 4409295 N

DISCUSSION

Rocky Hollow - Trend Study No. 16B-3

Study Information

This study is located about 15 miles north of Fairview on Division of Wildlife Resources property and samples the same area as an old line-intercept transect [elevation: 6,050 feet (1,845 m), slope: 5%, aspect: west]. Big game use has been relatively heavy during winters, especially by mule deer. Thistle Creek is located about 1.0 miles (1.6 km) to the west. Quadrat frequency of deer pellets has ranged from 38% to 51%, and the frequency of elk pellets has ranged from 1% to 22%. From pellet group transect data, there were an estimated 137 deer days use/acre (337 ddu/ha) in 2002 and 107 deer days use/acre (265 ddu/ha) in 2007. No elk pellet groups were sampled in the transect in 2002, but there were an estimated 35 elk days use/acre (86 edu/ha) in 2007. Cattle pats have been observed in all sampling years but they are few in number, apparently from just a few trespassing cattle.

Soil

The soil is classified within the Ant Flat series, a well drained, slowly permeable soil found on terraces and mountain slopes. Soils in this series formed in colluvium, residuum, and alluvium from calcareous sandstone and some quartzite, conglomerate, limestone and shale. These soils are classified as fine, smectitic, frigid Calcic Argixerolls (USDA-NRCS 2007). This soil has a porous surface horizon about 7 inches (17.8 cm) thick. The clay content increases below this depth. A calcareous zone is often located approximately 60 inches (152 cm) below the surface, and limits root penetration. The soil has a clay loam texture with a slightly acidic reaction (pH of 6.1). The soil is extremely compacted and rocky. The erosion condition was classified as stable in 2002 and 2007.

Browse

The key browse consists of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) which appears to be hybridizing with basin big sagebrush *(Artemisia tridentata* ssp. *tridentata*). Sagebrush canopy cover was 15% in 2007. Density was estimated at 2,599 plants/acre (6,433 plants/ha) in 1989 and decreased to 1,440 plants/acre (3,565 plants/ha) by 2007. Some of the decrease in density is likely the result of the increase in sample area beginning in 1997. Reproduction has remained low except in 2002 when seedling density was estimated at 400 seedlings/acre (990 seedlings/ha). However, the small number of young plants observed in 2007 suggest that the 2002 seedlings died. About one-third of the population has been categorized as decadent in all sample years. Plants exhibiting poor vigor have steadily increased from 5% in 1989 to 15% in 2007. Previous to 2002, it was reported that some of the decadency and reduced vigor could be the result of winter injury. In 2007, it was observed that some of the reduced vigor was caused by the sagebrush defoliator moth (*Aroga websteri*); 40% of the sampled sagebrush plants were infested by the moth. Annual leader growth on sagebrush averaged 2 inches (5.1 cm) in 2002 and 2007. Browse use was light to moderate in 1989 and 1997, and shifted towards more heavy use in 2002 and 2007.

Utah serviceberry (*Amelanchier utahensis*) and antelope bitterbrush (*Purshia tridentata*) are present at low densities and offer additional, but limited, forage. Canopy cover of each was less than 1% in 2007. These species will likely remain in low densities in the future as reproduction is nearly absent for both. The most abundant shrub is stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), which has had densities of approximately 2,000 plants/acre (4,950 plants/ha) to 3,000 plants/acre (7,426 plants/ha). The population consists of mostly mature plants. Pricklypear cactus (*Opuntia* sp.) canopy cover was 3% in 2007.

Herbaceous Understory

The herbaceous understory makes up about two-thirds of the vegetative cover and is dominated by annual species. Perennial grasses and forbs are found almost exclusively under the protection of shrub canopies. Since cover data was first collected in 1997, the grass component has averaged 18% of the total ground cover.

Annual grasses, primarily cheatgrass (*Bromus tectorum*), have been sampled in nearly every quadrat since 1997. Cheatgrass has been the dominant grass and cover has averaged 10% since 1997. Bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass (*Poa secunda*) are the most abundant perennial grasses. Collectively, these two species have comprised approximately 7% of the total ground cover since 1997. Bottlebrush squirreltail (*Sitanion hystrix*), needle-and-thread grass (*Stipa comata*), and Indian ricegrass (*Oryzopsis hymenoides*) are present but infrequent.

Perennial and annual forb cover has been approximately 16%. Since 2002, annual species have accounted for more cover than perennial species. Additionally, annuals have had higher nested and quadrat frequencies than perennials since 1997. Annual forbs consist mostly of very small species such as bur buttercup (*Ranunculus testiculatus*), pale alyssum (*Alyssum alyssoides*), and blue-eyed Mary (*Collinsia parviflora*). The most common perennial forbs are American vetch (*Vicia americana*) and scarlet globemallow (*Sphaeralcea coccinea*). Other perennials have been highly inconsistent in nested frequency and/or presence. Since 1997, the nested frequency of annuals has increased steadily, but the nested frequency of perennials has decreased.

1997 TREND ASSESSMENT

The browse trend is slightly down. Mountain big sagebrush density decreased by 35%. Some of the decrease is likely the result of the larger sample area used in 1997. Young plants increased slightly from 3% of the population to 8%. Sagebrush decadence decreased from 38% to 29% of the population. It was also noted that the average crown widths increased 61%, suggesting that the stand consisted of fewer, larger plants. The grass trend is up. The sum of nested frequency of perennial grasses increased, and there was a significant increase in the nested frequency of Sandberg bluegrass. Two new perennial grass species were also measured. Cheatgrass was sampled in 98% of the quadrats. The forb trend is up. The sum of nested frequency for perennial forbs increased more than two-fold. Much of this increase was the result of a significant increase in the nested frequency of American vetch. Additionally longstalk springparsely (*Cymopterus longipes*), Beckwith milkvetch (*Astragalus beckwithii*), and Utah locoweed (*Astragalus utahensis*) were all sampled for the first time. The Desirable Components Index (DCI) score was poor due to high annual grass cover, moderate preferred browse cover, and elevated shrub decadence.

winter range condition (DCI) - poor (43) Mid-level potential scale
browse - slightly down (-1) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is stable. All of the key parameters were stable, including density, reproduction, percent decadence, and vigor. Sagebrush reproductive potential increased ten-fold to 400 seedlings/acre (990 plants/ha). The density of dead plants remained constant at 660 plants/acre (1,634 plants/ha). The grass trend is slightly down. The sum of nested frequency of perennial grasses increased 5%, which would usually correspond to a stable trend. However, Japanese brome (*Bromus japonicus*) was measured for the first time, and was present in 32% of the quadrats and provided 1% cover. The nested frequency significantly increased for bluebunch wheatgrass and decreased for bottlebrush squirreltail. Cheatgrass cover The forb trend is down. The sum of nested frequency of perennial forbs decreased by 39%. There was a significant increase in nested frequency of bur buttercup, an allelopathic annual (Buchanan et al. 1978). Bur buttercup was found in 65% of the quadrats. The DCI score remained poor due to a decrease in perennial grass and forb cover that countered the slight increase in preferred browse cover.

winter range condition (DCI) - poor (41) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is slightly down. Sagebrush density decreased by 10% and cover decreased from 15% to 10%. Sagebrush decadence increased, and both reproduction and the number of dead plants decreased. Vigor

and percentage of plants showing moderate-heavy use remained stable. The grass trend is slightly up. The sum of nested frequency for perennial grasses increased 17% and annuals decreased 19%. There was a significant decrease in the nested frequency of bluebunch wheatgrass and a significant increase in that of Sandberg bluegrass. The decrease in the nested frequency of annuals was caused by the absence of Japanese brome . The forb trend is down. The sum of nested frequency of perennial forbs decreased 32%. The forb composition shifted towards smaller, annual plants. Bur buttercup increased significantly in nested frequency, accounted for 44% of forb cover, and was found in 83% of the quadrats. The DCI score decreased to very poor due to a decrease in preferred browse cover, perennial forb cover, and an increase in annual grass cover.

winter range condition (DCI) - very poor (32) Mid-level potential scale
browse - slightly down (-1) grass - slightly up (+1) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 3

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron smithii	-	2	-	-	.03	-	-
G	Agropyron spicatum	ab80	a63	b101	a65	3.84	4.05	4.61
G	Bromus japonicus (a)	-	-	86	-	-	.50	-
G	Bromus tectorum (a)	-	a328	a319	a327	13.18	6.80	10.16
G	Oryzopsis hymenoides	b15	ab3	a3	a2	.38	.03	.04
G	Poa secunda	a43	b104	b111	c168	3.18	2.15	3.25
G	Sitanion hystrix	ab23	b39	a12	a24	.89	.36	.35
G	Stipa comata	-	a9	a3	a9	.46	.18	.53
Total for Annual Grasses		0	328	405	327	13.18	7.31	10.16
Total for Perennial Grasses		161	220	230	268	8.80	6.80	8.79
Total for Grasses		161	548	635	595	21.98	14.11	18.96
F	Agoseris glauca	-	b15	ab9	a3	.26	.16	.03
F	Alyssum alyssoides (a)	-	a170	c317	b283	.71	6.76	3.03
F	Allium sp.	a13	b61	c84	a9	.20	.30	.01
F	Antennaria rosea	-	3	-	-	.00	-	-
F	Astragalus beckwithii	-	a21	a26	-	.58	.12	-
F	Astragalus utahensis	-	22	-	-	.79	-	-
F	Castilleja linariaefolia	-	b17	a4	-	.21	.00	-
F	Camelina microcarpa (a)	-	a2	a3	a-	.00	.00	.00
F	Cirsium sp.	-	3	-	-	.03	-	-
F	Collomia linearis (a)	-	b46	a15	a7	.11	.03	.01
F	Comandra pallida	3	-	-	-	-	-	-
F	Collinsia parviflora (a)	-	b313	c340	a251	3.76	8.25	1.36
F	Crepis acuminata	a4	a1	a3	-	.00	.00	-
F	Cryptantha sp.	-	-	-	3	-	-	.01

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Cymopterus longipes	-	$_{b}$39	-	$_{a}$14	.08	-	.06
F	Descurainia pinnata (a)	-	-	-	1	-	-	.00
F	Draba sp. (a)	-	-	-	152	-	-	.90
F	Erigeron pumilus	$_{a}$2	-	-	$_{a}$4	-	-	.00
F	Eriogonum racemosum	3	-	-	-	-	-	-
F	Lappula occidentalis (a)	-	-	-	1	-	-	.00
F	Lithospermum ruderale	$_{a}$3	$_{a}$15	$_{a}$10	$_{a}$3	.49	.19	.18
F	Lomatium triternatum	$_{b}$21	$_{a}$3	-	-	.00	-	-
F	Lupinus argenteus	$_{a}$6	$_{a}$6	-	$_{a}$14	.40	-	.19
F	Machaeranthera canescens	4	-	-	-	-	-	-
F	Microsteris gracilis (a)	-	$_{a}$6	$_{b}$26	$_{a}$2	.01	.06	.00
F	Phlox longifolia	$_{a}$1	$_{a}$7	$_{a}$2	$_{a}$3	.01	.01	.04
F	Polygonum douglasii (a)	-	$_{b}$14	$_{a}$1	-	.18	.00	-
F	Ranunculus testiculatus (a)	-	$_{a}$72	$_{b}$215	$_{c}$257	.54	4.22	5.96
F	Sphaeralcea coccinea	$_{a}$51	$_{a}$61	$_{a}$61	$_{a}$53	1.23	.99	1.07
F	Tragopogon dubius	-	$_{a}$5	-	$_{a}$2	.04	-	.00
F	Vicia americana	$_{a}$54	$_{b}$137	$_{a}$53	$_{a}$62	3.19	1.06	.76
Total for Annual Forbs		0	623	917	954	5.32	19.35	11.30
Total for Perennial Forbs		165	416	252	170	7.54	2.85	2.38
Total for Forbs		165	1039	1169	1124	12.87	22.21	13.68

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

BROWSE TRENDS --
Management unit 16B, Study no: 3

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	2	2	2	.03	.03	.15
B	Artemisia tridentata vaseyana	61	58	53	11.59	14.92	9.87
B	Chrysothamnus viscidiflorus viscidiflorus	54	61	51	3.90	2.82	2.35
B	Echinocereus sp.	0	0	1	-	-	-
B	Gutierrezia sarothrae	0	1	1	-	-	-
B	Mahonia repens	0	1	0	-	-	-
B	Opuntia sp.	56	55	61	1.75	2.12	2.09
Total for Browse		173	178	169	17.27	19.90	14.47

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 3

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	-	.41
Artemisia tridentata vaseyana	-	15.33
Chrysothamnus viscidiflorus viscidiflorus	-	3.81
Opuntia sp.	-	3.11

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 3

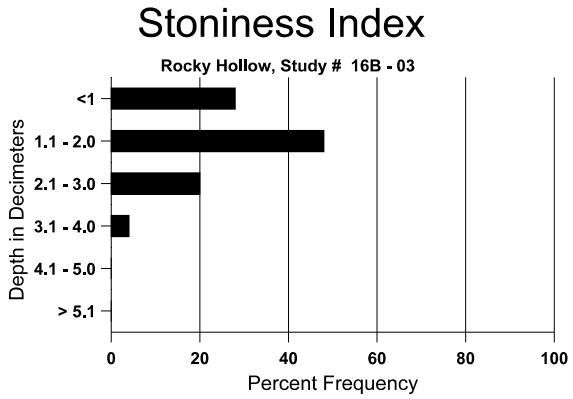
Species	Average leader growth (in)	
	'02	'07
Amelanchier utahensis	3.1	3.6
Artemisia tridentata vaseyana	2.0	1.9
Purshia tridentata	-	1.8

BASIC COVER --
Management unit 16B, Study no: 3

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	10.00	46.29	57.96	48.54
Rock	10.75	7.54	7.44	6.43
Pavement	6.00	.98	2.80	.90
Litter	53.25	37.26	32.64	42.15
Cryptogams	1.75	3.27	4.30	1.87
Bare Ground	18.25	16.51	15.26	15.87

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 03, Rocky Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
15.5	50.4 (15.7)	6.1	54.7	24.7	20.6	1.5	22.8	316.8	.4



PELLET GROUP DATA --
Management unit 16B, Study no: 3

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	5	24	28
Elk	19	1	22
Deer	38	48	51
Cattle	2	1	1
Sheep	-	-	-

Days use per acre (ha)	
'02	'07
-	-
-	35 (86)
137 (337)	107 (365)
1 (2)	-
1 (2)	-

BROWSE CHARACTERISTICS --
Management unit 16B, 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)
Amelanchier utahensis												
89	**199**	66	66	133	-	-	0	67	0	-	33	29/29
97	**40**	-	-	40	-	20	0	100	0	-	0	32/41
02	**40**	-	-	20	20	20	100	0	50	-	0	46/47
07	**40**	-	-	20	20	-	0	100	50	50	50	42/48
Artemisia tridentata vaseyana												
89	**2599**	-	66	1533	1000	-	46	0	38	3	5	32/31
97	**1700**	40	140	1060	500	660	44	0	29	11	11	35/51
02	**1600**	400	80	1040	480	660	41	16	30	14	14	31/39
07	**1440**	40	40	860	540	460	35	18	38	14	15	39/44

		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)
Chrysothamnus viscidiflorus viscidiflorus												
89	**2666**	-	200	2466	-	-	0	0	0	-	15	13/13
97	**2040**	-	40	1960	40	20	0	0	2	.98	2	12/17
02	**2960**	20	120	2300	540	20	.67	0	18	3	3	10/16
07	**2240**	-	40	2020	180	20	3	0	8	2	3	11/17
Echinocereus sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Eriogonum microthecum												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	9/10
Gutierrezia sarothrae												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**60**	-	-	60	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	7/11
Mahonia repens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Opuntia sp.												
89	**1199**	66	266	933	-	-	0	0	0	-	17	6/16
97	**2400**	-	20	2300	80	-	0	0	3	.83	.83	11/17
02	**1620**	-	20	1420	180	-	0	0	11	1	2	6/20
07	**3160**	20	20	2960	180	20	0	0	6	4	4	7/19
Purshia tridentata												
89	**66**	-	66	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	59/70

Trend Study 16B-4-07

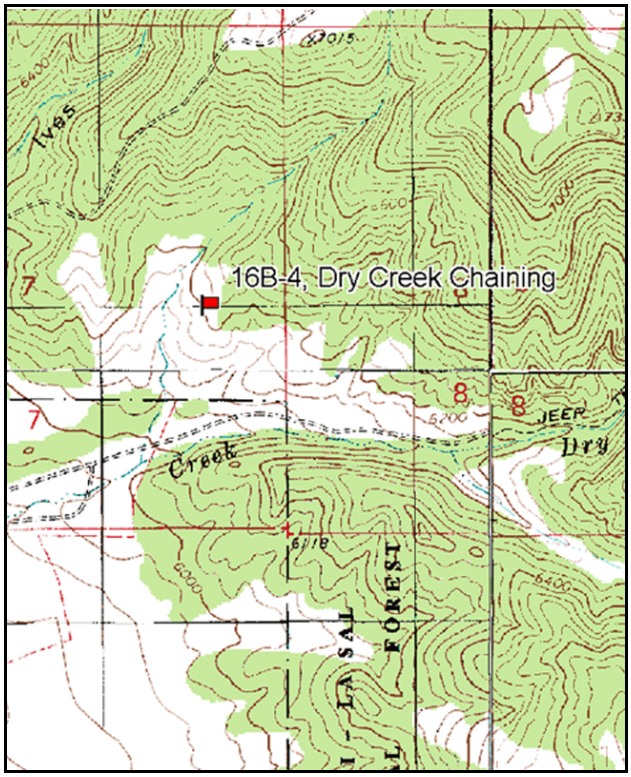
Study site name: Dry Creek Chaining . Vegetation type: Chained, Seeded P-J .

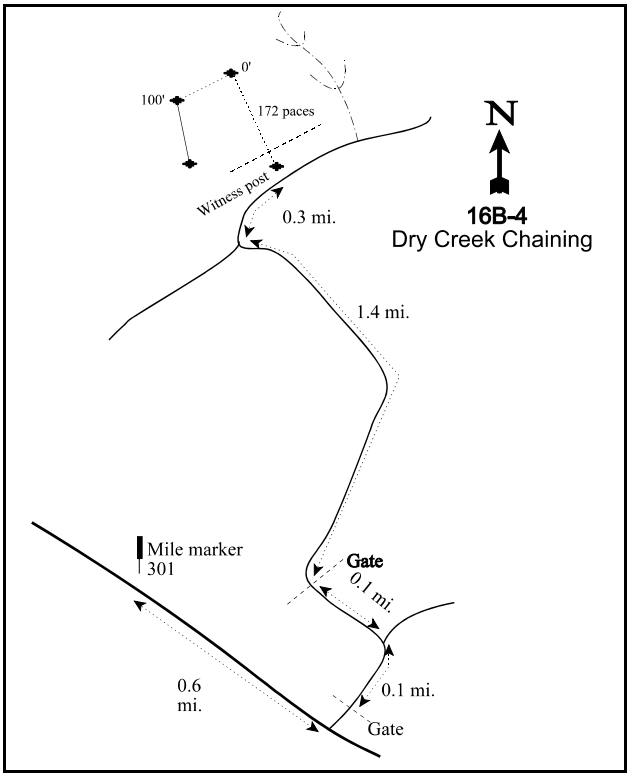
Compass bearing: frequency baseline 229 degrees magnetic (line 2 @ 162°M).

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

LOCATION DESCRIPTION

From mile marker 301 on U.S. 89, go south 0.6 miles to a gate on the left. Go through this gate (east) 0.1 miles to a fork. Stay left and go 0.1 miles through another gate and veer right. Go 1.4 miles to a fork and turn right. Go 0.3 miles to a witness post at a gully on the left. From this post, walk 172 paces north going over a fence about 100 feet from the road to the 0-foot baseline stake marked by browse tag # 188.





Map Name: Spencer Canyon

Diagrammatic Sketch

Township 11S , Range 4E , Section 7

GPS: NAD 83, UTM 12S 456266 E 4414177 N

DISCUSSION

Dry Creek Chaining - Trend Study No. 16B-4

Study Information

This winter range study was established in 1989 on an old pinyon-juniper chaining on Forest Service land, and is near the site of a 1978 line-intercept transect [elevation: 6,200 feet (1,890 m), slope: 20%, aspect: southwest]. Thistle Creek and a large pond are about 1.5 mile (2.4 km) to the west, though water may potentially be found closer in one of two nearby ephemeral streams. Big game use of the area has been moderately low. Other than a moderately small stand of true mountain mahogany (*Cercocarpus montanus*), very little preferred browse is growing within the chaining. As a result, the carrying capacity for wintering big game is limited. From the pellet group transect data, there were an estimated 11 deer days use/acre (28 ddu/ha) in 2002 and 5 deer days use/acre (13 edu/ha) in 2007. Elk use was estimated at 34 days use/acre (84 edu/ha) in 2002 and 25 days use/acre (61 edu/ha) in 2007. About half of the deer and elk pellet groups appeared to be from spring use in 2002. Rabbit pellets have been sampled in 20%-30% of the quadrats.

Soil

The soil is shallow, rocky, and has a clay loam texture. Percent organic matter is relatively high at 3.2% and the soil is neutral in reactivity (pH of 7.3). The relative litter cover has accounted for an average 40% of the total ground cover since 1989. There is evidence of some sheet erosion and sedimentation buildup in nearby gullies from past erosion events. The erosion condition was classified as stable in 2002. In 2007, the erosion condition increased to moderate as a result of litter, pavement, and soil movement, and the presence of rills.

Browse

The overstory is composed of pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), and Gambel oak (*Quercus gambelii*). The most important browse species is true mountain mahogany. Antelope bitterbrush (*Purshia tridentata*) is also present, but occurs at approximately one-half the density of mahogany. Gambel oak has a higher density than either mahogany or bitterbrush, but is less preferred and has a lower forage value. Canopy cover of mahogany has been consistent at 6%, and density has been estimated at 400 plants/acre (990 plants/ha) since 2002. Young plants have consistently comprised 10% or less of the population. The decadent portion of the population has been more variable. Decadent plants comprised 42% of the population in 1989, 0% in 1997, 50% in 2002, and 25% in 2007. The proportion of plants exhibiting poor vigor has followed a similar pattern. Eleven percent of the population had poor vigor in 1989, 0% in 1997, 20% in 2002, and 15% in 2007. Annual leader growth averaged only 1.8 inches (4.6 cm) in 2002 and 1.3 inches (3.4 cm) in 2007. It was noted that short leader growth may have caused an overestimation in browse use in 2002. Mahogany use was light-moderate in all sample years except 2002 when 60% of the plants had having heavy use.

Canopy cover of bitterbrush increased from 1% in 2002 to 3% in 2007. The estimated density declined from 360 plants/acre (890 plants/ha) in 1997 to 240 plants/acre (594 plants/ha) in 2002, and remained stable in 2007. Most of the decline was from the loss of young plants, and was likely the result of drought (Utah Climate Summaries 2007). Low reproduction often accompanies drought and so this decline is not surprising. Gambel oak density was estimated at 4,300 stems/acre (10,640 stems/ha) in 1989, most of which were classified as young. During subsequent sample years, a much larger, more representative area was sampled and oak density was estimated to be much lower. In 2007, oak density was estimated at 860 stems/acre (2,130 stems/ha). The percentage of plants exhibiting poor vigor has ranged from 0% to 14%. Browse use on oak remained low until 2007 when heavy use was observed on 28% of the plants.

Broom snakeweed (*Gutierrezia sarothrae*) and pricklypear cactus (*Opuntia* sp.) were common in more open areas near the baseline in 1997, although they were not sampled in the 1989 density plots. Since 1997, snakeweed density has ranged from 120 plants/acre (297 plants/ha) to 2,060 plants/acre (5,100 plants/ha).

Changes in snakeweed density coincide with variations in precipitation (Utah Climate Summaries 2007).

The canopy cover of Utah juniper decreased from 13% in 2002 to 11% in 2007. The population density was consistent at 96 to 99 trees/acre (238 to 245 trees/ha) from 1989 through 2002. In 2007, juniper density decreased to 87 trees/acre (215 trees/ha). The average trunk diameter increased from 3.7 inches (9.4 cm) in 1997 to 7.3 inches (18.5 cm) in 2007. The canopy cover of pinyon pine increased from 7% in 2002 to 9% in 2007. The density of pinyon pine has been more variable. In 1989, there were an estimated 87 trees/acre (215 trees/ha). The density decreased to 65 trees/acre (161 trees/ha) in 1997, and increased to 120 trees/acre (297 trees/ha) in 2002. In 2007, the density decreased to 64 trees/acre (158 trees/ha). Pinyon pine trunk diameter was 6.5 inches (16.5 cm) in 1997, 3.2 inches (8.1 cm) in 2002 and 4.3 inches (10.9 cm) in 2007. The increase in pinyon density and decrease in trunk diameter in 2002 suggest that the young trees had been recruited into the population. For both species, the populations consisted of fewer, larger trees in 2007.

Herbaceous Understory

The herbaceous understory makes up approximately one-third of the vegetation cover. Cover of perennial grasses decreased from 6% in 1997 to 3% in 2002, then increased to 4% in 2007. Perennial grasses are diverse but have steadily declined in the sum of nested frequency since the initial reading in 1989. This decline could be attributed, at least in part, to the increasing pinyon-juniper component in the community. The most common perennial grass species are crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), Sandberg bluegrass (*Poa secunda*). Of these three, intermediate wheatgrass is the dominant species and has comprised an average 3% cover since 1997. Quadrat frequency of intermediate wheatgrass decreased from 57% in 1989 to 24% by 2007. Cheatgrass (*Bromus tectorum*) is moderately abundant and has been found in 39% to 48% of the quadrats since 1997. Cheatgrass cover has not exceeded 2% in any sample year.

Forb species are diverse but infrequent, and are not a significant component of the vegetation. Perennial and annual forb cover have provided approximately 5% cover since 1997. Rock goldenrod (*Petradoria pumila*) is the most abundant perennial forb and accounts for the majority of forb cover. Bur buttercup (*Ranunculus testiculatus*), an allelopathic annual (Buchanan et al. 1978), has steadily increased in quadrat frequency each sample year, but has not comprised more than 1% of the total ground cover.

1997 TREND ASSESSMENT

The browse trend is stable. True mountain mahogany density decreased 43%, though some of the decrease appears to be the result of the larger area sampled beginning in 1997. Mahogany decadency decreased from 42% to 0%, and the proportion of plants exhibiting poor vigor decreased from 11% to 0% of the population. Antelope bitterbrush density increased eleven-fold, but this increase is likely to be the result of the increased sample area, as well. Browse use on bitterbrush shifted from light to moderate-heavy. The grass trend is down. The sum of nested frequency of perennial grasses decreased 29%. There were significant decreases in the nested frequencies of intermediate wheatgrass, smooth brome (*Bromus inermis*), and a sedge species (*Carex* sp.). The nested frequency of Sandberg bluegrass increased significantly. The forb trend is slightly up. Even though the sum of nested frequency increased 43%, forbs are still infrequent and account for a small proportion of vegetation cover. Additionally, the species that were present have a low forage value. The Desirable Components Index (DCI) score was fair due to the absence of decadent preferred browse species, a moderate percentage of young plants in the browse population, and low annual grass cover.

winter range condition (DCI) - fair (53) Mid-level potential scale
browse - stable (0) grass - down (-2) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is slightly down. Although mahogany density increased 11%, decadence increased from 0% to 50%. The proportion of plants exhibiting poor vigor and classified as dying increased from 0% to 20%.

Additionally, heavily browsed plants increased from 0% to 60% of the mahogany population. The density of bitterbrush decreased 33%. There were no young plants sampled, and decadence increased to 8% of the population. All of the decadent plants were classified as dying. Browse use shifted from light-moderate to moderate-heavy, and heavily browsed plants increased from 28% to 58% of the population However, mahogany can survive extreme browse use (Turley et al. 2003). The trend for grass is down. The sum of nested frequency decreased 25% for perennial grasses, including a significant decrease in the nested frequency of intermediate wheatgrass. The forb trend is slightly down. Even though the sum of nested frequency of perennial forbs decreased 39%, the forb component was relatively small and provided little forage. The DCI score decreased to very poor due to the large increase in preferred browse plants classified as decadent and the loss of more perennial grass cover.

winter range condition (DCI) - very poor (30) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is stable. Density of mahogany and bitterbrush remained constant. Mahogany decadence decreased from 50% to 25% of the population, and the plants with heavy browse use decreased from 60% to 0%. The proportion of mahogany plants exhibiting poor vigor decreased to 15% of the population. Young plants increased to 8% of the bitterbrush population, and heavy browse use decreased to 25%. Otherwise, the bitterbrush population was stable. Heavy browse use was measured on Gambel oak for the first time, and occurred on 28% of the population. Additionally, there was an increase in the percentage of Gambel oak plants with poor vigor, and the increase was likely from frost damage. The grass trend is slightly down. The sum of nested frequency of perennial grasses decreased 14%, and that of annual grasses increased 14%.. There was a significant decrease in the nested frequency of crested wheatgrass. The forb trend is stable. The sum of nested frequency of perennial forbs increased 36%, but they continued to make up a relatively small proportion of the vegetative community. The sum of nested frequency of annual forbs increased two-fold. One-third of this increase was from bur buttercup and the other two-thirds were from species that have little effect on trend. The increase in bur buttercup was significant and was larger than the increase in all of the perennials combined. The DCI score improved to poor due to the increase in young browse plants, although there was still low perennial grass and forb cover.

winter range condition (DCI) - poor (40) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 4

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{ab}$50	$_{b}$51	$_{b}$59	$_{a}$22	.43	.90	.16
G	Agropyron intermedium	$_{c}$171	$_{b}$121	$_{a}$66	$_{a}$60	4.38	1.51	2.14
G	Agropyron smithii	-	-	-	8	-	-	.18
G	Agropyron spicatum	$_{b}$45	$_{ab}$21	$_{ab}$31	$_{a}$15	.44	.48	.57
G	Bromus inermis	$_{b}$71	$_{a}$21	$_{a}$19	$_{a}$27	.47	.21	.46
G	Bromus japonicus (a)	-	-	$_{a}$2	$_{a}$6	-	.00	.01
G	Bromus tectorum (a)	-	$_{a}$121	$_{a}$117	$_{a}$130	1.60	1.82	1.91
G	Carex sp.	$_{b}$19	$_{a}$3	-	-	.15	-	-
G	Oryzopsis hymenoides	$_{b}$19	$_{b}$17	$_{a}$3	$_{ab}$5	.23	.03	.18
G	Poa fendleriana	$_{a}$11	-	$_{a}$8	$_{a}$2	-	.13	.03
G	Poa secunda	$_{a}$6	$_{b}$45	$_{ab}$25	$_{b}$42	.34	.15	.25
G	Sitanion hystrix	$_{a}$11	$_{a}$4	-	-	.03	-	-
Total for Annual Grasses		0	121	119	136	1.60	1.83	1.92
Total for Perennial Grasses		403	283	211	181	6.49	3.44	3.99
Total for Grasses		403	404	330	317	8.09	5.27	5.92
F	Alyssum alyssoides (a)	-	$_{a}$25	$_{b}$138	$_{c}$231	.06	1.58	1.73
F	Aster sp.	-	-	1	-	-	.00	-
F	Balsamorhiza sagittata	$_{a}$2	$_{a}$3	$_{a}$4	$_{a}$2	.24	.60	.33
F	Camelina microcarpa (a)	-	$_{a}$6	$_{a}$4	-	.04	.01	-
F	Calochortus nuttallii	-	6	-	-	.01	-	-
F	Chaenactis douglasii	-	3	-	-	.00	-	-
F	Cirsium sp.	$_{a}$12	$_{a}$13	-	-	.18	-	-
F	Cryptantha sp.	$_{a}$6	$_{a}$17	-	$_{a}$11	.10	-	.08
F	Cymopterus longipes	-	$_{a}$-	-	$_{b}$6	.00	-	.01
F	Descurainia pinnata (a)	-	$_{a}$13	$_{a}$7	$_{a}$9	.03	.01	.01
F	Draba sp. (a)	-	$_{a}$42	-	$_{a}$34	.08	-	.08
F	Epilobium brachycarpum (a)	-	1	-	-	.00	-	-
F	Eriogonum brevicaule	-	-	-	10	-	-	.02
F	Erodium cicutarium (a)	-	$_{a}$2	$_{a}$1	$_{a}$9	.00	.00	.07
F	Eriogonum umbellatum	$_{a}$1	-	$_{a}$5	$_{a}$5	-	.01	.18
F	Gayophytum ramosissimum(a)	-	15	-	-	.03	-	-
F	Gilia sp. (a)	-	-	-	3	-	-	.00
F	Holosteum umbellatum (a)	-	2	-	-	.00	-	-
F	Lappula occidentalis (a)	-	$_{a}$9	-	$_{a}$13	.02	-	.16
F	Lactuca serriola	$_{a}$3	-	$_{a}$2	-	-	.00	-

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Lesquerella sp.	-	-	-	5	-	-	.02
F	Medicago sativa	$_{a}$3	-	$_{a}$1	-	-	.00	-
F	Microsteris gracilis (a)	-	$_{a}$5	$_{a}$3	$_{a}$6	.01	.00	.01
F	Penstemon humilis	$_{a}$7	$_{a}$6	$_{a}$2	-	.18	.03	-
F	Petradoria pumila	$_{a}$43	$_{a}$55	$_{a}$46	$_{a}$60	2.95	1.92	2.30
F	Phlox longifolia	$_{a}$5	$_{a}$16	$_{a}$8	-	.22	.01	-
F	Polygonum douglasii (a)	-	$_{a}$3	$_{a}$1	$_{a}$1	.00	.00	.00
F	Ranunculus testiculatus (a)	-	$_{a}$20	$_{a}$50	$_{b}$109	.04	.18	.90
F	Streptanthus cordatus	$_{a}$1	-	$_{a}$4	-	-	.01	-
F	Unknown forb-annual (a)	-	44	-	-	.09	-	-
Total for Annual Forbs		0	187	204	415	0.42	1.80	2.99
Total for Perennial Forbs		83	119	73	99	3.91	2.61	2.95
Total for Forbs		83	306	277	514	4.34	4.42	5.95

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

BROWSE TRENDS --
Management unit 16B, Study no: 4

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	1	1	1	-	.03	.15
B	Cercocarpus montanus	17	16	15	5.50	4.05	3.05
B	Chrysothamnus nauseosus albicaulis	0	2	1	-	-	-
B	Gutierrezia sarothrae	32	3	20	.98	.00	.53
B	Juniperus osteosperma	6	9	11	3.23	5.64	7.93
B	Opuntia sp.	6	12	13	.18	.30	.21
B	Pinus edulis	3	6	5	3.64	5.24	5.76
B	Purshia tridentata	11	10	10	1.85	1.67	1.78
B	Quercus gambelii	10	13	13	2.11	2.78	2.17
B	Symphoricarpos oreophilus	5	7	9	.62	1.31	1.37
Total for Browse		91	79	98	18.13	21.03	22.98

BROWSE TRENDS--
CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 4

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	.06	.08
Cercocarpus montanus	6.18	6.09
Gutierrezia sarothrae	-	.68
Juniperus osteosperma	12.50	11.06
Opuntia sp.	.05	.06
Pinus edulis	6.61	9.41
Purshia tridentata	1.16	2.71
Quercus gambelii	3.61	2.04
Symphoricarpos oreophilus	2.75	2.71

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 4

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	-	1.3
Cercocarpus montanus	1.8	1.3
Purshia tridentata	1.7	1.5

POINT-QUARTER TREE DATA --
Management unit 16B, Study no: 4

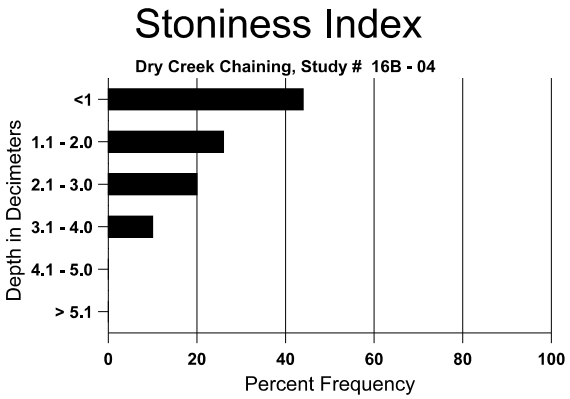
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Juniperus osteosperma	99	87	4.7	7.3
Pinus edulis	120	64	3.2	4.3

BASIC COVER --
Management unit 16B, Study no: 4

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	6.75	28.67	28.29	33.39
Rock	12.50	14.30	14.53	13.53
Pavement	10.25	7.50	7.72	13.73
Litter	57.50	41.10	45.35	35.95
Cryptogams	2.25	4.38	3.63	3.41
Bare Ground	10.75	14.62	25.72	22.22

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 04, Dry Creek Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
11.1	53.0 (15.6)	7.3	34.7	30.7	34.6	3.2	9.2	80.0	.6



PELLET GROUP DATA --
Management unit 16B, Study no: 4

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	20	21	31
Elk	13	13	12
Deer	9	5	2

Days use per acre (ha)	
'02	'07
-	-
34 (84)	25 (61)
11 (28)	5 (13)

BROWSE CHARACTERISTICS --
Management unit 16B, 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												
89	**33**	-	-	33	-	-	0	0	-	-	0	68/23
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	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)
Artemisia tridentata vaseyana												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	0	0	0	-	0	8/9
02	**20**	-	-	-	20	-	0	100	100	100	100	7/12
07	**20**	-	-	-	20	60	0	0	100	100	100	13/24
Cercocarpus montanus												
89	**632**	-	66	300	266	-	26	0	42	11	11	54/40
97	**360**	-	40	320	-	-	17	0	0	-	0	47/49
02	**400**	-	20	180	200	-	20	60	50	20	20	51/56
07	**400**	540	40	260	100	-	30	0	25	15	15	52/57
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	13/16
02	**40**	-	20	-	20	-	0	0	50	-	0	-/-
07	**40**	-	-	40	-	-	0	100	0	-	0	28/27
Chrysothamnus viscidiflorus viscidiflorus												
89	**33**	-	-	-	33	-	0	0	100	100	100	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	16/20
Gutierrezia sarothrae												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**2060**	60	180	1840	40	40	0	0	2	2	2	9/10
02	**120**	-	-	60	60	40	0	0	50	50	50	5/4
07	**1280**	-	20	1180	80	20	0	2	6	3	3	8/9
Juniperus osteosperma												
89	**132**	-	66	66	-	-	0	0	0	-	0	96/47
97	**120**	-	-	120	-	80	0	0	0	-	0	72/61
02	**200**	-	-	200	-	60	0	0	0	-	10	78/47
07	**260**	-	20	220	20	-	0	0	8	-	0	-/-
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**180**	-	-	140	40	20	0	0	22	22	22	5/10
02	**500**	-	20	460	20	-	0	0	4	4	4	5/9
07	**380**	-	-	340	40	-	0	5	11	5	5	6/13

		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)
Pinus edulis												
89	**66**	-	66	-	-	-	0	0	0	-	0	-/-
97	**60**	-	20	40	-	-	0	0	0	-	0	-/-
02	**140**	20	40	100	-	-	0	0	0	-	0	-/-
07	**120**	40	-	100	20	-	0	0	17	-	17	-/-
Purshia tridentata												
89	**33**	-	-	33	-	-	0	0	0	-	0	19/43
97	**360**	-	80	280	-	-	33	28	0	-	0	19/39
02	**240**	-	-	220	20	20	42	58	8	8	8	16/45
07	**240**	-	20	200	20	20	42	25	8	-	8	22/51
Quercus gambelii												
89	**4299**	100	2633	1333	333	-	.77	0	8	-	.77	73/30
97	**600**	20	-	560	40	20	0	0	7	-	0	36/29
02	**920**	-	-	860	60	160	0	0	7	4	4	37/23
07	**860**	20	340	340	180	300	5	28	21	14	14	37/27
Symphoricarpos oreophilus												
89	**33**	-	33	-	-	-	0	0	0	-	0	-/-
97	**220**	-	20	200	-	-	0	0	0	-	0	22/28
02	**260**	-	40	220	-	-	0	0	0	-	0	13/26
07	**720**	-	320	380	20	-	3	3	3	3	3	22/40

Trend Study 16B-5-07

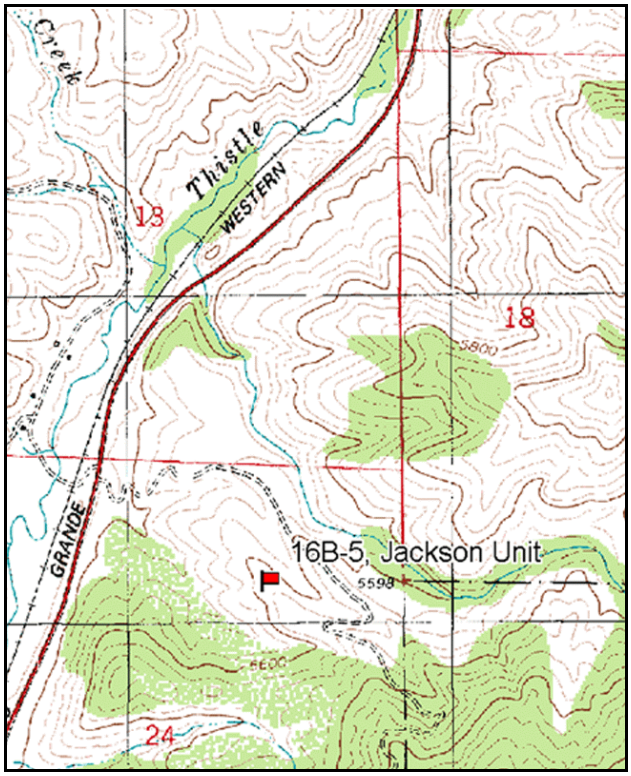
Study site name: Jackson Unit . Vegetation type: Chained, Seeded P-J .

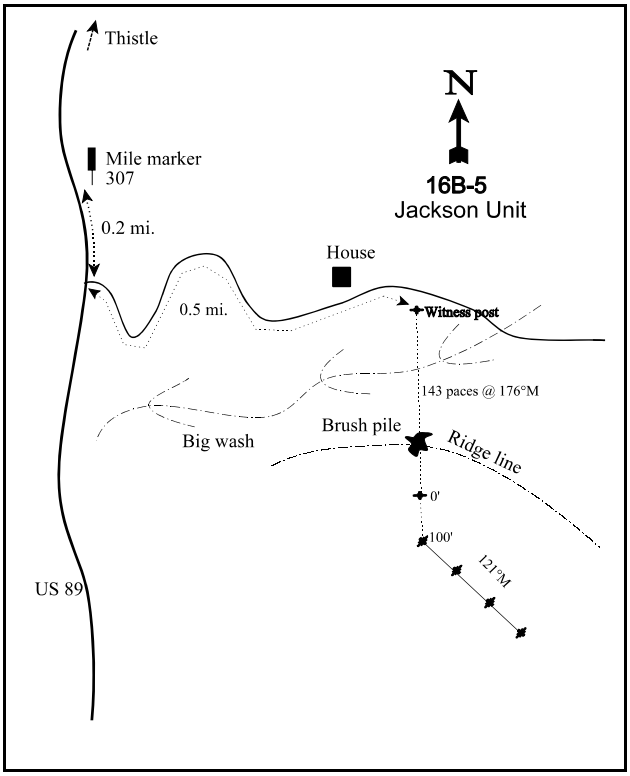
Compass bearing: frequency baseline 181 degrees magnetic (lines 2-4 @ 121°M).

Frequency belt placement: line 1 (11 & 95ft), line 2 (59ft), line 3 (79ft), line 4 (34ft). Rebar: belt 3 on 1ft.

LOCATION DESCRIPTION

From Thistle bridge, proceed south on U.S. 89 until 0.2 miles south of mile marker 307. From here, take a side road east onto a DWR reseeding for 0.5 miles. Stop at a full high witness post. From this post, walk 143 paces at 176 degrees magnetic to the 0-foot baseline stake marked by browse tag #417.





Map Name: Birdseye

Diagrammatic Sketch

Township 10S , Range 3E , Section 24

GPS: NAD 83, UTM 12S 454355 E 4421292 N

DISCUSSION

Jackson Unit - Trend Study No. 16B-5

Study Information

This study monitors a 1972 chaining and seedling north of the town of Birdseye [elevation: 5,600 feet (1,706 m), slope: 28%, aspect: southwest]. An older line-intercept transect is located approximately 360 feet (100 m) to the east. The nearest perennial sources of water are Blind Canyon Creek, which is located 1000 feet (0.3 km) to the northwest, and Thistle Creek, which is located 0.4 miles (0.6 km) to the west. Elk appear to be using the area in moderate numbers in winter and spring. Quadrat frequency of elk pellet groups was moderately high at 36% in 1997, with less sign of deer (quadrat frequency of 14%). The lack of palatable winter browse makes this area less important to deer. From the pellet group transect, deer use was estimated at 10 days use/acre (25 ddu/ha) in 2002 and 8 days use/acre (20 ddu/ha) in 2007. Elk use was estimated at 45 days use/acre (111 edu/ha) in 2002 and 29 days use/acre (71 edu/ha) in 2007. Horse use estimates in 2007 were 41 days use/acre (10 hdu/ha).

Soil

The soil is classified within the Bagard series; a very deep, well-drained, slowly permeable soil on terraces and mountain slopes. Soils in this series formed in colluvium and alluvium from igneous and sedimentary rocks. The surface horizon has a low porosity, and is about 7 inches (17.8 cm) thick, the first two inches (5 cm) being soft and having a granular texture. Below the surface horizon, the soil increases in hardness and becomes more clayey with an angular structure. Rooting depth ranges from 21 inches (53.3 cm) to 50 inches (127 cm) (USDA-NRCS 2007). Specifically on the study, the texture is a sandy clay loam, and the pH is neutral (7.2). Phosphorus is marginally low at only 6.9 ppm, and is slightly above the minimum threshold of 6 ppm that is necessary for normal plant growth and development (Tiedemann and Lopez 2004). Bare ground cover has ranged from 16% to 25%. The erosion condition was assessed as stable in 2002 and decreased to slight in 2007 because of evidence of recent soil movement.

Browse

Utah juniper (*Juniperus osteosperma*) is the dominant overstory vegetation and canopy cover increased from 11% in 2002 to 17% in 2007. Juniper accounts for 81% to 90% of the overstory cover. The density was estimated at 210 trees/acre (520 trees/ha) using the point-centered quarter method in 1997. Most of the trees were in the 4-8 foot (1.2-2.4 m) height class. Juniper density increased slightly to 219 trees/acre (542 trees/ha) in 2002, and trees increased in height. Average diameter was estimated at 5.3 inches (13.5 cm). By 2007, juniper density had decreased to 192 trees/acre (475 trees/ha) and the average diameter increased to 7.3 inches (18.5 cm). The increase in average diameter and line intercept canopy cover indicate that the juniper trees are getting larger and the canopy is closing. This area needs to be treated again to thin the juniper, and increase preferred browse cover. Although the juniper has poor forage value, it does provide good escape and thermal cover for big game.

Very little palatable forage for browsing animals exists here. There are a few basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) plants, and small clumps of young Gambel oak (*Quercus gambelii*) and skunkbush sumac (*Rhus trilobata*) scattered throughout the area. Pricklypear cactus (*Opuntia* sp.) is also common. Reestablishment of shrub populations will be difficult in the future because of intense competition from juniper and seeded perennial grasses.

Herbaceous Understory

Grasses are the prevalent vegetation both on the study and the surrounding hillslope. The understory is composed of a mixture of seeded and native species including crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), needle-and-thread grass (*Stipa comata*), Indian ricegrass (*Oryzopsis hymenoides*), and bluebunch wheatgrass (*Agropyron spicatum*). It was noted in past reports that

grasses had increased and the prevalence of cheatgrass (*Bromus tectorum*) had decreased prior to 1989. This is one of the few reports that makes mention of the presence/abundance of cheatgrass in the line-intercept studies, especially since annuals were not included in the range trend studies until 1992. The grasses receive some light grazing pressure from livestock and elk.

Forbs are sparse and the number of species has steadily decreased since 1989. The seeded species Lewis flax (*Linum lewisii*) and alfalfa (*Medicago sativa*) have not been observed since 1997. Pale alyssum (*Alyssum alyssoides*), an annual, is the most abundant forb species.

1997 TREND ASSESSMENT

The browse trend is stable. Although it appears that the live basin big sagebrush population disappeared, those plants were simply not measured due to the change in sample area. The only sagebrush sampled in 1997 was a dead plant. The grass trend is stable. The sum of nested frequency for perennial grasses increased 6% and sheep fescue (*Festuca ovina*) was measured for the first time. The forb trend is also stable. The nested frequency of perennial forbs was constant, and forbs continued to be a small component of the vegetative cover. The Desirable Components Index (DCI) score rated as very poor due to the absence of preferred browse species.

winter range condition (DCI) - very poor (32) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is stable. Preferred browse remained limited and virtually insignificant. The lack of palatable, abundant browse minimizes the usefulness of this study as a critical deer wintering area. The grass trend is down. There was a 20% decrease in the sum of nested frequency for perennial grasses. Intermediate wheatgrass and sheep fescue (*Festuca ovina*) decreased significantly in nested frequency. Cheatgrass nested frequency remained stable. The forb trend is slightly down. The sum of nested frequency of forbs decreased by 38%. Because forbs made up a very small portion of the vegetative cover, and most of this cover was comprised of pale alyssum, the impact of this decrease on overall forb trend was minimal. The number of sampled perennial forb species decreased from 11 to three. The DCI score remained very poor due to the lack of preferred browse species, and the decline in perennial grass and forb cover.

winter range condition (DCI) - very poor (28) Mid-level potential scale
browse - stable (0) grass - down (-2) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is stable. Preferred browse species continued to be rare, and the few shrubs observed appeared to be in poor health, having few to no flowering stalks. Scattered skunk bush sumac and Gambel oak plants were somewhat hedged and had poor vigor and reproduction. The juniper canopy continued to increase, though it was observed that new growth on some individuals was blackish and very dry. The grass trend is stable. The sum of nested frequency of perennial grasses decreased 4%. Grasses were observed to have little grazing use (wild or domestic). Crested wheatgrass and needle-and-thread grass had good seed production and vigor. The forb trend is stable. Although there was an increase in nested frequency and cover, once again it was mostly attributable to pale alyssum, a small annual with little forage value. The DCI score remained very poor due to the lack of preferred browse species. Retreatment of the juniper component and seeding of preferred browse for big game should be considered in the future.

winter range condition (DCI) - very poor (31) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 5

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{a}$136	$_{a}$133	$_{a}$126	$_{a}$145	3.98	4.24	7.00
G	Agropyron intermedium	$_{b}$91	$_{b}$97	$_{a}$65	$_{a}$28	1.54	.90	.85
G	Agropyron spicatum	$_{a}$41	$_{a}$57	$_{a}$67	$_{a}$64	2.84	2.57	3.64
G	Bromus inermis	4	-	-	-	-	-	-
G	Bromus tectorum (a)	-	$_{a}$103	$_{a}$113	$_{a}$102	.76	.38	.25
G	Elymus junceus	$_{a}$1	$_{a}$1	-	-	.00	-	-
G	Festuca ovina	-	$_{b}$36	$_{a}$17	$_{ab}$32	1.37	.89	1.54
G	Oryzopsis hymenoides	$_{b}$48	$_{ab}$44	$_{ab}$30	$_{a}$23	.95	1.43	.81
G	Poa secunda	$_{a}$2	$_{a}$11	$_{a}$6	$_{a}$15	.07	.04	.47
G	Sitanion hystrix	$_{a}$3	$_{a}$2	-	-	.06	-	-
G	Stipa comata	$_{c}$123	$_{bc}$94	$_{ab}$70	$_{a}$58	3.73	4.02	3.17
Total for Annual Grasses		0	103	113	102	0.76	0.38	0.25
Total for Perennial Grasses		449	475	381	365	14.58	14.12	17.51
Total for Grasses		449	578	494	467	15.34	14.51	17.76

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Agoseris glauca	-	$_{a}$2	-	$_{a}$3	.00	-	.15
F	Alyssum alyssoides (a)	-	$_{c}$331	$_{a}$227	$_{b}$294	4.27	.78	5.65
F	Allium sp.	$_{a}$1	$_{a}$3	-	-	.15	-	-
F	Astragalus sp.	$_{a}$1	$_{a}$4	-	-	.06	-	-
F	Astragalus utahensis	-	$_{a}$9	$_{a}$4	$_{a}$6	.55	.03	.09
F	Camelina microcarpa (a)	-	2	-	-	.00	-	-
F	Cirsium sp.	$_{a}$1	$_{a}$1	$_{a}$1	-	.15	.00	-
F	Descurainia pinnata (a)	-	$_{a}$1	-	$_{a}$3	.00	-	.00
F	Eriogonum sp.	14	-	-	-	-	-	-
F	Linum lewisii	$_{a}$11	$_{a}$10	-	-	.62	-	-
F	Medicago sativa	3	-	-	-	-	-	-
F	Oxytropis sp.	3	-	-	-	-	-	-
F	Phlox longifolia	-	5	-	-	.01	-	-
F	Ranunculus testiculatus (a)	-	-	$_{a}$5	$_{a}$9	-	.01	.04
F	Streptanthus cordatus	$_{a}$10	$_{a}$4	$_{a}$4	$_{a}$4	.03	.01	.01
F	Tragopogon dubius	$_{a}$3	$_{a}$8	-	-	.07	-	-
F	Unknown forb-perennial	-	3	-	-	.00	-	-
F	Verbascum thapsus	-	1	-	-	.00	-	-
Total for Annual Forbs		0	334	232	306	4.28	0.79	5.70
Total for Perennial Forbs		47	50	9	13	1.67	0.05	0.25
Total for Forbs		47	384	241	319	5.95	0.84	5.96

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

BROWSE TRENDS --
Management unit 16B, Study no: 5

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata tridentata	0	0	0	.15	-	.03
B	Chrysothamnus nauseosus albicaulis	1	3	1	-	.18	.38
B	Chrysothamnus viscidiflorus viscidiflorus	1	1	2	-	.15	.41
B	Gutierrezia sarothrae	7	1	1	.03	-	-
B	Juniperus osteosperma	8	15	14	6.07	8.62	11.42
B	Opuntia sp.	41	29	25	1.19	.61	.54
B	Quercus gambelii	1	0	0	-	-	-
B	Symphoricarpos oreophilus	0	0	0	-	-	.15
Total for Browse		59	49	43	7.45	9.56	12.94

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 5

Species	Percent Cover	
	'02	'07
Chrysothamnus nauseosus albicaulis	.20	.36
Chrysothamnus viscidiflorus viscidiflorus	.26	.23
Juniperus osteosperma	10.66	17.45
Opuntia sp.	.18	.20

POINT-QUARTER TREE DATA --
Management unit 16B, Study no: 5

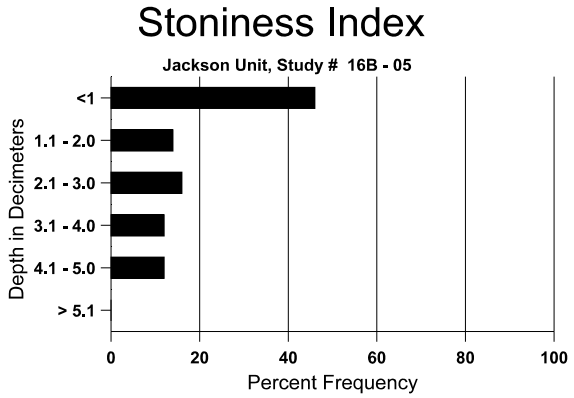
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Juniperus osteosperma	219	192	5.3	7.3

BASIC COVER --
Management unit 16B, Study no: 5

Cover Type	Average Cover %		
	'97	'02	'07
Vegetation	31.12	27.02	35.87
Rock	8.57	12.51	8.22
Pavement	8.26	9.68	12.89
Litter	29.96	37.19	32.29
Cryptogams	4.13	9.30	8.18
Bare Ground	16.14	24.74	17.10

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 05, Jackson Unit

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
14.6	52.6 (21.7)	7.2	56.7	19.7	23.6	2.5	6.9	128.0	.6



PELLET GROUP DATA --
Management unit 16B, Study no: 5

Type	Quadrat Frequency			Days use per acre (ha)	
	'97	'02	'07	'02	'07
Sheep	-	1	-	-	-
Rabbit	20	3	24	-	-
Horse	-	1	-	-	4 (10)
Elk	36	7	8	45 (111)	29 (71)
Deer	14	10	8	10 (25)	8 (20)
Cattle	-	1	-	1 (4)	-

BROWSE CHARACTERISTICS --
Management unit 16B, 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 tridentata												
89	**99**	-	-	33	66	-	33	0	67	-	0	29/21
97	**0**	-	-	-	-	20	0	0	0	-	0	62/65
02	**0**	-	-	-	-	20	0	0	0	-	0	61/26
07	**0**	-	-	-	-	-	0	0	0	-	0	38/30
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	0	0	0	-	0	31/37
02	**60**	-	-	-	60	-	0	0	100	33	33	28/44
07	**20**	-	-	-	20	-	100	0	100	100	100	26/22
Chrysothamnus viscidiflorus viscidiflorus												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	0	0	0	-	0	15/15
02	**20**	-	-	20	-	-	0	0	0	-	0	16/19
07	**40**	-	-	20	20	-	0	0	50	-	0	19/23
Gutierrezia sarothrae												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**220**	-	60	160	-	-	0	0	0	-	0	10/9
02	**20**	-	-	-	20	40	0	0	100	100	100	8/11
07	**20**	-	20	-	-	-	0	0	0	-	0	7/10
Juniperus osteosperma												
89	**66**	-	33	33	-	-	0	0	-	-	0	102/55
97	**180**	-	20	160	-	20	0	0	-	-	0	-/-
02	**340**	-	20	320	-	80	0	0	-	-	6	-/-
07	**360**	-	-	360	-	20	0	6	-	-	0	-/-
Opuntia sp.												
89	**866**	-	133	700	33	-	0	0	4	-	0	5/5
97	**1860**	-	20	1680	160	140	0	0	9	9	9	6/11
02	**1640**	40	260	1260	120	-	0	0	7	-	0	5/10
07	**1280**	-	180	1060	40	-	0	5	3	3	3	6/13
Quercus gambelii												
89	**400**	66	400	-	-	-	50	8	-	-	0	-/-
97	**40**	-	-	40	-	-	100	0	-	-	0	19/24
02	**0**	-	-	-	-	-	0	0	-	-	0	15/8
07	**0**	-	-	-	-	-	0	0	-	-	0	31/15

Trend Study 16B-6-07

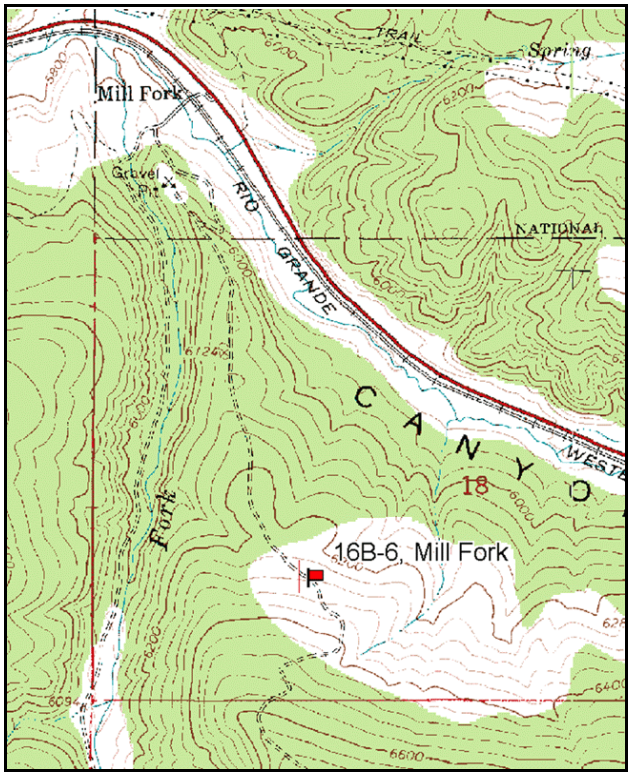
Study site name: Mill Fork . Vegetation type: Big Sagebrush .

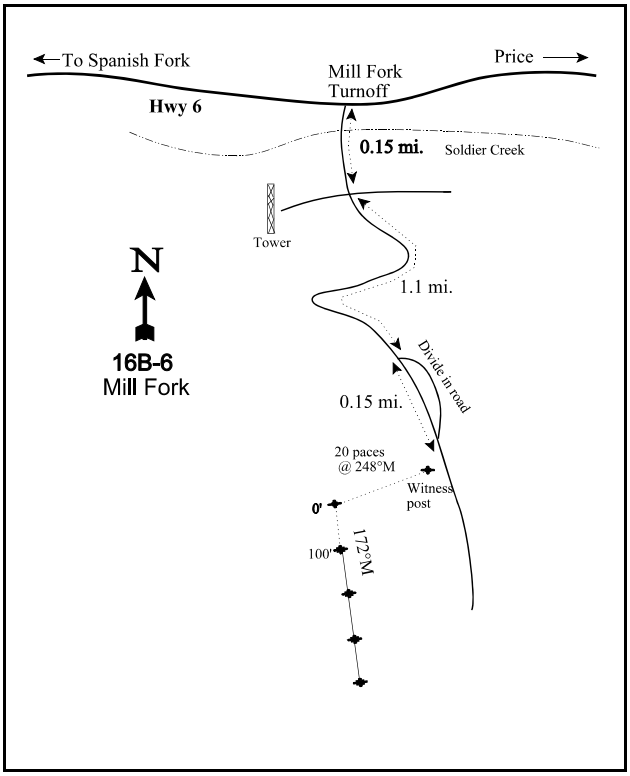
Compass bearing: frequency baseline 172 degrees magnetic.

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

LOCATION DESCRIPTION

From the Sheep Creek Cafe and Sheep Creek Turnoff on Highway 6, travel east on Highway 6 (toward Price) for 1.9 miles to the Mill Fork turnoff on the south side of the highway. Take this road 0.15 miles through a gate and crossing the river to a fork. Stay left (east) and go up the hill 1.1 miles to a division in the road. Here the dense pinyon/juniper forest opens up into a sagebrush stand (this p/j stand was chained in the fall of 2007). Proceed another 0.15 miles to a witness post on the west side of the road. From the witness post the 0-foot baseline stake is 20 paces away at 248 degrees magnetic. It is marked by browse tag #9091.





Map Name: Mill Fork

Diagrammatic Sketch

Township 10S , Range 6E , Section 18

GPS: NAD 83, UTM 12S 474109 E 4422068 N

DISCUSSION

Mill Fork - Trend Study No. 16B-6

Study Information

This study is considered important winter range for deer and elk, although the area supports a depleted sagebrush range [elevation: 6,300 feet (1,920 m), slope: 10%-15%, aspect: north]. There is a small, perennial stream located 0.25 miles (0.4 km) to the north. This same sagebrush community was originally sampled by a line-intercept transect in 1978. The 1978 report identified the sagebrush as basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), but in 1989 it was classified as mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana)*. It is likely a hybrid between the two subspecies. The sagebrush population is a relatively dense, old stand with low recruitment. Wildlife use has been light for elk and moderate for deer. From the pellet group transect, there were an estimated 58 deer days use/acre (144 ddu/ha) in 2002 and 69 deer days use/acre (170 ddu/ha) in 2007. There were an estimated 18 elk days use/acre (45 edu/ha) in 2002 and 25 elk days use/acre (61 edu/ha) in 2007. In 2007, a deer skeleton was found on the study. Domestic sheep are trailed through the general area during spring and summer, but use by sheep on the study itself is minimal.

Soil

The soil texture is a clay, and reactivity is neutral (pH of 7.3). Due to minimal understory vegetation and a high proportion of bare soil, erosion tends to be an increasingly negative factor. Soils have little protection, especially in the barren shrub interspaces. The erosion condition was classified as slight in 2002 and 2007. Pedestalling and active gullies throughout the study provide evidence that erosion is occurring. Bare soil is high, accounting for approximately 27% of the ground surface during all sampling years. The 2007 reading was conducted days after a large storm and there was ample evidence of recent soil movement along flow paths.

Browse

Mountain big sagebrush is the dominant species and has provided at least 80% of the vegetative cover. Sagebrush canopy cover increased from 27% in 2002 to 32% in 2007. Sagebrush density has fluctuated between sample years. The estimated density was highest in 1989 and 2002, at approximately 5,100 plants/acre (12,625 plants/ha). In alternate sample years the density decreased to 3,700 plants/acre (9,158 plants/ha) in 1997 and 4,060 plants/acre (10,050 plants/ha) in 2007. Decadence has been generally high but has also varied between sampling years. Decadence was lowest in 1997 (15%), which incidentally was a year of above normal precipitation throughout the region. Reproduction and recruitment have been low in all years after 1989. The proportion of sagebrush plants with poor vigor has ranged from 8% to 27% of the population. The sagebrush defoliator moth (*Aroga websteri*) had infested 17% of the sampled sagebrush plants in 2007. Annual growth averaged 1.4 inches (3.6 cm) in 2002 and 1.1 inches (2.8 cm) in 2007. Browse use has been predominantly light-moderate, though there was a shift towards moderate-heavy in 2007. This area was scheduled to receive a chaining treatment in the fall of 2007 to reduce the density and canopy cover of sagebrush. Treatment could help stimulate the reproduction of sagebrush and the establishment of perennial herbaceous species.

The study supports a variety of other browse, although these species are limited in abundance. Stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) density has steadily decreased from 2,266 plants/acre (5,610 plants/ha) in 1989 to 1,460 plants/acre (3,614 plants/ha) in 2007. Utah serviceberry (*Amelanchier utahensis*) and mountain snowberry (*Symphoricarpos oreophilus*) are also present, providing some additional forage.

Utah juniper (*Juniperus osteosperma*) canopy cover increased slightly from 4% in 2002 to 5% in 2007. Density was estimated at 64 trees/acre 158 trees/ha) in 1997. The density increased to 140 trees/acre (347 trees/ha) in 2002 and decreased to 115 trees/acre (285 trees/ha) in 2007. The average trunk diameter increased

from 2.8 inches (7.1 cm) in 1997 to 4.0 inches (10.2 cm) in 2002, and decreased to 3.2 inches (8.1 cm) in 2007. Several young trees were sampled in 2002, increasing the density estimate. In 2007, the juniper trees were found to be in good vigor and have high seed production.

Herbaceous Understory

The herbaceous component has been insignificant. Forb cover has been higher than grass cover, and both have provided less than 5% total cover since 1997. Diversity has been fair, suggesting a higher site potential. Five perennial grass species have been measured, producing about 1% cover each year since 1997. Bluebunch wheatgrass (*Agropyron spicatum*) is the most common perennial grass. In 2007, cheatgrass (*Bromus tectorum*) was sampled for the first time and was in one quadrat.

There is a moderate density of forbs, none of which are considered to be important forage species. The species that account for the majority of forb cover have been Western aster (*Aster chilensis*), longleaf phlox (*Phlox longifolia*), mat penstemon (*Penstemon caespitosus*), and low penstemon (*Penstemon humilis*). Annual forbs are a small component and only account for 1% of the total forb cover. The understory appears to be suppressed by the overabundance of sagebrush.

1997 TREND ASSESSMENT

The browse trend is slightly down. The density of mountain big sagebrush decreased by 28%. The decrease in density is likely the result of the larger area sampled beginning in 1997. The decadent age class decreased from 78% to 15%, and dying plants dropped from 27% to 12% of the population. These trends indicate that the sagebrush population was composed of fewer, but healthier plants. The density of Utah serviceberry was stable and mountain snowberry density increased two-fold. Neither of these species exhibited heavy browse use. The grass trend is stable. Although the sum of nested frequency for perennial grasses increased, these grasses occurred infrequently. Bluebunch wheatgrass was sampled for the first time. The forb trend is stable. Seven new species were observed in 1997 (5 perennial species), but the sum of nested frequency remained stable. The Desirable Components Index (DCI) score was poor-fair due to the high cover of mountain big sagebrush, low decadence, and low perennial grass cover.

winter range condition (DCI) - poor-fair (51) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is slightly up. Mountain big sagebrush density increased 37%, nearly returning to the 1989 density. Decadence increased to 43% of the population and the estimated number of dead plants nearly doubled to 1,100 plants/acre (2,723 plants/ha). Vigor improved and use shifted to predominantly light. Sagebrush cover also increased, even though the height and crown data indicated that the individual plants were slightly smaller. The grass trend is stable. The sum of nested frequency was stable, and only two species were sampled in 2002. The forb trend is down. The sum of nested frequency for perennial forbs declined by 48%, and 8 fewer species were sampled. Drought, coupled with high sagebrush competition, has severely depressed the understory. The DCI score declined to poor due to the increase in sagebrush decadence and the loss of perennial forbs.

winter range condition (DCI) - poor (39) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. Sagebrush density decreased by 20%, and few young plants were sampled. Decadence increased from 43% of the population to 59%. Plants exhibiting poor vigor increased from 8% of the population to 19%, and heavily browsed plants increased from 12% to 27%. There was also some insect infestation on the sagebrush and graystem rabbitbrush (*Chrysothamnus nauseosus* ssp. *hololeucus*). The

number of dead sagebrush plants decreased to 660 plants/acre (1,634 plants/ha). The grass trend is stable. The sum of nested frequency and cover of perennial grasses were stable, and the number of perennial species sampled increased to four. Additionally, cheatgrass was found on the study for the first time, in one quadrat. All grasses had low cover values and made up a small portion of the vegetative community. The forb trend is up. The sum of nested frequency increased by 34%, but forbs continued to provide relatively little forage. Species richness remained stable. Bur buttercup (*Ranunculus testiculatus*), an allelopathic annual (Buchanan et al. 1978) was sampled for the first time, in three quadrats. The DCI score decreased to very poor due to a decrease in browse cover and the high number of decadent browse plants.

winter range condition (DCI) - very poor (33) Mid-level potential scale
browse - down (-2) grass - stable (0) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 6

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	-	a22	a29	a27	.91	.85	1.10
G	Bromus tectorum (a)	-	-	-	2	-	-	.00
G	Oryzopsis hymenoides	a2	a1	-	a4	.00	-	.01
G	Poa fendleriana	a4	-	-	a2	-	-	.03
G	Sitanion hystrix	a2	a4	-	a3	.03	-	.00
G	Stipa lettermani	-	a3	a3	-	.03	.03	-
Total for Annual Grasses		0	0	0	2	0	0	0.00
Total for Perennial Grasses		8	30	32	36	0.99	0.88	1.14
Total for Grasses		8	30	32	38	0.99	0.88	1.14
F	Achillea millefolium	-	a4	a4	a3	.03	.03	.03
F	Astragalus beckwithii	-	a7	a1	b18	.10	.00	.06
F	Aster chilensis	a34	a28	a17	a14	.51	.22	.20
F	Astragalus convallarius	b43	a21	a11	ab28	.18	.05	.19
F	Astragalus utahensis	a2	a4	-	-	.10	-	-
F	Calochortus nuttallii	a1	b35	-	a2	.10	-	.00
F	Castilleja sp.	-	2	-	-	.03	-	-
F	Chaenactis douglasii	b17	b28	a2	-	.26	.01	-
F	Cirsium sp.	a2	a5	-	-	.01	-	-
F	Collinsia parviflora (a)	-	1	-	-	.00	-	-
F	Cymopterus sp.	-	a7	a5	a4	.02	.01	.01
F	Epilobium brachycarpum (a)	-	-	-	3	-	-	.03
F	Eriogonum brevicaule	a1	a1	a3	a5	.03	.15	.01
F	Erigeron eatonii	-	-	3	-	-	.00	-
F	Lomatium sp.	-	7	-	-	.02	-	-
F	Machaeranthera canescens	b24	ab13	a6	a4	.03	.04	.03

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Penstemon caespitosus	-	-	$_{a}$27	$_{b}$65	-	.80	2.61
F	Penstemon humilis	$_{a}$41	$_{a}$40	$_{a}$29	-	1.59	.85	-
F	Phlox longifolia	$_{c}$159	$_{b}$106	$_{a}$60	$_{ab}$82	.57	.26	.53
F	Polygonum douglasii (a)	-	3	-	-	.00	-	-
F	Ranunculus testiculatus (a)	-	-	-	8	-	-	.01
F	Taraxacum officinale	$_{a}$3	$_{a}$2	-	-	.00	-	-
F	Verbascum thapsus	$_{a}$3	$_{a}$7	-	-	.04	-	-
F	Vicia americana	$_{a}$4	$_{a}$4	$_{a}$2	$_{a}$3	.03	.00	.00
F	Viola sp.	-	4	-	-	.03	-	-
Total for Annual Forbs		0	4	0	11	0.00	0	0.04
Total for Perennial Forbs		334	325	170	228	3.73	2.44	3.71
Total for Forbs		334	329	170	239	3.74	2.44	3.75

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

BROWSE TRENDS --
Management unit 16B, Study no: 6

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	7	5	3	.36	.03	.15
B	Artemisia tridentata vaseyana	89	89	86	29.47	33.22	19.85
B	Chrysothamnus depressus	3	6	2	.18	.03	-
B	Chrysothamnus nauseosus hololeucus	2	5	6	.00	.09	.21
B	Chrysothamnus viscidiflorus viscidiflorus	44	37	32	1.15	.49	.42
B	Eriogonum corymbosum	0	0	2	-	-	-
B	Gutierrezia sarothrae	6	5	7	.15	.03	-
B	Juniperus osteosperma	6	4	5	2.67	3.29	2.34
B	Opuntia sp.	1	0	1	.00	-	-
B	Symphoricarpos oreophilus	13	17	18	.68	.21	.60
B	Tetradymia canescens	7	6	3	.06	.15	.15
Total for Browse		178	174	165	34.75	37.57	23.75

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 6

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	.16	.08
Artemisia tridentata vaseyana	26.91	32.23
Chrysothamnus depressus	.06	-
Chrysothamnus nauseosus hololeucus	.35	.45
Chrysothamnus viscidiflorus viscidiflorus	.30	.50
Juniperus osteosperma	4.30	4.86
Symphoricarpos oreophilus	.48	2.40
Tetradymia canescens	.38	-

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 6

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	3.5	1.1

POINT-QUARTER TREE DATA --
Management unit 16B, Study no: 6

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	140	122

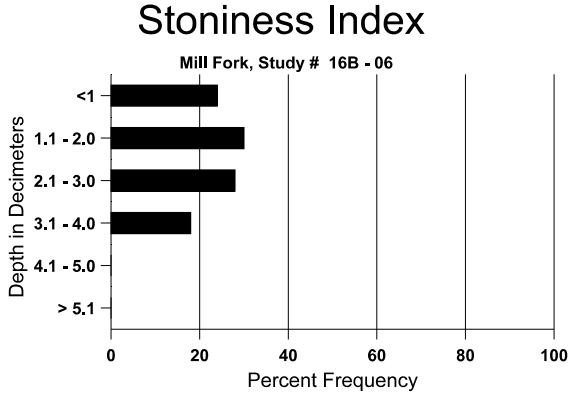
Average diameter (in)	
'02	'07
4.0	3.2

BASIC COVER --
Management unit 16B, Study no: 6

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	6.50	35.90	40.29	29.35
Rock	2.50	4.87	4.59	3.00
Pavement	15.25	6.28	5.86	10.11
Litter	47.25	42.78	38.99	39.10
Cryptogams	2.00	2.34	3.95	4.88
Bare Ground	26.50	27.07	27.53	30.68

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 06, Mill Fork

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.9	42.8 (15.0)	7.3	20.7	22.7	56.6	2.8	12.3	83.2	.5



PELLET GROUP DATA --
Management unit 16B, Study no: 6

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	2	5	19
Elk	11	3	7
Deer	26	30	25

Days use per acre (ha)	
'02	'07
-	-
18 (45)	25 (61)
58 (144)	69 (170)

BROWSE CHARACTERISTICS --
Management unit 16B, 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)
Amelanchier utahensis												
89	**133**	-	133	-	-	-	0	100	0	-	0	-/-
97	**140**	-	-	140	-	-	29	0	0	-	0	23/25
02	**120**	-	20	-	100	-	50	17	83	67	67	15/17
07	**60**	-	-	60	-	-	0	100	0	-	0	28/28

		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												
89	**5133**	-	533	600	4000	-	61	5	78	27	27	32/36
97	**3700**	40	20	3140	540	580	75	3	15	12	12	34/56
02	**5080**	20	-	2920	2160	1100	30	12	43	8	8	31/40
07	**4060**	-	40	1640	2380	660	41	27	59	14	19	34/44
Chrysothamnus depressus												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**80**	-	-	80	-	-	0	0	0	-	0	11/11
02	**200**	-	-	100	100	-	0	0	50	40	40	3/9
07	**40**	-	-	-	40	-	0	0	100	-	0	5/7
Chrysothamnus nauseosus hololeucus												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**40**	-	20	-	20	-	0	0	50	50	50	34/35
02	**160**	-	60	80	20	-	0	0	13	-	0	10/12
07	**200**	40	20	120	60	-	0	0	30	-	10	21/19
Chrysothamnus viscidiflorus viscidiflorus												
89	**2266**	-	1133	733	400	-	0	0	18	-	0	13/14
97	**2160**	40	560	1600	-	20	0	0	0	-	0	22/13
02	**1660**	-	40	1480	140	-	0	0	8	1	1	8/10
07	**1460**	120	20	780	660	100	8	0	45	7	26	8/10
Eriogonum corymbosum												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**40**	-	-	40	-	-	0	50	-	-	0	4/4
Gutierrezia sarothrae												
89	**1466**	66	66	1400	-	-	0	0	0	-	0	10/13
97	**160**	-	20	140	-	-	0	0	0	-	0	9/9
02	**140**	-	20	100	20	-	0	0	14	-	0	9/10
07	**160**	-	20	140	-	-	13	0	0	-	0	8/7
Juniperus osteosperma												
89	**0**	133	-	-	-	-	0	0	-	-	0	-/-
97	**140**	-	60	80	-	-	0	0	-	-	14	161/115
02	**80**	-	20	60	-	-	0	0	-	-	0	-/-
07	**100**	20	40	60	-	-	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)
Mahonia repens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	2/5
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Opuntia sp.												
89	**132**	-	66	-	66	-	0	0	50	-	0	-/-
97	**20**	-	20	-	-	-	0	0	0	-	0	2/1
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**20**	-	-	20	-	-	0	0	0	-	0	3/3
Quercus gambelii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	20	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Symphoricarpos oreophilus												
89	**199**	-	66	133	-	-	67	0	0	-	0	13/19
97	**400**	-	80	320	-	-	0	0	0	-	0	16/26
02	**460**	-	-	380	80	-	0	0	17	-	0	13/24
07	**480**	-	40	440	-	-	0	4	0	-	4	16/24
Tetradymia canescens												
89	**66**	-	-	66	-	-	0	0	0	-	0	8/4
97	**320**	-	60	260	-	-	0	0	0	-	0	8/6
02	**220**	-	-	180	40	-	0	0	18	-	0	8/8
07	**100**	-	-	60	40	-	0	0	40	-	0	7/8

Trend Study 16B-8-07

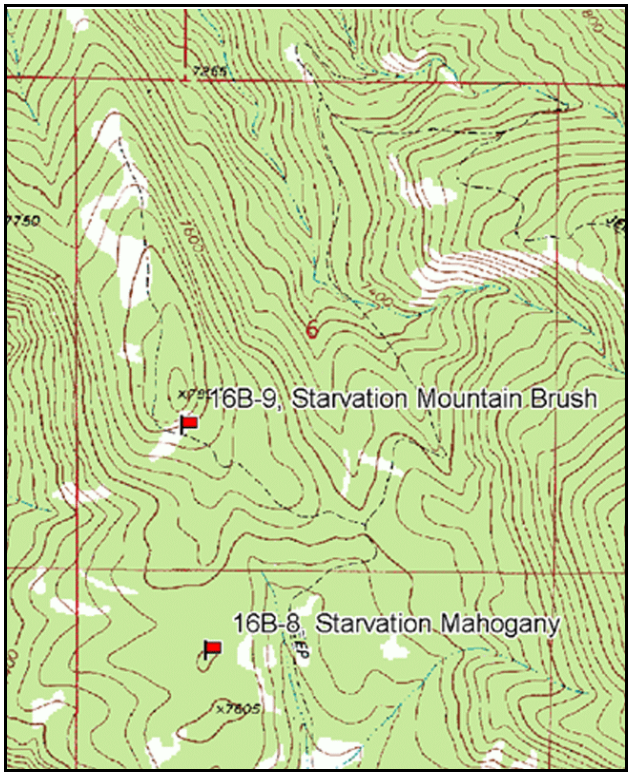
Study site name: Starvation Mahogany . Vegetation type: Curlleaf Mountain Mahogany .

Compass bearing: frequency baseline 160 degrees magnetic (line 2-4 @ 151°M).

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

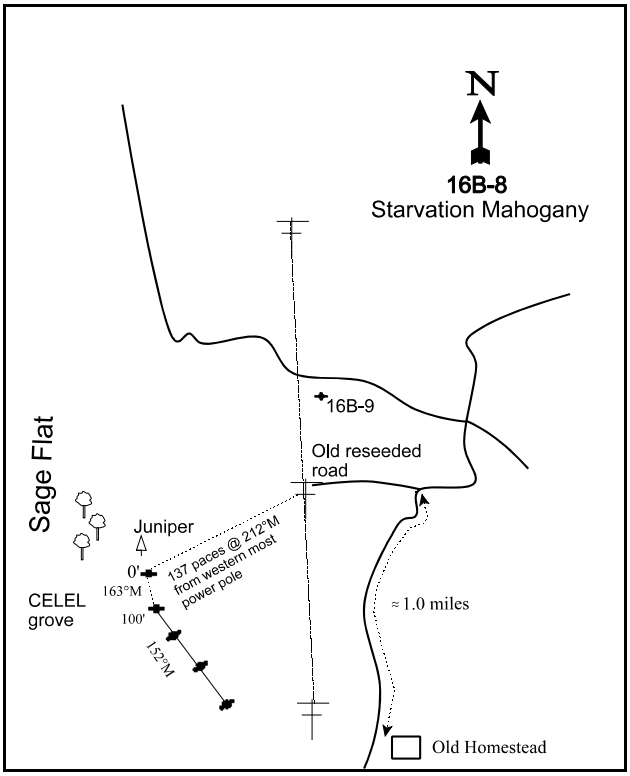
LOCATION DESCRIPTION

From Tucker rest area on Highway 6 in Spanish Fork Canyon, take the Starvation Canyon road 4.6 miles. Turn left and go 0.5 miles to another fork. Turn left and go up a small canyon on a rough road for 1.15 miles to a fork. Turn left, cross the creek, and go 0.3 miles to an old homestead site. Continue up the road about 1.0 miles to an old road on the left that has been seeded over. From here, walk east to the double powerlines on the hill. From the westernmost pole, walk 137 paces at 212 degrees magnetic to the 0-foot stake of the baseline. It is marked by browse tag #9047.



Map Name: Tucker

Township 11S , Range 7E , Section 7



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 484111 E 4414856 N

DISCUSSION

Starvation Mahogany - Trend Study No. 16B-8

Study Information

This study is located in the Starvation Creek drainage on Division of Wildlife Resources property and was established in 1989 [elevation: 7,600 feet (2,316 m), slope: 5%, aspect: southwest]. It is considered important winter range for both mule deer and elk. Starvation Creek is located 0.75 miles (1.2 km) to the west. From the pellet group transect data, deer use was estimated at 34 days use/acre (84 ddu/ha) in 1999, 58 days use/acre (144 ddu/ha) in 2002, and 56 days use/acre (139 ddu/ha) in 2007. Elk use was estimated at 34 days use/acre (84 edu/ha) in 1999, 18 days use/acre (45 edu/ha) in 2002 and 60 days use/acre (147 edu/ha) in 2007. Livestock use was very light with an estimated 4 cow days use/acre (9 cdu/ha) in 1999, 7 cow days use/acre (16 cdu/ha) in 2002 and 3 cow days use/acre (7 cdu/ha) in 2007. A large 4-point buck antler shed was found while hiking to the study in 1999, and deer were seen near the study in 2007.

Soil

The soil is a dark brown clay loam with a slightly alkaline pH (7.4). There is very little rock or pavement on the surface. There is a clay layer 12 inches (30.5 cm) below the surface that is about 6 inches (15.2 cm) thick. Erosion is minimal because of the high vegetation and litter cover. Organic matter is moderately high at 3.2%, while phosphorus levels are quite low (2.7 ppm). Phosphorus levels less than 6 ppm can be limiting to normal plant growth and development (Tiedemann and Lopez 2004). The composition of ground cover has steadily shown an increase in vegetation and bare soil, and a decrease in litter. The erosion condition was classified as slight in 2002 and improved to stable in 2007.

Browse

The browse community is diverse, with 14 species sampled. The key species include Utah serviceberry (*Amelanchier utahensis*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), true mountain mahogany (*Cercocarpus montanus*), curl-leaf mahogany (*Cercocarpus ledifolius*), and antelope bitterbrush (*Purshia tridentata*). These key species have accounted for about one-third of the total browse cover since 1999. Less preferred species such as mountain snowberry (*Symphoricarpos oreophilus*), Gambel oak (*Quercus gambelii*), and stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) provide the majority of the browse cover. The baseline was extended in 1999 to better sample browse populations that have clumped and/or discontinuous distributions. The extension of the baseline and discontinuation of the relatively small density plots accounts for some of the changes in population densities after 1989 for many of the shrub species.

Utah serviceberry canopy cover has been 1% since 2002. The population density has fluctuated between 480 and 580 plants/acre (1,190 and 1,535 plants/ha) since 1999. Recruitment was high in 1999; 52% of the plants were classified as young, which resulted in a slight increase in density in 2002. Recruitment remained good at 17% in 2002 and 25% in 2007. Decadence has been moderately low in all sample years, ranging from 7% to 14% of the population. The proportion of plants exhibiting poor vigor has ranged from 5% to 12%. The number of plants with heavy browse use was highest in 2002 (55%) and declined in 2007 to 21%.

Mountain big sagebrush canopy cover has been consistent at 2% since 2002. The density was approximately 900 plants/acre (2,230 plants/ha) in 1999 and 2002 and declined to 760 plants/acre (1,880 plants/ha) in 2007. Most plants occur in open areas. Sagebrush decadency has been high in all sample years, ranging from 43% in 1999 to 32% in 2007. The number of dead plants sampled has also steadily decreased since 1999. Reproduction and recruitment have been low in all years, except in 1989 when half of the population was categorized as young. Plants exhibiting poor vigor accounted for a small proportion of the population through 2002 (11% or less), and increased to 21% in 2007. In 2007 there were also galls and bugs on individual plants. Annual growth was minimal on sagebrush in 2002, averaging less than 2 inches (5.1 cm). Sagebrush

use has also been variable, though plants with heavy use increased from 7% in 2002 to 34% in 2007.

True mountain mahogany canopy cover decreased from 7% in 2002 to 5% in 2007. The density was estimated at 740 plants/acre (1,832 plants/ha) in 1999 and 2002, and decreased to 640 plants/acre (1,584 plants/ha) in 2007. Young plants decreased from 76% of the population in 1989 to 16% in 2002, and increased to 25% in 2007. The percent decadency has been low in all sample years, 5% or less. The percentage of plants with poor vigor has been low in all sample years. True mountain mahogany plants with heavy use increased from 2% in 1989 to 66% in 2007. Curl-leaf mahogany canopy cover decreased from 5% in 2002 to 4% in 2007. The population density was estimated at 180 plants/acre (445 plants/ha) in 1999, 300 plants/acre (743 plants/ha) in 2002, and 220 plants/acre (545 plants/ha) in 2007. Decadent curl-leaf plants have accounted for about 10% of the population since 1999. The plants exhibiting poor vigor have remained a relatively small portion of the population. Heavy browsing use increased from 0% in 1989 to 80% in 2002, and declined to 64% in 2007. Height and crown measurements have decreased each sample year. In 2007, the plants averaged 19 inches (48 cm) tall with a crown width of 16 inches (41 cm). However, there are taller, highlined curl-leaf plants present.

The antelope bitterbrush population is composed of mature, heavily utilized individuals. Canopy cover was 1% in 2002 and 2% in 2007. The estimated density has remained stable at approximately 130 plants/acre (320 plants/ha) since 1999. Decadence has been low and vigor has been normal. The moderate to heavy use on bitterbrush is expected because of the relatively low densities of this preferred species.

Herbaceous Understory

The herbaceous understory is diverse in both grasses and forbs. Fifteen species of grasses (14 perennial species) have been sampled since 1989. The most abundant species include bluebunch wheatgrass (*Agropyron spicatum*), western wheatgrass (*Agropyron smithii*), and three bluegrass species (*Poa* sp.). These species comprised 6% of the total ground cover in 1999, 8% in 2002, and 11% in 2007. The grasses have had good stature even in drought conditions. Cheatgrass is present, but was sampled for the first time in 2007 and was only in three quadrats.

Perennial forb cover has been stable at approximately 8% since 1999. Forb species richness is high; 46 species (38 perennial species) have been sampled since 1989. Hood's phlox (*Phlox hoodii*) is the most abundant forb and has consistently occurred in about half of the sampling quadrats. The remaining species occur at low frequencies. Annual forbs have accounted for 1% or less of the total ground cover since 1999. Bur buttercup (*Ranunculus testiculatus*), an allelopathic annual (Buchanan et al. 1978) was first sampled in 2007 in two quadrats.

1999 TREND ASSESSMENT

The browse trend is stable. There were large decreases in the estimated density for Utah serviceberry, curl-leaf mahogany, true mountain mahogany, and bitterbrush. However, the decrease was attributed to the change in the sample area measured in 1999. In this instance, trend was determined from other parameters. Seedling and young recruitment was high for serviceberry, true mountain mahogany, and curl-leaf mahogany. Percent decadence was also relatively low. These species all display evidence of moderate-heavy use. However, there was a decrease in young recruitment of sagebrush, and decadency remained high (43%). The grass trend is up. The sum of nested frequency of perennial grasses increased 54%. There were significant increases in the nested frequencies of western wheatgrass and Kentucky bluegrass (*Poa pratensis*). The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 25%, including significant decreases of the nested frequencies of five species. Trend was only rated as slightly down because the decrease in forbs was likely also a product of the change in sample area. The Desirable Components Index (DCI) score is fair-good due to the high percentage of preferred browse plants that were young, moderate levels of browse cover and decadence, and high perennial forb cover.

winter range condition (DCI) - fair-good (70) High potential scale
browse - stable (0) grass - up (+2) forb - slightly down (-1)

2002 TREND ASSESSMENT

The browse trend is stable. Even with drought in 2002 (Utah Climate Summaries 2007), the key species showed improvements in important parameters. Density increased or remained stable for most of the key species. Reproduction declined for serviceberry, true mountain mahogany, and curl-leaf mahogany. Mountain big sagebrush and bitterbrush already had very low reproduction prior to 2002. All of the key species had stable or decreasing decadency and poor vigor rates, which is a positive sign during periods of drought. Browse use appears to have increased on most of the key browse species. There are two possible explanations for the increase. First, browse use can be overestimated during years of minimal annual growth like 2002. Low annual growth results in plants having a heavily hedged appearance making ocular browse use estimates difficult to determine. Second, use may have increased because the key species occur in relatively low densities, and animals may have concentrated use on key areas due to drought conditions. The grass trend is stable. The sum of nested frequency of perennial grasses increased by 2%, and there were no annual grasses present. The forb trend is also stable. The sum of nested frequency of perennial forbs decreased 9%. There was an increase in annual forb nested frequency, but most of the increase was from species that are not regarded as weedy. The DCI score remained fair-good. The increase in preferred browse cover and perennial grass cover was countered by a decrease in young browse plants.

winter range condition (DCI) - fair-good (71) High potential scale
browse - stable (0) grass - stable (0) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is slightly down. Density declined for all the preferred browse species except bitterbrush. However, bitterbrush had a low enough density that it did not impact trend. The decadent and young components of the populations remained stable for the preferred species. Plants exhibiting poor vigor increased from 11% to 21% of the mountain big sagebrush population. Gambel oak density decreased by about 25%, and poor vigor increased from 17% to 47%. These changes in the oak population appeared to be the result of frost damage. The trend for grass is stable. The sum of nested frequency for perennial grasses increased 13%. Bluebunch wheatgrass and Kentucky bluegrass (Poa pratensis) increased significantly in nested frequency, while mutton bluegrass (Poa fendleriana) decreased significantly. However, cheatgrass (*Bromus tectorum*) was also observed for the first time and was found in three quadrats, which negatively impacts trend. The forb trend is slightly up. The sum of nested frequency for all forbs increased by 54%, but the nested frequency of perennial forbs only increased by 15%. The remainder of the increase was attributed to annual forbs, mostly blue-eyed Mary (*Collinsia parviflora*) and little polecat (*Microsteris gracilis*). The DCI score remained fair-good because the decrease in browse cover was countered by an increase in perennial grass cover.

winter range condition (DCI) - fair-good (71) High potential scale
browse - slightly down (-1) grass - stable (0) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 8

Type	Species	Nested Frequency				Average Cover %		
		'89	'99	'02	'07	'99	'02	'07
G	Agropyron cristatum	$_{b}$25	$_{a}$9	$_{ab}$13	$_{a}$5	.18	.39	.18
G	Agropyron smithii	$_{a}$59	$_{b}$125	$_{b}$137	$_{b}$156	1.98	2.26	2.38
G	Agropyron spicatum	$_{a}$80	$_{a}$92	$_{a}$86	$_{b}$127	2.56	3.23	5.12
G	Agropyron trachycaulum	16	-	-	-	-	-	-
G	Bromus inermis	-	$_{a}$2	$_{a}$4	$_{a}$6	.03	.15	.53
G	Bromus tectorum (a)	-	-	-	6	-	-	.01
G	Carex sp.	$_{a}$9	$_{a}$6	$_{a}$17	$_{a}$5	.44	1.00	.16
G	Koeleria cristata	$_{a}$4	$_{a}$12	$_{a}$-	$_{a}$12	.05	-	.25
G	Oryzopsis hymenoides	$_{a}$11	$_{a}$2	$_{a}$13	$_{a}$10	.06	.30	.39
G	Poa fendleriana	$_{a}$22	$_{a}$52	$_{b}$83	$_{a}$29	.69	2.42	1.13
G	Poa pratensis	$_{a}$4	$_{b}$49	$_{a}$16	$_{b}$37	.88	.42	2.00
G	Poa secunda	-	$_{a}$11	$_{ab}$25	$_{b}$43	.05	.16	.59
G	Sitanion hystrix	$_{a}$4	$_{a}$11	-	$_{a}$3	.10	-	.15
G	Stipa comata	-	$_{a}$2	$_{a}$8	$_{a}$12	.00	.33	.22
G	Stipa lettermani	$_{a}$37	$_{a}$43	$_{a}$21	$_{a}$33	.79	.51	.78
Total for Annual Grasses		0	0	0	6	0	0	0.01
Total for Perennial Grasses		271	416	423	478	7.87	11.19	13.92
Total for Grasses		271	416	423	484	7.87	11.19	13.94
F	Achillea millefolium	$_{a}$6	$_{a}$3	-	-	.15	-	-
F	Agoseris glauca	-	-	$_{a}$6	$_{b}$36	-	.04	.13
F	Alyssum alyssoides (a)	-	-	-	1	-	-	.00
F	Antennaria rosea	-	$_{a}$4	$_{a}$14	$_{a}$12	.15	.39	.17
F	Arabis sp.	$_{a}$1	$_{a}$3	$_{a}$2	-	.00	.01	-
F	Aster chilensis	$_{b}$57	$_{a}$16	$_{a}$25	$_{a}$16	.12	.13	.22
F	Astragalus convallarius	$_{a}$26	$_{a}$23	$_{a}$21	$_{a}$32	.19	.16	.25
F	Astragalus eurekensis	-	-	-	8	-	-	.09
F	Astragalus miser	-	$_{a}$1	$_{a}$2	$_{a}$2	.03	.15	.03
F	Astragalus sp.	$_{a}$9	$_{a}$9	$_{a}$10	-	.01	.07	-
F	Castilleja linariaefolia	-	-	-	1	-	-	.15
F	Calochortus nuttallii	-	$_{a}$1	$_{a}$3	$_{b}$11	.00	.00	.03
F	Chaenactis douglasii	$_{a}$9	$_{a}$2	$_{a}$1	$_{a}$3	.01	.00	.00
F	Cirsium sp.	$_{b}$30	$_{a}$13	$_{a}$12	$_{a}$9	.05	.07	.37
F	Comandra pallida	$_{a}$20	$_{a}$15	-	$_{a}$21	.10	-	.18
F	Collinsia parviflora (a)	-	-	$_{a}$41	$_{b}$101	-	.10	.71
F	Crepis acuminata	-	-	-	3	-	-	.04

Type	Species	Nested Frequency				Average Cover %		
		'89	'99	'02	'07	'99	'02	'07
F	Draba sp. (a)	-	3	-	-	.01	-	-
F	Erigeron sp.	-	-	3	-	-	.00	-
F	Eriogonum racemosum	-	-	$_{a}$-	$_{a}$-	-	.01	.00
F	Eriogonum umbellatum	$_{a}$20	$_{a}$12	$_{a}$15	$_{a}$16	.08	.11	.18
F	Ipomopsis aggregata	3	-	-	-	-	-	-
F	Lappula occidentalis (a)	-	-	-	4	-	-	.01
F	Lactuca serriola	-	-	-	1	-	-	.00
F	Lithospermum ruderale	-	-	-	-	-	-	.00
F	Lomatium sp.	$_{a}$3	$_{a}$5	$_{a}$4	$_{a}$4	.33	.21	.45
F	Machaeranthera canescens	$_{b}$95	$_{a}$42	$_{a}$27	$_{a}$22	.16	.19	.26
F	Microsteris gracilis (a)	-	-	$_{a}$7	$_{b}$80	-	.01	.40
F	Orthocarpus sp. (a)	-	$_{a}$6	$_{a}$2	$_{b}$18	.04	.01	.11
F	Penstemon caespitosus	-	$_{a}$31	$_{a}$21	$_{a}$26	.46	.41	.18
F	Penstemon cyananthus	$_{b}$69	$_{a}$7	$_{b}$51	$_{b}$50	.04	1.15	.93
F	Penstemon humilis	$_{b}$31	$_{a}$3	-	-	.00	-	-
F	Penstemon sp.	-	58	-	-	1.00	-	-
F	Phlox hoodii	$_{b}$154	$_{ab}$129	$_{a}$125	$_{a}$106	4.45	5.38	3.60
F	Phlox longifolia	$_{a}$4	$_{a}$6	$_{a}$9	$_{a}$11	.01	.05	.05
F	Polygonum douglasii (a)	-	$_{ab}$4	$_{a}$1	$_{b}$15	.01	.00	.03
F	Ranunculus testiculatus (a)	-	-	-	5	-	-	.01
F	Schoencrambe linifolia	-	-	-	1	-	-	.00
F	Senecio integerrimus	-	-	-	6	-	-	.06
F	Senecio multilobatus	$_{a}$8	-	$_{a}$10	$_{a}$1	-	.05	.00
F	Solidago sp.	-	2	-	-	.03	-	-
F	Taraxacum officinale	-	$_{a}$17	$_{a}$4	$_{a}$15	.03	.01	.05
F	Tragopogon dubius	-	-	$_{a}$2	$_{a}$5	-	.00	.01
F	Viguiera multiflora	$_{a}$1	$_{a}$3	$_{a}$3	-	.00	.03	-
F	Viola sp.	-	-	-	4	-	-	.01
F	Zigadenus paniculatus	-	-	$_{a}$-	$_{a}$2	-	.00	.00
Total for Annual Forbs		0	13	51	224	0.06	0.12	1.28
Total for Perennial Forbs		546	405	370	424	7.47	8.67	7.52
Total for Forbs		546	418	421	648	7.54	8.80	8.81

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

BROWSE TRENDS --
Management unit 16B, Study no: 8

Type	Species	Strip Frequency			Average Cover %		
		'99	'02	'07	'99	'02	'07
B	Amelanchier utahensis	21	25	19	.77	1.20	1.80
B	Artemisia tridentata vaseyana	34	34	30	.98	2.24	2.01
B	Cercocarpus ledifolius	8	14	9	.79	1.70	.36
B	Cercocarpus montanus	24	28	24	3.63	3.87	2.34
B	Chrysothamnus depressus	2	4	2	.53	.33	.06
B	Chrysothamnus viscidiflorus viscidiflorus	62	74	70	3.77	5.45	5.34
B	Gutierrezia sarothrae	14	16	16	.45	1.14	1.24
B	Juniperus scopulorum	0	0	0	-	.00	.00
B	Mahonia repens	33	31	31	2.75	2.49	1.05
B	Opuntia fragilis	4	3	1	-	.00	-
B	Pachistima myrsinites	0	0	1	-	-	-
B	Purshia tridentata	6	6	6	1.23	1.61	1.48
B	Quercus gambelii	14	17	15	4.83	2.41	2.04
B	Symphoricarpos oreophilus	57	54	58	6.97	6.71	7.53
B	Tetradymia canescens	13	16	15	.33	.33	.36
Total for Browse		292	322	297	27.06	29.51	25.67

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 8

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	1.00	1.25
Artemisia tridentata vaseyana	1.64	1.61
Cercocarpus ledifolius	4.81	4.44
Cercocarpus montanus	6.73	4.63
Chrysothamnus depressus	.15	.13
Chrysothamnus viscidiflorus viscidiflorus	8.01	6.38
Gutierrezia sarothrae	1.36	.90
Mahonia repens	2.01	.28
Purshia tridentata	1.31	1.51
Quercus gambelii	5.61	2.48
Symphoricarpos oreophilus	14.11	10.11
Tetradymia canescens	.53	.46

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 8

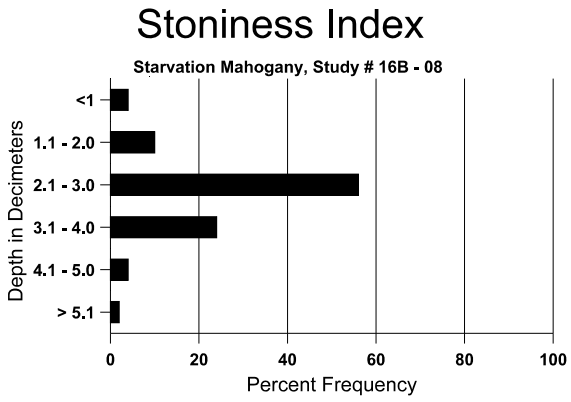
Species	Average leader growth (in)	
	'02	'07
Amelanchier utahensis	-	2.0
Artemisia tridentata vaseyana	1.9	-
Cercocarpus montanus	1.3	1.5
Purshia tridentata	1.1	-

BASIC COVER --
Management unit 16B, Study no: 8

Cover Type	Average Cover %			
	'89	'99	'02	'07
Vegetation	16.00	39.83	46.26	48.65
Rock	1.00	5.50	3.86	5.59
Pavement	.50	.72	1.46	.72
Litter	64.75	50.79	46.75	34.37
Cryptogams	.75	3.12	1.64	.32
Bare Ground	17.00	17.17	18.37	27.59

SOIL ANALYSIS DATA --
Herd Unit 16B, Study # 08, Starvation Mahogany

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.9	46.2 (15.1)	7.4	36.7	28.7	34.6	3.2	2.7	156.8	0.7



PELLET GROUP DATA --
Management unit 16B, Study no: 8

Type	Quadrat Frequency		
	'99	'02	'07
Rabbit	-	6	4
Elk	24	12	33
Deer	20	24	16
Cattle	2	2	-

Days use per acre (ha)		
'99	'02	'07
-	-	-
34 (84)	18 (45)	60 (147)
34 (84)	58 (144)	56 (139)
4 (10)	7 (16)	3 (7)

BROWSE CHARACTERISTICS --
Management unit 16B, Study no: 8

		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												
89	**2733**	200	2400	133	200	-	12	0	7	-	5	31/18
99	**500**	60	260	180	60	20	28	16	12	8	12	42/59
02	**580**	-	100	400	80	-	14	55	14	3	7	25/29
07	**480**	-	120	320	40	-	17	21	8	8	8	30/23
Artemisia tridentata vaseyana												
89	**799**	-	400	66	333	-	58	0	42	-	0	18/22
99	**940**	-	20	520	400	800	21	6	43	11	11	18/24
02	**900**	-	20	580	300	360	18	7	33	11	11	17/24
07	**760**	40	40	480	240	160	39	34	32	21	21	20/29
Cercocarpus ledifolius												
89	**1066**	1200	666	400	-	-	0	0	0	-	0	235/146
99	**180**	60	120	40	20	20	11	33	11	11	11	140/152
02	**300**	-	180	100	20	-	7	80	7	-	7	27/27
07	**220**	-	100	100	20	-	18	64	9	-	0	23/18
Ceanothus martinii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
99	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	9/26
07	**0**	-	-	-	-	-	0	0	-	-	0	10/30
Cercocarpus montanus												
89	**2799**	133	2133	600	66	-	36	2	2	-	0	30/20
99	**740**	100	420	320	-	-	30	19	0	-	0	38/40
02	**740**	-	120	580	40	-	11	59	5	3	5	24/27
07	**640**	20	160	460	20	-	6	66	3	3	3	27/30

		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)
Chrysothamnus depressus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
99	**220**	-	-	220	-	-	0	0	-	-	0	-/-
02	**280**	-	-	280	-	-	0	0	-	-	0	3/11
07	**60**	-	-	60	-	-	0	0	-	-	0	3/8
Chrysothamnus viscidiflorus viscidiflorus												
89	**5600**	-	4000	1200	400	-	0	0	7	.35	1	11/12
99	**4780**	-	220	4440	120	-	0	0	3	.83	.83	12/15
02	**6300**	-	220	5880	200	40	.31	0	3	-	0	10/15
07	**5080**	60	120	4920	40	-	0	0	1	.78	.78	10/16
Gutierrezia sarothrae												
89	**399**	-	133	266	-	-	0	0	-	-	0	8/7
99	**1020**	40	240	780	-	-	4	0	-	-	0	6/12
02	**1440**	-	20	1420	-	-	0	0	-	-	0	3/8
07	**1800**	-	20	1780	-	-	0	0	-	-	0	8/9
Juniperus scopulorum												
89	**0**	66	-	-	-	-	0	0	-	-	0	-/-
99	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Mahonia repens												
89	**14000**	666	12200	1800	-	-	0	0	0	-	0	4/4
99	**9900**	160	4280	5620	-	-	0	0	0	-	0	4/4
02	**8100**	-	560	7440	100	-	0	0	1	-	0	3/4
07	**6300**	-	20	6280	-	-	0	0	0	-	0	2/3
Opuntia fragilis												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
99	**140**	20	60	60	20	-	0	0	14	14	14	4/9
02	**80**	-	60	20	-	-	0	0	0	-	0	-/-
07	**60**	-	-	60	-	-	0	0	0	-	0	3/11
Pachistima myrsinites												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
99	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	6/8

		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												
89	**66**	-	66	-	-	-	0	0	-	-	100	-/-
99	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**200**	-	-	200	-	-	0	67	0	-	33	14/23
99	**120**	-	20	80	20	-	33	50	17	-	0	17/44
02	**120**	-	-	120	-	-	17	83	0	-	0	13/31
07	**140**	-	-	140	-	-	14	86	0	-	0	11/27
Quercus gambelii												
89	**1132**	133	666	66	400	-	0	0	35	-	0	177/39
99	**1980**	500	1060	880	40	220	1	0	2	-	0	86/38
02	**2420**	40	540	1280	600	240	.82	.82	25	17	17	46/20
07	**1840**	60	580	580	680	20	7	29	37	4	47	40/18
Symphoricarpos oreophilus												
89	**10599**	-	5933	3066	1600	-	10	0	15	.18	.62	17/20
99	**3120**	140	800	2180	140	-	0	0	4	1	1	17/38
02	**2420**	-	100	2140	180	-	0	13	7	2	3	13/32
07	**4380**	-	620	3740	20	-	.91	0	0	-	0	15/23
Tetradymia canescens												
89	**399**	-	133	133	133	-	0	0	33	-	0	16/12
99	**320**	-	60	200	60	-	0	0	19	-	0	12/15
02	**380**	-	20	320	40	-	5	0	11	5	5	10/14
07	**380**	-	20	340	20	-	21	42	5	5	5	10/16

Trend Study 16B-9-07

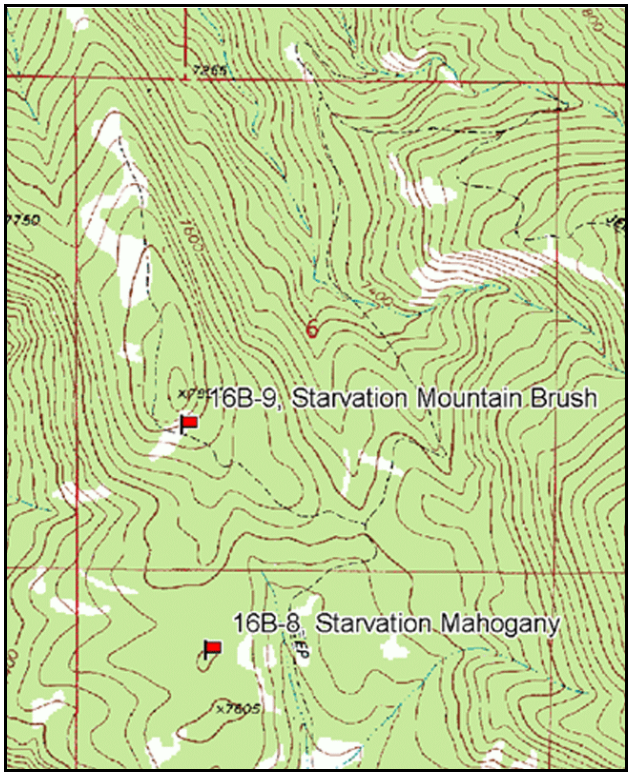
Study site name: Starvation Mountain Brush . Vegetation type: Mountain Brush .

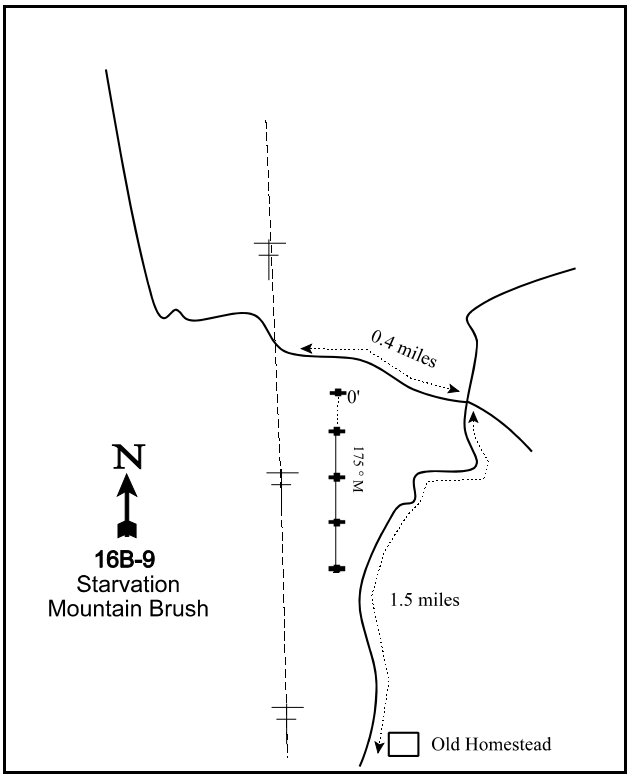
Compass bearing: frequency baseline 175 degrees magnetic.

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

LOCATION DESCRIPTION

From Tucker rest area on Highway 50/6 in Spanish Fork Canyon, take the Starvation Canyon road 4.6 miles. Turn left and go 0.5 miles to another fork. Turn left and go up a small canyon on a rough road for 1.15 miles to a fork. Turn left, cross the creek, and go 0.3 miles to an old homestead site. Continue on this road for 1.5 miles to a 4-way intersection. Turn left (west) and go 0.4 miles and park beneath the powerlines. The 0-foot stake of the baseline is 30 feet away from the road marked by browse tag #432.





Map Name: Tucker

Diagrammatic Sketch

Township 11S , Range 7E , Section 6

GPS: NAD 83, UTM 12S 484035 E 4415604 N

DISCUSSION

Starvation Mountain Brush - Trend Study No. 16B-9

Study Information

This study was established in 1989 and samples a mixed mountain brush community in the Starvation Creek drainage on Division of Wildlife Resources property [elevation: 7,800 feet (2,378 m), slope: 25%-35%, aspect: south]. This study lies above and north of the curl-leaf mahogany bench sampled by the Starvation Mahogany study (16B-8), and is within a power line easement. Starvation Creek is located 0.75 miles (1.2 km) to the west and there is a spring 0.75 miles (1.2 km) to the south. From the pellet group transect data, there were an estimated 45 deer days use/acre (111 ddu/ha) in 1999, 68 deer days use/acre (169 ddu/ha) in 2002, and 31 deer days use/acre (76 ddu/ha) in 2007. Elk use was estimated at 64 days use/acre (159 edu/ha) in 1999, 19 days use/acre (48 edu/ha) in 2002, and 94 days use/acre (233 edu/ha) in 2007. The surrounding area provides excellent thermal and escape cover for wildlife, with large curl-leaf mahogany thickets scattered in all directions.

Soil

The soil has a clay loam texture and is slightly alkaline in reactivity (pH of 7.4). The profile is shallow and rocky. Organic matter content is very high at 5.5% and may be related to the abundance of surface litter. Relative bare ground cover has been between 15% and 23% since 1999. When coupled with the steep slope, the rocky soils may produce runoff and reduce the amount of effective precipitation. Pedestalling and terracing occur on the steeper areas. The erosion condition was classified as slight in 2002 and improved to stable in 2007.

Browse

Browse is diverse with many key species present. The most important species include Utah serviceberry (*Amelanchier utahensis*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), true mountain mahogany (*Cercocarpus montanus*), and antelope bitterbrush (*Purshia tridentata*). These key species provide about half of the total browse cover and approximately 40% of the total vegetative cover. The sagebrush is classified as mountain big sagebrush, but some of the population displays characteristics of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). It is likely that a portion of the population is a hybrid of the two subspecies. Since 2002, sagebrush canopy cover has been 7%. The estimated sagebrush density has varied little since 1999 and averages 1,670 plants/acre (4,134 plants/ha). These estimates are lower than the initial estimate of 2,666 plants/acre (6,588 plants/ha) in 1989. The extension of the baseline in 1999 accounts for most of the differences in sagebrush density. This larger sample area better samples browse populations that have clumped and/or discontinuous distributions. Decadency has fluctuated each sample year and was highest in 1989 and 2002 at 35% and 26%, respectively. Reproduction and recruitment have been low since 1999. All of the sampled plants had good vigor in 1989, and in all successive sample years the plants exhibiting poor vigor have ranged from 10% to 14%. Annual growth on sagebrush averaged just under 1.9 inches (4.7 cm) in 2002 and 1.6 inches (4.0 cm) in 2007. About half of the sagebrush plants have had heavy browse use, except for in 1999 when only 13% of the plants had heavy use.

Canopy cover of Utah serviceberry has been approximately 1% since 2002. In 1999 the density of serviceberry was 1,060 plants/acre (2,624 plants/ha). The density increased to 1,400 plants/acre (3,465 plants/ha) in 2002, and decreased to 740 plants/acre (1,832 plants/ha) in 2007. Seedling plants were present at moderate densities in 1989 and 1999, but have not been sampled since. Young plants decreased from 72% of the population in 1989, to 25% in 1999, then increased to 30% in 2002, and decreased to 16% in 2007. Decadence was highest in 2002 (31%) and lowest in 2007 (5%). Since 1999, the proportion of plants with poor vigor decreased from 25% to 5%. In 1999, the annual leader growth on serviceberry averaged 3-5 inches (7.6-12.7 cm). The annual growth was longest on stems which were protected and/or unavailable to browsing animals. Average leader growth decreased to approximately 2 inches (5 cm) in 2002 and 2007. The majority

of browse use was moderate-heavy from 1989 to 2002, but changed to light use in 2007.

The canopy cover of true mountain mahogany has been approximately 3% since 2002. There was an estimated density of 1,120 plants/acre (2,772 plants/ha) in 1999 and 2002, which decreased slightly to 1,000 plants/acre (2,475 plants/ha) in 2007. Young plants have comprised a decreasing proportion of the population, declining from 33% in 1989 to approximately 9% in 2002 and 2007. Decadence has been moderate to low, ranging from 0% in 1989 to 27% in 2002. The moderate decadence in 2002 was likely the result of dry conditions (Utah Climate Summaries 2007). Eleven percent or less of the population has had poor vigor. Plants with moderate to heavy browse use have accounted for 84% or more since 1989 However, mahogany can tolerate heavy browsing, and may even require it to maintain new growth (Turley et al. 2003). Most of the population has had normal vigor in spite of the heavy browse use.

The canopy cover of antelope bitterbrush was 3% in 2002 and 2% in 2007. Bitterbrush has the lowest population density of the browse species, estimated at approximately 500 plants/acre (1,235 plants/ha). Decadence increased from 0% of the population in 1989 and 1999 to 50% in 2002, and decreased to 8% in 2007. Plants with moderate-heavy use increased each sample year and peaked at 100% of the population in 2002, then decreased slightly to 92% in 2007. In 2002, the few juniper trees present were cut down as routine maintenance on the powerline easement.

Herbaceous Understory

The herbaceous understory is dominated by perennial species and is quite diverse. Seeded grasses are present and were probably used to revegetate the power line corridor which runs directly through the area. Perennial grass cover increased from 6% in 1997 to 20% by 2007. Crested wheatgrass (*Agropyron cristatum*) is the dominant species, providing between 71% and 92% of the grass cover since 1999. Other perennial grasses include bluebunch wheatgrass (*Agropyron spicatum*), mutton bluegrass (*Poa fendleriana*), Indian ricegrass (*Oryzopsis hymenoides*), Kentucky bluegrass (*Poa pratensis*), and intermediate wheatgrass (*Agropyron intermedium*). Cheatgrass (*Bromus tectorum*) quadrat frequency was less than 10% in 1997 and 2002, and increased to 47% in 2007, but cover has been less than 1% all sample years.

Forbs are diverse as well, but perennial forb cover has been 4% or less since 1997. Hood's phlox (*Phlox hoodii*) is the most abundant forb, which provides nearly half of the forb cover. All other species occur infrequently. Annuals are present but infrequent, and have not been a significant component of the vegetative community. Houndstongue (*Cynoglossum officinale*), a noxious weed, was sampled in 1989 in one quadrat and has not been sampled since. With drought in 2002, the sum of nested frequency for perennial forbs declined while perennial grasses remained stable.

1999 TREND ASSESSMENT

The browse trend is stable. Density of Utah serviceberry and mountain big sagebrush decreased, and density of true mountain mahogany and bitterbrush increased. However, the changes were attributed to the change in the sample area measured in 1999. In this instance, trend was determined from other parameters. Decadence increased for serviceberry and true mountain mahogany, decreased for sagebrush, and remained the same for bitterbrush. There was a decline in recruitment for all four key browse species. The proportion of plants exhibiting poor vigor increased for serviceberry, sagebrush, and true mountain mahogany, but remained constant for bitterbrush. Use is moderate-heavy on these species. The grass trend is slightly up. The sum of nested frequency for perennial grasses increased by 23%, and two new perennial species were measured. Crested wheatgrass nested frequency increased significantly. However, these changes were likely to also be the result of the larger area sampled. The forb trend is stable. The sum of nested frequency changed little, decreasing 2%. The noxious weed houndstongue had been sampled in 1989, and was absent in 1999. The Desirable Components Index (DCI) score was fair due to the high preferred browse cover, moderate percentage of browse decadency, and low perennial herbaceous cover.

winter range condition (DCI) - fair (60) High potential scale
browse - stable (0) grass - slightly up (+1) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is stable. Overall, there was a 11% increase in density of Utah serviceberry, mountain big sagebrush, true mountain mahogany, and antelope bitterbrush. However, the preferred browse species showed some negative effects from the drought. Decadency increased for all four preferred browse species, and plants showing poor vigor increased in the sagebrush, mahogany, and bitterbrush populations. Moderate-heavy browse use increased on the four preferred species. With the exception of sagebrush, the key browse are tolerant to heavy browsing (Wandera et al. 1992). The grass trend is stable. The sum of nested frequency of perennial grasses changed little, increasing 2%, and species richness remained stable. The forb trend is down. The sum of nested frequency for perennial forbs decreased by 29%, including significant decreases in the nested frequencies of two perennial species. The DCI score remained fair because the increase in perennial grass cover countered the increase in browse decadency.

winter range condition (DCI) - fair (60) High potential scale
browse - stable (0) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is slightly down. The density of serviceberry and sagebrush decreased by 47% and 14%, respectively. Bitterbrush and mahogany densities also decreased, but to a smaller degree. However, vigor improved and decadency decreased for the four preferred browse species, but the overall decrease in plant density was given more weight than the improved plant health. The grass trend is stable. The sum of nested frequency for perennial grasses increased 6%, but the nested frequency of cheatgrass increased by nearly thirty-fold. The quadrat frequency of cheatgrass increased from 2% to 47%, however, it still provided less than 1% cover. Crested wheatgrass cover increased from 9% to 18%. The forb trend is stable. The sum of nested frequency for perennial forbs decreased 6%, and diversity remained high. The sum of nested frequency for annual forbs increased ten-fold, due to increases in pale alyssum (*Alyssum alyssoides*) and blue-eyed Mary (*Collinsia parviflora*). The DCI score improved to good due to the increase in perennial grass cover and a decrease in browse decadency.

winter range condition (DCI) - good (73) High potential scale
browse - slightly down (-1) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 9

Type	Species	Nested Frequency				Average Cover %		
		'89	'99	'02	'07	'99	'02	'07
G	Agropyron cristatum	$_{a}$78	$_{b}$168	$_{b}$180	$_{b}$197	4.31	9.44	17.70
G	Agropyron intermedium	$_{a}$6	$_{a}$8	$_{a}$6	$_{a}$6	.18	.07	.63
G	Agropyron smithii	-	-	$_{a}$4	$_{a}$2	-	.15	.01
G	Agropyron spicatum	$_{b}$55	$_{ab}$25	$_{a}$10	$_{a}$19	.62	.08	1.14
G	Bromus inermis	$_{a}$4	$_{a}$1	-	-	.00	-	-
G	Bromus tectorum (a)	-	$_{a}$23	$_{a}$4	$_{b}$118	.22	.03	.82
G	Carex sp.	-	$_{a}$3	$_{a}$5	-	.00	.09	-
G	Oryzopsis hymenoides	-	$_{a}$3	$_{a}$8	-	.03	.06	-

Type	Species	Nested Frequency				Average Cover %		
		'89	'99	'02	'07	'99	'02	'07
G	Poa fendleriana	$_{b}$26	$_{ab}$18	$_{b}$20	$_{a}$3	.36	.14	.03
G	Poa pratensis	-	$_{a}$5	$_{a}$6	$_{a}$21	.30	.18	.72
G	Sitanion hystrix	$_{b}$21	$_{ab}$4	$_{a}$1	$_{ab}$6	.02	.03	.18
G	Stipa lettermani	1	-	-	-	-	-	-
Total for Annual Grasses		0	23	4	118	0.21	0.03	0.82
Total for Perennial Grasses		191	235	240	254	5.85	10.26	20.44
Total for Grasses		191	258	244	372	6.07	10.29	21.27
F	Achillea millefolium	-	-	-	1	-	-	.00
F	Agoseris glauca	-	-	$_{a}$2	$_{a}$3	-	.00	.01
F	Alyssum alyssoides (a)	-	-	-	54	-	-	.21
F	Arabis sp.	-	-	$_{a}$1	$_{a}$2	-	.00	.01
F	Aster chilensis	-	-	$_{a}$4	$_{a}$3	-	.01	.01
F	Astragalus convallarius	-	-	1	-	-	.00	-
F	Astragalus sp.	8	-	-	-	-	-	-
F	Calochortus nuttallii	-	-	$_{a}$2	$_{a}$1	-	.00	.00
F	Chaenactis douglasii	$_{a}$14	$_{a}$19	$_{a}$4	$_{a}$6	.07	.01	.03
F	Cirsium sp.	$_{ab}$8	$_{b}$19	$_{ab}$7	$_{a}$2	.08	.09	.15
F	Collomia linearis (a)	-	-	3	-	-	.00	-
F	Comandra pallida	-	-	-	5	-	-	.03
F	Collinsia parviflora (a)	-	-	-	19	-	-	.09
F	Cryptantha sp.	-	$_{b}$16	$_{a}$7	$_{ab}$14	.45	.18	.22
F	Cymopterus sp.	-	-	-	3	-	-	.00
F	Cynoglossum officinale	2	-	-	-	-	-	-
F	Descurainia pinnata (a)	-	-	-	2	-	-	.03
F	Eriogonum racemosum	$_{a}$1	$_{a}$1	-	-	.00	-	-
F	Eriogonum umbellatum	$_{a}$2	$_{a}$3	$_{a}$3	$_{a}$2	.03	.00	.00
F	Lappula occidentalis (a)	-	-	-	1	-	-	.00
F	Lepidium sp. (a)	-	-	-	6	-	-	.02
F	Lomatium sp.	-	-	-	2	-	-	.03
F	Machaeranthera canescens	$_{b}$91	$_{a}$21	$_{a}$20	$_{a}$8	.13	.23	.18
F	Microsteris gracilis (a)	-	1	-	-	.00	-	-
F	Penstemon caespitosus	-	$_{a}$1	$_{a}$2	$_{a}$4	.00	.01	.03
F	Penstemon cyananthus	$_{a}$30	$_{a}$31	$_{a}$21	-	.18	.53	-
F	Penstemon humilis	$_{a}$11	-	$_{a}$4	-	-	.01	-
F	Penstemon sp.	$_{a}$14	$_{b}$31	$_{a}$14	$_{ab}$29	.85	.10	.32
F	Phlox hoodii	$_{a}$16	$_{c}$81	$_{bc}$59	$_{b}$44	1.89	1.14	1.07

Type	Species	Nested Frequency				Average Cover %		
		'89	'99	'02	'07	'99	'02	'07
F	Phlox longifolia	$_{b}$51	$_{a}$7	$_{a}$17	$_{a}$21	.01	.06	.05
F	Ranunculus testiculatus (a)	-	-	$_{a}$3	$_{b}$15	-	.01	.03
F	Senecio multilobatus	-	-	-	4	-	-	.06
F	Streptanthus cordatus	$_{a}$4	$_{a}$4	$_{a}$3	$_{a}$3	.01	.00	.03
F	Taraxacum officinale	$_{a}$1	$_{a}$7	-	$_{a}$6	.04	-	.07
F	Tragopogon dubius	-	3	-	-	.00	-	-
F	Veronica biloba (a)	-	-	3	-	-	.00	-
F	Verbascum thapsus	1	-	-	-	-	-	-
F	Viguiera multiflora	-	$_{a}$5	$_{a}$5	$_{a}$3	.06	.06	.03
Total for Annual Forbs		0	1	9	97	0.00	0.01	0.39
Total for Perennial Forbs		254	249	176	166	3.84	2.50	2.37
Total for Forbs		254	250	185	263	3.85	2.51	2.77

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

BROWSE TRENDS --
Management unit 16B, Study no: 9

Type	Species	Strip Frequency			Average Cover %		
		'99	'02	'07	'99	'02	'07
B	Amelanchier utahensis	42	42	28	2.33	2.07	2.00
B	Artemisia tridentata vaseyana	50	54	51	7.06	9.42	8.68
B	Cercocarpus montanus	46	41	38	4.28	3.96	3.57
B	Chrysothamnus depressus	2	3	0	-	-	-
B	Chrysothamnus viscidiflorus viscidiflorus	44	47	35	2.21	1.54	1.37
B	Juniperus osteosperma	0	0	0	1.23	.00	-
B	Mahonia repens	7	6	7	.51	.01	.09
B	Opuntia sp.	1	2	0	.00	.01	-
B	Purshia tridentata	19	18	19	3.33	2.73	2.52
B	Quercus gambelii	0	0	1	.00	-	.00
B	Symphoricarpos oreophilus	91	87	72	14.12	10.95	7.21
B	Tetradymia canescens	20	15	20	1.09	1.88	2.46
Total for Browse		322	315	271	36.20	32.61	27.94

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 9

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	1.46	1.26
Artemisia tridentata vaseyana	6.05	8.56
Cercocarpus montanus	4.01	2.18
Chrysothamnus depressus	.11	-
Chrysothamnus viscidiflorus viscidiflorus	2.84	2.88
Juniperus osteosperma	-	-
Mahonia repens	-	.20
Purshia tridentata	3.13	2.00
Symphoricarpos oreophilus	13.39	8.63
Tetradymia canescens	1.60	1.78

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 9

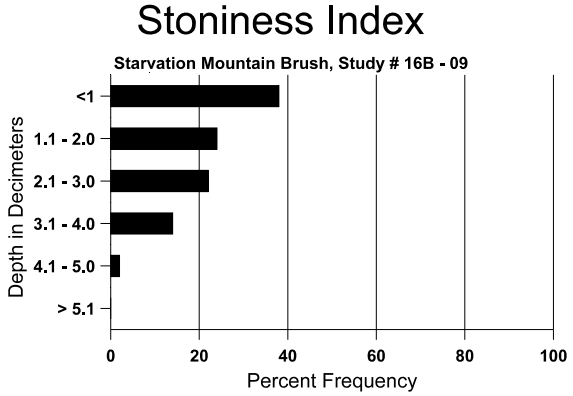
Species	Average leader growth (in)	
	'02	'07
Amelanchier utahensis	1.6	2.0
Artemisia tridentata vaseyana	1.9	1.6
Cercocarpus montanus	1.3	2.0
Purshia tridentata	3.8	-

BASIC COVER --
Management unit 16B, Study no: 9

Cover Type	Average Cover %			
	'89	'99	'02	'07
Vegetation	12.50	41.06	41.41	47.06
Rock	12.00	6.14	5.58	5.63
Pavement	11.50	3.91	3.01	2.76
Litter	54.25	50.65	40.02	35.72
Cryptogams	.50	2.03	.10	.03
Bare Ground	4.00	18.73	26.22	25.08

SOIL ANALYSIS DATA --
Herd Unit 16B, Study # 09, Starvation Mountain Brush

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
12.5	51.0 (13.3)	7.4	36.7	22.7	40.6	5.5	8.5	121.6	0.7



PELLET GROUP DATA --
Management unit 16B, Study no: 9

Type	Quadrat Frequency		
	'99	'02	'07
Sheep	3	1	-
Rabbit	2	7	-
Elk	37	20	47
Deer	22	31	6

Days use per acre (ha)		
'99	'02	'07
5 (11)	-	-
-	-	-
64 (158)	19 (48)	94 (233)
54 (111)	68 (168)	31 (76)

BROWSE CHARACTERISTICS --
Management unit 16B, Study no: 9

		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												
89	**4733**	733	3400	733	600	-	41	34	13	-	3	28/27
99	**1060**	100	260	540	260	180	30	36	25	19	25	24/23
02	**1400**	-	420	540	440	60	7	60	31	14	14	19/21
07	**740**	-	120	580	40	-	22	8	5	5	5	19/15
Artemisia tridentata vaseyana												
89	**2666**	66	600	1133	933	-	25	48	35	-	0	21/22
99	**1660**	40	100	1240	320	980	36	13	19	10	10	23/30
02	**1800**	-	20	1320	460	600	31	53	26	9	14	21/27
07	**1540**	-	80	1220	240	220	34	51	16	10	13	23/32
Cercocarpus montanus												
89	**399**	66	133	266	-	-	17	67	0	-	0	25/27
99	**1120**	120	160	820	140	-	29	55	13	5	9	32/33
02	**1120**	-	100	720	300	60	2	93	27	11	11	27/32
07	**1000**	20	100	720	180	40	24	74	18	4	4	24/23

		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)
Chrysothamnus depressus												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
99	**160**	-	-	140	20	-	0	13	13	13	13	-/-
02	**220**	-	-	220	-	-	73	0	0	-	0	6/11
07	**0**	-	-	-	-	-	0	0	0	-	0	-/-
Chrysothamnus viscidiflorus viscidiflorus												
89	**4333**	-	533	3400	400	-	0	0	9	-	2	12/15
99	**2780**	-	220	2400	160	-	8	0	6	4	4	8/14
02	**2300**	-	180	2080	40	-	0	0	2	-	.86	7/12
07	**1520**	-	40	1460	20	-	0	0	1	-	0	7/12
Cowania mexicana stansburiana												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
99	**0**	-	-	-	-	-	0	0	-	-	0	44/48
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Juniperus osteosperma												
89	**0**	66	-	-	-	-	0	0	-	-	0	-/-
99	**0**	20	-	-	-	-	0	0	-	-	0	-/-
02	**0**	20	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Mahonia repens												
89	**200**	-	200	-	-	-	0	0	-	-	0	-/-
99	**2040**	-	420	1620	-	-	0	0	-	-	0	2/5
02	**1140**	-	-	1140	-	-	0	0	-	-	0	4/4
07	**1480**	-	-	1480	-	-	0	0	-	-	0	2/3
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
99	**20**	-	-	20	-	-	0	0	-	-	0	3/21
02	**60**	-	40	20	-	-	0	0	-	-	0	2/13
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**132**	66	66	66	-	-	50	0	0	-	0	17/19
99	**540**	-	100	440	-	40	63	15	0	-	0	23/51
02	**520**	-	40	220	260	-	12	88	50	23	23	16/43
07	**500**	-	100	360	40	-	24	68	8	4	4	20/37

		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)
Quercus gambelii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
99	**0**	20	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	20	-	-	-	0	0	-	-	0	33/15
Symphoricarpos oreophilus												
89	**8332**	200	1533	5933	866	-	4	.80	10	.72	10	16/21
99	**5800**	320	1400	4160	240	60	2	0	4	3	5	19/33
02	**6980**	-	1060	5660	260	20	0	0	4	1	2	11/17
07	**3560**	40	1060	2500	-	-	3	0	0	-	0	12/18
Tetradymia canescens												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
99	**960**	140	220	600	140	-	6	0	15	2	2	13/20
02	**600**	-	20	460	120	-	3	3	20	13	13	12/21
07	**800**	40	80	680	40	-	0	0	5	-	0	11/22

Trend Study 16B-10-07

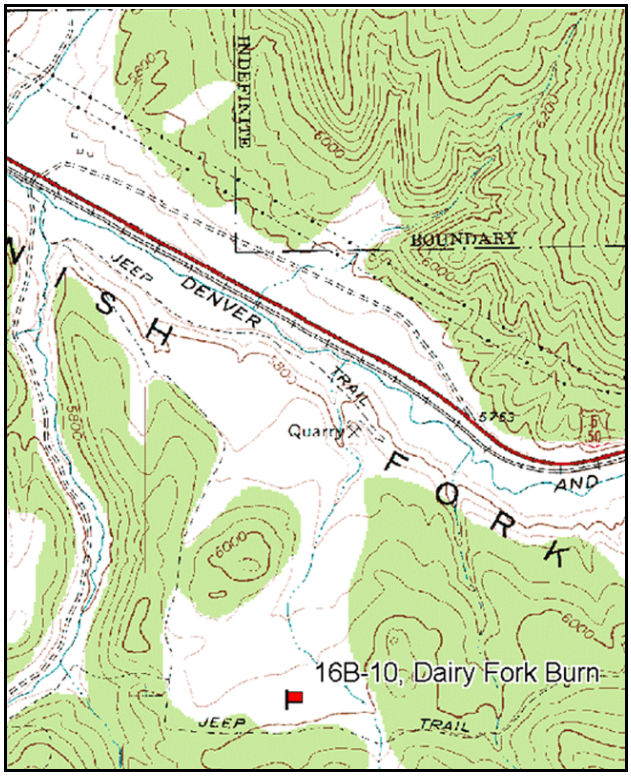
Study site name: Dairy Fork Burn . Vegetation type: Big Sagebrush-Burn .

Compass bearing: frequency baseline 165 degrees magnetic.

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

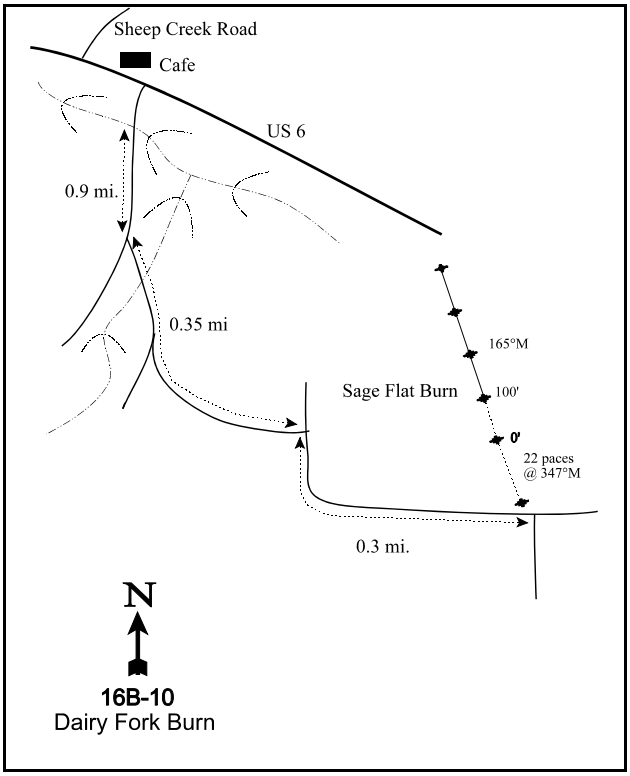
LOCATION DESCRIPTION

Near the Sheep Creek cafe on Highway 6, take Dairy Fork Road on the south side of the highway 0.9 miles to a left hand fork. Take this fork, cross the creek and go 0.35 miles staying east (left) to a sagebrush flat/burn and a 3-way intersection. Turn right (south) and follow the road around upper edge of flat for 0.3 miles to a junction on the right and a witness post on the left. Stop here and walk north into the flat about 22 paces at an azimuth of 347 degrees magnetic to the l00-foot baseline stake.



Map Name: Mill Fork

Township 15S ,Range 5E , Section 7



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 471934 E 4423126 N

DISCUSSION

Dairy Fork Burn - Trend Study No. 16B-10

Study Information

This study was established in 1989 and samples a burned sagebrush flat surrounded by juniper [elevation: 6,000 feet (1,830 m), slope: 3%, aspect: north]. This Division of Wildlife Resources property was burned, treated with a disc-chain, and seeded in 1988. As a result, the basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) population was largely eliminated. A 1978 line-intercept transect is located at the north end of the flat, and the present study was established to monitor recovery of basin big sagebrush. The study is 0.6 miles (1 km) south of Soldier Creek. There has been light deer use and moderate-heavy elk use. Quadrat frequency of deer and elk pellet groups has averaged 12% and 41%, respectively, since 1997. From the pellet group transect data, there were an estimated 5 deer days use/acre (13 ddu/ha) in 2002 and 2 deer days use/acre (5 ddu/ha) in 2007. Elk use was estimated at 116 days use/acre (288 edu/ha) in 2002 and 115 days use/acre (284 edu/ha) in 2007. Domestic sheep had been trailed through the area in 2002, just prior to sampling, and use was estimated at 34 days use/acre (84 sdu/ha). About one-third of the elk pellet groups were from spring.

Soil

The moderately deep soil has a clay texture and reactivity is slightly alkaline (pH 7.4). Bare soil cover was approximately 40% from 1989 to 2002, then decreased to 25% in 2007. Due to the gentle slope, erosion is minimal. Adjacent areas without herbaceous cover appear to have significant soil movement. The erosion condition was classified as be slight in 2002 and was at the upper threshold of stable in 2007. There is a gully paralleling the study that shows some sign of activity, though the gully bottom is vegetated.

Browse

When this study was established in 1989, no density plots were established to estimate sagebrush density because there were no plants to sample. In 1997, sagebrush density was estimated at 300 plants/acre (743 plants/ha), which steadily increased to 520 plants/acre (1,287 plants/ha) in 2007. Sagebrush canopy cover was 5% in 2007. Recruitment from the young age class was high in 1997 at 40% of the population, and decreased to approximately 20% in 2002 and 2007. Decadent plants were first sampled in 2002, with only 13% of the population being classified as such. Decadency remained stable in 2007. The dead sagebrush plants listed in the browse characteristics table in 1997 and 2002 were plants that existed in the original population before the burn treatment. The percentage of plants exhibiting poor vigor was low until 2007, when one-third of the plants were infested by the sagebrush defoliator moth (*Aroga websteri*). Sagebrush annual growth was estimated at nearly 3 inches (7.4 cm) in 2002 and was only 1.6 inches (4 cm) in 2007. Browse use has been light every sample year.

Herbaceous Understory

The herbaceous understory was initially dominated by forbs in 1989, but in subsequent sample years perennial grasses have been more abundant. This transition is partly the result of the larger area sampled beginning in 1997, and partly the result of the establishment of seeded grass species. Perennial grass cover increased from 19% in 1997 to 36% by 2007. The two most abundant grasses are crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*Agropyron intermedium*). Crested wheatgrass provided 8% cover in 1997, 16% in 2002, and 29% in 2007. Since 2002, crested wheatgrass has accounted for over 60% of the vegetation cover. The decrease in cheatgrass (*Bromus tectorum*) frequency coincides with an increase in crested wheatgrass, suggesting that the crested wheatgrass is out-competing the cheatgrass. Native grasses are present, but at lower frequencies than the seeded grasses.

Since 1989, the sum of nested frequency for forbs has steadily declined due to a significant reduction in the frequency of two weedy species, musk thistle (*Carduus nutans*) and prickly lettuce (*Lactuca serriola*). Perennial forb cover was 3% in 1997, less than 1% in 2002, and 4% in 2007. Musk thistle was the dominant

herbaceous species in the treated area in 1989. However, this undesirable, noxious weed was infested with a weevil and there was little viable seed. Musk thistle has steadily declined, and was not sampled in 2002 or 2007. Some of the decline may be the result of competition with perennial grasses. Drought in 2002 (Utah Climate Summaries 2007) also likely played a role in decreased nested frequency of perennial forbs. Whitetop (*Cardaria draba*), another noxious weed, was sampled in 7% of the quadrats in 2002 and 2007.

1997 TREND ASSESSMENT

The browse trend is up. The density of basin big sagebrush increased from 0 plants/acre to 300 plants/acre (743 plants/ha). Young plants made up 40% of the population, and there were no decadent plants. Plant vigor is normal on nearly all of the sagebrush plants, and browse use was light. The grass trend is up. The sum of nested frequency for perennial grasses increased six-fold, and the increase in nested frequency was statistically significant for 5 of the 8 perennial grasses. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased by 57%, and most of the decrease was from timber poisonvetch (*Astragalus convallarius*), prickly lettuce, and false yarrow (*Chaenactis douglasii*). However, there was also a significant decline (54%) in nested frequency of musk thistle, and this decline countered the decline in nested frequency of the perennial forbs. Despite the high perennial grass cover, the Desirable Components Index (DCI) score was very poor-poor due to the low browse cover and the presence of a noxious weed.

winter range condition (DCI) - very poor-poor (34) Mid-level potential scale
browse - up (+2) grass - up (+2) forb - slightly down (-1)

2002 TREND ASSESSMENT

The browse trend is slightly up. The density of sagebrush increased 38% to 480 plants/acre (1,188 plants/ha). Young plants make up 21% of the population in spite of drought conditions. Decadency increased to 13% of the population. Vigor remained stable and browse use remained light. The grass trend is slightly down. The sum of nested frequency of perennial grasses decreased by 19%, and most of the decrease was due to a significant decrease in the nested frequency of bottlebrush squirreltail (*Sitanion hystrix*). Other perennial species decreased, but not significantly. However, the nested frequency of crested wheatgrass increased significantly. Bottlebrush squirreltail was the only perennial grass that had not been heavily grazed by domestic sheep. There was also a significant decrease in cheatgrass nested frequency. The forb trend is down. The sum of nested frequency for perennial forbs declined by 81%, including a significant decrease in the nested frequency of timber poisonvetch. The number of perennial forb species sampled decreased from 14 to six. The nested frequency of annual forbs decreased by 86%, and is likely the result of the drought. Musk thistle decreased from a quadrat frequency of 46% to 0%, but a new noxious weed, whitetop, was sampled in 7% of the quadrats. The DCI score decreased to very poor due to the decrease in perennial forb cover.

winter range condition (DCI) - very poor (31) Mid-level potential scale
browse - slightly up (+1) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is stable. Sagebrush density increased 8%. The young and decadent age classes changed little, and the proportion of plants exhibiting poor vigor increased to 35%. This increase was partly caused by the sagebrush defoliator moth (*Aroga websteri*) and to the high number of chlorotic plants. The grass trend is up. The sum of nested frequency for perennial grasses increased by 18%, including a significant increase in the nested frequency of smooth brome (*Bromus inermis*). Perennial grass cover increased from 22% to 36%. Cheatgrass abundance remained low. Crested wheatgrass may be out-competing cheatgrass. The forb trend is up. The sum of nested frequency for perennial forbs increased nearly five-fold. Most of the increase was from a significant increase in the nested frequency of timber poisonvetch. However, the sum of nested frequency also increased for annual forbs, especially bur buttercup (*Ranunculus testiculatus*). Whitetop remained stable. The DCI score improved to poor due to increased perennial forb cover.

winter range condition (DCI) - poor (39) Mid-level potential scale
browse - stable (0) grass - up (+2) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 10

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	a11	b209	c285	c287	8.24	15.97	28.93
G	Agropyron intermedium	a1	b108	b85	b109	5.00	4.20	4.12
G	Bromus inermis	a1	bc86	b50	c85	2.21	.58	1.70
G	Bromus tectorum (a)	-	b132	a18	a19	.88	.32	.11
G	Dactylis glomerata	a9	a10	a2	-	.09	.00	-
G	Oryzopsis hymenoides	a1	ab6	b15	ab4	.56	.31	.41
G	Poa fendleriana	1	-	-	-	-	-	-
G	Poa pratensis	a2	b27	-	b35	.53	-	.66
G	Poa secunda	-	a5	-	a1	.12	-	.00
G	Sitanion hystrix	b69	c118	a25	a22	2.71	.90	.49
Total for Annual Grasses		0	132	18	19	0.88	0.31	0.11
Total for Perennial Grasses		95	569	462	543	19.49	21.97	36.34
Total for Grasses		95	701	480	562	20.38	22.29	36.46
F	Achillea millefolium	a3	a4	a5	a3	.63	.03	.63
F	Alyssum alyssoides (a)	-	a6	a6	a15	.01	.03	.04
F	Astragalus cibarius	3	-	-	-	-	-	-
F	Astragalus convallarius	c113	b62	a3	c120	.46	.00	2.35
F	Astragalus tenellus	a9	a5	-	a3	.04	-	.38
F	Cardaria draba	-	-	a16	a14	-	.04	.03
F	Camelina microcarpa (a)	-	42	-	-	.13	-	-
F	Carduus nutans (a)	b230	a106	-	-	3.23	-	-
F	Chaenactis douglasii	b145	a25	a4	-	.05	.01	-
F	Cirsium sp.	-	a3	-	a3	.03	-	.02
F	Comandra pallida	-	b36	-	a3	.56	-	.00
F	Collinsia parviflora (a)	-	a2	-	a5	.00	-	.01
F	Descurainia pinnata (a)	-	2	-	-	.00	-	-
F	Epilobium brachycarpum (a)	-	5	-	-	.01	-	-
F	Grindelia squarrosa	6	-	-	-	-	-	-
F	Iva axillaris	-	-	-	27	-	-	.13
F	Lactuca serriola	b217	a32	-	-	.14	-	-
F	Machaeranthera canescens	5	-	-	-	-	-	-
F	Medicago sativa	-	a1	-	a-	.03	-	.03

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Microsteris gracilis (a)	-	$_{b}$58	$_{a}$27	$_{a}$22	.36	.05	.09
F	Penstemon caespitosus	$_{a}$7	$_{a}$13	$_{a}$14	$_{a}$7	.74	.22	.18
F	Phlox longifolia	-	$_{a}$3	$_{a}$2	$_{a}$7	.00	.00	.01
F	Ranunculus testiculatus (a)	-	$_{a}$4	-	$_{b}$81	.00	-	.70
F	Sanguisorba minor	$_{a}$5	$_{a}$9	-	-	.16	-	-
F	Sisymbrium altissimum (a)	-	5	-	-	.01	-	-
F	Taraxacum officinale	$_{a}$11	$_{a}$8	-	-	.07	-	-
F	Tragopogon dubius	$_{b}$23	$_{a}$8	-	-	.05	-	-
F	Vicia americana	-	$_{a}$24	-	$_{a}$19	.04	-	.43
Total for Annual Forbs		230	230	33	123	3.78	0.08	0.84
Total for Perennial Forbs		547	233	44	206	3.03	0.31	4.23
Total for Forbs		777	463	77	329	6.82	0.39	5.07

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

BROWSE TRENDS --
Management unit 16B, Study no: 10

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata tridentata	13	19	21	.41	1.86	2.24
B	Chrysothamnus nauseosus	0	1	1	-	-	-
B	Juniperus osteosperma	1	0	0	.15	.63	.15
Total for Browse		14	20	22	0.56	2.50	2.39

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 10

Species	Percent Cover	
	'02	'07
Artemisia tridentata tridentata	-	4.80
Juniperus osteosperma	-	.21

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 10

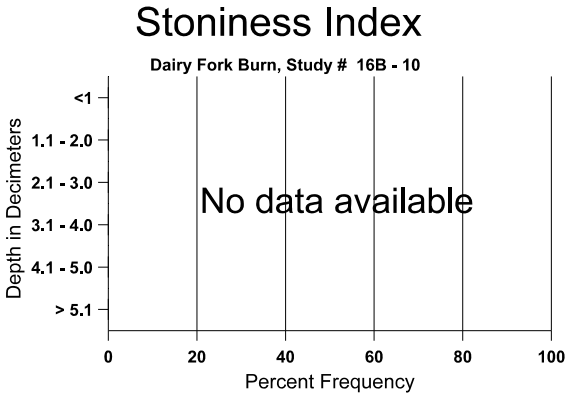
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata tridentata	2.9	1.6

BASIC COVER --
Management unit 16B, Study no: 10

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	4.00	32.15	25.91	47.31
Rock	0	.00	.01	.06
Pavement	0	.22	.06	.16
Litter	58.25	24.80	49.02	38.76
Cryptogams	0	.16	.03	.64
Bare Ground	37.75	43.81	41.40	25.25

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 10, Dairy Fork Burn

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.7	59.0 (13.2)	7.5	25.4	26.8	47.8	2.2	8.0	217.6	.4



PELLET GROUP DATA --
Management unit 16B, Study no: 10

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	11	-
Rabbit	12	8	13
Elk	33	46	43
Deer	9	13	14
Cattle	1	-	-

Days use per acre (ha)	
'02	'07
34 (84)	-
-	-
116 (288)	115 (284)
5 (13)	2 (5)
-	-

BROWSE CHARACTERISTICS --
Management unit 16B, 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 tridentata tridentata												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**300**	40	120	180	-	2360	0	0	0	-	7	49/43
02	**480**	-	100	320	60	1280	25	8	13	4	8	33/30
07	**520**	200	120	340	60	640	8	0	12	4	35	37/37
Chrysothamnus nauseosus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	100	-	-	0	24/27
07	**20**	-	-	20	-	40	0	0	-	-	0	29/35
Chrysothamnus viscidiflorus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	7/7
Juniperus osteosperma												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16B-11-07

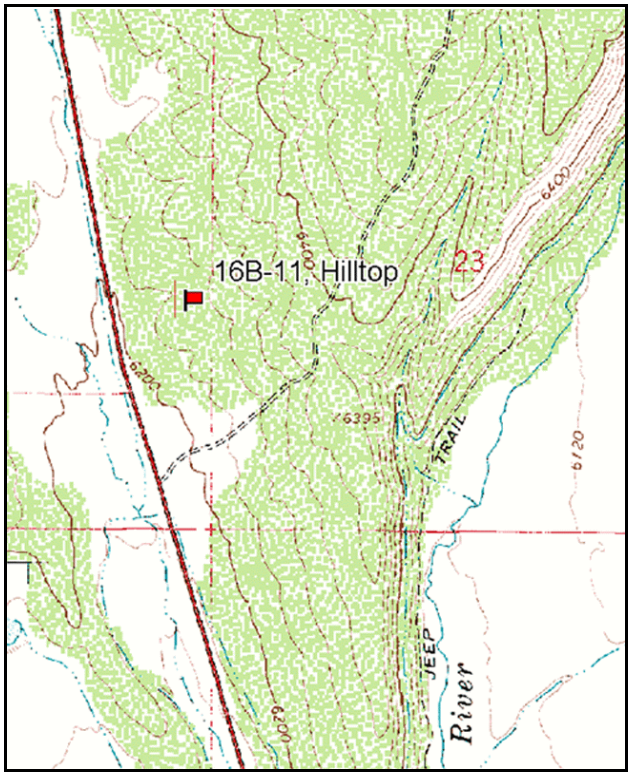
Study site name: Hilltop . Vegetation type: Chained, Seeded P-J .

Compass bearing: frequency baseline 168 degrees magnetic.

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

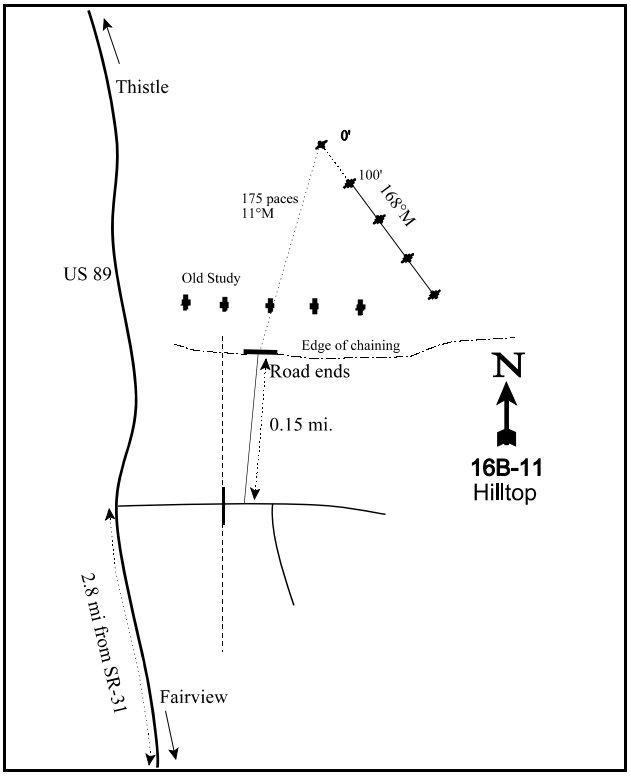
LOCATION DESCRIPTION

From the intersection of US-89 and SR-31 in Fairview, travel north on US-89 for 2.8 miles. Turn right (east) onto DWR property. Pass through a gate and turn to the left, following a road that parallels the fence. Go 0.15 miles to the end of the road. The 0-foot baseline stake, marked by browse tag #439, is 175 paces at an azimuth of 11 degrees magnetic from the end of the road.



Map Name: Fairview

Township 13S , Range 4E , Section 22



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 461110 E 4391620 N

DISCUSSION

Hilltop - Trend Study No. 16B-11

Study Information

This study was established on land formerly owned by the Division of Wildlife Resources, north of Fairview and just east of US-89 [elevation: 6,200 feet (1,890 m), slope: 5%-10%, aspect: west]. The area was part of a land swap between the Division of Wildlife Resources and a private land owner. A conservation easement was established, which allows grazing for a short time in spring and fall. The study monitors a 250 acre (101 ha) pinyon-juniper chaining treatment that was completed in 1978. It was established in the lower, southern end of the chaining. The nearest perennial body of water is Cottonwood Canyon Creek, 3 miles (4.8 km) to the southeast. Quadrat frequency of deer pellets decreased from 25% in 1997 to 4% in 2002, and increased to 9% in 2007. However, quadrat frequency of rabbit pellets increased from 6% in 1997 to 21% in 2002, and 42% in 2007. From the pellet group transect, there were an estimated 4 deer days use/acre (10 ddu/ha) in 2002 and 11 deer days use/acre (26 ddu/ha) in 2007. Elk use was estimated at 2 days use/acre (5 edu/ha) in 2002 and 12 days use/acre (30 edu/ha) in 2007. The study had been heavily utilized by both cows and sheep before sampling occurred in 1997 and 2002. In 2002, cattle use was estimated at 19 days use/acre (47 cdu/ha) and sheep use was estimated at 50 days use/acre (124 shu/ha). In 2007, there was no indication of grazing by cattle or sheep.

Soil

The soil is classified within the Borvant-Lodar soil complex. Soils in this series are shallow, well-drained, and formed in alluvium, colluvium, or residuum, from limestone or sandstone parent material. They are moderately permeable and have a medium to very high surface runoff potential (USDA-NRCS 2007). Specifically at the study, soil depth varies along the baseline and is about 10 inches (25.4 cm) along the first half and about 20 inches (51 cm) along the last half. The texture is a clay loam with a slightly alkaline pH (7.4). Organic matter content is the second highest in the unit at 3.9%. The erosion condition was classified as moderate in 2002, but had improved to the upper threshold of stable in 2007. Relative bare ground cover decreased from 43% in 2002 to 27% in 2007, and relative vegetation cover increased from 18% in 2002 to 35% in 2007. Despite the change in cover composition, there was evidence of moderate soil movement in 2007.

Browse

Browse species were seeded in the initial treatment, however, the establishment of seeded browse has been poor and is suspected to be a reason for the low wildlife use. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and four-wing saltbush (*Atriplex canescens*) were included in the aerial broadcast mix, while Stansbury cliffrose (*Cowenia mexicana* ssp. *stansburiana*) and bitterbrush (*Purshia tridentata*) were seeded with a dribbler. With the exception of big sagebrush, none of the species that were seeded have been sampled in any year. Sagebrush canopy cover was less than 1% in both 2002 and 2007. The estimated density decreased from approximately 300 plants/acre (743 plants/ha) in 1989, to 40 plants/acre (99 plants/ha)in 2002, and increased to 160 plants/acre (396 plants/ha) in 2007. The fluctuation is due to the change in young and decadent individuals sampled. The mature population has remained stable at 40 plants/acre since 1997. Decadence and poor vigor were low in 1989 and 2002. However, in 1997, 20% of the population was decadent and in poor vigor. In 2007, 38% of the population was decadent and 13% had poor vigor. Additionally, 38% of the sagebrush plants were infested with the sagebrush defoliator moth (*Aroga websteri*) in 2007. The average annual leader growth was not measured in 2002 because of the low density, but was 2.0 inches (5.1 cm) in 2007. Browse use has been mostly light.

The most common shrub is broom snakeweed (*Gutierrezia sarothrae*), though density has fluctuated widely in the sample years. There are also scattered clumps of Gambel oak (*Quercus gambelii*). Elderberry (*Sambucus racemosa*), slenderbush eriogonum (*Eriogonum microthecum*), and white rubber rabbitbrush (*Chrysothamnus*

nauseosus ssp. *albicaulis*) occur infrequently.

Utah juniper trees (*Juniperus osteosperma*) in the chaining had an average height between 8 feet (2.4 m) and 12 feet (3.7 m) in 2007. Although tree heights were not measured prior to 2007, tree density and diameter have increased since 1997. Using point-center quarter data, the juniper density increased from 47 trees/acre (116 trees/ha) in 1997 to 56 trees/acre (139 trees/ha) in 2007. Average tree diameter was 5.0 inches (12.7 cm) in 1997 and 7.8 inches (19.8 cm) in 2007. Canopy cover of juniper was less than 1% in 2002 and 2007.

Herbaceous Understory

Seeded perennial grasses are the dominant component in the vegetative community. Perennial grass cover has ranged from 16%-18% since 1997. Crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*Agropyron intermedium*) are the primary forage species, combining to produce approximately 90% of the grass cover, and averaging 16% of the ground cover since 1997. Native grasses are also present, but in very low frequencies. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) are present in the understory and occur in low, but increasing, numbers. Cheatgrass cover was less than 1% in 1997 and 2002, but increased to 2% in 2007.

Diversity of forbs is fair, yet none are particularly abundant. Perennial forb cover has been 1% or less since 1997. Two noxious weeds, musk thistle *(Carduus nutans*) and field bindweed (*Convolvulus arvensis*), have been sampled at low quadrat frequencies. Musk thistle was only present in 1997, and field bindweed was present in 1997 and 2007. Annual forbs, primarily bur buttercup (*Ranunculus testiculatus*) and pale alyssum (*Alyssum alyssoides*), occur in higher frequencies than do perennial species. Changes in the sum of nested frequency for perennial forbs appear to follow precipitation patterns and may be most affected by the availability of water, and not from competition with other vegetation. Forb nested frequency and cover were lowest in 2002, a drought year (Utah Climate Summaries 2007).

1997 TREND ASSESSMENT

The browse trend is slightly down. Mountain big sagebrush had decreased density, increased decadence, and increased poor vigor. Rubber rabbitbrush and slenderbush eriogonum also had heavy sheep use. There were few young plants and no seedlings of any shrub species. The trend for grass is stable. The sum of nested frequency of perennial grasses changed little, decreasing 6%. Nested frequency increased significantly for bluebunch wheatgrass (*Agropyron spicatum*) and Indian ricegrass (*Oryzopsis hymenoides*), and decreased for intermediate wheatgrass and squirreltail (*Sitanion hystrix*). The forb trend is slightly up. The sum of nested frequency for perennial forbs increased four-fold, but perennial forbs were such a small vegetative component that the increase was inconsequential. The number of perennial species sampled increased from four to 13. Musk thistle and bindweed were sampled in 19 and 7 quadrats, respectively. The Desirable Components Index (DCI) score was very poor because of the extremely low cover of preferred browse species, low perennial forb cover, and the presence of two noxious weed species.

winter range condition (DCI) - very poor (30) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is slightly down. Browse remained very limited. Sagebrush density declined and there was no recruitment of young plants into the population. The few white-stemmed rubber rabbitbrush and bitterbrush plants observed around the study showed heavy use by sheep. With virtually no reproduction of any palatable browse, this study is losing its value as critical winter range for big game. The trend for grass is slightly down. The sum of nested frequency decreased by 13%, and the number of perennial grass species sampled decreased from six to three. However, cheatgrass nested frequency significantly decreased. The forb trend is slightly down. The sum of nested frequency decreased 87%, but the abundance was so low that the decrease had a small impact. There were significant increases in the nested frequencies of bur buttercup and

pale alyssum. Musk thistle and field bindweed were not sampled in 2002. The DCI score remained very poor.

winter range condition (DCI) - very poor (31) Mid-level potential scale
browse - slightly down (-1) grass - slightly down (-1) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is slightly up. Sagebrush density increased four-fold, though is still extremely low. Reproduction and recruitment both increased; sagebrush seedlings were sampled for the first time. Conversely, sagebrush decadence increased as did the number of plants with poor vigor. The poor vigor was attributed to extensive sagebrush defoliator moth (*Aroga websteri*) damage on mature plants. White rubber rabbitbrush plants continued to show heavy use and have a short growth form. The high quadrat frequency of rabbit pellets suggests that the high rabbitbrush browse use is likely from rabbits and not deer. The trend for grass is slightly up. The sum of nested frequency for perennial grasses increased 21%, including significant increases in the nested frequencies of intermediate wheatgrass and Indian ricegrass. Adversely, there was a significant increase in cheatgrass nested frequency. Cheatgrass cover increased from less than 1% to 2%. The forb trend is down. The sum of nested frequency for perennial forbs increased, but abundance continued to be low. The sum of nested frequency of annual forbs also increased, including significant increases in bur buttercup and pale alyssum. The increase in bur buttercup is of greater concern because it is allelopathic (Buchanan et al. 1978). Annual forb cover increased from 2% to 13%. Additionally, the noxious weed field bindweed was measured again. The DCI score remained very poor.

winter range condition (DCI) - very poor (29) Mid-level potential scale
browse - slightly up (+1) grass - slightly up (+1) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 11

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	a203	a198	a238	a193	11.51	12.36	8.49
G	Agropyron intermedium	b182	a129	a107	b204	3.53	3.68	9.04
G	Agropyron spicatum	a3	b40	-	-	.91	-	-
G	Bromus brizaeformis (a)	-	-	-	4	-	-	.01
G	Bromus japonicus (a)	-	a4	-	a14	.01	-	.06
G	Bromus tectorum (a)	-	b48	a16	c116	.33	.06	1.67
G	Elymus junceus	a7	-	-	a6	-	-	.18
G	Oryzopsis hymenoides	a4	b23	a5	b19	.40	.15	.32
G	Poa secunda	a4	a4	-	a2	.01	-	.03
G	Sitanion hystrix	b24	a8	-	-	.02	-	-
Total for Annual Grasses		0	52	16	134	0.34	0.06	1.74
Total for Perennial Grasses		427	402	350	424	16.39	16.21	18.07
Total for Grasses		427	454	366	558	16.73	16.27	19.82
F	Alyssum alyssoides (a)	-	a41	b71	c339	.40	.17	7.43
F	Arabis sp.	-	-	-	3	-	-	.01
F	Astragalus convallarius	a3	-	-	a2	-	-	.03

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Astragalus sp.	-	$_{a}$1	-	$_{b}$7	.00	-	.09
F	Astragalus utahensis	-	$_{a}$4	$_{a}$4	$_{b}$10	.01	.01	.29
F	Camelina microcarpa (a)	-	-	-	6	-	-	.01
F	Carduus nutans (a)	-	40	-	-	.44	-	-
F	Chaenactis douglasii	-	1	-	-	.00	-	-
F	Chenopodium fremontii (a)	-	9	-	-	.04	-	-
F	Cirsium sp.	-	$_{a}$5	-	$_{a}$5	.04	-	.07
F	Convolvulus arvensis	-	$_{a}$16	-	$_{a}$20	.11	-	.39
F	Descurainia pinnata (a)	-	$_{b}$11	-	$_{a}$2	.04	-	.00
F	Draba sp. (a)	-	-	-	17	-	-	.02
F	Erodium cicutarium (a)	-	-	-	3	-	-	.01
F	Erigeron eatonii	-	-	-	2	-	-	.00
F	Lappula occidentalis (a)	-	$_{a}$3	-	$_{a}$2	.01	-	.00
F	Medicago sativa	-	3	-	-	.09	-	-
F	Phlox hoodii	$_{a}$11	$_{a}$16	$_{a}$5	$_{a}$9	.25	.18	.08
F	Phlox longifolia	$_{a}$2	$_{a}$4	-	$_{a}$7	.01	-	.02
F	Ranunculus testiculatus (a)	-	$_{a}$163	$_{b}$196	$_{c}$279	.97	1.86	5.03
F	Salsola iberica (a)	-	-	-	3	-	-	.03
F	Sisymbrium altissimum (a)	-	4	-	-	.04	-	-
F	Sphaeralcea coccinea	$_{a}$1	$_{a}$4	-	$_{a}$11	.03	-	.03
F	Streptanthus cordatus	-	-	-	5	-	-	.06
F	Taraxacum officinale	-	2	-	-	.00	-	-
F	Tragopogon dubius	-	$_{a}$1	-	$_{a}$5	.00	-	.04
F	Verbascum thapsus	-	11	-	-	.48	-	-
F	Viguiera multiflora	-	3	-	-	.01	-	-
Total for Annual Forbs		0	271	267	651	1.96	2.03	12.56
Total for Perennial Forbs		17	71	9	86	1.06	0.19	1.13
Total for Forbs		17	342	276	737	3.02	2.23	13.69

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

BROWSE TRENDS --
Management unit 16B, Study no: 11

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	5	2	7	.46	.18	.03
B	Chrysothamnus nauseosus albicaulis	2	0	0	.38	-	-
B	Chrysothamnus viscidiflorus viscidiflorus	2	2	5	.15	.15	.33
B	Gutierrezia sarothrae	20	6	26	.37	.12	.43
B	Juniperus osteosperma	1	0	0	.63	.15	.53
B	Opuntia sp.	3	2	0	-	.03	.06
B	Quercus gambelii	1	2	1	.63	.63	.38
Total for Browse		34	14	39	2.63	1.27	1.75

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 11

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	.38	.56
Chrysothamnus viscidiflorus viscidiflorus	.36	.10
Gutierrezia sarothrae	.03	1.08
Juniperus osteosperma	.80	.95
Quercus gambelii	1.79	.60

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16B, Study no: 11

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	-	2.0

POINT-QUARTER TREE DATA --
Management unit 16B, Study no: 11

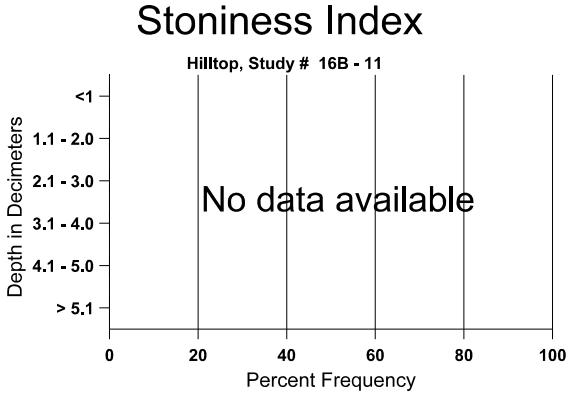
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Juniperus osteosperma	53	56	5.3	7.8

BASIC COVER --
Management unit 16B, Study no: 11

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	10.50	22.73	19.68	39.06
Rock	4.75	3.01	3.42	1.52
Pavement	11.25	5.28	7.03	6.73
Litter	46.75	20.90	33.79	34.16
Cryptogams	0	.04	.02	.37
Bare Ground	26.75	35.57	48.51	29.79

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 11, Hilltop

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.8	55.6 (14.3)	7.4	38.7	25.1	36.2	3.9	8.8	134.5	.5



PELLET GROUP DATA --
Management unit 16B, Study no: 11

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	13	15	-
Rabbit	6	21	42
Elk	1	-	3
Deer	25	4	9
Cattle	3	-	1

Days use per acre (ha)	
'02	'07
50 (124)	-
-	-
2 (5)	12 (30)
4 (10)	11 (26)
19 (47)	-

BROWSE CHARACTERISTICS --
Management unit 16B, 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 vaseyana												
89	**299**	-	33	233	33	-	89	0	11	-	0	33/30
97	**100**	-	40	40	20	-	20	0	20	20	20	31/35
02	**40**	-	-	40	-	20	0	0	0	-	0	26/28
07	**160**	120	60	40	60	-	25	0	38	13	13	23/27
Chrysothamnus nauseosus albicaulis												
89	**33**	-	-	33	-	-	100	0	-	-	0	47/91
97	**40**	-	20	20	-	-	50	50	-	-	0	20/34
02	**0**	-	-	-	-	-	0	0	-	-	0	5/8
07	**0**	-	-	-	-	-	0	0	-	-	0	36/68
Chrysothamnus viscidiflorus viscidiflorus												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**80**	-	-	80	-	-	0	0	0	-	0	7/9
02	**200**	-	-	200	-	-	0	0	0	-	0	5/11
07	**220**	-	40	160	20	-	18	0	9	-	0	6/13
Eriogonum microthecum												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	4/8
02	**0**	-	-	-	-	-	0	0	-	-	0	7/11
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
89	**133**	-	-	133	-	-	0	0	0	-	0	7/10
97	**720**	-	180	520	20	20	0	0	3	3	3	10/12
02	**200**	-	40	120	40	20	30	30	20	-	0	4/7
07	**920**	20	40	860	20	-	0	0	2	-	0	7/10
Juniperus osteosperma												
89	**33**	-	-	33	-	-	0	0	-	-	0	69/35
97	**20**	-	-	20	-	20	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Opuntia sp.												
89	**33**	-	-	33	-	-	0	0	-	-	0	7/20
97	**60**	-	-	60	-	-	0	0	-	-	0	6/19
02	**40**	-	-	40	-	-	0	0	-	-	0	4/9
07	**0**	-	-	-	-	-	0	0	-	-	0	7/8

		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)
Quercus gambelii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**80**	-	40	40	-	20	0	0	-	-	0	98/47
02	**100**	-	-	100	-	-	0	0	-	-	0	6/3
07	**140**	-	20	120	-	-	0	0	-	-	0	62/40
Rhus trilobata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	32/69
Sambucus cerulea												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	119/98
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16B-13-07

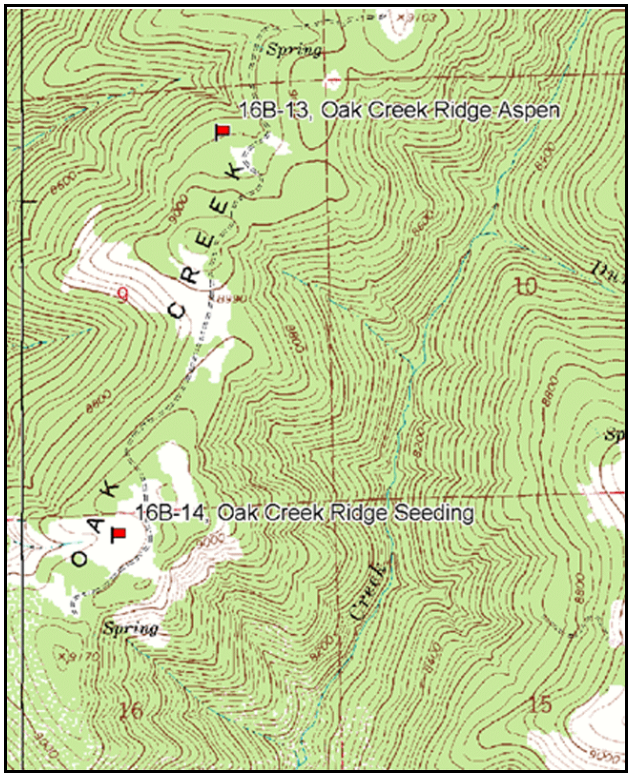
Study site name: Oak Creek Ridge Aspen . Vegetation type: Quaking Aspen .

Compass bearing: frequency baseline 303 degrees magnetic (line 4 @ 165°M).

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

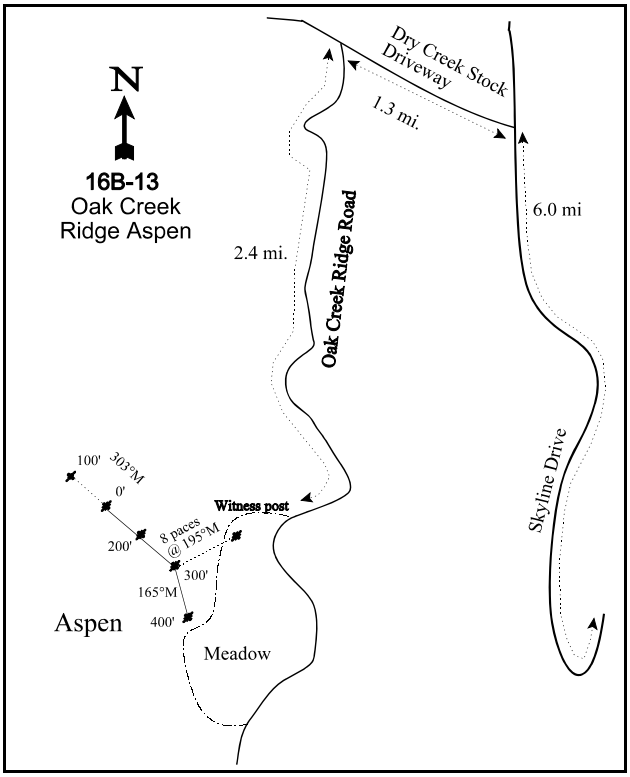
LOCATION DESCRIPTION

From the intersection of Highways 89 and 31 in Fairview, take Highway 31 eastward 8.4 miles to Skyline Drive. Turn north on Skyline Drive and go approximately 6 miles, passing the Gooseberry Road. Turn west onto the Dry Creek Stock Driveway and go 1.3 miles to a fork. Take the left fork (south) through a fence and stay on the Oak Creek Ridge Road for 2.4 miles passing numerous side roads (staying left) until a sign is reached. The sign reads, "seeded area", and is on the west side of the road in a clearing. The witness post is back in the clearing. From this post the 300-foot baseline stake is 8 paces away at an azimuth of 195 degrees magnetic.



Map Name: Fairview Lakes

Township 13S , Range SE , Section 9



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 468554 E 4395677 N

DISCUSSION

Oak Creek Ridge Aspen - Trend Study No. 16B-13

Study Information

One of two studies on Oak Creek Ridge, this study samples an aspen community in an area that is thought to be important spring elk range [elevation: 8,900 feet (2,713 m), slope: 5%-10%, aspect: northwest]. Oak Creek Ridge is a Forest Service allotment that allows cattle grazing. The allotment was rested for two seasons following the meadow seeding in 1988. The closest water sources are Oak Creek 0.6 miles (1 km) to the east, and a stock pond 0.9 miles (1.4 km) to the north. Pellet group frequency data since 1997 suggested light use by elk, deer, and cattle. From the pellet group transect, there were an estimated 3 deer days use/acre (7 ddu/ha) in both 2002 and 2007. Elk use was estimated at 2 days use/acre (5 edu/ha) in 2002 and 3 days use/acre (7 edu/ha) in 2007. Cattle use was estimated at 15 days use/acre (36 cdu/ha) in 2002 and decreased to 4 days use/acre (9 cdu/ha) in 2007. The 2007 deer and elk pellet groups were from that spring, and the cattle pats were from the summer/fall of 2006.

Soil

Soil texture is a clay with a neutral pH (6.8). Organic matter is prevalent in the rich soil. The soil is relatively deep and has few rocks in the profile. A humus-rich layer extends down to a depth of 4 to 6 inches (10 to 15 cm), followed by a clay horizon which extends down to about 20 inches (51 cm). Compaction and erosion are not a problem, although gopher activity is significant. The ground cover composition has shifted each year since 1997 to higher vegetation and bare ground cover, and less litter cover. The erosion condition was classified as stable in 2002 and 2007.

Browse

This aspen (*Populus tremuloides*) stand is mostly mature, with few seedling or young trees. The population consists of tall trees, most of which are unavailable to browsing due to their height. Because aspen does not provide a significant source of browse, it is not considered as an indicator of browse trend for this study. Point quarter data from 2002 estimated 590 trees/acre (1,460 trees/ha) with an average diameter of 8 inches (20 cm). Point quarter and tree diameter data were not collected in 2007. Overhead canopy cover was 70% in 2002 and decreased to 61% in 2007.

Understory shrubs consist of elderberry (*Sambucus racemosa*) and very few mountain snowberry (*Symphoricarpos oreophilus*). Elderberry density was estimated at 1,133 plants/acre (2,805 plants/ha) in 1989, but has ranged from 60 to 240 plants/acre (149 to 594 plants/ha) since 1997. The change in density is attributed to the much larger sample area used in 1997. The larger sample area gives a better density estimate for species that are characteristically clumped or discontinuous in their distributions. The population has been composed almost exclusively of young and mature plants. Fewer than 10% of the elderberry shrubs have ever exhibited poor vigor. Browse use in 1997 was moderate to heavy, but light in 2002 and 2007. Few snowberry plants have been sampled in the shrub density strips, resulting in density estimates of 20 to 40 plants/acre (50 to 100 plants/ha).

Herbaceous Understory

The dense herbaceous understory is the key component being monitored. Grass cover increased from 6% in 1997 to 15% in 2002, and decreased to 9% in 2007. The number of grass species present has steadily increased each sample year. Only two species of grass, slender wheatgrass (*Agropyron trachycaulum*) and big mountain brome (*Bromus carinatus*), were sampled in 1989. Since then, Kentucky bluegrass (*Poa pratensis*) was first sampled in 1997, subalpine needlegrass (*Stipa columbiana*) was first sampled in 2002, and intermediate wheatgrass (*Agropyron intermedium*) was first sampled in 2007. Mountain brome and slender wheatgrass remained the dominant species through 2002. In 2007, mountain brome was the dominant species. Subalpine needlegrass has been sampled in the more open areas. Annual grasses have not been sampled.

Forbs account for the majority of the vegetative cover and represent the most significant vegetative component. Forb cover increased from 39% in 1997 to 43% in 2002 and 2007. Since 1997, forb species richness has ranged from 22 to 28. Common species include bedstraw (*Galium aparine*), ballhead waterleaf (*Hydrophyllum capitatum*), sweet anise (*Osmorhiza occidentalis*), tuber starwort (*Stellaria jamesiana*), American vetch (*Vicia americana*), western coneflower *(Rudbeckia occidentalis*), and slenderleaf collomia (*Collomia linearis*). No animal use was noticed on either grasses or forbs in 2002 and 2007.

1997 TREND ASSESSMENT

The browse trend is stable. The density of elderberry decreased by 79%. The decrease is attributed to the larger sample area used in 1997, and therefore trend was determined from other parameters. The plants showing moderate and heavy browse use increased from 21% to 59%. The age class distribution shifted from predominantly young plants to mature plants. Decadency and plants with poor vigor both increased from 0% to 8%. The trend for grass is slightly down. The sum of nested frequency for perennial grasses decreased by 19%, and there was a significant decrease in the nested frequency of big mountain brome. However, Kentucky bluegrass was sampled for the first time. The forb trend is up. The sum of nested frequency for perennial forbs increased by 45%. Forb species richness increased from 13 to 19. The Desirable Components Index (DCI) does not apply to this study because it is located on summer range.

winter range condition (DCI) - Not applicable, summer range
browse - stable (0) grass - slightly down (-1) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is down. The estimated elderberry density declined from 240 plants/acre (594 plants/ha) to 60 plants/acre (149 plants/ha). Young plants comprised 67% of the population and mature plants comprised the remaining 33%. There was no decadency or poor vigor evident on any of the plants, and all browse use was classified as light. The trend for grass is slightly up. The sum of nested frequency for perennial grasses increased by 17% and subalpine needlegrass was sampled for the first time. Although the nested frequency of mountain brome changed little, cover increased from 3% to 9%. The forb trend is down. The sum of nested frequency for annual forbs increased by 41%, while perennial forb frequency decreased by 39%. The decrease in perennial forbs was likely the result of the drought conditions (Utah Climate Summaries 2007).

winter range condition (DCI) - Not applicable, summer range
browse - down (-2) grass - slightly up (+1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is up. The estimated elderberry density increased nearly four-fold to 220 plants/acre (545 plants/ha). Though shrub density remained low, this was a marked improvement. Elderberry shrubs had good vigor and good regrowth from summer browsing in 2006. The number of young plants doubled since 2002, and there were still no decadent plants. Half of the few snowberry plants sampled had heavy browse use, though the bite marks suggested that the use was probably from rodent-like animals and not from deer or elk. The grass trend is down. The sum of nested frequency decreased by 26%, due to significant declines in the nested frequencies of subalpine needlegrass and slender wheatgrass. Grasses had good vigor in 2007 but showed no wildlife use. The forb trend is stable. The sum of nested frequency for perennial forbs changed little, decreasing 7%, and cover decreased by nearly 10%. However, the combined annual and perennial cover remained unchanged. The sum of nested frequency for annual forbs increased 49%, and annual forb cover increased by nearly 10%. Annual forbs have been an increasingly larger component of total forb nested frequency since 1997. It was noted that all forbs had good vigor and flower production, except American vetch, which had few flowers. There was little or no wildlife use on forbs in 2007.

winter range condition (DCI) - Not applicable, summer range
browse - up (+2) grass - down (-2) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 13

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron intermedium	-	-	-	3	-	-	.01
G	Agropyron trachycaulum	$_{b}$141	$_{b}$137	$_{b}$146	$_{a}$32	2.03	3.86	.66
G	Bromus carinatus	$_{b}$301	$_{a}$175	$_{a}$182	$_{a}$203	3.23	8.60	7.64
G	Poa pratensis	-	$_{a}$48	$_{a}$64	$_{a}$64	.67	1.89	.72
G	Stipa columbiana	-	-	$_{b}$29	$_{a}$10	-	.90	.36
Total for Annual Grasses		0	0	0	0	0	0	0
Total for Perennial Grasses		442	360	421	312	5.94	15.27	9.41
Total for Grasses		442	360	421	312	5.94	15.27	9.41
F	Achillea millefolium	-	$_{b}$33	$_{b}$47	$_{a}$2	1.35	2.78	.06
F	Agoseris glauca	-	$_{a}$8	$_{a}$9	$_{a}$8	.04	.07	.09
F	Aquilegia sp.	-	-	$_{a}$-	$_{a}$3	-	.03	.00
F	Aster sp.	-	16	-	-	.54	-	-
F	Chenopodium sp. (a)	-	$_{a}$15	-	$_{a}$22	.20	-	.10
F	Cirsium sp.	-	2	-	-	.15	-	-
F	Claytonia lanceolata	-	$_{b}$182	$_{a}$12	$_{a}$6	1.44	.07	.03
F	Collomia linearis (a)	-	$_{a}$15	$_{b}$138	$_{c}$240	.22	2.00	4.17
F	Cynoglossum officinale	-	-	$_{a}$5	$_{b}$39	-	.21	1.22
F	Descurainia californica	$_{b}$125	-	-	$_{a}$2	-	-	.00
F	Epilobium brachycarpum (a)	-	-	$_{a}$40	$_{a}$39	-	.29	.29
F	Erodium cicutarium (a)	-	-	-	3	-	-	.03
F	Erigeron eatonii	-	$_{a}$-	$_{b}$20	$_{ab}$7	.00	.98	.07
F	Eriogonum racemosum	-	-	$_{a}$-	$_{a}$1	-	.00	.03
F	Fritillaria atropurpurea	-	22	-	-	2.68	-	-
F	Frasera speciosa	-	-	5	-	-	.01	-
F	Galium aparine (a)	-	$_{b}$249	$_{a}$169	$_{b}$264	8.15	5.34	12.70
F	Hackelia patens	66	-	-	-	-	-	-
F	Hedysarum boreale	-	-	$_{a}$2	$_{a}$1	-	.03	.00
F	Helenium hoopesii	$_{a}$9	$_{b}$39	$_{b}$46	$_{a}$8	1.65	3.51	.33
F	Hydrophyllum capitatum	-	$_{c}$188	$_{a}$32	$_{b}$79	4.03	.31	.75
F	Lappula occidentalis (a)	-	-	$_{a}$-	$_{a}$1	-	.03	.03
F	Madia glomerata (a)	-	$_{a}$4	$_{c}$72	$_{b}$34	.01	.89	.30
F	Mertensia ciliata	-	13	-	-	.12	-	-
F	Medicago sativa	2	-	-	-	-	-	-
F	Osmorhiza occidentalis	$_{a}$60	$_{ab}$60	$_{b}$89	$_{ab}$65	1.37	2.53	2.34
F	Phacelia sp.	-	-	$_{a}$4	$_{a}$3	-	.15	.18

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Polygonum douglasii (a)	-	$_{a}$3	-	$_{b}$20	.01	-	.04
F	Rudbeckia occidentalis	$_{b}$175	$_{a}$79	$_{a}$89	$_{a}$72	3.59	7.43	4.66
F	Senecio serra	$_{a}$4	$_{a}$-	$_{a}$5	$_{a}$4	.00	.78	.53
F	Stellaria jamesiana	$_{b}$242	$_{b}$243	$_{a}$170	$_{ab}$202	7.25	5.82	8.68
F	Taraxacum officinale	$_{a}$3	$_{b}$48	$_{b}$34	$_{a}$12	.88	1.74	.74
F	Thalictrum fendleri	$_{a}$6	$_{a}$1	-	-	.03	-	-
F	Tragopogon dubius	-	-	-	-	-	-	.00
F	Unknown forb-annual (a)	-	11	-	-	.48	-	-
F	Unknown forb-perennial	-	75	-	-	1.80	-	-
F	Vaccinium caespitosum	-	3	-	-	.01	-	-
F	Vicia americana	$_{ab}$107	$_{a}$82	$_{b}$134	$_{ab}$118	1.31	6.46	4.60
F	Viguiera multiflora	$_{a}$13	$_{b}$68	$_{a}$10	$_{a}$25	.37	.42	.59
F	Viola sp.	$_{a}$54	$_{b}$91	$_{a}$58	$_{a}$58	1.10	.70	.81
Total for Annual Forbs		0	297	419	623	9.08	8.56	17.68
Total for Perennial Forbs		866	1253	771	715	29.76	34.10	25.77
Total for Forbs		866	1550	1190	1338	38.84	42.66	43.45

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

BROWSE TRENDS --
Management unit 16B, Study no: 13

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Abies concolor	0	0	0	.00	-	-
B	Populus tremuloides	31	29	26	.21	.36	.30
B	Sambucus racemosa	10	2	8	.18	.03	.45
B	Symphoricarpos oreophilus	1	1	2	.15	.15	.15
Total for Browse		42	32	36	0.55	0.53	0.89

CANOPY COVER, LINE INTERCEPT --
Management unit 16B, Study no: 13

Species	Percent Cover	
	'02	'07
Populus tremuloides	70.59	60.56
Sambucus racemosa	-	.61
Symphoricarpos oreophilus	-	.08

POINT-QUARTER TREE DATA --
Management unit 16B, Study no: 13

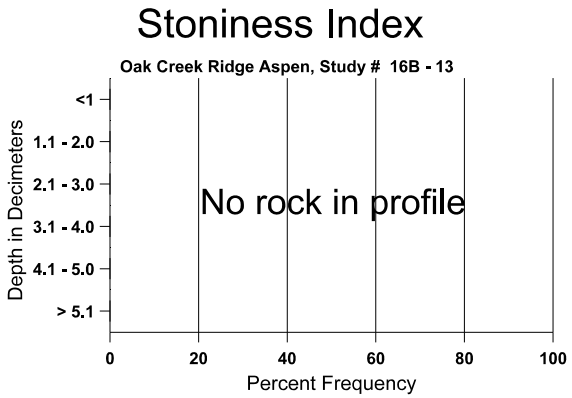
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Populus tremuloides	590	-	8.3	-

BASIC COVER --
Management unit 16B, Study no: 13

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	15.25	48.09	56.34	62.00
Rock	.25	.66	.59	.44
Pavement	0	.10	.05	.04
Litter	64.50	63.64	53.44	31.69
Cryptogams	0	.00	0	0
Bare Ground	20.00	8.44	10.53	17.03

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 13, Oak Creek Ridge Aspen

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
20.1	38.6 (17.7)	6.8	24.0	27.8	48.2	6.7	22.3	182.4	.4



PELLET GROUP DATA --
Management unit 16B, Study no: 13

Type	Quadrat Frequency			Days use per acre (ha)	
	'97	'02	'07	'02	'07
Rabbit	3	-	-	-	-
Grouse	-	1	-	-	-
Elk	1	1	1	2 (5)	3 (7)
Deer	2	-	1	3 (7)	3 (7)
Cattle	2	4	1	15 (36)	4 (9)

BROWSE CHARACTERISTICS --
Management unit 16B, 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)
Chrysothamnus nauseosus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	22/32
Populus tremuloides												
89	**499**	33	133	366	-	-	0	0	-	-	0	393/158
97	**800**	20	-	800	-	160	3	0	-	-	0	-/-
02	**660**	-	20	640	-	140	0	0	-	-	0	-/-
07	**560**	-	20	540	-	120	0	0	-	-	0	-/-
Sambucus racemosa												
89	**1133**	-	900	233	-	-	21	0	0	-	0	79/39
97	**240**	-	20	200	20	-	42	17	8	8	8	31/14
02	**60**	-	40	20	-	20	0	0	0	-	0	15/17
07	**220**	-	80	140	-	-	0	18	0	-	9	22/21
Symphoricarpos oreophilus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	7/12
07	**40**	-	-	40	-	-	0	50	-	-	0	8/11

Trend Study 16B-14-07

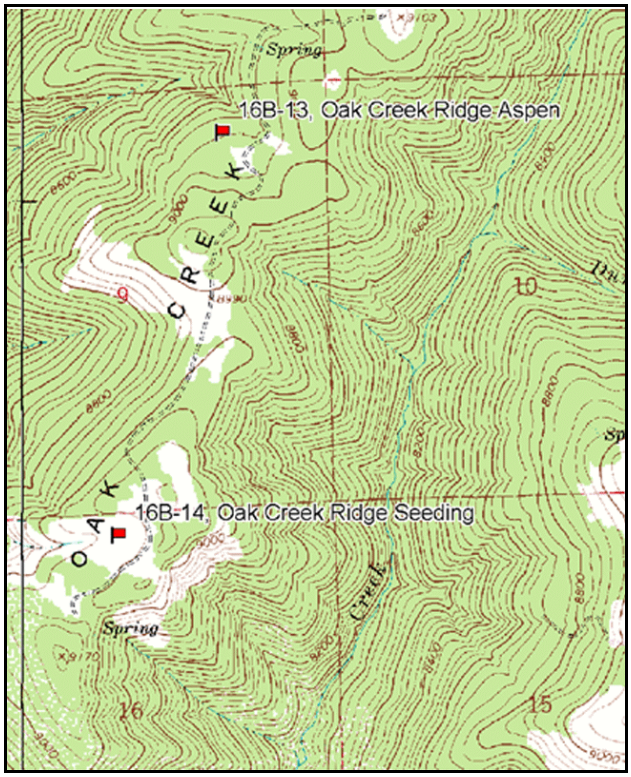
Study site name: Oak Creek Ridge Seeding . Vegetation type: Dry Meadow .

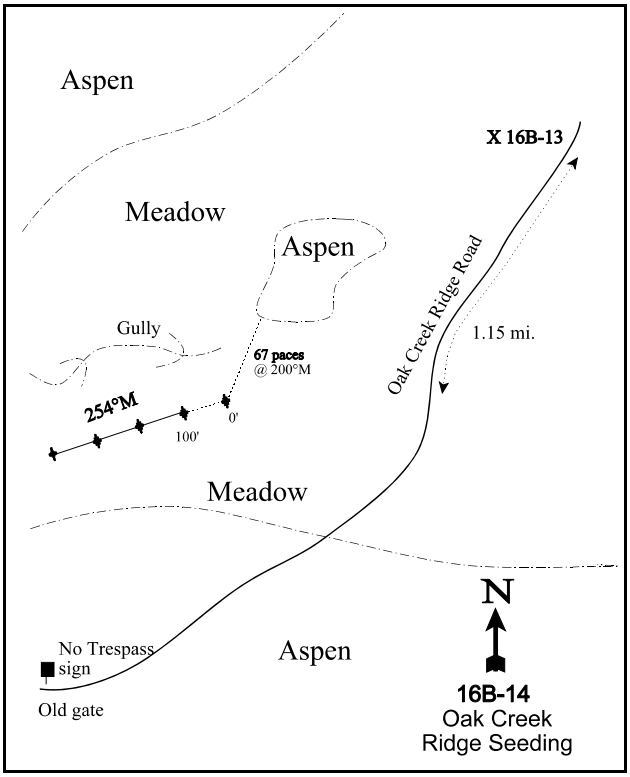
Compass bearing: frequency baseline 254 degrees magnetic.

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

LOCATION DESCRIPTION

From the intersection of Highways 89 and 31 in Fairview, take Highway 31 eastward 8.4 miles to Skyline Drive. Go north on Skyline Drive for approximately 6 miles and turn left towards the Dry Creek Stock Driveway (FS road #138). Go 0.35 miles to an intersection, continue straight for mile to the fence marking the boundary of the Oak Creek Ridge Allotment. Drive 2.4 miles to the witness post for study #16B-13. Continue on the main road 1.15 miles to a large meadow. This is the last meadow on the ridge. The 0' baseline stake is about 100 yards into the meadow and is marked by browse tag #257. (From the edge of the aspen patch the 0-foot baseline stake is 67 paces away at an azimuth of 200 degrees magnetic). Do not confuse the transect with a U.S.F.S. study that runs southwest/northeast and is marked by orange and green fenceposts.





Map Name: Fairview Lakes

Diagrammatic Sketch

Township 13S , Range 5E , Section 16

GPS: NAD 83, UTM 12S 468141 E 4394109 N

DISCUSSION

Oak Creek Ridge Seeding - Trend Study No. 16B-14

Study Information

This study samples one of several meadows on Oak Creek Ridge that were part of a 1988 restoration project [elevation: 9,050 feet (2,758 m), slope: 5%, aspect: west]. The project included a weed treatment and subsequent re-seeding. Located on the end of the ridge, it is the largest meadow in the project and appeared to have better grass establishment than some of the other meadows when first sampled in 1989. Previously, these aspen openings had an abundance of tarweed (*Madia glomerata*). This meadow is also monitored by a Forest Service photo-point transect. The nearest water sources are Oak Creek, which lies in a valley 0.6 miles (1 km) to the east, and a stock pond is located 2 miles (3.2 km) to the north. Pellet group data since 1997 has indicated moderately low elk and cattle use, with light use by deer. From the pellet group transect, there were an estimated 2 deer days use/acre (5 ddu/ha) in 2002, and 3 deer days use/acre (7 ddu/ha) in 2007. Elk use was estimated at 7 days use/acre (17 edu/ha) in 2002 and 10 days use/acre (25 edu/ha) in 2007. Cattle use was fairly high at an estimated 43 days use/acre (106 cdu/ha) in 2002 and decreased to 9 days use/acre (23 cdu/ha) in 2007. A doe and fawn were seen at the study in 2007.

Soil

There are few rocks in the soil profile. The soil has a clay texture and is slightly acidic (pH 6.5). The two largest components of ground cover are vegetation and bare ground, and they account for 80% to 90% of ground cover. Vegetation cover was lowest in 1989 (13%) and increased in later years (40% to 51%). Bare ground cover was highest in 1989 (84%) and has been lower in subsequent sample years (42% to 53%). The bare ground cover was higher in 1989 because the seeding had just taken place the previous year and vegetation wasn't completely established yet. There were definite signs of erosion across the meadow and down the adjacent gully in 1989. Additionally, sheet erosion and small rills occurred on the gentle slope. The erosion condition was classified as stable in 2002 and 2007. Gopher activity is prominent and, as a result, the soil does not appear to be compact.

Browse

The meadow is surrounded by mature aspen (*Populus tremuloides*) stands with an abundant herbaceous understory. The browse component in the meadow itself is virtually non-existent with only one mature mountain snowberry (*Symphoricarpos oreophilus*) plant sampled in 2002.

Herbaceous Understory

The seeded understory species were not well established in 1989. There was ample space for germination and the spread of rhizomatous species. The intermediate wheatgrass (*Agropyron intermedium*) plants that had established were large and some had been grazed. In 1997, the seeded species appeared to be more abundant, and the sum of nested frequency for grasses doubled, mostly due to smooth brome (*Bromus inermis*) and orchardgrass (*Dactylis glomerata*). Japanese brome (*Bromus japonicus*) was sampled once in 1989 and has not been present since. Grass cover was 10% in 1997, 24% in 2002, and 15% in 2007.

Like the nearby Oak Creek Aspen study, forbs are the dominant vegetation type. The forb composition is poor in that many of the species have poor forage value. The study was originally treated to reduce tarweed, which provided 18% cover in 1997, 3% in 2002, and 7% in 2007. Other common species include wavyleaf thistle (*Cirsium undulatum*), western aster (*Aster chilensis*), lanceleaf springbeauty (*Claytonia lanceolata*), and slenderleaf collomia (*Collomia linearis*). Seeded forbs are uncommon. Houndstongue (*Cynoglossum officinale*), a noxious weed, has also been present during all sample years. Since 1997, houndstongue cover has been 1%-2%.

1997 TREND ASSESSMENT

Browse were absent, so the trend is considered to be stable. The grass trend is up. The sum of nested frequency of perennial species increased two-fold. Much of the increase is attributed to smooth brome and orchardgrass, two species that were not present in 1989. The forb trend is slightly down. The sum of nested frequency for perennial forbs increased more than seven-fold, but most of that increase was from wavyleaf thistle and houndstongue. Additionally, there was a significant increase in tarweed nested frequency. Tarweed was found in 98% of the quadrats and accounted for nearly half (46%) of the vegetative cover. Despite these changes, the number of perennial species sampled increased from 14 to 19.

winter range condition (DCI) - Not applicable, summer range
browse - stable (0) grass - up (+2) forb - slightly down (-1)

2002 TREND ASSESSMENT

Browse continues to be stable with no browse species sampled. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased by 18%, including significant increases of intermediate wheatgrass and slender wheatgrass (*Agropyron trachycaulum*). The ground cover occupied by intermediate wheatgrass increased from 2% to 20%. Conversely, there were significant decreases in the nested frequencies of smooth brome and orchardgrass. The decrease of these mesic grass species was likely from dry conditions (Utah Climate Summaries 2007) and/or competition from other perennial grasses. The trend for the forbs is slightly up. The sum of nested frequency for perennial forbs decreased by 6%. However, there was a statistically significant decrease in the nested frequencies of two undesirable species, houndstongue and tarweed. The amount of ground cover occupied by tarweed decreased from 18% to 3% .

winter range condition (DCI) - Not applicable, summer range
browse - stable (0) grass - slightly up (+1) forb - slightly up (+1)

2007 TREND ASSESSMENT

Browse continues to be stable with no browse species sampled. The grass trend is slightly down. The sum of nested frequency for perennial grasses decreased by 13%, including a significant decrease in intermediate wheatgrass nested frequency. There were also four fewer grass species sampled in 2007 than in 2002. The grasses all looked vigorous and were beginning to produce inflorescences when the study was sampled. The forb trend is stable. The sum of nested frequency increased for perennial forbs by 11%, which was mostly attributed to a significant increase in showy goldeneye (*Viguiera multiflora*). There were also significant increases in the nested frequency of two annuals; slenderleaf collomia and Douglas knotweed (*Polygonum douglasii*). Tarweed nested frequency and quadrat frequency slightly decreased, yet tarweed cover slightly increased. When the study was sampled, there was no apparent animal use on grasses or forbs, even though elk and deer pellets were from spring and summer of 2007.

winter range condition (DCI) - Not applicable, summer range
browse - stable (0) grass - slightly down (-1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16B, Study no: 14

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	-	-	1	-	-	.00	-
G	Agropyron intermedium	a87	b99	d256	c207	2.26	19.62	10.73
G	Agropyron trachycaulum	-	a12	b54	b73	.22	1.70	1.62
G	Bromus carinatus	-	-	a4	a5	-	.18	.03
G	Bromus inermis	-	b100	a36	a44	3.39	1.58	2.01
G	Bromus japonicus (a)	1	-	-	-	-	-	-
G	Bromus sp.	a1	a2	-	-	.03	-	-
G	Dactylis glomerata	-	b116	a25	a3	3.59	.55	.06
G	Lolium perenne	26	-	-	-	-	-	-
G	Phleum pratense	b42	a8	a13	a11	.07	.59	.10
G	Poa pratensis	-	-	3	-	-	.03	-
G	Stipa lettermani	-	-	4	-	-	.18	-
Total for Annual Grasses		1	0	0	0	0	0	0
Total for Perennial Grasses		156	337	396	343	9.57	24.45	14.57
Total for Grasses		157	337	396	343	9.57	24.45	14.57
F	Achillea millefolium	a2	ab6	b12	ab7	.33	.86	.36
F	Agoseris glauca	-	a49	ab56	b94	.57	1.10	2.51
F	Arabis sp.	-	-	4	-	-	.06	-
F	Aster chilensis	-	a19	b40	b42	1.97	3.32	2.51
F	Chenopodium album (a)	-	a3	-	a8	.00	-	.16
F	Cirsium undulatum	a1	c124	b66	b57	2.29	.63	1.33
F	Claytonia lanceolata	-	b174	b206	a100	1.50	1.97	.66
F	Collomia linearis (a)	-	-	a82	b196	-	.40	2.80
F	Cynoglossum officinale	a10	c113	b72	bc83	2.35	1.28	1.62
F	Descurainia californica	14	-	-	-	-	-	-
F	Epilobium brachycarpum (a)	-	-	a138	b212	-	1.08	2.35
F	Epilobium sp.	2	-	-	-	-	-	-
F	Eriogonum brevicaule	-	-	-	3	-	-	.00
F	Eriogonum caespitosum	a4	a6	-	-	.16	-	-
F	Erigeron eatonii	-	a3	b22	ab14	.00	.56	.10
F	Eriogonum racemosum	-	-	4	-	-	.00	-
F	Galium aparine (a)	-	3	-	-	.00	-	-
F	Geranium sp.	-	a3	a1	a-	.00	.03	.38
F	Hedysarum boreale	6	-	-	-	-	-	-
F	Helenium hoopesii	-	-	-	2	-	-	.00

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Lactuca serriola	$_{a}$8	-	-	$_{a}$4	-	-	.01
F	Linum lewisii	$_{a}$7	$_{a}$2	$_{a}$1	-	.16	.06	-
F	Machaeranthera canescens	-	-	-	3	-	-	.00
F	Machaeranthera spp	-	-	3	-	-	.03	-
F	Madia glomerata (a)	$_{a}$25	$_{c}$363	$_{b}$262	$_{b}$255	17.90	3.40	6.55
F	Machaeranthera grindelioides	-	-	-	13	-	-	.36
F	Mertensia ciliata	-	3	-	-	.00	-	-
F	Melilotus officinalis	8	-	-	-	-	-	-
F	Mertensia sp.	-	-	-	7	-	-	.04
F	Medicago sativa	-	1	-	-	.15	-	-
F	Oenethera flava	$_{b}$11	$_{a}$3	$_{ab}$10	-	.00	.28	-
F	Oenothera sp.	-	-	-	21	-	-	.19
F	Penstemon sp.	-	$_{a}$-	$_{a}$10	$_{a}$1	.00	.21	.03
F	Polygonum douglasii (a)	-	$_{b}$81	$_{a}$5	$_{c}$201	.27	.01	.78
F	Senecio multilobatus	1	-	-	-	-	-	-
F	Stellaria jamesiana	-	$_{a}$2	-	$_{a}$2	.01	-	.15
F	Taraxacum officinale	-	$_{a}$7	$_{a}$4	$_{a}$15	.21	.06	.16
F	Tragopogon dubius	$_{a}$1	$_{a}$9	$_{ab}$9	$_{b}$30	.07	.05	.45
F	Unknown forb-annual (a)	-	3	-	-	.15	-	-
F	Vicia americana	-	$_{a}$12	$_{a}$3	$_{a}$8	.02	.15	.18
F	Viguiera multiflora	-	$_{a}$23	$_{a}$23	$_{b}$89	.61	.71	1.87
F	Viola sp.	$_{a}$6	$_{b}$40	$_{a}$17	$_{ab}$31	.39	.12	.31
Total for Annual Forbs		25	453	487	872	18.34	4.89	12.65
Total for Perennial Forbs		81	599	563	626	10.85	11.52	13.31
Total for Forbs		106	1052	1050	1498	29.19	16.42	25.97

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

BROWSE TRENDS --
Management unit 16B, Study no: 14

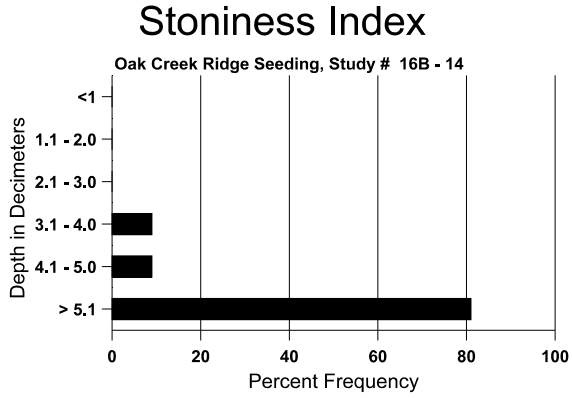
Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Sambucus racemosa	0	0	0	-	-	.00
B	Symphoricarpos oreophilus	0	1	0	.00	-	-
Total for Browse		0	1	0	0.00	0	0.00

BASIC COVER --
Management unit 16B, Study no: 14

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	13.25	39.88	41.42	51.20
Rock	1.50	.70	2.25	2.05
Pavement	0	.58	.58	.99
Litter	1.50	11.58	16.60	6.10
Cryptogams	0	0	0	0
Bare Ground	83.75	42.25	53.04	49.68

SOIL ANALYSIS DATA --
Herd Unit 16B, Study no: 14, Oak Creek Ridge Seeding

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
24.8	47.9 (17.7)	6.5	24.0	32.4	43.6	3.5	35.3	214.4	.4



PELLET GROUP DATA --
Management unit 16B, Study no: 14

Type	Quadrat Frequency		
	'97	'02	'07
Elk	12	1	1
Deer	1	2	-
Cattle	9	17	10

Days use per acre (ha)	
'02	'07
7 (17)	10 (25)
2 (5)	3 (7)
43 (106)	9 (23)

BROWSE CHARACTERISTICS --
Management unit 16B, 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)
Symphoricarpos oreophilus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	11/15
07	**0**	-	-	-	-	-	0	0	-	-	0	10/13

SUMMARY

WILDLIFE MANAGEMENT SUBUNIT 16B - CENTRAL MOUNTAINS, MANTI NORTH

Trend studies in this management unit were established in 1989 and reread in 1997, 2002, and 2007. Two studies, Oak Creek Ridge Aspen (16B-13) and Oak Creek Ridge Seeding (16B-14) have slightly different sampling schedules and were reread in 1999, 2002, and 2007. Two studies, East Dairy Fork (16B-7) and Oak Creek (16B-12) were not sampled in 2002 or 2007.

Community Types

The studies in this unit primarily monitor sagebrush, mountain brush, and chained pinyon-juniper communities. Specifically, one study is dominated by aspen (*Populus tremuloides*), four are mountain brush studies, four are mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) studies, two are basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) studies, and one is a high elevation, dry meadow.

Precipitation

Precipitation, both the annual and seasonal plays an important role in vegetation trends. Data from two weather stations within the boundaries of unit 16B, Fairview 8N and Scofield-Skyland Mine, were summarized for precipitation patterns over the past two decades. The combined average annual precipitation during that time from both stations is 20.7 inches (52.6 cm). Drought conditions (less than 75% of annual precipitation) occurred in 1989, and precipitation was below normal in 1984, 1986-1988, 1990-1992, 1994, 1999, and 2001-2003 (Figure 1).

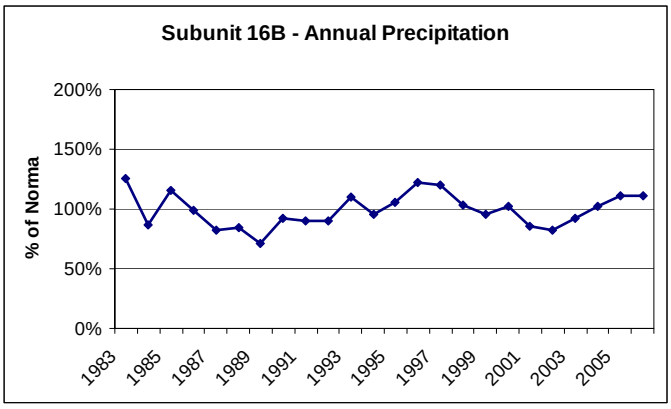


Figure 1. Percent of normal annual precipitation averaged for weather stations in subunit 16B (Utah Climate Summaries 2007).

Seasonal distribution of precipitation (spring vs. fall) may have a larger impact on vegetation trends than total annual precipitation. Analysis of the weather station data showed that spring precipitation was below normal for more than half of the period of record including from 2000-2002, and again in 2004 and 2007 (Figure 2). Spring precipitation is essential for cool season perennial species to germinate and be productive. Fall precipitation was also below normal for more than half of the period of record, and was lowest in 1995 and 1999.

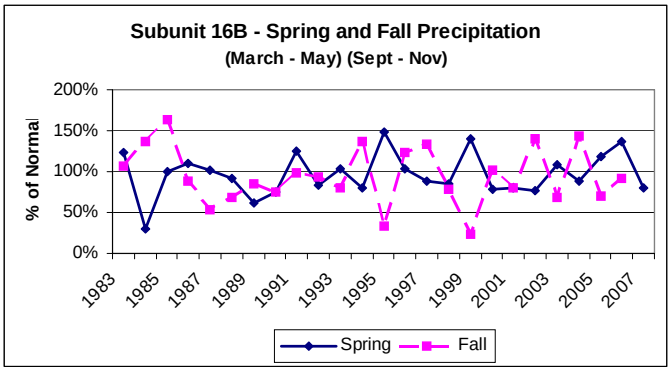


Figure 2. Percent of normal seasonal precipitation for weather stations in subunit 16B (Utah Climate Summaries).

Browse

The cumulative browse trend for subunit 16B was nearly stable since 1997 (Figure 3). Browse trend was down at Mill Fork (16B-6). Trend was slightly down at five studies: Long Ridge South (16B-1),

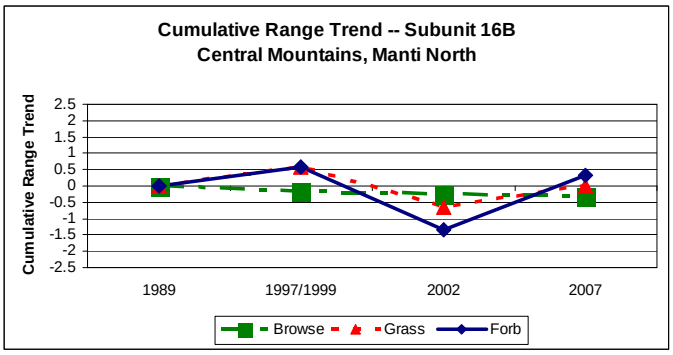


Figure 3. Cumulative range trend for the browse, grass, and forb components in subunit 16B.

Long Ridge North (16B-2), Rocky Hollow (16B-3), Starvation Mahogany (16B-8), and Starvation Mountain Browse (16B-9). Browse trend remained stable at four studies: Dry Creek Chaining (16B-4), Jackson Unit (16B-5), Dairy Fork Burn (16B-10), and Oak Creek Ridge Seeding (16B-14). Browse trend was slightly up at, Hilltop (16B-11). And lastly, browse trend was up at Oak Creek Ridge Aspen (16B-13). Of the studies with mountain brush communities, browse trend was slightly down for three, and stable for one. Of the studies with mountain big sagebrush communities, browse trend was down for one, slightly down for two, and slightly up for one. Both of the basin big sagebrush studies had a stable browse trend. Browse trend was up at the aspen study, and was stable in the dry meadow study (there continues to be no preferred browse species).

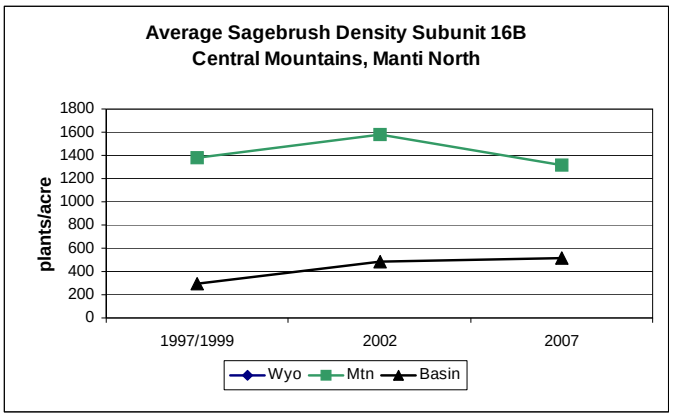


Figure 4. Average density of mountain big sagebrush and basin big sagebrush in subunit 16B.

The changes in browse trend were largely influenced by changes in preferred browse density. The subunit average density of mountain big sagebrush decreased by 16% from 2002 to 2007 (Figure 4). Basin big sagebrush occurred at densities great enough to be detected at only one study, Dairy Fork Burn (16B-10) and increased by 8% since 2002.

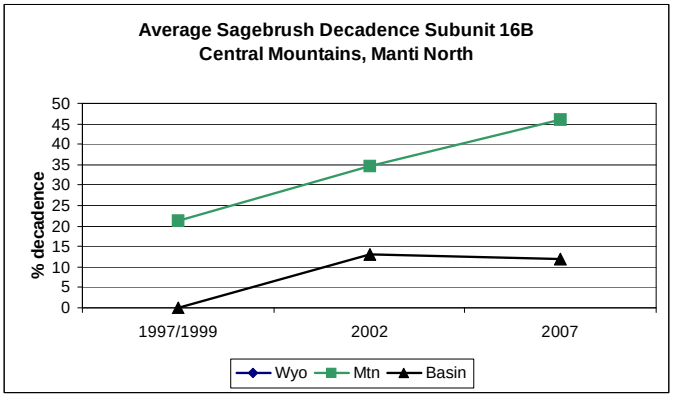


Figure 5. Average percent decadence of mountain big sagebrush and basin big sagebrush in subunit 16B.

The subunit average mountain big sagebrush decadence increased from 21% in 1997, to 35% in 2002, and 46% in 2007 (Figure 5). The subunit average was largely influenced by the all-decadent, low-density population at Dry Creek Chaining (16B-4). If that population was not decadent, than the subunit average would have been 22% in 2002 and 33% in 2007. Regardless, there was an increase in average decadence from 2002 to 2007. Some of this increase is attributed to the presence of the sagebrush defoliator moth (*Aroga websteri*), which infested an average of 25% of the plants on four of the mountain big sagebrush studies. Interestingly, the defoliator moth was found at Long Ridge South, but not at Long Ridge North, which lies 70 paces away. The reason may be the difference in aspect of the two studies, and the expected difference in soil moisture. It is possible that the plants on the drier Long Ridge South study are more stressed, and thus more susceptible to infestation. Percent decadence for basin big sagebrush slightly decreased at Dairy Fork Burn, even though defoliator moth damage was observed on 42% of the plants.

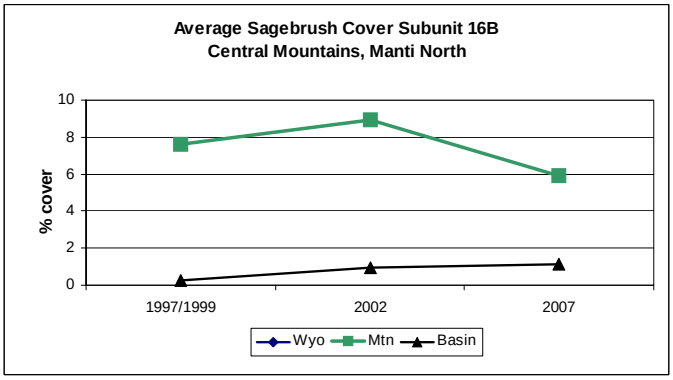


Figure 6. Average percent cover of mountain big sagebrush and basin big sagebrush in subunit 16B.

The subunit average percent of ground cover occupied by mountain big sagebrush decreased from 9% to 5% since 2002, and is at the lowest level since sagebrush cover data were collected (Figure 6). The percentage of ground cover occupied by basin big sagebrush is an average of two studies, Dairy Fork Burn and Jackson Unit.

The cover was much lower at Jackson Unit (near zero for all sample years) than at Dairy Fork Burn.

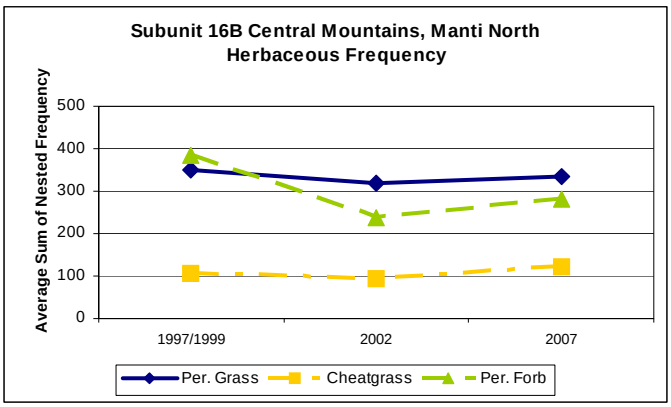


Figure 7. Average sum of nested frequency for the herbaceous understory in subunit 16B.

Grass

The subunit average grass trend decreased from 1997 to 2002 and was relatively stable to 2007 (Figure 3). The grass trend was down for two studies, Long Ridge South and Oak Creek Ridge Aspen; and was slightly down for two other studies, Dry Creek Chaining and Oak Creek Ridge Seeding. The grass trend was stable at four studies, Jackson Unit, Mill Fork, Starvation Mahogany, and Starvation Mountain Brush. The grass trend was slightly up at Rocky Hollow and Hilltop, and was up at Long Ridge North and Dairy Fork Burn.

The average sum of nested frequency for perennial grasses increased slightly in 2007 (Figure 7). The average ground cover occupied by perennial grass has steadily increased from 10% in 1997 and was 14% in 2007 (Figure 8). Cheatgrass frequency and cover both declined slightly from 1997 to 2002, then increased slightly in 2007, but remained below the 1997 values. Cheatgrass is most abundant at Long Ridge South and Rocky Hollow. Cheatgrass was sampled for the first time in 2007 at Mill Fork and Starvation Mahogany.

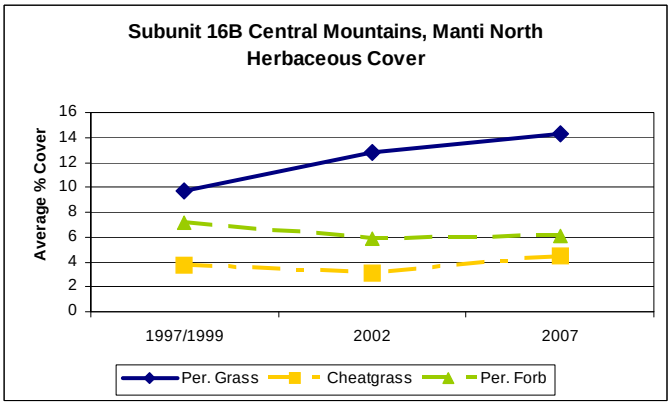


Figure 8. Average percent cover for the herbaceous understory in subunit 16B.

Forb

The subunit average forb trend increased from 2002 to 2007 and is the only vegetative trend to have an average positive score in 2007 (Figure 3). The forb trend was down at two studies, Rocky Hollow and Hilltop. The forb trend was stable at five studies, Dry Creek Chaining, Jackson Unit, Starvation Mountain Brush, Oak Creek Ridge Aspen, and Oak Creek Ridge Seeding. The forb trend was slightly up at two studies, Long Ridge North, and Starvation Mahogany. And lastly, the forb trend was up at three studies, Long Ridge South, Mill Fork, and Dairy Fork Burn.

The average sum of nested frequency for perennial forbs decreased by 37% from 1997 to 2002, and increased by 19% between 2002 and 2007 (Figure 7). The subunit average ground cover occupied by perennial forbs has remained nearly constant since 1997 and was 6% in 2007 (Figure 8). The average nested frequency and average ground cover of bur buttercup(*Ranunculus testiculatus*), an allelopathic annual (Buchanan et al. 1978), has steadily increased since 1997. Bur buttercup increase was greatest at Dry Creek Chaining, Mill Fork, and Hilltop, three studies with open understory spaces and with moderate to low competition from other herbaceous species.

Desirable Components Index

The Desirable Components Index (DCI) was calculated for 10 of the 12 studies in subunit 16B. Two of these studies are in the high potential category and eight are in the mid-level potential category. The remaining two studies are summer range studies and the DCI does not apply to them. The average DCI score improved from fair in 1997 and 2002 to good in 2007 for the two high potential studies, Starvation Mahogany and Starvation Mountain Brush (Figure 9). The improvement was attributed to an increase in perennial grass cover and a decrease in shrub decadency. The DCI score has steadily declined for the mid-level potential studies from

poor in 1997 and 2002 to very poor in 2007. The decline is attributed to less shrub cover and increased shrub decadence. Collectively, the DCI scores would be lower were it not for a general increase in perennial grass cover.

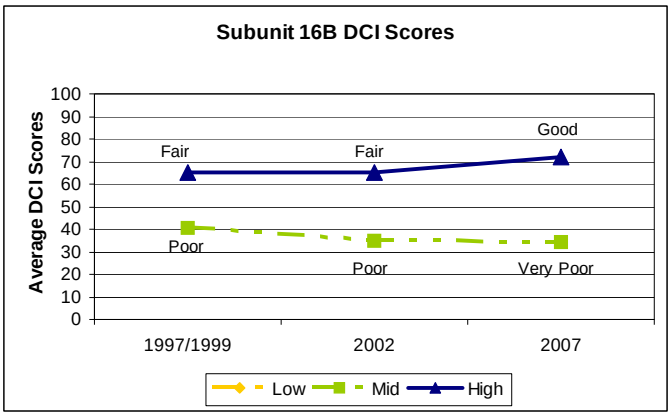
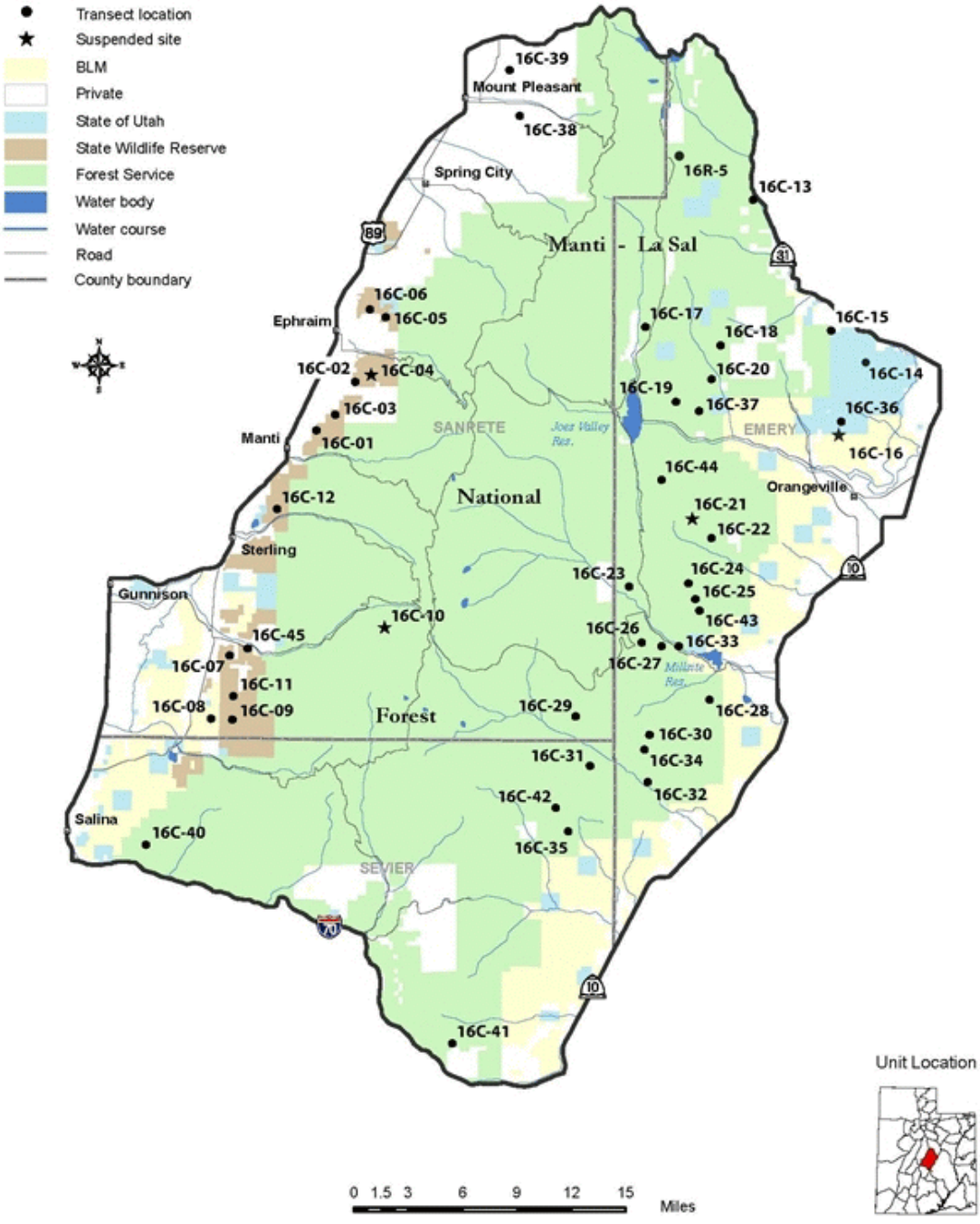


Figure 9. Average DCI scores for subunit 16B. The scores are divided into categories based on ecological potential and include: high, mid-level, and low.

Management Unit 16C



WILDLIFE MANAGEMENT UNIT 16 - MANTI-NEBO

SUBUNIT 16C - MANTI-NEBO, MANTI SOUTH

Boundary Description

Sanpete, Emery, and Sevier Counties - Boundary begins at the junction of SR-10 and SR-31 at Huntington; then south on SR-10 to I-70; west on I-70 to US-89 at Salina; north on US-89 to SR-31 at Fairview; southeast on SR-31 to SR-10 at Huntington and beginning point.

Management Unit Description

Management subunit 16C covers both the east and west slopes of the Wasatch Plateau that lie within the above listed unit boundaries. The western portion of this unit, which includes the areas from Fairview south to about Mayfield was monitored in 2007. The eastern side of this management unit is monitored as part of the Southeastern Region rotation that was last sampled in 2004, and will be sampled again in 2009. The range trend studies on the western portion of management subunit 16C monitor several chained and seeded pinyon-juniper sites in the foothill ranges above Ephraim, Manti, and Mayfield. Additional studies monitor mountain brush, and sagebrush-grass types, as well as a high elevation meadow.

As with management subunit 16B, the availability of winter range and its condition and productivity have always been an issue on these important deer herd units in central Utah. Due to location and access, a large number of hunters use these units, and they continue to contribute an important portion of the yearly statewide deer harvest. A large portion of the critical winter range in subunit 16C is found along highway corridors or adjacent to agricultural areas. As a result, two issues facing wildlife managers in this unit are crop depredation and highway mortality. Many of the range trend studies monitor Utah Division of Wildlife Resources-owned wildlife management areas (WMAs) in this unit that were purchased to try to minimize the effects of these two factors on wildlife herds. Habitat management objectives for this unit include the following: working with federal agencies, local governments, and private landowners to achieve long-term habitat protection and preservation; carrying out habitat improvements such as re-seedings, controlled burns, and water developments; and providing long-term habitat quantity and quality sufficient to maintain wildlife population objectives.

Big Game Management Objectives

The current management objective is to maintain a herd of 38,000 wintering deer for management units 16B and 16C. The estimated herd size has grown from 26,000 deer in 2002 to 32,700 in 2005. The buck:doe ratio has averaged 11.3:100 during the three year period from 2003 to 2005, slightly below the objective of 15 to 20 bucks per 100 does (Hersey and McLaughlin 2006). From 1999 to 2005 the fawn:doe ratio has averaged 66:100.

The current elk management objective is to maintain a winter herd population of 12,000. From 2002 to 2005 the estimated population has ranged from 8,800 to 11,100 (Hersey and McLaughlin 2006)

Range Trend Studies

Fourteen studies were originally established on the west portion of the subunit in 1989, and one new one was established in 2007. Most of the studies were reread in 2997 and 2002. Thirteen of the studies were read in 2007, and two were suspended.

Trend Study 16C-1-07

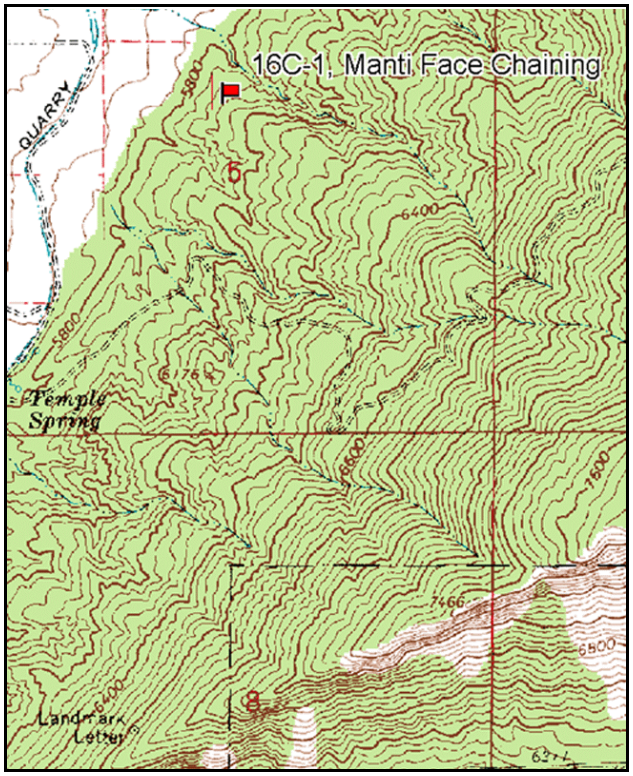
Study site name: Manti Face Chaining . Vegetation type: Chained, Seeded P-J .

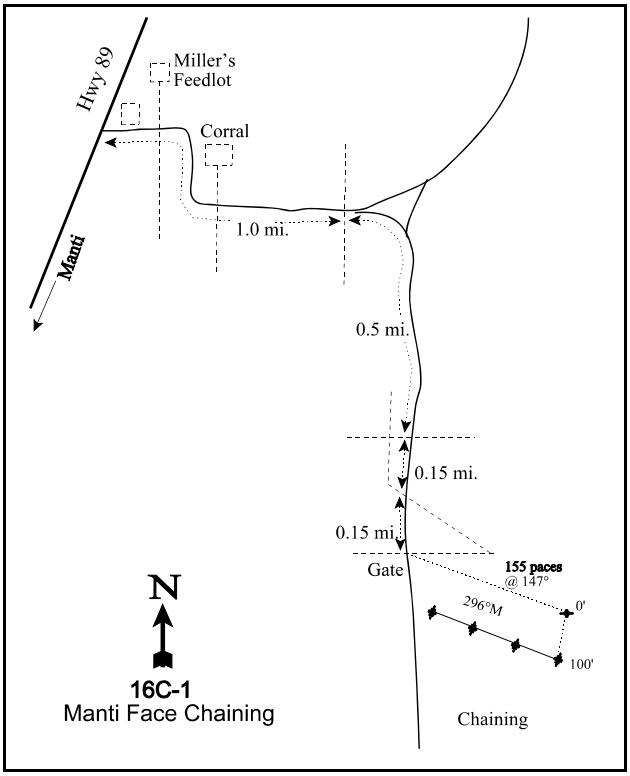
Compass bearing: frequency baseline 192 degrees magnetic (line 2-4 @ 296°M).

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

LOCATION DESCRIPTION

Go north out of Manti on Highway 89 about 1 mile or so to a feedlot on the right (east) side of the road. Turn right on the south side of these corrals. Go up this county road 1 mile, following the main road around the upper corrals, to an old fence line. Just past the fence, bear right off the main road onto a faint road. Follow this road 0.5 miles to the first DWR fence. Go through this small section of DWR land 0.15 miles to another fence. Go 0.15 miles to another DWR fence. Stop at this gate. From here, the study site is up the hill in the chaining. Walk 155 paces at 139 degrees magnetic to the 0-foot baseline stake, which is marked by browse tag #9043.





Map Name: Ephraim

Diagrammatic Sketch

Township 18S , Range 3E , Section 5

GPS: NAD 83, UTM 12S 447653 E 4348004 N

DISCUSSION

Manti Face Chaining - Trend Study No. 16C-1

Study Information

This study is located on Utah Division of Wildlife Resources property northeast of Manti [elevation: 5,920 feet (1,804 m), slope: 28%, aspect: west]. It was placed on one of the many chainings along the Ephraim/Manti front that are adjacent to cultivated fields. Because the project was done when chainings were treated as large rectangular areas, protective cover is lacking on the treated area and there is limited sign of deer and elk use. The deer pellet group data estimates were 63 days use/acre (155 ddu/ha) in 2002 and 28 days use/acre (69 ddu/ha) in 2007. The elk pellet group data estimates were less than 1 day use/acre (2 edu/ha) in 2002 and 11 days use/acre (28 edu/ha) in 2007. The sheep pellet group data estimates were 1 day use/acre (3 sdu/ha) in 2002. The cattle use estimates were 2 days use/acre (5 cdu/ha) in 2002 and 9 days use/acre (22 cdu/ha) in 2007. The deer and elk pellets sampled in 2002 and 2007 appeared to be primarily from winter or spring and the sampled cattle pats and sheep pellets appeared to be from the previous year.

Soil

The soil is in the Sanpete series, which consists of very deep, well to somewhat excessively drained, moderately-rapidly permeable soils that formed in alluvium dominantly from limestone, sandstone, and shale (USDA-NRCS 2007). The soil has a loam texture and is neutral to slightly alkaline reactivity (pH of 7.3). Rock and pavement are abundant on the surface and throughout the profile. Combined relative rock and pavement cover was 30%-32% from 1997 to 2007. Combined relative vegetation and litter cover was 53%-55% from 1997 to 2007. Relative bare ground cover was low at 14% or less since 1997. This area was chained partly to reduce the erosion potential. In 2002, the erosion condition was classified as stable. In 2007, the erosion condition was classified as slight due to pedestalling around vegetation, flow patterns and slight transportation of soil and surface litter.

Browse

There is limited browse forage available on the chaining, and there are few seeded species. A few large, robust fourwing saltbush (*Atriplex canescens*) and an occasional small antelope bitterbrush (*Purshia tridentata*) have been found within the planting rows left by seed dribblers. Black sagebrush (*Artemisia nova*) is also present, but accounted for less than 1% of the canopy cover in 2002 and 2007. Black sagebrush density was estimated at 832 plants/acre (2,055 plants/ha) in 1989, 500 plants/acre (1,235 plants/ha) in 1997, 680 plants/acre (1,680 plants/ha) in 2002, and 340 plants/acre (840 plants/ha) in 2007. Young plants comprised 8% of the population in 1989, 48% in 1997, 62% in 2002, and 41% in 2007. Decadence was 20% in 1989, 0% in 1997, 6% in 2002 and 18% in 2007. Plants classified as having poor vigor has comprised of 0%-12% of the population since 1989. Utilization was mostly light-moderate in all sample years. Average annual leader growth was 1.4 inches (3.6 cm) in 2002 and 1.2 inches (3 cm) in 2007.

During the initial sampling in 1989, surviving Utah juniper (*Juniperus osteosperma*) appeared to be rapidly increasing in size in the treated area. From point-center quarter data juniper density was estimated at 183 trees/acre (452 trees/ha) in 1997, 118 trees/acre (291 trees/ha) in 2002, and 124 trees/acre (306 trees/ha) in 2007. Average juniper trunk diameter was 1.5 inches (3.8 cm) in 1997, 1.8 inches (4.6 cm) in 2002, and 2.6 inches (6.6 cm) in 2007. Estimated pinyon pine (*Pinus edulis*) density was 6 trees/acre (15 trees/ha) in 1997, 21 trees/acre (52 trees/ha) in 2002, and 22 pinyon/acre (54 trees/ha) in 2007. Pinyon average trunk diameter was 2.1 inches (5.3 cm) in 1997, 1.3 inches (3.3 cm) in 2002, and 1.9 inches (4.8 cm) in 2007.

Herbaceous Understory

Grasses are the dominant component in the community. Both seeded and native species are abundant. The most abundant grass is crested wheatgrass (*Agropyron cristatum*). It provided 6% cover in 1997 and 11% cover in 2002 and 2007. Intermediate wheatgrass (*Agropyron intermedium*) provided 4% cover in 1997 and

3% cover in 2002 and 2007. Bluebunch wheatgrass (*Agropyron spicatum*) cover was 1% in 1997, 5% in 2002, and 3% in 2007. Sandberg bluegrass (*Poa secunda*) provided 2% cover in 1997, 1% cover in 2002, and 5% cover in 2007. Though not dominant in previous years, cheatgrass (*Bromus tectorum*) cover increased from 1% in 1997 and nearly 0% in 2002 to 4% cover in 2007. Less abundant species include Indian ricegrass (*Oryzopsis hymenoides*), sheep fescue (*Festuca ovina*), and bottlebrush squirreltail (*Sitanion hystrix*). Due to spring drought conditions in 2002 (Utah Climate Summaries 2007), grass identification was difficult because there was minimal production and seedhead development.

Forbs are limited, with annual species being more abundant than perennials. Bur buttercup (*Ranunculus testiculatus*), a weed that has allelopathic characteristics (Buchanan et al. 1978), was the most abundant species. It provided 4% cover in 1997, less than 1% cover in 2002, and 5% cover in 2007. In 2002, most of the understory biomass was desiccated. Seeded species such as alfalfa (*Medicago sativa*) and small burnet (*Sanguisorba minor*) have not been sampled since 1997. Field bindweed (*Convolvulus arvensis*), a noxious weed, has been present since 1997, but has only been sampled in 10% or less of the quadrats.

1997 TREND ASSESSMENT

The browse trend is stable. The browse component is low and comprised 2% of the ground cover, with few preferred browse species that contribute little browse for wintering big game. The density of black sagebrush decreased 40%, but the recruitment of young into the population increased from 8% to 48%. Percent decadence decreased from 20% to 0%, and plants classified as having poor vigor improved from 12% of the population to 0%. The grass trend is stable. The sum of nested frequency values for perennial grasses remained stable. The nested frequency for crested wheatgrass significantly increased and, significantly decreased for bottlebrush squirreltail. The trend for forbs is stable. The sum of the nested frequency for perennial forbs was unchanged. Bur buttercup provided 76% of the total forb cover. Field bindweed, a noxious weed, was also sampled for the first time. The Desirable Components Index (DCI) score was fair due to high perennial grass cover and low annual grass cover, but low cover and recruitment of preferred browse and low perennial forb cover.

winter range condition (DCI) - fair (29) Low potential scale
browse - stable (0) grass -stable (0) forb - stable (0)

2002 TREND ASSESSMENT

The trend for browse is slightly up. Black sagebrush density increased 36%. The recruitment of young increased to 62% of the population. Percent decadence increased slightly to 6% of the population, and plants classified with poor vigor increased to 3%. Fourwing saltbush and antelope bitterbrush had low densities of 40 plants/acre (99 plants/ha) and 60 plants/acre (148 plants/ha), respectively, and all of the plants were vigorous. The grass trend is stable. The sum of nested frequency of perennial grasses changed little, while the sum of the nested frequency of annual grasses decreased 84%. Additionally, perennial grasses increased from 15% of the ground cover to 22%. The nested frequency of cheatgrass significantly decreased. The trend for forbs is slightly down. The sum of nested frequency of perennial forbs decreased 79%. Alfalfa, the dominant perennial forb in previous years, was not sampled. The nested frequency of bur buttercup significantly decreased, while the nested frequency for field bindweed remained stable. The DCI score remained fair.

winter range condition (DCI) - fair (28) Low potential scale
browse - slightly up (+1) grass - stable (0) forb - slightly down (-1)

2007 TREND ASSESSMENT

The trend for browse is down. Black sagebrush density decreased 50%. Recruitment also decreased to 41%, and percent decadence increased to 18% of the population. Plants classified with poor vigor increased to 12% of the population, and all of these plants were classified as dying. The trend for grass is slightly down. The sum of nested frequency of perennial grasses changed little, while the sum of nested frequency of annual

grasses greatly increased. Cheatgrass nested frequency significantly increased, and it increased from nearly 0% to 4% ground cover. The forb trend is down. The sum of nested frequency for perennials forbs increased more than two-fold. However, the sum of nested frequency for annual forbs increased four-fold. Bur buttercup nested frequency significantly increased, and provided 96% of the total forb cover, and 5% ground cover. Field bindweed nested frequency and cover changed little. The DCI score declined to fair-poor due to and increase in annual grass cover.

winter range condition (DCI) - fair-poor (26) Low potential scale
browse - down (-2) grass - slightly down (-1) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 1

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{a}$125	$_{b}$182	$_{b}$216	$_{b}$202	5.77	10.67	11.07
G	Agropyron intermedium	$_{a}$118	$_{a}$128	$_{a}$101	$_{a}$98	4.05	3.20	3.22
G	Agropyron spicatum	$_{a}$47	$_{a}$43	$_{a}$64	$_{a}$67	1.23	5.36	2.57
G	Bromus inermis	1	-	-	-	-	-	-
G	Bromus japonicus (a)	-	$_{a}$5	-	$_{a}$8	.15	-	.02
G	Bromus tectorum (a)	-	$_{b}$81	$_{a}$14	$_{c}$205	.71	.05	3.96
G	Elymus junceus	$_{b}$18	$_{b}$26	-	$_{a}$5	1.39	-	.15
G	Festuca ovina	$_{b}$21	$_{ab}$14	$_{ab}$16	$_{a}$6	.25	.91	.01
G	Oryzopsis hymenoides	$_{a}$1	$_{a}$6	-	$_{a}$2	.41	-	.03
G	Poa secunda	$_{a}$129	$_{ab}$158	$_{a}$137	$_{b}$194	1.60	1.41	5.54
G	Sitanion hystrix	$_{c}$130	$_{b}$28	$_{ab}$7	$_{a}$5	.39	.07	.06
Total for Annual Grasses		0	86	14	213	0.87	0.05	3.98
Total for Perennial Grasses		590	585	541	579	15.11	21.64	22.68
Total for Grasses		590	671	555	792	15.98	21.69	26.67
F	Alyssum alyssoides (a)	-	$_{a}$1	-	$_{b}$137	.00	-	.64
F	Arabis sp.	1	-	-	-	-	-	-
F	Arenaria fendleri	-	$_{a}$3	-	$_{a}$2	.00	-	.00
F	Astragalus sp.	$_{a}$3	-	-	$_{a}$2	-	-	.00
F	Camelina microcarpa (a)	-	$_{a}$31	-	$_{a}$41	.09	-	.12
F	Chaenactis douglasii	-	6	-	-	.01	-	-
F	Chenopodium fremontii (a)	-	1	-	-	.00	-	-
F	Chorispora tenella (a)	-	3	-	-	.03	-	-
F	Convolvulus arvensis	-	$_{a}$13	$_{a}$11	$_{a}$19	.40	.07	.17
F	Collinsia parviflora (a)	-	-	1	-	-	.00	-
F	Cryptantha sp.	$_{a}$14	$_{a}$21	-	$_{a}$11	.22	-	.02
F	Descurainia pinnata (a)	-	$_{a}$14	-	$_{a}$30	.03	-	.07
F	Draba sp. (a)	-	3	-	-	.00	-	-

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Erodium cicutarium (a)	-	$_{a}$1	-	$_{a}$6	.00	-	.01
F	Galium aparine (a)	-	1	-	-	.00	-	-
F	Lappula occidentalis (a)	-	3	-	-	.00	-	-
F	Lactuca serriola	$_{a}$3	$_{a}$3	-	-	.00	-	-
F	Medicago sativa	$_{a}$23	$_{a}$12	-	-	.29	-	-
F	Penstemon pachyphyllus	3	-	-	-	-	-	-
F	Phlox hoodii	$_{a}$7	$_{a}$8	$_{a}$1	$_{a}$4	.04	.03	.03
F	Phlox longifolia	-	-	1	-	-	.00	-
F	Ranunculus testiculatus (a)	-	$_{b}$297	$_{a}$131	$_{c}$335	3.84	.46	5.11
F	Sanguisorba minor	8	-	-	-	-	-	-
F	Sisymbrium sp. (a)	7	-	-	-	-	-	-
F	Streptanthus cordatus	$_{a}$3	$_{a}$1	-	-	.00	-	-
F	Taraxacum officinale	-	-	3	-	-	.00	-
F	Tragopogon dubius	$_{b}$19	$_{ab}$14	$_{a}$1	$_{ab}$7	.07	.00	.01
Total for Annual Forbs		7	355	132	549	4.02	0.47	5.96
Total for Perennial Forbs		84	81	17	45	1.05	0.11	0.25
Total for Forbs		91	436	149	594	5.08	0.58	6.21

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

BROWSE TRENDS --
Management unit 16C, Study no: 1

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia nova	12	7	7	.03	.15	.30
B	Atriplex canescens	2	2	1	-	-	-
B	Ephedra viridis	2	1	0	.03	.00	-
B	Gutierrezia sarothrae	2	7	3	.09	.33	-
B	Juniperus osteosperma	11	11	11	2.03	2.55	1.75
B	Purshia tridentata	2	3	2	.03	.00	.00
Total for Browse		31	31	24	2.22	3.05	2.06

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 1

Species	Percent Cover	
	'02	'07
Artemisia nova	.38	.43
Gutierrezia sarothrae	.10	-
Juniperus osteosperma	1.31	2.86

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 1

Species	Average leader growth (in)	
	'02	'07
Artemisia nova	1.4	1.2

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 1

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	118	124
Pinus edulis	21	22

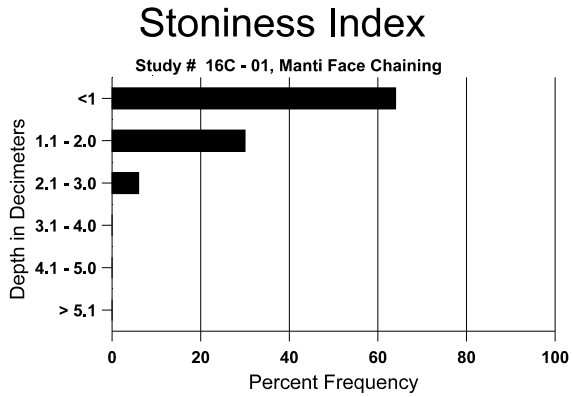
Average diameter (in)	
'02	'07
1.8	2.6
1.3	1.9

BASIC COVER --
Management unit 16C, Study no: 1

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	13.50	28.21	25.92	38.96
Rock	7.00	7.33	8.05	7.76
Pavement	47.00	26.63	25.63	26.55
Litter	25.25	31.50	34.34	19.71
Cryptogams	.25	.55	3.27	4.09
Bare Ground	7.00	13.08	15.64	9.27

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 01, Manti Face Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
9.6	59.8 (12.4)	7.3	38.0	34.4	26.6	3.3	9.2	150.4	.5



PELLET GROUP DATA --
Management unit 16C, Study no: 1

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	-	-
Rabbit	17	27	58
Elk	23	5	4
Deer	36	54	37
Cattle	1	-	2

Days use per acre (ha)	
'02	'07
1 (3)	-
-	-
1 (2)	11 (28)
63 (155)	28 (69)
2 (5)	9 (22)

BROWSE CHARACTERISTICS --
Management unit 16C, 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 nova												
89	**832**	33	66	600	166	-	16	8	20	4	12	7/13
97	**500**	-	240	260	-	-	24	0	0	-	0	12/20
02	**680**	20	420	220	40	60	24	12	6	3	3	11/20
07	**340**	-	140	140	60	-	24	18	18	12	12	11/21
Atriplex canescens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	-	50	50	-	-	0	38/61
02	**40**	-	-	40	-	20	50	0	-	-	0	46/62
07	**20**	-	-	20	-	-	0	0	-	-	0	47/67

		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)
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	42/36
07	**0**	-	-	-	-	-	0	0	-	-	0	24/40
Ephedra viridis												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**40**	-	20	20	-	-	0	50	0	-	0	-/-
02	**20**	-	-	-	20	-	0	0	100	100	100	7/12
07	**0**	-	-	-	-	-	0	0	0	-	0	-/-
Gutierrezia sarothrae												
89	**1765**	-	166	1333	266	-	0	0	15	6	6	7/10
97	**700**	40	440	260	-	-	0	0	0	-	0	9/9
02	**540**	-	-	420	120	120	0	0	22	-	0	6/7
07	**80**	-	20	60	-	-	0	0	0	-	0	8/8
Juniperus osteosperma												
89	**466**	166	300	133	33	-	0	0	7	-	7	54/44
97	**240**	40	140	100	-	120	8	0	0	-	0	15/35
02	**240**	-	60	180	-	-	8	0	0	-	0	-/-
07	**220**	-	120	100	-	-	0	0	0	-	0	-/-
Pinus edulis												
89	**66**	66	66	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**40**	20	-	40	-	-	50	50	0	-	0	6/14
02	**60**	-	20	40	-	-	0	67	0	-	0	6/20
07	**40**	-	-	20	20	-	0	100	50	50	50	4/10

Trend Study 16C-2-07

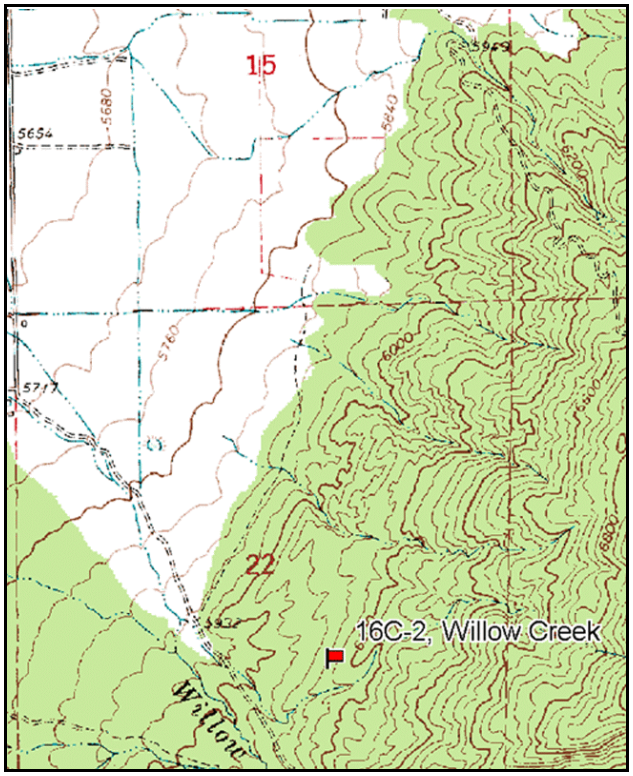
Study site name: Willow Creek . Vegetation type: Chained, Seeded P-J .

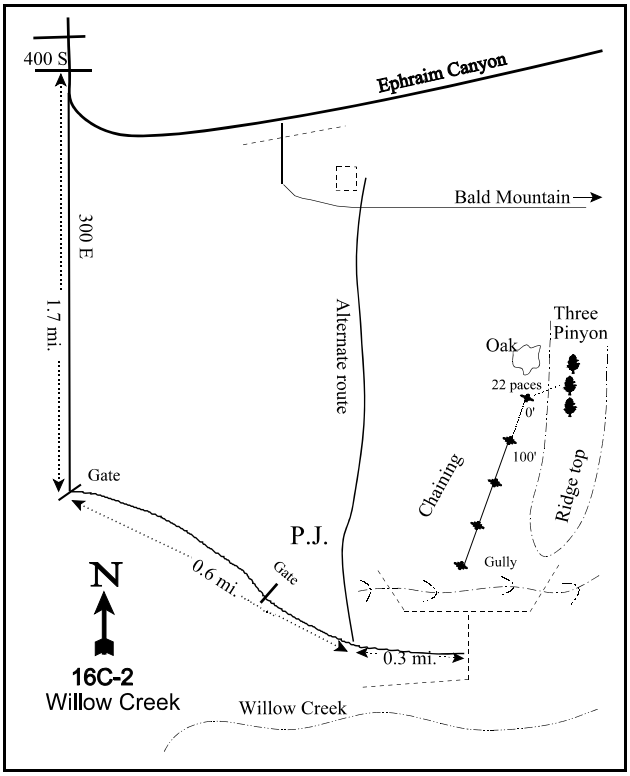
Compass bearing: frequency baseline 210 degrees magnetic.

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

LOCATION DESCRIPTION

From the intersection of 400 South and 300 East in Ephraim, take 300 East south for 1.7 miles to a gate. Pass through the gate onto a gravel road and follow this road for 0.6 miles to a fork. Stay to the right and continue for 0.3 miles to a gate. Park here. Cross the fence and the gully and go up the white shale ridge to the northeast (30°-35° magnetic). From the gully, go about 188 paces to a high point on the ridge where 3 large pinyons grow. Enroute you will pass the 400-foot stake which is near the ridge top. The 0-foot baseline stake, however, is 22 paces downhill from the 3 pinyons just south of an oak clump. The 0-foot stake is marked by browse tag #414. Consult diagrammatic sketch below for alternate route.





Map Name: Ephraim

Diagrammatic Sketch

Township 17S , Range 3E , Section 22

GPS: NAD 83, UTM 12S 451126 E 4352341 N

DISCUSSION

Willow Creek - Trend Study No. 16C-2

Study Information

This study is located on the lower slopes of Bald Mountain, southeast of Ephraim. It lies inside the 700 acre (283 ha) Bald Mountain chaining and seeding treatment that was completed in 1969 [elevation: 6,130 feet (1,868 m), slope: 35%, aspect: west]. The treatment was done to determine if chaining could be done successfully on steep slopes. Sheep graze surrounding parcels of land and some have trespassed on this piece of Utah Division of Wildlife Resources land, but overall, livestock use is light. There is abundant sign of wintering big game, especially deer. Deer pellets were sampled in at least half of the quadrats since 2009. The deer pellet group data estimates were 174 days use/acre (430 ddu/ha) in 2002 and 181 days use/acre (448 ddu/ha) in 2007. The elk pellet group data estimates were 8 days use/acre (20 edu/ha) in 2002 and 50 days use/acre (122 edu/ha) in 2007. The amount of deer use is one of the highest in the unit. Thermal cover is abundant, and there is a better preferred browse component compared to most of the other chainings in the area.

Soil

The soil is in the Atepic series that consists of shallow, well-drained, slowly permeable soils formed in colluvium and residuum derived from shale (USDA-NRCS 2007). The substratum is a layer of very strongly calcareous shaley silty clay loam. On the surface, the soil has a sandy clay loam texture. Runoff is usually rapid and the erosion hazard is severe. Moderately large patches of bare soil can be found on the surface. Relative bare ground cover was 19% in 1997, 28% in 2002, and 22% in 2007. Rock and pavement combined for 17%-18% cover in all samples. With drought in 2002, combined vegetation and litter cover declined from 64% to 54% and increased to 60% in 2007. In 2002, the erosion condition was classified as slight due to pedestalling around vegetation, flow patterns, and slight transportation of soil and surface litter. In 2007, the erosion condition was classified as stable.

Browse

Browse diversity is higher than what is found on most chainings, with a significant number of valuable winter browse species. The most common preferred browse species is antelope bitterbrush (*Purshia tridentata*), which has comprised 4% of the canopy cover since 2002. The density of was estimated at 532 plants/acre (1,314 plants/ha) in 1989, 840 plants/acre (2,075 plants/ha) in 1997, 640 plants/acre (1,581 plants/ha) in 2002, and 800 plants/acre (1,976 plants/ha) in 2007. The population is composed mostly of mature plants, with recruitment from young plants being low at 3%-7% of the population in all samples. Decadence decreased from 25% in 1989 to 0% in 1997 and decreased to 16% in 2002 and 13% in 2007. Plants classified with poor vigor were 6% or less of the population in all sample years. Utilization has been moderate-heavy. The average annual leader growth was 3.1 inches (7.9 cm) in 2002 and 0.9 inches (2.3 cm) in 2007.

True mountain mahogany (*Cercocarpus montanus*) is the second most abundant preferred browse, and comprised 1% of the canopy cover in 2002 and 2007. Mahogany density was estimated 133 plants/acre (329 plants/ha) in 1989, 420 plants/acre (1,037 plants/ha) in 1997, 300 plants/acre (741 plants/ha) in 2002, and 340 plants/acre (840 plants/ha) in 2007. There has been no recruitment except in 1997, when 24% of the population was in the young age class. Plants classified as decadent increased slightly from 0% in 1997 to 12%-13% in 2002 and 2007. Increased decadence and low reproduction are normal during periods of drought. Utilization has been moderate-heavy. Annual average leader growth was 1.8 inches (4.6 cm) in 2002 and 1.7 inches (4.3 cm) in 2007.

Less abundant palatable browse include mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), whiterubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), stansbury cliffrose (*Cowania mexicana* ssp *stansburiana*), Mormon tea (*Ephedra viridis*), and Utah serviceberry (*Amelanchier utahensis*). Most of

these less abundant species displayed moderate-heavy use in 2002 and 2007.

Scattered clumps of Gambel oak (*Quercus gambelii*), and a moderate stand of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) occur throughout the area. Point-centered quarter data estimates were 109 juniper trees/acre (269 trees/ha) in 2002 and 174 trees/acre (430 trees/ha) in 2007. Average trunk diameter was 2.5 inches (6.4 cm) in 2002 and 3.0 inches (7.6 cm) in 2007. Density estimates for pinyon were 69 trees/acre (170 trees/ha) in 2002 and 59 trees/acre (146 trees/ha) in 2007. Average trunk diameter was 2.7 inches (6.7 cm) in 2002 and 3.3 inches (8.4 cm) in 2007.

Herbaceous Understory

Grasses are abundant and diverse. Total perennial grass cover has been 14%-15% since 1997. Crested wheatgrass (*Agropyron cristatum*) was the dominant grass, providing 4%-6% cover since 1997. Bluebunch wheatgrass (*Agropyron spicatum*) provided 2% cover since 1997. Intermediate wheatgrass (*Agropyron intermedium*) cover decreased from 3% in 1997 to 1% in 2002 and 2007. Sheep fescue (*Festuca ovina*) provided 2% cover in 1997, increasing to 4% in 2002 and 2007. Cheatgrass (*Bromus tectorum*) is present, but provided only 1% cover in 1997, nearly 0% in 2002, and 2% cover in 2007. The decrease in 2002 is due in part to below normal precipitation conditions (Utah Climate Summaries 2007).

Forb abundance has fluctuated. Between five and 19 forb species have been sampled. Forbs provided 4% cover in 1997, declined with drought conditions to near 0% in 2002, and increased to 4% in 2007. Bur buttercup (*Ranunculus testiculatus*), an allelopathic winter annual (Buchanan et al. 1978), was moderately abundant in 1997 providing 2% cover, declined to nearly 0% cover in 2002, and increased to 3% cover in 2007. Alfalfa (*Medicago sativa*), which was seeded at the time of treatment, has steadily declined. It provided 1% cover in 1997 and nearly 0% cover in 2002 and 2007. Field bindweed (*Convolvulus arvensis*), a noxious weed, was sampled in 1989, 1997, and 2007 in low frequencies.

1997 TREND ASSESSMENT

The browse trend is up. There was a good mixture of shrubs, although the preferred species only contributed approximately half of the total browse cover. Bitterbrush density increased from 532 plants/acre (1,314 plants/ha) to 840 plants/acre (2,075 plants/ha), although this increase may be partly due to the increased sampling area in 2007. Recruitment continued to be low at 7% of the population. Decadency decreased from 25% of the population to 0%, and plants classified with poor vigor decreased slightly from 6% to 2%. True mountain mahogany density increased from 133 plants/acre (329 plants/ha) to 420 plants/acre (1,037 plants/ha). Recruitment increased from 0% of the population to 24%. Decadent plants and plants classified as having poor vigor remained at 0% of the population. Plant use decreased from mostly heavy to mostly moderate. Heavily browsed mahogany plants decreased from 75% of the population to 19%. The trend for grass is stable. The sum of nested frequency for perennial grasses remained stable. Crested wheatgrass decreased significantly in nested frequency, while Indian ricegrass (*Oryzopsis hymenoides*) and Sandberg bluegrass (*Poa secunda*) increased significantly in nested frequency. The forb trend is slightly up. The sum of nested frequency for perennial forbs increased 91%.However there were few forbs sampled. The total number of perennial forbs increased from five to 13. Bur buttercup was sampled in 65% of the quadrats. The nested and quadrat frequencies of alfalfa both decreased by at least half. The Desirable Components Index (DCI) score was fair due to low browse cover, with high decadence, and low recruitment, very high perennial grass cover, and low annual grass and perennial forb cover.

winter range condition (DCI) - fair (61) Mid-level potential scale
browse - up (+2) grass - stable (0) forb - slightly up (+1)

2002 TREND ASSESSMENT

The trend for browse is down. Bitterbrush density decreased to 640 plants/acre (1,581 plants/ha). Recruitment remained low at 6% of the population. Decadency increased to 16% and plants showing poor vigor increased

to 6% of the population. Plant use increased from moderate-heavy to mostly heavy. Heavily browsed bitterbrush plants increased from 40% of the population to 94%. True mountain mahogany density decreased to 300 plants/acre (741 plants/ha). Recruitment decreased to 0% of the population. Decadency increased to 13% of the population, and plant vigor was excellent. Plant use increased from light-moderate to all heavy. The trend for grass is slightly up. The sum of nested frequency for perennial grasses changed little, but the nested frequency for cheatgrass declined by 87%. The trend for forbs is slightly down. The sum of nested frequency of perennial and annual forbs decreased greatly. The total number of forb species sample decreased from 18 to seven. Bur buttercup remained the dominant forb species. The nested and quadrat frequencies for alfalfa declined slightly. The DCI score was very poor due to decreases in browse cover and the recruitment of young browse and perennial forb cover, and increase in browse decadence.

winter range condition (DCI) - very poor (34) Mid-level potential scale
browse - down (-2) grass - slightly up (+1) forb - slightly down (-1)

2007 TREND ASSESSMENT

The trend for browse is slightly up. Bitterbrush density increased to 800 plants/acre (1,976 plants/ha). Recruitment remained low at 3%, and decadency decreased to 13% of the population. Only 5% of the population displayed poor vigor. True mountain mahogany density increased slightly to 340 plants/acre (840 plants/ha). No young plants were sampled, and decadence remained stable at 12% of the population. Vigor remained excellent. Use on bitterbrush and mahogany remained heavy. The trend for grass is slightly down. The nested frequency for perennial grasses increased slightly, however, average cover decreased. The sum of nested frequency for annual grasses greatly increased. The nested frequency of cheatgrass increased more than eight-fold. The trend for forbs is stable. The sum of nested frequency for perennial and annual forbs greatly increased. The total number of forbs sampled increased from seven to 19 species. Bur buttercup increased significantly in nested frequency. Alfalfa was sampled in one quadrat. The DCI score remained very poor.

winter range condition (DCI) - very poor (32) Mid-level potential scale
browse - slightly up (+1) grass - slightly down (-1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 2

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{b}$190	$_{a}$116	$_{a}$119	$_{a}$123	4.50	5.72	4.25
G	Agropyron intermedium	$_{b}$159	$_{ab}$122	$_{a}$87	$_{a}$80	2.95	1.27	1.16
G	Agropyron spicatum	$_{a}$20	$_{ab}$32	$_{ab}$35	$_{b}$42	2.37	2.14	1.75
G	Bromus inermis	$_{a}$8	$_{a}$9	$_{a}$4	$_{a}$9	.04	.16	.44
G	Bromus japonicus (a)	-	-	-	3	-	-	.00
G	Bromus tectorum (a)	-	$_{b}$92	$_{a}$12	$_{b}$105	1.39	.02	1.77
G	Elymus junceus	$_{a}$17	$_{a}$9	$_{a}$18	$_{a}$21	.90	1.17	.68
G	Festuca ovina	$_{a}$40	$_{a}$35	$_{ab}$64	$_{b}$90	1.71	3.81	4.21
G	Oryzopsis hymenoides	$_{a}$6	$_{b}$37	$_{a}$12	$_{a}$11	.65	.25	.25

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Poa secunda	$_{a}$31	$_{b}$84	$_{b}$66	$_{b}$75	1.50	.84	1.30
G	Sitanion hystrix	-	2	-	-	.01	-	-
Total for Annual Grasses		0	92	12	108	1.39	0.01	1.77
Total for Perennial Grasses		471	446	405	451	14.66	15.40	14.06
Total for Grasses		471	538	417	559	16.05	15.42	15.84
F	Agoseris glauca	-	3	-	-	.03	-	-
F	Alyssum alyssoides (a)	-	$_{b}$118	$_{a}$1	$_{c}$178	.34	.00	1.00
F	Arabis sp.	-	-	-	2	-	-	.00
F	Arenaria sp.	-	-	-	3	-	-	.06
F	Astragalus sp.	-	-	-	5	-	-	.01
F	Astragalus utahensis	-	$_{a}$13	$_{a}$1	$_{a}$3	.34	.03	.01
F	Balsamorhiza sagittata	-	5	-	-	.02	-	-
F	Camelina microcarpa (a)	-	$_{a}$6	-	$_{a}$5	.01	-	.01
F	Chaenactis douglasii	-	8	-	-	.02	-	-
F	Cirsium sp.	1	-	-	-	-	-	-
F	Convolvulus arvensis	$_{a}$3	$_{a}$8	$_{a}$-	$_{a}$6	.06	.00	.03
F	Collinsia parviflora (a)	-	-	-	2	-	-	.00
F	Cryptantha sp.	-	$_{a}$4	-	$_{a}$1	.18	-	.03
F	Cymopterus sp.	-	$_{a}$2	-	$_{a}$4	.00	-	.01
F	Descurainia pinnata (a)	-	$_{a}$4	-	$_{b}$16	.01	-	.10
F	Erodium cicutarium (a)	-	-	-	6	-	-	.06
F	Gilia sp. (a)	-	-	-	3	-	-	.03
F	Machaeranthera canescens	-	4	-	-	.06	-	-
F	Medicago sativa	$_{b}$33	$_{ab}$16	$_{a}$12	$_{a}$2	.78	.15	.03
F	Microsteris gracilis (a)	-	$_{a}$9	-	$_{a}$1	.02	-	.00
F	Petradoria pumila	-	1	-	-	.03	-	-
F	Phlox hoodii	$_{a}$4	$_{a}$9	$_{a}$6	$_{a}$4	.18	.15	.15
F	Phlox longifolia	$_{a}$3	$_{a}$6	$_{a}$12	$_{a}$8	.01	.08	.04
F	Ranunculus testiculatus (a)	-	$_{b}$183	$_{a}$23	$_{c}$241	1.70	.04	2.70
F	Tragopogon dubius	-	$_{a}$5	$_{a}$1	$_{a}$1	.06	.00	.03
Total for Annual Forbs		0	320	24	452	2.08	0.04	3.92
Total for Perennial Forbs		44	84	32	39	1.79	0.42	0.42
Total for Forbs		44	404	56	491	3.88	0.46	4.34

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

BROWSE TRENDS --
Management unit 16C, Study no: 2

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	1	1	1	.03	.15	.03
B	Artemisia tridentata vaseyana	3	2	3	.03	-	-
B	Cercocarpus montanus	18	14	16	.93	.54	.71
B	Chrysothamnus nauseosus albicaulis	5	5	6	.81	.38	.15
B	Chrysothamnus viscidiflorus stenophyllus	23	26	28	.76	1.10	1.52
B	Cowania mexicana stansburiana	1	1	2	-	-	-
B	Eriogonum microthecum	1	2	1	.03	.03	.03
B	Gutierrezia sarothrae	9	12	7	.06	.21	.39
B	Juniperus osteosperma	9	9	8	4.97	4.35	4.58
B	Opuntia sp.	4	2	1	.15	.03	-
B	Pinus edulis	5	7	8	1.99	3.33	3.35
B	Purshia tridentata	30	28	26	5.79	3.56	3.16
B	Quercus gambelii	1	1	1	.00	-	-
Total for Browse		110	110	108	15.58	13.71	13.95

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 2

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	.13	.11
Cercocarpus montanus	1.06	.98
Chrysothamnus nauseosus albicaulis	.36	.21
Chrysothamnus viscidiflorus stenophyllus	2.98	2.54
Eriogonum microthecum	.15	.05
Gutierrezia sarothrae	.23	-
Juniperus osteosperma	6.94	7.68
Opuntia sp.	.05	-
Pinus edulis	3.81	4.33
Purshia tridentata	3.65	3.66
Rhus trilobata	.50	-

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 2

Species	Average leader growth (in)	
	'02	'07
Cercocarpus montanus	1.8	1.7
Purshia tridentata	3.1	0.9

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 2

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	109	174
Pinus edulis	69	59

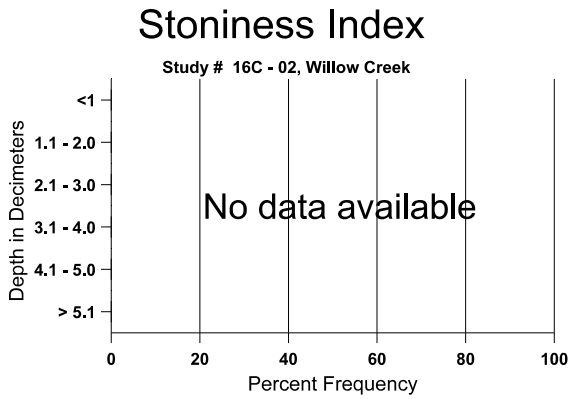
Average diameter (in)	
'02	'07
2.5	3.0
2.7	3.3

BASIC COVER --
Management unit 16C, Study no: 2

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	8.00	33.14	29.02	35.28
Rock	9.00	6.12	7.28	5.32
Pavement	8.00	10.93	14.11	13.21
Litter	47.25	33.43	33.65	32.42
Cryptogams	0	1.17	1.71	1.80
Bare Ground	27.75	19.32	32.48	25.38

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 02, Willow Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
14.9	59.0 (14.9)	7.4	48.0	25.4	26.6	7.4	9.2	150.4	.5



PELLET GROUP DATA --
Management unit 16C, Study no: 2

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	19	9	35
Elk	8	5	13
Deer	56	54	50
Cattle	-	1	-

Days use per acre (ha)	
'02	'07
-	-
8 (20)	50 (122)
174 (430)	181 (448)
-	4 (9)

BROWSE CHARACTERISTICS --
Management unit 16C, 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 utahensis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	-	100	0	-	-	0	13/17
02	**20**	-	-	20	-	-	0	100	-	-	0	13/18
07	**20**	-	-	20	-	-	0	100	-	-	0	7/13
Artemisia tridentata vaseyana												
89	**66**	-	-	-	66	-	0	0	100	-	0	-/-
97	**60**	-	-	60	-	20	33	67	0	-	0	18/26
02	**40**	-	-	20	20	-	0	100	50	-	0	15/21
07	**60**	-	-	20	40	-	0	100	67	67	67	16/21
Atriplex canescens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	22/19
02	**0**	-	-	-	-	-	0	0	-	-	0	13/18
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Cercocarpus montanus												
89	**133**	-	-	133	-	-	0	75	0	-	0	8/9
97	**420**	-	100	320	-	20	48	19	0	-	0	25/34
02	**300**	-	-	260	40	-	0	100	13	-	0	24/31
07	**340**	-	-	300	40	-	0	100	12	-	0	23/34
Chrysothamnus nauseosus albicaulis												
89	**133**	-	33	100	-	-	25	0	0	-	0	22/24
97	**100**	-	20	80	-	-	20	0	0	-	0	35/37
02	**100**	-	20	40	40	-	0	20	40	-	0	31/32
07	**120**	-	-	20	100	-	67	17	83	50	67	35/39

		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)
Chrysothamnus viscidiflorus stenophyllus												
89	**1399**	-	300	966	133	-	0	0	10	2	5	14/17
97	**1080**	20	280	800	-	-	0	0	0	-	0	15/20
02	**1100**	-	-	1000	100	-	7	0	9	2	2	12/19
07	**1080**	-	-	1020	60	-	0	0	6	-	0	14/23
Cowania mexicana stansburiana												
89	**33**	-	-	33	-	-	100	0	0	-	0	13/14
97	**40**	-	-	40	-	-	100	0	0	-	0	24/18
02	**20**	-	-	-	20	-	0	100	100	100	100	26/33
07	**80**	-	-	20	60	-	0	100	75	-	0	17/23
Ephedra viridis												
89	**33**	-	-	33	-	-	100	0	-	-	0	17/15
97	**0**	-	-	-	-	-	0	0	-	-	0	21/40
02	**0**	-	-	-	-	-	0	0	-	-	0	11/13
07	**0**	-	-	-	-	-	0	0	-	-	0	17/17
Eriogonum microthecum												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	5/7
02	**40**	-	-	40	-	-	0	50	-	-	0	6/14
07	**40**	-	-	40	-	-	0	0	-	-	0	10/4
Gutierrezia sarothrae												
89	**1399**	-	266	1133	-	-	0	0	0	-	0	9/11
97	**680**	-	160	500	20	-	0	0	3	3	3	11/13
02	**700**	-	-	700	-	100	0	0	0	-	0	7/9
07	**280**	-	20	260	-	-	0	0	0	-	0	10/13
Juniperus osteosperma												
89	**199**	-	166	33	-	-	0	0	-	-	0	33/59
97	**180**	-	80	100	-	80	0	0	-	-	0	-/-
02	**200**	-	60	140	-	20	0	0	-	-	0	-/-
07	**160**	-	40	120	-	20	0	0	-	-	13	-/-
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**140**	-	20	120	-	-	0	0	0	-	0	4/5
02	**40**	-	-	20	20	-	0	0	50	50	50	5/6
07	**20**	-	-	20	-	-	0	0	0	-	0	6/7

		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)
Pinus edulis												
89	**66**	-	66	-	-	-	0	0	-	-	0	-/-
97	**100**	-	20	80	-	-	0	0	-	-	0	-/-
02	**140**	-	60	80	-	-	0	0	-	-	0	-/-
07	**160**	20	20	140	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**532**	-	33	366	133	-	75	19	25	-	6	8/23
97	**840**	-	60	780	-	-	31	40	0	-	2	18/38
02	**640**	-	40	500	100	-	3	94	16	6	6	14/48
07	**800**	-	20	680	100	20	5	95	13	5	5	13/48
Quercus gambelii												
89	**33**	-	33	-	-	-	100	0	-	-	0	-/-
97	**20**	20	-	20	-	-	0	0	-	-	0	20/26
02	**20**	-	-	20	-	-	0	0	-	-	0	31/17
07	**20**	-	-	20	-	-	100	0	-	-	0	102/83
Rhus trilobata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	43/89
07	**0**	-	-	-	-	-	0	0	-	-	0	40/89

Trend Study 16C-3-07

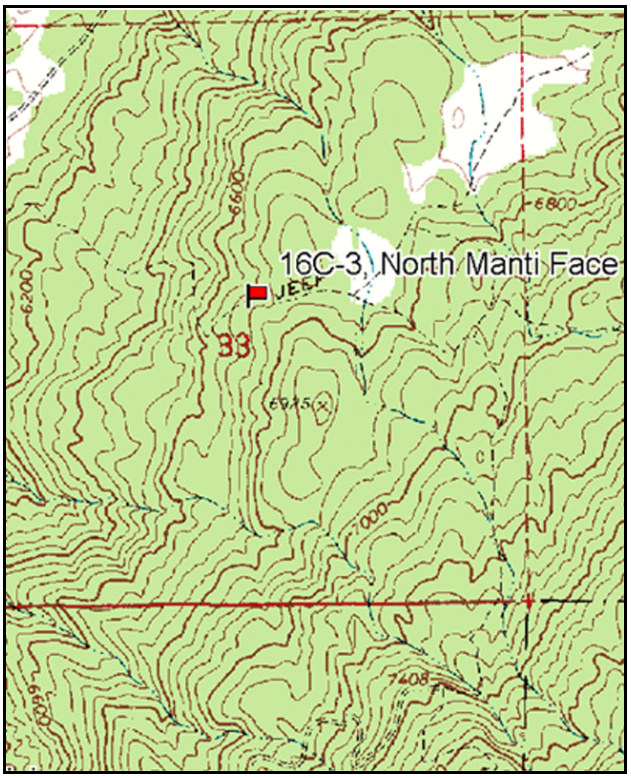
Study site name: North Manti Face . Vegetation type: Big Sagebrush - Grass .

Compass bearing: frequency baseline 180 degrees magnetic (line 3-4 @ 150°M).

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

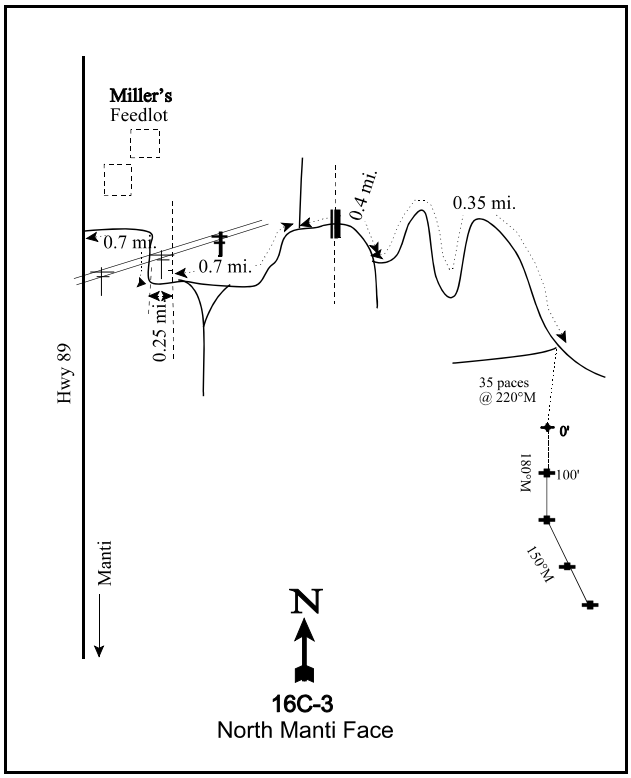
LOCATION DESCRIPTION

From the Manti LDS temple visitor's center in Manti, proceed north on Highway 89 for 1.5 miles. Just south of Miller's feedlot, turn east on a dirt road (Miller's Lane) and go 0.7 miles to a gate. Proceed down the road another 0.25 miles to a fence. Continue 0.7 miles to a fork in the road. Go right for 0.4 miles crossing a cattle guard onto DWR property to another fork in the road. From here, stay left switchbacking up the mountain for 0.35 miles to another fork. Stop here and walk 35 paces at 220 degrees magnetic to the 0-foot baseline stake, which is marked by browse tag #9044.



Map Name: Ephraim

Township 17S , Range 3E , Section 33



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 449335 E 4349427 N

DISCUSSION

North Manti Face - Trend Study No. 16C-3

Study Information

This study is located on Utah Division of Wildlife Resources land and samples a mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) community with a substantial Utah juniper (*Juniperus osteosperma*) component. [elevation: 6,700 feet (2,042 m), slope: 30-40%, aspect: west]. The area is important winter range for big game, especially deer. The abundance of juniper has provided good thermal cover for wintering animals. Quadrat frequency of deer pellets was high at 67% in 1997 and 58% in 2002 and 2007. From the pellet group transect, deer use was estimated at 181 days use/acre (448 ddu/ha) in 2002 and 117 days use/acre (289 ddu/ha) in 2007. Elk use was estimated at 2 days use/acre (5 edu/ha) in 2002 and 28 days use/acre (69 edu/ha) in 2007. In 2002, several sheep pellet groups were also sampled, apparently from trespassing animals. Pellet group data estimates were 1 sheep day use/acre (3 sdu/ha).

Soil

The soil is in the Fontreen series, which consists of very deep, well-drained, moderately to rapidly-permeable soils that formed in alluvium and colluvium from limestone, sandstone, chert, and shale (USDA-NRCS 2007). The soil has a clay texture and a slightly alkaline reactivity (pH of 7.4). Rock and pavement are abundant on the surface and throughout the profile, providing 38%-40% relative cover since 1997. Relative bare ground cover has been low at 8% in 1997, 7% in 2002, and 11% in 2007. Combined relative cover of vegetation and litter was 50%-53% between 1997 to 2007. Originally, sheet erosion was active and there were numerous rills and small gullies. There has been heavy terracing in the past, but rock and pavement on the surface help prevent erosion. In 2002, the erosion condition was classified as stable. In 2007, the erosion condition was classified as slight due to pedestalling around vegetation, flow patterns, and some transportation of soil and surface litter.

Browse

The preferred browse species is mountain big sagebrush. Its density was estimated at 2,865 plants/acre (7,077 plants/ha) in 1989. In 1997, the sample area was increased and strip counts were used rather than circular plots. Density was estimated at 1,000 plants/acre (2,470 plant/ha) in 1997, 840 plants/acre (2,075 plants/ha) in 2002, and 460 plants/acre (1,136 plants/ha) in 2007. Young plants comprised 5% of the population in 1989 and 12% in 1997, but no young plants were sampled in 2002 or 2007. Decadence has increased from 36%-37% of the population in 1989 and 1997 to 52% in 2002 and 70% in 2007. Plants classified with poor vigor increased from 2% of the population in 1989 to 65% in 2007. Utilization was moderate-heavy in 1997, but mostly heavy in all other sample years. The annual average leader growth was 1.3 inches (3.3 cm) in 2002 and 0.9 inches (2.3 cm) in 2007.

Other palatable browse species include squaw-apple (*Peraphyllum ramosissimum*), fourwing saltbush (*Atriplex canescens*), Utah serviceberry (*Amelanchier utahensis*), black sagebrush (*Artemisia nova*), dwarf rabbitbrush (*Chrysothamnus depressus*), and snowberry (*Symphoricarpos oreophilus*). Most of these have been moderately to heavily browsed as they occur in low densities. Broom snakeweed (*Gutierrezia sarothrae*) is moderately abundant, the population density was estimated at 3,532 plants/acre (8,724 plants/ha) in 1989, 2,520 plants/acre (6,224 plants/ha) in 1997, 3,120 plants/acre (7,706 plants/ha) in 2002, and 1,620 plants/acre (4,001 plants/ha) in 2007.

Juniper use has been evident, with many trees highlined. The point-centered quarter data estimate of juniper density was 84 trees/acre (208 trees/ha) in 1997, 75 trees/acre (185 trees/ha) in 2002 and 94 trees/acre (232 trees/ha) in 2007. The average trunk diameter was 6.0 inches (15.2 cm) in 1997, 5.7 inches (14.5 cm) in 2002 and 7.8 inches (19.8 cm) in 2007. The canopy cover of juniper was 7% in 2002 and 17% in 2007. If juniper overstory cover increases it is expected that the browse understory will decrease (Taush and West, 1994). A

zone of oakbrush (*Quercus gambelii*) occurs to the east and upslope of the area.

Herbaceous Understory
Bluebunch wheatgrass (*Agropyron spicatum*) is uniformly distributed, and is the dominant understory species. It provided 11% cover in 1997 and 2002, and 6% cover in 2007. Sandberg bluegrass (*Poa secunda*) is the second most abundant grass, providing 1% cover in 1997, 0.5% in 2002 and 2% in 2007. Sandberg bluegrass was already desicate when the study was sampled in July 2002. Two annual grasses, cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*), were sampled in 1997. In 2002, Japanese brome was not sampled, and cheatgrass was sampled in only one quadrat. In 2007, Japanese brome measurements were similar to those in 1997, and cheatgrass increased, with a quadrat frequency of 40%. Other grasses sampled include Indian ricegrass (*Oryzopsis hymenoides*) and mutton bluegrass (*Poa fendleriana*). Grasses showed very little use in 2002, and moderate use in 2007.

The forb composition is diverse. The number of forb species sampled has ranged from 16 to 29 since 1997. Forbs provided 6% cover in 1997 and 2007. With drought conditions in 2002, cover decreased to 3%. One of the dominant species, rock goldenrod (*Petradoria pumila*), has remained stable in frequency and provided 2% cover all years. Bur buttercup (*Ranunculus testiculatus*), a weed that has allelopathic characteristics (Buchanan et al. 1978), noticeably increased from near 0% cover in 2002 to 2% cover in 2007.

1997 TREND ASSESSMENT
The browse trend is slightly down. Mountain big sagebrush density declined from 2,865 plants/acre (7,077 plants/ha) to 1,000 plants/acre (2,470 plants/ha), but this decrease may have been partly due to the change in sample area in 1997. The recruitment of young increased to 12% of the population, and decadence was stable at 36% of the population. Plants classified as having poor vigor increased to 18% of the population. Use on sagebrush decreased from heavy to moderate-heavy and heavily browsed plants decreased from 93% of the population to 36%. The trend for grass is stable. The sum of nested frequency for perennial grasses was stable. The nested frequency for mutton bluegrass significantly declined. The forb trend is slightly down. The sum of nested frequency for perennial forbs decreased 16%, including significant decreases in the nested frequencies of five perennial species. The Desirable Components Index (DCI) score was fair due to low browse cover with moderate decadence and low recruitment, high perennial grass and forb cover, and low annual grass cover.

winter range condition (DCI) - fair (51) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - slightly down (-1)

2002 TREND ASSESSMENT
The browse trend is slightly down. Mountain big sagebrush density decreased 16%. No young plants were sampled, and decadence increased to 52% of the population. Plants classified as having poor vigor increased to 33%, and use increased to mostly heavy. Heavily browsed plants increased to 76% of the population. Other palatable species such as serviceberry, fourwing saltbush, and squaw-apple remained in low densities, and showed moderate-heavy use. The grass trend is stable. The sum of nested frequency of perennial grass decreased 18%. The dominant species, bluebunch wheatgrass, remained stable, but Sandberg bluegrass significantly declined in nested frequency. The sum of nested frequency of annual grasses greatly decreased. Japanese brome was not sampled and cheatgrass was measured in one quadrat. The forb trend is down. The sum of nested frequency of perennial and annual forbs greatly decreased. Additionally, the number of forb species sampled decreased from 29 to 16. The DCI score was poor due to an increase in browse decadence, a decrease in young browse, and decreased perennial forb cover.

winter range condition (DCI) - poor (37) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. Mountain big sagebrush density decreased 45%. No young plants were sampled, and decadence increased to 70% of the population. Plants with poor vigor increased to 65% of the population. Plant use remained heavy, 91% of the sagebrush plants had been heavily browsed. Most other palatable species showed moderate-heavy use. The grass trend is down. The sum of nested frequency of perennial grasses remained stable, but cover decreased from 12% to 8%. The nested frequency of cheatgrass significantly increased and that of bluebunch wheatgrass significantly decreased. There was also a significant increase in the nested frequency of Sandberg bluegrass. The forb trend is down. The sum of nested frequency of perennial forbs greatly decreased, and the sum of nested frequency for annual forbs greatly increased. This increase was attributed to bur buttercup. It increased in nested frequency, quadrat frequency, and cover. The DCI score was very poor. This was due to a decrease in preferred browse and perennial grass cover.

winter range condition (DCI) - very poor (22) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 3

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron intermedium	-	-	3	-	-	.00	-
G	Agropyron spicatum	$_{b}$287	$_{b}$268	$_{b}$254	$_{a}$194	10.96	11.42	6.26
G	Bromus japonicus (a)	-	$_{a}$42	-	$_{a}$25	.16	-	.10
G	Bromus tectorum (a)	-	$_{b}$35	$_{a}$1	$_{c}$104	.15	.00	1.12
G	Oryzopsis hymenoides	-	$_{a}$1	-	$_{a}$2	.03	-	.03
G	Poa fendleriana	$_{b}$60	$_{a}$23	$_{a}$14	$_{a}$14	.15	.22	.10
G	Poa secunda	$_{ab}$105	$_{b}$137	$_{a}$79	$_{b}$114	.85	.46	1.68
Total for Annual Grasses		0	77	1	129	0.31	0.00	1.22
Total for Perennial Grasses		452	429	350	324	12.00	12.12	8.08
Total for Grasses		452	506	351	453	12.31	12.13	9.31
F	Agoseris glauca	-	-	-	2	-	-	.00
F	Alyssum alyssoides (a)	-	$_{a}$8	$_{a}$1	$_{b}$107	.01	.00	.72
F	Antennaria rosea	-	$_{a}$3	$_{a}$1	-	.00	.03	-
F	Arabis sp.	-	$_{a}$3	$_{a}$1	-	.00	.00	-
F	Arenaria fendleri	-	$_{b}$111	$_{a}$49	$_{a}$54	1.11	.25	.39
F	Astragalus megacarpus	$_{b}$24	$_{a}$5	-	-	.01	-	-
F	Astragalus sp.	-	15	-	-	.26	-	-
F	Astragalus utahensis	-	7	-	-	.01	-	-
F	Camelina microcarpa (a)	-	$_{a}$9	-	$_{a}$2	.02	-	.00
F	Calochortus nuttallii	-	4	-	-	.01	-	-
F	Cirsium sp.	$_{b}$18	$_{a}$5	$_{a}$1	$_{a}$2	.06	.00	.03
F	Crepis acuminata	$_{a}$12	$_{a}$6	$_{a}$3	-	.02	.00	-
F	Cryptantha sp.	$_{b}$16	$_{a}$4	-	$_{a}$3	.03	-	.00

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Cymopterus sp.	-	1	-	-	.00	-	-
F	Descurainia pinnata (a)	-	$_{a}$4	-	$_{b}$41	.03	-	.28
F	Eriogonum brevicaule	-	-	$_{a}$8	$_{a}$8	-	.07	.21
F	Erigeron sp.	-	4	-	-	.04	-	-
F	Eriogonum jamesii	$_{a}$13	$_{a}$13	-	-	.36	-	-
F	Eriogonum umbellatum	-	2	-	-	.03	-	-
F	Haplopappus acaulis	$_{a}$6	$_{a}$3	$_{b}$20	-	.15	.22	-
F	Helianthus annuus (a)	1	-	-	-	-	-	-
F	Lathyrus brachycalyx	-	-	$_{a}$2	$_{a}$2	-	.00	.00
F	Lappula occidentalis (a)	-	$_{a}$2	-	$_{a}$2	.00	-	.00
F	Leucelene ericoides	$_{ab}$21	$_{b}$41	$_{a}$20	$_{a}$15	.98	.15	.16
F	Penstemon humilis	-	-	$_{a}$2	$_{a}$4	-	.03	.04
F	Penstemon sp.	$_{b}$50	$_{a}$11	$_{a}$18	$_{a}$1	.10	.10	.00
F	Petradoria pumila	$_{a}$46	$_{a}$47	$_{a}$49	$_{a}$42	1.78	2.18	1.68
F	Phlox hoodii	$_{ab}$182	$_{a}$29	$_{a}$15	$_{a}$14	.14	.16	.11
F	Phlox longifolia	$_{a}$10	$_{a}$18	$_{a}$16	$_{a}$7	.06	.10	.02
F	Ranunculus testiculatus (a)	-	$_{b}$160	$_{a}$34	$_{c}$242	.62	.06	1.93
F	Streptanthus cordatus	-	1	-	-	.00	-	-
F	Tragopogon dubius	1	-	-	-	-	-	-
F	Vicia americana	-	3	-	-	.03	-	-
Total for Annual Forbs		1	183	35	394	0.69	0.07	2.95
Total for Perennial Forbs		399	336	205	154	5.22	3.34	2.67
Total for Forbs		400	519	240	548	5.91	3.41	5.62

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

BROWSE TRENDS --
Management unit 16C, Study no: 3

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	1	2	1	.00	-	-
B	Artemisia nova	2	0	4	-	-	.21
B	Artemisia tridentata vaseyana	37	33	18	3.92	4.14	.60
B	Atriplex canescens	2	0	1	.15	-	.03
B	Chrysothamnus depressus	17	12	14	.54	.40	.09
B	Chrysothamnus nauseosus hololeucus	5	5	1	.09	.38	-
B	Chrysothamnus viscidiflorus viscidiflorus	4	5	0	.01	.19	.03
B	Gutierrezia sarothrae	37	42	36	.25	.53	.41
B	Juniperus osteosperma	5	6	4	8.07	7.50	4.81
B	Peraphyllum ramosissimum	1	2	1	.38	-	.00
B	Pinus edulis	0	0	0	-	.63	-
B	Symphoricarpos oreophilus	1	2	1	.00	.03	.03
Total for Browse		112	109	81	13.45	13.82	6.23

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 3

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	.10	.06
Artemisia tridentata vaseyana	3.51	2.70
Chrysothamnus depressus	-	.05
Chrysothamnus nauseosus hololeucus	.43	-
Gutierrezia sarothrae	.56	.38
Juniperus osteosperma	6.59	17.38
Peraphyllum ramosissimum	-	.20
Symphoricarpos oreophilus	.03	-

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 3

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.3	0.9

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 3

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	75	94

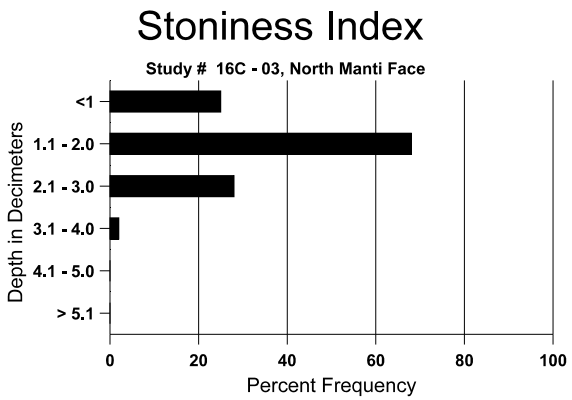
Average diameter (in)	
'02	'07
6.0	7.8

BASIC COVER --
Management unit 16C, Study no: 3

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	13.00	31.28	30.78	24.40
Rock	18.00	10.76	13.59	8.77
Pavement	41.25	30.36	35.96	33.51
Litter	23.00	25.97	33.26	30.67
Cryptogams	0	.58	1.37	.82
Bare Ground	4.75	8.14	8.81	11.97

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 03, North Manti Face

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
8.7	56.4 (13.5)	7.4	32.0	27.4	40.6	7.4	9.4	201.6	.5



PELLET GROUP DATA --
Management unit 16C, Study no: 3

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	1	-
Rabbit	18	30	46
Elk	6	1	-
Deer	67	58	58

Days use per acre (ha)	
'02	'07
1 (3)	-
-	-
2 (5)	28 (69)
181 (448)	117 (289)

BROWSE CHARACTERISTICS --
Management unit 16C, 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)
Amelanchier utahensis												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	0	100	0	-	0	21/37
02	**40**	-	-	20	20	-	0	0	50	50	50	17/23
07	**20**	-	-	20	-	-	0	100	0	-	0	17/22
Artemisia nova												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**40**	-	-	40	-	-	50	0	0	-	0	12/33
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**80**	-	-	-	80	20	25	0	100	100	100	12/25
Artemisia tridentata vaseyana												
89	**2865**	-	133	1666	1066	-	2	93	37	2	2	23/27
97	**1000**	-	120	520	360	220	42	36	36	18	18	21/33
02	**840**	-	-	400	440	520	10	76	52	26	33	17/29
07	**460**	-	-	140	320	280	4	91	70	65	65	21/35
Atriplex canescens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	-	100	0	-	-	0	38/38
02	**0**	-	-	-	-	-	0	0	-	-	0	25/20
07	**20**	-	-	20	-	-	100	0	-	-	0	31/41
Chrysothamnus depressus												
89	**132**	-	66	66	-	-	0	0	0	-	0	3/6
97	**860**	-	20	780	60	-	40	2	7	-	0	15/11
02	**560**	-	-	560	-	-	0	4	0	-	0	4/10
07	**620**	-	-	600	20	60	0	100	3	-	0	3/7

		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)
Chrysothamnus nauseosus hololeucus												
89	**199**	-	-	133	66	-	33	67	33	-	0	19/14
97	**120**	-	40	60	20	-	17	0	17	17	17	32/39
02	**100**	-	-	20	80	-	40	40	80	-	0	21/24
07	**20**	-	-	-	20	20	0	0	100	100	100	21/39
Chrysothamnus viscidiflorus viscidiflorus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**140**	-	80	60	-	-	0	0	-	-	0	9/11
02	**100**	-	20	80	-	-	0	20	-	-	0	5/11
07	**0**	-	-	-	-	-	0	0	-	-	0	6/11
Gutierrezia sarothrae												
89	**3532**	66	466	2666	400	-	0	0	11	6	6	7/7
97	**2520**	160	1600	900	20	20	0	0	1	-	0	9/9
02	**3120**	-	100	2660	360	420	0	0	12	2	2	4/5
07	**1620**	-	60	1440	120	40	0	0	7	2	2	7/7
Juniperus osteosperma												
89	**66**	-	-	66	-	-	100	0	-	-	0	79/98
97	**100**	20	-	100	-	-	0	0	-	-	0	-/-
02	**120**	-	-	120	-	60	0	0	-	-	0	-/-
07	**80**	-	-	80	-	20	0	0	-	-	0	-/-
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	5/19
Peraphyllum ramosissimum												
89	**332**	-	66	266	-	-	0	80	0	-	0	24/16
97	**20**	-	-	20	-	-	0	100	0	-	0	18/29
02	**40**	-	-	20	20	-	0	100	50	-	0	18/24
07	**20**	-	-	20	-	-	0	100	0	-	0	17/24
Symphoricarpos oreophilus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	100	-	-	0	6/15
02	**40**	-	-	40	-	-	0	0	-	-	0	3/7
07	**20**	-	20	-	-	-	0	0	-	-	0	5/15

Trend Study 16C-5-07

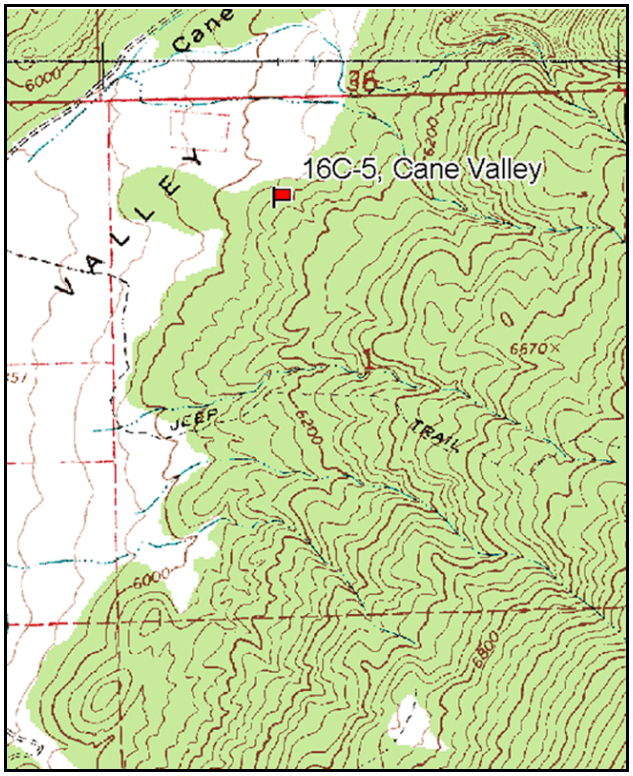
Study site name: Cane Valley . Vegetation type: Chained, Seeded P-J .

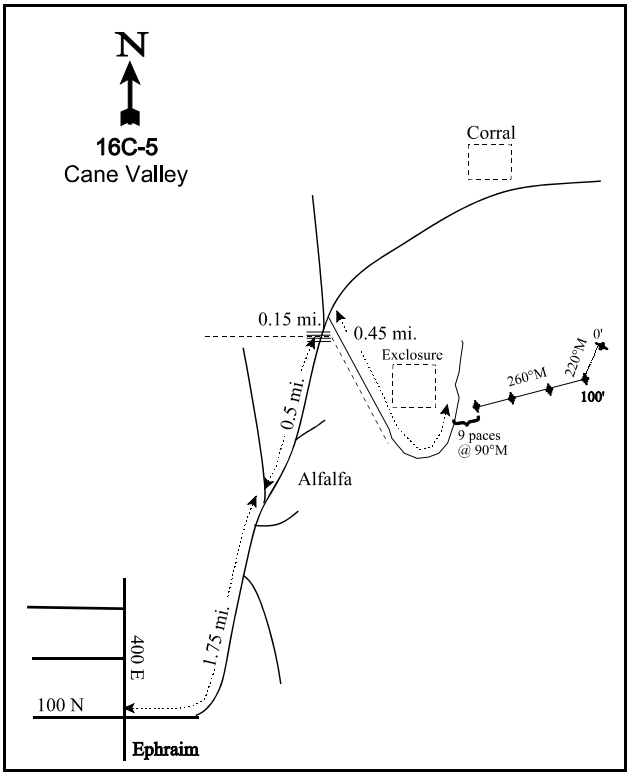
Compass bearing: frequency baseline 220 degrees magnetic (lines 2-4 @ 260°M).

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

LOCATION DESCRIPTION

From the intersection of 400 East and 100 North in Ephraim, proceed up 100 North for 1.75 miles. The pavement will end and the road will head in a northerly direction. At 1.75 miles the road will fork, stay right. Proceed up the road for an additional 0.50 miles until you come to a cattleguard where a fence crosses the road. At this point the road forks twice. Take the road to the right for 0.15 miles. Turn right and follow along the fence in a southeasterly direction for 0.25 miles to an exclosure on the east side of the road. From the exclosure, continue left up the road for 0.2 miles where the 400-foot stake is 50 feet east of the road.





Map Name: Ephraim

Diagrammatic Sketch

Township 17S , Range 3E , Section 1

GPS: NAD 83, UTM 12S 453813 E 4358071 N

DISCUSSION

Cane Valley - Trend Study No. 16C-5

Study Information

This study monitors a chained and seeded Utah juniper (*Juniperus osteosperma*) site east of Ephraim [elevation: 6,100 feet (1,859 m), slope: 30%, aspect: west]. The slopes above Cane Valley were two-way chained and aerially seeded in 1982, including 650 acres (263 ha) of Utah Division of Wildlife Resources land. In the fall of 2003, a two-way horrow and seeding treatment was done on the level ground below the study, including the lower 100 feet (30 m) of the study baseline. A spring about 200 yards (183 m) north provides a permanent water source for the area. From the pellet group transect, deer use was estimated at 76 days use/acre (187 ddu/ha) in 2002 and 122 days use/acre (301 ddu/ha) in 2007. Elk use was estimated at 25 days use/acre (61 edu/ha) in 2002 and 58 days use/acre (144 edu/ha) in 2007. Several domestic sheep pellet groups were also sampled in the transect in 2002 and there was an estimated 13 sheep days use/acre (31 sdu/ha). Sheep are grazed on the adjacent private land. Chukar, partridge, mourning doves, and rabbits have also been observed on the site.

Soil

The soil is in the Atepic series which consists of shallow, well-drained, slowly permeable soils formed in colluvium and residuum derived from shale on hillsides with a 10%-40% slope (USDA-NRCS 2007). The soil is clay to clay loam in texture and slightly alkaline in reactivity (pH of 7.4). Sheet erosion was active before the treatment in 1982. Since the treatment, there has been an increase in herbaceous cover and less evidence of erosion. There are large gullies on both sides of the study that show no erosion activity. Relative bare ground cover was 21% in 1997, 14% in 2002, and 18% in 2007. The sum of the relative vegetation and litter cover has averaged 61%-63% since 1997. In 2002, the erosion condition was classified as stable. In 2007, the erosion condition was classified as moderate due to light pedestalling around plants, the formation of rills and gullies, and the moderate translocation of soil, surface rock, and litter.

Browse

Palatable browse is limited, which may be due to poor establishment following seeding. The canopy cover of all these species was less than 1% in 2002 and 2007. The density of mountain big sagebrush increased from 40 plants/acre (99 plants/ha) in 1997 to 360 plants/acre (889 plants/ha) in 2007, and the age structure of the population shifted from mostly mature to mostly young. Average annual leader growth on mountain big sagebrush was 2 inches (5.1 cm) in 2002 and 1.7 inches (4.4 cm) in 2007. Utah serviceberry (*Amelanchier utahensis*), fourwing saltbush (*Atriplex canescens*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), winterfat (*Ceratoides lanata*), and antelope bitterbrush (*Purshia tridentata*) all occur in low densities. Use of these species has been mostly moderate-heavy. In 2002, none of the preferred browse had any seedlings or young in their populations. Average annual leader growth of winterfat was 3.7 inches (9.4 cm) in 2007. Bitterbrush average annual leader growth was 0.9 inches (2.3 cm) in 2007. Narrowleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *stenophyllus*) broom snakeweed (*Gutierrezia sarothrae*) are the most abundant species in terms of density.

The canopy cover of juniper decreased from 13% in 2002 to 8% in 2007. The point-centered quarter data estimate was 343 trees/acre (847 trees/ha) in 2002 and 262 trees/acre (647 trees/ha) in 2007. The average trunk diameter was 2.2 inches (5.6 cm) in 2002 and 2.7 inches (6.9 cm) in 2007. Pinyon pine (*Pinus edulis*) estimates were 19 trees/acre (47 trees/ha), and average trunk diameter was 5 inches (12.7 cm) in 2007. As juniper and pinyon overstory cover increases it is expected that the browse understory will decrease (Taush and West 1994). In 2007, it was noted that a mechanical treatment of some kind was used north and west of the study. It was noticed in 2007 photographs that mountain big sagebrush and junipers were missing compared to 2002 photographs, which is probably due to this treatment.

Herbaceous Understory

Grasses are the dominant vegetation type. Perennial grasses comprised 15% of the ground cover in 1997, and 20% in 2002 and 2007. Both native and introduced species are present with three wheatgrass species, bluebunch (*Agropyron spicatum*), intermediate (*Agropyron intermedium*), and crested (*Agropyron cristatum*), being the most abundant. Since 1997, bluebunch wheatgrass provided 7%-13% total ground cover, intermediate wheatgrass provided 4%-5% cover, and crested wheatgrass provided 1%-3% cover. Other perennial grasses sampled include orchardgrass (*Dactylis glomerata*), Russian wildrye (*Elymus junceus*), Indian ricegrass (*Oryzopsis hymenoides*), mutton bluegrass (*Poa fendleriana*), Sandberg bluegrass (*Poa secunda*), and bottlebrush squirreltail (*Sitanion hystrix*). Annual species, specifically cheatgrass (*Bromus tectorum*), were infrequent in 1997, and were not sampled in 2002. In 2007, cheatgrass had a quadrat frequency of 63%, and provided 2% of the total ground cover.

Forbs are moderately diverse and low growing species are the most abundant. Perennial forbs comprised 4% of the ground cover in 1997, 3% in 2002, and 4% in 2007. Rock goldenrod (*Petradoria pumila*), Hood's phlox (*Phlox hoodii*), stemless goldenweed (*Haplopappus acaulis*), and Fendler sandwort (*Arenaria fendleri*) are the most abundant perennial species. Annual forbs are infrequent, and bur buttercup (*Ranunculus testiculatus*), an allelopathic species (Buchanan et al. 1978), is the most common. It provided less than 1% cover in 2002, increasing to 5% in 2007. Annual forb cover has increased from less than 1% in 1997 and 2002 to 8% in 2007. Two noxious weeds, field bindweed (*Convolvulus arvensis*) and musk thistle (*Cardus nutans*) have been sampled, but at low abundance.

1997 TREND ASSESSMENT

The trend for browse is stable. There was little preferred browse. Mountain big sagebrush density increased from 0 plants/acre to 40 plants/acre (99 plants/ha). There was no recruitment of young and no decadence in the population, and vigor was excellent. Plant use was light-moderate. Winterfat density increased from 0 plants/acre to 140 plants/acre (346 plants/ha). All of the plants sampled were mature and healthy, despite heavy browsing. Bitterbrush density increased from 0 plants/acre to 40 plants/acre (99plants/ha). All of the plants were mature, health, and had been heavily browsed. The trend for grass is slightly down. The sum of nested frequency of perennial grasses decreased 12%. The nested frequencies of bluebunch wheatgrass, intermediate wheatgrass, and orchardgrass all significantly increased. The nested frequency for bottlebrush squirreltail significantly decreased. The forb trend is stable. There was little change in the sum of nested frequency of perennial forbs. Field bindweed was not sampled, but musk thistle was. The Desirable Components Index (DCI) score was very poor due to very little browse cover, excellent perennial grass cover, little annual grass cover, moderate-high perennial forb cover, and the presence of a noxious weed species.

winter range condition (DCI) - very poor (30) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is stable. Preferred forage species remained limited. Mountain big sagebrush density increased to 80 plants/acre (198 plants/ha), winterfat density decreased to 80 plants/acre (198 plants/ha), and bitterbrush density remained stable. The recruitment of young, decadence, plant vigor, and browse use of these species remained stable. The grass trend is slightly down. The sum of nested frequency for perennial grasses decreased 13%. Orchardgrass and bottlebrush squirreltail decreased significantly in nested frequency, while bluebunch wheatgrass increased significantly in nested frequency. No annual grasses were measured. The forb trend is stable. Perennial forbs declined 15% in sum of nested frequency. However, the nested frequency of bur buttercup decreased significantly and quadrat frequency decreased from 42% to 12%. Additionally, there were no noxious weeds sampled. The DCI score remained very poor.

winter range condition (DCI) - very poor (29) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is slightly up. Preferred forage species remained limited. Mountain big sagebrush density increased four-fold to 360 plants/acre (889 plants/ha), and 94% of these were young. This increase is likely the result of the two-way harrow and seeding treatment. Decadence and plant vigor was similar to previous years. Browse use was mostly light-moderate. Winterfat density decreased to 40 plants/acre (98 plants/ha) and bitterbrush density decreased to 20 plants/acre (49 plants/ha). The number of young and decadent plants, plant vigor, and use of these species was similar to previous measurements. The grass trend is stable. The sum of nested frequency of perennial grasses greatly increased, however, that of cheatgrass also increased significantly. Cheatgrass was not measured in 2002, but was measured in 63% of the quadrats in 2007, providing 2% of the total ground cover. The forb trend is slightly down. The nested frequency of perennial forbs greatly increased. However, the increase in bur buttercup nested frequency was even greater. It increased from 2% of the total forb cover in 2002 to 67% of the total forb cover in 2007. The DCI score remained very poor.

winter range condition (DCI) - very poor (28) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - slightly down (-1)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 5

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{a}$5	$_{a}$18	$_{a}$20	$_{b}$59	.85	1.54	2.78
G	Agropyron intermedium	$_{a}$18	$_{b}$117	$_{b}$91	$_{b}$113	3.94	4.74	5.28
G	Agropyron spicatum	$_{a}$61	$_{b}$118	$_{c}$162	$_{bc}$140	7.21	12.67	10.58
G	Bromus japonicus (a)	-	2	-	-	.00	-	-
G	Bromus tectorum (a)	-	$_{a}$33	-	$_{b}$173	.15	-	2.36
G	Dactylis glomerata	$_{a}$3	$_{b}$23	$_{a}$3	$_{a}$4	.64	.03	.03
G	Elymus junceus	$_{a}$1	$_{a}$2	$_{a}$4	-	.15	.18	-
G	Festuca ovina	-	-	-	3	-	-	.03
G	Oryzopsis hymenoides	$_{b}$47	$_{ab}$30	$_{a}$10	$_{a}$16	.95	.26	.11
G	Poa bulbosa	-	-	-	1	-	-	.01
G	Poa fendleriana	$_{a}$7	$_{a}$1	$_{a}$4	$_{a}$1	.03	.03	.03
G	Poa secunda	$_{bc}$30	$_{ab}$15	$_{a}$9	$_{c}$41	.58	.02	.53
G	Sitanion hystrix	$_{c}$230	$_{b}$31	$_{a}$5	$_{a}$10	.56	.03	.12
Total for Annual Grasses		0	35	0	173	0.15	0	2.36
Total for Perennial Grasses		402	355	308	388	14.93	19.53	19.53
Total for Grasses		402	390	308	561	15.09	19.53	21.89
F	Alyssum alyssoides (a)	-	$_{a}$7	$_{a}$6	$_{b}$270	.02	.01	2.61
F	Antennaria rosea	-	$_{a}$6	$_{a}$4	-	.01	.01	-
F	Arabis sp.	$_{a}$1	$_{a}$3	-	-	.00	-	-
F	Arenaria fendleri	-	$_{a}$34	$_{a}$23	$_{b}$59	.10	.12	.22
F	Astragalus calycosus	-	$_{a}$5	$_{a}$2	$_{a}$9	.01	.00	.07

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Astragalus convallarius	-	-	-	2	-	-	.03
F	Astragalus sp.	$_{a}$5	$_{a}$12	-	$_{a}$1	.05	-	.00
F	Castilleja linariaefolia	-	-	-	3	-	-	.00
F	Camelina microcarpa (a)	-	$_{a}$5	-	$_{a}$1	.01	-	.00
F	Carduus nutans (a)	-	-	-	-	.03	-	-
F	Calochortus nuttallii	-	-	-	1	-	-	.00
F	Chaenactis douglasii	-	$_{a}$5	-	$_{a}$3	.04	-	.00
F	Chenopodium fremontii (a)	-	3	-	-	.00	-	-
F	Cirsium sp.	$_{a}$7	$_{a}$1	-	-	.00	-	-
F	Convolvulus arvensis	8	-	-	-	-	-	-
F	Cryptantha sp.	$_{b}$33	$_{a}$8	-	$_{a}$3	.03	-	.01
F	Descurainia pinnata (a)	-	-	-	15	-	-	.08
F	Erigeron sp.	-	1	-	-	.00	-	-
F	Eriogonum sp.	$_{a}$3	$_{a}$4	-	-	.03	-	-
F	Haplopappus acaulis	$_{a}$5	$_{bc}$21	$_{c}$37	$_{ab}$15	.61	.91	.63
F	Lactuca serriola	$_{a}$12	-	-	$_{a}$4	-	-	.01
F	Linum lewisii	-	-	-	13	-	-	.03
F	Lomatium sp.	-	-	-	12	-	-	.15
F	Machaeranthera canescens	$_{a}$8	-	-	$_{a}$3	-	-	.04
F	Medicago sativa	-	$_{a}$-	-	$_{a}$3	.01	-	.03
F	Penstemon humilis	$_{a}$8	$_{a}$2	$_{a}$8	$_{a}$3	.01	.01	.03
F	Petradoria pumila	$_{a}$1	$_{b}$30	$_{b}$45	$_{b}$42	1.82	1.54	1.71
F	Phlox hoodii	$_{a}$107	$_{a}$97	$_{a}$89	$_{a}$78	1.09	.78	.82
F	Phlox longifolia	-	-	4	-	-	.03	-
F	Ranunculus testiculatus (a)	-	$_{b}$111	$_{a}$29	$_{c}$297	.65	.08	5.31
F	Salsola iberica (a)	-	-	-	-	-	-	.00
F	Sanguisorba minor	$_{b}$19	$_{a}$3	-	$_{a}$8	.03	-	.04
F	Sphaeralcea coccinea	$_{a}$3	$_{a}$3	-	$_{a}$4	.01	-	.03
F	Sphaeralcea grossulariifolia	-	-	-	-	-	-	.00
F	Streptanthus cordatus	5	-	-	-	-	-	-
F	Trifolium douglasii	-	11	-	-	.07	-	-
F	Tragopogon dubius	$_{b}$31	$_{a}$3	$_{a}$1	-	.00	.00	-
F	Trifolium sp.	-	-	-	8	-	-	.02
Total for Annual Forbs		0	126	35	583	0.71	0.10	8.02
Total for Perennial Forbs		256	249	213	274	3.99	3.43	3.93
Total for Forbs		256	375	248	857	4.70	3.53	11.95

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

BROWSE TRENDS --
Management unit 16C, Study no: 5

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	1	0	0	-	-	-
B	Artemisia tridentata vaseyana	2	3	13	-	-	.03
B	Atriplex canescens	0	1	0	-	.03	-
B	Ceratoides lanata	5	3	2	.06	.04	-
B	Chrysothamnus depressus	2	0	2	-	-	.03
B	Chrysothamnus nauseosus albicaulis	1	0	0	-	-	-
B	Chrysothamnus viscidiflorus stenophyllus	46	53	52	3.88	4.23	3.56
B	Ephedra viridis	0	1	0	-	-	-
B	Gutierrezia sarothrae	3	14	10	-	.84	.06
B	Juniperus osteosperma	18	23	14	3.65	9.14	6.65
B	Purshia tridentata	2	2	1	-	-	-
Total for Browse		80	100	94	7.60	14.28	10.35

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 5

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	.06	-
Ceratoides lanata	.01	-
Chrysothamnus viscidiflorus stenophyllus	3.91	2.73
Gutierrezia sarothrae	.16	.08
Juniperus osteosperma	12.71	7.53
Purshia tridentata	.13	-

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 5

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.0	1.7
Ceratoides lanata	-	3.7

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 5

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	343	262

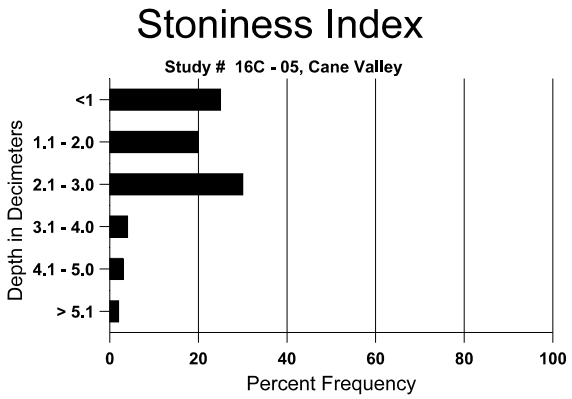
Average diameter (in)	
'02	'07
2.2	2.7

BASIC COVER --
Management unit 16C, Study no: 5

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	11.50	27.65	35.98	40.87
Rock	11.75	8.64	10.51	12.12
Pavement	15.25	6.38	15.90	12.04
Litter	48.50	33.02	35.79	29.60
Cryptogams	0	.27	1.75	.93
Bare Ground	13.00	20.74	15.79	20.34

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 05, Cane Valley

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
14.0	60.0 (14.7)	7.4	28.0	29.4	42.6	5.0	12.4	188.8	.4



PELLET GROUP DATA --
Management unit 16C, Study no: 5

Type	Quadrat Frequency			Days use per acre (ha)	
	'97	'02	'07	'02	'07
Sheep	4	7	-	13 (31)	-
Rabbit	4	24	42	-	-
Elk	26	10	12	25 (61)	58 (144)
Deer	25	43	49	76 (187)	122 (301)
Cattle	1	-	1	-	-

BROWSE CHARACTERISTICS --
Management unit 16C, 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)
Amelanchier utahensis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	-	0	0	-	-	0	1/7
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Artemisia tridentata vaseyana												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	20	50	0	-	-	0	12/11
02	**80**	-	-	80	-	20	25	25	-	-	0	15/23
07	**360**	-	340	20	-	-	17	6	-	-	0	11/16
Atriplex canescens												
89	**33**	-	-	33	-	-	0	0	-	-	0	37/26
97	**0**	-	-	-	-	-	0	0	-	-	0	61/77
02	**20**	-	-	20	-	-	0	0	-	-	0	30/48
07	**0**	-	-	-	-	-	0	0	-	-	0	38/25
Ceratoides lanata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**140**	-	-	140	-	-	14	71	-	-	0	4/5
02	**80**	-	-	80	-	-	25	50	-	-	0	7/10
07	**40**	-	-	40	-	-	0	100	-	-	0	7/9
Chrysothamnus depressus												
89	**33**	-	-	33	-	-	0	0	-	-	0	4/9
97	**40**	-	-	40	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**60**	-	40	20	-	-	0	100	-	-	0	4/7

		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)
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	-	0	0	-	-	0	15/17
02	**0**	-	-	-	-	-	0	0	-	-	0	8/9
07	**0**	-	-	-	-	-	0	0	-	-	0	11/12
Chrysothamnus viscidiflorus stenophyllus												
89	**566**	-	33	533	-	-	0	0	0	-	0	8/10
97	**3640**	40	560	3080	-	-	7	0	0	-	0	11/16
02	**4920**	-	120	4340	460	160	7	.40	9	.40	.40	8/15
07	**4120**	-	220	3300	600	140	37	13	15	8	8	7/12
Ephedra viridis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	100	-	-	0	5/4
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
89	**366**	-	-	333	33	-	0	0	9	-	0	9/12
97	**100**	-	-	100	-	-	0	0	0	-	0	6/6
02	**860**	-	-	800	60	40	0	0	7	-	0	7/9
07	**440**	-	100	320	20	40	0	0	5	5	5	6/7
Juniperus osteosperma												
89	**266**	133	233	33	-	-	0	0	-	-	0	71/52
97	**380**	-	240	140	-	20	0	0	-	-	0	-/-
02	**480**	-	100	380	-	60	0	4	-	-	0	-/-
07	**320**	-	200	120	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	-	0	100	-	-	0	6/14
02	**40**	-	-	40	-	-	0	100	-	-	0	8/17
07	**20**	-	-	20	-	-	0	100	-	-	0	7/12
Symphoricarpos oreophilus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	10/21
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16C-6-07

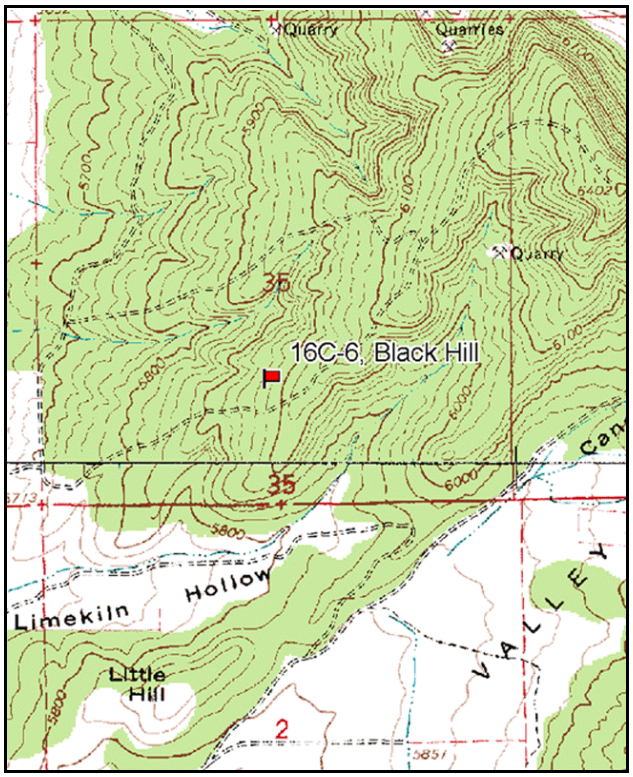
Study site name: Black Hill . Vegetation type: Chained, Seeded P-J .

Compass bearing: frequency baseline 190 degrees magnetic.

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

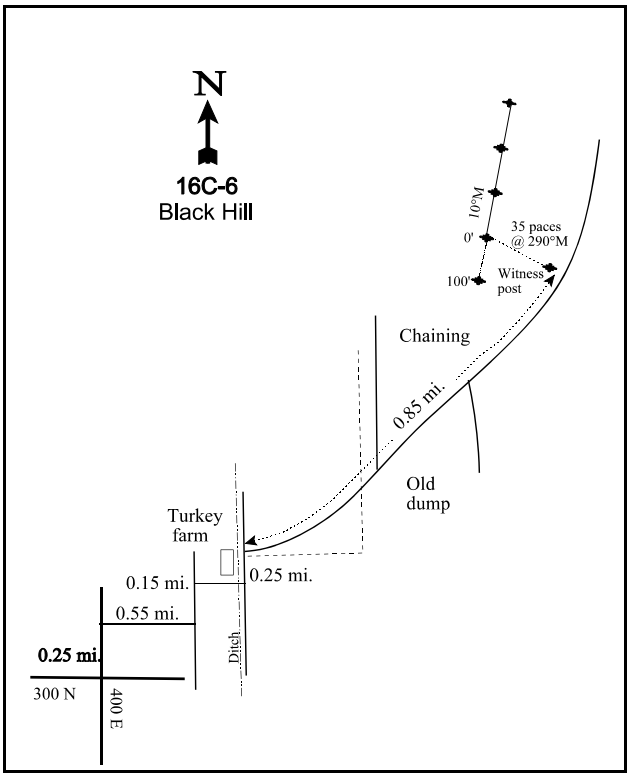
LOCATION DESCRIPTION

From the intersection of 300 North and 400 East in Ephraim, go north on 400 East for 0.25 miles. Just before the white brick home, turn east and go 0.55 miles. From here, bear left and then right, going 0.15 miles to where the road crosses the Gobble field ditch on the south side of a turkey pen. Cross the ditch and turn left (north) for 0.25 miles. Turn right here and go 0.85 miles into the chaining where you will come to a 4 foot, green witness post on the west side of the road. Stop here and walk 35 paces westward at 290 degrees magnetic to the 0-foot baseline stake marked by browse tag # 427.



Map Name: Chester

Township 16S , Range 3E , Section 35



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 452432 E 4358785 N

DISCUSSION

Black Hill - Trend Study No. 16C-6

Study Information

This study is located on a chained and seeded juniper (*Juniperus osteosperma*) treatment northeast of Ephraim [elevation: 5,985 feet (1,824 meters), slope: 10%-16%, aspect: west]. It is located on Utah Division of Wildlife Resources land above several turkey farms, pastures, and alfalfa fields. The Black Hills drop sharply down to Cane Valley on the east, but slope moderately to the west. Prior to the 1987 chaining and seedling treatment, the area was characterized as an open stand of juniper with a sparse understory of black sagebrush (*Artemsia nova*) and cheatgrass (*Bromus tectorum*). Patches of juniper were left on the ridge for cover and travel corridors for big game. Most of the big game use comes from wintering deer. From the pellet group transect, deer use was estimated at 66 days use/acre (164 ddu/ha) in 2002 and 171 days use/acre (422 ddu/ha) in 2007. Elk use was estimated at 13 days use/acre (33 edu/ha) in 2002 and 18 days use/acre (45 edu/ha) in 2007. Livestock also graze the area during the summer. Cattle use was estimated at 11 days use/acre (27 cdu/ha) in 2002 and 5 days use/acre (13 cdu/ha) in 2007.

Soil

The soil is in the Amtoft series which consists of shallow, well-drained and somewhat excessively drained soils formed in material weathered from calcareous sedimentary rocks. The soil is described as Amtoft flaggy loam which characteristically is 12-18 inches (30-46 cm) deep over limestone (USDA-NRCS 2007). The soil has a clay loam texture with a neutral to slightly alkaline reactivity (pH of 7.3). Since 1997, combined relative cover of vegetation and litter was 71%-78%, rock and pavement combined relative cover was 8%-11%, and relative bare ground cover was 13%-16%. The erosion condition was classified as stable in 2002. In 2007, the erosion condition was classified as slight due to the increased translocation of soil, surface rock, and litter.

Browse

As with the nearby Cane Valley study, palatable browse is limited. Black sagebrush, Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) , fourwing saltbush (*Atriplex canescens*), and bitterbrush (*Purshia tridentata*) are all present, but only black sagebrush is moderately abundant. Black sagebrush density was 732 plants/acre (1,808 plants/ha) in 1989, 420 plants/acre (1,037 plants/ha) in 1997, 760 plants/acre (1,877 plants/ha) in 2002, and 620 plants/acre (1,534 plants/ha) in 2007. Recruitment of young has been low at less than 15% of the population. Decadence decreased from 36% of the population in 1989 to 14% in 1997, and increased to 42% by 2007. Plants classified as having poor vigor have been low-moderat at 3%-23% of the population. Browse use was light in 1997, light-moderate in 1989 and 2002, and heavy in 2007. The average annual leader growth on black sagebrush was 1.4 inches (3.6 cm) in 2002 and 1.2 inches (3.1 cm) in 2007.

Wyoming big sagebrush density increased from 0 plants/acre in 1989 to 440 plants/acre (1,087 plants/ha) in 1997, decreasing to 40 plants/acre (99 plants/ha) in 2002 and 20 plants/acre (49 plants/ha) in 2007. The wide fluctuation in density was caused by the difficulty in distinguishing between black sagebrush and Wyoming sagebrush. Apparently, most of the plants classified as Wyoming big sagebrush in 1997 were classified as black sage in 2002. It is likely that many of the sagebrush are hybrids between Wyoming big sagebrush and black sage. The recruitment of young was low at 0%-9%, and decadence was low at 0%-5% of the population in all sample years. The plant vigor has been excellent, and browse use has increased from light in 1989 and 1997, to light-moderate in 2002, and heavy in 2007.

The junipers on the ridge surrounding the study have been highlined. The point-center quarter data estimate of juniper density was 69 trees/acre (170 trees/ha) in 1997, 77 trees/acre (190 trees/ha) in 2002, and 58 trees/acre (143 trees/ha) in 2007. A small proportion of the trees are survivors from the treatment but many were young trees in the 2 to 3 foot size class. Average diameter of juniper was 3 inches (7.6 cm) in 1997 and 2002, and 3.5 inches (8.9 cm) in 2007.

Herbaceous Understory

Perennial grasses, both seeded and native, dominate the vegetative community. Perennial grasses comprised 17% of the ground cover in 1997, 21% in 2002, and 23% in 2007. Perennial grasses contributed 48% of the total vegetative cover in 1997, 65% in 2002, and 46% in 2007. Intermediate wheatgrass (*Agropyron intermedium*) is the most abundant species, providing 13%-17% cover every sample year. Crested wheatgrass (*Agropyron cristatum*) and Indian ricegrass (*Oryzopsis hymenoides*) are moderately abundant. Cheatgrass provided 2% cover in 1997, decreased to less than 1% cover in 2002, and increased to 6% cover in 2007. Grasses appeared to have been grazed by cattle prior to sampling in 2002, but with abundant litter and wolfy material on many plants, grazing has not been a problem in the past.

Forbs, especially perennial species, have not been significant in the understory, providing less than 2% cover in all sample years. Small burnet (*Sanguisorba minor*), a seeded species, was moderately abundant in 1989. However, the quadrat frequency of small burnet decreased from 40% in 1989 to 5% in 1997, and has not been sampled since. Only three perennial forbs were measured in 2002. Annual species were moderately abundant, providing 6% cover in 1997, 3% cover in 2002, and 13% cover in 2007. Bur buttercup (*Ranunculus testiculatus*) and pale alyssum (*Alyssum alyssoides*) have been the most abundant forbs. Bur buttercup has been shown to be allelopathic (Buchanan et al. 1978).

1997 TREND ASSESSMENT

The browse trend is stable. Black sagebrush density decreased 43%, to 420 plants/acre (1,037 plants/ha). This decrease was partly attributed to the larger sample area used in 1997. The recruitment of young remained stable at 14% of the population. Decadence decreased to 14%. Plants showing poor vigor increased to 14% of the population, and browse use decreased to light. Wyoming big sagebrush density increased from 0 plants/acre to 440 plants/acre (1,087 plants/ha). The recruitment of young increased slightly from 0% to 9%. Decadence increased slightly to 5%. Plant vigor was excellent, and browse use remained light. The grass trend is up. The sum of nested frequency for perennial grasses increased 80%. Intermediate wheatgrass and Sandberg bluegrass (*Poa secunda*) increased significantly in nested frequency. The forb trend is down. The sum of nested frequency of perennial forbs decreased 68%. The weedy species, pale alyssum and bur buttercup, provided 75% of the total forb cover. The Desirable Components Index (DCI) score was fair due very low browse cover, excellent perennial grass cover, low annual grass cover, and low perennial forb cover.

winter range condition (DCI) - fair (33) Low potential scale
browse - stable (0) grass - up (+2) forb - down (-2)

2002 TREND ASSESSMENT

The browse trend is stable. Overall sagebrush density is stable. The density of black sagebrush increased 81%. The recruitment of young decreased to 0% of the population, and decadence changed little at 16%. Plants classified with poor vigor decreased to 3% of the population, and browse use was mostly light-moderate. The density of Wyoming big sagebrush decreased 91%. The recruitment of young decreased to 0% of the population, and decadence and plants classified with poor vigor remained stable. Browse use was light-moderate. The grass trend is slightly up. The sum of nested frequency for perennial grasses remained stable. The nested frequency of intermediate wheatgrass increased significantly, and that of Indian ricegrass and bottlebrush squirreltail decreased significantly. However, the nested frequency for cheatgrass decreased 71%. The forb trend is slightly down. The number of perennial species sampled decreased from 10 to three. The sum of nested frequency for perennial forbs decreased 77%, and, the sum of nested frequency for annual forbs decreased 60%. Even though the nested frequencies of pale alyssum and bur buttercup significantly decreased, these species increased to 99% of the total forb cover. The DCI score remained fair.

winter range condition (DCI) - fair (31) Low potential scale
browse - stable (0) grass - slightly up (+1) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is slightly down. The density of black sagebrush decreased 18%. The recruitment of young plants increased slightly to 3% of the population, and decadent plants increased to 42%. Plants classified as having poor vigor increased to 23% of the population. Browse use shifted to heavy, and heavily browsed plants increased to 90% of the black sagebrush population. The density of Wyoming big sagebrush decreased 50%. Recruitment, decadence, and vigor all remained stable at 0% of the population. All of the sampled plants had been heavily browsed. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased 33%. Crested wheatgrass and Sandberg bluegrass increased significantly in nested frequency. However, the nested frequency of cheatgrass increased more than four-fold. The forb trend is down. Only two perennial forbs were measured, and the sum of nested frequency for perennial forbs changed little. The sum of nested frequency of annual forbs greatly increased. Pale alyssum and bur buttercup both increased significantly in nested frequency and continued to provide 99% of the total forb cover. The DCI score remained fair.

winter range condition (DCI) - fair (27) Low potential scale
browse - slightly down (-1) grass - slightly up (+1) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 6

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	a16	ab34	b52	c90	1.50	2.34	4.92
G	Agropyron intermedium	a93	b178	c225	c249	12.55	16.99	14.70
G	Agropyron spicatum	-	a-	-	a1	.00	-	.15
G	Bromus inermis	-	3	-	-	.03	-	-
G	Bromus tectorum (a)	-	b181	a52	c226	1.98	.34	5.96
G	Elymus junceus	-	a4	a4	a7	.21	.03	.18
G	Oryzopsis hymenoides	ab52	b90	a35	a34	1.21	1.47	1.38
G	Poa bulbosa	-	-	-	1	-	-	.03
G	Poa fendleriana	1	-	-	-	-	-	-
G	Poa pratensis	1	-	-	-	-	-	-
G	Poa secunda	a9	b44	b43	c103	.16	.26	1.15
G	Sitanion hystrix	b46	b39	a6	-	1.14	.07	-
Total for Annual Grasses		0	181	52	226	1.98	0.34	5.96
Total for Perennial Grasses		218	392	365	485	16.81	21.18	22.54
Total for Grasses		218	573	417	711	18.80	21.52	28.50
F	Alyssum alyssoides (a)	-	b271	a32	c336	1.96	.10	7.75
F	Allium sp.	-	-	7	-	-	.01	-
F	Arabis sp.	-	3	-	-	.03	-	-
F	Astragalus sp.	3	-	-	-	-	-	-
F	Camelina microcarpa (a)	-	a5	-	a2	.01	-	.01
F	Chenopodium album (a)	-	1	-	-	.00	-	-

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Cirsium sp.	6	-	-	-	-	-	-
F	Cymopterus sp.	-	$_{a}$1	-	$_{b}$10	.00	-	.04
F	Descurainia pinnata (a)	-	-	-	20	-	-	.06
F	Lactuca serriola	$_{a}$14	$_{a}$4	-	-	.01	-	-
F	Linum lewisii	$_{a}$1	$_{a}$2	-	-	.03	-	-
F	Mentzelia albicaulis (a)	-	3	-	-	.03	-	-
F	Medicago sativa	$_{a}$7	$_{a}$2	-	-	.04	-	-
F	Phlox longifolia	-	$_{a}$2	$_{a}$1	$_{a}$1	.00	.00	.01
F	Ranunculus testiculatus (a)	-	$_{b}$272	$_{a}$193	$_{b}$289	3.46	2.81	5.59
F	Sanguisorba minor	$_{b}$88	$_{a}$15	-	-	1.12	-	-
F	Sisymbrium altissimum (a)	$_{a}$3	$_{a}$3	-	-	.41	-	-
F	Sphaeralcea coccinea	-	$_{a}$1	$_{a}$1	-	.03	.00	-
F	Trifolium douglasii	-	3	-	-	.06	-	-
F	Tragopogon dubius	$_{a}$3	$_{a}$6	-	-	.04	-	-
Total for Annual Forbs		3	555	225	647	5.87	2.91	13.42
Total for Perennial Forbs		122	39	9	11	1.39	0.01	0.05
Total for Forbs		125	594	234	658	7.27	2.93	13.47

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

BROWSE TRENDS --
Management unit 16C, Study no: 6

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia nova	10	21	19	.39	.66	1.01
B	Artemisia tridentata wyomingensis	15	2	1	.45	.30	-
B	Atriplex canescens	3	1	1	-	-	.03
B	Chrysothamnus viscidiflorus stenophyllus	57	50	44	5.29	4.30	1.85
B	Gutierrezia sarothrae	5	7	1	.07	.03	-
B	Juniperus osteosperma	7	8	7	2.51	2.75	3.58
B	Opuntia sp.	0	1	2	-	-	.03
Total for Browse		97	90	75	8.72	8.06	6.51

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 6

Species	Percent Cover	
	'02	'07
Artemisia nova	.95	1.20
Artemisia tridentata wyomingensis	.28	-
Atriplex canescens	.56	-
Chrysothamnus viscidiflorus stenophyllus	4.59	2.48
Gutierrezia sarothrae	.05	-
Juniperus osteosperma	3.56	4.86

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 6

Species	Average leader growth (in)	
	'02	'07
Artemisia nova	1.4	1.2

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 6

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	77	58

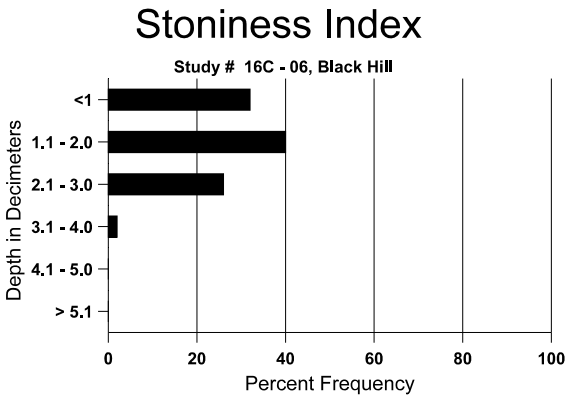
Average diameter (in)	
'02	'07
3.2	3.5

BASIC COVER --
Management unit 16C, Study no: 6

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	4.50	34.90	32.80	43.96
Rock	2.50	2.73	4.11	4.49
Pavement	13.75	4.38	7.83	6.02
Litter	63.25	40.56	50.98	38.87
Cryptogams	1.00	1.42	4.36	3.31
Bare Ground	15.00	12.78	18.33	17.43

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 06, Black Hill

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
8.5	61.6 (10.4)	7.3	36.7	34.7	28.6	4.5	13.1	160.0	.5



PELLET GROUP DATA --
Management unit 16C, Study no: 6

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	1	-	1
Rabbit	12	19	56
Elk	1	9	8
Deer	40	31	47
Cattle	-	2	3

Days use per acre (ha)	
'02	'07
-	1 (3)
-	-
13 (33)	18 (45)
66 (164)	171 (422)
11 (27)	5 (13)

BROWSE CHARACTERISTICS --
Management unit 16C, 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 nova												
89	**732**	66	100	366	266	-	41	9	36	-	5	12/12
97	**420**	-	60	300	60	20	0	0	14	14	14	13/23
02	**760**	-	-	640	120	60	42	16	16	3	3	10/18
07	**620**	60	20	340	260	80	10	90	42	23	23	11/17
Artemisia tridentata wyomingensis												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**440**	-	40	380	20	-	5	0	5	-	0	15/20
02	**40**	-	-	40	-	-	50	0	0	-	0	19/20
07	**20**	-	-	20	-	-	0	100	0	-	0	23/28

		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)
Atriplex canescens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**60**	-	-	60	-	-	0	0	-	-	0	41/21
02	**20**	-	-	20	-	-	0	0	-	-	0	59/57
07	**20**	-	-	20	-	-	100	0	-	-	0	63/49
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	54/85
02	**0**	-	-	-	-	-	0	0	-	-	0	38/44
07	**0**	-	-	-	-	-	0	0	-	-	0	64/81
Chrysothamnus viscidiflorus stenophyllus												
89	**1832**	-	66	1166	600	-	0	0	33	9	93	15/22
97	**2920**	-	400	2440	80	-	0	0	3	.68	.68	14/23
02	**2460**	-	20	2140	300	80	3	0	12	2	2	12/21
07	**2000**	-	100	1140	760	60	41	37	38	11	14	9/14
Gutierrezia sarothrae												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**300**	60	140	160	-	-	0	0	0	-	0	10/9
02	**320**	-	-	240	80	100	0	0	25	-	0	6/8
07	**20**	-	-	20	-	-	0	0	0	-	0	9/11
Juniperus osteosperma												
89	**199**	33	66	-	133	-	0	0	67	-	17	-/-
97	**160**	-	60	100	-	40	0	0	0	-	0	-/-
02	**240**	-	20	180	40	40	0	0	17	-	8	-/-
07	**160**	-	20	140	-	-	0	0	0	-	25	-/-
Opuntia sp.												
89	**66**	-	33	33	-	-	0	0	-	-	0	4/15
97	**0**	-	-	-	-	-	0	0	-	-	0	4/18
02	**20**	-	-	20	-	-	0	0	-	-	0	5/30
07	**100**	-	20	80	-	-	0	0	-	-	0	3/5
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	4/10
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16C-7-07

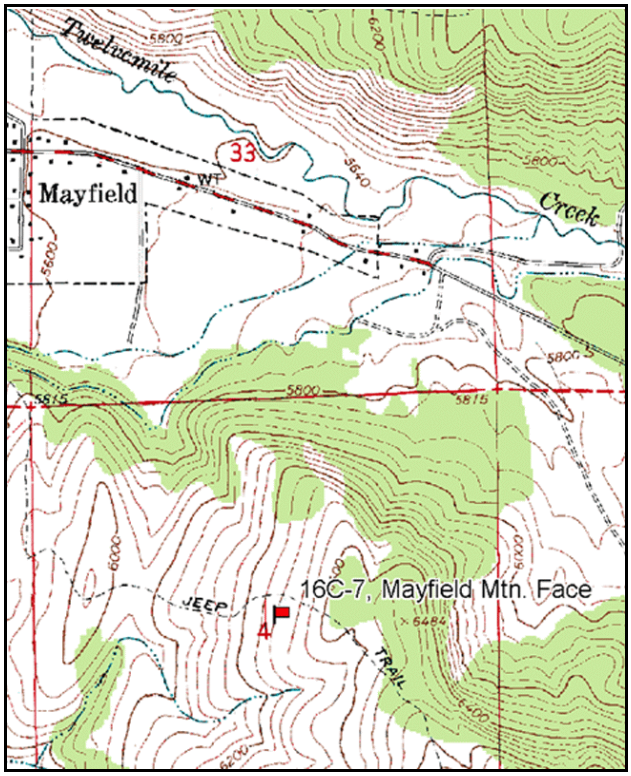
Study site name: Mayfield Mtn. Face . Vegetation type: Chained, Seeded P-J .

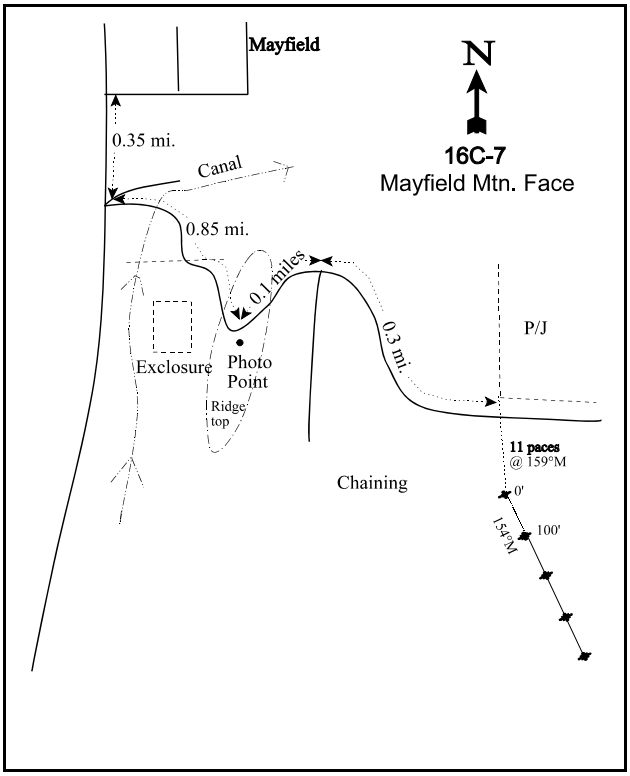
Compass bearing: frequency baseline 154 degrees magnetic.

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

LOCATION DESCRIPTION

From the intersection of the main road and Twelve Mile Canyon Road in Mayfield, go south out of town on the main road for 0.35 miles into Arapien Valley to an intersection. At the intersection, turn east up a steep four-wheel drive road that goes up the hill. Take this road 0.85 miles to an old line-intercept photo point on the ridge top (a canal and fence will be crossed 0.1 miles east of the ridge top and you will come to a fork in the road). Go straight (east) for 0.3 miles to a fence corner on the north side of the road. From the fence corner, walk 11 paces at 159 degrees magnetic to the 0-foot baseline stake.





Map Name: Mayfield

Diagrammatic Sketch

Township 20S , Range 2E ,Section 4

GPS: NAD 83, UTM 12S 439946 E 4328014 N

DISCUSSION

Mayfield Mountain Face - Trend Study No. 16C-7

Study Information

This study is located on a large, 35-year-old chaining and seeding treatment southeast of Mayfield [elevation: 6,300 feet (1,920 m), slope: 15-20%, aspect: west]. The area is critical for wintering deer, but also receives some spring-fall use by big game. Quadrat frequency of deer pellets was 47% in 1997, 43% in 2002, and 41% in 2007. From the pellet group transect deer use was estimated at 56 days use/acre (139 ddu/ha) in 2002 and 179 days use/acre (441 ddu/ha) in 2007. Elk use was estimated at 3 days use/acre (7 edu/ha) in 2002 and 13 days use/acre (31 edu/ha) in 2007. Cattle use was estimated at 4 days use/acre (9 cdu/ha) in 2002 and 17 days use/acre (43 cdu/ha) in 2007.

Soil

The soil is in the Fontreen series that consists of very deep, well-drained, moderately-rapidly permeable soils that formed in alluvium and colluvium from limestone, sandstone, chert, and shale. Fontreen soils are on alluvial fans, hillslopes and mountain slopes. They are strongly calcareous, allowing calcium carbonate precipitates to form a hardened caliche layer (USDA-NRCS 2007). The soil has a clay loam texture and reactivity is neutral to slightly alkaline (pH of 7.3). There is a well-developed hardpan within localized areas about 10 inches (25 cm) below the surface. Relative rock and pavement cover was moderate at 23%-26% in all sample years. Relative bare ground cover was low at 5% in 1997, increased to 20% in 2002 with drought, and decreased slightly to 17% in 2007. Combined relative cover of vegetation and litter was 64% in 1997, decreased to 51% with drought in 2002, and increased slightly to 58% in 2007. Vegetation and litter has been well-distributed, and adequate to prevent serious erosion. The erosion condition was classified as slight in 2002 due to pedestalling around plants. In 2007, the erosion condition was classified as stable.

Browse

Black sagebrush (*Artemisia nova*) is the most common shrub, and preferred browse species. The canopy cover of black sagebrush was 8% in 2002 and 9% in 2007. The density of black sagebrush was 2,540 plants/acre (6,274 plants/ha) in 1997, 2,660 plants/acre (6,570 plants/ha) in 2002, and 2,260 plants/acre (5,582 plants/ha) in 2007. Young plants comprised 13% of the population in 1989, 16% in 1997, 1% in 2002, and 29% in 2007. Decadence decreased from 32% of the population in 1989 to 12%-13% in 1997 and 2002. In 2007, 19% of the population was decadent. Plants classified with poor vigor have accounted for 4%-33% of the population. Utilization on black sagebrush was light-moderate. Annual average leader growth was 0.6 inches (1.6 cm) in 2002 and 0.9 inches (2.4 cm) in 2007. The few mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), antelope bitterbrush (*Purshia tridentata*), and fourwing saltbush (*Atriplex canescens*) that occur have been heavily browsed.

The density of Utah juniper (*Juniperus osteosperma*) since the treatment has remained stable. Juniper canopy cover was 1% in 2002 and 2007. The point-centered quarter data estimate of junipers density was 31 trees/acre (77 trees/ha) in 1997, 32 trees/acre (79 trees/ha) in 2002, and 34 trees/acre (84 trees/ha) in 2007. Average diameter of juniper was estimated 2.5 inches (6.4 cm) at 3 inches (7.6 cm) in 2002, and 4.1 inches (10.4 cm) in 2007. Pinyon pine (*Pinus edulis*) point-centered quarter estimates were 9 trees/acre (22 trees/ha) in 1997, 8 trees/acre (20 trees/ha) in 2002, and 17 trees/acre (42 trees/ha) in 2007. Average diameter of pinyon was estimated at 3.5 inches (8.9 cm) in 1997, and 5.2 inches (13.1 cm) in 2002 and 2007. In 2002, it was noticed that older trees within the adjacent unchained stand had been highlined.

Herbaceous Understory

Perennial grasses are the dominant vegetative component. They provided 19% of the ground cover in 1997, 11% in 2002, and 13% in 2007. Perennial grasses made up 52% of the total vegetative cover in 1997, 41% in 2002, and 32% in 2007. Bluebunch wheatgrass (*Agropyron spicatum*), crested wheatgrass (*Agropyron*

cristatum), and Sandberg bluegrass (*Poa secunda*) are the most abundant species. They provided 87% of the total grass cover in 1997, 99% in 2002, and 68% in 2007. Other less abundant grasses that have been sampled include intermediate wheatgrass (*Agropyron intermedium*), smooth brome (*Bromus inermis*), Russian wildrye (*Elymus junceus*), and cheatgrass (*Bromus tectorum*). Grasses were heavily grazed by cattle prior to sampling in July 2002, and most plants, including the perennial species, were already desiccated. Visually, this site looked poor in 2002 due to drought and heavy use. In 2007, most grasses had moderate-heavy grazing by cattle, but had good vigor and seed production.

Forbs comprised 5% of the ground cover in 1997, 6% in 2002, and 20% in 2007. Perennial forb cover has been less than 1% since 1997. The dominant forb was bur buttercup (*Ranunculus testiculatus*), an allelopathic species that prevents the germination of many native species (Buchanan et al. 1978). It provided 5%-6% of the total ground cover in 1997 and 2002, and 18% in 2007.

1997 TREND ASSESSMENT

The browse trend is slightly down. Black sagebrush density decreased 54%, which was partly attributed to the increased sample area. The recruitment of young increased from 13% to 16% of the population, and decadence declined from 32% to 12%. Plants classified as having poor vigor decreased from 33% to 4% of the population, and browse use was mostly light. The grass trend is stable. The sum of nested frequency of perennial grasses changed little. Crested wheatgrass and intermediate wheatgrass increased significantly in nested frequency, while bluebunch wheatgrass decreased significantly in nested frequency. The forb trend is stable. The sum of nested frequency of perennial forbs decreased 36%. However, the abundance of perennial forbs had already been very low. The Desirable Components Index (DCI) score was good-excellent due to moderate browse cover with low decadence and moderate recruitment, excellent perennial grass cover, low annual grass cover, and low perennial forb cover.

winter range condition (DCI) - good-excellent (64) Low potential scale
browse - slightly down (-1) grass - stable (0) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is stable. Black sagebrush density increased 5%. The recruitment of young decreased to 1% of the population, and decadence remained low at 13%. Plants showing poor vigor remained at 4% of the population, and browse use was light-moderate. However, heavily browsed plants increased from 0% of the population to 35%. The grass trend is down. The sum of nested frequency of perennial grasses decreased 29%. The nested frequencies of Sandberg bluegrass, intermediate wheatgrass, and smooth brome decreased significantly. The quadrat frequency for cheatgrass decreased from 31% to 3%. The forb trend is stable. The sum of nested frequency of both perennial and annual forbs decreased greatly and only two species were sampled. Bur buttercup decreased significantly in nested frequency, but remained abundant. Project personnel noted that the herbaceous understory looked very poor due to drought conditions and heavy use on the grasses by cattle prior to sampling. The DCI score declined to good due to very low recruitment of young browse, and a decrease in perennial grass cover.

winter range condition (DCI) - good (47) Low potential scale
browse - stable (0) grass - down (-2) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is slightly down. The density of black sagebrush decreased 15%. The recruitment of young increased to 29% of the population, but decadence increased to 19%. Plants classified as having poor vigor increased to 11% of the population, and browse use remained light-moderate. The grass trend is slightly down. The sum of nested frequency of perennial grasses increased slightly while that for annual grass increased greatly. The nested frequencies of Sandberg bluegrass, intemediate wheatgrass, and Russian wildrye all increased significantly. However, crested wheatgrass significantly decreased. Cheatgrass cover increased

from 0% to 2% and quadrat frequency increased to 35%. The forb trend is stable. The sum of nested frequency for perennial forbs increased slightly. However, perennial forbs remained sparse. Bur buttercup increased significantly in nested frequency, and its average cover increased from 6% to 18%. The DCI remained good.

winter range condition (DCI) - good (62) Low potential scale
browse - slightly down (-1) grass - slightly down (-1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 7

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	ab94	c147	bc127	a78	6.38	4.06	2.90
G	Agropyron intermedium	a7	b36	a5	b36	.89	.03	1.43
G	Agropyron spicatum	b226	a135	a134	a102	6.23	5.69	3.05
G	Bromus inermis	b27	b35	a1	a4	.40	.00	.07
G	Bromus tectorum (a)	-	b31	a3	c99	.40	.00	2.42
G	Elymus junceus	-	ab7	a2	b16	.30	.00	.66
G	Koeleria cristata	-	-	-	3	-	-	.15
G	Oryzopsis hymenoides	a1	a7	-	-	.53	-	-
G	Poa pratensis	-	-	3	-	-	.03	-
G	Poa secunda	b196	b205	a135	b214	4.19	1.18	4.59
G	Vulpia octoflora (a)	-	-	-	3	-	-	.00
Total for Annual Grasses		0	31	3	102	0.40	0.00	2.43
Total for Perennial Grasses		551	572	407	453	18.93	11.02	12.89
Total for Grasses		551	603	410	555	19.34	11.02	15.33
F	Alyssum alyssoides (a)	-	-	-	67	-	-	.90
F	Antennaria rosea	a1	-	-	a3	-	-	.00
F	Arabis sp.	a5	a1	-	-	.00	-	-
F	Astragalus utahensis	a2	a2	-	a9	.03	-	.04
F	Camelina microcarpa (a)	-	a1	-	a6	.00	-	.04
F	Calochortus nuttallii	-	a5	-	a3	.01	-	.01
F	Collinsia parviflora (a)	-	-	-	4	-	-	.01
F	Cryptantha sp.	4	-	-	-	-	-	-
F	Descurainia pinnata (a)	-	a9	-	b35	.02	-	.20
F	Draba sp. (a)	-	-	-	1	-	-	.00
F	Gilia sp. (a)	-	-	-	21	-	-	.14
F	Holosteum umbellatum (a)	-	a1	-	b24	.00	-	.15
F	Lactuca serriola	-	4	-	-	.01	-	-

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Medicago sativa	$_{a}$2	$_{a}$5	-	-	.18	-	-
F	Phlox hoodii	$_{b}$22	$_{a}$6	$_{a}$2	$_{a}$2	.06	.01	.03
F	Ranunculus testiculatus (a)	-	$_{b}$317	$_{a}$255	$_{c}$360	5.05	5.85	18.04
Total for Annual Forbs		0	328	255	518	5.08	5.85	19.50
Total for Perennial Forbs		36	23	2	17	0.30	0.01	0.09
Total for Forbs		36	351	257	535	5.38	5.86	19.59

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

BROWSE TRENDS --
Management unit 16C, Study no: 7

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia nova	51	53	47	8.85	8.24	9.00
B	Artemisia tridentata vaseyana	10	9	7	.96	.93	.91
B	Atriplex canescens	0	1	0	-	-	-
B	Chrysothamnus nauseosus albicaulis	0	3	0	-	-	-
B	Chrysothamnus viscidiflorus stenophyllus	21	17	18	1.50	.28	.24
B	Ephedra viridis	0	1	0	-	-	-
B	Gutierrezia sarothrae	19	13	38	.10	.04	1.56
B	Juniperus osteosperma	1	1	2	-	.53	.53
Total for Browse		102	98	112	11.42	10.03	12.24

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 7

Species	Percent Cover	
	'02	'07
Artemisia nova	7.78	9.21
Artemisia tridentata vaseyana	.58	1.01
Atriplex confertifolia	.05	-
Chrysothamnus viscidiflorus stenophyllus	.18	1.56
Gutierrezia sarothrae	.03	.80
Juniperus osteosperma	.86	1.26

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 7

Species	Average leader growth (in)	
	'02	'07
Artemisia nova	0.6	0.9

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 7

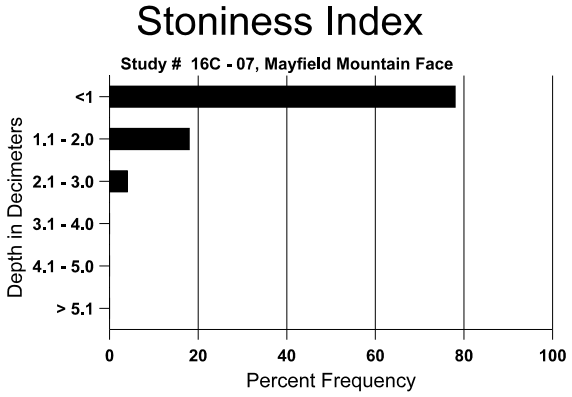
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Juniperus osteosperma	32	36	3.0	4.1
Pinus edulis	8	19	5.2	5.2

BASIC COVER --
Management unit 16C, Study no: 7

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	10.00	36.70	27.01	50.19
Rock	7.75	11.17	13.73	11.81
Pavement	46.00	12.71	15.39	13.56
Litter	27.25	25.64	29.80	15.96
Cryptogams	0	6.10	2.51	.54
Bare Ground	9.00	5.19	22.09	18.52

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 07, Mayfield Mountain Face

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
8.7	61.0 (10.2)	7.3	30.0	37.4	32.6	4.9	11.9	144.0	.4



PELLET GROUP DATA --
Management unit 16C, Study no: 7

Type	Quadrat Frequency			
	'89	'97	'02	'07
Rabbit	-	19	10	30
Elk	-	4	2	7
Deer	-	47	43	41
Cattle	-	-	5	5

Days use per acre (ha)	
'02	'07
-	-
3 (7)	13 (31)
56 (139)	179 (441)
4 (9)	17 (43)

BROWSE CHARACTERISTICS --
Management unit 16C, Study no: 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)
Artemisia nova												
89	**5466**	266	733	3000	1733	-	40	5	32	-	33	14/16
97	**2540**	80	400	1840	300	140	10	0	12	4	4	15/28
02	**2660**	-	20	2300	340	140	17	35	13	4	4	13/26
07	**2260**	3540	660	1160	440	80	29	28	19	7	11	14/29
Artemisia tridentata vaseyana												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**220**	-	20	160	40	-	45	18	18	-	9	18/30
02	**240**	-	-	180	60	20	33	58	25	8	8	15/30
07	**200**	560	20	140	40	40	50	10	20	10	10	18/32
Atriplex canescens												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**20**	-	-	-	20	-	100	0	100	100	100	60/80
07	**0**	-	-	-	-	-	0	0	0	-	0	56/83
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**60**	-	-	60	-	-	0	100	-	-	0	26/37
07	**0**	-	-	-	-	-	0	0	-	-	0	65/71
Chrysothamnus viscidiflorus stenophyllus												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**760**	-	40	700	20	-	0	0	3	-	0	11/12
02	**620**	-	-	420	200	20	3	97	32	19	26	7/16
07	**900**	380	280	600	20	-	2	27	2	-	0	10/15

		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)
Ephedra viridis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	100	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
89	**600**	-	-	600	-	-	0	0	0	-	0	8/5
97	**960**	120	440	520	-	-	0	0	0	-	0	9/11
02	**540**	-	-	360	180	180	0	4	33	11	11	5/6
07	**1840**	20	60	1760	20	20	0	0	1	-	0	10/12
Juniperus osteosperma												
89	**66**	-	66	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	40	0	0	-	-	0	-/-
02	**20**	-	-	20	-	40	0	0	-	-	0	-/-
07	**40**	-	-	40	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	11/19
07	**0**	-	-	-	-	-	0	0	-	-	0	12/29

Trend Study 16C-8-07

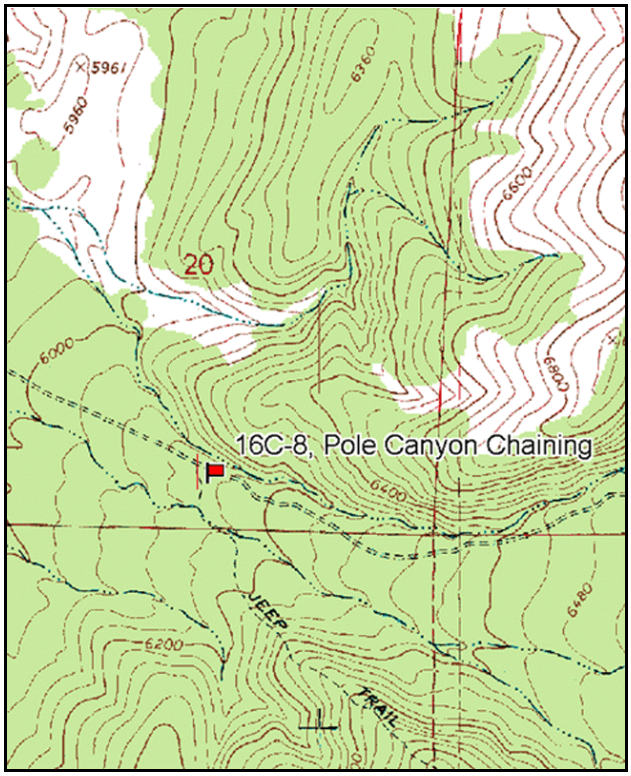
Study site name: Pole Canyon Chaining . Vegetation type: Chained, Seeded P-J .

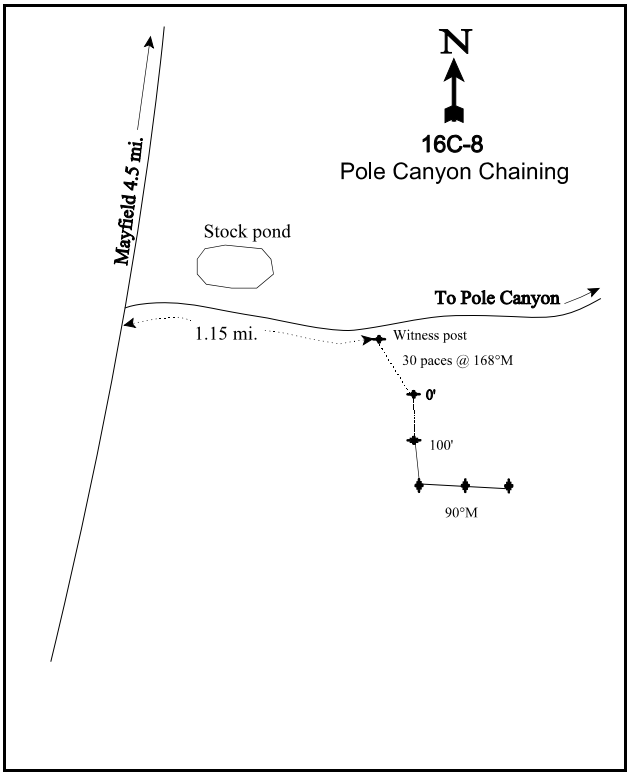
Compass bearing: frequency baseline 180 degrees magnetic (line 2-3 @ 90°M).

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

LOCATION DESCRIPTION

From Mayfield, go south down Arapien Valley for 4.5 miles to the Pole Canyon Road. Turn east and go 1.1 miles to a witness post in a chaining. The witness post is 6 paces south of the road. From the witness post to the 0-foot baseline stake is 32 paces at 215 degrees magnetic. Browse tag #4091 marks the 0-foot baseline stake.





Map Name: Mayfield

Diagrammatic Sketch

Township 20S , Range 2E , Section 20

NAD 83 UTM 12S 438289 E 4322411 N

DISCUSSION

Pole Canyon Chaining - Trend Study No. 16C-8

Study Information

This study samples a pre-1960 pinyon pine-Utah juniper (*Pinus edulis-Juniperus osteosperma*) chaining on a level alluvial fan at the mouth of Pole Canyon. It is on Bureau of Land Management (BLM) property at the south end of the Mayfield Face [elevation: 6,150 feet (1,875 m), slope: 2%, aspect: north-west]. There is a stock pond located 0.7 miles (1.1 km) to the west. The same area was sampled by a line-intercept transect in 1978. Just prior to the 2002 sampling, trees on the study were removed in a lop and scatter treatment. It is considered an important wintering area for deer, but pellet group quadrat frequency steadily decreased from 53% in 1997 to 48% in 2002 and 34% in 2007. From the pellet group transect, deer use was estimated at 99 days use/acre (245 ddu/ha) in 2002 and 50 days use/acre (122 ddu/ha) in 2007. Elk use was estimated at 6 days use/acre (15 edu/ha) in 2007. Sheep estimates were 1 day use/acre (3 sdu/ha) in 2002. Cattle estimates were 2 days use/acre (5 cdu/ha) in 2002 and 23 days use/acre (57 cdu/ha) in 2007. Grasses were reported to be heavily to severely grazed by cattle in 1989 and 1997. In the past, this area has been permitted for grazing as part of the South Hollow allotment from May 1 to June 30.

Soil

The soil is in the Fontreen series, which consists of very deep, well-drained, moderately-rapidly permeable soils that formed in alluvium and colluvium from limestone, sandstone, chert, and shale. Fontreen soils are on alluvial fans, hillslopes and mountain slopes (USDA-NRCS 2007). The soil is sandy clay loam in texture and has a slightly alkaline reactivity (pH of 7.4). Litter cover has remained moderately high in all sampling periods. Relative litter cover was 42% in 1997, 50% in 2002, and 32% in 2007. Relative vegetation cover was 28% in 1997, 9% in 2002, and 37% in 2007. Relative bare ground cover was 18% in 1997, 26% in 2002 and 25% in 2007. The decrease in vegetation cover and increase in bare ground cover in 2002 correlated with below normal precipitation (Utah Climate Summaries 2007). In the past, the area was susceptible to sheet erosion and excessive soil movement, and active gullies were present to the north and south. The erosion condition was classified as slight in 2002 due to pedestal formation, gullies with light activity, and light transportation of litter and soil. In 2007, the erosion condition was classified as slight due to pedestal, gully, and rill formation, flow patterns, and the light transportation of soil and surface litter.

Browse

Rubber rabbitbrush (*Chrysothamnus* sp.) is the preferred browse species. The density of rabbitbrush was 932 plants/acre (2,302 plants/ha) in 1989 and 3,000 plants/acre (7,410 plants/ha) in 1997. In 2002 and 2007, rabbitbrush was split into two subspecies, white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), a white-stemmed more palatable form, and threadleaf rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *consimilis*), a green-stemmed less palatable form. Density of white rubber rabbitbrush was 1,640 plants/acre (4,051 plants/ha) in 2002 and 1,740 plants/acre (4,298 plants/ha) in 2007. The recruitment of young was high at 44%-46% of the population, and decadence was moderate at 15%-18%. Plants classified with poor vigor have been low at less than 10% of the population, and use has been mostly light-moderate. The density of threadleaf rubber rabbitbrush was 740 plants/acre (1,828 plants/ha) in 2002 and 240 plants/acre (593 plants/ha) in 2007. The recruitment of young was 17%-25% of the population, and decadence was low-moderate at 17%-19%. Browse use has been light-moderate. Other preferred species that occur in low densities include four-wing saltbush (*Atriplex canescens*), antelope bitterbrush (*Purshia tridentata)*, and true mountain mahogany (*Cercocarpus montanus*).

Even though the original chaining was done prior to 1960, the density of juniper and pinyon has been moderately low. Point-centered quarter data estimated juniper density at 76 trees/acre (188 trees/ha) in 1997. Following the lop and scatter treatment in 2002, tree density was too low to accurately sample. However, juniper density had increased to 37 trees/acre (91 trees/ha) in 2007. The average juniper trunk diameter was

6.7 inches (17.0 cm) in 1997 and 1.6 inches (4.1 cm) in 2007. Pinyon density was estimated at 26 trees/acre (64 trees/ha) in 1997, and 20 trees/acre (49 trees/ha) in 2007. The average diameter for pinyon was 4.8 inches (12.2 cm) in 1997 and 1.9 inches (4.8 cm) in 2007. The area to the east and west have large, mature pinyon and juniper trees that provide thermal and escape cover.

Herbaceous Understory

Perennial grasses and annual forbs dominated the herbaceous understory. The dominant grass is crested wheatgrass (*Agropyron cristatum*). It provided 6% of the total ground cover in 1997, 1% in 2002, and 10% cover in 2007. This species is often heavily grazed, but the decline in 2002 didn't appear to be from livestock use. In 2002, project personnel described crested wheatgrass as being 3 inches of stem with no leaves. The decline was probably due in part to the combination of drought and defoliation by grasshoppers. The dominant annual grass was cheatgrass (*Bromus tectorum*). It provided less than 1% cover in 1997 and 2002, increasing to 2% in 2007.

There are very few perennial forbs. Perennial forbs provided less than 1% of the total ground cover since 1997. Annual forbs are moderately abundant. The dominant forb was bur buttercup (*Ranunculus testiculatus*) an allelopathic annual (Buchanan et al. 1978). It provided 5% cover in 1997, 2% in 2002, and 7% in 2007. Most of the forbs are low growing and/or weedy increasers that provide very little forage or cover.

1997 TREND ASSESSMENT

The browse trend is slightly up. Rubber rabbitbrush density increased from 932 plants/acre (2,303 plants/ha) to 3,000 plants/acre (7,410 plants/ha), although this increase may be partly attributed to the increase in sample area in 1997. However, other parameters also indicate a slightly up trend. The recruitment of young remained high at 57% of the population and decadence remained low at 3%. Vigor remained excellent, with only 1% of the population showing poor vigor. Browse use increased from light to light-moderate. The grass trend is stable. The sum of nested frequency of perennial grasses changed little. The forb trend is down. The sum of nested frequency of perennial forbs decreased 39%. The Desirable Components Index (DCI) score was poor due to very poor browse cover, very little recruitment of young browse, fair perennial grass cover, little annual grass cover, and very little perennial forb cover.

winter range condition (DCI) - poor (17) Low potential scale
browse - slightly up (+1) grass - stable (0) forb - down (-2)

2002 TREND ASSESSMENT

The browse trend is stable. Rubber rabbitbrush was split into two subspecies, white and threadleaf. White rubber rabbitbrush was the most abundant preferred species. Its density was 1,640 plants/acre (4,051 plants/ha). The recruitment of young decreased slightly, but remained high at 44% of the population. Decadence increased to 18% of the population. Plants classified as having poor vigor comprised 5% of the population, and use was mostly light. The grass trend was slightly down. The sum of nested frequency of perennial grasses decreased 61%. Crested wheatgrass, the dominant perennial grass species, significantly declined in nested frequency. The nested frequency of cheatgrass also significantly decreased, and it continued to provided less than 1% total cover. The forb trend is slightly down. The number of perennial forb species sampled decreased from nine to five. The sum of nested frequency of perennial forbs decreased 51% and that of annual forbs decreased 45%. Bur buttercup cover decreased from 5% to 2%. The DCI score was very poor due to a decrease in perennial grass cover.

winter range condition (DCI) - very poor (3) Low potential scale
browse - stable (0) grass - slightly down (-1) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is stable. The density of white rubber rabbitbrush increased 6%. The recruitment of young

remained high at 46% of the population and decadent plants decreased to 15%. Plants showing poor vigor increased to 8% of the population. Browse use remained mostly light. The grass trend is stable. The sum of nested frequency of perennial grasses increased nearly three-fold, and average cover increased from 1% to 11%. Crested wheatgrass nested frequency significantly increased. The nested frequency of cheatgrass also increased significantly. Cheatgrass cover increased from almost 0% to 2%. The forb trend is down. The sum of nested frequency for perennial forbs decreased 31%. The sum of nested frequency for annual forbs increased three-fold. The nested frequency for bur buttercup increased two-fold. The DCI score improved to poor due to the increase in perennial grass cover.

winter range condition (DCI) - poor (23) Low potential scale
browse - stable (0) grass - stable (0) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 8

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{b}$278	$_{b}$262	$_{a}$103	$_{b}$267	5.89	.55	10.49
G	Bromus tectorum (a)	-	$_{b}$91	$_{a}$4	$_{c}$167	.57	.01	2.48
G	Elymus junceus	-	-	-	4	-	-	.30
G	Poa fendleriana	$_{a}$4	$_{a}$3	-	-	.01	-	-
G	Poa secunda	$_{a}$3	-	$_{a}$1	$_{a}$1	-	.00	.01
G	Sitanion hystrix	$_{a}$5	$_{a}$2	-	-	.03	-	-
Total for Annual Grasses		0	91	4	167	0.57	0.00	2.48
Total for Perennial Grasses		290	267	104	272	5.93	0.55	10.80
Total for Grasses		290	358	108	439	6.51	0.56	13.28
F	Alyssum alyssoides (a)	-	$_{a}$50	$_{a}$53	$_{b}$319	.22	.28	7.09
F	Antennaria rosea	-	$_{a}$1	$_{a}$2	-	.00	.01	-
F	Astragalus utahensis	$_{ab}$10	$_{b}$18	-	$_{a}$3	.28	-	.01
F	Castilleja linariaefolia	-	2	-	-	.03	-	-
F	Chorispora tenella (a)	-	-	-	1	-	-	.03
F	Collinsia parviflora (a)	-	$_{a}$11	-	$_{a}$18	.02	-	.08
F	Cryptantha sp.	$_{b}$18	$_{ab}$13	$_{a}$6	$_{a}$1	.14	.04	.03
F	Descurainia pinnata (a)	-	$_{a}$27	$_{a}$25	$_{b}$50	.09	.28	.46
F	Draba sp. (a)	-	-	-	3	-	-	.00
F	Erodium cicutarium (a)	-	9	-	-	.02	-	-
F	Gilia sp. (a)	-	-	-	10	-	-	.02
F	Haplopappus acaulis	2	-	-	-	-	-	-
F	Lappula occidentalis (a)	-	-	-	4	-	-	.03
F	Lactuca serriola	$_{b}$20	$_{ab}$7	-	$_{a}$1	.04	-	.00
F	Leucelene ericoides	-	-	3	-	-	.00	-
F	Lithospermum sp.	$_{a}$7	$_{a}$3	$_{a}$4	-	.15	.05	-

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Machaeranthera canescens	$_{b}$13	$_{a}$3	-	$_{ab}$4	.00	-	.06
F	Microsteris gracilis (a)	-	$_{b}$23	-	$_{a}$3	.10	-	.01
F	Phlox longifolia	-	-	-	2	-	-	.00
F	Ranunculus testiculatus (a)	-	$_{b}$299	$_{a}$151	$_{b}$312	4.55	2.01	7.26
F	Senecio multilobatus	2	-	-	-	-	-	-
F	Streptanthus cordatus	$_{a}$14	$_{a}$5	$_{a}$11	$_{a}$5	.01	.03	.06
F	Tragopogon dubius	$_{a}$1	-	-	$_{a}$2	-	-	.03
F	Unknown forb-perennial	-	1	-	-	.01	-	-
Total for Annual Forbs		0	419	229	720	5.01	2.57	15.02
Total for Perennial Forbs		87	53	26	18	0.69	0.14	0.20
Total for Forbs		87	472	255	738	5.71	2.72	15.23

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

BROWSE TRENDS --
Management unit 16C, Study no: 8

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Atriplex canescens	0	0	1	-	-	.03
B	Chrysothamnus nauseosus albicaulis	51	35	45	3.30	1.14	2.35
B	Chrysothamnus nauseosus consimilis	0	18	11	-	1.49	1.03
B	Chrysothamnus viscidiflorus viscidiflorus	6	0	0	.78	-	-
B	Gutierrezia sarothrae	77	57	61	4.39	1.24	3.65
B	Juniperus osteosperma	11	1	1	3.08	.03	.30
B	Pinus edulis	6	2	1	1.74	.38	.63
B	Purshia tridentata	1	1	0	.15	.15	.15
B	Quercus gambelii	1	1	0	-	.03	.03
Total for Browse		153	115	120	13.46	4.46	8.18

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 8

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	-	.28
Chrysothamnus nauseosus albicaulis	1.45	2.73
Chrysothamnus nauseosus consimilis	.80	1.73
Gutierrezia sarothrae	1.06	4.06
Juniperus osteosperma	.21	.13
Pinus edulis	.63	.58

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 8

Species	Average leader growth (in)	
	'02	'07
Atriplex canescens	6.7	2.8

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 8

Species	Trees per Acre		
	'97	'02	'07
Juniperus osteosperma	76	-	37
Pinus edulis	26	-	20

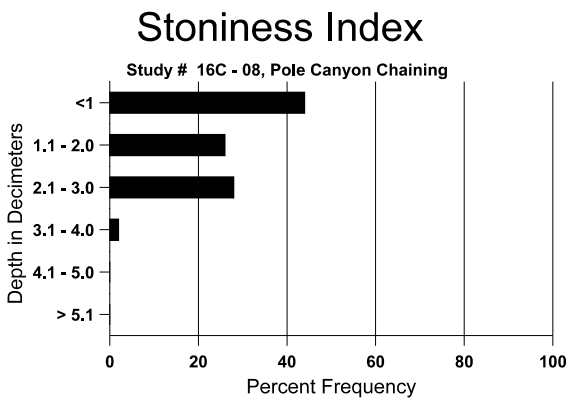
Average diameter (in)		
'97	'02	'07
6.7	-	1.6
4.8	-	1.9

BASIC COVER --
Management unit 16C, Study no: 8

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	4.00	30.03	9.11	41.15
Rock	5.75	4.93	7.54	5.57
Pavement	19.25	6.02	7.19	2.04
Litter	44.25	45.14	53.75	35.15
Cryptogams	0	1.67	1.52	.01
Bare Ground	26.75	19.13	27.63	27.36

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 08, Pole Canyon Chaining

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
10.3	61.4 (11.7)	7.4	48.7	27.1	24.2	5.9	11.25	195.2	.5



PELLET GROUP DATA --
Management unit 16C, Study no: 8

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	1	-
Rabbit	19	28	69
Elk	3	-	3
Deer	53	48	34
Cattle	5	2	12

Days use per acre (ha)	
'02	'07
1 (3)	-
-	-
-	6 (15)
99 (245)	50 (122)
2 (5)	23 (57)

BROWSE CHARACTERISTICS --
Management unit 16C, Study no: 8

		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												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	13/29

		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)
Atriplex canescens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	50/73
02	**0**	-	-	-	-	-	0	0	-	-	0	43/44
07	**20**	-	20	-	-	-	0	0	-	-	0	56/90
Cercocarpus montanus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	25/32
02	**0**	-	-	-	-	-	0	0	-	-	0	25/31
07	**0**	-	-	-	-	-	0	0	-	-	0	28/37
Chrysothamnus nauseosus albicaulis												
89	**932**	133	466	433	33	-	4	4	4	-	0	28/25
97	**3000**	40	1700	1220	80	20	22	.66	3	-	1	29/30
02	**1640**	20	720	620	300	40	16	10	18	5	5	20/23
07	**1740**	40	800	680	260	20	16	1	15	7	8	24/30
Chrysothamnus nauseosus consimilis												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**740**	-	40	560	140	80	30	0	19	-	0	21/27
07	**240**	-	60	140	40	-	0	0	17	8	17	30/37
Chrysothamnus viscidiflorus viscidiflorus												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**200**	-	20	160	20	-	10	0	10	-	0	32/38
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	11/23
Ephedra viridis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	11/11
Gutierrezia sarothrae												
89	**8733**	25966	1333	7300	100	-	0	0	1	-	0	10/9
97	**14940**	120	2460	12420	60	120	.13	0	0	-	0	10/9
02	**3740**	-	140	2920	680	3140	0	0	18	7	9	7/8
07	**4780**	2060	20	4680	80	200	0	0	2	.41	.83	10/13

		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)
Juniperus osteosperma												
89	**133**	33	100	33	-	-	0	0	0	-	0	91/71
97	**380**	-	240	140	-	80	0	0	0	-	0	-/-
02	**20**	-	-	20	-	100	0	0	0	-	0	-/-
07	**20**	-	-	-	20	20	0	0	100	100	100	-/-
Pinus edulis												
89	**33**	-	-	33	-	-	0	0	-	-	0	71/79
97	**120**	-	100	20	-	-	0	0	-	-	0	-/-
02	**40**	-	40	-	-	-	0	0	-	-	50	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	-	20	-	0	100	100	-	0	10/17
02	**20**	-	-	-	20	-	0	100	100	100	100	8/31
07	**0**	-	-	-	-	-	0	0	0	-	0	6/22
Quercus gambelii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	100	0	-	-	0	85/17
02	**20**	-	-	20	-	-	0	0	-	-	0	100/22
07	**0**	-	-	-	-	-	0	0	-	-	0	32/29

Trend Study 16C-9-07

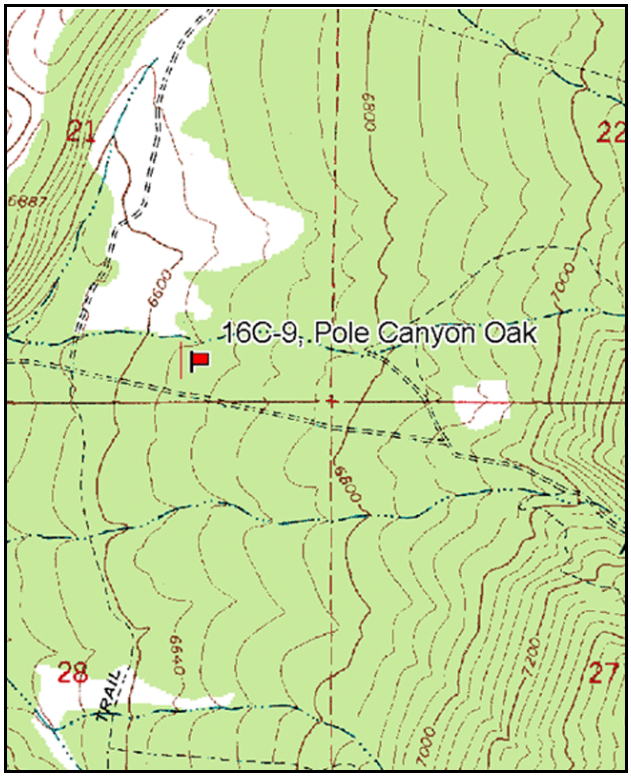
Study site name: Pole Canyon Oak . Vegetation type: Mountain Brush .

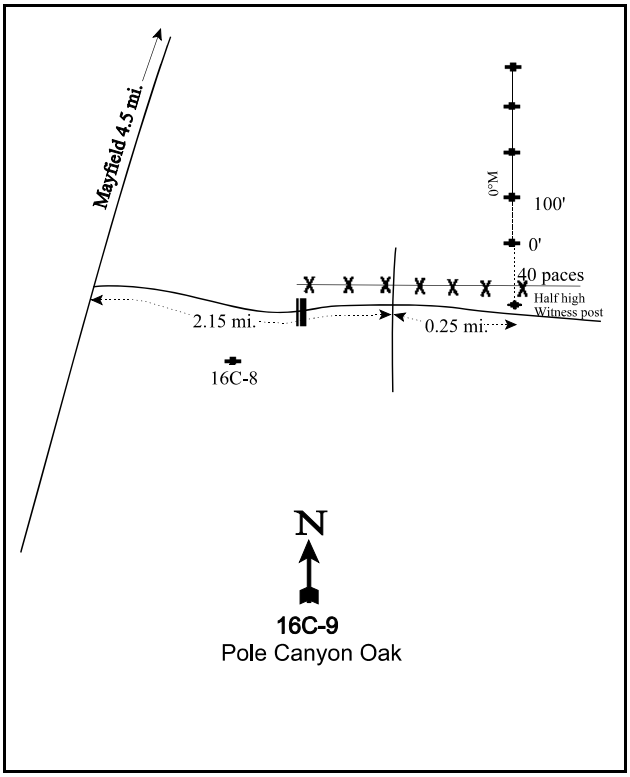
Compass bearing: frequency baseline 0 degrees magnetic.

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

LOCATION DESCRIPTION

Go south from Main street in Mayfield through Arapien Valley for 4.5 miles to the Pole Canyon Road. Turn east and go 2.15 miles, passing study number 16C-8 and crossing a cattle guard to a 4-way intersection (South Hollow Road). From the intersection, go east (straight) for another 0.25 miles to a half high witness post on the north side of the road. The 0-foot baseline stake (marked by browse tag #9042) is 40 paces due north.





Map Name: Mayfield

Diagrammatic Sketch

Township 20S , Range 2E , Section 21

GPS: NAD 83, UTM 12S 440172 E 4322328 N

DISCUSSION

Pole Canyon Oak - Trend Study No. 16C-9

Study Information

This study is located 4.5 miles (7.2 km) south of Mayfield, on the south end of South Hollow, in Pole Canyon on Utah Division of Wildlife Resources property [elevation: 6,670 feet (2,033 m), slope: 8%, aspect: west]. It samples a mixed mountain brush community dominated by Gambel oak (*Quercus gambelii*), pinyon pine (*Pinus edulis*), and Utah juniper (*Juniperus osteosperma*). Some of the surrounding area was experimentally treated with herbicide in strips to remove the dense overstory of oak. However, this study does not lie within a treated area. It receives moderate use by deer. From the pellet group transect, deer use was estimated at 88 days use/acre (217 ddu/ha) in 2002 and 85 days use/acre (210 ddu/ha) in 2007. Elk was estimated at 9 days use/acre (22 edu/ha) in 2007. Sheep was estimated at 1 day use/acre in 2002. Cattle use was estimated at 1 day use/acre (2 cdu/ha) in 2007.

Soil

The soil is in the Fontreen series, which consist of very deep, well-drained, moderately-rapidly permeable soils that formed in alluvium and colluvium from limestone, sandstone, chert, and shale. Fontreen soils are on alluvial fans, hillslopes and mountain slopes (USDA-NRCS 2007). The soil had a loam texture and a neutral reactivity (pH of 7.2). Since 1997, the combined relative cover of vegetation and litter was high at 79%-82%, and the relative bare ground cover was 12%-15%. Most of the areas of bare soil are in the interspaces between trees and shrubs. This is where the majority of the erosion occurs. In 2002 and 2007, the erosion condition was classified as slight due to the formation of rills, pedestalling, flow patterns, and light translocation of litter, rock, and soil.

Browse

The dominant overstory is oakbrush in association with a considerable stand of juniper and pinyon. The canopy cover of oak increased from 12% in 2002 to 20% in 2007. The density of oak was estimated at 3,265 stems/acre (8,065 stems/ha) in 1989, 4,980 stems/acre (12,300 stems/ha) in 1997, 6,260 stems/acre (15,462 stems/ha) in 2002, and 5,860 stems/acre (14,474 stems/ha) in 2007. Young oak plants were abundant in all sample years, and decadent plants have comprised 11% or less of the population. Browse use has been light-moderate.

The canopy cover of juniper was 17% in 2002 and 2007. The point-centered quarter data estimated juniper density at 141 trees/acre (348 trees/ha) in 1997, 179 trees/acre (442 trees/ha) in 2002, and 174 trees/acre (430 trees/ha) in 2007. The average juniper trunk diameter was estimated at 4 inches (10.2 cm) in 1997, 5 inches (12.7 cm) in 2002, and 6.2 inches (15.7 cm) in 2007. The canopy cover of pinyon increased from 9% in 2002 to 13% in 2007. Pinyon density estimates were 89 trees/acre (220 trees/ha) in 1997, 51 trees/acre (126 trees/ha) in 2002, and 77 trees/acre (190 trees/ha) in 2007. The average pinyon trunk diameter was 9.4 inches (23.9 cm) in 1997, 6.2 inches (15.7 cm) in 2002, and 6.8 inches (17.3 cm) in 2007.

Several preferred browse were sampled in lower densities. The dominant preferred browse species was mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Sagebrush comprised 3% of the canopy cover in 2002 and 2% in 2007. Sagebrush density steadily declined from 1,233 plants/acre (3,046 plants/ha) in 1989, to 400 plants/acre (988 plants/ha) in 2007. Young plants were only sampled in 1997, comprising 4% of the population. Decadence has been high, ranging from 42% of the population to 97%. Plants classified as having poor vigor have ranged from 19% of the population to 73%. Browse use has been light-heavy. Drought and competition with increasing tree canopy may be negatively impacting sagebrush. Average annual leader growth on mountain big sagebrush was 1.8 inches (4.5 cm) in 2002 and 3 inches (7.7 cm) in 2007.

Canopy cover of antelope bitterbrush decreased from 2% in 2002 to 1% in 2007. Bitterbrush density was 233 plants/acre (576 plants/ha) in 1989, 540 plants/acre (1,334 plants/ha) in 1997, 520 plants/acre (1,284 plants/ha) in 2002, and 260 plants/acre (642 plants/ha) in 2007. Young plants comprised 14% of the population in 1989, 15% in 1997, and 0% in 2002 and 2007. There has been no decadence or poor vigor in the population. Browse use has been mostly moderate-heavy. Average annual leader growth on antelope bitterbrush was 1.7 inches (4.2 cm) in 2002 and 4.8 inches (12.2 cm) in 2007.

Canopy cover of true mountain mahogany (*Cercocarpus montanus*) was 2% in 2002 and 2007. Mahogany density was estimated at 66 plants/acre (163 plants/ha) in 1989, 140 plants/acre (346 plants/ha) in 1997 and 2007, and 180 plants/acre (445 plants/ha) in 2002. Young plants were only sampled in 2007, accounting for 14% of the population, and decadent plants were only sampled in 1989, comprising 50% of the population. Plant vigor has been excellent, and browse use has been mostly moderate-heavy. Average annual leader growth on true mountain mahogany was 1.6 inches (4.1 cm) in 2002 and 5.5 inches (13.9 cm) in 2007. Other browse sampled include Utah serviceberry (*Amelanchier utahensis*) and broom snakeweed (*Gutierrezia sarothrae*).

Herbaceous Understory

The herbaceous understory is sparse. Heavy competition with woody plants limits sunlight and moisture for understory species. Since 1997, herbaceous species provided only 7%-17% of the total vegetation cover. Although total cover was low, species diversity was moderately high with 36 species of grasses and forbs being sampled since 1989. The diversity of species indicates that with less canopy from pinyon, juniper, and oak, there may be potential for a greater productive understory. Mutton bluegrass (*Poa fendleriana*) was the dominant grass in 1997 and 2002, providing 2% of the total ground cover. In 2007, bluebunch wheatgrass (*Agropyron spicatum*) was dominant, providing 1% cover. Cheatgrass (*Bromus tectorum*) was also measured, but provided less than 1% cover in all samples.

Though forb diversity has been moderate, forbs are sparse, and no single species has been dominant. The herbaceous plants that have been present were sampled mainly under the protection of woody plants, which leaves the large shrub interspaces devoid of vegetation. A treatment to decrease woody overstory cover and the subsequent seeding of herbaceous plants may be considered to improve the vegetative community.

1997 TREND ASSESSMENT

The browse trend is slightly up. Mountain big sagebrush density decreased 22%. The recruitment of young increased from 0% to 4% of the population. Decadent plants decreased from 97% to 42% of the population. Plants classified as having poor vigor decreased from 73% to 19% of the population. Browse use decreased from heavy to mostly light. Antelope bitterbrush density increased more than two-fold. The recruitment of young increased from 14% to 15% of the population. There were no decadent plants. Plant vigor remained excellent, and browse use decreased from heavy to mostly moderate. True mountain mahogany density increased more than two-fold. There was no recruitment of young, and decadence decreased to 0% of the population. Plant vigor remained excellent, and browse use decreased from heavy to moderate-heavy. Gamble oak density increased 53%. The recruitment of young decreased from 72% of the population to 37%. Decadence decreased from 11% to 5%, and vigor remained good on most plants. Individuals that were not out of reach showed light-moderate browse use. The changes in browse densities were due in part to the larger sampling area. The grass trend is down. The sum of nested frequency for perennial grass decreased 39%. Mutton bluegrass, Indian ricegrass, and Sandberg bluegrass (*Poa secunda*) decreased significantly in nested frequency. The forb trend is slightly up. The sum of nested frequency for perennial forbs increased 17%. The number of perennial forb species sampled increased from 12 to 18. There was a significant decrease in the nested frequency of desert parsley (*Lomatium* sp.). The Desirable Components Index (DCI) score was fair due to good preferred browse cover with low decadence and good recruitment, very little perennial and annual grass cover, and very little perennial forb cover.

winter range condition (DCI) - fair (59) Mid-level potential scale
browse - slightly up (+1) grass - down (-2) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is slightly down. The density of mountain big sagebrush decreased 19%. There was no recruitment of young into the population, and decadence increased to 72% of the population. Plants classified as having poor vigor increased to 31% of the population. The density of dead plants increased from 380 plants/acre (939 plants/ha) to 580 plants/acre (1,433 plants/ha). Browse use was light-heavy. The density of antelope bitterbrush decreased 4%. There was no recruitment of young, and vigor remained excellent. Browse use was mostly heavy. The density of true mountain mahogany increased 29%. There were no young or decedent plants in the population, and vigor remained excellent. Browse use was mostly heavy. Gamble oak cover decreased from 16% to 8%, and density increased 26%. The recruitment of young increased to 42%, and decadence decreased to 3% of the population. Plants with poor vigor increased to 24% of the population, and browse use was light. The grass trend is slightly down. The sum of nested frequency for perennial grass decreased 17%. There was a significant decrease in the nested frequency of needle-and-thread grass (*Stipa comata)*, however, the nested frequency for cheatgrass decreased 50%. The forb trend is down. The sum of nested frequency of perennial forbs decreased 61%, and the sum of nested frequency for annual forbs changed little. The number of perennial species sampled decreased from 18 to seven. The DCI score was poor due to a decrease in browse cover and the recruitment of young, an increase in browse decadence.

winter range condition (DCI) - poor (43) Mid-level potential scale
browse - slightly down (-1) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of mountain big sagebrush decreased 49%. There were no young, but decadence decreased to 65% of the population. Plants showing poor vigor increased to 65% of the population. Browse use was mostly light-moderate. The density of antelope bitterbrush decreased 50%. There were no young or decadent plants in the population. Plant vigor was excellent, and browse use was mostly heavy. The density of true mountain mahogany decreased 22%. The recruitment of young increased to 14% of the population. There was no decadence, and plant vigor was excellent. Browse use was light-heavy. Oak cover increased slightly to 10%, however, density decreased slightly 6%. The recruitment of young decreased to 23%, and decadence increased to 11% of the population. Plants with poor vigor decreased to 4% of the population and browse use remained mostly light. The grass trend is stable. The sum of nested frequency for perennial grass changed little. The nested frequency for mutton bluegrass significantly decreased, while the nested frequency for bluebunch wheatgrass significantly increased. The nested frequency for cheatgrass significantly increased, although cover remained less than 1%. The forb trend is slightly down. The sum of nested frequency for perennial forbs was stable. However, the nested frequency for bur buttercup significantly increased. This allelopathic annual may be limiting the establishment of other species (Buchanan et al. 1978). The DCI score remained poor.

winter range condition (DCI) - poor (43) Mid-level potential scale
browse - down (-2) grass - stable (0) forb - slightly down (-1)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 9

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{a}$9	$_{a}$14	$_{a}$7	$_{b}$55	.08	.08	1.28
G	Bromus tectorum (a)	-	$_{b}$40	$_{a}$20	$_{b}$48	.82	.03	.62
G	Carex sp.	-	-	-	4	-	-	.09
G	Oryzopsis hymenoides	$_{b}$42	$_{a}$15	$_{a}$11	$_{a}$7	.11	.18	.15
G	Poa fendleriana	$_{c}$143	$_{b}$75	$_{b}$84	$_{a}$33	2.24	1.56	.56
G	Poa pratensis	-	11	-	-	.07	-	-
G	Poa secunda	$_{b}$21	$_{a}$5	$_{ab}$8	$_{a}$1	.06	.02	.03
G	Sitanion hystrix	-	-	$_{a}$1	$_{b}$7	-	.00	.08
G	Stipa comata	$_{ab}$6	$_{b}$15	$_{a}$1	$_{ab}$4	.11	.00	.18
Total for Annual Grasses		0	40	20	48	0.81	0.03	0.62
Total for Perennial Grasses		221	135	112	111	2.69	1.86	2.39
Total for Grasses		221	175	132	159	3.51	1.89	3.01
F	Agoseris glauca	$_{a}$1	$_{a}$3	$_{a}$3	-	.03	.00	-
F	Arabis sp.	-	5	-	-	.01	-	-
F	Astragalus consobrinus	2	-	-	-	-	-	-
F	Astragalus sp.	$_{a}$2	$_{a}$-	-	-	.00	-	-
F	Balsamorhiza sagittata	3	-	-	-	-	-	-
F	Castilleja linariaefolia	$_{a}$1	$_{a}$2	$_{a}$3	-	.00	.00	-
F	Chaenactis douglasii	$_{a}$5	$_{a}$8	-	$_{a}$2	.02	-	.01
F	Comandra pallida	-	33	-	-	.10	-	-
F	Collinsia parviflora (a)	-	$_{a}$23	$_{a}$33	$_{b}$144	.05	.07	.56
F	Crepis acuminata	-	2	-	-	.03	-	-
F	Cymopterus sp.	-	$_{a}$19	$_{a}$26	$_{a}$10	.08	.07	.10
F	Descurainia pinnata (a)	-	-	-	1	-	-	.00
F	Erigeron divergens	-	$_{a}$2	$_{a}$3	-	.00	.03	-
F	Eriogonum umbellatum	$_{a}$7	$_{a}$9	$_{a}$1	$_{a}$4	.07	.00	.18
F	Lactuca serriola	-	1	-	-	.00	-	-
F	Lesquerella sp.	-	$_{a}$7	-	$_{a}$6	.04	-	.01
F	Lomatium sp.	$_{b}$66	$_{a}$3	-	-	.01	-	-
F	Machaeranthera spp	-	3	-	-	.00	-	-
F	Microsteris gracilis (a)	-	$_{a}$15	-	$_{b}$38	.03	-	.11
F	Penstemon sp.	-	3	-	-	.03	-	-
F	Petradoria pumila	-	-	$_{a}$2	$_{a}$2	-	.18	.06
F	Phlox longifolia	$_{a}$12	$_{a}$14	$_{a}$11	$_{a}$22	.11	.02	.12
F	Ranunculus testiculatus (a)	-	$_{a}$10	$_{a}$16	$_{b}$66	.02	.03	.51

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Senecio multilobatus	$_a$5	$_a$7	-	$_a$1	.06	-	.03
F	Taraxacum officinale	-	1	-	-	.01	-	-
F	Tragopogon dubius	$_a$1	-	-	$_a$2	-	-	.03
F	Zigadenus paniculatus	$_a$1	$_a$2	-	-	.03	-	-
Total for Annual Forbs		0	48	49	249	0.11	0.10	1.19
Total for Perennial Forbs		106	124	49	49	0.67	0.31	0.54
Total for Forbs		106	172	98	298	0.78	0.43	1.74

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

BROWSE TRENDS --
Management unit 16C, Study no: 9

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	5	2	2	.21	.03	.00
B	Artemisia tridentata vaseyana	35	28	18	2.45	3.32	.93
B	Cercocarpus montanus	7	8	7	1.54	.78	1.45
B	Gutierrezia sarothrae	7	6	4	.04	.18	-
B	Juniperus osteosperma	8	6	6	6.83	6.23	3.54
B	Opuntia sp.	1	3	0	-	.03	.03
B	Pinus edulis	5	8	5	7.35	6.19	3.69
B	Purshia tridentata	11	14	10	2.77	2.57	2.45
B	Quercus gambelii	46	54	53	16.01	8.21	10.38
Total for Browse		125	129	105	37.22	27.57	22.48

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 9

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	.18	.63
Artemisia tridentata vaseyana	3.18	2.13
Cercocarpus montanus	1.79	2.11
Gutierrezia sarothrae	.23	.15
Juniperus osteosperma	16.58	17.01
Pinus edulis	8.58	12.85
Purshia tridentata	2.03	1.48
Quercus gambelii	12.08	20.38

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 9

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.8	3.0
Cercocarpus montanus	1.6	5.5
Purshia tridentata	1.7	4.8

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 9

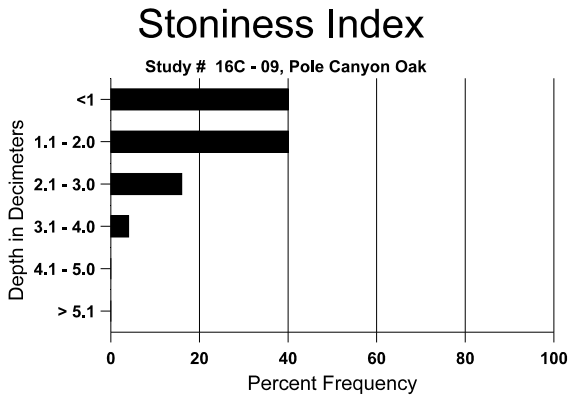
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Juniperus osteosperma	179	174	5.1	6.2
Pinus edulis	51	77	6.2	6.8

BASIC COVER --
Management unit 16C, Study no: 9

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	5.00	40.13	29.32	30.44
Rock	2.75	2.16	2.30	2.01
Pavement	13.75	5.42	5.69	5.39
Litter	67.00	59.63	66.83	57.90
Cryptogams	.50	.28	.21	.10
Bare Ground	11.00	14.36	17.06	16.36

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 09, Pole Canyon Oak

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
9.1	54.4 (11.3)	7.2	46.7	28.7	24.6	3.5	9.9	108.8	.7



PELLET GROUP DATA --
Management unit 16C, Study no: 9

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	12	10	34
Elk	3	1	10
Deer	28	26	30
Cattle	1	1	-

Days use per acre (ha)	
'02	'07
-	-
-	9 (22)
88 (217)	85 (210)
-	1 (2)

BROWSE CHARACTERISTICS --
Management unit 16C, Study no: 9

		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												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**100**	20	20	80	-	-	0	0	-	-	0	43/23
02	**40**	-	-	40	-	-	0	0	-	-	0	27/16
07	**60**	-	40	20	-	-	67	0	-	-	33	46/79
Artemisia tridentata vaseyana												
89	**1233**	-	-	33	1200	-	0	100	97	73	73	19/28
97	**960**	-	40	520	400	380	6	0	42	19	19	29/33
02	**780**	-	-	220	560	580	10	23	72	31	31	27/32
07	**400**	-	-	140	260	300	35	10	65	50	65	32/38

		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)
Cercocarpus montanus												
89	**66**	-	-	33	33	-	0	100	50	-	0	60/55
97	**140**	-	-	140	-	-	43	29	0	-	0	34/40
02	**180**	-	-	180	-	-	11	78	0	-	0	34/37
07	**140**	-	20	120	-	-	0	57	0	-	0	33/39
Chrysothamnus depressus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	9/12
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Chrysothamnus viscidiflorus												
89	**233**	-	-	100	133	-	0	100	57	43	43	3/2
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	-/-
Gutierrezia sarothrae												
89	**1165**	-	33	1066	66	-	0	0	6	3	3	9/9
97	**240**	-	-	240	-	-	0	0	0	-	0	9/7
02	**220**	-	-	220	-	-	0	0	0	-	0	8/9
07	**140**	-	-	140	-	-	0	0	0	-	0	9/9
Juniperus osteosperma												
89	**133**	-	133	-	-	-	0	0	-	-	25	-/-
97	**160**	-	60	100	-	-	0	0	-	-	0	-/-
02	**120**	-	40	80	-	40	17	0	-	-	17	-/-
07	**120**	20	20	100	-	-	0	0	-	-	0	-/-
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	-	0	0	-	-	0	7/12
02	**100**	20	60	40	-	-	0	0	-	-	0	6/4
07	**0**	-	-	-	-	-	0	0	-	-	0	3/14
Peraphyllum ramosissimum												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	17/12
07	**0**	-	-	-	-	-	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)
Pinus edulis												
89	**66**	66	33	33	-	-	0	0	-	-	0	177/171
97	**120**	60	60	60	-	-	0	0	-	-	0	-/-
02	**180**	40	60	120	-	-	0	0	-	-	0	-/-
07	**120**	80	20	100	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**233**	-	33	200	-	-	0	100	-	-	0	13/18
97	**540**	-	80	460	-	-	56	11	-	-	0	13/49
02	**520**	-	-	520	-	-	23	77	-	-	0	13/38
07	**260**	-	-	260	-	-	8	77	-	-	0	14/39
Quercus gambelii												
89	**3265**	1633	2366	533	366	-	16	0	11	-	0	39/30
97	**4980**	300	1840	2880	260	980	18	.40	5	2	2	55/44
02	**6260**	60	2600	3480	180	660	3	4	3	2	24	42/22
07	**5860**	840	1360	3860	640	1480	13	.34	11	2	4	34/26
Tetradymia canescens												
89	**33**	-	33	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16C-11-07

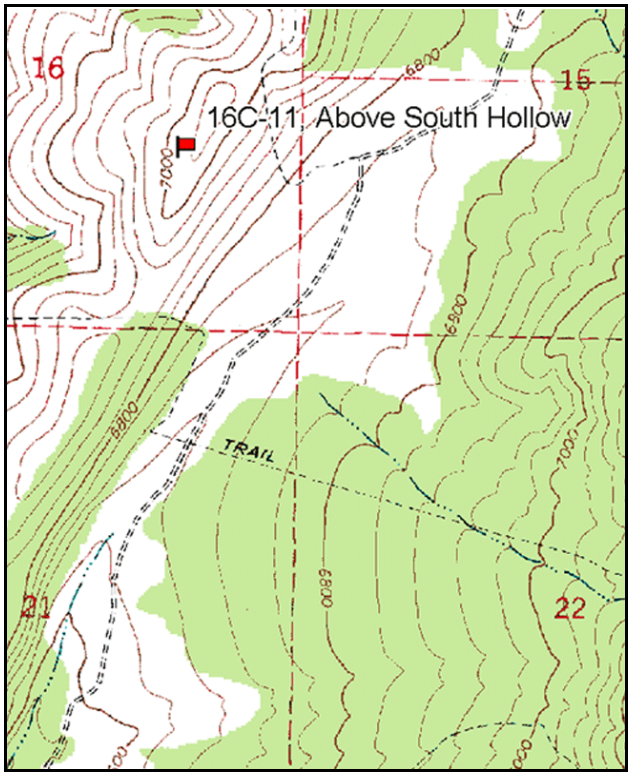
Study site name: Above South Hollow . Vegetation type: Chained, Seeded P-J .

Compass bearing: frequency baseline 255 degrees magnetic.

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

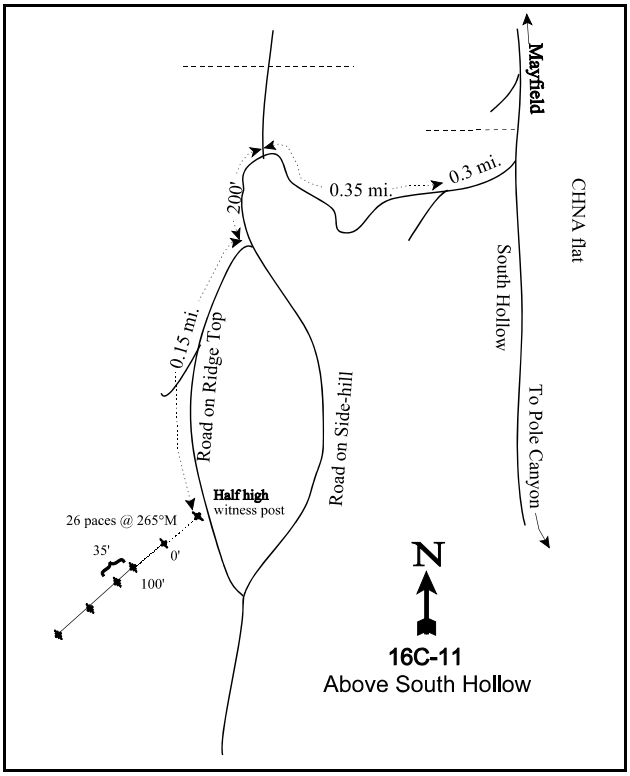
LOCATION DESCRIPTION

From the Mayfield post office, go 1.75 miles up the Twelve Mile Canyon Road. Take the right hand fork south down South Hollow 3 miles to a large rabbitbrush flat. Take the fork past the fence west for 0.3 miles to another fork. Take the right fork up a steep dugway for 0.35 miles to a fence line where the road forks again. Take the left fork south for 200 feet to another fork. Take the right fork up a very steep road for 0.15 miles to a half high witness post on the west side of the road. From here, walk 26 paces at 265 degrees magnetic to the 0-foot baseline stake.



Map Name: Mayfield

Township 20S , Range 2E , Section 16



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 440283 E 4324415 N

DISCUSSION

Above South Hollow - Trend Study No. 16C-11

Study Information

This study samples a pre-1960 chaining on the upper slope of the Mayfield Face west of South Hollow [elevation: 7,000 feet (2,134 m), slope: 20%-25%, aspect: west]. Utah juniper (*Juniperus osteosperma*) and pinyon pine (*Pinus edulis*) trees have re-established, and the populations of both contain large, mature trees. Seeded grasses are still present. From the pellet group transect, deer use was estimated at 60 days use/acre (149 ddu/ha) in 2002 and 55 days use/acre (136 ddu/ha) in 2007. Elk use was estimated at 8 days use/acre (20 edu/ha) in 2002 and 21 days use/acre (51 edu/ha) in 2007. Cattle use was estimated at 11 days use/acre (27 cdu/ha) in 2002 and 3 days use/acre (7 cdu/ha) in 2007. There is a tall fence that encloses a 100 square foot (9.3 sq. m) area at the western end of the transect. Another chaining treatment is planned for the fall of 2008, pending funding.

Soil

The soil is in the Fontreen series which consists of very deep, well-drained, moderately rapidly permeable soils that formed in alluvium and colluvium from limestone, sandstone, chert, and shale. Fontreen soils are on alluvial fans, hillslopes and mountain slopes (USDA-NRCS 2007). This soil is 10-20 inches (25-51 cm) deep over bedrock and rock fragments are normally present up to 50% in the surface layer. The soil has a clay loam texture and a neutral reactivity (pH of 7.1). Combined relative cover of rock and pavement was estimated at 11%-24% since 1997. With drought conditions in 2002, more rock, pavement, and bare ground was exposed as perennial grass cover decreased. Since 1997, relative bare ground cover was 9%-14%, and combined relative cover of vegetation and litter was 62%-79%. The erosion condition was classified as stable in 2002. In 2007, the erosion condition was classified as slight due to pedestal formation, flow patterns, and light translocation of litter, rock, and soil.

Browse

There are very few preferred browse species. True mountain mahogany (*Cercocarpus montanus*) and antelope bitterbrush (*Purshia tridentata*) have been the dominant preferred browse species. The canopy cover of mahogany was less than 1% in 2002 and had slightly increased to 1% in 2007. Mahogany density was estimated at 33 plants/acre (82 plants/ha) in 1989, 100 plants/acre (247 plants/ha) in 1997, 120 plants/acre (296 plants/ha) in 2002, and 40 plants/acre (99 plants/ha) in 2007. Young plants were only sampled in 1997, comprising 20% of the population. Decadence has fluctuated widely, and accounted for 100% of the population in 1989, 20% in 1997, 83% in 2002, and 0% in 2007. In 1989, all of the sampled plants had poor vigor, and in 2002, 67% of the plants had poor vigor. In both 1997 and 2007, all of the plants had good vigor. The average annual leader growth was 2.0 inches (5.1 cm) in 2002 and 5.8 inches (14.8 cm) in 2007. Browse use has been moderate-heavy. Antelope bitterbrush was first sampled in 1997 at a density of 60 plants/acre (148 plants/ha) and increased to 80 plants/acre (198 plants/ha) in 2002 and 2007. Bitterbrush canopy cover was 1% in both 2002 and 2007. The population was mostly mature with little decadence. Vigor was good on all plants in 1997 and 2007, but 25% of the population displayed poor vigor in 2002. The average annual leader growth was 2.9 inches (7.4 cm) in 2002 and 6.5 inches (16.5 cm) in 2007. Browse use has been heavy. The canopy cover of Gambel oak (*Quercus gambelii*) increased slightly from 1% in 2002 to 2% in 2007. Gambel oak had an estimated density 2,598 stems/acre (6,417 stems/ha) in 1989, of 280 stems/acre (692 stems/ha) in 1997, 760 stems/acre (1,878 stems/ha) in 2002, and 360 stems/acre (890 stems/ha) in 2007. The recruitment of young plants was estimated at 64% of the population in 1989, 0% in 1997, 24% in 2002, and 22% in 2007. The oak population shows low decadence and light-moderate browse use. Vigor has been excellent, except in 2007 when 50% of the plants displayed poor vigor.

The pinyon-juniper overstory that existed prior to treatment has become dominant. Juniper canopy cover decreased from 19% in 2002 to 16% in 2007. The point-centered quarter data estimate of juniper density was

90 trees/acre (222 trees/ha) in 2002 and 2007. The average trunk diameter for juniper was estimated at 7 inches (17.9 cm) in 2002 and 7.3 inches (18.5 cm) in 2007. Canopy cover of pinyon pine increased from 8% in 2002 to 11% in 2007. Pinyon was estimated at 67 trees/acre (165 trees/ha) in 2002 and 75 trees/acre (185 trees/ha) in 2007. The average pinyon trunk diameter was 5.5 inches (14 cm) in 2002 and 6.2 inches (15.7 cm) in 2007. If the combined pinyon-juniper overstory cover increases, it is expected that the browse understory will decrease (Taush and West. 1994). The pinyon-juniper overstory may need to be retreated to maintain a healthy understory.

Herbaceous Understory

The understory is fairly poor for a chained and seeded site. Perennial grasses are moderately abundant. Grass production was high in 1997, providing 15% total ground cover. In 2002, due in part to spring drought conditions (Utah Climate Summaries 2007), grass cover decreased considerably, providing only 7% of the total ground cover. In 2007, grass cover increased, providing 13% of the total ground cover. Smooth brome (*Bromus inermis*) is the dominant seeded species, providing 11% cover in 1997, 6% cover in 2002, and 10% cover in 2007. Crested wheatgrass (*Agropyron cristatum*) was also moderately abundant, providing 4% cover in 1997, 1% cover in 2002, and 2% cover in 2007. Eight other grass species have also been measured, but are not abundant. There are very few forbs. Forbs provided 1% or less of the total ground cover in all samples. Field bindweed (*Convolvulus arvensis*), a noxious weed, was sampled in one quadrat in 1989.

1997 TREND ASSESSMENT

The browse trend is slightly up. The density of true mountain mahogany increased three-fold. No young plants were sampled, but decadence decreased from 100% of the population to 20%. Plant vigor was excellent, and browse use decreased from heavy to light-moderate. Antelope bitterbrush was measured for the first time. There were no young or decadent plants in the population. Plant vigor was excellent, and browse use was heavy. Gamble oak density decreased 89%. Young plants decreased from 64% of the population to 0%, and decadence decreased from 3% to 0%. Plant vigor was excellent, and browse use was mostly light. The change in browse density was due mostly to the increased sample area. The grass trend is stable. The sum of nested frequency for perennial grass changed little. Mutton bluegrass (*Poa fendleriana*) and sedge (*Carex* sp.) decreased significantly in nested frequency. No annual grasses were measured. The forb trend is slightly down. The sum of nested frequency for perennial forbs decreased 38%, however, forbs have been sparse. Field bindweed was sampled in 1989, but was not found in 1997. The Desirable Components Index (DCI) score was very poor-poor due to very low browse cover with low recruitment and high decadence, very little perennial forb cover, and the presence of one noxious weed.

winter range condition (DCI) - very poor-poor (35) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - slightly down (-1)

2002 TREND ASSESSMENT

The browse trend is slightly down. The density of true mountain mahogany increased 20%. No young plants were sampled and decadence increased to 83% of the population. Plants classified as having poor vigor increased to 67% of the population, and browse use was mostly heavy. The density of bitterbrush increased 33%. No young were measured. Decadence increased to 50% of the population. Plants classified as having poor vigor increased to 25% of the population, and browse use remained heavy. The density of gamble oak increased 63%. Young plants sampled increased to 24% of the population, and decadence increased slightly to 5%. Plants showing poor vigor increased slightly to 3% of the population, and remained mostly light. The grass trend is down. The sum of nested frequency for perennial grasses decreased 21%, and perennial grass cover decreased from 15% to 7%. Smooth brome decreased significantly in nested frequency. Additionally, Japanese brome (*Bromus japonicus*) was sampled for the first time, and had a quadrat frequency of 1%. The forb trend is down. The sum of nested frequency for both perennial and annual forbs decreased 77% and 85%, respectively. However, forb abundance was already quite low. Forb cover decreased from 1% to nearly 0%. The DCI score was very poor due to decreased perennial grass and forb cover.

winter range condition (DCI) - very poor (15) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is slightly down. The density of true mountain mahogany decreased 67%. There were no young or decadent plants in the population. Plant vigor was excellent. Browse use was light-moderate. The density of antelope bitterbrush was stable. No young were measured. Decadence decreased to 0% of the population. Plant vigor was excellent, and browse use remained heavy. The density of gamble oak decreased 53%. The recruitment of young changed little at 22% of the population, and decadent plants increased to 11%. Plants showing poor vigor increased to 50% of the population, and all browse use was light. The grass trend is stable. The sum of nested frequency for perennial grass changed little, but the average cover increased from 7% to 13%. Cheatgrass (*Bromus tectorum*) was measured for the first time at a quadrat frequency of 4%, and provided less than 1% cover. The forb trend is down. The sum of nested frequency for perennial forbs increased two-fold, however, there were very few perennial forbs. The sum of nested frequency for annual forbs increased significantly. Bur buttercup (*Ranunculus testiculatus*) was measured for the first time and provided 54% of the total forb cover. Bur buttercup produces allopathic chemicals that prevent seed germination in many native species (Buchanan et al. 1978). The DCI score remained very poor, despite the increase in perennial grass cover.

winter range condition (DCI) - very poor (26) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 11

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	a94	a105	a92	a91	3.54	.95	2.16
G	Agropyron intermedium	a48	a26	-	-	.13	-	-
G	Agropyron spicatum	-	a1	a3	a6	.03	.03	.33
G	Bromus inermis	ab231	b271	a236	a220	11.03	5.71	9.84
G	Bromus japonicus (a)	-	-	a3	a3	-	.03	.00
G	Bromus tectorum (a)	-	-	-	10	-	-	.19
G	Carex sp.	b13	a3	-	a1	.06	-	.03
G	Oryzopsis hymenoides	13	-	-	-	-	-	-
G	Poa fendleriana	b50	a3	a6	a10	.03	.16	.36
G	Poa secunda	-	a17	-	a6	.34	-	.06
Total for Annual Grasses		0	0	3	13	0	0.03	0.19
Total for Perennial Grasses		449	426	337	334	15.17	6.85	12.80
Total for Grasses		449	426	340	347	15.17	6.88	12.99
F	Astragalus convallarius	-	1	-	-	.00	-	-
F	Astragalus sp.	a1	-	-	a1	-	-	.00
F	Convolvulus arvensis	1	-	-	-	-	-	-
F	Collinsia parviflora (a)	-	a1	a6	a12	.00	.01	.02

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Cryptantha sp.	$_{a}$6	$_{a}$3	$_{a}$1	$_{a}$1	.03	.00	.03
F	Descurainia pinnata (a)	-	$_{a}$5	-	$_{b}$45	.01	-	.20
F	Lappula occidentalis (a)	-	-	-	4	-	-	.01
F	Medicago sativa	$_{a}$11	$_{a}$13	$_{a}$4	-	.87	.03	-
F	Microsteris gracilis (a)	-	$_{a}$30	-	$_{a}$35	.05	-	.08
F	Penstemon humilis	9	-	-	-	-	-	-
F	Phlox longifolia	$_{b}$24	$_{ab}$9	$_{a}$2	$_{ab}$13	.02	.01	.02
F	Ranunculus testiculatus (a)	-	-	-	60	-	-	.43
F	Senecio multilobatus	$_{a}$3	-	-	$_{a}$3	-	-	.00
F	Tragopogon dubius	$_{a}$1	$_{a}$9	$_{a}$1	-	.17	.00	-
F	Unknown forb-annual (a)	-	3	-	-	.00	-	-
Total for Annual Forbs		0	39	6	156	0.07	0.00	0.74
Total for Perennial Forbs		56	35	8	18	1.09	0.05	0.06
Total for Forbs		56	74	14	174	1.17	0.06	0.80

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

BROWSE TRENDS --
Management unit 16C, Study no: 11

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Cercocarpus montanus	4	4	2	1.48	.39	.09
B	Chrysothamnus nauseosus consimilis	2	1	0	.00	.03	-
B	Juniperus osteosperma	13	9	7	9.55	6.90	4.27
B	Pinus edulis	5	6	5	3.54	6.50	6.30
B	Purshia tridentata	2	3	2	.30	.56	.18
B	Quercus gambelii	4	9	6	2.09	1.99	1.57
Total for Browse		30	32	22	16.98	16.38	12.42

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 11

Species	Percent Cover	
	'02	'07
Cercocarpus montanus	.40	.63
Juniperus osteosperma	19.20	16.00
Pinus edulis	8.48	10.83
Purshia tridentata	.90	.95
Quercus gambelii	1.46	1.88

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 11

Species	Average leader growth (in)	
	'02	'07
Cercocarpus montanus	2.0	5.8
Purshia tridentata	2.9	6.5

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 11

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	90	97
Pinus edulis	67	76

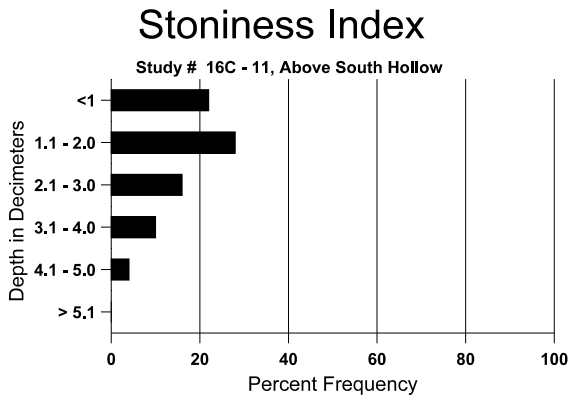
Average diameter (in)	
'02	'07
7.0	7.3
5.5	6.2

BASIC COVER --
Management unit 16C, Study no: 11

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	9.00	31.20	23.18	27.92
Rock	8.00	3.42	9.11	3.19
Pavement	11.50	8.08	21.08	15.49
Litter	60.75	50.84	52.78	49.54
Cryptogams	0	.05	0	.18
Bare Ground	10.75	9.65	17.61	15.00

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 11, Above South Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
11.0	58.0 (15.4)	7.1	36.4	31.1	32.6	6.6	18.0	268.8	.9



PELLET GROUP DATA --
Management unit 16C, Study no: 11

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	14	18	31
Elk	9	2	6
Deer	31	36	30
Cattle	1	1	-

Days use per acre (ha)	
'02	'07
-	-
8 (20)	21 (51)
60 (149)	55 (136)
11 (27)	3 (7)

BROWSE CHARACTERISTICS --
Management unit 16C, 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)
Cercocarpus montanus												
89	**33**	-	-	-	33	-	0	100	100	100	100	-/-
97	**100**	20	-	80	20	-	40	20	20	-	0	52/50
02	**120**	-	-	20	100	-	0	83	83	33	67	44/39
07	**40**	-	-	40	-	20	50	0	0	-	0	45/44
Chrysothamnus nauseosus consimilis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	20	20	-	-	50	0	-	-	0	40/40
02	**20**	-	-	20	-	-	0	0	-	-	0	13/6
07	**0**	-	-	-	-	-	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)
Cowania mexicana stansburiana												
89	**33**	-	-	33	-	-	0	0	-	-	0	30/33
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Ephedra viridis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	39/29
02	**0**	-	-	-	-	-	0	0	-	-	0	35/29
07	**0**	-	-	-	-	-	0	0	-	-	0	55/81
Juniperus osteosperma												
89	**232**	-	66	166	-	-	0	0	-	-	0	61/67
97	**280**	-	20	260	-	80	0	0	-	-	0	-/-
02	**200**	-	20	180	-	100	0	10	-	-	10	-/-
07	**160**	20	-	160	-	-	0	0	-	-	0	-/-
Pediocactus simpsonii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	21/81
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Pinus edulis												
89	**66**	-	66	-	-	-	0	0	-	-	0	-/-
97	**100**	-	20	80	-	-	0	0	-	-	0	-/-
02	**120**	-	20	100	-	-	0	0	-	-	0	-/-
07	**100**	20	-	100	-	-	0	0	-	-	0	-/-
Pseudotsuga menziesii												
89	**33**	-	33	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**60**	-	-	60	-	-	0	100	0	-	0	27/58
02	**80**	-	-	40	40	-	0	100	50	-	25	29/77
07	**80**	-	-	80	-	-	0	100	0	-	0	29/58

		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)
Quercus gambelii												
89	**2598**	100	1666	866	66	-	1	28	3	-	0	71/33
97	**280**	-	-	280	-	40	14	0	0	-	0	47/49
02	**760**	-	180	540	40	-	29	0	5	-	3	47/25
07	**360**	240	80	240	40	20	0	0	11	-	50	39/34
Sambucus cerulea												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	22/31
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	80/108

Trend Study 16C-12-07

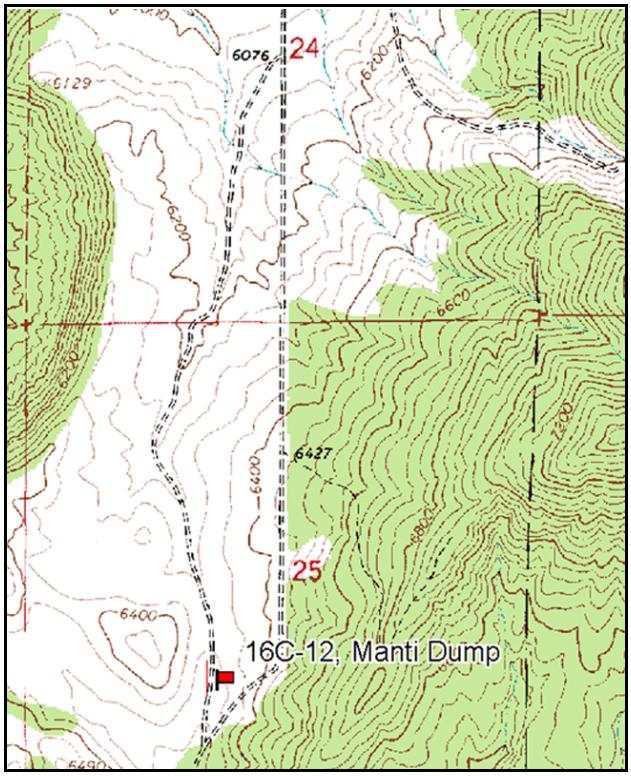
Study site name: Manti Dump . Vegetation type: Chained, Seeded P-J .

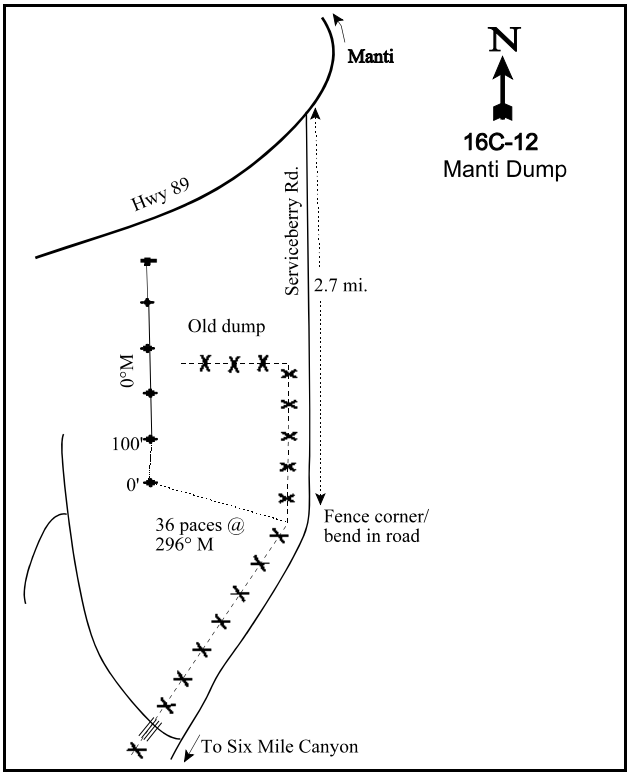
Compass bearing: frequency baseline 0 degrees magnetic.

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

LOCATION DESCRIPTION

On Highway 89 south of Manti, just outside of town, the highway makes a gradual turn to the southwest. At this point, there is a graded gravel road (Serviceberry Road) that goes straight south past the old city dump and over to Six Mile Canyon. Take this road for approximately 2.7 miles to where the road turns rather sharply to the southwest. The fence on the west side of the road also makes a slight corner here and begins to head southwest. From where the fence makes a corner, walk 36 paces at 296 degrees magnetic to the 0-foot baseline stake marked by browse tag #179.





Map Name: Sterling

Diagrammatic Sketch

Township 18S , Range 2E , Section 25

GPS: NAD 83, UTM 12S 444177 E 4341038 N

DISCUSSION

Manti Dump - Trend Study No. 16C-12

Study Information

This study is on Utah Division of Wildlife Resources land south of the old Manti dump. It samples a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) range type that was part of the east Manti Dump chain and seeding project completed in 1961 [elevation: 6,320 feet (1,926 m), slope: 10%-12%, aspect: southwest]. There is little evidence of the chaining except for a few remnant tree trunks on the slopes above the study. It usually receives 1-2 feet (0.3-0.6 m) of snow, yet it still receives moderately heavy use by wintering deer. Elk use is light in most years. From the pellet group transect, deer use was estimated at 37 days use/acre (93 ddu/ha) in 2002 and 5 days use/acre (13 ddu/ha) in 2007. The cattle estimates were 2 days/use acre (5 cdu/ha) in 2002 and 2007. Sheep estimates were 25 days use/acre (61 sdu/ha) in 2007. The seeded grasses have been utilized by sheep, which graze the area in the spring. Several deer antler sheds have also been observed during past readings.

Soil

The soil is in the Fontreen series that consists of very deep, well-drained, moderately-rapidly permeable soils that formed in alluvium and colluvium from limestone, sandstone, chert, and shale. Fontreen soils are on alluvial fans, hillslopes and mountain slopes (USDA-NRCS 2007). The soil has a clay loam texture with a neutral reactivity (pH of 7.3). The combined relative cover of vegetation and litter has been 59%-64% since 1997, providing good protection for the soils from high intensity summer storms. The combined relative cover of pavement and rock was 32% in 1997, 28% in 2002, and 18% in 2007. Relative bare ground cover was low at 5%-8% in 1997 and 2002, and increased to16% in 2007. Soils have a severe erosion hazard on the steeper slopes above the study as evidenced by active sheet and rill erosion. In 1989, there was evidence of soil movement and plant pedestalling. Since 1989, erosion appears to have decreased. The erosion condition was classified as stable in 2002 and 2007.

Browse

The most abundant preferred browse is Wyoming big sagebrush. Canopy cover of Wyoming big sagebrush was 6% in 2002 and 7% in 2007. Its density was 4,066 plants/acre (10,043 plants/ha) in 1989, 2,360 plants/acre (5,829 plants/ha) in 1997, 1,900 plants/acre (4,693 plants/ha) in 2002, and 1,220 plants/acre (3,013 plants/ha) in 2007. The 1997 decline is due in part to the increased sample area. This larger sample gives more accurate estimates for shrub populations that have clumped and/or discontinuous distributions. The decline is also partially due to an increase in the proportion of dying plants from 21% of the population in 1997 to 39% in 2007. The recruitment of young has been low at 0%-5% of the population. Decadence has been high and ranged from 36% of the population to 68%. Plants showing poor vigor have increased from 0% of the population in 1989 to 46% in 2007. Browse use has been moderate-heavy. Lower than average precipitation periods in the late 1980's as well as 2000-2002 (Utah Climate Summaries 2007) may have contributed to low recruitment, high decadence, and increased poor vigor of the Wyoming big sagebrush. Moderate-heavy browsing for an extended period of time may have played a role as well. The average annual leader growth was 1.1 inches (2.8 cm) in 2002 and 0.9 inch (2.4 cm) in 2007.

The presence of black sagebrush (*Artemisia nova*) indicates areas of shallow, and dry stony soil (Zamora and Tueller 1973). Canopy cover of black sagebrush increased from 1% in 2002 to 2% in 2007. The black sagebrush density was 1,132 plants/acre (2,796 plants/ha) in 1989, 400 plants/acre (988 plants/ha) in 1997, 800 plants/acre (1,976 plants/ha) in 2002, and 500 plants/acre (1,235 plants/ha) in 2007. As with Wyoming big sagebrush, the 1997 decline in density is mostly due to the enlarged sampling area which more accurately estimates shrub populations. Young plants increased from 18% of the population in 1989 to 20% in 1997, and decreased to 4% by 2007. Decadence increased from 5%-6% of the population in 1989 and 1997 to 40% in 2007. Plants with poor vigor and classified as dying have increased from 0% of the population in 1989 to

16% in 2007. Browse use has been mostly light-moderate.

Canopy cover of Utah juniper (*Juniperus osteosperma*) increased from 1% in 2002 to 4% in 2007. The point-centered quarter data estimate of juniper density was 32 trees/acre (79 trees/ha) in 1997, 40 trees/acre (99 trees/ha) in 2002, and 46 trees/acre (114 trees/ha) in 2007. The average trunk diameter was estimated at 3.9 inches (9.9 cm) in 1997, 2.8 inches (7 cm) in 2002, and 4.7 inches (11.9 cm) in 2007. Canopy cover of pinyon pine (*Pinus edulis*) was 0% in 2002 and 2% in 2007. The pinyon density was estimated at 7 trees/acre (17 trees/ha) in 1997, 11 trees/acre (27 trees/ha) in 2002, and 28 trees/acre (69 trees/ha) in 2007. The average trunk diameter was 4.4 inches (11.2 cm) in 1997, 3.1 inches (7.8 cm) in 2002, and 5.5 inches (14 cm) in 2007.

Herbaceous Understory

The herbaceous understory has displayed low diversity and is dominated by crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*Agropyron intermedium*), which are found mostly in the protection of the sagebrush crowns. Crested wheatgrass provided 8%-9% of the total ground cover in 1997 and 2002, and 15% cover in 2007. Intermediate wheatgrass provided 3%-6% of the total ground cover in all sample years. Sandberg bluegrass (*Poa secunda*), bottlebrush squirreltail (*Sitanion hystrix*), and Indian ricegrass (*Oryzopsis hymenoides*) have also been sampled in very low frequencies. Cheatgrass is present, but its density is very low. It has provided less than 1% of the total ground cover in all sample years. Bulbous bluegrass (*Poa bulbosa*), which has a life cycle similar to that of cheatgrass (Stewart and Hull 1949),was sampled in three quadrats in 2002 and 11 quadrats in 2007.

There are very few forbs. A total of three perennial forb species and four annual forb species have been sampled since 1989. The dominant forb is bur buttercup (*Ranunculus testiculatus*). It has provided 1%-2% of the total ground cover since 1997. It is allopathic, and prevents the seed germination of many native species (Buchanan et al. 1978).

1997 TREND ASSESSMENT

The browse trend is down. The density of Wyoming big sagebrush declined 42%. The recruitment of young decreased from 5% of the population to 3%, and decadence decreased from 38% to 36% of the population. Plants classified as having poor vigor increased to from 0% of the population 23% of the population. Browse use was heavy-moderate. The density of black sagebrush decreased 65%. The recruitment of young increased from 18% of the population to 20%, and decadence changed little, decreasing from 6% to 5% of the population. Plants classified as having poor vigor increased from 0% to 5%. Browse use remained light-moderate. The grass trend is up. The sum of nested frequency for perennial grass increased 29%. The forb trend is stable. There were very few forbs, and only one perennial forb was measured. Bur buttercup had a quadrat frequency of 90%. The Desirable Components Index (DCI) score was good due to moderate preferred browse cover with low decadence and recruitment, excellent perennial grass cover, little annual grass cover, and very little perennial forb cover.

winter range condition (DCI) - good (52) Low potential scale
browse - down (-2) grass - up (+2) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is slightly down. The overall density for sagebrush changed little, however, the trend was determined by decreases in recruitment, increases in decadence, and declines in vigor. The density of Wyoming big sagebrush decreased 19%. The recruitment of young decreased to 0% of the population, and decadent plants increased to 68%. Plants classified as having poor vigor and dying increased to 35% of the population. Browse use remained moderate-heavy. The density of black sagebrush increased two-fold. The recruitment of young decreased to 8% of the population, and decadence increased to 25%. Plants classified as having poor vigor and dying increased to 13% of the population. Browse use remained light-moderate. The grass trend is stable. The sum of nested frequency for perennial grass decreased 15%. The nested frequency

for cheatgrass significantly declined 94%. Bulbous bluegrass was sampled for the first time, though only in 3% of the quadrats. The forb trend is stable. The sum of nested frequency for perennial and annual forbs remained stable. Only two forbs were sampled. The DCI score declined to fair mainly due to increased browse decadence, and very little recruitment of young browse.

winter range condition (DCI) - fair (36) Low potential scale
browse - slightly down (-1) grass - stable (0) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is down. The density of Wyoming big sagebrush decreased 36%. There was no recruitment of young, and decadence decreased to 62% of the population. Plants classified as having poor vigor increased to 46% of the population. Browse use was mostly moderate-heavy. The density of black sagebrush decreased 38%. The recruitment of young decreased to 4% of the population, and decadence increased to 40%. The plants classified as having poor vigor and dying increased to 16% of the population. Browse use was mostly light-moderate. The grass trend is down. The sum of nested frequency for perennial grass increased 17%. Crested wheatgrass increased significantly in nested frequency. However, the nested frequencies of cheatgrass and bulbous bluegrass also significantly increased. Additionally, Japanese brome (*Bromus japonicus*) was sampled for the first time, with a quadrat frequency of 3%. The forb trend is stable. The sum of nested frequency for perennial forbs remained stable. Only one perennial forb individual was sampled. The nested frequency for bur buttercup significantly decreased. The DCI score remained fair.

winter range condition (DCI) - fair (34) Low potential scale
browse - down (-2) grass - down (-2) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 12

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{a}$174	$_{ab}$225	$_{a}$193	$_{b}$242	8.59	8.35	14.82
G	Agropyron intermedium	$_{ab}$168	$_{b}$183	$_{ab}$158	$_{a}$131	5.50	5.27	3.00
G	Bromus japonicus (a)	-	-	-	4	-	-	.01
G	Bromus tectorum (a)	-	$_{b}$67	$_{a}$4	$_{c}$116	.43	.01	.63
G	Oryzopsis hymenoides	-	$_{a}$2	-	$_{a}$-	.03	-	.00
G	Poa bulbosa	-	-	$_{a}$4	$_{b}$30	-	.04	.18
G	Poa secunda	$_{a}$3	$_{ab}$27	$_{b}$38	$_{b}$50	.21	.29	.82
G	Sitanion hystrix	$_{ab}$13	$_{b}$24	-	$_{a}$5	.31	-	.01
Total for Annual Grasses		0	67	4	120	0.43	0.00	0.64
Total for Perennial Grasses		358	461	393	458	14.64	13.97	18.84
Total for Grasses		358	528	397	578	15.08	13.98	19.49
F	Alyssum alyssoides (a)	-	$_{a}$3	-	$_{b}$21	.00	-	.09
F	Collinsia parviflora (a)	-	-	-	2	-	-	.00
F	Descurainia pinnata (a)	-	-	-	1	-	-	.00
F	Penstemon sp.	1	-	-	-	-	-	-
F	Phlox longifolia	-	-	2	-	-	.00	-

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Ranunculus testiculatus (a)	-	$_{b}$251	$_{b}$253	$_{a}$171	1.44	1.57	1.33
F	Sphaeralcea coccinea	-	$_{a}$2	-	$_{a}$1	.00	-	.00
Total for Annual Forbs		0	254	253	195	1.44	1.57	1.44
Total for Perennial Forbs		1	2	2	1	0.00	0.00	0.00
Total for Forbs		1	256	255	196	1.45	1.58	1.44

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

BROWSE TRENDS --
Management unit 16C, Study no: 12

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia nova	16	20	17	1.55	1.00	.45
B	Artemisia tridentata wyomingensis	66	58	42	10.78	8.16	5.01
B	Atriplex canescens	2	0	0	-	-	-
B	Chrysothamnus viscidiflorus stenophyllus	2	0	2	-	-	-
B	Gutierrezia sarothrae	23	23	23	.41	1.19	.25
B	Juniperus osteosperma	3	3	3	1.97	1.54	1.67
B	Pinus edulis	0	0	0	.38	.63	-
Total for Browse		112	104	87	15.10	12.52	7.40

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 12

Species	Percent Cover	
	'02	'07
Artemisia nova	1.03	2.08
Artemisia tridentata wyomingensis	6.46	6.90
Gutierrezia sarothrae	1.66	.70
Juniperus osteosperma	.81	3.88
Pinus edulis	-	1.63

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 12

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata wyomingensis	1.1	0.9

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 12

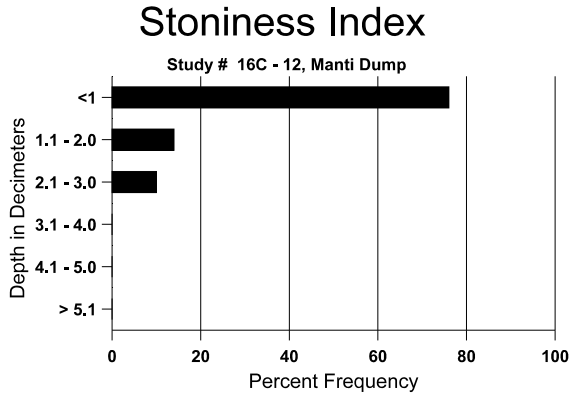
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Juniperus osteosperma	40	46	2.8	4.7
Pinus edulis	11	28	3.1	5.5

BASIC COVER --
Management unit 16C, Study no: 12

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	9.00	29.62	28.17	31.17
Rock	1.00	1.15	2.36	.59
Pavement	29.00	31.22	30.13	18.81
Litter	55.00	31.75	38.28	37.74
Cryptogams	.75	3.03	6.03	1.79
Bare Ground	5.25	4.92	8.87	17.45

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 12, Manti Dump

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
12.2	63.0 (14.2)	7.3	38.4	35.1	26.6	3.1	8.1	137.6	.6



PELLET GROUP DATA --
Management unit 16C, Study no: 12

Type	Quadrat Frequency			Days use per acre (ha)	
	'97	'02	'07	'02	'07
Sheep	11	-	-	-	25 (61)
Rabbit	7	25	45	-	-
Elk	3	-	7	-	-
Deer	53	44	16	37 (93)	5 (13)
Cattle	-	1	-	2 (5)	2 (4)

BROWSE CHARACTERISTICS --
Management unit 16C, 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												
89	**1132**	-	200	866	66	-	53	0	6	-	0	16/25
97	**400**	-	80	300	20	-	55	0	5	5	5	17/27
02	**800**	-	60	540	200	40	18	3	25	13	13	13/24
07	**500**	-	20	280	200	40	36	12	40	16	16	15/26
Artemisia tridentata wyomingensis												
89	**4066**	266	200	2333	1533	-	25	70	38	-	0	27/29
97	**2360**	-	80	1420	860	800	31	62	36	21	23	42/64
02	**1900**	-	-	600	1300	980	53	23	68	35	35	20/33
07	**1220**	-	-	460	760	840	31	39	62	39	46	21/36
Atriplex canescens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	20	20	-	-	0	50	-	-	0	33/43
02	**0**	-	-	-	-	80	0	0	-	-	0	49/61
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Chrysothamnus viscidiflorus stenophyllus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**60**	-	-	60	-	-	0	100	-	-	0	8/11
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**40**	-	-	40	-	-	0	50	-	-	0	-/-
Ephedra viridis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	21/35
07	**0**	-	-	-	-	-	0	0	-	-	0	20/19

		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)
Gutierrezia sarothrae												
89	**199**	-	66	133	-	-	0	0	0	-	0	12/6
97	**3100**	60	720	2380	-	-	0	0	0	-	0	8/7
02	**3020**	-	-	1220	1800	360	0	0	60	20	21	4/7
07	**1680**	-	20	1620	40	20	0	0	2	2	2	7/8
Juniperus osteosperma												
89	**0**	66	-	-	-	-	0	0	-	-	0	-/-
97	**60**	-	20	40	-	-	0	0	-	-	0	-/-
02	**60**	-	-	60	-	40	0	0	-	-	0	-/-
07	**60**	-	-	60	-	-	0	0	-	-	0	-/-
Opuntia sp.												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	5/14

Trend Study 16C-38-07

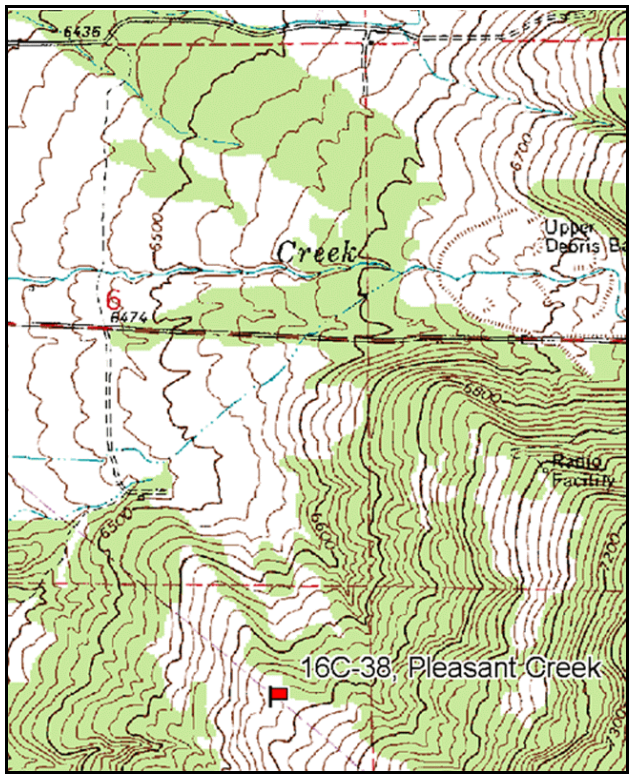
Study site name: Pleasant Creek . Vegetation type: Mountain Brush .

Compass bearing: frequency baseline 133 degrees magnetic.

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

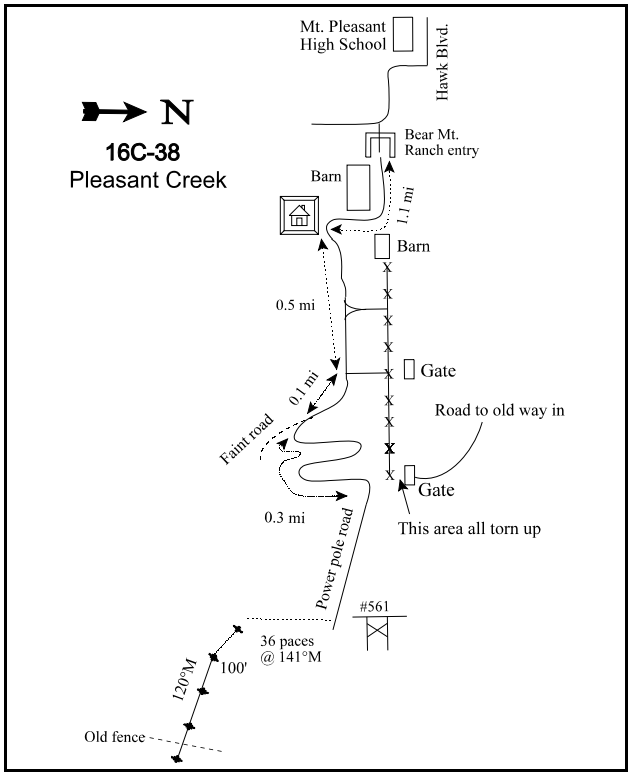
LOCATION DESCRIPTION

From Mt. Pleasant High School (on 700 South 3 blocks east of State St. in Mt. Pleasant) continue east on Hawk Blvd. (same as 700 South), following several turns in the road until an eastbound dirt road jutting off at one of the curves leads the way to Bear Mt. Ranch. Enter the ranch and go 1.1 miles to some barns and house(s). Continue on this road (alongside a fence) and go 0.5 miles to the second intersection, the left side of which leads to a gate. Take the right side and go 0.1 miles to another "Y" intersection of a faint road. Continue on the clearer road (to the left) for 0.3 miles. At 0.3 miles you will see to your left an old intersection where the road is all torn up, behind which is a gate and a road leading to the old way into the site. Continue straight on the road you're on for 0.2 miles; the road will become a power line road. Stop at power pole # 561. The 0-foot baseline stake is 36 paces from the power pole at an azimuth of 141 degrees magnetic.



Map Name: Mt. Pleasant

Township 15S , Range 5E , Section 7



Diagrammatic Sketch

GPS: NAD 83, UTM 12S 465742 E 4375986 N

DISCUSSION

Pleasant Creek - Trend Study No. 16C-38

Study Information

This study samples a mixed mountain brush community located in the foothills above the town of Mt. Pleasant [elevation: 6,760 feet (2,060 m), slope: 7%-11%, aspect: northwest]. It is located beneath the large power transmission lines which cross the mountain. This area is considered important winter range as it supports several preferred browse species. Pellet group quadrat frequencies indicate elk and deer use to be light-moderate, with cattle and sheep use being light. From the pellet group transect, deer use was estimated at 80 days use/acre (197 ddu/ha) in 2002 and 62 days use/acre (154 ddu/ha) in 2007. Elk use was estimated at 27 days use/acre (68 edu/ha) in 2002, and 58 days use/acre (142 edu/ha) in 2007. No cattle pats or sheep pellets were sampled in 2002 and 2007.

Soil

The soil is in the Mower series. Typically, Mower soils have grayish brown, moderately alkaline, clay loam A horizons; light brownish gray, strongly alkaline, silty clay loam B2 horizons; and white, strongly alkaline, shaly silty clay loam Cca horizons over shale at some depth between 20 and 40 inches (51 and 102 cm) (USDA-NRCS 2007). The soil texture is clay, and a neutral reaction (pH of 7.2). Rock is common throughout the upper 16 inches (41 cm) of the profile. Since 1997, the combined relative cover of vegetation and litter has been 73%-84%, providing good protection for the soils. The relative bare ground was stable in 1997 and 2002 at 21%-22%. In 2007, it decreased to 11%. In 2002, it was noted that bare interspaces exhibited slight erosion, with moderate pedestalling around the base of shrubs and bunchgrasses. The erosion condition was classified as stable in 2002 and 2007.

Browse

The most abundant preferred browse species is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Its density was 1,799 plants/acre (4,444 plants/ha) in 1989, 1,780 plants/acre (4,397 plants/ha) in 1997, 2,740 plants/acre (6,768 plants/ha) in 2002, and 1,760 plants/acre (4,347 plants/ha) in 2007. Young plants increased from 19% of the population in 1989 to 27% in 1997, and decreased to 14% by 2007. Decadence decreased from 22% in 1989 to 9% by 2002, and increased to 27% in 2007. Plant vigor has been good, except for 2007 when 17% of the population had poor vigor. Browse use has been light-moderate. The average annual leader growth was 1.7 inches (4.2 cm) in 2002 and 1.6 inches (4 cm) in 2007.

Other palatable browse species sampled include Utah serviceberry (*Amelanchier utahensis*), basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), and antelope bitterbrush (*Purshia tridentata*). The density of serviceberry has been low at 133 plants/acre (331 plants/ha) or less in all sample years. Young serviceberry were only sampled in 1997 and comprised 50% of the population. Decadence and plant vigor have been excellent, except in 2002 when decadent plants with poor vigor comprised 67% of the population. Browse use was moderate-heavy. Canopy cover of basin big sagebrush increased from 3% in 2002 to 4% in 2007. The density of basin big sagebrush was 400 plants/acre (988 plants/ha) in 1997, 540 plants/acre (1,334 plants/ha) in 2002, and 580 plant/acre (1,433 plants/ha) in 2007. Young plants comprised 40% of the population in 1997 and decreased to 4% in 2002 and 3% in 2007. Decadent plants comprised 25% of the population in 1997, 7% in 2002, and 52% in 2007. Plant vigor was good in 1989 and 2002, but 20% and 31% of the population had poor vigor in 1997 and 2007, respectively. Browse use has been mostly light-moderate. The canopy cover of bitterbrush decreased from 7% in 2002 to 4% in 2007. The density of bitterbrush was 720 plants/acre (1,778 plants/ha) in 1997, 940 plants/acre (2,322 plants/ha) in 2002, and 620 plants/acre (1,531 plants/ha) in 2007. Young plants were only sampled in 2007, accounting for 10% of the population. There were few or no decadent plants, except for 2007 when 26% of the population was decadent. Plant vigor has been good. Browse use was mostly moderate-heavy. The average annual leader growth of antelope bitterbrush was 2.3 inches (5.9 cm) in 2002 and 2.1 inches (5.4 cm) in 2007.

The most numerous browse species is low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*). It comprised 9% of the canopy cover in 2002 and 8% in 2007. The density of low rabbitbrush declined from 18,065 plants/acre (44,638 plants/ha) in 1989 to 7,500 plants/acre (18,532 plants/ha) in 2007. The population is mostly mature plants. In 1989, the population showed signs of significant browsing by domestic sheep earlier in the season. Utah Juniper (*Juniperus osteosperma*) has been measured, and canopy cover was constant at 11% in 2002 and 2007. The point-centered quarter data estimate for juniper density was 70 trees/acre (173 trees/ha) in 1997, 80 trees/acre (198 trees/ha) in 2002, and 101 trees/acre (249 trees/ha) in 2007. The average trunk diameter was 3.8 inches (9.7 cm) in 1997, which increased to 4.7 inches (12.1 cm) in 2002 and 2007. From line intercept data, canopy cover was estimated at 11% since 2002.

Herbaceous Understory

The grass component is diverse. Between seven and 15 grass species have been sampled from 1989 to 2007. Grass provided 16% of the total ground cover in 1997 and 12%-13% in 2002 and 2007. The dominant perennial grasses were Kentucky bluegrass (*Poa pratensis*) and bluebunch wheatgrass (*Agropyron spicatum*). They provided 12% of the total ground cover in 1997, 10% in 2002, and 9% in 2007. Both showed moderate utilization during the 1997 reading. However, neither showed noticeable use during 2002 and 2007. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) are the only annul grasses that have been sampled. They provided 2% of the total ground cover in 1997, 0.04% in 2002, and 3% in 2007. The decreases in the number of species sampled, cover, and nested frequency in 2002 were likely the results of lower than normal annual precipitation conditions (Utah Climate Summaries 2007). These parameters should improve with better precipitation in the future.

The forb diversity was high. Between 17 and 24 perennial species, and six and 11 annual species have been sampled in all sample years. Diversity was highest in 1997. The forbs provided 7%-10% of the total ground cover since 1997. The dominant forb species was low penstemon (*Penstemon humilis*). It provided 3%-4% of the total ground cover in all measurements. Several noxious weeds have been sampled: musk thistle (*Carduus nutans*), field bindweed (*Convolvulus arvensis*), and houndstongue (*Cynoglossum officinale*). These species decreased in abundance or were not sampled in 2007.

1997 TREND ASSESSMENT

The browse trend is stable. The density of mountain big sagebrush remained stable at 1,780 plants/acre (4,398 plants/ha). The recruitment of young increased from 19% of the population to 27%, and decadence decreased from 22% to 12%. Plants classified with poor vigor remained low at 6% of the population, and browse use increased from light to light-moderate. Basin big sagebrush was measured for the first time. It was likely present before 1997, but was not sampled until the transect was extended and the sample area was increased. Forty percent of the population was young, and 25% was decadent. Plants classified with poor vigor comprised 20% of the population, and browse use was light. The density of antelope bitterbrush increased ten-fold. There were no young or decadent plants in the population, and vigor was excellent. Browse use was mostly heavy. The grass trend was slightly up. The sum of nested frequency for perennial grass increased 18%. The nested frequencies of Kentucky bluegrass and bluebunch wheatgrass changed little. However, Sandberg bluegrass (*Poa secunda*) increased significantly in nested frequency. The forb trend is slightly down. The sum of nested frequency for perennial forbs decreased 18%, and musk thistle and field bindweed were sampled for the first time. Six perennial species decreased significantly in nested frequency. However, one of those species was houndstongue. The number of perennial species sampled increased from 19 to 24, and yellow salsify (*Tragopogon dubius*) increased significantly in nested frequency. The Desirable Components Index (DCI) score was good due to good preferred browse cover, little browse decadence, few young browse, excellent perennial grass cover, little annual grass cover, excellent perennial forb cover, and three noxious weeds.

winter range condition (DCI) - good (71) Mid-level potential scale
browse - stable (0) grass - slightly up (+1) forb - slightly down (-1)

2002 TREND ASSESSMENT

The browse trend is up. The density of mountain big sagebrush increased 54%. The recruitment of young decreased to 19% of the population, and decadence decreased to 9%. Plants showing poor vigor changed little, decreasing to 4% of the population. Browse use was mostly light. The density of basin big sagebrush increased 35%. The recruitment of young decreased to 4% of the population, and decadence decreased to 7%. Plants classified with poor vigor decreased to 4% of the population, and browse use increased to light-moderate. The density of antelope bitterbrush increased 31%. No young plants were sampled. Plant vigor was excellent, and heavily browsed plants decreased from 83% of the population to 64%.. The grass trend is stable. The sum of nested frequency for perennial grass decreased 19%, and the nested frequency of Kentucky bluegrass significantly declined. However, the sum of nested frequency for annual grass decreased 91%, and the nested frequency of both cheatgrass and Japanese brome significantly decreased. Annual grass cover decreased from 2% to nearly 0%. The forb trend is down. The sum of nested frequency for perennial forbs decreased 26%. Houndstongue and musk thistle were both sampled, but field bindweed was not. The nested frequency for bur buttercup (*Ranunculus testiculatus*) significantly decreased. It has allopathic chemicals that prevent the seed germination of many native species (Buchanan et al. 1978). Total forb cover decreased from 9% to 7%. The decrease in the sum of nested frequency, and cover of grass and forbs is likely due to drought (Utah Climate Summaries 2007). The DCI score remained good.

winter range condition (DCI) - good (70) Mid-level potential scale
browse - up (+2) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of mountain big sagebrush decreased 36%. The recruitment of young decreased to 14% of the population, and decadence increased to 27%. Plants classified with poor vigor increased to 17% of the population, and browse use increased to light-moderate. The density for basin big sagebrush was stable. The recruitment of young remained low at 3% of the population, and decadence increased to 52%. Plants classified with poor vigor increased to 31% of the population, and browse use remained mostly light-moderate. The sagebrush defoliator moth (*Aroga websteri*) had infested 28% of the mountain big sagebrush population and 34% of the basin big sagebrush population. The density of antelope bitterbrush decreased 34%. The recruitment of young increased to 10% of the population, and decadence increased to 26%. Plants classified as having poor vigor increased to 6% of the population, and browse use was moderate-heavy. The grass trend is down. The sum of nested frequency for perennial grass decreased 13%, and the sum of nested frequency of annual grass increased ten-fold. The nested frequency of cheatgrass significantly increased, and its average cover increased from nearly 0% to 3%. The forb trend is slightly down. The sum of nested frequency for perennial forbs was stable. However, the sum of nested frequency for annual forbs increased five-fold, and most of that increase was the result of a significant increase in the nested frequency of bur buttercup. Houndstongue was the only noxious weed that was sampled. The DCI score declined to poor due to decreased browse cover, increased browse decadence, decreased perennial grass cover, and increased annual grass cover.

winter range condition (DCI) - poor (38) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - slightly down (-1)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 38

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	-	$_{a}$6	$_{a}$5	$_{a}$5	.06	.15	.18
G	Agropyron smithii	-	-	-	1	-	-	.00
G	Agropyron spicatum	$_{a}$166	$_{a}$171	$_{a}$196	$_{a}$159	8.60	8.50	7.31
G	Bromus japonicus (a)	-	$_{b}$93	$_{a}$7	$_{a}$25	.99	.02	.07
G	Bromus tectorum (a)	-	$_{b}$73	$_{a}$8	$_{c}$130	.63	.02	3.11
G	Carex sp.	-	-	$_{a}$1	$_{a}$4	-	.03	.15
G	Melica bulbosa	$_{a}$1	$_{a}$2	$_{a}$2	$_{a}$7	.00	.16	.01
G	Oryzopsis hymenoides	-	$_{a}$9	$_{a}$5	$_{a}$1	.08	.16	.03
G	Poa bulbosa	-	-	-	1	-	-	.03
G	Poa fendleriana	$_{a}$8	-	$_{a}$1	$_{a}$8	-	.00	.06
G	Poa pratensis	$_{c}$115	$_{bc}$101	$_{a}$45	$_{ab}$70	3.78	1.49	1.52
G	Poa secunda	$_{a}$10	$_{b}$48	$_{ab}$33	$_{a}$9	.46	.56	.09
G	Sitanion hystrix	$_{ab}$16	$_{b}$29	$_{a}$2	$_{a}$1	.34	.03	.01
G	Stipa columbiana	-	$_{a}$2	$_{b}$18	$_{a}$3	.03	.83	.15
G	Stipa lettermani	$_{ab}$15	$_{b}$24	$_{a}$8	$_{a}$5	.71	.24	.09
Total for Annual Grasses		0	166	15	155	1.62	0.04	3.19
Total for Perennial Grasses		331	392	316	274	14.10	12.17	9.67
Total for Grasses		331	558	331	429	15.73	12.21	12.86
F	Achillea millefolium	-	$_{a}$4	$_{a}$4	$_{a}$4	.38	.15	.15
F	Agoseris glauca	-	$_{a}$3	$_{a}$5	$_{a}$3	.00	.01	.00
F	Alyssum alyssoides (a)	-	$_{a}$7	$_{a}$3	$_{b}$50	.01	.00	.18
F	Allium sp.	$_{a}$3	$_{a}$12	$_{ab}$16	$_{b}$33	.05	.07	.11
F	Arabis sp.	$_{a}$4	$_{a}$2	-	-	.00	-	-
F	Astragalus convallarius	$_{a}$40	$_{a}$45	$_{a}$32	$_{a}$38	.59	.38	.94
F	Aster sp.	$_{a}$79	$_{a}$76	$_{a}$54	$_{a}$47	1.18	.52	.57
F	Astragalus sp.	$_{b}$14	$_{a}$1	$_{a}$2	-	.00	.03	-
F	Astragalus utahensis	-	$_{a}$5	$_{a}$5	$_{a}$7	.01	.01	.07
F	Carduus nutans (a)	-	$_{a}$10	$_{a}$12	-	.21	.10	-
F	Chaenactis douglasii	$_{b}$13	$_{ab}$16	$_{a}$4	$_{a}$1	.06	.01	.00
F	Cirsium sp.	$_{a}$13	$_{a}$15	$_{a}$12	$_{a}$13	.06	.10	.13
F	Convolvulus arvensis	-	3	-	-	.01	-	-
F	Collomia linearis (a)	-	$_{b}$15	-	$_{a}$7	.03	-	.01
F	Collinsia parviflora (a)	-	$_{ab}$58	$_{a}$41	$_{b}$75	.12	.17	.33
F	Cymopterus sp.	-	$_{ab}$2	$_{b}$14	$_{a}$3	.01	.06	.00
F	Cynoglossum officinale	$_{b}$94	$_{a}$21	$_{a}$12	$_{a}$9	.17	.08	.05

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Epilobium brachycarpum (a)	-	$_{a}$3	$_{a}$3	-	.02	.03	-
F	Erigeron eatonii	-	-	1	-	-	.00	-
F	Eriogonum ovalifolium	-	-	3	-	-	.03	-
F	Eriogonum umbellatum	$_{b}$28	$_{a}$-	$_{a}$9	-	.00	.05	-
F	Hackelia patens	$_{b}$97	$_{b}$89	$_{a}$30	$_{a}$25	.77	.45	.41
F	Holosteum umbellatum (a)	-	-	-	2	-	-	.03
F	Lepidium sp. (a)	-	6	-	-	.01	-	-
F	Linum kingii	7	-	-	-	-	-	-
F	Lithospermum ruderale	$_{a}$3	$_{a}$4	$_{a}$6	$_{a}$2	.03	.21	.00
F	Machaeranthera canescens	$_{c}$79	$_{b}$40	$_{a}$3	-	.26	.06	-
F	Microsteris gracilis (a)	-	$_{b}$30	$_{a}$3	$_{a}$3	.08	.00	.03
F	Penstemon humilis	$_{b}$242	$_{a}$190	$_{a}$181	$_{a}$178	3.26	3.89	4.48
F	Phlox longifolia	$_{ab}$123	$_{ab}$114	$_{a}$89	$_{b}$144	.30	.32	1.02
F	Polygonum douglasii (a)	-	8	-	-	.01	-	-
F	Ranunculus testiculatus (a)	-	$_{b}$132	$_{a}$4	$_{c}$192	.45	.01	.91
F	Senecio multilobatus	-	-	3	-	-	.00	-
F	Sphaeralcea coccinea	$_{a}$10	$_{ab}$19	$_{b}$24	$_{ab}$21	.14	.15	.10
F	Taraxacum officinale	$_{a}$1	$_{a}$10	-	-	.02	-	-
F	Tragopogon dubius	$_{a}$4	$_{b}$20	$_{a}$2	-	.04	.01	-
F	Unknown forb-annual (a)	-	2	-	-	.00	-	-
F	Veronica biloba (a)	-	$_{b}$106	-	$_{a}$25	.46	-	.04
F	Vicia americana	-	$_{b}$33	$_{b}$22	$_{a}$1	.27	.10	.03
F	Viguiera multiflora	$_{b}$35	$_{a}$4	$_{a}$6	$_{a}$1	.05	.04	.00
F	Viola sp.	-	3	-	-	.03	-	-
Total for Annual Forbs		0	377	66	354	1.44	0.33	1.55
Total for Perennial Forbs		889	731	539	530	7.77	6.79	8.12
Total for Forbs		889	1108	605	884	9.22	7.13	9.68

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

BROWSE TRENDS --
Management unit 16C, Study no: 38

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	2	3	1	.03	-	.03
B	Artemisia tridentata tridentata	11	19	20	.90	2.64	2.64
B	Artemisia tridentata vaseyana	49	67	46	7.25	7.91	2.32
B	Chrysothamnus nauseosus albicaulis	2	10	3	.38	.72	.03
B	Chrysothamnus viscidiflorus viscidiflorus	94	93	82	7.21	5.82	6.82
B	Eriogonum heracleoides	0	2	0	-	-	.00
B	Gutierrezia sarothrae	2	5	9	.06	.18	.33
B	Juniperus osteosperma	6	7	8	5.63	7.75	6.18
B	Mahonia repens	0	2	2	-	-	.15
B	Purshia tridentata	24	27	22	5.65	4.80	1.99
B	Rosa woodsii	2	2	0	.30	.03	-
B	Symphoricarpos oreophilus	50	53	50	2.62	2.83	2.34
B	Tetradymia canescens	2	2	2	.15	.03	.03
Total for Browse		244	292	245	30.21	32.73	22.88

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 38

Species	Percent Cover	
	'02	'07
Artemisia tridentata tridentata	3.21	4.33
Artemisia tridentata vaseyana	6.61	5.65
Chrysothamnus nauseosus albicaulis	.76	.05
Chrysothamnus viscidiflorus viscidiflorus	9.43	8.10
Eriogonum heracleoides	.01	-
Gutierrezia sarothrae	-	.16
Juniperus osteosperma	10.80	10.76
Mahonia repens	.05	.08
Purshia tridentata	6.65	4.13
Rosa woodsii	.01	-
Symphoricarpos oreophilus	2.71	3.09
Tetradymia canescens	.21	.15

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 38

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.7	1.6
Purshia tridentata	2.3	2.1

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 38

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	80	101

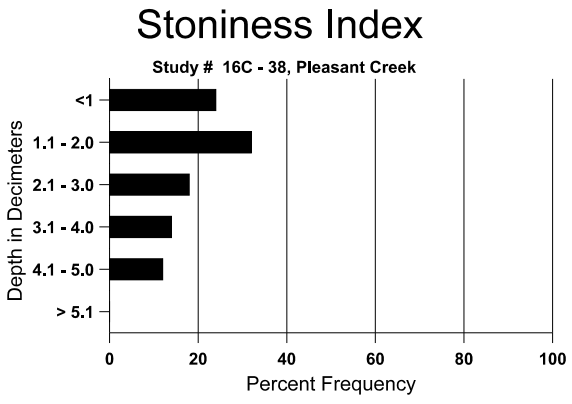
Average diameter (in)	
'02	'07
4.8	4.7

BASIC COVER --
Management unit 16C, Study no: 38

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	16.50	46.87	51.43	51.87
Rock	1.75	.58	1.11	.73
Pavement	2.75	1.09	1.56	3.40
Litter	54.00	42.92	37.88	40.47
Cryptogams	0	1.62	3.67	1.87
Bare Ground	25.00	24.11	26.76	12.01

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 38, Pleasant Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
12.2	53.0 (14.1)	7.2	25.7	29.4	44.8	4.7	10.9	246.4	.5



PELLET GROUP DATA --
Management unit 16C, Study no: 38

Type	Quadrat Frequency			Days use per acre (ha)	
	'97	'02	'07	'02	'07
Sheep	6	-	-	-	-
Rabbit	3	4	7	-	-
Elk	11	11	18	27 (68)	58 (142)
Deer	12	24	29	80 (197)	62 (154)
Cattle	1	-	-	-	-

BROWSE CHARACTERISTICS --
Management unit 16C, Study no: 38

		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												
89	**133**	-	-	133	-	-	50	50	0	-	0	17/15
97	**40**	-	20	20	-	-	0	50	0	-	0	21/27
02	**60**	-	-	20	40	-	0	67	67	67	67	16/19
07	**20**	-	-	20	-	-	0	100	0	-	0	16/19
Artemisia tridentata tridentata												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**400**	20	160	140	100	260	0	0	25	20	20	54/53
02	**540**	-	20	480	40	120	41	4	7	4	4	49/52
07	**580**	-	20	260	300	180	41	10	52	14	31	44/48
Artemisia tridentata vaseyana												
89	**1799**	66	333	1066	400	-	15	0	22	-	4	27/34
97	**1780**	300	480	1080	220	620	31	2	12	6	6	29/32
02	**2740**	20	520	1980	240	740	9	3	9	4	4	23/28
07	**1760**	40	240	1040	480	280	28	6	27	13	17	23/30
Chrysothamnus nauseosus albicaulis												
89	**866**	-	200	400	266	-	15	0	31	-	0	35/22
97	**40**	-	-	20	20	-	100	0	50	50	50	30/40
02	**440**	-	-	440	-	20	0	0	0	-	0	13/13
07	**60**	-	20	20	20	20	0	0	33	-	0	19/20
Chrysothamnus viscidiflorus viscidiflorus												
89	**18065**	66	6066	9666	2333	-	21	8	13	-	0	11/12
97	**13140**	380	2320	10620	200	40	3	0	2	.30	.30	9/12
02	**12340**	-	60	11880	400	80	1	0	3	.48	.48	9/12
07	**7500**	-	200	6140	1160	40	2	0	15	2	47	11/14

		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)
Eriogonum heracleoides												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	-	40	-	-	0	0	-	-	0	4/6
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**180**	-	60	120	-	-	0	0	0	-	0	8/7
02	**240**	-	-	220	20	-	0	0	8	-	0	8/9
07	**400**	-	-	400	-	-	0	0	0	-	0	9/9
Juniperus osteosperma												
89	**66**	-	-	66	-	-	0	0	-	-	0	93/89
97	**120**	-	40	80	-	-	0	0	-	-	0	-/-
02	**160**	60	40	120	-	-	0	0	-	-	0	-/-
07	**160**	40	-	160	-	-	0	0	-	-	0	-/-
Mahonia repens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**360**	-	-	360	-	-	0	0	-	-	0	2/3
07	**1760**	-	-	1760	-	-	0	0	-	-	0	3/3
Purshia tridentata												
89	**66**	-	-	66	-	-	100	0	0	-	0	16/26
97	**720**	-	-	720	-	-	17	83	0	-	0	44/49
02	**940**	-	-	920	20	-	0	64	2	-	0	11/39
07	**620**	40	60	400	160	-	39	52	26	6	6	15/50
Rosa woodsii												
89	**2333**	-	1200	1133	-	-	0	0	-	-	0	14/16
97	**200**	-	40	160	-	-	0	0	-	-	0	10/17
02	**200**	-	-	200	-	-	0	0	-	-	0	6/7
07	**0**	-	-	-	-	-	0	0	-	-	0	9/7
Symphoricarpos oreophilus												
89	**3866**	266	1333	2200	333	-	12	0	9	-	3	17/17
97	**2340**	-	480	1840	20	20	20	.85	1	-	0	11/23
02	**2020**	-	80	1880	60	-	3	.99	3	-	0	13/20
07	**1820**	-	380	1340	100	-	14	2	5	-	11	13/19

		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)
Tetradymia canescens												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**440**	40	240	200	-	-	0	0	0	-	0	12/25
02	**560**	-	80	480	-	-	0	0	0	-	0	11/18
07	**160**	-	20	-	140	-	0	0	88	38	38	13/22

Trend Study 16C-39-07

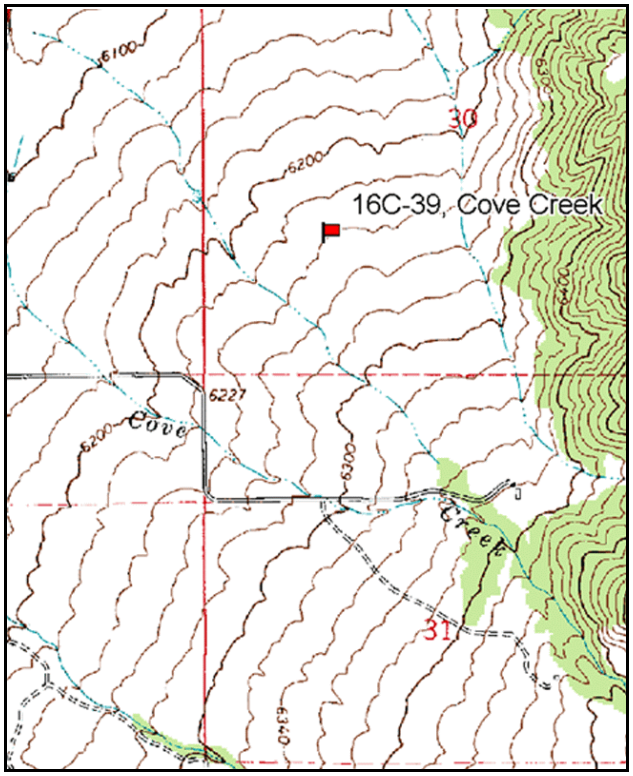
Study site name: Cove Creek . Vegetation type: Bitterbrush .

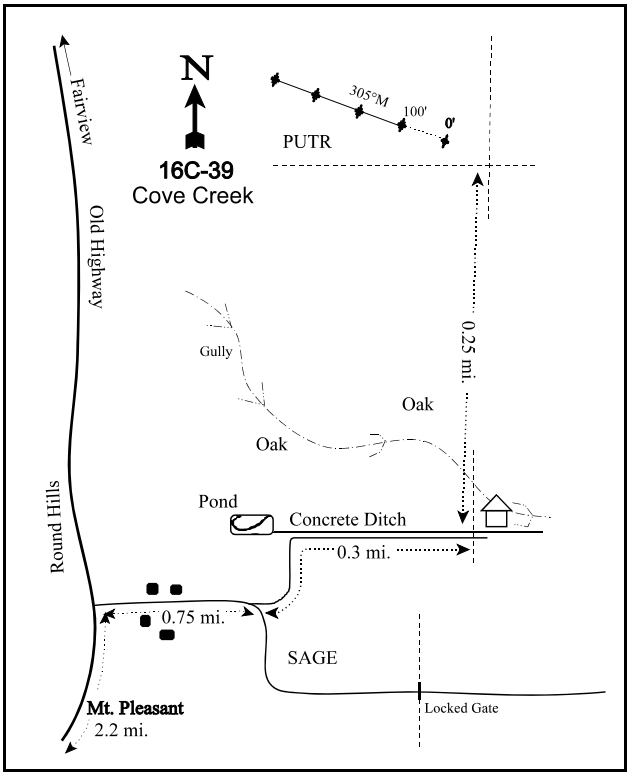
Compass bearing: frequency baseline 305 degrees magnetic.

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

LOCATION DESCRIPTION

From State Street (Highway 89) and 200 North in Mt. Pleasant, proceed east on 200 North which curves northward and becomes the old highway to Fairview. Follow this road for 2.2 miles, then turn east on a gravel road for 0.75 miles to an intersection at the first curve in the road. Turn left and drive (~0.3 miles) to a fence. Park here. Walk north across the ditch and along the fence until the road ends or a place where 3 fences intersect and the road ends (about 0.25 miles). The 0-foot baseline stake, which is red, is 12 paces west of the fence corner. The 100-foot baseline stake is rebar.





Map Name: Mount Pleasant . Diagrammatic Sketch

Township 14 S , Range 5E , Section 30 GPS: NAD 83, UTM 12S 464817 E 4380050 N

DISCUSSION

Cove Creek - Trend Study No. 16C-39

Study Information

This study samples an antelope bitterbrush (*Purshia tridentata*) and basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) community in the foothills between Fairview and Mt. Pleasant [elevation: 6,230 feet (1,898 m), slope: 0%-6%, aspect: west]. There is a canal and a stock pond 0.25 miles (0.4 km) to the south, both of which had water in 2002 and 2007. All of the area is privately owned. Domestic sheep graze the area in winter and/or spring, and there have been a few cattle in the large pasture. One fawn carcass from winter was found in 1989. In 2007, five deer carcasses were found. This number of dead deer seemed abnormally high for such a small area. It is likely that deer use the area as cover during the day, and forage in nearby agricultural fields at night. From the pellet group transect, deer use was estimated at 35 days use/acre (88 ddu/ha) in 2002 and 92 days use/acre (227 ddu/ha) in 2007. Elk were estimated at 8 days use/acre (20 edu/ha) in 2002 and 12 days use/acre (30 edu/ha) in 2007. Cattle use was estimated at 1day use/acre (2 cdu/ha) in 2002. Rabbits and small rodents are fairly common.

Soil

The soil is in the Mountainville series that consists of very deep, well-drained soils that formed in alluvium. These soils are on alluvial fans (USDA-NRCS 2007). The soil has sandy loam and a neutral to slightly acidic reactivity (pH of 6.6). The relative bare ground cover has been 3%-7% since 1997. Relative vegetation and litter cover has been high at 92%-95%, and adequately protects the soil from erosion. The erosion condition was classified as stable in 2002 and 2007. There are many game trails that may become flow patterns with intense precipitation events. There was also a road and four-wheeler paths through the area.

Browse

The preferred browse species that is most heavily used is antelope bitterbrush. Many of the plants have a tall growth form. However, there are also prostrate forms, often looking distorted due to severe hedging. Bitterbrush canopy cover was 13% in both 2002 and 2007. It had a density of 832 plants/acre (2,055 plants/ha) in 1989, 960 plants/acre (2,371 plants/ha) in 1997, 940 plants/acre (2,321 plants/ha) in 2002, and 800 plants/acre (1,976 plants/ha) in 2007. Young plants were abundant in 1989, comprising 48% of the population, but have made up 5% or less of the population since 1997, and decadence has been 8%-13%. Plants classified with poor vigor have steadily increased from 0% of the population in 1989 to 15% by 2007. Browse use has been mostly moderate-heavy. The average annual leader growth of antelope bitterbrush was 3.5 inches (8.9 cm) in 2002 and 2.6 inches (6.5 cm) in 2007.

Canopy cover of basin big sagebrush increased from 15% in 2002 to 17% in 2007. Basin big sagebrush had a density of 1,266 plants/acre (3,127 plants/ha) in 1989, 2,400 plants/acre (5,982 plants/ha) in 1997, 2,940 plants/acre (7,262 plants/ha) in 2002, and 1,560 plants/acre (3,853 plants/ha) in 2007. The recruitment of young decreased from 92% of the population in 1989 to 22% in 1997 and 2002, and 10% in 2007. Decadence steadily increased from 0% in of the population in 1989 to 15% by 2007. Plants classified with poor vigor have comprised 0%-17% of the population, and browse use was light-moderate. The average annual leader growth was 3.2 inches (8.1 cm) in 2002 and 2.4 inches (6.0 cm) in 2007.

There have been tall oak (*Quercus gambelii*) clones scattered around the study. It was first sampled in 1997. when the transect was extended, and the sample area increased. Canopy cover of oak increased from 1% in 2002 to 2% in 2007. It had a density of 940 stems/acre (2,322 stems/ha) in 1997, 1,640 stems/acre (4,051 stems/ha) in 2002, and 440 stems/acre (1,087 stems/ha) in 2007. The recruitment of young has remained relatively stable at 16%-18% of the population, however decadence has fluctuated from 0% in 1997, increasing to 44% in 2002, and decreasing to 5% in 2007. Plants showing poor vigor has been low at 5% or less of the population, and browse use has been light-moderate.

Herbaceous Understory

Due in part to the long history of grazing, increaser spiecies dominate the herbaceous understory. These weedy species contribute a high proportion of the total vegetative cover. Most of the preferred perennial grasses are protected by shrubs or cactus. Cheatgrass (*Bromus tectorum*) and bulbous bluegrass (*Poa bulbosa*) are common in the interspaces. Bulbous bluegrass is the most abundant perennial grass. It is a short-lived perennial, with low forage value ,and a life cycle similar to that of cheatgrass (Stewart and Hull 1949). It provided 14% of the total ground cover in 1997, 47% in 2002, and 33% in 2007. More desirable perennial grasses are present in relatively low abundance and include bluebunch wheatgrass (*Agropyron spicatum*), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass (*Poa secunda*), needle-and-thread (*Stipa comata*), and sand dropseed (*Sporobolus cryptandrus*). Cheatgrass provided 16% of the total ground cover in 1997, 5% in 2002, and 8% in 2007.

The forb component is comprised of weedy species, including the noxious species field bindweed (*Convolvulus arvensis*), musk thistle (*Carduus nutans)*, and houndstongue (*Cynoglossum officinale*). Bindweed is the dominant forb. It provided 12% of the total ground cover in 1997, and 3%-4% in 2002 and 2007. Additionally, storksbill (Erodium circutarium) and bur buttercup (Ranunculus testiculatus), both of which are allelopathic annuals (Kimball and Schiffman 2003, Buchanan et al. 1978) have been sampled.

1997 TREND ASSESSMENT

The browse trend is slightly up. The density of basin big sagebrush increased nearly two-fold. This increase was due in part to the increased sample area. The recruitment of young decreased from 92% of the population to 22%, and decadence changed little, increasing from 0% to 1%. Plant vigor remained excellent, and browse use was light. The density of antelope bitterbrush increased 15%. The recruitment of young decreased from 48% of the population to 4%, and decadence increased from 8% to 13%. Plants classified with poor vigor remained low at 2% of the population. Browse use shifted from moderate-heavy to heavy, and heavily browsed plants increased from 56% of the population to 90%. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grass changed little. Bulbous bluegrass was sampled for the first time and provided 14% average cover. Cheatgrass was also sampled for the first time and provided 16% cover. The forb trend is stable. The sum of nested frequency for perennial forbs decreased 16%. However, if noxious weeds are excluded, the sum of nested frequency of perennial forbs changed little, decreasing 2%. The nested frequency of storksbill increased significantly. Houndstongue was not sampled, but musk thistle was, and bindweed changed little in nested frequency. The Desirable Components Index (DCI) score was very poor due to low recruitment, high annual grass cover, and noxious weeds.

winter range condition (DCI) - very poor (31) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is slightly up. The density of basin big sagebrush increased 23%. The recruitment of young, decadence, vigor, and browse use changed little. The density of antelope bitterbrush changed little. There were no young, and decadence decreased to 9% of the population. Plants classified with poor vigor increased to 6%. Browse use was moderate-heavy. The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency for perennial grasses, increased 79%. The nested frequencies of Sandberg bluegrass and needle-and-thread increased significantly. The sum of nested frequency for bulbous bluegrass increased 42%, and its average cover increased from 14% to 47%. However, the increase in bulbous bluegrass was offset by a decrease in annual grasses. The sum of nested frequency for annual grass decreased 37%. The nested frequency for cheatgrass decreased 46%, and its average cover decreased from 16% to 5%. The forb trend is slightly down. The sum of nested frequency for perennial forbs decreased 34%. If noxious weeds are excluded, the sum of nested frequency of perennial forbs decreased 65%, but non-noxious, perennial species abundance had already been low. However, the sum of nested frequency for annual forbs decreased 62%. Bur buttercup, bindweed, and storksbill all decreased significantly in nested frequency. Musk thistle was not

sampled, and bindweed was the only noxious weed present. The DCI score improved to fair due to increased browse cover, increased perennial grass cover, and decreased annual grass cover.

winter range condition (DCI) - fair (62) Mid-level potential scale
browse - slightly up (+1) grass - up (+2) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is down. The density of basin big sagebrush decreased 47%. The recruitment of young decreased to 10% of the population, and decadence increased to 15%. Plants classified with poor vigor increased to 17% of the population, and the sagebrush defoliator moth (*Aroga websteri*) had infested 41% of the population. Browse use increased to light-moderate. The density of antelope bitterbrush decreased 15%. The recruitment of young increased to 5% of the population, and decadence increased to 13%. Plants classified as having poor vigor increased to 15% of the population, and browse use was mostly moderate-heavy. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency for perennial grasses decreased 49%. The nested frequency for bulbous bluegrass changed little, but its average cover decreased to 33%. The sum of nested frequency for annual grass increased 47%. The nested frequency of cheatgrass increased significantly, and its average cover increased from 5% to 8%. The forb trend is stable. The sum of nested frequency for perennial forbs changed little. The sum of nested frequency for annual forbs increased 35%. However, this was mostly due to the 53% increase in the nested frequency of pale alyssum (*Alyssum alyssoides*). The DCI score declined to poor with results similar to 1997 measurements.

winter range condition (DCI) - poor (36) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 16C, Study no: 39

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron intermedium	-	-	$_{a}$9	$_{a}$5	-	.19	.03
G	Agropyron spicatum	$_{a}$15	$_{a}$17	$_{a}$10	$_{a}$21	.77	.36	.95
G	Bromus japonicus (a)	-	$_{a}$2	$_{b}$30	$_{a}$15	.03	.07	.02
G	Bromus tectorum (a)	-	$_{c}$302	$_{a}$162	$_{b}$258	15.94	4.80	8.43
G	Oryzopsis hymenoides	$_{a}$1	$_{a}$-	$_{a}$5	-	.00	.18	-
G	Poa bulbosa	-	$_{a}$214	$_{b}$303	$_{b}$332	14.45	47.29	32.80
G	Poa fendleriana	-	$_{a}$9	-	$_{a}$4	.07	-	.04
G	Poa pratensis	$_{b}$19	$_{ab}$18	$_{a}$3	-	.25	.03	-
G	Poa secunda	$_{a}$23	$_{a}$32	$_{b}$67	$_{a}$24	1.11	1.14	.22
G	Sporobolus cryptandrus	$_{a}$22	$_{a}$15	$_{a}$33	$_{a}$12	.13	.83	.36
G	Stipa comata	$_{ab}$27	$_{a}$13	$_{b}$59	$_{b}$29	.71	7.05	1.64
G	Vulpia octoflora (a)	-	-	-	9	-	-	.04
Total for Annual Grasses		0	304	192	282	15.97	4.87	8.49
Total for Perennial Grasses		107	318	489	427	17.52	57.09	36.06
Total for Grasses		107	622	681	709	33.49	61.95	44.56

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Alyssum alyssoides (a)	-	-	$_{a}$76	$_{b}$116	-	.99	1.03
F	Allium sp.	-	10	-	-	.09	-	-
F	Artemisia ludoviciana	3	-	-	-	-	-	-
F	Carduus nutans (a)	-	10	-	-	.40	-	-
F	Cirsium sp.	$_{a}$1	$_{a}$7	-	-	.21	-	-
F	Convolvulus arvensis	$_{b}$234	$_{b}$202	$_{a}$148	$_{a}$145	12.14	3.55	3.08
F	Collinsia parviflora (a)	-	-	$_{a}$1	$_{a}$3	-	.00	.01
F	Cryptantha sp.	-	4	-	-	.01	-	-
F	Cynoglossum officinale	16	-	-	-	-	-	-
F	Epilobium brachycarpum (a)	-	$_{a}$11	$_{a}$5	-	.03	.01	-
F	Erodium cicutarium (a)	$_{b}$127	$_{c}$221	$_{a}$9	$_{a}$32	3.83	.02	.45
F	Eriogonum racemosum	$_{a}$9	$_{a}$8	$_{a}$7	$_{a}$4	.16	.04	.01
F	Galium aparine (a)	-	-	-	3	-	-	.15
F	Hackelia patens	-	-	-	4	-	-	.03
F	Lactuca serriola	9	-	-	-	-	-	-
F	Lepidium sp. (a)	-	$_{b}$55	$_{a}$31	$_{ab}$34	.92	.39	.74
F	Lithospermum ruderale	4	-	-	-	-	-	-
F	Machaeranthera canescens	$_{b}$23	$_{ab}$10	$_{a}$2	$_{a}$3	.03	.03	.15
F	Phlox longifolia	$_{a}$3	$_{a}$3	$_{a}$5	-	.01	.01	-
F	Polygonum douglasii (a)	-	$_{b}$38	$_{a}$11	-	.13	.03	-
F	Ranunculus testiculatus (a)	-	$_{b}$54	$_{a}$11	$_{a}$8	.25	.05	.04
F	Sisymbrium altissimum (a)	$_{a}$6	$_{a}$-	$_{a}$3	$_{a}$2	.00	.00	.03
F	Sphaeralcea coccinea	-	$_{a}$2	$_{a}$4	$_{a}$3	.15	.03	.03
F	Taraxacum officinale	-	3	-	-	.03	-	-
F	Tragopogon dubius	-	3	-	-	.00	-	-
F	Viguiera multiflora	-	1	-	-	.03	-	-
Total for Annual Forbs		133	389	147	198	5.57	1.50	2.48
Total for Perennial Forbs		302	253	166	159	12.87	3.67	3.30
Total for Forbs		435	642	313	357	18.44	5.18	5.78

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

BROWSE TRENDS --
Management unit 16C, Study no: 39

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata tridentata	47	48	48	5.71	11.89	10.59
B	Gutierrezia sarothrae	4	1	5	.03	.00	.00
B	Opuntia sp.	67	65	49	5.97	3.95	4.00
B	Purshia tridentata	37	42	35	10.05	12.92	5.67
B	Quercus gambelii	4	4	4	.53	1.00	1.00
B	Rosa woodsii	1	2	0	-	-	-
Total for Browse		160	162	141	22.29	29.78	21.28

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 39

Species	Percent Cover	
	'02	'07
Artemisia tridentata tridentata	15.19	17.25
Gutierrezia sarothrae	-	.06
Opuntia sp.	2.84	1.38
Purshia tridentata	12.61	13.21
Quercus gambelii	.86	1.78
Rosa woodsii	.05	-

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 39

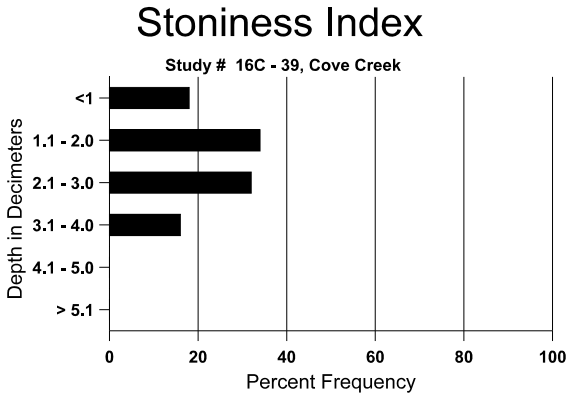
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata tridentata	3.2	2.4
Purshia tridentata	3.5	2.6

BASIC COVER --
Management unit 16C, Study no: 39

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	20.50	62.59	80.27	75.54
Rock	3.75	1.16	.66	1.15
Pavement	0	.15	.25	.11
Litter	53.25	49.92	28.67	21.89
Cryptogams	0	.26	.71	.02
Bare Ground	22.50	5.58	3.61	7.94

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 39, Cove Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
9.7	65.8 (13.3)	6.6	66.4	19.8	13.8	1.7	30.9	208.0	.5



PELLET GROUP DATA --
Management unit 16C, Study no: 39

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	20	1	3
Rabbit	18	29	35
Horse	-	1	-
Elk	11	3	11
Deer	34	22	13
Cattle	-	2	1

Days use per acre (ha)	
'02	'07
1 (3)	-
-	-
-	-
8 (20)	12 (30)
35 (88)	92 (227)
1 (2)	-

BROWSE CHARACTERISTICS --
Management unit 16C, 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)
Artemisia tridentata tridentata												
89	**1266**	600	1166	100	-	-	32	11	0	-	5	28/30
97	**2400**	60	520	1860	20	80	5	0	1	-	0	34/39
02	**2940**	100	660	2180	100	80	0	0	3	1	1	31/37
07	**1560**	180	160	1160	240	100	51	3	15	9	17	38/44

		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)
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	18/23
Gutierrezia sarothrae												
89	**33**	-	-	33	-	-	0	0	-	-	0	5/4
97	**340**	-	-	340	-	-	0	0	-	-	0	16/15
02	**20**	-	-	20	-	-	0	0	-	-	0	10/13
07	**200**	-	40	160	-	-	0	0	-	-	0	12/14
Opuntia sp.												
89	**732**	-	166	433	133	-	0	0	18	-	5	9/52
97	**6840**	20	-	6460	380	160	0	0	6	5	5	7/21
02	**5400**	-	240	4660	500	40	0	0	9	2	4	7/15
07	**2720**	-	40	2620	60	-	4	0	2	.73	1	6/10
Purshia tridentata												
89	**832**	100	400	366	66	-	28	56	8	-	0	38/53
97	**960**	-	40	800	120	100	4	90	13	2	2	48/67
02	**940**	-	-	860	80	-	28	51	9	6	6	37/57
07	**800**	40	40	660	100	80	38	55	13	5	15	43/56
Quercus gambelii												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**940**	-	160	780	-	40	57	0	0	-	0	17/17
02	**1640**	-	260	660	720	-	0	0	44	-	0	25/14
07	**440**	-	80	340	20	20	55	0	5	5	5	41/18
Rosa woodsii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**80**	-	-	80	-	-	0	0	-	-	0	13/12
02	**140**	-	-	140	-	-	0	0	-	-	0	11/7
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 16C-45-07

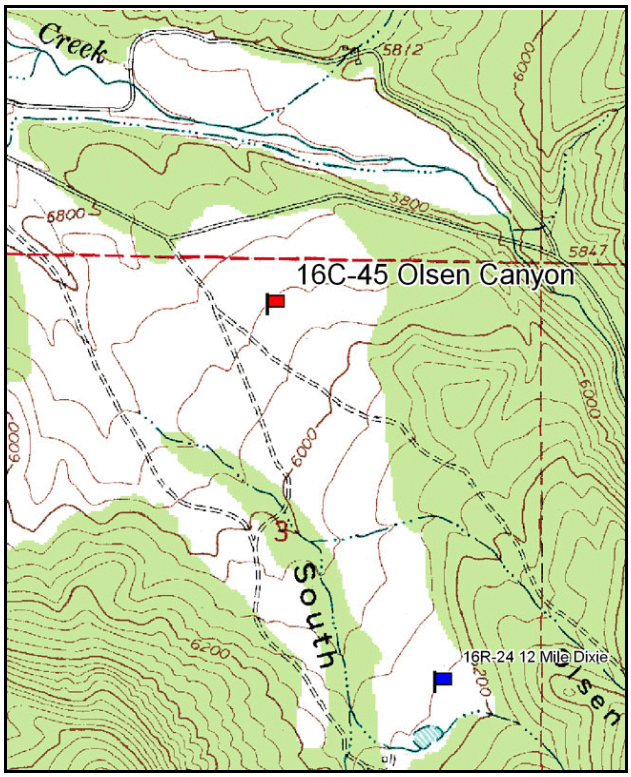
Study site name: Olsen Canyon . Vegetation type: Wyoming Sagebrush .

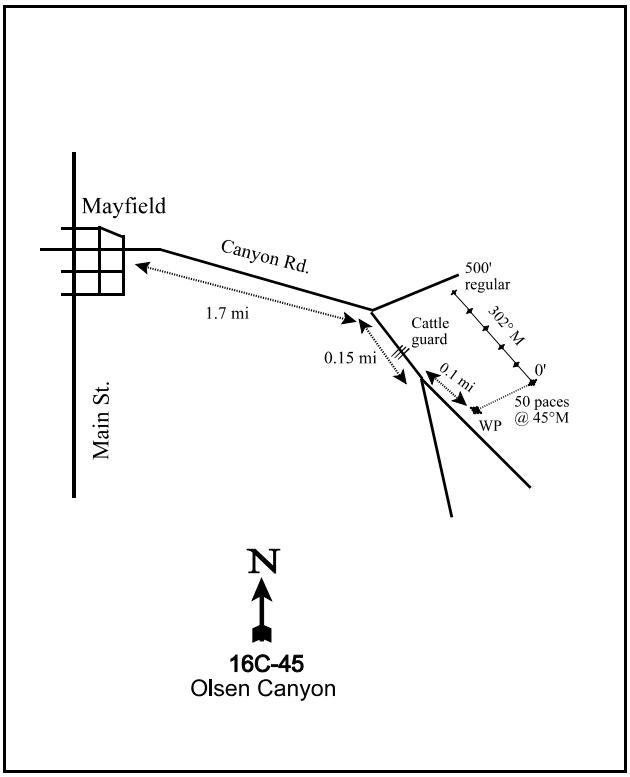
Compass bearing: frequency baseline 302 degrees magnetic.

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

LOCATION DESCRIPTION

Traveling south on Main St. in Mayfield, turn left (east) onto Canyon Road. Go for 1.7 miles to a "Y" intersection. Take the right fork (a dirt road) and go for 0.15 mile, crossing a cattle guard along the way, and take the left fork of another "Y" intersection. Go 0.1 mile to a witness post on the left side of the road. From the witness post the 0-foot baseline stake is 50 paces at 45 degrees magnetic and is marked by browse tag #196.





Map Name: Mayfield Diagrammatic Sketch

Township 20S , Range 2E , Section 4 GPS: NAD 83, UTM 12S 441564 E 4328634 N

DISCUSSION

Olsen Canyon - Trend Study No. 16C-45

Study Information

This study is located on a large, 35-year-old chaining and seeding treatment on Utah Division of Wildlife Resources land to the east of Mayfield [elevation: 5,930 feet (1,807 m), slope: 5%, aspect: west]. It was established in 2007 as part of the 12-mile WMA habitat improvement, to monitor the thinning (lop and scatter) of encroaching juniper (*Juniperus osteosperma*) trees on a Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*) flat. In 2007, from a pellet group transect, deer use was estimated at 252 days use/acre (622 ddu/ha), and was from fall, winter, and spring. Elk use was estimated at 6 days use/acre (15 edu/ha), and was primarily spring use. Cattle use was estimated at 6 days use/acre (14 cdu/ha), and was from spring or summer use.

Soil

The soil is in the Fontreen series, which consists of very deep, well-drained, moderately-rapidly permeable soils that formed in alluvium and colluvium from limestone, sandstone, chert, and shale. Fontreen soils are on alluvial fans, hillslopes, and mountain slopes (USDA-NRCS 2007). The soil has a loam texture and a neutral reactivity (pH of 7.2). It is light brown in color, with rock and pavement scattered about the surface. The combined relative vegetation and litter cover was 62%. The relative bare ground cover was 20%. In 2007, the erosion condition was classified as stable.

Browse

The dominant preferred browse is Wyoming big sagebrush. Canopy cover of Wyoming big sagebrush was 7% in 2007. It had a density of 980 plants/acre (2,420 plants/ha). There were no young, however, seedlings were estimated at 60 plants/acre (148 plants/ha). Decadent plants comprised 20% of the population in 2007, and plants with poor vigor comprised 6%. Browse use was mostly moderate. The leader growth averaged 2.7 inches (7.0 cm). Black sagebrush (*Artemisia nova*) was also present. Canopy cover of black sagebrush was 3% in 2007, and the density was estimated at 420 plants/acre (1,037 plants/ha). There were no decadent or young plants in the population. However, seedlings were estimated at 400 plants/acre (988 plants/ha). Plant vigor was excellent, and browse use was light-moderate. Other preferred browse species sampled in lower densities were white rubber rabbitbrush (*Chrysothamnus nauseosus* spp. *albicalis*) and Nevada ephedra (*Ephedra nevadensis*). The dominant browse species is broom snakeweed (*Gutierrezia sarothrae*). It had a density of 6,000 plants/acre (14,820 plants/ha). There were a few scattered juniper trees. Juniper was not sampled in the line intercept canopy cover, but the point-centered quarter data estimate of juniper was 25 trees/acre (62 trees/ha). The average trunk diameter was 5.7 inches (14.5 cm).

Herbaceous Understory

The understory is dominated by perennial grass, which provided 24% of the total ground cover. The dominant perennial grasses were crested wheatgrass (*Agropyron cristatum*) and Sandberg bluegrass (*Poa secunda*), which provided 10% and 7% cover, respectively. All of the grasses showed some use. There are few forbs in the understory. They provided 2% of the total ground cover. Bur buttercup (Ranunculus testiculatus) is the dominant forb, and it provided 75% of the total forb cover. It has allelopathic chemicals that prevent the seed germination of many native species (Buchanan et al. 1978). The dominant perennial forb is timber poisonvetch (*Astragalus convallarius*).

2007 PRE-TREATMENT ASSESSMENT

The winter range condition determined by the Desirable Components Index (DCI) score was good. Browse cover was low-moderate. Wyoming big sagebrush provided 7% canopy cover. Twenty percent of the population was decadent, and no young plants were sampled. Browse use was light-moderate. Black sagebrush provided 3% canopy cover. There were no decadent plants, however, there were no young plants

either. Browse use was light-moderate. The perennial grasses provided 23% average cover, and annual grass cover was 1%. Grasses provided 70 % of the total vegetation cover. Perennial forb cover was poor, providing less than 1% cover.

2007 winter range condition (DCI) - good (48) Low potential scale

HERBACEOUS TRENDS --
Management unit 16C, Study no: 45

Type	Species	Nested Frequency '07	Average Cover % '07
G	Agropyron cristatum	252	10.11
G	Agropyron intermedium	92	2.93
G	Agropyron spicatum	46	1.38
G	Bromus tectorum (a)	110	.81
G	Oryzopsis hymenoides	8	.46
G	Poa bulbosa	3	.03
G	Poa secunda	289	6.55
G	Stipa comata	49	1.43
Total for Annual Grasses		110	0.81
Total for Perennial Grasses		739	22.91
Total for Grasses		849	23.72
F	Astragalus convallarius	48	.34
F	Astragalus utahensis	1	.03
F	Collinsia parviflora (a)	3	.00
F	Lesquerella sp.	1	.00
F	Phlox hoodii	17	.11
F	Ranunculus testiculatus (a)	292	1.50
Total for Annual Forbs		295	1.51
Total for Perennial Forbs		67	0.49
Total for Forbs		362	2.00

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

BROWSE TRENDS --
Management unit 16C, Study no: 45

Type	Species	Strip Frequency '07	Average Cover % '07
B	Artemisia nova	13	1.62
B	Artemisia tridentata wyomingensis	32	4.00
B	Chrysothamnus nauseosus albicaulis	2	.15
B	Chrysothamnus viscidiflorus stenophyllus	20	.09
B	Ephedra nevadensis	2	.03
B	Gutierrezia sarothrae	67	2.41
B	Opuntia sp.	1	-
Total for Browse		137	8.31

CANOPY COVER, LINE INTERCEPT --
Management unit 16C, Study no: 45

Species	Percent Cover '07
Artemisia nova	2.50
Artemisia tridentata wyomingensis	6.58
Chrysothamnus viscidiflorus stenophyllus	.36
Ephedra nevadensis	.65
Gutierrezia sarothrae	1.45

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 16C, Study no: 45

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

POINT-QUARTER TREE DATA --
Management unit 16C, Study no: 45

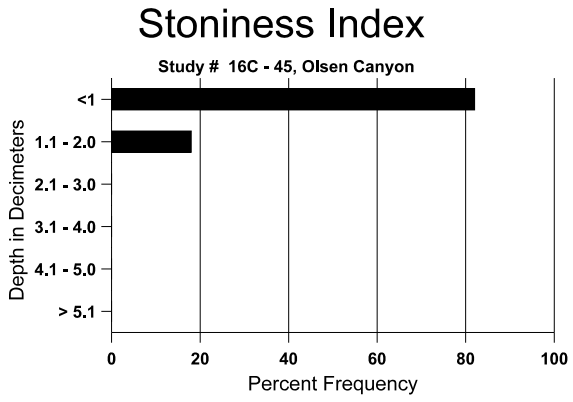
Species	Trees per Acre '07	Average diameter (in) '07
Juniperus osteosperma	29	5.7

BASIC COVER --
Management unit 16C, Study no: 45

Cover Type	Average Cover % '07
Vegetation	40.14
Rock	3.48
Pavement	12.90
Litter	27.57
Cryptogams	4.00
Bare Ground	21.63

SOIL ANALYSIS DATA --
Herd Unit 16C, Study no: 45, Olsen Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
-	-	7.2	46.2	22.8	31.0	2.8	11.6	188.8	.9



PELLET GROUP DATA --
Management unit 16C, Study no: 45

Type	Quadrat Frequency '07	Days use per acre (ha) '07
Rabbit	39	-
Elk	4	6 (15)
Deer	68	252 (622)
Cattle	3	6 (14)

BROWSE CHARACTERISTICS --
Management unit 16C, Study no: 45

		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	**420**	400	-	420	-	-	52	0	-	-	0	18/37
Artemisia tridentata wyomingensis												
07	**980**	60	-	780	200	80	53	18	20	6	6	25/39
Chrysothamnus nauseosus albicaulis												
07	**40**	-	-	-	40	-	50	50	100	50	100	33/49
Chrysothamnus viscidiflorus stenophyllus												
07	**520**	-	20	460	40	20	19	27	8	-	0	10/16
Ephedra nevadensis												
07	**80**	-	40	-	40	-	50	50	50	-	0	12/17
Gutierrezia sarothrae												
07	**6000**	-	220	5720	60	60	3	.33	1	.33	.66	8/9
Opuntia sp.												
07	**20**	-	-	20	-	-	0	0	-	-	0	4/10

SUMMARY

WILDLIFE MANAGEMENT UNIT 16C - MANTI-NEBO, MANTI-SOUTH

Community types

The studies for subunit 16C are found in areas from Fairview south to Mayfield. Fourteen trend studies were established in this management unit in 1989, and one in 2007. Julius Pasture (16C-10) was not read in 2002 and 2007 due to access problems. In 2007, at the request of the region biologist Bald Mountain (16C-4) was suspended. Nine of the 13 studies that were sampled in 2007 are pinyon-juniper sites that have been chained and seeded. Some of these showed an increasing overstory of pinyon, juniper, and oak. Of the remaining four, two studies sample mountain brush communities, one study samples a sagebrush-grass community, and one samples an antelope bitterbrush-Wyoming big sagebrush community.

Precipitation

Precipitation data from weather stations at Ephraim and Manti show alternating wet and dry cycles from 1983 to 2007. Precipitation is the single most important factor determining the type and productivity of vegetation of an area (Holechek 2004). The average annual precipitation for the subunit has not been below 75% (drought conditions) (Figure 1). Spring precipitation was less than 75% of normal in 2002 and 2007 (Figure 2). Spring precipitation is important for shrub, perennial grass, and forb recruitment. Fall precipitation, which benefits cheatgrass (*Bromus tectorum*), was less than 75% of normal in 1995, 1999, and 2003.

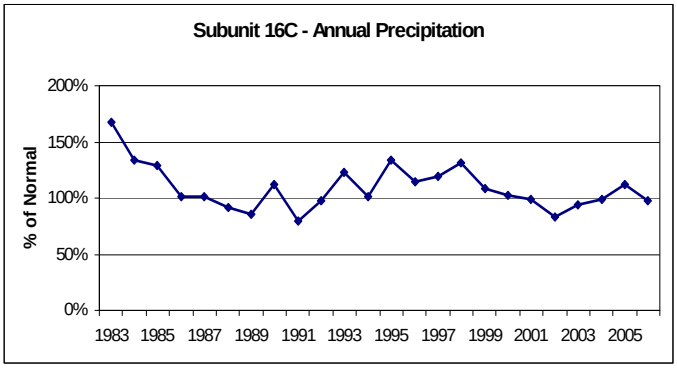


Figure 1. Percent of normal annual precipitation for subunit 16C. Data were collected at the Manti and Ephraim weather stations (Utah Climate Summaries 2007).

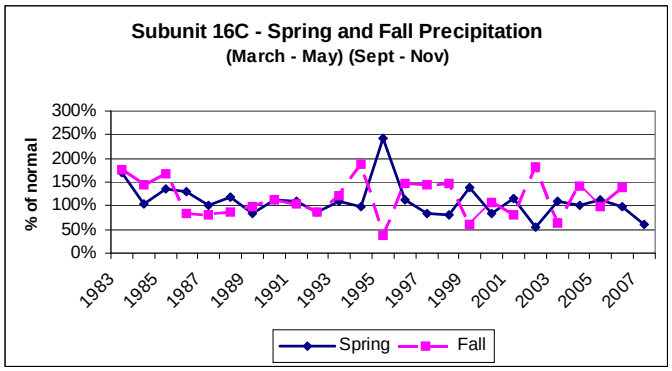


Figure 2. Spring and fall precipitation for subunit 16C. Data were collected at the Manti and Ephraim weather stations (Utah Climate Summaries 2007).

Browse

The cumulative browse trend showed decreasing conditions from 1997 to 2007 (Figure 3). This decline was attributed to changes in density, recruitment of young, decadence, and poor plant vigor of the preferred browse population. Pleasant Creek (16C-38) and Cove Creek (16C-39) were the studies in the subunit with basin big sagebrush. The average basin big sagebrush density increased 24% in 2002, and decreased 39% in 2007 (Figure 4). The subunit average cover increased to near 7% in 2002 and changed little in 2007 (Figure 5). The average decadence decreased to 5% in 2002, and increased to 34% in 2007 (Figure 6).

Mountain big sagebrush was sampled at Willow Creek (16C-2), North Manti Face (16C-3), Cane Valley (16C-5), Mayfield Mountain Face (16C-7), Pole Canyon Oak (16C-9), and Cove Creek. The average mountain big sagebrush density for the subunit increased 16% in 2002 and decreased 31% in 2007 (Figure 4). Average cover was stable at

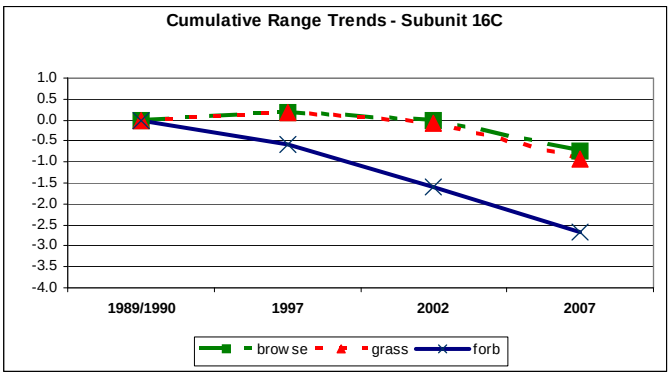


Figure 3. Cumulative range trends for subunit 16C.

2%-3% in 2002 and decreased to 1% in 2007 (Figure 5). Average decadence increased to 34% in 2002, and 42% in 2007 (Figure 6). Wyoming big sagebrush was sampled at Black Hill (16C-6) and Manti Dump (16C-12). The average Wyoming big sagebrush density for the subunit decreased 31% in 2002 and 24% in 2007 (Figure 4). Average cover decreased to 4% in 2002 and 3% in 2007 (Figure 5). The average decadence increased to 34% in 2002, and decreased to 27% in 2007 (Figure 6). Black sagebrush was sampled at Manti Face Chaining (16C-1), North Manti Face, Black Hill, Mayfield Mtn. Face, Manti Dump, and Olsen Canyon (16C-45). The average black sagebrush density increased 26% in 2002 and decreased 28% in 2007 (Figure 4). Average cover was stable at 2% in all samples (Figure 5). The average decadence increased to 12% in 2002 and 37% in 2007 (Figure 6).

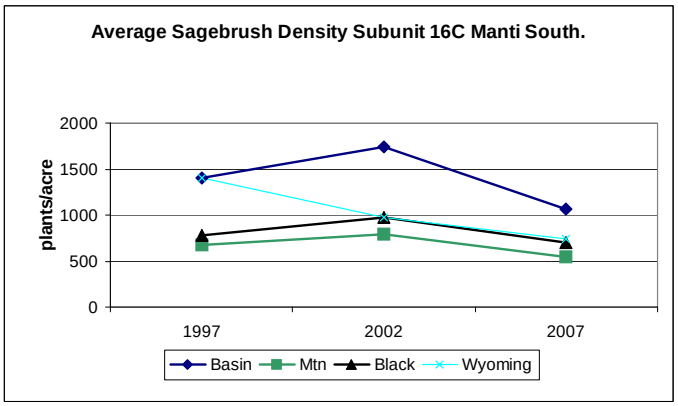


Figure 4. Average density of basin big, mountain big, Wyoming big, and black sagebrush for subunit 16C.

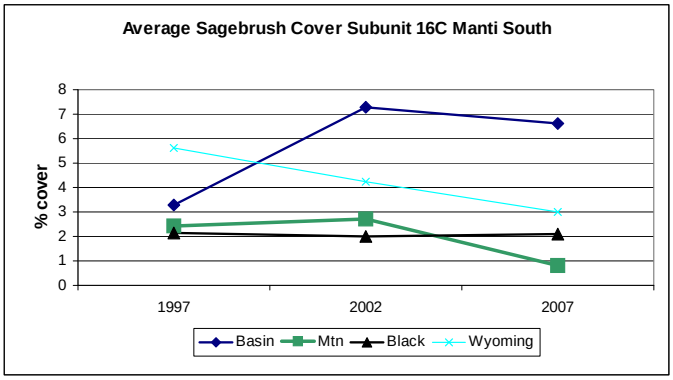


Figure 5. Average cover of basin big, mountain big, Wyoming big, and black sagebrush for subunit 16C.

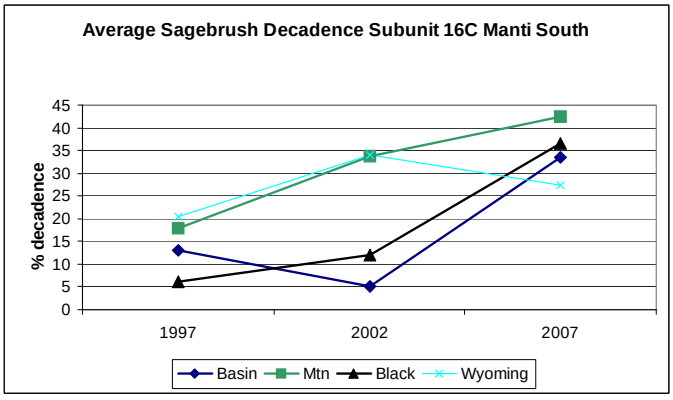


Figure 6. Average decadence for basin big, mountain big, Wyoming big, and black sagebrush for subunit 16C.

Grass

The cumulative grass trend for subunit 16C was stable from 1989 to 1997, and declined in 2002, and 2007 (Figure 3). The nested frequency of perennial grass for subunit 16C decreased 16% in 2002 and increased 19% in 2007 (Figure 7). However, the average cover was 12% in 1997 and 2002, and increased to 14% in 2007 (Figure 8). Cheatgrass was sampled at all thirteen studies in 2007. The average nested frequency of cheatgrass decreased 70% in 2002 and increased five-fold in 2007 (Figure 7). The average cover of cheatgrass decreased from 2% in 1997 to 1% in 2002, and increased to 3% in 2007 (Figure 8). Bulbous bluegrass was sampled at Cove Creek (16C-39) in 1997, at Cove Creek and Manti Dump (16C-12) in 2002, and at Cove Creek, Manti Dump, Cane Valley (16C-5), Black Hill (16C-6), and Pleasant Creek (16C-39) in 2007. The average nested frequency of bulbous bluegrass increased 44% in 2002 and decreased 10% in 2007 (Figure 7). The average cover of bulbous bluegrass increased from 1% in 1997 to 4% in 2002, and decreased to 3% in 2007 (Figure 8). A common trend throughout the unit in 2002 was declining nested frequency values for herbaceous species (Figure 7). The decline could be due to the near drought conditions experienced during the fall of 2001, and drought conditions in the spring of 2002 (Utah Climate Summaries 2007).

Forb

The cumulative perennial forb trend has steadily declined from 1989 to 2007. The nested frequency for perennial forbs decreased 37% in 2002 and increased 17% in 2007 (Figure 7). The average cover decreased from 3% in 1997 to 2% in 2002 and 2007 (Figure 8).

Desirable Components Index

The DCI scores are divided into three categories based on ecological potentials, which include low, mid-level, and high. The average Desirable Components Index (DCI) rating decreased from fair-poor in 1997 to poor in 2002, and very poor in 2007 for the mid-level potential scale studies (Figure 9). For the low potential scale studies, the DCI rating remained fair from 1997 to 2007.

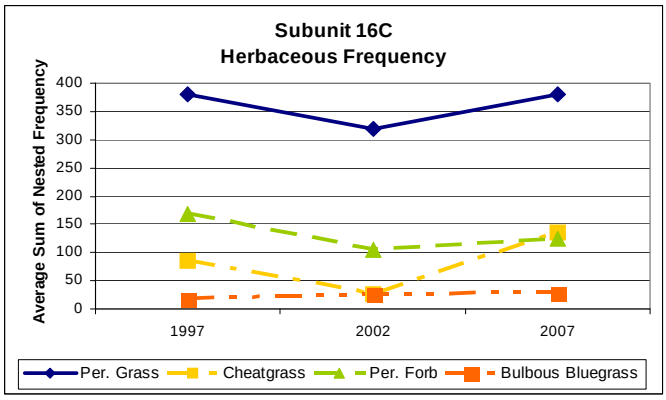


Figure 7. Average herbaceous frequency for subunit 16C.

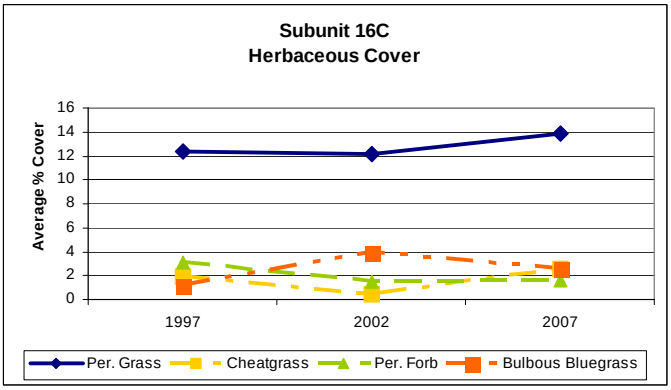


Figure 8. Average herbaceous cover for subunit 16C.

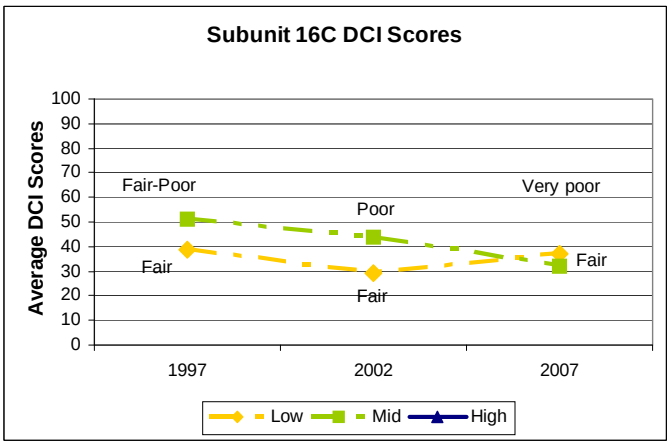
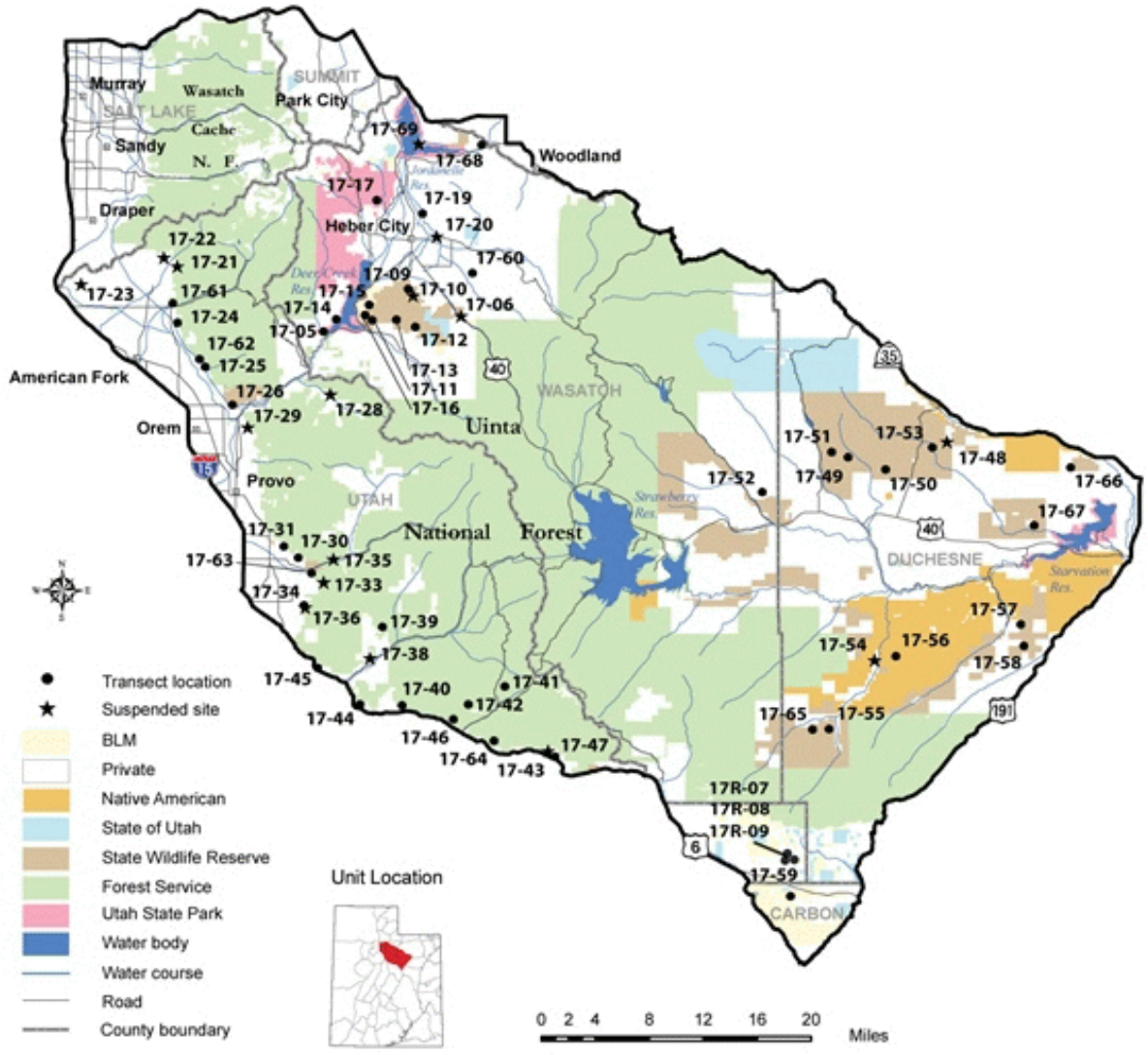


Figure 9. Average Desirable Components Index (DCI) score for subunit 16C. DCI scores are categorized based on ecological potentials that include: high, mid-level, and low.

Management Unit 17



MANAGEMENT UNIT 17 - WASATCH MOUNTAINS

BOUNDARY DESCRIPTION

Salt Lake, Summit, Wasatch, Duchesne, Carbon, and Utah Counties - Boundary begins at the junction of I-15 and I-80 in Salt Lake City; east on I-80 to US-40; south on US-40 to SR-32; east on SR-32 to SR-35; southeast on SR-35 to SR-87; south on SR-87 to Duchesne and US-191; south on US-191 to US-6; northeast on US-6 to I-15; north on I-15 to I-80 in Salt Lake City and beginning point.

MANAGEMENT UNIT DESCRIPTION

Management unit 17 is divided into eight smaller, more manageable subunits. These are: Diamond Fork, Hobble Creek, Timpanogos, Salt Lake County-East Bench, Heber, Currant Creek, Avintaquin, and Price Canyon. The 2007 report covers only the Diamond Fork, Hobble Creek, Timpanogos, and Heber subunits. The Salt Lake County-East Bench subunit no longer contains range trend studies due to lack of access and development. The Currant Creek and Avintaquin subunits are monitored as part of the Division's Northeastern Region rotation which were last read in 2005 and will be reread in 2010. The Price Canyon subunit is monitored as part of the Division's Southeastern Region rotation which was last read in 2004 and will be reread in 2009.

Of the total area within this management unit, 63% is summer range, 35% is winter range, and 2% is classified as year-long range. The areas of most concern in this unit are the winter ranges, which are very limited in quantity and quality. Residential developments along the Wasatch Front have consumed much of the critical winter range that was available to wildlife, and this will continue in the future. Because most of the winter range in this unit now lies on private land, managing wildlife populations is a challenge. Critical issues facing management of big game in unit 17 include crop depredation, habitat quantity and quality, and highway mortality (Hersey and McLaughlin 2006).

Habitat Management Objectives/Strategies

The primary habitat management objectives for this unit are: 1) maintain and/or enhance forage production through direct range improvements throughout the unit on winter range; 2) work with private landowners and federal, state, local, and tribal governments to maintain and protect critical and existing winter range from future losses; and 3) provide improved habitat security and escapement opportunities for deer. The strategies to be used to accomplish these objectives are: 1) monitor range trend studies throughout the unit, specifically those found on remaining winter ranges; 2) work cooperatively to utilize grazing, prescribed burning, and other recognized vegetative manipulation techniques to enhance deer forage quantity and quality; 3) utilize antlerless deer harvest to improve or protect forage when vegetative declines are attributed to deer over-utilization; and 4) cooperate with and provide input to land management planning efforts dealing with management affecting habitat security, quality, and quantity (Hersey and McLaughlin 2006).

Range Trend Studies

The range trend studies in the Diamond Fork, Hobble Creek, and Timpanogos subunits were established in 1983, and resampled in 1989, 1997, 2002, and 2007. The trend studies in the Heber subunit were established in 1983 and 1984, and resampled in 1989, 1996, 2002, and 2007. Several studies were suspended in 2002 due to lack of access and loss to development. Some studies were not read because they no longer are representative of critical winter range. Several new studies were established in 2002 to monitor new areas considered critical for big game, including a few for Rocky Mountain bighorn sheep. In 2007, two studies were suspended due to lack of access. The suspension of old studies and the establishment of new sites is done with input from Division biologists and federal land managers.

Trend Study 17-5-07

Study site name: Deer Creek Dam . Vegetation type: Big Sagebrush-Grass .

Compass bearing: frequency baseline 180 degrees magnetic (line 2-4 @ 108°M).

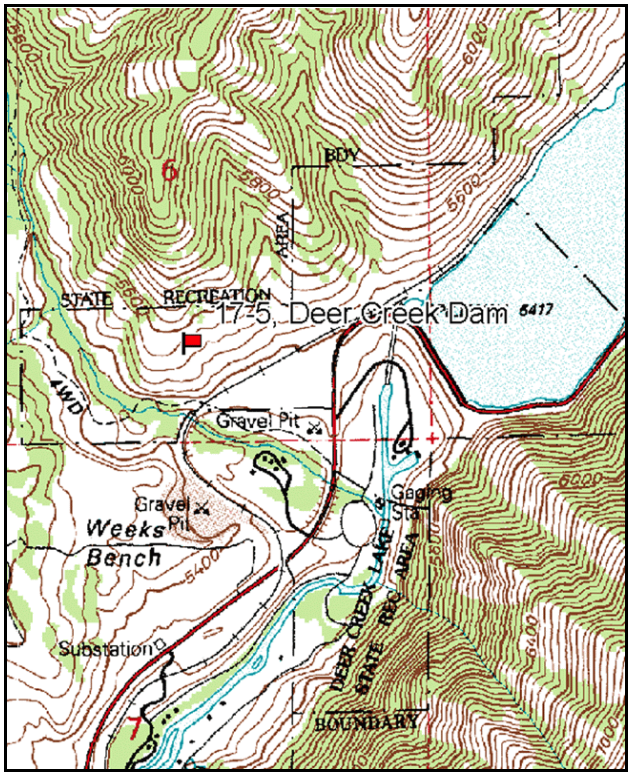
Frequency belt placement: line 1 (11 & 95ft), line 2 [belt 4] (71ft), line 3 (34ft), line 4 [belt 3] (71ft).

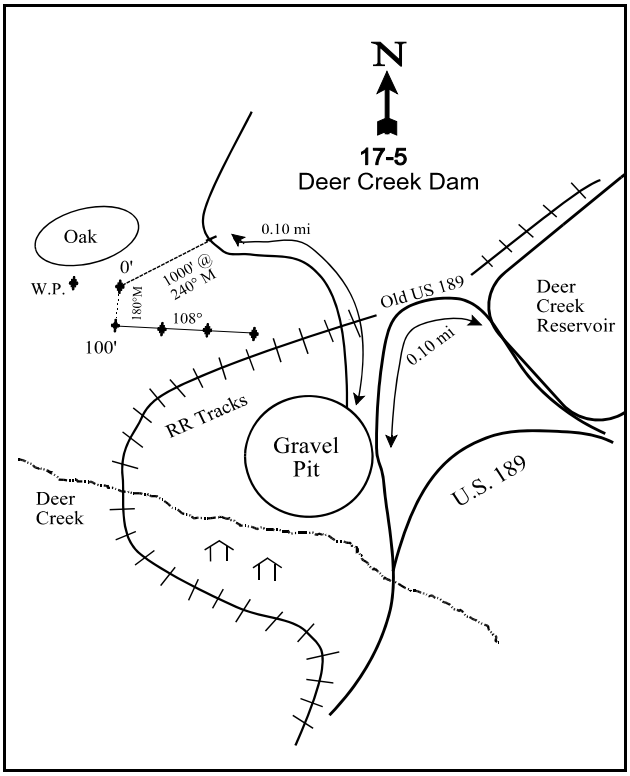
Rebar: In 2007 rebar was found on belts 1 & 5 but not on belts 2, 3 & 4

LOCATION DESCRIPTION

***When the study was sampled in 2007, U.S. 189 was under construction and was being realigned. Once construction is completed, these directions may no longer be valid.

From the dam at the south end of Deer Creek Reservoir, proceed south on U.S. 189 for 0.10 miles to an intersection to the west that enters a gravel pit. Turn right toward Deer Creek and proceed northwesterly to the intersection of the Denver and Rio-Grande railroad tracks. Continue for 0.1 miles to where the road bends to the north. Walk 1000 feet at heading of 240 degrees to a full high witness post. The 0-foot baseline stake is 20 feet from the witness post. A red browse tag, number 3914, is attached to the 0-foot baseline stake. Line 4 belt 3 was mistakenly put at 71 feet, and in order to be consistent, belt 3 has not been moved to 59 feet.





Map Name: Aspen Grove

Diagrammatic Sketch

Township 5S , Range 4E , Section 6

GPS: NAD 83, UTM 12S 454470 E 4473073 N

DISCUSSION

Deer Creek Dam - Trend Study No. 17-5

Study Information

This study is located within deer winter range on a moderately sloping bench at the mouth of Deer Creek [elevation: 5,540 feet (1,689 m), slope (12%-20%), aspect: south-southeast]. The study is on land administered by the Utah Division of Parks and Recreation about 0.5 miles (2.6 km) west of Deer Creek dam. Power line construction previous to site establishment in 1989 disturbed the ground along the end of the frequency lines. This resulted in a decrease many of the mature sagebrush being eliminated and a proliferation of sagebrush and annual weeds. The study is approximately 1000 feet (305 m) to the west of a staging area and gravel pit that were actively being used in 2007 as a part of the realignment project on US-189. Winter and spring deer use has been moderate. From the pellet group transect, there were an estimated 32 deer days use/acre (79 ddu/ha) in 2002 and 30 deer days use/acre (74 ddu/ha) in 2007. Elk use was estimated at 6 days use/acre (15 edu/ha) in 2002 and 17 days use/acre (41 edu/ha) in 2007. The deer and elk pellets sampled in 2007 appeared to be one year old. The lack of more recent big game use may be related to the construction work being done on US-189.

Soil

The soil is classified in the Burgi-Agassiz association. Soils in this series are well-drained, moderately permeable, and formed in alluvium and colluvium derived from mixed sedimentary rocks, mainly sandstone, quartzite, and limestone (USDA-NRCS 2007). Specifically at the study, the soil has a clay loam texture, and the profile is very rocky. A calcium carbonate layer is present 9 inches (22.9 cm) below the surface. Vegetation and litter have accounted for at least 77% of the ground cover since 1996. The erosion condition was classified as stable in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant preferred browse species. Sagebrush canopy cover was 25% in 2002 and decreased to 16% in 2007. Density has fluctuated between years, and some of the change in density is likely the result of the increased sample area used beginning in 1996, which is more accurate at determining shrub densities. The density increased from 4,120 plants/acre (10,198 plants/ha) in 1996 to 5,320 plants/acre (13,168 plants/ha) in 2002, and decreased to 2,800 plants/acre (6,931 plants/ha) in 2007. Seedling density has decreased dramatically from 21,000 seedlings/acre (51,980 seedlings/ha) in 1989 to 2,020 seedlings/acre (5,000 seedlings/ha) in 1996, and 0 seedlings/acre in 2002 and 2007. Young plants increased from 5% of the population in 1983 to 38% in 1996, then decreased to 4% by 2007. Conversely, decadence decreased from 24% of the population in 1983 to 8% in 1996, then increased to 34% by 2007. The density of dead plants has increased from 440 plants/acre (1,089 plants/ha) in 1996 to 920 plants/acre (2,277 plants/ha) in 2007. The proportion of plants exhibiting poor vigor was 53% of the population in 1983, but has been low since 1989. The average annual leader growth was 3.3 inches (8.4 cm) in 2002 and 1.4 inches (3.6 cm) in 2007. Browse use on sagebrush has been light to light-moderate.

Stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) was first sampled in 1996 and had an estimated density of 2,060 plants/acre (5,099 plants/ha). In 2007, the density had decreased to 1,300 plants/acre (3,218 plants/ha). Very few plants showed browse use in any reading. Broom snakeweed (*Gutierrezia sarothrae*) density was estimated at 1,140 plants/acre in 1996, increased to 2,940 plants/acre in 2002, and decreased to 600 plants/acre (1,485 plants/ha) in 2007. Other species present in low densities include chokecherry (*Prunus virginiana*), antelope bitterbrush (*Purshia tridentata*), snowberry (*Symphoricarpos oreophilus*), serviceberry (*Amelanchier alnifolia*), and white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*).

Herbaceous Understory

The herbaceous understory is weedy in composition. Since they were initially measured in 1996, annual grasses have had higher nested and quadrat frequencies than perennial grasses. Annual grass cover was 19% in 1996, 2% in 2002, and 9% in 2007. In 1996 and 2007, cheatgrass (*Bromus tectorum*) was the dominant understory species. Japanese brome (*Bromus japonicus*) and jointed goatgrass (*Aegilops cylindrica*), a noxious weed, were first sampled in 2002. Perennial grass cover has been 3%-4% since 1996, and the most abundant species are bluebunch wheatgrass (*Agropyron spicatum*) and Kentucky bluegrass (*Poa pratensis*). The cover of bluebunch wheatgrass has increased with every reading, while that of Kentucky bluegrass has decreased.

Perennial forb cover has averaged 10% since 1996. Many of the forbs sampled are increasers and weeds, including both annuals and perennials. The most abundant forbs are pale alyssum (*Alyssum alyssoides*), longleaf phlox (*Phlox longifolia*), bur buttercup (*Ranunculus testiculatus*), and yellow salsify (*Tragopogon dubius*). Bur buttercup is an allelopathic annual (Buchanan et al. 1978), and buttercup quadrat frequency has increased from 7% in 1996 to 38% in 2007. Dalmatian toadflax (*Linaria dalmatica*) and houndstongue (*Cynoglossum officinale*), both noxious weed species, have also been sampled and cover has averaged 2% since 1996.

1989 TREND ASSESSMENT

The browse trend is down. The density of mountain big sagebrush decreased 53%, though most of the decrease is due to the construction of a power line through the study. Although the population density decreased, the density of seedling plants increased from 0 plants/acre to 21,000 plants/acre (51,980 plants/ha). Decadence decreased from 24% to 11% of the population, and plants exhibiting poor vigor decreased from 53% to 0%. Browse use shifted from light-moderate to exclusively light. Chokecherry was sampled for the first time, and there were 266 plants/acre (658 plants/ha). The grass trend is up. The sum of nested frequency of perennial grasses increased two-fold. The nested frequencies of bluebunch wheatgrass and Kentucky bluegrass increased significantly. The forb trend is down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 41%, including a significant decrease in the nested frequency of northern sweetvetch (*Hedysarum boreale*). Houndstongue was sampled for the first time, though it was only in one quadrat.

browse - down (-2) grass - up (+2) forb - down (-2)

1996 TREND ASSESSMENT

The browse trend is up. The density of sagebrush increased more than three-fold. This increase was due to the higher density of young and mature plants. Decadency remained stable, though the density of dead plants increased from 0 plants/acre to 440 plants/acre (1,089 plants/ha). The proportion of plants exhibiting poor vigor also increased from 0% to 14% of the population. The grass trend is down. The sum of nested frequency of perennial grasses decreased 21%, including a significant decrease in the nested frequency of Kentucky bluegrass. Cheatgrass had a quadrat frequency of 96% and accounted for 19% of the total ground cover. The forb trend is slightly down. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased more than four-fold. However, much of the increase was attributed to species with little forage value. Dalmatian toadflax was sampled for the first time and had a quadrat frequency of 23%, and the quadrat frequency of houndstongue increased to 16%. There were significant increases in the nested frequency of wavyleaf thistle (*Cirsium undulatum*), houndstongue, and longleaf phlox. The Desirable Components Index (DCI) score was fair due to high browse cover with low decadence and high recruitment, and high perennial forb cover. The score was lowered because of high annual grass cover and the presence of two noxious weed species.

winter range condition (DCI) - fair (54) Mid-level potential scale
browse - up (+2) grass - down (-2) forb - slightly down (-1)

2002 TREND ASSESSMENT

The browse trend is slightly up. The density of sagebrush increased 29%. There were no seedlings sampled, and the density of young plants decreased nearly 50%. Young and decadent plants each accounted for 15% of the population, and the density of dead plants increased two-fold. The change in the sagebrush age class distribution, and the decrease in sagebrush height and crown measurements, suggest that the sagebrush stand may be experiencing intraspecific competition. Poor vigor was exhibited by 5% of the plants. The grass trend is slightly down. The sum of nested frequency of perennial forbs decreased 10%, including a significant decrease in the nested frequency of Kentucky bluegrass. Cheatgrass nested frequency also decreased significantly, and cover decreased from 19% to 2%. However, the trend was lowered due to the presence of Japanese brome and jointed goatgrass. Japanese brome was fairly abundant and had a quadrat frequency of 69%, but goatgrass had a quadrat frequency of only 2%. The forb trend is stable. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 14%. The two perennial species that decreased significantly in nested frequency, wavyleaf thistle and bedstraw (*Galium* sp.), have little forage value. Houndstongue was not sampled, and there were significant increases in the nested frequencies of wild onion (*Allium* sp.) and yellow salsify. The DCI remained fair because the decrease in browse recruitment was offset by a decrease in annual grass cover.

winter range condition (DCI) - fair (57) Mid-level potential scale
browse - slightly up (+1) grass - slightly down (-1) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 47%, and sagebrush canopy cover decreased from 25% to 16%. There were no seedlings sampled, and young plants comprised 4% of the population. Decadence increased to 34%, and plants with poor vigor increased to 11% of the population. All plants with poor vigor were classified as dying. Despite the decrease in density and the increase in decadence, the average height and crown measurements increased 5 inches (13 cm) and 11 inches (28 cm), respectively. Browse use shifted from light to light-moderate. The grass trend is down. The sum of nested frequency of perennial grasses decreased 35%, while the sum of nested frequency of annual grasses increased 30%. There was a significant increase in the nested frequency of cheatgrass and a significant decrease in that of Japanese brome. Cheatgrass cover increased to 9% and it was sampled in 84% of the quadrats. The forb trend is slightly down. The sum of nested frequency of perennial forbs increased 7%. Houndstongue was sampled again and the nested frequency of dalmatian toadflax increased significantly. Additionally, there were significant increases in the nested frequencies of two allelopathic annuals, bur buttercup (Buchanan et al. 1978) and storksbill (*Erodium cicutarium*) (Kimball and Schiffman 2003). The DCI score decreased to very poor-poor due to the decrease in preferred browse cover, increased browse decadence and decreased young, increased annual grass cover, and presence of three noxious species.

winter range condition (DCI) - very poor-poor (35) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - slightly down (-1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 5

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Aegilops cylindrica (a)	-	-	-	$_{a}$3	$_{a}$2	-	.03	.03
G	Agropyron cristatum	-	-	-	$_{a}$3	$_{a}$2	-	.03	.06
G	Agropyron spicatum	$_{a}$5	$_{b}$37	$_{bc}$70	$_{c}$93	$_{bc}$63	2.07	2.19	2.90

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Bromus japonicus (a)	-	-	-	$_{b}$171	$_{a}$111	-	1.43	.99
G	Bromus tectorum (a)	-	-	$_{c}$356	$_{a}$125	$_{b}$276	19.20	1.63	8.72
G	Elymus cinereus	-	-	$_{a}$5	$_{a}$-	$_{a}$4	.18	.00	.78
G	Melica bulbosa	-	-	$_{a}$3	$_{a}$7	$_{a}$3	.00	.21	.18
G	Oryzopsis hymenoides	-	-	-	3	-	-	.15	-
G	Poa fendleriana	$_{a}$3	$_{a}$10	-	-	$_{a}$1	-	-	.03
G	Poa pratensis	$_{b}$96	$_{c}$164	$_{b}$92	$_{a}$43	$_{a}$26	1.24	.52	.35
G	Poa secunda	$_{a}$1	$_{a}$3	-	$_{a}$1	-	-	.00	-
G	Sitanion hystrix	-	-	-	3	-	-	.03	-
Total for Annual Grasses		0	0	356	299	389	19.20	3.11	9.75
Total for Perennial Grasses		105	214	170	153	99	3.50	3.15	4.30
Total for Grasses		105	214	526	452	488	22.70	6.26	14.05
F	Agoseris glauca	-	-	-	-	3	-	-	.00
F	Alyssum alyssoides (a)	-	-	$_{a}$96	$_{b}$157	$_{c}$229	.36	.81	1.75
F	Allium sp.	$_{ab}$31	$_{a}$9	$_{a}$16	$_{b}$46	$_{ab}$21	.06	.44	.10
F	Artemisia ludoviciana	$_{a}$3	-	$_{a}$6	$_{a}$6	$_{a}$5	.06	.21	.16
F	Astragalus beckwithii	-	-	-	$_{b}$24	$_{a}$11	-	.78	.39
F	Astragalus convallarius	$_{a}$13	$_{a}$5	$_{ab}$24	$_{ab}$25	$_{b}$45	.24	.50	1.67
F	Astragalus utahensis	-	-	-	1	-	-	.00	-
F	Camelina microcarpa (a)	-	-	-	$_{a}$3	$_{b}$47	-	.03	.21
F	Calochortus nuttallii	$_{a}$14	$_{a}$3	-	$_{a}$7	$_{a}$2	-	.02	.00
F	Cirsium undulatum	$_{a}$21	$_{a}$12	$_{b}$47	$_{a}$20	$_{a}$12	.82	.35	.21
F	Collomia linearis (a)	-	-	-	$_{a}$9	$_{a}$6	-	.02	.01
F	Comandra pallida	-	-	$_{a}$2	$_{a}$3	$_{b}$24	.00	.01	.11
F	Collinsia parviflora (a)	-	-	-	$_{a}$2	$_{a}$2	-	.00	.01
F	Cynoglossum officinale	-	$_{a}$2	$_{b}$37	-	$_{a}$9	2.34	-	.39
F	Epilobium brachycarpum (a)	-	-	-	-	3	-	-	.00
F	Eriogonum brevicaule	-	$_{a}$7	$_{a}$6	$_{a}$1	$_{a}$2	.18	.00	.00
F	Erodium cicutarium (a)	-	-	-	$_{a}$11	$_{b}$28	-	.09	.59
F	Galium sp.	-	-	$_{c}$147	$_{b}$60	$_{a}$27	1.05	1.14	1.54
F	Gayophytum ramosissimum(a)	-	-	$_{b}$20	$_{a}$3	-	.04	.00	-
F	Hackelia patens	-	$_{a}$3	-	-	$_{a}$1	-	-	.03
F	Helianthus annuus (a)	-	$_{a}$1	-	$_{a}$5	-	-	.03	-
F	Hedysarum boreale	$_{c}$69	$_{ab}$13	$_{b}$28	-	$_{a}$8	.63	-	.04
F	Lactuca serriola	-	$_{a}$20	$_{a}$17	$_{a}$3	$_{a}$12	.04	.01	.11
F	Linaria dalmatica	-	-	$_{a}$52	$_{a}$41	$_{b}$71	.85	1.37	2.01

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Lithospermum ruderale	$_{a}$1	$_{a}$3	$_{a}$6	$_{a}$6	$_{a}$8	.44	.18	.53
F	Lupinus argenteus	$_{a}$8	$_{a}$1	$_{a}$2	$_{a}$-	$_{a}$1	.15	.16	.06
F	Machaeranthera canescens	$_{a}$2	$_{a}$5	$_{a}$1	$_{a}$-	$_{a}$6	.00	.03	.01
F	Melilotus officinalis	-	-	9	-	-	.04	-	-
F	Microsteris gracilis (a)	-	-	-	$_{a}$4	$_{a}$8	-	.01	.02
F	Oenothera sp.	$_{a}$4	$_{b}$10	$_{a}$3	-	$_{a}$1	.00	-	.03
F	Phlox longifolia	$_{a}$26	$_{a}$15	$_{b}$109	$_{b}$123	$_{b}$115	2.21	2.59	1.79
F	Ranunculus testiculatus (a)	-	-	$_{a}$12	$_{a}$30	$_{b}$125	.06	.13	1.33
F	Solidago sp.	3	-	-	-	-	-	-	-
F	Tragopogon dubius	-	$_{a}$10	$_{b}$61	$_{c}$92	$_{d}$141	.39	1.08	1.78
Total for Annual Forbs		0	1	128	224	448	0.45	1.13	3.96
Total for Perennial Forbs		195	118	573	458	525	9.56	8.91	11.02
Total for Forbs		195	119	701	682	973	10.02	10.05	14.98

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

BROWSE TRENDS --
Management unit 17 , Study no: 5

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Acer grandidentatum	0	1	0	-	-	-
B	Amelanchier alnifolia	2	3	3	-	.53	.15
B	Artemisia tridentata vaseyana	78	82	74	20.79	23.60	14.10
B	Chrysothamnus nauseosus albicaulis	18	16	13	.90	.58	.96
B	Chrysothamnus viscidiflorus viscidiflorus	39	31	33	3.54	1.55	1.34
B	Crataegus douglasii	0	1	0	-	-	-
B	Gutierrezia sarothrae	26	40	15	.32	1.21	.42
B	Mahonia repens	0	10	0	-	.36	-
B	Prunus virginiana	3	11	4	.36	.63	.91
B	Purshia tridentata	2	1	1	.15	-	.03
B	Quercus gambelii	0	0	1	-	-	-
B	Rosa woodsii	0	2	0	-	-	-
B	Symphoricarpos oreophilus	19	17	11	3.25	3.36	1.25
Total for Browse		187	215	155	29.33	31.84	19.17

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 5

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	.20	.96
Artemisia tridentata vaseyana	24.79	15.64
Chrysothamnus nauseosus albicaulis	1.31	1.54
Chrysothamnus viscidiflorus viscidiflorus	1.50	2.91
Gutierrezia sarothrae	2.54	.25
Mahonia repens	.63	-
Prunus virginiana	.93	.61
Symphoricarpos oreophilus	4.93	1.66

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 5

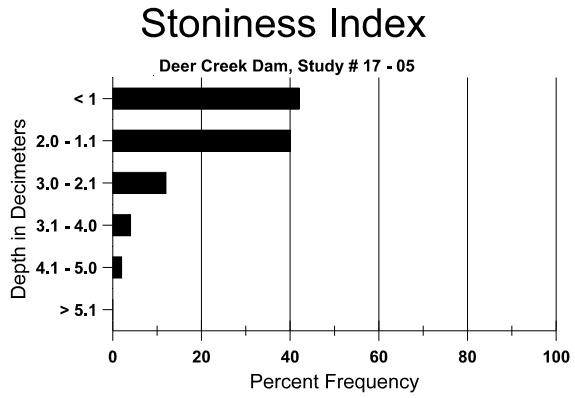
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	3.4	1.4

BASIC COVER --
Management unit 17 , Study no: 5

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	4.25	9.25	56.32	46.84	51.81
Rock	1.25	1.75	5.36	3.31	3.42
Pavement	5.50	15.25	5.72	6.73	5.44
Litter	82.75	68.50	57.25	45.51	46.59
Cryptogams	.25	0	0	0	0
Bare Ground	6.00	5.25	6.69	17.03	9.81

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 05, Deer Creek Dam

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.8	66.2 (14.0)	7.3	29.3	42.7	28.0	3.3	12.9	150.4	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 5

Type	Quadrat Frequency		
	'96	'02	'07
Rabbit	-	-	2
Elk	1	3	-
Deer	15	11	5

Days use per acre (ha)	
'02	'07
-	-
6 (15)	17 (41)
32 (79)	30 (74)

BROWSE CHARACTERISTICS --
Management unit 17 , 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)
Acer grandidentatum												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	-	40	-	-	0	0	-	-	0	15/6
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Amelanchier alnifolia												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**66**	-	-	-	66	-	0	100	100	-	100	-/-
96	**40**	-	-	20	20	-	0	100	50	-	50	25/26
02	**60**	-	-	40	20	-	0	33	33	-	0	52/46
07	**60**	-	-	20	40	-	33	67	67	33	33	33/34

		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												
83	**2533**	-	133	1800	600	-	32	18	24	-	53	23/33
89	**1199**	21000	200	866	133	-	0	0	11	-	0	27/41
96	**4120**	2020	1560	2220	340	440	18	2	8	5	14	24/39
02	**5320**	-	800	3700	820	880	17	2	15	5	5	24/28
07	**2800**	-	100	1760	940	920	27	16	34	11	11	29/39
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**66**	-	-	66	-	-	0	0	0	-	0	21/27
96	**580**	-	80	400	100	20	3	21	17	10	24	23/26
02	**520**	-	-	360	160	60	0	0	31	19	23	17/20
07	**320**	-	-	180	140	60	0	0	44	6	19	26/26
Chrysothamnus viscidiflorus viscidiflorus												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
96	**2060**	120	280	1780	-	-	11	0	0	-	0	12/21
02	**1760**	-	-	1720	40	20	0	0	2	1	1	12/17
07	**1300**	-	120	1040	140	20	0	0	11	3	8	12/20
Crataegus douglasii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	-	40	-	-	0	100	-	-	0	28/40
07	**0**	-	-	-	-	-	0	0	-	-	0	31/33
Gutierrezia sarothrae												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**66**	133	-	66	-	-	0	0	0	-	0	19/20
96	**1140**	600	340	760	40	-	2	2	4	4	5	6/9
02	**2940**	-	80	2640	220	320	0	0	7	3	3	10/13
07	**600**	20	40	560	-	-	0	0	0	-	0	10/9
Mahonia repens												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**5180**	-	-	5180	-	-	0	0	-	-	0	4/5
07	**0**	-	-	-	-	-	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)
Prunus virginiana												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**266**	-	266	-	-	-	0	0	0	-	0	-/-
96	**320**	420	280	40	-	-	13	0	0	-	0	46/23
02	**680**	-	20	640	20	-	12	68	3	-	0	11/8
07	**700**	-	700	-	-	-	0	0	0	-	0	-/-
Purshia tridentata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**100**	20	20	80	-	-	80	0	-	-	0	14/42
02	**20**	-	-	20	-	-	100	0	-	-	0	19/33
07	**20**	-	-	20	-	-	0	100	-	-	0	12/42
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	37/27
07	**20**	-	-	20	-	-	0	0	-	-	100	19/32
Rosa woodsii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	40	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**66**	-	-	-	66	-	100	0	100	-	0	-/-
96	**540**	-	60	480	-	-	7	11	0	-	0	25/33
02	**480**	-	20	380	80	40	8	8	17	-	0	25/31
07	**300**	-	20	240	40	40	27	7	13	-	7	19/32

Trend Study 17-9-07

Study site name: Lower Big Hollow . Vegetation type: Mixed Oak-Sage .

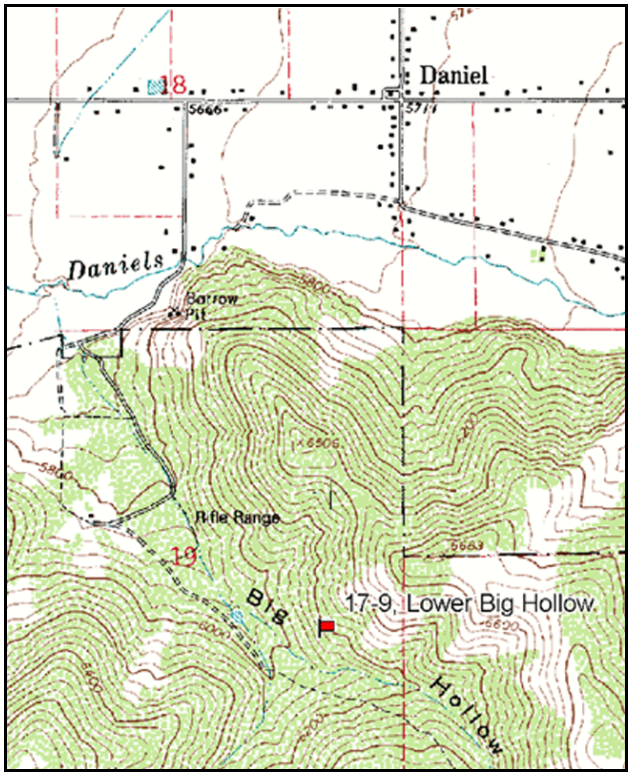
Compass bearing: frequency baseline 346 degrees magnetic.

Frequency belt placement: line 1 (11 & 95ft), line 2 (71ft), line 3 (59ft), line 4 [only 50 ft. long] (34ft).

Rebar: belt 5 on 3ft.

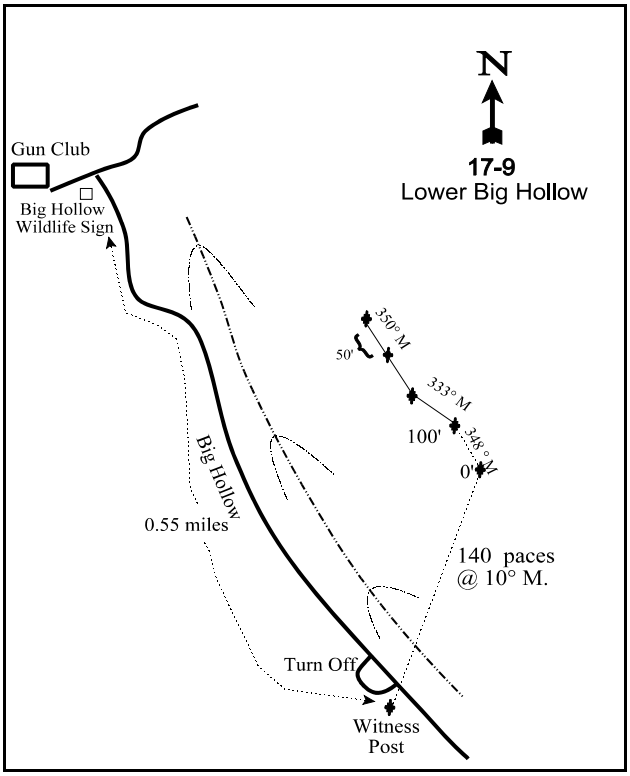
LOCATION DESCRIPTION

Beginning at the gun club parking lot at the mouth of Big Hollow, proceed east 0.10 miles to the road which runs up Big Hollow. Turn right and proceed up Big Hollow for 0.55 miles to a turnoff to the south and a green steel "T" fencepost. From the fencepost, the 0-foot baseline stake is located 140 paces away across Big Hollow, at an azimuth of 10 degrees magnetic. A red browse tag, number 67, is attached to the 0-foot stake of the frequency baseline.



Map Name: Charleston

Township 4S , Range 5E , Section 19 ,



Diagrammatic Sketch

GPS: NAD 83, UTM 12T 464569.7 E 4478191.0 N

DISCUSSION

Lower Big Hollow - Trend Study No. 17-9

Study Information

This study is located on Division of Wildlife Resources property approximately 0.5 miles (0.8 km) above the mouth of Big Hollow [elevation: 6,200 feet (1,890 m), slope: 30%-35%, aspect: southwest]. This is a mountain brush community with a rather sparse native understory. There is an ephemeral stream 200 feet (61 m) to the west, and a stock pond 750 feet (230 m) to the northwest. The majority of Big Hollow, at least the portion south of the stream, was consumed by an extremely hot fire in 1976. It was seeded the following fall with perennial grasses and forbs. Wildlife use during the winter is probably restricted to years with little snowfall. In management terms, the area may be equally or even more important as fawn-rearing habitat for deer and spring-fall range for elk. During 1983, at least two yearling bucks and several does with fawns were observed in the vicinity. In 1996, several deer and a deer carcass were observed on the study. From the pellet group transect, there were an estimated 38 deer days use/acre (94 ddu/ha) in 2002 and 29 deer days use/acre (73 ddu/ha) in 2007. Elk use was estimated at 4 days use/acre (10 edu/ha) in 2002 and 2 days use/acre (5 edu/ha) in 2007. Cattle were observed in the clearing below the study, and several deer skeletons were found on and around the study in 2007.

Soil

The soil is classified in the Wallsburg series and consists of shallow, well-drained, moderately-slowly permeable soils that formed in residuum and colluvium from limestone, sandstone and shale (USDA-NRCS 2007). Specifically at the study, the soil texture is a sandy clay loam and has neutral reactivity (pH of 7.1). The soil is moderately deep with many small rocks on the surface. Litter is abundant, but relative litter cover has decreased from 50% in 1996 to 42% in 2007. Relative cover of bare soil has been estimated at 10% or less in all sample years. The soil surface and profile have an abundance of large rocks and cobbles. The erosion condition was classified as stable-slight in 2002 and increased to slight in 2007, due to indications of surface litter, rock, and soil movement.

Browse

Although all sagebrush plants were classified as mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), some plants had characteristics of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). Sagebrush canopy cover was 17% in 2002 and 15% in 2007. The estimated density has oscillated between increasing and decreasing with alternate sample years. It has ranged from 1,500 plants/acre (3,713 plants/ha) in 2007 to 1,932 plants/acre (4,782 plants/ha) in 1989. Seedling sagebrush were sampled only in 1996. Young plants increased from 8% of the population in 1983 to 22% in 1996, and decreased to 0% by 2007. Decadence has fluctuated widely, accounting for 16%-76% of the population, and was greatest when the density was highest in 1989. There has been a steady increase in the density of dead plants from 580 plants/acre (1,436 plants/ha) in 1996 to 900 plants/acre (2,228 plants/ha) in 2007. The proportion of plants exhibiting poor vigor has ranged from 1% to 28%, and again was highest in 1989. Below-normal precipitation in 1989 (Utah Climate Summaries 2007) was likely the cause of the high decadence and poor vigor. The average crown measurements were also smaller in 1989 than in any other sample year. The average annual leader growth on sagebrush was 1.9 inches (4.8 cm) in 2002 and 2.1 inches (5.4 cm) in 2007. The population has shown light-moderate and moderate browse use.

Serviceberry (*Amelanchier alnifolia*) and antelope bitterbrush (*Purshia tridentata*) plants are present in low densities. Like the sagebrush population, the serviceberry density has oscillated, ranging from 40 plants/acre (99 plants/ha) in 2007 to 400 plants/acre (990 plants/ha) in 2002, and the majority of plants have been in the young or mature age classes. Vigor has been good except in 2002, when 45% of the population had poor vigor. Browse use has been light and moderate. The bitterbrush density increased from 66 plants/acre (163 plants/ha) in 1983 to 140 plants/acre (347 plants/ha) in 1996, and decreased to 20 plants/acre (50 plants/ha) in

2007. Most bitterbrush plants have been in the mature age class. Bitterbrush vigor has been good except in 2002, when 17% of the population was in poor vigor. Browse use has increased from exclusively light in 1983 to exclusively heavy in 2007.

Gambel oak (*Quercus gambelii*) is the second most abundant browse species, and comprised 9% canopy cover in 2002 and 6% in 2007. No oak were sampled in 1983 or 1989. However, after the sample area increased in 1996, the estimated density increased from 1,200 stems/acre (2,970 stems/ha) to 2,840 stems/acre (7,030 stems/ha) in 2002, and decreased to 1,900 plants/acre (4,703 plants/ha) in 2007. Decadent plants, and plants with poor vigor have been low in all sample years. Browse use has been light. The oak clones provide some escape and cover for wildlife during the summer and fall. Increaser shrubs are also present, including small numbers of broom snakeweed (*Gutierrezia sarothrae*) and pricklypear cactus (*Opuntia* sp.).

Herbaceous Understory

The herbaceous understory has fairly high diversity, but desirable species are limited. Perennial grass cover was 6% in 1996, and 7% in 2002 and 2007. Between four and nine perennial grass species have been sampled, and the dominant perennial species include bluebunch wheatgrass (*Agropyron spicatum*), smooth brome (*Bromus inermis*), and Sandberg bluegrass (*Poa secunda*). Collectively, the cover of these grasses has averaged 5% since 1996. Bulbous bluegrass (Poa bulbosa), which has a phenology similar to annual grasses (Stewart and Hull 1949), is present and quadrat frequency increased from 1% in 1996 to 7% in 2007. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) were sampled beginning in 1996. Cheatgrass has been the dominant grass and comprised an average 12% cover since 1996. Cheatgrass has had a higher quadrat frequency than all perennial grasses combined.

Forbs have been a small understory component and cover has decreased from 4% in 1996 to 3% in 2002, and 2% in 2007. The forb composition has included increaser species with little forage value. The dominant species have been pale alyssum (*Alyssum alyssoides*) and arrowleaf balsamroot (*Balsamorhiza sagittata*).

1989 TREND ASSESSMENT

The browse trend is slightly down. Although the density of mountain big sagebrush increased 21%, decadence increased from 21% to 76% of the population. Thus, the density of non-decadent plants actually went down, decreasing from 1,266 plants/acre (3,134 plants/ha) to 466 plants/acre (1,153 plants/ha). The proportion of plants exhibiting poor vigor increased from 4% to 28% of the population. Browse use on sagebrush shifted from light to moderate. Despite the negative changes in the sagebrush population, the browse trend was determined to only be slightly down because serviceberry and true mountain mahogany (*Cercocarpus montanus*) were sampled for the first time, and bitterbrush density increased. The grass trend is slightly up. Although the sum of nested frequency of perennial grass increased nearly four-fold, abundance remained low. There was a significant increase in the nested frequency of Sandberg bluegrass. The forb trend is up. The sum of nested frequency of perennial forbs increased 72%, and the number of perennial species increased from seven to 13.

browse - slightly down (-1) grass - slightly up (+1) forb - up (+2)

1996 TREND ASSESSMENT

The browse trend is slightly up. The density of sagebrush decreased 20%. However, most other parameters indicate that the sagebrush stand is improving. Seedling sagebrush were sampled for the first time, and the young age class increased from 10% to 22% of the population. Decadence decreased to 18%, and only 1% of the population was classified as dying. The density of dead plants increased from 0 to 580 plants/acre (1,436 plants/ha). Browse use on sagebrush shifted from moderate to light. Serviceberry and true mountain mahogany densities decreased, and the density of bitterbrush remained stable. The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 58%. There was a significant increase in the nested frequency of bluebunch wheatgrass, and the number of perennial species that

were sampled increased from six to 11. Bulbous bluegrass was sampled for the first time, in one quadrat. Annual grasses were likely to have been present prior to 1996, but were not included. Cheatgrass was sampled in 84% of the quadrats and comprised 70% of the grass cover. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased 24%, but the increase was muted by the poor forage value of the species. The Desirable Components Index (DCI) score was fair due to the moderate browse cover, low perennial grass and forb cover, and high annual grass cover.

winter range condition (DCI) - fair (55) Mid-level potential scale
browse - slightly up (+1) grass - up (+2) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is slightly up. The density of sagebrush increased 25%. No seedlings were sampled and young plants declined to only 3% of the population. Decadence increased to 24%, and 10% of the population was classified as dying. Additionally, the density of dead plants increased 35%. The proportion of plants exhibiting poor vigor increased from 1% to 10%. Serviceberry density increased three-fold and bitterbrush density decreased 14%. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 15%. However, there was a significant decrease in the frequency of cheatgrass. The forb trend is down. The sum of nested frequency of perennial forbs decreased 72%, including a significant decrease in pale stickseed (*Hackelia patens*). There were also six fewer perennial species sampled. The DCI score remained fair.

winter range condition (DCI) - fair (54) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 22%. There were no seedling or young plants sampled. Decadence decreased to 16%, and 8% of the population was classified as dying. The density of dead plants increased 15%. The proportion of plants exhibiting poor vigor increased to 13%. The sagebrush defoliator moth (*Aroga websteri*) had infested 75% of the sagebrush. Serviceberry and bitterbrush densities decreased 90% and 83%, respectively, and both species were hedged. The grass trend is slightly down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grass increased 10%. The increase was countered by significant increases in the nested frequencies of cheatgrass and bulbous bluegrass. The forb trend is stable. The sum of nested frequency increased 24%, but forb abundance remained low. Neither grasses nor forbs had animal use. The DCI score decreased to very poor-poor due to the decrease in browse cover, absence of young browse plants, and increase in annual grass cover.

winter range condition (DCI) - very poor-poor (35) Mid-level potential scale
browse - down (-2) grass - slightly down (-1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 9

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Agropyron intermedium	-	-	a16	a12	a10	.81	.76	.54
G	Agropyron spicatum	a8	a15	b64	b51	b52	3.34	3.95	4.01
G	Bromus inermis	-	a2	a3	a6	b16	.15	.33	1.08
G	Bromus japonicus (a)	-	-	a2	a8	a6	.00	.16	.01

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Bromus tectorum (a)	-	-	$_{b}$298	$_{a}$240	$_{b}$311	13.48	7.15	16.84
G	Dactylis glomerata	-	$_{a}$3	$_{a}$1	-	$_{a}$1	.00	-	.00
G	Poa bulbosa	-	-	$_{a}$1	$_{a}$7	$_{b}$21	.03	.53	.49
G	Poa fendleriana	$_{a}$1	$_{a}$8	$_{a}$9	$_{a}$5	$_{a}$2	.56	.18	.03
G	Poa pratensis	$_{a}$6	$_{a}$19	$_{a}$24	-	-	.28	-	-
G	Poa secunda	$_{a}$10	$_{b}$48	$_{ab}$32	$_{b}$50	$_{b}$46	.62	1.14	.89
G	Sitanion hystrix	-	-	$_{a}$1	$_{a}$3	-	.03	.15	-
Total for Annual Grasses		0	0	300	248	317	13.49	7.31	16.85
Total for Perennial Grasses		25	95	151	134	148	5.84	7.06	7.06
Total for Grasses		25	95	451	382	465	19.33	14.38	23.92
F	Agoseris glauca	-	$_{a}$1	-	-	$_{a}$1	-	-	.03
F	Alyssum alyssoides (a)	-	-	$_{b}$163	$_{a}$102	$_{a}$74	1.13	.82	.18
F	Arabis sp.	$_{a}$28	$_{a}$17	$_{a}$18	-	-	.03	-	-
F	Aster sp.	-	$_{a}$7	$_{a}$7	$_{a}$6	-	.03	.03	-
F	Astragalus sp.	-	2	-	-	-	-	-	-
F	Balsamorhiza sagittata	-	$_{a}$7	$_{a}$5	$_{a}$9	$_{a}$2	.68	1.14	1.11
F	Castilleja chromosa	$_{a}$3	$_{a}$2	-	-	$_{a}$3	-	-	.03
F	Camelina microcarpa (a)	-	-	-	$_{a}$4	$_{a}$1	-	.08	.00
F	Calochortus nuttallii	-	$_{a}$3	-	$_{a}$2	-	-	.00	-
F	Chaenactis douglasii	-	-	4	-	-	.06	-	-
F	Cirsium sp.	-	-	6	-	-	.23	-	-
F	Collomia linearis (a)	$_{a}$5	-	$_{a}$2	$_{b}$29	$_{a}$7	.03	.06	.01
F	Comandra pallida	-	-	$_{a}$6	$_{a}$3	$_{a}$1	.01	.00	.00
F	Collinsia parviflora (a)	-	-	-	3	-	-	.00	-
F	Crepis acuminata	-	-	-	11	-	-	.30	-
F	Descurainia sp. (a)	-	-	$_{a}$3	-	$_{a}$3	.00	-	.01
F	Epilobium brachycarpum (a)	-	-	2	-	-	.00	-	-
F	Erigeron sp.	-	-	25	-	-	.42	-	-
F	Galium sp.	-	-	-	$_{a}$3	$_{a}$6	-	.15	.15
F	Grindelia squarrosa	-	-	3	-	-	.00	-	-
F	Hackelia patens	$_{a}$9	$_{ab}$26	$_{b}$37	$_{a}$9	$_{ab}$26	.38	.09	.56
F	Holosteum umbellatum (a)	-	-	-	$_{a}$11	$_{a}$9	-	.06	.05
F	Ipomopsis aggregata	-	$_{a}$6	$_{a}$3	-	$_{a}$3	.00	-	.00
F	Lappula occidentalis (a)	-	-	-	4	-	-	.03	-
F	Lactuca serriola	-	$_{a}$7	$_{a}$1	-	-	.01	-	-
F	Machaeranthera canescens	-	$_{a}$16	$_{a}$20	-	-	.22	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Microsteris gracilis (a)	-	-	-	26	-	-	.27	-
F	Orobanche sp.	-	-	-	-	9	-	-	.04
F	Orthocarpus tolmiei (a)	-	-	$_{a}$3	$_{a}$12	-	.03	.02	-
F	Phlox longifolia	-	-	-	-	5	-	-	.01
F	Polygonum douglasii (a)	-	-	2	-	-	.00	-	-
F	Senecio multilobatus	$_{b}$25	$_{b}$25	$_{a}$3	$_{a}$2	-	.07	.00	-
F	Solidago sparsiflora	3	-	-	-	-	-	-	-
F	Tragopogon dubius	$_{a}$7	$_{a}$10	$_{a}$19	-	-	.17	-	-
F	Viguiera multiflora	-	-	3	-	-	.01	-	-
Total for Annual Forbs		5	0	175	191	94	1.21	1.36	0.26
Total for Perennial Forbs		75	129	160	45	56	2.37	1.74	1.94
Total for Forbs		80	129	335	236	150	3.59	3.10	2.21

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

BROWSE TRENDS --
Management unit 17 , Study no: 9

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Amelanchier alnifolia	4	5	2	1.93	2.29	.00
B	Artemisia tridentata vaseyana	49	59	52	11.55	12.98	10.48
B	Gutierrezia sarothrae	5	0	0	.06	-	-
B	Mahonia repens	1	0	0	-	-	-
B	Opuntia sp.	7	6	5	.18	.03	.03
B	Purshia tridentata	6	6	1	1.82	.68	-
B	Quercus gambelii	24	30	25	6.91	6.28	5.18
B	Symphoricarpos oreophilus	4	7	8	.06	.56	.21
Total for Browse		100	113	93	22.52	22.85	15.91

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 9

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	.86	-
Artemisia tridentata vaseyana	16.50	15.44
Opuntia sp.	.18	.11
Purshia tridentata	1.73	1.14
Quercus gambelii	8.56	6.33
Symphoricarpos oreophilus	.20	.46

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 9

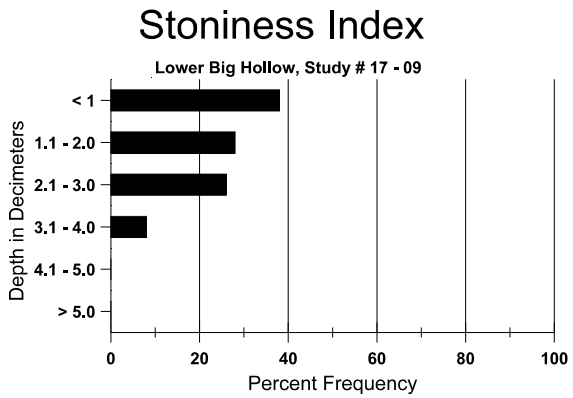
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.9	2.1

BASIC COVER --
Management unit 17 , Study no: 9

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	.50	5.50	43.07	38.29	44.39
Rock	7.75	13.75	10.48	13.89	11.75
Pavement	1.75	9.50	2.45	5.50	3.29
Litter	79.00	65.00	58.93	54.93	47.44
Cryptogams	1.50	.75	.15	.56	.07
Bare Ground	9.50	5.50	3.63	12.10	6.88

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 09, Lower Big Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
14.5	49.5 (16.0)	7.1	49.8	19.4	30.7	3.0	13.2	128.0	.6



PELLET GROUP DATA --
Management unit 17 , Study no: 9

Type	Quadrat Frequency		
	'96	'02	'07
Rabbit	3	-	3
Elk	3	2	2
Deer	8	8	8

Days use per acre (ha)	
'02	'07
-	-
4 (10)	2 (5)
38 (94)	30 (73)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 9

		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												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**266**	-	266	-	-	-	0	0	0	-	0	-/-
96	**120**	-	40	80	-	-	17	0	0	-	0	47/73
02	**400**	-	260	80	60	20	65	15	15	10	45	29/24
07	**40**	-	-	40	-	-	100	0	0	-	0	36/55
Artemisia tridentata vaseyana												
83	**1599**	-	133	1133	333	-	25	0	21	-	4	31/46
89	**1932**	-	200	266	1466	-	66	0	76	28	28	28/30
96	**1540**	140	340	920	280	580	22	0	18	1	1	26/50
02	**1920**	-	60	1400	460	780	15	1	24	10	10	28/43
07	**1500**	-	-	1260	240	900	29	5	16	8	13	32/46

		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)
Cercocarpus montanus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**66**	-	-	66	-	-	100	0	-	-	0	45/39
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	69/82
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
83	**200**	-	-	200	-	-	0	0	-	-	0	13/6
89	**1666**	-	-	1666	-	-	0	0	-	-	0	11/12
96	**360**	40	60	300	-	-	0	0	-	-	0	12/16
02	**0**	-	-	-	-	-	0	0	-	-	0	9/10
07	**0**	-	-	-	-	-	0	0	-	-	0	13/18
Mahonia repens												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**20**	-	-	20	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Opuntia sp.												
83	**933**	-	-	933	-	-	0	0	0	-	0	6/8
89	**1200**	-	600	600	-	-	0	0	0	-	0	6/14
96	**200**	-	-	200	-	-	0	0	0	-	0	5/14
02	**160**	-	-	80	80	-	0	0	50	38	38	4/11
07	**100**	-	-	100	-	-	0	0	0	-	0	5/10
Purshia tridentata												
83	**66**	-	-	66	-	-	0	0	0	-	0	16/24
89	**133**	-	-	133	-	-	100	0	0	-	0	12/18
96	**140**	-	-	120	20	-	71	29	14	-	0	27/75
02	**120**	-	-	60	60	-	0	83	50	17	17	26/66
07	**20**	-	-	20	-	60	0	100	0	-	0	39/74
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
96	**1200**	-	200	980	20	20	2	0	2	2	2	36/35
02	**2840**	-	440	2340	60	620	8	0	2	1	1	32/19
07	**1900**	40	180	1620	100	460	3	0	5	-	0	35/20

		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)
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
96	**100**	-	20	80	-	-	0	0	0	-	0	19/29
02	**160**	-	-	160	-	-	0	13	0	-	0	25/29
07	**160**	-	-	140	20	40	0	0	13	13	13	21/30

Trend Study 17-11-07

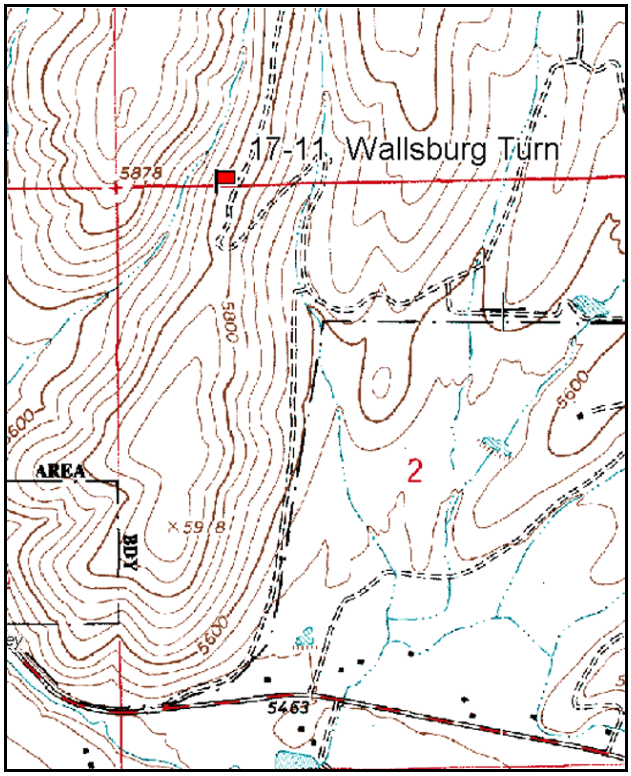
Study site name: Wallsburg Turn . Vegetation type: Big Sagebrush-Grass .

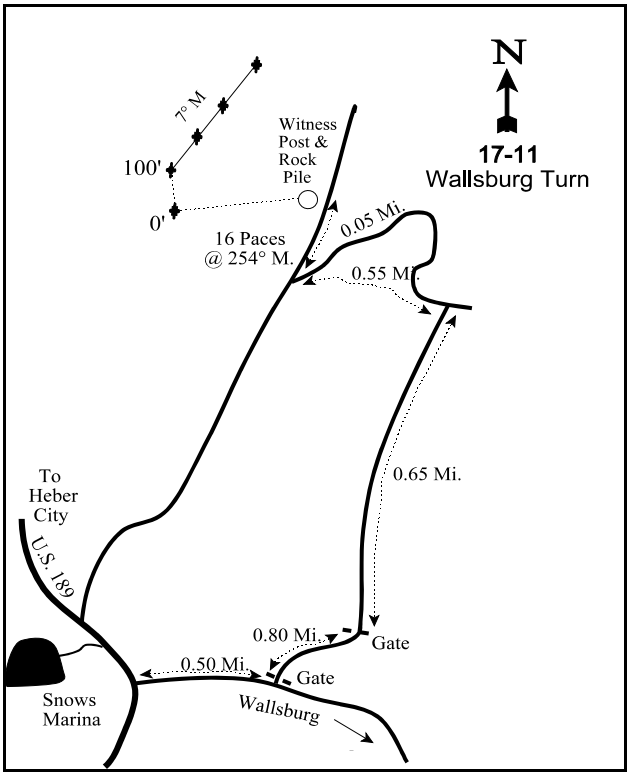
Compass bearing: frequency baseline 338 degrees magnetic.

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

LOCATION DESCRIPTION

Beginning at the intersection of U.S. 189 and the Wallsburg turnoff, proceed 0.50 miles towards Wallsburg to an intersection. Turn left at the intersection and proceed northerly for 0.8 miles passing through two DWR gates. Continue on this road for 0.65 miles to an intersection. Take a left at the intersection and go 0.55 miles to another intersection. Go right for 0.05 miles to a small rock pile on the left (east) side of the road. From the rock monument, walk 16 paces at an azimuth of 264 degrees magnetic to the 0-foot baseline stake. The frequency baseline is marked by green steel "T" fenceposts approximately 12 to 18 inches in height.





Map Name: Charleston

Diagrammatic Sketch

Township 5S , Range 4E , Section 2

GPS: NAD 83, UTM 12T 460271 E 4474422 N

DISCUSSION

Wallsburg Turn - Trend Study No. 17-11

Study Information

This study is on critical deer winter range located approximately 0.75 miles (1.2 km) northeast of the junction of highways US-189 and SR-222. It is on land owned by the Utah Division of Wildlife Resources near a broad ridge top [elevation: 5,800 feet (1,768 m), slope: 25%, aspect: west]. In August 1976, an exceptionally hot wildfire destroyed virtually all the vegetation. A seeding effort conducted immediately after the fire appears to have been successful, resulting in fair grass cover and a resurgent sagebrush population. An ephemeral stream is located 300 feet (91 m) to the west, and Main Creek is located 0.85 miles (1.4 km) to the south. Aside from terrain features, the area is devoid of thermal or escape cover. Use by deer is moderate, while elk use is light. From the pellet group transect, there were an estimated 54 deer days use/acre (134 ddu/ha) in 2002 and 52 deer days use/acre (129 ddu/ha) in 2007. Elk use was estimated at 17 days use/acre (43 edu/ha) in 2002 and 35 days use/acre (86 edu/ha) in 2007. Deer and elk pellets were from the fall of 2006 and winter of 2007. Cattle use was estimated at 6 days use/acre (14 cdu/ha) in 2007.

Soil

The soil is classified in the Henefer series and consists of very deep, well-drained, slowly permeable soils. Soils in this series formed in alluvium and colluvium from quartzite and sandstone on fan remnants, mountain toeslopes and mountain slopes. Soil depths may reach 49 inches (124 cm) (USDA-NRCS 2007). Specifically at the study, the soil has a silty clay loam texture and is slightly alkaline in reactivity (pH of 7.6). Considerable erosion occurred after the fire because of insufficient ground cover. Since 1996, the relative bare ground cover has decreased slightly from 10% to 6%. Vegetation and litter have provided the majority of the ground cover. The erosion condition was classified as the upper threshold of stable in 2002 and was stable in 2007. Pedestalling at the base of sagebrush and bunchgrass stems is abundant and provides the most evidence of past erosion.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) canopy cover was 14% in 2002 and 15% in 2007. The density increased from 1,366 plants/acre (3,381 plants/ha) in 1983 to 2,320 plants/acre (5,743 plants/ha) by 1996, then decreased to 1,780 plants/acre (4,406 plants/ha) by 2007. Some of the change in the estimated density between 1989 and 1996 was due to an increase in sample area. Few seedlings have been sampled, and young plants peaked at 30% of the population in 1989 and decreased to 0% in 2007. Decadence has steadily increased from 0% of the population in 1983 and 1989 to 53% in 2007. There were no dead plants in 1983 or 1989, but the density of dead plants has also increased since 1996. Vigor has been mostly good; plants with poor vigor have accounted for 0% to 14% of the population. The average annual leader growth was 1.4 inches (3.6 cm) in 2002 and 2007. Browse use has been light, moderate, and moderate-heavy.

Broom snakeweed (*Gutierrezia sarothrae*) and stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) are also present, but have had widely varying densities. The density of snakeweed has fluctuated from 100 plants/acre (248 plants/ha) to 2,600 plants/acre (6,436 plants/ha) and the density of rabbitbrush has ranged from 66 plants/acre (163 plants/ha) to 1,360 plants/acre (3,366 plants/ha). Antelope bitterbrush (*Purshia tridentata*) was sampled only in 1983 and 1989. Bitterbrush plants are scattered across the landscape in low numbers and have been severely hedged.

Herbaceous Understory

The herbaceous understory dominates the vegetative component. Perennial grass cover was 16% in 1996, 22% in 2002, and 20% in 2007. Crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), and Sandberg bluegrass (*Poa secunda*) are the most abundant perennial species. Since 1996, these three species have comprised an average 91% of the grass cover. Bulbous bluegrass, a

perennial with a phenology similar to annual grasses (Stewart and Hull 1949) was first sampled in 2007, in 3% of the quadrats. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) are present, but in lower frequencies than the perennial species. Cheatgrass cover was less than 1% in 1996 and 2002, and 3% in 2007. However, cheatgrass quadrat frequency increased from 9% in 1996 to 13% in 2002, and 53% in 2007.

There has been a moderately diverse community of forbs, including seeded species. Between four and 13 perennial species were sampled since 1983. Perennial forb cover increased from 13% in 1996 to 19% in 2002, and decreased to 10% in 2007. The dominant perennial species is alfalfa (*Medicago sativa*), which has comprised an average 89% of the perennial forb cover since 1996. Annual forb cover was relatively high in 2002 (9%) and 2007 (6%). The dominant annual forb was blue-eyed Mary. Bur buttercup (*Ranunculus testiculatus*), an allelopathic annual (Buchanan et al. 1978), has increased in quadrat frequency from 12% in 1996 to 26% in 2007.

1989 TREND ASSESSMENT

The browse trend is slightly up. The density of mountain big sagebrush increased 12%. The density of young plants increased two-fold and they comprised 30% of the population. There were no decadent plants, and none of the plants were classified as dying or having poor vigor. Browse use shifted from light to light-moderate. The density of bitterbrush also increased 23%, and the population was all healthy mature and young plants. The grass trend is up. Even thought there were two fewer species sampled, the sum of nested frequency of perennial species increased 74%. There was a significant increase in the nested frequency of Sandberg bluegrass. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased 81%, but forbs were still relatively infrequent. There were significant increases in annual sunflower (*Helianthus annuus*) and alfalfa.

browse - slightly up (+1) grass - up (+2) forb - slightly up (+1)

1996 TREND ASSESSMENT

The browse trend is slightly up. The density of sagebrush increased 51%. However, this increase was attributed to the larger sample area used in 1996. The increase in density was still a factor of trend, but other parameters were also given strong consideration. For example, the density of young plants decreased and they accounted for 8% of the population. Decadence and the proportion of plants exhibiting poor vigor remained low. Browse use shifted from light-moderate to moderate. There were no bitterbrush plants sampled, but this could also be the result of the change in sample area. The grass trend is down. The sum of nested frequency of perennial grasses decreased 22%, including a significant decrease in Sandberg bluegrass. Cheatgrass was sampled in 9% of the quadrats. The forb trend is up. The sum of nested frequency increased more than two-fold, and the number of perennial species increased from four to 13. The Desirable Components Index (DCI) score was good due to the moderate browse cover with low decadence, and high perennial grass and forb cover.

winter range condition (DCI) - good (71) Mid-level potential scale
browse - slightly up (+1) grass - down (-2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush decreased 7%, which would usually correspond to a stable trend. However, young plants decreased to 2% of the population, and decadence increased from 1% to 26%. The density of dead plants increased from 20 plants/acre (50 plants/ha) to 160 plants/acre (396 plants/ha). The proportion of plants exhibiting poor vigor increased from 4% to 14%. Browse use shifted from moderate to moderate-heavy, and heavily browsed plants increased from 17% of the population to 44%. The grass trend is stable. The sum of nested frequency of perennial grasses increased 5%, and there was a significant increase in the nested frequency of intermediate wheatgrass. Cheatgrass frequency and cover remained stable. The forb trend is down. The sum of nested frequency of perennial forbs decreased 27%, and

the number of perennial species decreased from 13 to eight. There were significant increases and decreases in the nested frequencies of four annual species, and a significant increase in wild onion (*Allium* sp.). The DCI score decreased to fair-good due to an increase in browse decadence.

winter range condition (DCI) - fair-good (64) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 18%, and decadence increased from 26% to 53% of the population. Few seedling and no young plants were sampled. The density of dead plants increased to 220 plants/acre (545 plants/ha). The sagebrush defoliator moth (*Aroga websteri*) had infested 56% of the sampled plants. Plants exhibiting poor vigor decreased to 11%, and it was noted that sagebrush had good flower production. Browse use shifted to light-moderate. The grass trend is slightly down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 9%. There was a significant increase in Sandberg bluegrass. However, bulbous bluegrass was sampled for the first time, and there was a significant increase in the nested frequency of cheatgrass. Cheatgrass quadrat frequency increased from 13% to 53%. The forb trend is down. The sum of nested frequency of perennial forbs decreased 31%. There were significant decreases in the nested frequencies of wild onion and alfalfa, and there was a significant increase in that of bur buttercup. The DCI score decreased to fair due to increases in browse decadence and annual grass cover.

winter range condition (DCI) - fair (53) Mid-level potential scale
browse - down (-2) grass - slightly down (-1) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 11

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Agropyron cristatum	a169	ab195	b220	ab196	ab200	8.60	11.37	8.46
G	Agropyron intermedium	a84	ab260	bc138	d191	cd158	4.97	7.65	6.93
G	Agropyron spicatum	b53	-	a7	a3	a16	.53	.38	.54
G	Bromus japonicus (a)	-	-	-	a3	a10	-	.01	.07
G	Bromus tectorum (a)	-	-	a28	a36	b156	.57	.62	3.26
G	Festuca ovina	3	-	-	-	-	-	-	-
G	Poa bulbosa	-	-	-	-	5	-	-	.01
G	Poa secunda	a54	c178	b126	b127	c188	1.93	2.11	4.49
G	Vulpia octoflora (a)	-	-	-	2	-	-	.00	-
Total for Annual Grasses		0	0	28	41	166	0.56	0.63	3.33
Total for Perennial Grasses		363	633	491	517	567	16.04	21.52	20.44
Total for Grasses		363	633	519	558	733	16.61	22.16	23.78
F	Agoseris glauca	-	-	a12	a8	a7	.08	.04	.04
F	Alyssum alyssoides (a)	-	-	b124	a11	b93	.33	.03	.23
F	Allium sp.	a1	a2	a1	b23	a3	.00	.17	.01

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Artemisia ludoviciana	-	1	-	-	-	-	-	-
F	Astragalus miser	-	-	$_{a}$40	$_{a}$20	$_{a}$26	1.05	.16	.30
F	Castilleja linariaefolia	-	-	$_{a}$8	$_{a}$8	$_{a}$1	.01	.22	.03
F	Calochortus nuttallii	$_{a}$1	-	-	$_{a}$2	$_{a}$4	-	.01	.01
F	Castilleja sp.	-	-	8	-	-	.04	-	-
F	Cirsium sp.	-	-	3	-	-	.00	-	-
F	Collomia linearis (a)	-	-	$_{b}$82	$_{a}$6	$_{a}$1	.18	.01	.00
F	Collinsia parviflora (a)	-	-	$_{a}$146	$_{b}$245	$_{b}$252	1.02	8.10	3.74
F	Cymopterus sp.	-	-	$_{a}$17	$_{a}$8	$_{a}$9	.09	.07	.07
F	Delphinium nuttallianum	-	-	1	-	-	.00	-	-
F	Descurainia pinnata (a)	-	-	-	-	3	-	-	.00
F	Draba sp. (a)	-	-	$_{a}$30	$_{a}$28	$_{b}$125	.22	.05	.46
F	Erigeron divergens	-	-	45	-	-	.13	-	-
F	Eriogonum racemosum	$_{a}$8	$_{a}$16	$_{a}$22	$_{a}$15	$_{a}$12	.27	.18	.10
F	Gayophytum ramosissimum(a)	-	-	3	-	-	.01	-	-
F	Helianthus annuus (a)	$_{a}$3	$_{b}$23	-	$_{a}$3	-	-	.00	-
F	Holosteum umbellatum (a)	-	-	$_{b}$194	$_{a}$97	$_{b}$173	.53	.56	.77
F	Lactuca serriola	$_{b}$16	-	$_{a}$6	-	-	.01	-	-
F	Medicago sativa	$_{a}$22	$_{bc}$77	$_{bc}$78	$_{c}$95	$_{b}$61	10.93	8.77	4.33
F	Microsteris gracilis (a)	-	-	-	$_{a}$11	$_{a}$10	-	.02	.02
F	Polygonum douglasii (a)	-	-	$_{a}$2	$_{a}$2	$_{a}$2	.01	.00	.00
F	Ranunculus testiculatus (a)	-	-	$_{a}$29	$_{a}$36	$_{b}$59	.06	.12	.30
F	Sanguisorba minor	2	-	-	-	-	-	-	-
F	Sphaeralcea coccinea	$_{a}$3	-	$_{a}$2	-	-	.03	-	-
F	Tragopogon dubius	-	-	2	-	-	.01	-	-
Total for Annual Forbs		3	23	610	439	718	2.38	8.92	5.56
Total for Perennial Forbs		53	96	245	179	123	12.69	9.63	4.90
Total for Forbs		56	119	855	618	841	15.08	18.55	10.47

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

BROWSE TRENDS --
Management unit 17 , Study no: 11

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Artemisia tridentata vaseyana	62	64	64	10.17	12.65	12.85
B	Chrysothamnus viscidiflorus viscidiflorus	8	28	25	.52	.61	1.25
B	Gutierrezia sarothrae	42	10	4	1.18	.05	.03
B	Opuntia sp.	6	5	6	.16	.30	.15
Total for Browse		118	107	99	12.04	13.61	14.28

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 11

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	13.66	14.81
Chrysothamnus viscidiflorus viscidiflorus	.66	.90
Gutierrezia sarothrae	.05	-
Opuntia sp.	.18	.11

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 11

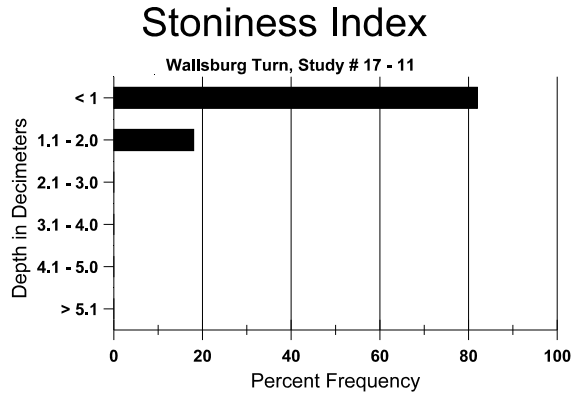
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.4	1.4

BASIC COVER --
Management unit 17 , Study no: 11

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	5.75	18.75	44.34	48.84	53.00
Rock	10.75	15.50	11.94	8.77	6.86
Pavement	19.00	32.00	9.28	7.74	8.35
Litter	39.25	27.00	41.57	44.34	37.93
Cryptogams	18.50	1.50	2.24	1.72	.69
Bare Ground	6.75	5.25	11.85	8.97	7.08

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 11, Wallsburg Turn

Effective rooting depth (in)	Temp °F (depth)	pH	Silty clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
8.9	52.4 (10.7)	7.6	18.9	53.0	28.0	3.1	16.3	156.8	.5



PELLET GROUP DATA --

Management unit 17 , Study no: 11

Type	Quadrat Frequency			Days use per acre (ha)	
	'96	'02	'07	'02	'07
Sheep	-	1	-	-	-
Rabbit	2	5	14	-	-
Elk	7	6	6	17 (43)	35 (86)
Deer	12	20	20	54 (134)	52 (129)
Cattle	2	-	-	-	6 (14)

BROWSE CHARACTERISTICS --
Management unit 17 , 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 vaseyana												
83	**1366**	33	233	1133	-	-	0	0	0	-	0	14/13
89	**1532**	-	466	1066	-	-	48	4	0	-	0	18/19
96	**2320**	40	180	2120	20	20	66	17	1	-	4	20/36
02	**2160**	-	40	1560	560	160	41	44	26	6	14	25/35
07	**1780**	20	-	840	940	220	29	1	53	8	11	31/43

		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)
Chrysothamnus viscidiflorus viscidiflorus												
83	**66**	-	33	33	-	-	0	0	0	-	0	10/17
89	**266**	-	200	33	33	-	0	0	12	-	0	5/5
96	**200**	80	80	120	-	-	0	0	0	-	0	10/17
02	**1360**	-	20	1220	120	60	0	0	9	-	0	7/11
07	**1200**	-	-	1180	20	-	0	0	2	-	13	10/12
Gutierrezia sarothrae												
83	**133**	-	-	133	-	-	0	0	0	-	0	10/13
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
96	**2600**	440	320	2280	-	-	0	0	0	-	0	8/12
02	**400**	-	-	320	80	20	0	0	20	-	0	7/5
07	**100**	-	-	100	-	-	0	0	0	-	0	9/10
Opuntia sp.												
83	**100**	-	-	100	-	-	0	0	0	-	0	6/8
89	**100**	-	-	100	-	-	0	0	0	-	0	6/14
96	**120**	20	-	120	-	-	0	0	0	-	0	5/19
02	**140**	-	-	140	-	-	0	0	0	-	0	5/36
07	**120**	-	-	80	40	-	0	0	33	-	17	6/19
Purshia tridentata												
83	**566**	-	-	566	-	-	94	0	-	-	0	16/20
89	**733**	-	100	633	-	-	27	23	-	-	0	15/32
96	**0**	-	-	-	-	-	0	0	-	-	0	18/69
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	14/36

Trend Study 17-12-07

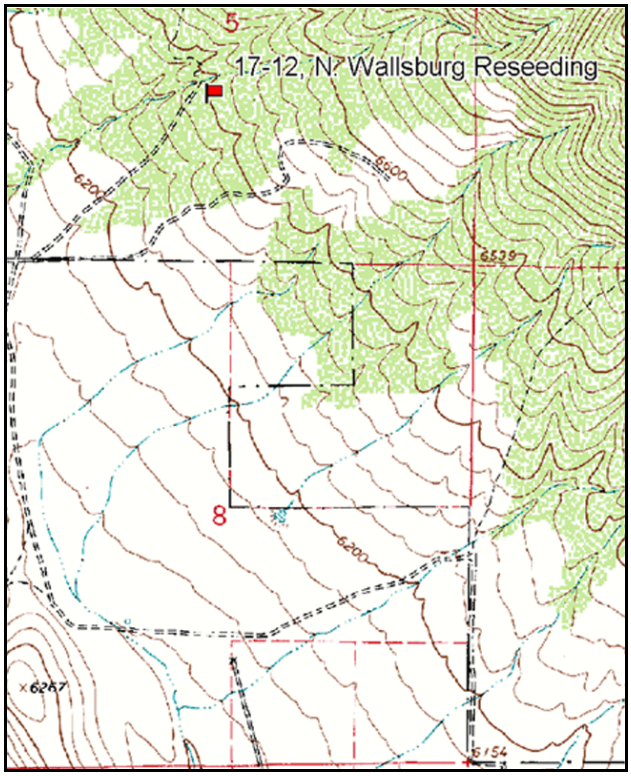
Study site name: North Wallsburg Reseeding . Vegetation type: Mixed Oak - Sage .

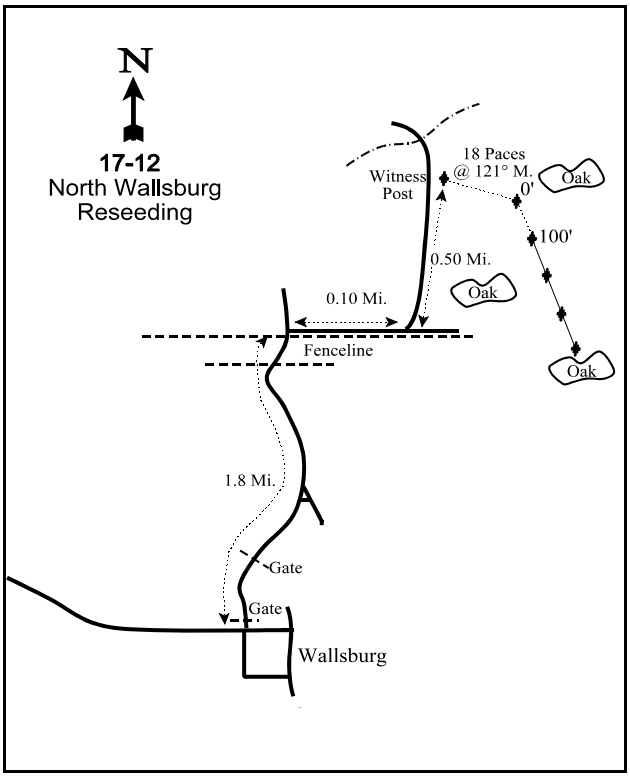
Compass bearing: frequency baseline 172 degrees magnetic.

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

LOCATION DESCRIPTION

From the town of Wallsburg, take Center St., going north for 1.8 miles, staying on the main road until coming to a gate. Proceed through the gate and turn east immediately after passing through the gate. Proceed east traveling along the fenceline for 0.10 miles to another intersection. Turn left at the intersection and proceed north for 0.50 miles to a green steel "T" fencepost on the right (i.e., east) side of the road. From the fencepost the 0-foot baseline stake is 18 paces away at an azimuth of 121 degrees magnetic. A red browse tag, number 3953, is attached to the 0-foot baseline stake.





Map Name: Charleston

Diagrammatic Sketch

Township 5S , Range 5E , Section 5

GPS: NAD 83, UTM 12T 465440.0 E 4473635.1 N

DISCUSSION

North Wallsburg Seeding - Trend Study No. 17-12

Study Information

This study is located on deer and elk winter range northeast of Wallsburg [elevation: 6,400 feet (1,951 m), slope: 10%-15%, aspect: southwest]. The study is within the boundaries of a 1976 wildfire between Main Canyon and Daniels Canyon. The fire varied in intensity, leaving patches of shrubs that survived. The area was seeded later that year. Except for the presence of seeded grasses and forbs, the area is vegetatively similar to adjacent, unburned oak-sagebrush communities. There is a water trough located 40 feet (12 m) southeast of the 400 foot stake. From the pellet group transect, there were an estimated 69 deer days use/acre (170 ddu/ha) in 2002, and 48 deer days use/acre (119 ddu/ha) in 2007. Elk use was estimated at 10 days use/acre (25 edu/ha) in 2002 and 19 days use/acre (46 edu/ha) in 2007. A deer skeleton was found near the 400-foot stake in 2007.

Soil

The soil is part of the Yeates Hollow soil series. Soils in this series are deep, well-drained and moderately well- drained, slowly permeable, and formed in alluvium, colluvium and residuum from conglomerate, sandstone and quartzite. Soils are typically up to 46 inches (117 cm) deep (USDA-NRCS 2007). Specifically at the study, the soil texture is a clay loam with a neutral reactivity (pH of 7.1). The soil is moderately deep with many rocks and gravel on the surface and throughout the profile. Litter and vegetation are the dominant cover classes and accounted for 71%-81% of the relative ground cover since 1996. The erosion condition was classified as stable in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) canopy cover was 5% in 2002 and 4% in 2007. The density of sagebrush decreased from 1,433 plants/acre (3,547 plants/ha) in 1983 to 320 plants/acre (792 plants/ha) in 2002, and increased to 360 plants/acre (891 plants/ha) in 2007. No seedling plants have been sampled in any given year. The density of young plants decreased in 1989 and 1996, and no young plants have been sampled since. Decadence has been low (0%-14%) except in 2007 (44%). Vigor has been good, and few dead or dying plants have been sampled. The average annual leader growth was 2.0 inches (5.1 cm) in 2002 and 2.2 inches (5.5 cm) in 2007. Browse use has varied from light to moderate-heavy.

Canopy cover of Gambel oak (*Quercus gambelii*) decreased from 11% in 2002 to 8% in 2007. The density has increased every sample year. Gambel oak vigor has been good, except in 2002 when 30% of the stems had poor vigor. The poor vigor was attributed to frost damage. Browse use on oak has varied from light to moderate. The density of antelope bitterbrush (*Purshia tridentata*) has ranged from 80 plants/acre (198 plants/ha) to 100 plants/acre (248 plants/ha). Mature plants have made up the entire population. Plant vigor has been good in all sample years. Annual leader growth averaged 2.2 inches (5.5 cm) in 2002 and 2.6 inches (6.5 cm) in 2007. Browse use was varied from light-moderate to light-heavy.

The populations of stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) and broom snakeweed (*Gutierrezia sarothrae*) are larger than the sagebrush and bitterbrush populations, though they provide less cover. Rabbitbrush and snakeweed densities have followed a similar pattern of increasing from 1983 to 1989, and then sharply decreasing since 1996. Densities of both peaked at over 7,500 plants/acre (18,565 plants/ha) in 1989. Rabbitbrush decreased to 340 plants/acre (842 plants/ha), and snakeweed decreased to 80 plants/acre (198 plants/ha) in 2007. There have been a few scattered antelope bitterbrush (*Purshia tridentata*) plants since 1996.

Herbaceous Understory

Perennial grasses are the dominant component of the community and provided 22% cover in 1996, 19% in

2002, and 31% in 2007. Crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*Agropyron intermedium*) were the most frequent grasses in 1983 and 1989. In subsequent sample years, sheep fescue (*Festuca ovina*) has been the dominant grass. Bulbous bluegrass (*Poa bulbosa*) has been present since 1996, and cover has increased from 1% in 1996 to 4% in 2007. This perennial grass has a phenology similar to annual grasses (Stewart and Hull 1949). Cheatgrass (*Bromus tectorum*) has also been present, but has accounted for less than 1% cover since 1996.

Forbs have been an insignificant component of the understory. Forb cover has averaged 1% cover since 1996. Alfalfa (*Medicago sativa*) was seeded following the 1976 wildfire, but has only been sampled in low frequencies. Since the sampling of annual species began in 1996, pale alyssum (*Alyssum alyssoides*) has been the most frequently occurring of all forbs.

1989 TREND ASSESSMENT

The browse trend is down. The density of mountain big sagebrush decreased 35%. The decrease in the population density was largely from a decrease in the density of young plants. Decadence increased from 0% to 14% of the population, and 4% were classified as dying. Browse use shifted from light to light-moderate. In addition to the changes in sagebrush, there were increases in Gambel oak, stickyleaf low rabbitbrush, and broom snakeweed densities. Browse use on Gambel oak was moderate. The grass trend is up. The sum of nested frequency of perennial grasses increased 66%. Nested frequency increased significantly for crested wheatgrass, intermediate wheatgrass, and sheep fescue. Three perennial species were sampled that had not been sampled in 1983. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 59%, but forbs had already existed in low frequencies.

browse - down (-2) grass - up (+2) forb - slightly down (-1)

1996 TREND ASSESSMENT

The browse trend is stable. The estimated density of sagebrush decreased 64%. Although this decrease seems large, it was attributed to the larger area sampled in 1996. Within the new sample area, young plants comprised 18% of the population, and decadence decreased to 6%. None of the sampled plants had poor vigor, and browse use remained light-moderate. Gambel oak density increased three-fold, and browse use shifted to light-moderate. Antelope bitterbrush was sampled for the first time and had light-moderate browse use. Heavy browsing use was noted on the few true mountain mahogany shrubs scattered throughout the study. The grass trend is slightly down. The sum of nested frequency of perennial grass, excluding bulbous bluegrass, decreased 7%. Bulbous bluegrass was sampled for the first time. Additionally, there were significant decreases in crested wheatgrass and intermediate wheatgrass, and significant increases in sheep fescue and Sandberg bluegrass (*Poa secunda*). The forb trend is slightly up. The sum of nested frequency of perennial forbs increased three-fold, but forbs remained a small component. The Desirable Components Index (DCI) score was fair-good due to the moderate browse cover, low browse decadence, high perennial grass cover, and low perennial forb cover.

winter range condition (DCI) - fair-good (64) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush decreased 6%. There were no young sagebrush plants sampled and decadent plants increased to 13% of the population. Vigor remained constant, but browse use shifted to moderate-heavy. The density of Gambel oak increased 55%. Frost damage was suspected to have caused the proportion of plants with poor vigor to increase from 0% to 30%. Oak did not appear to have been browsed by wildlife in this sample year, and as a result, the increase in oak density did not improve the browse trend. Serviceberry (*Amelanchier alnifolia*) was sampled for the first time, and was present at a low density. The density of bitterbrush decreased 20%. The grass trend is slightly down. Excluding bulbous bluegrass, the

sum of nested frequency of perennial grasses decreased 8%. There was a significant decrease in Sandberg bluegrass and a significant increase in bulbous bluegrass. The forb trend is stable. Even though the sum of nested frequency of perennial forbs decreased 25%, forb frequency was already low. The DCI score remained fair-good.

winter range condition (DCI) - fair-good (65) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush increased 13%. No seedling or young plants were sampled, and decadent plants increased to 44% of the population. The proportion of plants exhibiting poor vigor increased to 11%, and all of these plants were classified as dying. Sagebrush defoliator moths (*Aroga websteri*) had infested 67% of the population. Browse use shifted from moderate-heavy to light-moderate. The density of Gambel oak increased 20% and browse use remained light. The densities of serviceberry and bitterbrush remained stable, and the bitterbrush plants were moderately hedged. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 11%. There were significant increases in the nested frequencies of bulbous bluegrass and cheatgrass. The forb trend is stable. The sum of nested frequency of perennial forbs increased 19%, but forbs remained a small component of the understory. The DCI score decreased to fair due to a decrease in browse cover and an increase in browse decadence.

winter range condition (DCI) - fair (61) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 12

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Agropyron cristatum	a90	b148	a66	a56	a56	2.41	1.25	2.25
G	Agropyron intermedium	a117	b192	a135	ab157	b182	3.32	5.92	7.19
G	Bromus tectorum (a)	-	-	ab16	a7	b33	.10	.53	.57
G	Dactylis glomerata	a8	a7	-	a-	a3	-	.00	.03
G	Festuca ovina	a42	b96	c190	c171	c199	14.72	8.35	16.71
G	Oryzopsis hymenoides	a2	a7	-	a4	-	-	.18	-
G	Poa bulbosa	-	-	a32	b92	c115	.62	2.79	4.23
G	Poa fendleriana	-	8	-	-	-	-	-	-
G	Poa pratensis	a27	a8	a26	a8	-	.41	.04	-
G	Poa secunda	-	a3	b24	a7	a8	.08	.06	.09
G	Sitanion hystrix	-	a6	a1	a1	-	.00	.00	-
G	Stipa comata	-	-	-	a2	a1	-	.03	.03
Total for Annual Grasses		0	0	16	7	33	0.10	0.53	0.56
Total for Perennial Grasses		286	475	474	498	564	21.57	18.66	30.55
Total for Grasses		286	475	490	505	597	21.67	19.19	31.12

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Agoseris glauca	-	-	$_{a}2$	$_{a}1$	$_{a}1$	.00	.00	.00
F	Alyssum alyssoides (a)	-	-	$_{b}134$	$_{a}22$	$_{b}86$	.36	.08	.45
F	Allium sp.	-	$_{a}2$	-	$_{a}2$	$_{a}1$	-	.00	.00
F	Aster chilensis	-	-	-	-	2	-	-	.03
F	Astragalus convallarius	-	-	-	-	8	-	-	.09
F	Astragalus sp.	-	$_{a}2$	$_{a}1$	$_{a}9$	$_{a}8$	.03	.05	.10
F	Astragalus utahensis	$_{a}3$	$_{a}1$	$_{a}10$	$_{a}10$	$_{a}5$	.33	.07	.16
F	Balsamorhiza sagittata	-	-	-	-	1	-	-	.03
F	Calochortus nuttallii	$_{a}5$	-	-	$_{a}2$	$_{a}3$	-	.00	.01
F	Chaenactis douglasii	-	$_{a}2$	$_{a}3$	-	-	.03	-	-
F	Cirsium sp.	$_{a}2$	-	$_{a}6$	-	$_{a}4$	.26	-	.01
F	Collomia linearis (a)	-	-	-	$_{a}5$	$_{a}1$	-	.01	.00
F	Comandra pallida	-	-	-	3	-	-	.00	-
F	Descurainia pinnata (a)	-	-	-	$_{a}4$	$_{a}8$	-	.01	.02
F	Draba sp. (a)	-	-	-	-	19	-	-	.11
F	Epilobium brachycarpum (a)	-	-	3	-	-	.00	-	-
F	Erigeron sp.	-	-	1	-	-	.03	-	-
F	Eriogonum racemosum	-	-	$_{a}7$	$_{a}3$	$_{a}6$	.05	.04	.03
F	Grindelia squarrosa	-	-	$_{a}3$	$_{a}5$	-	.06	.01	-
F	Lactuca serriola	8	-	-	-	-	-	-	-
F	Linum lewisii	-	-	$_{a}3$	$_{a}1$	$_{a}1$	.00	.03	.00
F	Lithospermum ruderale	-	-	$_{a}1$	$_{b}11$	$_{a}2$	.15	.13	.19
F	Medicago sativa	$_{a}3$	$_{a}1$	$_{a}10$	$_{a}4$	$_{a}2$	.33	.21	.30
F	Orthocarpus sp. (a)	-	-	2	-	-	.00	-	-
F	Phlox longifolia	-	$_{a}2$	$_{b}23$	$_{ab}11$	$_{b}29$	.06	.03	.14
F	Polygonum douglasii (a)	-	-	$_{a}5$	-	$_{a}1$	.01	-	.00
F	Ranunculus testiculatus (a)	-	-	-	-	3	-	-	.00
F	Sphaeralcea coccinea	$_{a}3$	$_{a}3$	-	$_{a}1$	$_{a}2$	-	.00	.00
F	Tragopogon dubius	$_{b}28$	$_{a}7$	$_{a}8$	$_{a}2$	$_{a}1$	.01	.01	.00
F	Viguiera multiflora	$_{b}11$	$_{ab}7$	$_{ab}9$	-	$_{a}1$	.19	-	.00
F	Zigadenus paniculatus	2	-	-	-	-	-	-	-
Total for Annual Forbs		0	0	144	31	118	0.37	0.09	0.59
Total for Perennial Forbs		65	27	87	65	77	1.55	0.62	1.13
Total for Forbs		65	27	231	96	195	1.93	0.72	1.73

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

BROWSE TRENDS --
Management unit 17 , Study no: 12

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Amelanchier alnifolia	0	2	2	-	.41	.18
B	Artemisia tridentata vaseyana	12	11	12	1.62	3.91	3.24
B	Cercocarpus montanus	1	0	0	.03	-	-
B	Chrysothamnus viscidiflorus viscidiflorus	35	13	10	.72	.04	.06
B	Gutierrezia sarothrae	21	4	4	.47	.03	.03
B	Opuntia sp.	6	4	4	.03	-	-
B	Purshia tridentata	5	4	4	1.59	1.69	1.95
B	Quercus gambelii	26	25	26	5.13	6.09	3.73
B	Symphoricarpos oreophilus	1	0	0	.15	-	-
B	Tetradymia canescens	7	8	7	.06	.51	.48
Total for Browse		114	71	69	9.81	12.69	9.69

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 12

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	.26	.13
Artemisia tridentata vaseyana	4.56	4.28
Chrysothamnus viscidiflorus viscidiflorus	.25	.91
Gutierrezia sarothrae	-	.05
Opuntia sp.	.01	.01
Purshia tridentata	2.06	1.98
Quercus gambelii	11.25	7.91
Tetradymia canescens	.78	.81

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 12

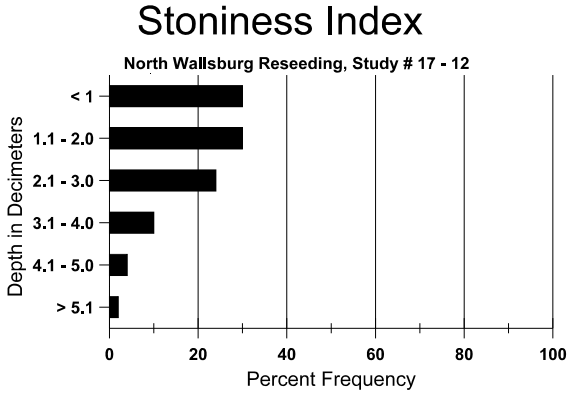
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.0	2.1
Purshia tridentata	2.2	2.6

BASIC COVER --
Management unit 17 , Study no: 12

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	1.50	4.25	35.09	33.00	48.28
Rock	5.75	5.50	6.78	5.06	3.71
Pavement	6.25	10.75	10.14	4.41	2.83
Litter	65.00	59.75	40.23	58.65	42.93
Cryptogams	1.50	.25	.81	.06	.10
Bare Ground	20.00	19.50	12.07	20.63	14.95

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 12, North Wallsburg Reseeding

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
11.5	46.2 (14.8)	7.1	40.2	29.1	30.7	3.5	21.1	163.2	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 12

Type	Quadrat Frequency		
	'96	'02	'07
Rabbit	8	-	17
Elk	5	5	6
Deer	27	24	31
Cattle	5	-	-

Days use per acre (ha)	
'02	'07
-	-
10 (25)	19 (46)
69 (170)	48 (119)
-	-

BROWSE CHARACTERISTICS --
Management unit 17 , 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)
Amelanchier alnifolia												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	-	40	-	-	50	50	-	-	0	31/35
07	**40**	-	-	40	-	-	50	0	-	-	0	27/35
Artemisia tridentata vaseyana												
83	**1433**	-	1200	233	-	-	0	0	0	-	0	26/30
89	**932**	-	633	166	133	-	39	0	14	4	4	28/36
96	**340**	-	60	260	20	40	53	6	6	-	0	28/47
02	**320**	-	-	280	40	40	44	56	13	-	0	27/40
07	**360**	-	-	200	160	20	39	6	44	11	11	30/49
Cercocarpus montanus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**20**	-	-	20	-	-	0	100	-	-	0	32/38
02	**0**	-	-	-	-	-	0	0	-	-	0	27/35
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Chrysothamnus viscidiflorus viscidiflorus												
83	**5333**	-	433	4900	-	-	0	0	0	-	0	8/7
89	**7766**	33	233	6933	600	-	0	0	8	-	18	10/13
96	**1300**	60	200	1020	80	60	0	0	6	2	2	11/20
02	**480**	-	20	440	20	20	0	0	4	4	4	7/13
07	**340**	-	-	260	80	-	0	0	24	6	6	9/13
Gutierrezia sarothrae												
83	**4933**	-	833	4100	-	-	0	0	0	-	0	8/9
89	**7533**	-	100	7300	133	-	0	0	2	-	15	9/9
96	**840**	20	280	560	-	-	0	0	0	-	0	8/10
02	**120**	-	-	100	20	-	0	0	17	-	0	7/9
07	**80**	-	-	60	20	-	0	0	25	25	25	9/12

		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)
Opuntia sp.												
83	**266**	-	-	266	-	-	0	0	0	-	0	6/8
89	**200**	-	-	200	-	-	0	0	0	-	33	6/18
96	**160**	-	-	160	-	-	0	13	0	-	0	5/23
02	**80**	-	-	80	-	-	0	0	0	-	0	5/8
07	**80**	-	-	60	20	-	0	0	25	-	0	5/11
Purshia tridentata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**100**	-	-	100	-	-	40	0	-	-	0	31/78
02	**80**	-	-	80	-	-	0	50	-	-	0	36/77
07	**80**	-	-	80	-	-	75	0	-	-	0	41/80
Quercus gambelii												
83	**666**	-	-	666	-	-	0	0	0	-	0	53/34
89	**899**	133	433	466	-	-	93	7	0	-	0	89/37
96	**2840**	240	560	2100	180	240	51	4	6	-	.70	50/32
02	**4400**	-	1160	3140	100	440	0	0	2	2	30	47/26
07	**5320**	-	2400	2120	800	1540	3	0	15	.75	11	81/48
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**20**	-	-	20	-	-	0	0	-	-	0	35/35
02	**0**	-	-	-	-	-	0	0	-	-	0	24/48
07	**0**	-	-	-	-	-	0	0	-	-	0	41/74
Tetradymia canescens												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
96	**400**	-	80	320	-	-	0	0	0	-	0	9/15
02	**640**	-	100	540	-	-	0	0	0	-	0	9/22
07	**680**	-	60	580	40	-	0	0	6	-	26	9/17

Trend Study 17-13-07

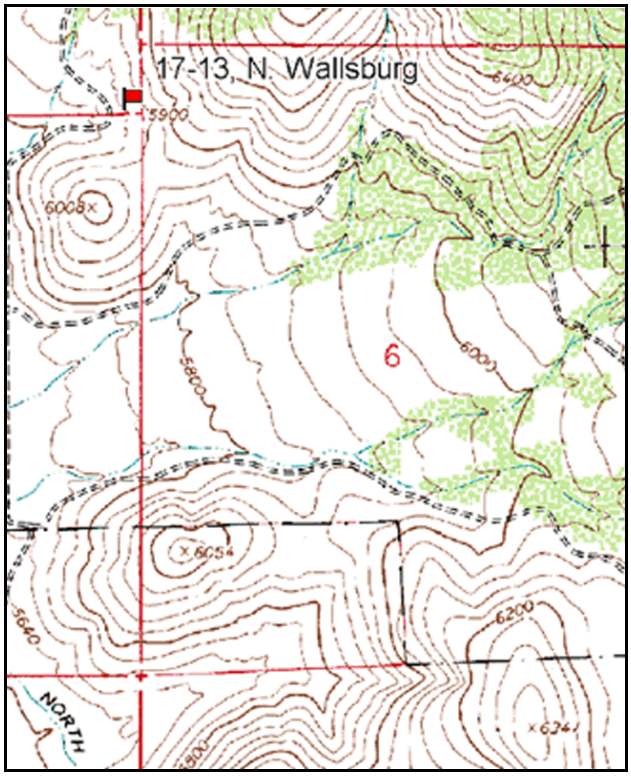
Study site name: North Wallsburg . Vegetation type: Big Sagebrush-Grass .

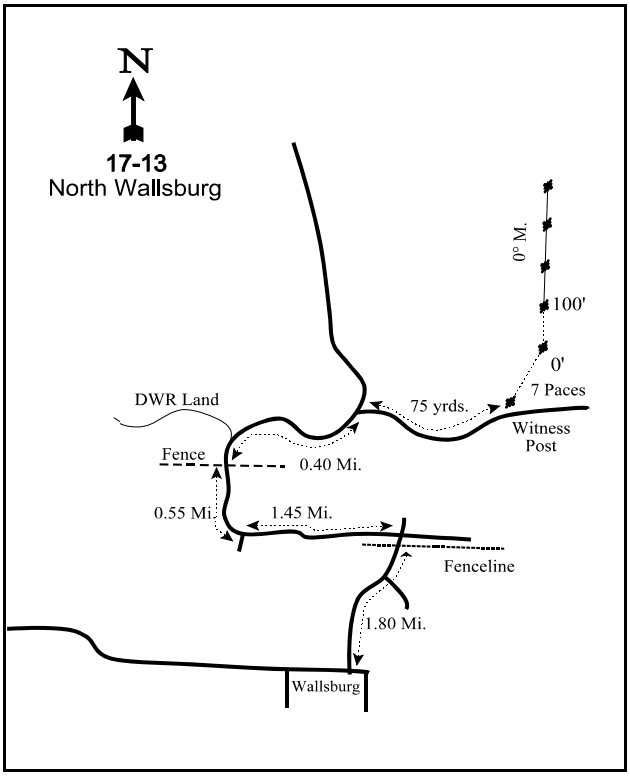
Compass bearing: frequency baseline 0 degrees magnetic.

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

LOCATION DESCRIPTION

Beginning at the town of Wallsburg, proceed northerly for 1.80 miles staying on the main road. At 1.80 miles the road will come to a fence line and a gate, proceed through the gate and turn left. Proceed west for 1.45 miles to where the road bends northward at the DWR fence line. Continue on the same road northward for 0.55 additional miles to a cattle guard. Cross the fence and take the immediate right fork, then proceed 0.40 miles to another fork in the road. Walk 75 yards up the old road to a red steel fencepost and a full high witness post on the left side of the road and stop. From the fencepost, the 0-foot stake of the baseline is 7 paces to the northeast.





Map Name: Charleston

Diagrammatic Sketch

Township 4S , Range 4E , Section 36

GPS: NAD 83, UTM 12T 463193 E 4474484 N

DISCUSSION

North Wallsburg - Trend Study No. 17-13

Study Information

This study is on Division of Wildlife Resources property located north of Wallsburg [elevation: 5,900 feet (1,798 m), slope: 20%, aspect: southwest]. The study site is typical of the sagebrush-grass communities that were prevalent in the Wallsburg area before a series of wildfires that burned much of the area in the 1960s and 1970s. There is an ephemeral stream 700 feet (213 m) to the west, and a group of stock ponds approximately 1 mile (1.6 km) to the southwest. The area reportedly receives heavy deer and light-moderate elk use in winter. From the pellet group transect, there were an estimated 147 deer days use/acre (364 ddu/ha) in 2002 and 87 deer days use/acre (215 ddu/ha) in 2007. Elk use was estimated at 9 days use/acre (21 edu/ha) in 2002 and increased to 38 days use/acre (93 edu/ha) in 2007. Numerous winter-killed fawns were found in 1989, and there were scattered bones near the baseline in 2007.

Soil

The soil is classified in the Wallsburg series and consists of shallow, well-drained, moderately-slowly permeable soils that formed in residuum and colluvium from limestone, sandstone and shale. The Wallsburg series is classified as clayey-skeletal, smectitic, frigid Lithic Argixerolls (USDA-NRCS 2007). Specifically at the study, the soil texture is a sandy clay loam and reactivity is neutral (pH of 7.1). The soil is moderately deep with some rocks on the surface and in the profile. The relative vegetation cover has increased from 40% in 1996 to 48% in 2007. Relative litter cover has decreased from 41% in 1996 to 34% in 2007. There was evidence of soil erosion when the study was established, but the erosion condition was classified as stable in 2002. In 2007, there was an increase in soil movement, resulting in an increase in the erosion condition to slight.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species. Sagebrush canopy cover was 16% in 2002, and increased to 18% in 2007. The density of sagebrush was initially estimated at 2,866 plants/acre (7,094 plants/ha) in 1983, and decreased to 1,732 plants/acre (4,287 plants/ha) in 1989. During the next two sample years, the density increased and was 2,540 plants/acre (6,287 plants/ha) in 2002. In 2007, the density had decreased to 1,780 plants/acre (4,405 plants/ha). The number of seedling and young plants have been moderately low in all sample years except in 1996 when 16% of the population consisted of young plants. Decadent plants have accounted for 26% of the population or greater in all sample years, and was highest in 1989 at 69%. Dead plants were not sampled in 1983 or 1989, but have ranged in density from 880 plants/acre (2,178 plants/ha) to 1,180 plants/acre (2,921 plants/ha) since 1996. Plant vigor has been mostly good, and only 8%-16% of the population has exhibited poor vigor. The average annual leader growth was 1.2 inches (3.0 cm) in 2002 and 1.6 inches (4.0 cm) in 2007. Browse use has ranged from light-moderate to moderate.

White rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), broom snakeweed (*Gutierrezia sarothrae*), and pricklypear cactus (*Opuntia* sp.) are also present. White rubber rabbitbrush were first sampled in 1996 when the baseline was extended and a larger area was sampled. The density of snakeweed has varied from a low of 399 plants/acre (988 plants/ha) in 1983 to a high of 4,500 plants/acre (11,140 plants/ha) in 1996, and the variation appears to be partly the result of drought periods. The pricklypear density has been steadily decreased from 799 plants/acre (1,978 plants/ha) in 1989 to 260 plants/acre (644 plants/ha) in 2007.

Herbaceous Understory

Perennial grass cover was 12% in 1996, 27% in 2002, and 28% in 2007. Grasses account for approximately two-thirds of the total vegetation cover. The grass component consists primarily of two less desirable species,

cheatgrass (*Bromus tectorum*) and bulbous bluegrass (*Poa bulbosa*). Bulbous bluegrass is a short-lived perennial that has a similar phenology to cheatgrass (Stewart and Hull 1949). Collectively, the cover of these two species increased from 24% in 1996 to 28% in 2002, and 33% in 2007. The quadrat frequency of bulbous bluegrass has steadily increased from 2% in 1983 to 86% in 2007. Cheatgrass quadrat frequency peaked at 96% in 2007. Other perennial species that have been present, but much less frequent, include four species of wheatgrass (*Agropyron* sp.), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass (*Poa secunda*), bottlebrush squirreltail (*Sitanion hystrix*), and needle-and-thread grass (*Stipa comata*).

Forbs, especially perennial species, have been a small component in all years. Collectively, the cover of annual and perennial forbs has averaged 1% since 1996. Frequency of perennial forbs was highest in 1989, and segolily (*Calochortus nuttallii*) was the dominant species. Since being included in 1996, annuals have been more frequent and provide more cover than perennial species. Pale alyssum (*Alyssum alyssoides*) and storksbill (*Erodium cicutarium*) have been the most dominant.

1989 TREND ASSESSMENT

The browse trend is down. The density of mountain big sagebrush decreased 40%. Decadence increased from 26% to 69% of the population. The proportion of plants exhibiting poor vigor decreased from 16% to 12%, and only 3% of the population was classified as dying. The average crown width decreased from 45 inches (114 cm) to 22 inches (59 cm). The decrease in density and average crown width, and the increase in decadence were attributed to lower than normal precipitation (Utah Climate Summaries 2007). The grass trend is slightly up. Excluding bulbous bluegrass, the sum of nested frequency of perennial species increased nearly four-fold, and there were significant increases in western wheatgrass (*Agropyron smithii*) and Sandberg bluegrass. However, there was also a significant increase in bulbous bluegrass. The grass trend was only slightly up because of the increase in bulbous bluegrass, and the low frequency of the other perennial species. The forb trend is up. The sum of nested frequency of perennial forbs increased four-fold, including a significant increase in segolily.

browse - down (-2) grass - slightly up (+1) forb - up (+2)

1996 TREND ASSESSMENT

The browse trend is up. The density of sagebrush increased 29%. Some of the change in density was attributed to the larger area sampled, so other parameters were emphasized in determining trend. For example, seedling plants were sampled for the first time, and the young age class increased from 4% of the population to 16%. Additionally, decadence declined to from 69% of the population to 31%. Dead plants were sampled at a density of 880 plants/acre (2,178 plants/ha). It is probable that dead plants were present, but not sampled, prior to 1996. Thus, it is difficult to determine a trend in the number of dead plants. Plants with poor vigor decreased to 8% of the population. Browse use shifted from moderate to light-moderate. The grass trend is slightly up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased two-fold, and there was a significant increase in the nested frequency of Sandberg bluegrass. Conversely, there was also a significant increase in bulbous bluegrass. While it was not reported prior to 1996, cheatgrass was sampled in 88% of the quadrats. The forb trend is down. The sum of nested frequency of perennial forbs decreased 70%, and there was a change in species composition. Segolily and longleaf phlox (*Phlox longifolia*) had been the dominant forbs in 1989, yet neither species was sampled in 1996. Instead, the most frequent forbs were pale alyssum and storksbill. The Desirable Components Index score (DCI) was very poor due to the moderate-low browse cover, high browse decadence, low perennial grass and forb cover, and high annual grass cover.

winter range condition (DCI) - very poor (25) Mid-level potential scale
browse - up (+2) grass - slightly up (+1) forb - down (-2)

2002 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush increased 13%, which was the only positive change in the population. No seedling plants were sampled, and young plants decreased to 5% of the population. Decadence increased to 33% of the population, and dying plants increased to 11%. The density of dead plants increased to 1,180 plants/acre (2,921 plants/ha). Browse use remained predominantly light-moderate, though there was an increase in the percentage of plants showing heavy browse use. The grass trend is stable. Excluding bulbous bluegrass, which increased significantly in nested frequency, the sum of nested frequency of perennial grasses decreased 3%. Despite the increase in bulbous bluegrass, trend was stable because the nested frequency of cheatgrass significantly decreased. Additionally, three perennial grasses, crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), and needle-and-thread grass were sampled for the first time. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 73%, and forbs remained a very minor component of the vegetation community. Perennial forbs were only sampled in 6% of the quadrats. The DCI score remained very poor.

winter range condition (DCI) - very poor (30) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 30%. No seedlings were sampled, and the young age class decreased to 2% of the population. Decadence increased to 42%, and dying plants increased to 15% of the population. The density of dead plants decreased slightly to 1,060 plants/acre (2,624 plants/ha). More than half of the sampled population was infested with the sagebrush defoliator moth (*Aroga websteri*). Browse use remained light-moderate, and there was a decrease in the percentage of plants with heavy browse use. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 20%. There were significant increases in the nested frequencies of both cheatgrass and bulbous bluegrass. The quadrat frequency of cheatgrass increased from 67% to 96%, and cover increased from 5% to 9%. The forb trend is stable. The sum of nested frequency of perennial forbs increased 85%, but forbs remained a very minor component of the vegetation community. The DCI score remained very poor.

winter range condition (DCI) - very poor (19) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 13

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Agropyron cristatum	-	-	-	a2	a3	-	.03	.30
G	Agropyron intermedium	-	-	-	a10	a6	-	.68	.15
G	Agropyron smithii	a10	b14	-	-	-	-	-	-
G	Agropyron spicatum	-	-	-	-	1	-	-	.00
G	Bromus tectorum (a)	-	-	b303	a200	b305	16.14	5.23	9.12
G	Oryzopsis hymenoides	a10	a13	a6	a17	a5	.36	.74	.21

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Poa bulbosa	$_{a}$5	$_{b}$69	$_{c}$157	$_{d}$285	$_{d}$299	7.55	22.75	23.93
G	Poa secunda	$_{a}$2	$_{b}$53	$_{c}$166	$_{c}$140	$_{c}$123	3.73	2.66	3.52
G	Sitanion hystrix	-	-	$_{a}$9	$_{a}$3	-	.19	.03	-
G	Stipa comata	-	-	-	$_{a}$4	$_{a}$3	-	.18	.00
Total for Annual Grasses		0	0	303	200	305	16.14	5.23	9.12
Total for Perennial Grasses		27	149	338	461	440	11.84	27.09	28.14
Total for Grasses		27	149	641	661	745	27.98	32.32	37.27
F	Agoseris glauca	-	-	4	-	-	.01	-	-
F	Alyssum alyssoides (a)	-	-	$_{b}$101	$_{a}$13	$_{a}$8	.69	.03	.02
F	Arabis sp.	-	$_{a}$3	$_{a}$1	-	-	.03	-	-
F	Astragalus eurekensis	-	-	-	-	-	-	.00	-
F	Astragalus sp.	$_{a}$3	$_{a}$3	-	-	-	-	-	-
F	Astragalus utahensis	$_{a}$3	-	$_{a}$1	$_{a}$4	$_{a}$2	.03	.01	.03
F	Calochortus nuttallii	$_{b}$25	$_{c}$112	-	$_{a}$1	$_{ab}$7	-	.00	.02
F	Descurainia pinnata (a)	-	-	-	-	3	-	-	.00
F	Draba sp. (a)	-	-	-	-	28	-	-	.10
F	Epilobium brachycarpum (a)	-	-	9	-	-	.02	-	-
F	Erodium cicutarium (a)	-	-	$_{ab}$49	$_{a}$28	$_{b}$64	.23	.08	.90
F	Erigeron sp.	-	-	6	-	-	.04	-	.00
F	Eriogonum racemosum	$_{a}$2	$_{a}$6	$_{a}$5	$_{a}$3	$_{a}$3	.01	.00	.03
F	Helianthus annuus (a)	-	-	-	2	-	-	.00	-
F	Holosteum umbellatum (a)	-	-	-	$_{a}$34	$_{a}$49	-	.11	.37
F	Machaeranthera canescens	2	-	-	-	-	-	-	-
F	Phlox longifolia	-	$_{b}$21	-	$_{a}$5	$_{ab}$8	-	.01	.02
F	Polygonum douglasii (a)	-	-	4	-	-	.01	-	-
F	Sisymbrium altissimum (a)	-	-	-	$_{b}$5	$_{a}$-	-	.01	.00
F	Tragopogon dubius	$_{a}$1	$_{a}$6	$_{b}$31	-	$_{a}$1	.17	-	.00
F	Zigadenus paniculatus	$_{a}$2	$_{b}$9	-	-	$_{a}$3	-	-	.03
Total for Annual Forbs		0	0	163	82	152	0.95	0.25	1.40
Total for Perennial Forbs		38	160	48	13	24	0.29	0.03	0.13
Total for Forbs		38	160	211	95	176	1.25	0.28	1.54

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

BROWSE TRENDS --
Management unit 17 , Study no: 13

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Artemisia tridentata vaseyana	74	71	56	9.16	13.57	11.05
B	Chrysothamnus nauseosus albicaulis	15	14	10	1.79	1.22	.94
B	Chrysothamnus viscidiflorus viscidiflorus	0	1	0	-	-	-
B	Gutierrezia sarothrae	39	14	21	1.99	.10	.15
B	Opuntia sp.	19	15	11	.35	.18	.18
Total for Browse		147	115	98	13.30	15.08	12.32

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 13

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	16.06	17.64
Chrysothamnus nauseosus albicaulis	1.16	1.79
Gutierrezia sarothrae	.18	.58
Opuntia sp.	-	.25

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 13

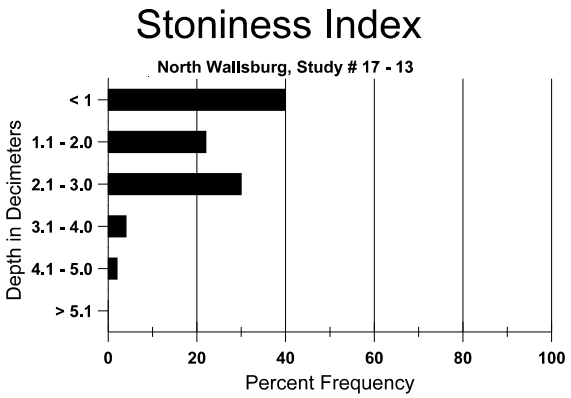
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.2	1.6

BASIC COVER --
Management unit 17 , Study no: 13

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	1.50	4.00	44.31	47.95	54.80
Rock	8.50	8.75	12.07	11.63	11.07
Pavement	3.75	14.00	3.82	4.53	2.47
Litter	64.75	53.25	44.58	41.18	39.22
Cryptogams	3.00	2.00	1.00	.87	.22
Bare Ground	18.50	18.00	4.32	12.44	6.54

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 13, North Wallsburg

Effective rooting depth (in)	Temp °F (depth)	pH				%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
11.8	50.0 (14.0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A



PELLET GROUP DATA --
Management unit 17 , Study no: 13

Type	Quadrat Frequency		
	'96	'02	'07
Sheep	1	-	-
Rabbit	11	6	2
Elk	12	4	10
Deer	36	47	56

Days use per acre (ha)	
'02	'07
-	-
-	-
9 (21)	38 (93)
147 (364)	87 (215)

BROWSE CHARACTERISTICS --
Management unit 17 , 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 vaseyana												
83	**2866**	-	200	1933	733	-	16	40	26	-	16	26/45
89	**1732**	-	66	466	1200	-	73	0	69	12	12	22/22
96	**2240**	380	360	1180	700	880	38	8	31	8	8	23/44
02	**2540**	-	120	1580	840	1180	31	30	33	11	11	21/30
07	**1780**	-	40	1000	740	1060	39	13	42	15	15	27/39

		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)
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
96	**360**	120	40	240	80	60	11	6	22	11	11	33/50
02	**280**	-	-	60	220	-	0	0	79	29	29	20/22
07	**280**	-	-	60	220	20	0	0	79	36	36	29/32
Chrysothamnus viscidiflorus viscidiflorus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	8/11
07	**0**	-	-	-	-	-	0	0	-	-	0	11/16
Gutierrezia sarothrae												
83	**399**	66	133	266	-	-	0	0	0	-	0	11/11
89	**1266**	-	-	1266	-	-	0	0	0	-	0	10/15
96	**4500**	100	520	3980	-	-	0	0	0	-	0	9/13
02	**520**	-	-	400	120	320	0	0	23	8	8	9/8
07	**660**	20	80	540	40	-	0	0	6	-	0	9/9
Opuntia sp.												
83	**466**	-	133	333	-	-	0	0	0	-	0	6/14
89	**799**	-	133	666	-	-	8	0	0	-	0	7/22
96	**420**	-	40	340	40	-	0	0	10	-	0	5/18
02	**380**	-	40	300	40	-	0	0	11	-	0	5/11
07	**260**	-	-	240	20	-	0	0	8	-	8	6/12

Trend Study 17-14-07

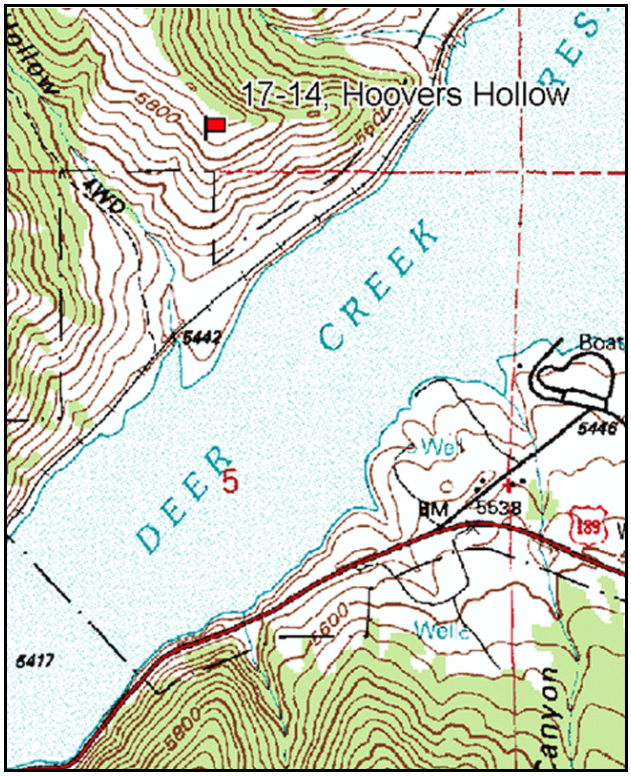
Study site name: Hoovers Hollow . Vegetation type: Big Sagebrush-Grass .

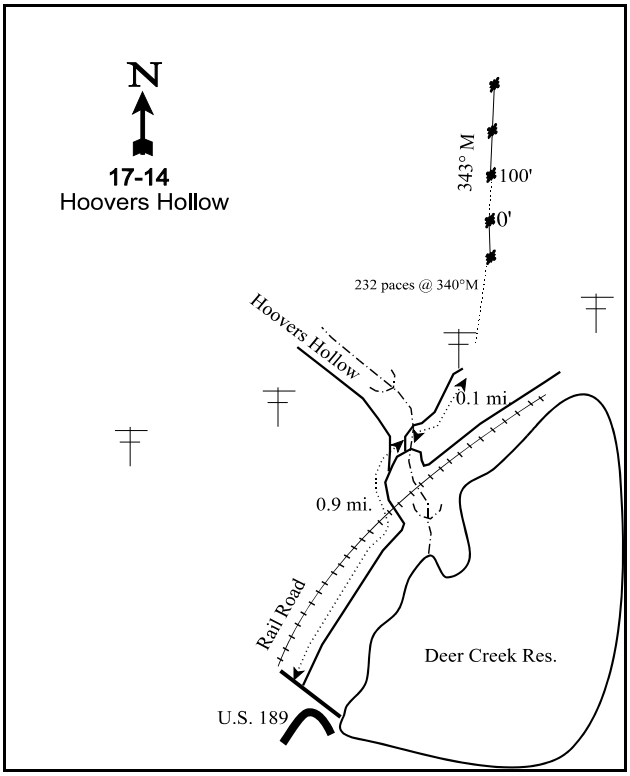
Compass bearing: frequency baseline 343 degrees magnetic.

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

LOCATION DESCRIPTION

From the locked gate at the southwest corner of Deer Creek Reservoir, walk 0.9 miles on the maintenance road along the northern edge of the reservoir, crossing the railroad tracks. Stop where the road crosses Hoovers Hollow. Follow a faint road that leads through the brush, across the hollow, and then leads to the first power pole northeast of the hollow. From the power pole, walk 232 paces at an azimuth of 340 degrees magnetic, to the 0-foot baseline stake. A red browse tag, number 3949, is attached to the 0-foot baseline stake.





Map Name: Aspen Grove

Diagrammatic Sketch

Township 4S , Range 4E , Section 32

GPS: NAD 83, UTM 12T 455968.4 E 4474548.1 N

DISCUSSION

Hoovers Hollow - Trend Study No. 17-14

Study Information

This study is located on a ridge top, near the mouth of Hoovers Hollow, on the west side of Deer Creek Reservoir [elevation: 5,800 feet (1,768 m), slope: 30%, aspect: south]. The area burned as a part of the Cascade wildfire in 2003. The fire was hot enough to kill most of the sagebrush, but did not consume the plants. There were no efforts to reseed the study area, or the surrounding hillslope. Deer Creek Reservoir is approximately 0.75 miles (1.2 km) downslope to the east. The hillslopes above the reservoir are heavily used by deer in the winter. Deer and elk use both increased in 2007 despite the lack of escape or thermal cover. From the pellet group transect data, there were an estimated 68 deer days use/acre (169 ddu/ha) in 2002 and 119 deer days use/acre (293 ddu/ha) in 2007. Elk use was estimated at 21 days use/acre (51 edu/ha) in 2002 and 58 days use/acre (144 edu/ha) in 2007. Cattle use was low at only 1 cattle day use/acre (3 cdu/ha) in 2002. It was reported in 1989 that domestic sheep had made a significant impact on this site for many years.

Soil

The soil is classified in the Wallsburg series and consists of shallow, well-drained, moderately-slowly permeable soils that formed in residuum and colluvium from limestone, sandstone and shale. The Wallsburg series is classified as clayey-skeletal, smectitic, frigid Lithic Argixerolls (USDA-NRCS 2007). Specifically at the study, the soil texture is a clay loam and has a neutral reactivity (pH of 7.3). The soil is shallow and very rocky, both on the surface and throughout the profile. Cracks in the soil surface, and along the edges of rocks may elevate the permeability of the soil. The relative cover of rock and pavement combined has averaged 23% since 1996. The relative vegetation cover has increased from 34% in 1996 to 45% in 2007, despite the wildfire. However, the majority of the vegetation cover comes from annual grasses and forbs. In past years, a high rate of erosion was reported and a loss of topsoil resulted. Since 1996, surface erosion has been minimal, and the soil erosion condition was classified as stable in 2002 and 2007.

Browse

The browse component was noted to be limited before the 2003 wildfire, and was even more limited following the wildfire. Sagebrush canopy cover decreased from 2% in 2002 to 0% in 2007. The density of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) increased from 266 plants/acre (658 plants/ha) in 1983 to 399 plants/acre (988 plants/ha) in 1989. In 1996 and 2002, the density was estimated at 340 plants/acre (842 plants/ha), and in 2007 it had decreased to 20 plants/acre (50 plants/ha). The age structure shifted from a young to a mature stand prior to the wildfire. Seedling plants were only sampled in 1996, and the proportion of the population classified as young decreased from 50% in 1983 to 0% in 2002 and 2007. Before the wildfire, decadence had steadily decreased from 38% to 12%, but was 100% after the fire. Vigor has been good since 1989, and few sagebrush have been classified as dying. The average annual leader growth was 3.2 inches (8.1 cm) in 2002, but there were no leaders to sample in 2007. Other preferred browse species that are present include white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), serviceberry (*Amelanchier alnifolia*), and a few scattered antelope bitterbrush (*Purshia tridentata*). The densities of these species have decreased or remained low since 1996.

The density of broom snakeweed (*Gutierrezia sarothrae*), a less desirable increaser, has fluctuated widely. The fluctuations coincide with periods of above and below normal precipitation (Utah Climate Summaries 2007). The density peaked at 11,540 plants/acre (28,564 plants/ha) in 1996 and had decreased to 160 plants/acre (396 plants/ha) in 2002. Pricklypear cactus (*Opuntia* sp.) is also present and the density has averaged 1,000 plants/acre (2,475 plants/ha) since 1989.

Herbaceous Understory

The herbaceous understory is dominated by annual species. The grass component has low diversity; only two or three perennial species have been sampled in any year. Perennial grass cover has remained consistent since 1996 at 7%. Unlike many other studies around the state, cheatgrass (*Bromus tectorum*) increased in average cover and retained nearly the same nested frequency value in 2002. Since 1996, cheatgrass has comprised an average 13% of the total ground cover, and has been the dominant grass species. In 2002 and 2007, it was sampled in 100% of the quadrats. Bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass (*Poa secunda*) are the most common perennial grass species. Combined, these species have accounted for an average 7% of the total ground cover.

Annual forbs have comprised an average 10% cover since 1996. The most frequently occurring annual forbs include pale alyssum (*Alyssum alyssoides*), storksbill (*Erodium cicutarium*), blue-eyed Mary (*Collinsia parviflora*), common sunflower (*Helianthus annuus*), and bur buttercup (*Ranunculus testiculatus*). Perennial forbs have averaged 3% of the total ground cover since 1996. The perennial forb composition has been composed of mostly less desirable species such as thistle (*Cirsium* sp.) and hairy goldaster (*Heterotheca villosa*). Perennial forb cover has averaged 4% since 1996. Two noxious weed species have also been sampled: houndstongue (*Cynoglossum officinale*) and dalmatian toadflax (*Linaria dalmatica*).

1989 TREND ASSESSMENT

The browse trend is stable. Although the density of mountain big sagebrush increased 50%, the population is small. No seedlings were sampled, and the density of young plants increased from 133 plants/acre (329 plants/ha)to 166 plants/acre (411 plants/ha). However, since the population density increase was larger, the young age class decreased from 50% to 42% of the population. Decadent plants decreased from 38% to 25%, and plants exhibiting poor vigor decreased from 25% to 8% of the population. Browse use shifted from light and heavy to moderate-heavy. The density of white rubber rabbitbrush decreased 31%. Decadence increased to 55%, poor vigor increased to 18%, and 11% of the population was classified as dying. Browse use on rabbitbrush shifted from exclusively light to light-moderate. The grass trend is up. The sum of nested frequency of perennial grasses increased four-fold, including a significant increase in Sandberg bluegrass. Grass diversity remained low. The forb trend is slightly down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 12%, and there was a significant decrease in yellow salsify (*Tragopogon dubius*). Houndstongue, a noxious weed, was sampled for the first time and had a quadrat frequency of 2%. There was also a significant increase in common sunflower, an annual forb.

browse - stable (0) grass - up (+2) forb - stable (0)

1996 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush decreased 15%. However, the population was already relatively small. Seedling plants were sampled, but the density of young plants decreased, and young plants comprised 18% of the population. Decadence decreased to 18%, but 6% of the population was classified as dying. There were also 180 dead plants/acre (446 plants/ha). There was a 13 inch (33 cm) increase in the average crown width. Browse use on sagebrush remained moderate-heavy, though heavily browsed plants decreased from 58% of the population to 29%. The density of white rubber rabbitbrush increased 31%, and the age distribution shifted to a mature population. The average crown width on rabbitbrush increased 19 inches (48 cm). Rabbitbrush vigor and browse use remained fairly stable. The grass trend is stable. The sum of nested frequency of perennial grasses increased 5%. Bluebunch wheatgrass increased significantly in nested frequency. Annual species were recorded for the first time, and cheatgrass was sampled in 98% of the quadrats. The forb trend is up. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased more than three-fold, and the number of perennial species increased from nine to 14. There were significant increases in tapertip onion (*Allium acuminatum*), hairy goldaster, and yellow salsify. Houndstongue was not sampled, but dalmatian toadflax was sampled in 2% of the quadrats. Storksbill was found in 100% of the quadrats, and other annuals had very high frequencies as well. The Desirable

Components Index (DCI) score was very poor due to the low browse cover, low perennial grass and forb cover, high annual grass cover, and the presence of one noxious weed species.

winter range condition (DCI) - very poor (20) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush remained stable. There were no seedling or young plants sampled, but only 12% of the population was decadent. There were no plants with poor vigor, and browse use shifted to light-moderate. However, the density of rabbitbrush decreased 63%, and since rabbitbrush is considered a preferred browse species at this study, this decrease resulted in the slightly down trend. Decadence increased from 25% to 56%, and plants classified as dying increased to 22% of the population. Browse use shifted to light. The grass trend is stable. Excluding bulbous bluegrass (*Poa bulbosa*), the sum of nested frequency of perennial grasses increased 12%, including a significant increase in the nested frequency of bluebunch wheatgrass. These changes would normally correspond to a slightly up trend. However, two less desirable species, Japanese brome (*Bromus japonicus*) and bulbous bluegrass were both sampled for the first time. Cheatgrass was sampled in 100% of the quadrats, and cover increased from 6% to 20%. The forb trend is down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 70%, and there were significant decreases in four perennial species. The DCI score remained very poor.

winter range condition (DCI) - very poor (4) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The browse component was destroyed in the 2003 wildfire, and did not recover. The density of sagebrush decreased 94%, and all of the remaining plants were classified as decadent. The density of dead plants increased to 300 plants/acre (743 plants/ha), most of which showed evidence of being killed in the wildfire. The rabbitbrush density decreased 89%. All surviving rabbitbrush plants were mature and in good vigor. Neither browse species had produced flowers or seeds when the study was sampled. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 12%, including a significant increase in Sandberg bluegrass. There was also a significant decrease in the nested frequency of Japanese brome. Cheatgrass was sampled in 100% of the quadrats, but cover had decreased to 15%. The forb trend is up. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased 53%, including a significant increase in yellow salsify. There were significant increases in the nested frequencies of bur buttercup and storksbill, both of which limit the establishment of other species (Buchanan et al. 1978, Stewart and Hull 1949). The DCI score remained very poor.

winter range condition (DCI) - very poor (10) Mid-level potential scale
browse - down (-2) grass - stable (0) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 14

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Agropyron cristatum	-	1	-	-	-	-	-	-
G	Agropyron spicatum	a18	ab37	b65	c101	c96	3.63	4.47	3.11
G	Bromus japonicus (a)	-	-	-	b92	a6	-	.57	.06
G	Bromus tectorum (a)	-	-	a346	a347	a353	5.82	20.35	14.66
G	Poa bulbosa	-	-	-	a2	a6	-	.01	.15
G	Poa secunda	a35	bc180	bc159	b155	c190	3.69	2.52	3.75
G	Sporobolus cryptandrus	-	-	4	-	-	.03	-	-
Total for Annual Grasses		0	0	346	439	359	5.82	20.92	14.72
Total for Perennial Grasses		53	218	228	258	292	7.35	7.00	7.02
Total for Grasses		53	218	574	697	651	13.17	27.92	21.75
F	Agoseris glauca	-	-	b32	a1	-	.19	.00	-
F	Allium acuminatum	-	a3	b18	b31	-	.05	.13	-
F	Alyssum alyssoides (a)	-	-	b302	a198	b288	1.58	2.08	1.61
F	Astragalus beckwithii	-	-	-	4	-	-	.15	-
F	Astragalus tenellus	-	-	4	-	-	.04	-	-
F	Astragalus utahensis	a2	a2	a13	a6	a10	.08	.19	.07
F	Castilleja linariaefolia	a2	-	a8	a1	-	.10	.15	-
F	Calochortus nuttallii	-	a6	a12	a13	-	.03	.04	-
F	Cirsium sp.	b65	b78	b67	a2	a7	1.11	.01	.05
F	Collomia linearis (a)	-	-	b21	a3	-	.05	.00	-
F	Collinsia parviflora (a)	-	-	b182	b147	a20	1.11	1.20	.04
F	Cymopterus sp.	-	-	a31	a32	a42	.10	.39	.12
F	Cynoglossum officinale	-	4	-	-	-	-	-	-
F	Draba sp. (a)	-	-	b50	-	a17	.10	-	.06
F	Epilobium brachycarpum (a)	-	-	-	5	-	-	.01	-
F	Erodium cicutarium (a)	-	-	b312	a81	c336	6.44	.80	10.44
F	Eriogonum racemosum	-	a1	a11	a1	a4	.02	.01	.19
F	Galium aparine (a)	-	-	1	-	-	.00	-	-
F	Gilia sp. (a)	-	-	-	1	-	-	.00	-
F	Helianthus annuus (a)	a6	c173	-	b100	-	-	.27	-
F	Heterotheca villosa	a5	a18	c88	ab31	b60	1.67	.94	2.65
F	Holosteum umbellatum (a)	-	-	ab190	a171	b231	2.63	.94	1.00
F	Lappula occidentalis (a)	-	-	-	a3	a3	-	.00	.00
F	Lactuca serriola	-	a3	a2	-	-	.01	-	-
F	Linaria dalmatica	-	-	a4	a1	a11	.03	.03	.05

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Machaeranthera spp	-	-	44	-	-	.08	-	-
F	Oenothera pallida	-	-	$_{a}$24	$_{a}$8	-	.04	.02	-
F	Polygonum douglasii (a)	-	-	3	-	-	.00	-	-
F	Ranunculus testiculatus (a)	-	-	$_{a}$58	$_{a}$66	$_{b}$105	.20	.23	.42
F	Sanguisorba minor	-	-	-	-	10	-	-	.18
F	Saxifragaceae	-	-	-	-	28	-	-	.49
F	Tragopogon dubius	$_{c}$64	$_{a}$10	$_{c}$73	$_{a}$3	$_{b}$39	.78	.00	.25
F	Verbascum thapsus	-	-	4	-	-	.15	-	-
Total for Annual Forbs		6	173	1119	775	1000	12.14	5.58	13.60
Total for Perennial Forbs		138	125	435	134	211	4.53	2.09	4.08
Total for Forbs		144	298	1554	909	1211	16.68	7.67	17.68

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

BROWSE TRENDS --
Management unit 17 , Study no: 14

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Amelanchier alnifolia	2	1	1	.15	.38	.63
B	Artemisia tridentata vaseyana	15	15	1	1.16	1.28	.15
B	Chrysothamnus nauseosus albicaulis	18	9	1	.72	1.17	-
B	Gutierrezia sarothrae	73	6	3	1.55	-	.15
B	Opuntia sp.	40	36	30	2.77	1.54	.57
B	Symphoricarpos oreophilus	1	1	1	.15	.15	.15
Total for Browse		149	68	37	6.51	4.54	1.65

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 14

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	-	.10
Artemisia tridentata vaseyana	2.33	-
Chrysothamnus nauseosus albicaulis	1.36	.28
Gutierrezia sarothrae	-	.21
Opuntia sp.	1.75	.70

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 14

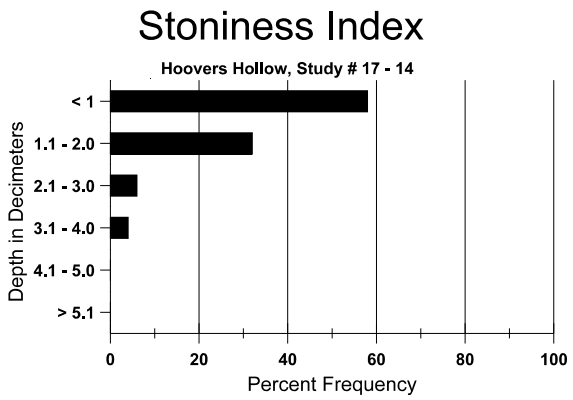
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	3.2	-

BASIC COVER --
Management unit 17 , Study no: 14

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	2.00	9.25	36.09	45.96	50.93
Rock	9.25	13.50	18.57	17.48	16.91
Pavement	12.25	41.75	7.71	9.44	6.25
Litter	62.75	20.50	28.28	23.36	28.89
Cryptogams	.25	.75	2.79	1.22	.31
Bare Ground	13.50	14.25	12.42	15.90	10.87

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 14, Hoovers Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
8.9	49.2 (7.2)	7.3	34.9	35.1	30.0	2.6	25.6	92.8	.5



PELLET GROUP DATA --
Management unit 17 , Study no: 14

Type	Quadrat Frequency		
	'96	'02	'07
Rabbit	1	2	-
Elk	10	12	36
Deer	28	29	32
Cattle	-	-	-

Days use per acre (ha)	
'02	'07
-	-
21 (51)	58 (144)
68 (169)	119 (293)
2 (4)	-

BROWSE CHARACTERISTICS --
Management unit 17 , 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)
Amelanchier alnifolia												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
96	**40**	-	-	20	20	-	50	50	50	-	0	13/21
02	**20**	-	-	20	-	-	0	100	0	-	0	18/25
07	**20**	-	-	20	-	-	0	0	0	-	0	22/29
Artemisia tridentata vaseyana												
83	**266**	-	133	33	100	-	0	50	38	-	25	20/22
89	**399**	-	166	133	100	-	25	58	25	-	8	15/18
96	**340**	80	60	220	60	180	47	29	18	6	6	17/31
02	**340**	-	-	300	40	180	65	12	12	-	0	19/32
07	**20**	-	-	-	20	300	100	0	100	-	0	20/37
Chrysothamnus nauseosus albicaulis												
83	**533**	-	-	533	-	-	0	0	0	-	0	24/30
89	**366**	-	33	133	200	-	45	9	55	18	18	18/20
96	**480**	40	40	320	120	80	33	21	25	13	17	23/39
02	**180**	-	-	80	100	100	11	11	56	22	22	31/39
07	**20**	-	-	20	-	60	0	0	0	-	0	23/28
Gutierrezia sarothrae												
83	**3266**	-	-	3266	-	-	0	0	0	-	0	9/11
89	**2466**	3333	100	1700	666	-	0	0	27	8	19	8/10
96	**11540**	21280	6760	4740	40	100	0	0	0	-	0	5/8
02	**160**	-	20	120	20	1280	0	0	13	13	13	5/8
07	**80**	-	-	80	-	-	0	0	0	-	0	9/13
Opuntia sp.												
83	**6100**	-	-	6100	-	-	0	0	0	-	0	6/6
89	**733**	100	333	300	100	-	0	0	14	5	27	5/22
96	**1000**	20	40	560	400	20	0	0	40	16	18	6/33
02	**1400**	-	160	860	380	100	0	1	27	13	13	5/16
07	**1000**	-	60	920	20	-	0	0	2	-	0	5/11

		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)
Purshia tridentata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	7/28
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	8/38
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**20**	-	20	-	-	-	0	0	-	-	0	6/11
02	**20**	-	-	20	-	-	0	0	-	-	0	7/14
07	**20**	-	-	20	-	-	0	100	-	-	0	4/8

Trend Study 17-15-07

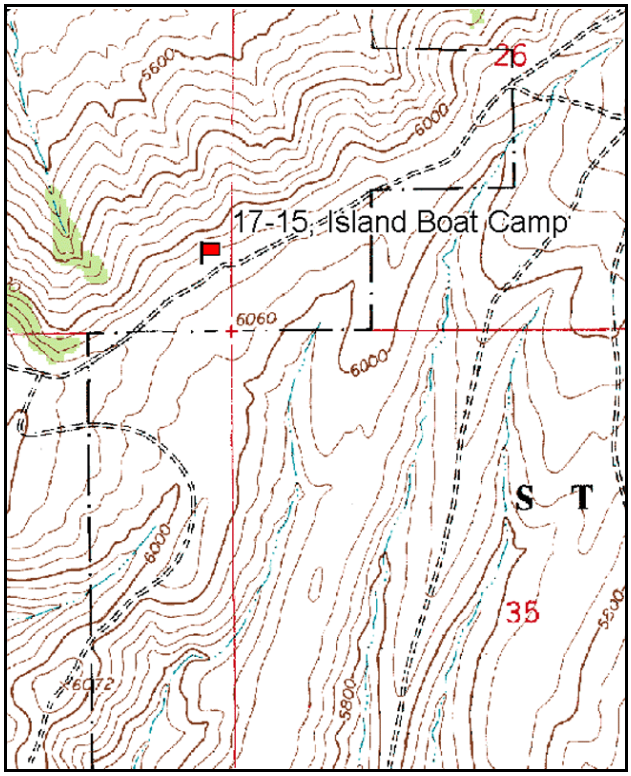
Study site name: Island Boat Camp . Vegetation type: Mountain Brush .

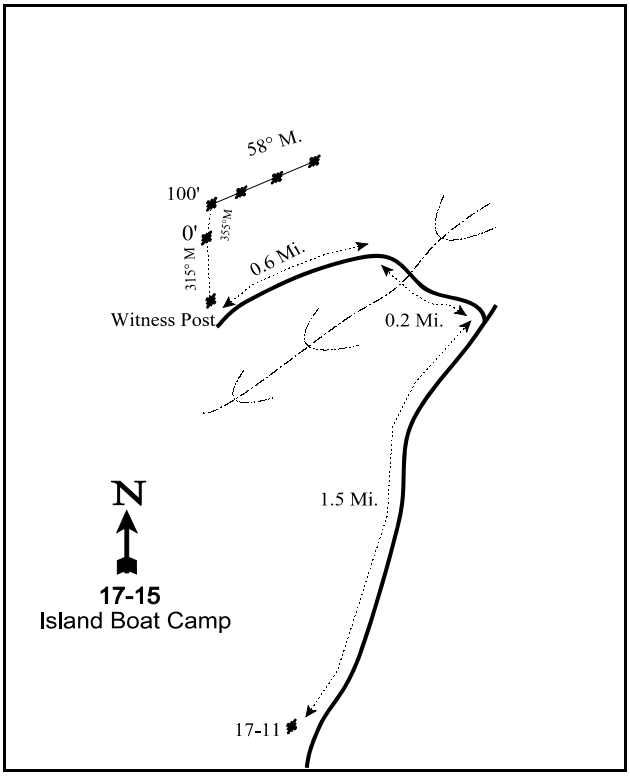
Compass bearing: line 1 frequency baseline 355 degrees magnetic.

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

LOCATION DESCRIPTION

Beginning at the intersection of U.S. 189 and the Wallsburg turnoff, proceed 0.50 miles towards Wallsburg to an intersection. Turn left at the intersection and proceed northerly for just over 1 mile passing through two DWR gates to another intersection, and turn right. Proceed 0.05 miles to a small rock pile on the left(i.e., east) side of the road which marks study #17-11, Wallsburg Turn. Continue down the road traveling north passing a left fork for 1.5 miles to a fork. Bear left and go 0.2 miles thru a drainage to another ridge top and bear left. Drive along the ridge 0.6 miles to a witness post on the north side of the road. 0-foot stake marked with a browse tag #415.





Map Name: Charleston

Diagrammatic Sketch

Township 4S , Range 4E , Section 26

GPS: NAD 83, UTM 12T 459901 E 4476255 N

DISCUSSION

Island Boat Camp - Trend Study No. 17-15

Study Information

This winter range study is located on a ridge overlooking both Wallsburg and the Island Boat Camp [elevation: 6,100 feet (1,860 m), slope: 5%, aspect: northwest]. It is representative of the unburned mountain brush community that existed on better quality sites between Wallsburg and Deer Creek Reservoir. Virtually all of the winter range to the north, east and south of this site was burned in 1976. The nearest source of perennial water is Deer Creek Reservoir, 1.4 miles (2.2 km) to the northwest. Big game use, as evidenced by hedging on the principal browse and frequency of deer and elk pellet groups, is moderately high. From the pellet group transect, there were an estimated 125 deer days use/acre (309 ddu/ha) in 2002 and 66 deer days use/acre (164 ddu/ha) in 2007. Elk use was estimated at 31 days use/acre (78 edu/ha) in 2002 and 9 days use/acre (22 edu/ha) in 2007. Most of the deer and elk pellet groups appear to be from winter use, but about 15% are from spring use. Cattle have used the area in the past, and cattle use was estimated at 19 days use/acre (47 cdu/ha) in 2007. Numerous game/livestock trails cross the study, and cattle had recently grazed through the area in 2007.

Soil

The soil is classified as the Watkins Ridge soil series and consists of very deep, well-drained, moderately permeable soils that formed in alluvium and residuum from limestone, sandstone and shale. The taxonomic classification is fine-loamy, mixed, superactive, frigid Typic Calcixerolls (USDA-NRCS 2007). Specifically at the study, the soil texture is a clay loam that is slightly alkaline in reactivity (pH of 7.8). The relative, combined cover of vegetation and litter has averaged 89% of the total ground cover since 1996. Though there are few rocks on the surface, they are abundant in the profile. The soil erosion condition was classified as stable in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), serviceberry (*Amelanchier alnifolia*), and antelope bitterbrush (*Purshia tridentata*) are the dominant preferred browse species. Mountain big sagebrush provided 10% canopy cover in 2002, and decreased to 3% in 2007. The sagebrush density has decreased from 3,199 plants/acre (7,918 plants/ha) in 1983 to 520 plants/acre (1,287 plants/ha) by 2007. Few or no seedling plants have been sampled. The young age class decreased from 19% of the population in 1983 to 2% by 1996, then increased to 16% by 2007. Decadent plants have comprised 20% of the population or greater in all sample years, and was highest in 2007 (65%). Dead plants were first sampled in 1996, and since then the density has increased from 560 dead plants/acre (1,400 plants/ha) in 1996 to 1,340 dead plants/acre (3,317 plants/ha) in 2007. The proportion of the plants that exhibit poor vigor has ranged from 0% to 29%, and since 1996 most of those plants were classified as dying. In 2007, 15% of the plants were infested with the sagebrush defoliator moth (*Aroga websteri*). The average annual leader growth was 2.2 inches (5.6 cm) in 2002 and 2.0 inches (5.1 cm) in 2007. Browse use has on sagebrush has been light to light-moderate.

Antelope bitterbrush canopy cover was 8% in 2002 and 4% in 2007. The density has decreased from 999 plants/acre (2,473 plants/ha) in 1989 to 400 plants/acre (990 plants/ha) in 2007. The population is comprised mostly of mature and decadent plants. Seedling and young plants were last sampled in 1989. Decadence has ranged from 13% to 40%, and was highest in 1989. Plants with poor vigor have accounted for 5% to 11% of the population since 1996, and all of those plants were classified as dying. The average leader growth was 2.4 inches (6.1 cm) in 2002 and 3.5 inches (8.8 cm) in 2007. Browse use on bitterbrush has been moderate or heavy.

The canopy cover of serviceberry decreased from 6% in 2002 to 5% in 2007. The serviceberry population density increased from 532 plants/acre (1,317 plants/ha) in 1983 to 1,532 plants/acre (3,792 plants/ha) in 1989,

and decreased to 700 plants/acre (1,733 plants/ha) in 2002. In 2007, the density was estimated at 780 plants/acre (1,931 plants/ha). Young plants comprised 30% of the population in 1989, 33% in 1996, and decreased to 5% in 2007. Decadence has been highly variable between sample years. Decadent plants increased from 50% of the population in 1983 to 57% in 1989, decreased to 7% in 1996, increased 29% in 2002, and decreased to 5% in 2007. Plants with poor vigor accounted for 25% and 48% of the population in 1983 and 1989, respectively. Since 1996, few plants have had poor vigor. Browse use on serviceberry has been light-moderate to moderate-heavy.

The most abundant browse species is stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*). The population density has ranged from 4,066 plants/acre (10,064 plants/ha) to 6,060 plants/acre (15,000 plants/ha). Other browse species present include snowberry (*Symphoricarpos oreophilus*), gray horsebrush (*Tetradymia canescens*), and broom snakeweed (*Gutierrezia sarothrae*). Browse use on these species has been light.

Herbaceous Understory

The herbaceous understory is abundant and diverse. Perennial grasses comprised 14% cover in 1996, 23% in 2002 and 18% in 2007. Between five and nine perennial grass species have been sampled. Bluebunch wheatgrass (*Agropyron spicatum*), mutton bluegrass (*Poa fendleriana*), and Sandberg bluegrass (*Poa secunda*) are the dominant grasses. Since 1996, these species have comprised a combined average 16% cover. Other grasses sampled include Indian ricegrass (*Oryzopsis hymenoides*), crested wheatgrass (*Agropyron cristatum*), and oniongrass (*Melica bulbosa*). Cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus)*, and bulbous bluegrass (*Poa bulbosa*) are also present. Although bulbous bluegrass is a perennial, it has a phenology similar to annual grasses (Stewart and Hull 1949). Of these three, only cheatgrass has been sampled in more than one quadrat. Quadrat frequency of cheatgrass was 22% in 1996, 4% in 2002, and 60% in 2007. Cheatgrass cover has averaged 1% since 1996.

Perennial forb diversity and abundance are higher at this study when compared to other studies near Deer Creek Reservoir and Wallsburg. Between 19 and 31 perennial species have been sampled. Perennial forb cover has decreased from 16% in 1996 to 12% in 2002, and 9% in 2007. Silky milkvetch (*Astragalus cibarius*), arrowleaf balsamroot (*Balsamorhiza sagittata*), sulfur eriogonum (*Eriogonum umbellatum*), and silvery lupine (*Lupinus argenteus*) have been the dominant perennial forbs. Annual forbs had a higher sum of nested frequency than perennials in 2007. The dominant annual forbs are pale alyssum (*Alyssum alyssoides*), blue-eyed Mary (*Collinsia parviflora*) and Douglas knotweed (*Polygonum douglasii*). Houndstongue (*Cynoglossum officinale*), a noxious weed, was sampled in 1996 and had a 1% quadrat frequency.

1989 TREND ASSESSMENT

The browse trend is stable. The density of mountain big sagebrush decreased 21%. The young age class decreased from 19% to 8% of the population, and decadence increased from 21% to 42%. The proportion of plants exhibiting poor vigor increased from 0% to 29%. Browse use remained light-moderate. The decrease in sagebrush was countered by a near three-fold increase in the density of serviceberry. Seedling and young serviceberry plants were sampled, and young plants comprised 30% of the population. However, decadence increased from 50% to 57%, and plants with poor vigor increased from 25% to 48% of the population. Browse use on serviceberry switched from moderate to light-moderate. The average height and crown measurements increased 21 and 25 inches (53 cm and 64 cm), respectively. The bitterbrush density remained stable, but decadence increased from 29% to 40%. The grass trend is up. The sum of nested frequency of perennial grasses increased 61%, including significant increases in Indian ricegrass and mutton bluegrass. The forb trend is up. The sum of nested frequency of perennial forbs increased 88%, including a significant increase in wild onion (*Allium* sp.).

browse - stable (0) grass - up (+2) forb - up (+2)

1996 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush decreased 18%, serviceberry decreased 20%, and bitterbrush decreased 40%. However, the changes were partly due to the larger area sampled in 1996, and trend was determined from other parameters. Fewer young plants were sampled, but sagebrush decadence decreased to 27%. Plants with poor vigor decreased to 10% of the population, and the average crown width increased 13 inches (33 cm). Serviceberry decadence decreased from 57% to 7% of the population. Additionally, there were no plants with poor vigor. The average crown height decreased 16 inches (41 cm), and browse use remained light-moderate. No young or seedling bitterbrush plants were sampled, but decadence decreased to 13% of the population. The majority of the plants were heavily browsed, but despite the browsing, the average crown width increased 24 inches (61 cm). The grass trend is up. The sum of nested frequency of perennial grasses increased 22%, including a significant increase in bluebunch wheatgrass. The forb trend is up. The sum of nested frequency of perennial forbs increased two-fold. There were significant increases in arrowleaf balsamroot, tapertip hawksbeard (*Crepis acuminata*), sulphur eriogonum, and Lewis flax (*Linum lewisii*). The number of sampled perennial forb species increased from 22 to 31. Houndstongue was sampled in one quadrat. The Desirable Components Index (DCI) score was good due to the high browse, perennial grass, and perennial forb cover. High browse decadence, low browse recruitment, and the presence of a noxious weed lowered the DCI score.

winter range condition (DCI) - good (74) High potential scale
browse - stable (0) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 16%, and most all of the decrease occurred in the mature age class. Decadence increased to 38% of the population. The density of dead sagebrush increased from 560 plants/acre (1,387 plants/ha) to 780 plants/acre (1,930 plants/ha). Additionally, the density of serviceberry decreased 43%, and decadence increased to 29% of the population. Browse use on serviceberry shifted from light-moderate to heavy. The density of bitterbrush decreased 7%, and decadence increased to 29% of the population. The grass trend is up. The sum of nested frequency of perennial grasses increased 23%. There was a significant increase in the nested frequency of Sandberg bluegrass and a significant decrease in that of cheatgrass. The grasses had not been grazed when the study was sampled. The forb trend is down. The sum of nested frequency of perennial forbs decreased 40%. There were significant decreases in the nested frequencies of five perennial species. Houndstongue was not sampled. The DCI score remained good since the increase in browse and perennial grass cover offset the increase in browse decadence.

winter range condition (DCI) - good (78) High potential scale
browse - down (-2) grass - up (+2) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 70%; again, most of the decrease occurred in the mature age class. Sagebrush canopy cover decreased from 10% to 3%. Seedling sagebrush were sampled for the first time at a density of 40 plants/acre (99 plants/ha). The density of young plants decreased slightly, but still comprised 15% of the population. Decadence increased to 65% of the population. The density of dead plants increased to 1,340 plants/acre (3,317 plants/ha); more than twice the density of live plants. Plants with poor vigor increased to 23% of the population, and all of these plants were classified as dying. Additionally, 15% of the plants were infested with the sagebrush defoliator moth. The density of serviceberry increased 11%, and decadent plants decreased to 5% of the population. Although hedged, the serviceberry plants appeared healthy. The bitterbrush density decreased 29%, and decadence increased to 35%. The grass trend is down. The sum of nested frequency of perennial grasses decreased 24%, including a significant decrease in the nested frequency of mutton bluegrass. Both wheatgrasses had been heavily grazed when the study was sampled. There was a significant increase in the nested frequency of cheatgrass. Cheatgrass quadrat frequency increased from 4% to 60%, and cover increased from 0% to 2%. Japanese brome and

bulbous bluegrass were sampled for the first time. The forb trend is down. The sum of nested frequency of perennial forbs decreased 48%, including significant decreases in the nested frequencies of six perennial species. The DCI score decreased to fair due to a decrease in preferred browse cover.

winter range condition (DCI) - fair (57) High potential scale
browse - down (-2) grass - down (-2) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 15

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Agropyron cristatum	-	$_{ab}$8	$_{a}$8	$_{ab}$25	$_{b}$31	.06	1.82	1.73
G	Agropyron spicatum	$_{a}$104	$_{a}$119	$_{b}$178	$_{b}$205	$_{b}$198	6.32	10.72	12.36
G	Bromus japonicus (a)	-	-	-	-	1	-	-	.00
G	Bromus tectorum (a)	-	-	$_{b}$67	$_{a}$7	$_{c}$172	.68	.02	2.37
G	Festuca ovina	$_{b}$15	-	-	-	$_{a}$2	-	-	.03
G	Melica bulbosa	-	-	$_{ab}$4	$_{b}$7	$_{a}$-	.06	.19	.00
G	Oryzopsis hymenoides	$_{ab}$19	$_{c}$46	$_{abc}$24	$_{bc}$32	$_{a}$2	.91	1.35	.03
G	Poa sp.	-	-	-	15	-	-	1.52	-
G	Poa bulbosa	-	-	-	-	1	-	-	.00
G	Poa fendleriana	$_{a}$103	$_{b}$172	$_{b}$198	$_{b}$172	$_{a}$46	5.01	4.99	.82
G	Poa pratensis	-	$_{a}$12	$_{a}$5	$_{a}$7	$_{a}$8	.06	.18	.33
G	Poa secunda	-	$_{a}$30	$_{a}$60	$_{b}$125	$_{b}$159	1.27	2.52	2.93
G	Sitanion hystrix	-	-	-	-	-	-	.00	-
G	Stipa comata	$_{a}$3	$_{a}$5	-	-	-	-	-	-
Total for Annual Grasses		0	0	67	7	173	0.68	0.01	2.38
Total for Perennial Grasses		244	392	477	588	447	13.72	23.32	18.27
Total for Grasses		244	392	544	595	620	14.40	23.34	20.65
F	Agoseris glauca	$_{a}$5	-	$_{c}$141	$_{b}$36	$_{b}$30	.95	.23	.15
F	Alyssum alyssoides (a)	-	-	$_{b}$105	$_{a}$19	$_{c}$263	.18	.04	3.64
F	Allium sp.	$_{a}$9	$_{b}$70	$_{a}$31	$_{b}$93	$_{a}$19	.08	.36	.09
F	Antennaria rosea	-	$_{a}$21	$_{a}$40	$_{a}$32	-	.52	.64	-
F	Arabis sp.	$_{a}$5	-	-	-	$_{a}$3	-	-	.00
F	Astragalus cibarius	-	-	$_{c}$93	$_{b}$50	$_{a}$23	2.68	.66	.12
F	Astragalus convallarius	$_{a}$13	$_{a}$9	$_{a}$3	$_{a}$11	$_{a}$15	.01	.05	.31
F	Balsamorhiza sagittata	$_{a}$18	$_{ab}$33	$_{c}$85	$_{bc}$56	$_{c}$75	4.46	4.77	5.32
F	Castilleja linariaefolia	-	$_{a}$3	$_{a}$2	$_{a}$4	-	.03	.06	-
F	Calochortus nuttallii	$_{ab}$7	$_{b}$15	$_{ab}$13	$_{a}$3	$_{ab}$3	.03	.00	.01
F	Castilleja sp.	-	-	3	-	-	.03	-	-
F	Chaenactis douglasii	-	-	$_{a}$1	-	$_{a}$3	.03	-	.03

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Cirsium sp.	$_{a}$2	-	$_{a}$3	$_{a}$1	-	.00	.03	-
F	Collomia linearis (a)	-	-	$_{b}$30	$_{a}$3	$_{b}$47	.11	.01	.11
F	Comandra pallida	$_{ab}$24	$_{b}$27	$_{ab}$22	$_{a}$3	$_{a}$6	.10	.01	.01
F	Collinsia parviflora (a)	-	-	$_{a}$198	$_{a}$216	$_{a}$191	.70	1.07	.98
F	Crepis acuminata	-	$_{a}$4	$_{b}$95	$_{a}$26	$_{a}$24	.84	.55	.40
F	Cryptantha sp.	$_{a}$2	-	-	-	$_{a}$3	-	-	.00
F	Cymopterus longipes	-	-	$_{c}$70	$_{b}$29	$_{a}$3	.33	.12	.03
F	Cynoglossum officinale	-	-	3	-	-	.00	-	-
F	Delphinium nuttallianum	-	-	$_{b}$41	$_{a}$3	-	.11	.03	-
F	Descurainia pinnata (a)	-	-	-	-	22	-	-	.04
F	Erigeron divergens	-	-	-	$_{a}$10	$_{a}$6	-	.24	.15
F	Eriogonum ovalifolium	-	-	-	3	-	-	.00	-
F	Erigeron pumilus	-	$_{a}$6	$_{ab}$23	$_{ab}$18	$_{b}$25	.07	.14	.15
F	Eriogonum racemosum	$_{ab}$25	$_{b}$25	$_{b}$14	$_{b}$16	$_{a}$7	.06	.16	.06
F	Eriogonum umbellatum	$_{ab}$74	$_{ab}$80	$_{c}$143	$_{bc}$107	$_{a}$51	2.49	2.04	.56
F	Galium sp.	-	-	3	-	-	.01	-	-
F	Hackelia patens	$_{a}$5	$_{a}$16	$_{a}$20	$_{a}$10	-	.07	.05	-
F	Holosteum umbellatum (a)	-	-	-	-	3	-	-	.01
F	Lactuca serriola	2	-	-	-	-	-	-	-
F	Linum lewisii	$_{a}$3	$_{a}$3	$_{b}$21	$_{ab}$13	$_{a}$3	.22	.13	.03
F	Lomatium triternatum	-	$_{a}$24	$_{a}$17	-	-	.04	-	-
F	Lupinus argenteus	$_{ab}$21	$_{ab}$34	$_{b}$43	$_{a}$19	$_{a}$18	1.00	.43	1.08
F	Machaeranthera canescens	$_{ab}$11	$_{b}$22	$_{a}$3	-	-	.00	-	-
F	Machaeranthera spp	5	-	-	-	-	-	-	-
F	Mertensia sp.	-	-	8	-	-	.05	-	-
F	Microsteris gracilis (a)	-	-	-	$_{a}$6	$_{a}$14	-	.01	.03
F	Orthocarpus sp. (a)	-	-	9	-	-	.05	-	-
F	Penstemon humilis	-	3	-	-	-	-	-	-
F	Phlox longifolia	-	$_{ab}$90	$_{b}$134	$_{b}$144	$_{a}$62	.30	.86	.31
F	Polygonum douglasii (a)	-	-	$_{b}$19	$_{a}$3	-	.03	.00	-
F	Ranunculus testiculatus (a)	-	-	$_{a}$3	-	$_{b}$10	.00	-	.04
F	Senecio multilobatus	$_{b}$23	$_{a}$6	$_{ab}$9	$_{a}$8	-	.04	.04	-
F	Sisymbrium altissimum (a)	-	-	-	-	2	-	-	.00
F	Taraxacum officinale	-	-	$_{a}$1	$_{a}$4	-	.00	.03	-
F	Tragopogon dubius	$_{ab}$23	$_{b}$23	$_{b}$27	$_{b}$29	$_{a}$1	.09	.19	.00
F	Vicia americana	-	6	-	-	-	-	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Viola sp.	-	-	103	-	-	1.35	-	-
Total for Annual Forbs		0	0	364	247	552	1.09	1.13	4.87
Total for Perennial Forbs		277	520	1215	728	380	16.08	11.90	8.87
Total for Forbs		277	520	1579	975	932	17.18	13.04	13.74

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

BROWSE TRENDS --
Management unit 17 , Study no: 15

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Amelanchier alnifolia	41	30	33	3.92	4.71	3.04
B	Artemisia tridentata vaseyana	62	56	22	10.25	10.47	.92
B	Chrysothamnus viscidiflorus viscidiflorus	81	81	74	7.44	7.40	9.36
B	Gutierrezia sarothrae	10	6	8	.34	.45	.21
B	Purshia tridentata	27	27	19	5.14	7.72	2.47
B	Symphoricarpos oreophilus	18	19	21	1.90	3.75	3.42
B	Tetradymia canescens	8	7	6	.03	.15	.18
Total for Browse		247	226	183	29.05	34.68	19.63

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 15

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	5.58	4.78
Artemisia tridentata vaseyana	10.21	3.04
Chrysothamnus viscidiflorus viscidiflorus	7.30	13.16
Gutierrezia sarothrae	.21	.48
Purshia tridentata	7.88	3.70
Symphoricarpos oreophilus	2.04	3.68
Tetradymia canescens	-	.06

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 15

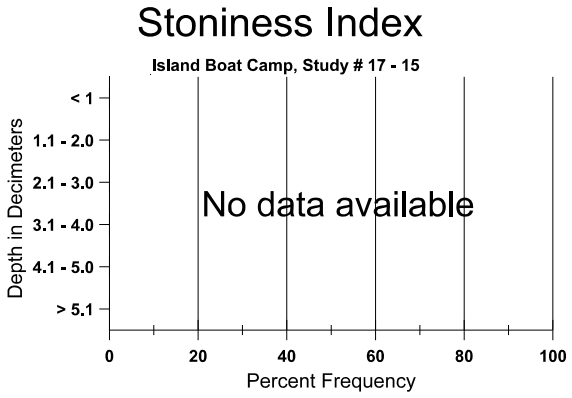
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.2	2.0
Purshia tridentata	2.4	3.5

BASIC COVER --
Management unit 17 , Study no: 15

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	.50	12.00	54.79	60.15	61.49
Rock	1.00	1.25	1.50	.68	.66
Pavement	2.75	17.25	2.71	4.29	3.43
Litter	75.75	58.75	61.57	55.50	39.52
Cryptogams	.75	1.25	.64	.98	.44
Bare Ground	19.25	9.50	8.54	7.38	7.30

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 15, Island Boat Camp

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
17.6	50.2 (18.1)	7.6	32.9	33.1	34.0	4.8	12.8	160.0	07



PELLET GROUP DATA --
Management unit 17 , Study no: 15

Type	Quadrat Frequency		
	'96	'02	'07
Rabbit	5	1	2
Elk	19	17	12
Deer	35	52	29
Cattle	1	-	6

Days use per acre (ha)	
'02	'07
-	-
31 (78)	9 (22)
125 (309)	66 (164)
-	19 (47)

BROWSE CHARACTERISTICS --
Management unit 17 , 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)
Amelanchier alnifolia												
83	**532**	-	-	266	266	-	75	13	50	8	25	26/18
89	**1532**	200	466	200	866	-	48	17	57	4	48	47/43
96	**1220**	60	400	740	80	20	26	11	7	-	0	31/40
02	**700**	-	120	380	200	20	26	54	29	6	6	32/36
07	**780**	-	40	700	40	-	36	10	5	-	0	35/36
Artemisia tridentata vaseyana												
83	**3199**	-	600	1933	666	-	27	2	21	-	0	24/26
89	**2532**	-	200	1266	1066	-	37	0	42	.78	29	25/30
96	**2080**	-	40	1480	560	560	56	12	27	9	10	27/43
02	**1740**	-	100	980	660	780	34	17	38	11	11	29/35
07	**520**	40	80	100	340	1340	31	23	65	23	23	34/38
Chrysothamnus viscidiflorus viscidiflorus												
83	**4066**	-	-	4066	-	-	0	0	0	-	0	9/9
89	**4466**	66	133	3733	600	-	0	0	13	-	9	13/16
96	**6060**	60	640	5420	-	-	.66	0	0	-	0	12/21
02	**4760**	-	200	4500	60	-	0	.42	1	-	.42	11/17
07	**4140**	-	40	3720	380	-	0	0	9	-	.48	14/23
Gutierrezia sarothrae												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
96	**920**	100	260	560	100	60	0	0	11	-	0	8/10
02	**580**	-	-	540	40	40	0	3	7	7	7	6/6
07	**820**	-	-	800	20	-	0	0	2	-	0	8/9

		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)
Purshia tridentata												
83	**932**	-	266	400	266	-	50	14	29	-	0	43/54
89	**999**	66	266	333	400	-	93	7	40	-	0	38/47
96	**600**	-	-	520	80	20	20	77	13	10	10	40/71
02	**560**	-	-	400	160	-	18	79	29	11	11	43/62
07	**400**	-	-	260	140	100	40	55	35	5	5	40/48
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	66	-	-	-	-	0	0	0	-	0	-/-
96	**560**	20	180	380	-	-	4	0	0	-	0	23/29
02	**540**	-	-	520	20	20	0	0	4	4	4	27/31
07	**520**	280	40	480	-	-	0	0	0	-	4	30/42
Tetradymia canescens												
83	**466**	-	200	200	66	-	0	0	14	-	0	12/12
89	**199**	-	133	66	-	-	0	0	0	-	0	6/10
96	**160**	-	100	60	-	-	13	0	0	-	0	8/12
02	**160**	-	40	120	-	-	13	0	0	-	0	8/16
07	**120**	-	-	100	20	-	17	0	17	-	0	9/17

Trend Study 17-16-07

Study site name: Rainbow Bay . Vegetation type: Big Sagebrush-Grass .

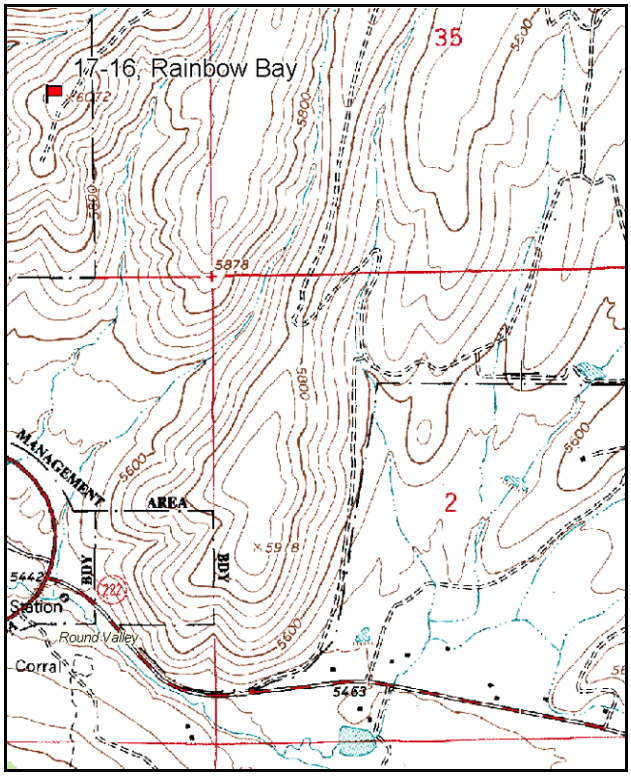
Compass bearing: frequency baseline 345 degrees magnetic.

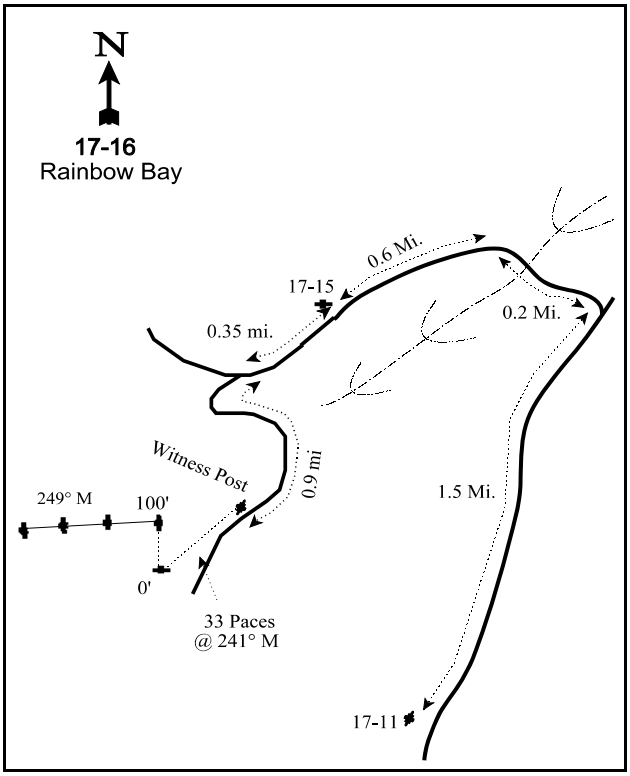
Frequency belt placement: line 1 (11 & 95ft), line 2 (59ft), line 3 (34ft), line 4 (71ft).

Rebar: No rebar on belts 4 or 5

LOCATION DESCRIPTION

Beginning at the intersection of U.S. 189 and the Wallsburg turnoff, proceed 0.50 miles towards Wallsburg to an intersection. Turn left at the intersection and proceed northerly for just over 1 mile passing through two DWR gates to another intersection, and turn right. Proceed 0.05 miles to a small rock pile on the left (east) side of the road which marks study #17-11, Wallsburg Turn. Continue down the road 1.5 miles from study 17-11 to a fork. Bear left and go 0.2 miles thru a drainage to another ridge top and bear left. Drive along the ridge 0.6 miles to a witness post on the north side of the road which marks study #17-15. Continue down this road 0.35 miles to an intersection with a short telephone post and a Mountain Bell wire warning sign. Turn left and stay left for 0.9 miles to a witness post on the north side of the road. From the witness post, the 0-foot stake is 33 paces away at an azimuth of 241 degrees magnetic, marked with browse tag #3947.





Map Name: Charleston

Diagrammatic Sketch

Township 4S , Range 4E , Section 34

GPS: NAD 83, UTM 12T 459422 E 4475040 N

DISCUSSION

Rainbow Bay - Trend Study No. 17-16

Study Information

This study is located on big sagebrush-grass rangeland near the top of the high knoll immediately east of Rainbow Bay on Deer Creek Reservoir [elevation: 6,000 feet (1,830 m), slope: 15-20%, aspect: west-southwest]. The nearest perennial source of water is Deer Creek Reservoir, 0.65 miles (1 km) to the west. This area, although within a short distance of the 1976 burn, was spared from the fire. However, the presence of numerous fire scarred sagebrush stumps provides evidence of a past fire on the site, before 1976. Although winter deer and elk use was reportedly heavy prior to 1989, data and observations from 1989 showed only light-moderate levels of hedging and pellet group densities. In 1996 and 2002, deer use was high while elk use was light-moderate. From the pellet group transect data, there were an estimated 100 deer days use/acre (248 ddu/ha) in 2002 and 111 deer days use/acre (274 ddu/ha) in 2007. Elk use was estimated at 26 days use/acre (64 edu/ha) in 2002 and 13 days use/ha (31 edu/ha) in 2007. Cattle were seen below the study in 1996, but livestock use has been minimal.

Soil

This study is located within the Whipstock soil series and consists of deep, well-drained soils that formed in alluvium and residuum from shale, sandstone and quartzite. The soil is classified as very-fine, smectitic, frigid Typic Palexerolls, and the mollic epipedon is 10-20 inches (25-51 cm) thick (USDA-NRCS 2007). Specifically at the study the soil has a clay loam texture and the reactivity is neutral (pH of 7.2). In 1983, it was reported that there was evidence of sheet erosion. Also, a large percentage of the ground surface was occupied either by pavement, bare ground, or a thin cover of fine litter. Vegetation has increased from 2% of the total ground cover in 1983, to approximately 50% in 2007. The soil erosion condition was classified as stable in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*) are the dominant preferred browse species. Sagebrush canopy cover was 6% in 2002 and 4% in 2007. The density of mountain big sagebrush has decreased each sample year. The density was 4,732 plants/acre (11,713 plants/ha) in 1983, and by 2007 it had reached 860 plants/acre (2,130 plants/ha). The seedling density has varied from 0 to 166 plants/acre (410 plants/ha). Young plants have accounted for between 1% and 17% of the population. Decadence was 16% in 1983, and has averaged 49% since 1989. Since 1996, the density of dead plants has increased from 500 plants/acre (1,240 plants/ha) to 860 plants/acre (2,130 plants/ha). The proportion of plants exhibiting poor vigor was low in 1983 and 1989, and increased to approximately 25% of the population in subsequent sample years. Additionally, since 1996, all of the plants with poor vigor were classified as dying. The average annual leader growth was 2.8 inches (7.1 cm) in 2002 and 1.9 inches (4.8 cm) in 2007. Browse use on sagebrush has been light to light-moderate.

The bitterbrush canopy cover decreased from 6% in 2002 to 4% in 2007. The estimated density increased from 299 plants/acre (740 plants/ha) in 1983 to 699 plants/acre (1,730 plants/ha) in 1989, then decreased to 340 plants/acre (842 plants/ha) by 2002. In 2007, there were an estimated 360 plants/acre (891 plants/ha). The population has largely consisted of mature, healthy plants. Seedling plants were only sampled in 1989, and though they were common from 1983 to 1996, young plants have not been sampled since. Decadence has ranged from 0% to 12% of the population. Vigor has been good in all sample years. The average annual leader growth was 3 inches (7.6 cm) in 2002 and 4.4 inches (11.1 cm) in 2007. Browse use has varied from light to heavy.

Broom snakeweed (*Gutierrezia sarothrae*) and stickyleaf low rabbitbrush *(Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) are also present. The broom snakeweed density increased from 1983 to 1996, and then declined

in 2002 and 2007. The density has ranged from 1,700 plants/acre (4,210 plants/ha) to 14,580 plants/acre (36,090 plants/ha). Most of the broom snakeweed is located near the ridge top where open patches exist. The stickyleaf low rabbitbrush density has varied from 640 plants/acre (1,584 plants/ha) to 3,166 plants/acre (7,837 plants/ha). This species shows no use, good vigor, and virtually no decadency in all years.

Herbaceous Understory

The herbaceous understory is abundant and diverse. Perennial grass cover was 13% in 1996, 17% in 2002, and 16% in 2007. The dominant perennial grasses include crested wheatgrass (*Agropyron cristatum*), bluebunch wheatgrass (*Agropyron spicatum*), and Sandberg bluegrass (*Poa secunda*). Bluebunch wheatgrass has provided 11% cover since 1996, which is more than any other species. Since 1996, cheatgrass (*Bromus tectorum*) cover has increased from 3% to 9%, and quadrat frequency has increased from 84% to 96%. Bulbous bluegrass (*Poa bulbosa*), which has a phenology similar to cheatgrass (Stewart and Hull 1949), and Japanese brome (*Bromus japonicus*) are also present, but at low frequencies.

Perennial forb cover has decreased from 12% in 1996 to 7% in 2002 and 2007. Between 13 and 33 forb species have been sampled since 1983, and most were perennial species. The dominant perennial forb species have been silky milkvetch (*Astragalus cibarius*) and arrowleaf balsamroot (*Balsamorhiza sagittata*). Annual forb cover has averaged 5% since 1996. The dominant annual species are pale alyssum (*Alyssum alyssoides*), blue-eyed Mary (*Collinsia parviflora*), and holosteum (*Holosteum umbellatum*). Dalmatian toadflax (*Linaria dalmatica*), a noxious weed, is also present.

1989 TREND ASSESSMENT

The browse trend is slightly down. The density of mountain big sagebrush decreased 20%. Few seedlings were sampled, and there was a decrease in the density of young plants. Decadence increased from 16% to 45% of the population. The proportion of plants exhibiting poor vigor remained stable. Browse use shifted from light to light-moderate. The density of bitterbrush increased more than two-fold. There was an increase in both seedling and young plants, and decadence remained stable at 0% of the population. Browse use on bitterbrush shifted from light-moderate to light. The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased more than two-fold, including a significant increases in bluebunch wheatgrass. The number of perennial grass species increased from three to seven. However, bulbous bluegrass was one of the species that was sampled for the first time. Quadrat frequency of bulbous bluegrass was 1%. The forb trend is up. The sum of nested frequency of perennial grasses increased more than five-fold, including significant increases in seven species. Additionally, the number of perennial species increased from 12 to 19.

browse - slightly down (-1) grass - up (+2) forb - up (+2)

1996 TREND ASSESSMENT

The browse trend is slightly down. The densities of sagebrush and bitterbrush decreased 60% and 31%, respectively. The changes in densities were attributed to the larger area sampled in 1996, and determination of trend was more dependant on other parameters. For example, there were large decreases in the densities of seedling and young sagebrush plants. Although the density of decadent plants decreased, the proportion of sagebrush in the decadent age class increased from 45% to 51%. Plants exhibiting poor vigor increased to 12% of the population, and all of these were classified as dying. Browse use on sagebrush remained moderate. There were fewer seedlings and young bitterbrush, but decadence and vigor remained stable. The grass trend is up. The sum of nested frequency of perennial grasses increased 51%, including a significant increase in bluebunch wheatgrass. Cheatgrass was sampled in 84% of the quadrats. The forb trend is up. The sum of nested frequency of perennial grasses increased 91%, including a significant increase in four species. There was a significant decrease in the nested frequency of segolily (*Calochortus nuttallii*). It was noted that longstalk springparsley (*Cymopterus longipes*) and arrowleaf balsamroot had been eaten. The Desirable Components Index (DCI) score was fair due to the moderate browse cover, high browse decadence, low

browse recruitment, and high perennial grass and forb cover.

winter range condition (DCI) - fair (58) Mid-level potential scale
browse - slightly down (-1) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The trend for browse is down. The density of sagebrush decreased 30%. There were few seedlings or young plants sampled, and decadence remained stable. Plants exhibiting poor vigor increased to 25%, and all of those plants were classified as dying. The density of dead sagebrush increased from 500 plants/acre (1,238 plants/ha) to 800 plants/acre (1,980 plants/ha). Trend was also down because of changes in the bitterbrush population. The density of bitterbrush decreased 29%. No seedling or young plants were sampled, and decadence increased to 12% of the population. Bitterbrush plants showing heavy browse use increased from 58% of the population to 94%. The grass trend is slightly down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 5%, which would normally correspond to a stable trend. Although there was a significant increase in Sandberg bluegrass, bulbous bluegrass was sampled again, and Japanese brome was sampled for the first time. Cheatgrass frequency remained stable, but cover increased from 3% to 8%. The forb trend is down. The sum of nested frequency of perennial forbs decreased 57%, including the significant decrease in four species. Dalmatian toadflax was sampled for the first time, but only in 2% of the quadrats. The DCI score remained fair.

winter range condition (DCI) - fair (57) Mid-level potential scale
browse - down (-2) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush decreased 19%. Few seedling or young plants were sampled; young plants comprised 5% of the population. Decadence remained stable, and the density of dead plants increased to 860 plants/acre (2,130 plants/ha), which was the same as the density of live plants. The proportion of plants exhibiting poor vigor remained stable. The sagebrush defoliator moth (*Aroga websteri*) had infected 58% of the population. Browse use on sagebrush remained light-moderate. The density of bitterbrush increased 6% and browse use shifted to light-moderate. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 3%. There was a significant increase in the nested frequency of cheatgrass. The forb trend is down. The sum of nested frequency of perennial forbs decreased 34%, including a significant decrease in longstalk springparsley. Dalmatian toadflax was present on the study, though it was not sampled in any of the quadrats. Storksbill (*Erodium cicutarium*) was sampled for the first time in 16% of the quadrats. The DCI score decreased to poor-fair due to the decrease in browse cover.

winter range condition (DCI) - poor-fair (51) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 16

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Agropyron cristatum	$_{a}$6	$_{a}$13	$_{ab}$18	$_{b}$41	$_{ab}$26	1.39	3.54	2.08
G	Agropyron intermedium	-	$_{a}$2	$_{a}$12	$_{a}$8	-	.22	.02	-
G	Agropyron spicatum	$_{a}$70	$_{b}$150	$_{c}$222	$_{bc}$182	$_{bc}$197	10.96	10.41	11.19

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Bromus japonicus (a)	-	-	-	a43	a37	-	.18	.17
G	Bromus tectorum (a)	-	-	a270	a261	b310	3.04	7.90	8.92
G	Oryzopsis hymenoides	-	a11	a11	a4	a-	.19	.18	.00
G	Poa bulbosa	-	a3	-	b25	ab19	-	.58	.41
G	Poa fendleriana	-	-	6	-	-	.06	-	-
G	Poa secunda	a5	ab26	b42	c89	c111	.45	1.95	2.01
G	Sitanion hystrix	-	a1	-	a1	a2	-	.03	.03
Total for Annual Grasses		0	0	270	304	347	3.04	8.07	9.09
Total for Perennial Grasses		81	206	311	350	355	13.28	16.71	15.75
Total for Grasses		81	206	581	654	702	16.32	24.79	24.84
F	Agoseris glauca	-	a2	b91	a17	a12	.82	.10	.10
F	Allium acuminatum	-	-	a14	b41	-	.18	.17	-
F	Alyssum alyssoides (a)	-	-	c289	a83	b258	1.41	.28	1.83
F	Arabis sp.	-	a11	a3	a3	a1	.01	.00	.00
F	Artemisia ludoviciana	a3	a1	-	-	-	-	-	-
F	Astragalus cibarius	-	-	b123	a22	a17	4.16	.11	.30
F	Astragalus convallarius	-	-	2	-	-	.00	-	-
F	Astragalus utahensis	b19	b17	ab6	a1	-	.03	.00	-
F	Balsamorhiza sagittata	a7	b44	c76	bc67	c77	4.84	5.31	5.19
F	Castilleja linariaefolia	-	-	b40	a11	a3	.22	.36	.09
F	Calochortus nuttallii	a1	b41	a12	a13	a-	.03	.03	.00
F	Chaenactis douglasii	-	3	-	-	-	-	-	-
F	Cirsium sp.	a3	-	b8	-	a3	.05	-	.15
F	Collomia linearis (a)	-	-	b101	a3	a2	.28	.01	.01
F	Comandra pallida	a8	b22	-	-	a7	-	-	.19
F	Collinsia parviflora (a)	-	-	b252	c328	a209	2.10	5.61	.81
F	Crepis acuminata	a4	b20	ab12	ab12	a6	.08	.16	.30
F	Cymopterus longipes	-	ab22	c101	b27	a5	.80	.15	.04
F	Delphinium nuttallianum	-	-	a11	a5	-	.07	.01	-
F	Descurainia pinnata (a)	-	-	-	1	-	-	.00	-
F	Draba sp. (a)	-	-	a58	a34	b96	.16	.08	.39
F	Eriogonum brevicaule	-	-	-	a2	a1	-	.00	.00
F	Erodium cicutarium (a)	-	-	-	-	41	-	-	.18
F	Erigeron pumilus	-	-	a9	-	a1	.01	-	.03
F	Eriogonum racemosum	a12	a37	a22	a30	a18	.15	.26	.09
F	Eriogonum umbellatum	-	-	a4	-	a3	.01	-	.01

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Gayophytum ramosissimum(a)	-	-	3	-	-	.00	-	-
F	Hackelia patens	-	-	$_{a}$3	$_{a}$8	-	.03	.02	-
F	Helianthus annuus (a)	$_{a}$5	$_{b}$83	-	$_{a}$24	-	-	.07	-
F	Holosteum umbellatum (a)	-	-	$_{b}$179	$_{a}$89	$_{b}$160	1.15	.29	.44
F	Lactuca serriola	-	-	-	-	5	-	-	.01
F	Linaria dalmatica	-	-	-	4	-	-	.15	-
F	Lithospermum ruderale	-	$_{a}$3	$_{a}$8	$_{a}$8	$_{a}$3	.05	.06	.01
F	Lupinus argenteus	$_{a}$3	$_{a}$4	$_{a}$5	$_{a}$1	-	.27	.15	-
F	Machaeranthera canescens	-	$_{a}$3	$_{a}$2	-	-	.00	-	-
F	Medicago sativa	3	-	-	-	-	-	-	-
F	Microsteris gracilis (a)	-	-	-	$_{b}$43	$_{a}$18	-	.18	.06
F	Orthocarpus sp. (a)	-	-	3	-	-	.00	-	-
F	Penstemon sp.	$_{a}$1	$_{b}$66	-	-	-	-	-	-
F	Phlox longifolia	-	-	$_{a}$8	-	$_{a}$5	.02	-	.01
F	Polygonum douglasii (a)	-	-	$_{b}$103	-	$_{a}$7	.22	-	.02
F	Ranunculus testiculatus (a)	-	-	$_{a}$4	$_{a}$9	$_{a}$4	.00	.01	.01
F	Sisymbrium altissimum (a)	-	-	-	-	14	-	-	.34
F	Sphaeralcea coccinea	-	-	-	1	-	-	.03	-
F	Sphaeralcea grossulariifolia	-	-	-	$_{a}$2	$_{a}$1	-	.03	.03
F	Taraxacum officinale	-	-	3	-	-	.00	-	-
F	Tragopogon dubius	$_{a}$2	$_{b}$31	$_{c}$76	-	$_{a}$3	.45	-	.03
F	Unknown forb-perennial	-	7	-	-	-	-	-	-
F	Vicia americana	-	$_{a}$2	-	-	$_{a}$10	-	-	.04
F	Viguiera multiflora	-	$_{a}$1	$_{a}$6	-	$_{a}$2	.04	-	.00
Total for Annual Forbs		5	83	992	614	809	5.38	6.56	4.11
Total for Perennial Forbs		66	337	645	275	183	12.38	7.17	6.68
Total for Forbs		71	420	1637	889	992	17.76	13.73	10.79

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

BROWSE TRENDS --
Management unit 17 , Study no: 16

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Amelanchier alnifolia	3	3	3	-	.03	-
B	Artemisia tridentata vaseyana	57	41	34	9.22	6.10	3.50
B	Chrysothamnus viscidiflorus viscidiflorus	19	22	32	1.37	2.20	3.25
B	Gutierrezia sarothrae	91	58	29	3.22	2.12	.70
B	Opuntia sp.	14	14	19	.12	.36	.42
B	Purshia tridentata	20	16	17	3.81	6.55	3.99
B	Symphoricarpos oreophilus	0	1	0	-	.03	-
B	Tetradymia canescens	0	1	0	.15	.38	-
Total for Browse		204	156	134	17.91	17.79	11.86

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 16

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	.13	.25
Artemisia tridentata vaseyana	6.01	3.81
Chrysothamnus viscidiflorus viscidiflorus	1.76	2.03
Gutierrezia sarothrae	.86	.58
Opuntia sp.	.05	.03
Purshia tridentata	6.25	3.90
Tetradymia canescens	.46	.05

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 16

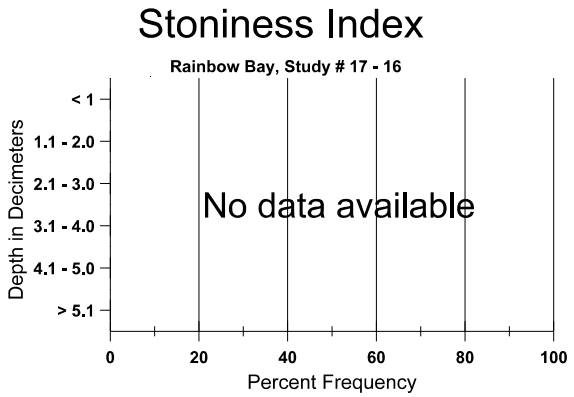
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.8	1.9
Purshia tridentata	3.0	4.4

BASIC COVER --
Management unit 17 , Study no: 16

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	1.50	6.25	49.61	48.02	53.79
Rock	2.75	3.50	6.05	3.92	2.34
Pavement	33.25	36.75	6.51	10.85	7.23
Litter	57.75	46.25	49.93	48.27	41.40
Cryptogams	.25	3.25	1.35	.76	.08
Bare Ground	4.50	4.00	7.23	11.08	6.58

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 16, Rainbow Bay

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
10.4	51.0 (10.9)	7.2	42.6	27.4	30.0	3.6	27.5	265.6	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 16

Type	Quadrat Frequency		
	'96	'02	'07
Rabbit	-	4	1
Elk	21	9	9
Deer	40	53	45
Cattle	1	-	-

Days use per acre (ha)	
'02	'07
-	-
26 (64)	13 (31)
100 (248)	111 (274)
-	-

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 16

		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												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**33**	-	33	-	-	-	0	100	-	-	100	-/-
96	**60**	-	40	20	-	-	67	0	-	-	0	15/18
02	**60**	-	40	20	-	-	33	67	-	-	0	11/11
07	**60**	-	20	40	-	-	33	67	-	-	0	18/22
Artemisia tridentata vaseyana												
83	**4732**	-	800	3166	766	-	26	8	16	-	0	26/28
89	**3766**	166	466	1600	1700	-	49	4	45	-	3	26/31
96	**1520**	20	20	720	780	500	59	1	51	12	12	23/43
02	**1060**	-	60	480	520	800	38	11	49	25	25	27/42
07	**860**	60	40	380	440	860	28	5	51	23	23	28/40
Chrysothamnus nauseosus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	35/46
Chrysothamnus viscidiflorus viscidiflorus												
83	**1766**	-	-	1766	-	-	0	0	0	-	0	9/9
89	**3166**	33	800	2333	33	-	0	0	1	-	1	12/13
96	**640**	-	-	640	-	-	0	0	0	-	0	12/23
02	**820**	-	-	800	20	-	0	0	2	2	2	11/18
07	**1200**	-	40	1060	100	-	0	0	8	-	3	13/23
Gutierrezia sarothrae												
83	**1933**	-	-	1900	33	-	0	0	2	-	2	10/13
89	**4732**	100	566	3933	233	-	0	0	5	-	0	11/11
96	**14580**	17520	4500	9920	160	220	0	0	1	.13	.13	7/10
02	**3500**	-	-	2520	980	5020	0	0	28	14	14	7/8
07	**1700**	-	80	1620	-	-	0	0	0	-	0	9/8

		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.												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**33**	-	33	-	-	-	0	0	0	-	0	-/-
96	**280**	-	80	160	40	-	0	0	14	7	7	5/13
02	**300**	-	40	200	60	20	0	0	20	-	7	5/11
07	**400**	-	20	360	20	-	0	0	5	-	5	7/13
Purshia tridentata												
83	**299**	-	66	233	-	-	33	11	0	-	0	41/124
89	**699**	33	266	433	-	-	19	5	0	-	0	41/81
96	**480**	-	80	380	20	20	21	58	4	-	0	24/59
02	**340**	-	-	300	40	40	6	94	12	-	0	30/62
07	**360**	-	-	320	40	60	33	11	11	-	0	30/55
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	20	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Tetradymia canescens												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	20	0	0	-	-	0	15/23
02	**20**	-	-	20	-	-	0	0	-	-	0	15/24
07	**0**	20	-	-	-	-	0	0	-	-	0	11/22

Trend Study 17-17-07

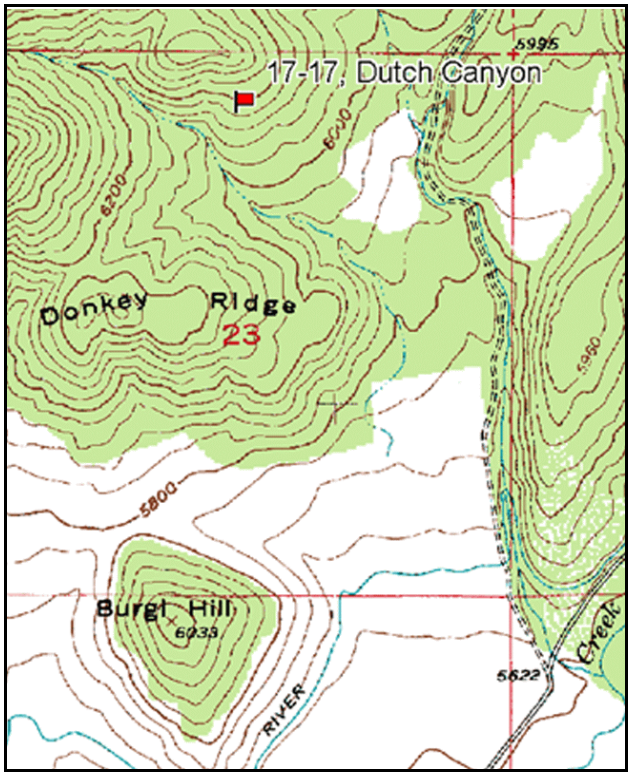
Study site name: Dutch Canyon . Vegetation type: Big Sagebrush-Grass .

Compass bearing: frequency baseline 359 degrees magnetic.

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

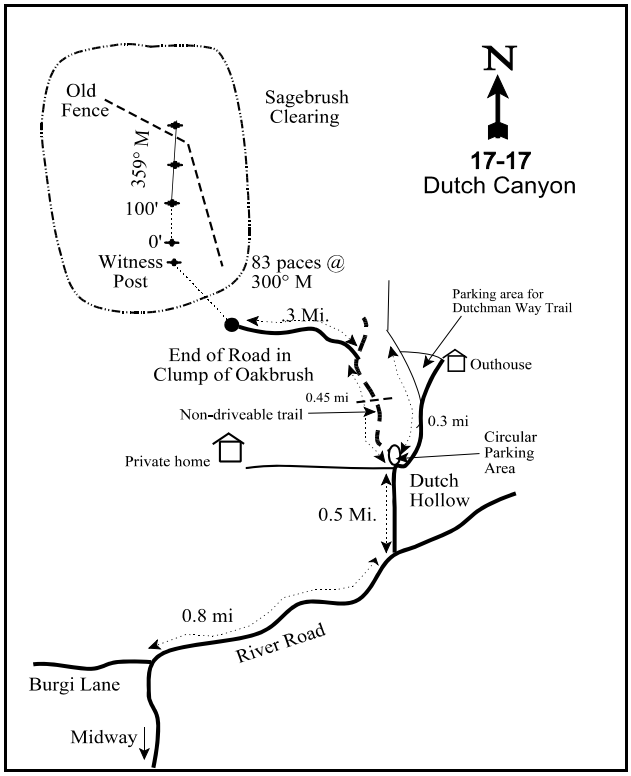
LOCATION DESCRIPTION

Beginning at the intersection of River Road and Burgi Lane (north of Midway), proceed northward on River Road for 0.80 miles to an intersection. Turn left and proceed 0.50 miles to a circular parking area. Take a dirt Forest Service road on the east side of the parking area for 0.3 miles to a dirt parking area with an outhouse. Across from the parking area is the Dutchman Way Trail head. Park in the dirt lot and take this trail up to the site. Use the GPS to navigate up the hills to the site (0.44 miles). The frequency baseline is marked by green steel "T" fenceposts, approximately 12 to 18 inches in height. A red browse tag, number 3952, is attached to the 0-foot baseline stake.



Map Name: Heber

Township 3S , Range 4E , Section 23



Diagrammatic Sketch

GPS: NAD 83, UTM 12T 460836 E 4488842 N

DISCUSSION

Dutch Canyon - Trend Study No. 17-17

Study Information

This winter range study is located within a small sagebrush-grass clearing surrounded by thick Gambel oak [elevation: 6,200 feet (1,890 m), slope: 15%, aspect: south-southeast]. Several of the baseline posts were missing in 2002, so the baseline was reset and is now only 300 feet in length. Therefore, the sample area has changed twice; once in 1996 when the baseline was extended, and then again in 2002 when the baseline was contracted. These changes to the baseline and the sample area is likely to have an impact on the changes in cover, frequency, and density data. The nearest perennial source of water is a stream flowing down Dutch Hollow located 0.35 miles (0.6 km) to the east. Big game use has been moderate. From the pellet group transect, there were an estimated 65 deer days use/acre (160 ddu/ha) in 2002 and 62 deer days use/acre (152 ddu/ha) in 2007. Elk use was estimated at 9 days use/acre (23 edu/ha) in 2002 and 25 days use/acre (63 edu/ha) in 2007. A deer skeleton was found at the north edge of the baseline in 2007.

Soil

This study is located within the Cloud Rim soil series, which consists of very deep, well-drained, moderately permeable soils. The series formed in alluvium and colluvium derived from mixed sedimentary and metamorphic rocks of sandstone and quartzite. The soil is classified as fine-loamy, mixed, superactive, frigid Typic Argixerolls (USDA-NRCS 2007). Specifically at the study, the soil texture is a sandy clay loam with a neutral reactivity (pH of 6.9). The profile is rocky, but surface rock and pavement cover are low, averaging approximately 5% since 1996. The combined, relative vegetation and litter cover have comprised an average 90% of the total ground cover since 1996. The erosion condition was classified as slight in 2002 and 2007. Most evidence of erosion comes from the abundance of trails that traverse the study and serve as flow paths.

Browse

The browse component is dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and Gambel oak (*Quercus gambelii*). As mentioned above, some of the changes in the browse component are likely the result of the change in sample area. Sagebrush canopy cover was 25% in 2002 and 2007. The estimated density decreased from 2,798 plants/acre (6,925 plants/ha) in 1983 to approximately 1,370 plants/acre (3,391 plants/ha) in 1989 and 1996. The density increased to 2,380 plants/acre (5,891 plants/ha) in 2002, and decreased to 1,680 plants/acre (4,158 plants/ha) in 2007. The density of seedling plants has been low in all sample years, and the young plants have decreased from 31% of the population in 1983 to 0% in 2007. Decadence increased from 24% of the population in 1983 to 44% in 1989, and decreased to 15% by 2002. In 2007, decadence had increased to 24% of the population. Dead plants were first sampled in 1996 at a density of 1,060 plants/acre (2,624 plants/ha), and the density of dead plants steadily decreased to 860 plants/acre (2,129 plants/ha) by 2007. There have been few plants with poor vigor, except in 2007 when 29% of the plants were in poor vigor. The average annual leader growth was 2.5 inches (6.4 cm) in 2002 and 1.2 inches (3.2 cm) in 2007. Browse use has ranged from light to moderate.

Gambel oak clones surround the sagebrush opening sampled by the baseline. Canopy cover was 8% in 2002 and 10% in 2007. The estimated oak density has vacillated from increasing to decreasing in alternate sample years. The lowest estimate was 1,533 plants/acre (3,795 plants/ha) in 1983, and the highest estimate was 2,832 plants/acre (7,010 plants/ha) in 1989. The age class distribution has shifted from a young to a mature population. Vigor was good through 1996, and the proportion of plants exhibiting poor increased to 16% and 30% in 2002 and 2007, respectively. Browse use on oak stems has been light to light-moderate.

Antelope bitterbrush (*Purshia tridentata*) is present, but less abundant than sagebrush or oak. Canopy cover was 5% in 2002 and 2007. The density has varied from 66 plants/acre (163 plants/ha) in 1983 to 240 plants/acre (594 plants/ha) in 2007. The bitterbrush population is composed mostly of mature plants. Plants

vigor has been good in all sample years. Bitterbrush annual leader growth averaged 3.4 inches (8.6 cm) in 2002 and 2.4 inches (6 cm) in 2007. Browse use on bitterbrush has been moderate to heavy.

Herbaceous Understory

The herbaceous understory is dominated by annual species. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) cover has averaged 8% since 1996. Cheatgrass quadrat frequency was 96% in 1996, 76% in 2002, and 88% in 2007. Perennial grass cover has been 2% or less since 1996, and between two and four perennial species have been sampled. The dominant perennial grasses are Kentucky bluegrass (*Poa pratensis*) and bulbous bluegrass (*Poa bulbosa*). Although bulbous bluegrass is a perennial species, it has a phenology similar to annual grasses (Stewart and Hull 1949). Nearly all of the perennial grasses sampled were found growing in or near oak clones.

Forbs are diverse, but composition is poor. Perennial forb cover was 3% in 1996, 9% in 2002, and 7% in 2007. Leafy spurge (*Euphorbia esula*), a noxious weed, is one of the most abundant perennial species and has comprised an average of 7% cover since 2002. Dalmatian toadflax (*Linaria dalmatica*), another noxious weed, was sampled in 2007. Other perennial species that have been sampled with relatively moderate frequencies include prickly lettuce (*Lactuca serriola*), yellow salsify (*Tragopogon dubius*), and showy goldeneye (*Viguiera multiflora*). Pale alyssum (*Alyssum alyssoides*) is the dominant annual forb species, and has increased in percent cover since 1996.

1989 TREND ASSESSMENT

The browse trend is slightly down. The density of mountain big sagebrush decreased 51%. The young age class decreased from 31% to 22%, and decadence increased from 24% to 44% of the population. Because the decrease in young plants did not correspond to an increase in the mature age class, it is assumed that those plants died. Additionally, the average crown width decreased 18 inches (46 cm). Browse use on sagebrush remained light. The negative sagebrush trend was partly countered by increases in the Gambel oak population. The density of Gambel oak increased 85%. Young plants accounted for 59% of the population, and decadence increased from 7% to 13% of the population. Browse use on oak remained light-moderate. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased three-fold, but perennial grasses remained a very small vegetative component. The number of perennial species increased from one to four. The forb trend is up. The sum of nested frequency of perennial forbs increased six-fold, including a significant increase in showy goldeneye. Four additional perennial species were sampled that had not been sampled previously.

browse - slightly down (-1) grass - slightly up (+1) forb - up (+2)

1996 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush remained stable, and the population shifted to a mostly mature stand. Young plants comprised 16% of the population, and decadent plants comprised another 16%. The density of dead plants was estimated at 1,060 plants/acre (2,624 plants/ha). The proportion of plants exhibiting poor vigor increased to 10%, all of which were classified as dying. The average crown width increased 21 inches (53 cm), which more than compensated for the decrease that was measured in 1989. None of the sagebrush had evidence of moderate or high browse use. The density of Gambel oak decreased 22% and, like sagebrush, the population shifted to a mature stand. Young plants accounted for 38% of the population, and decadence decreased to 4% of the population. The average height and crown widths increased 28 inches (71 cm) and 37 inches (94 cm), respectively. The increases in crown sizes of both sagebrush and Gambel oak is likely the result of above-average precipitation in 1995 and 1996 (Utah Climate Summaries 2007). The grass trend is stable. The sum of nested frequency of perennial grasses increased 36%, but perennial grasses remained a very small vegetative component. It is likely that cheatgrass, which was sampled in 96% of the quadrats and provided 8% cover, was limiting the establishment of perennial grasses. The forb trend is up. The sum of nested frequency of perennial forbs increased 33%. There was a significant decrease

in the nested frequency of showy golden-eye, and a significant increase in that of yellow salsify. The Desirable Components Index (DCI) score was poor due to the high preferred browse cover, low browse decadence, moderate browse recruitment, low perennial grass and forb cover, and high annual grass cover.

winter range condition (DCI) - poor (46) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is up. The density of sagebrush increased 73%. The population continued to shift to a predominantly mature stand. No seedlings were sampled, and young plants decreased to 3% of the population. Decadence remained stable, and there was an 11% decrease in the density of dead plants. Vigor remained stable, and browse use remained light. The Gambel oak population density increased 18%. Young plants comprised 28% of the population, and decadence increased to 13%. The proportion of plants exhibiting poor vigor increased to 16%, most of which were classified as dying. Browse use shifted to light-moderate. The average height and crown measurements decreased 24 and 25 inches (61 and 64 cm), respectively. Again, the change in height and crown measurements was attributed to precipitation amounts Both 2001 and 2002 were considered drought years for the Heber Valley (Utah Climate Summaries 2007). The grass trend is slightly down. Excluding bulbous bluegrass, the sum of nested frequency of perennial forbs increased 2%. Bulbous bluegrass and Japanese brome were sampled for the first time, and had quadrat frequencies of 5% and 34%, respectively. However, there was a significant decrease in the nested frequency of cheatgrass. The forb trend is down. Excluding leafy spurge, the sum of nested frequency of perennial forbs decreased 75%. Leafy spurge accounted for 68% of the perennial forb cover. The DCI score declined to poor due to a decrease in browse recruitment, a decrease in perennial forb cover, and the presence of a noxious weed species.

winter range condition (DCI) - poor (41) Mid-level potential scale
browse - up (+2) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 29%. No young plants were sampled, and decadence increased to 24% of the population. Sagebrush plants exhibiting poor vigor increased to 29%, and 12% of the population was classified as dying. In addition to the poor vigor, 45% of the plants were infested with the sagebrush defoliator moth (*Aroga websteri*). Browse use shifted to moderate. The density of Gambel oak decreased 31%. Young plants comprised 20% of the population, and the percentage of decadent plants remained stable. The proportion of oak plants exhibiting poor vigor increased to 30%, and dying plants accounted for 6% of the population. Browse use on oak was light. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 30%. Although the decrease in perennial grasses was muted by the already low abundance, there was a significant increase in the nested frequency of cheatgrass. The forb trend is slightly down. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased 6%. Leafy spurge continued to be the dominant perennial forb species. Additionally, dalmatian toadflax was sampled for the first time. The DCI score decreased to very poor-poor due to the increase in browse decadence and the presence of an additional noxious weed.

winter range condition (DCI) - very poor-poor (34) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - slightly down (-1)

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

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
G	Agropyron spicatum	-	-	-	a-	a3	-	.00	.00
G	Bromus carinatus	-	-	2	-	-	.00	-	-
G	Bromus inermis	-	a5	a10	-	-	.33	-	-
G	Bromus japonicus (a)	-	-	-	a81	a70	-	.70	.86
G	Bromus tectorum (a)	-	-	c336	a228	b280	8.16	8.21	4.71
G	Poa bulbosa	-	-	-	a17	a21	-	.86	1.44
G	Poa fendleriana	-	7	-	-	-	-	-	-
G	Poa pratensis	a10	ab18	b30	ab36	ab22	1.11	.56	.60
G	Poa secunda	-	a1	-	a7	a5	-	.56	.06
Total for Annual Grasses		0	0	336	309	350	8.16	8.91	5.57
Total for Perennial Grasses		10	31	42	60	51	1.44	1.98	2.10
Total for Grasses		10	31	378	369	401	9.61	10.90	7.68
F	Alyssum alyssoides (a)	-	-	a245	a198	b283	2.12	2.73	6.74
F	Artemisia dracunculus	a3	a2	-	-	-	-	-	-
F	Artemisia ludoviciana	a3	a3	a8	a1	a3	.33	.03	.06
F	Aster chilensis	-	-	-	-	-	-	-	.00
F	Astragalus sp.	-	-	-	1	-	-	.00	-
F	Camelina microcarpa (a)	-	-	-	a3	a4	-	.00	.01
F	Calochortus nuttallii	ab5	b21	-	a4	a2	-	.01	.01
F	Chenopodium fremontii (a)	-	-	a3	a5	-	.00	.04	-
F	Cirsium sp.	-	-	a9	a2	a4	.02	.04	.21
F	Collomia linearis (a)	-	-	a16	b36	a9	.04	.15	.04
F	Collinsia parviflora (a)	-	-	-	3	-	-	.00	-
F	Cryptantha sp.	-	2	-	-	-	-	-	-
F	Descurainia pinnata (a)	-	-	-	-	14	-	-	.10
F	Draba sp. (a)	-	-	-	a2	b11	-	.00	.19
F	Epilobium brachycarpum (a)	-	-	a4	a5	a3	.04	.01	.00
F	Eriogonum brevicaule	-	-	-	1	-	-	.00	-
F	Erodium cicutarium (a)	-	-	-	-	3	-	-	.01
F	Erigeron sp.	-	-	a18	-	a21	.16	-	.32
F	Eriogonum racemosum	-	a4	a10	a3	a1	.03	.06	.00
F	Euphorbia esula	-	-	-	a114	a127	-	7.96	5.71
F	Galium aparine (a)	-	-	-	-	2	-	-	.03
F	Gayophytum ramosissimum(a)	-	-	-	a2	a3	-	.00	.00
F	Heterotheca villosa	-	-	-	-	-	.15	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'96	'02	'07	'96	'02	'07
F	Holosteum umbellatum (a)	-	-	-	$_{a}$20	$_{a}$21	-	.14	.11
F	Lactuca serriola	$_{a}$3	$_{ab}$14	$_{b}$34	-	-	.24	-	-
F	Linaria dalmatica	-	-	-	-	13	-	-	.07
F	Lupinus argenteus	-	-	$_{a}$5	$_{a}$6	$_{a}$4	.21	.45	.15
F	Polygonum douglasii (a)	-	-	$_{b}$28	$_{a}$8	$_{a}$6	.05	.02	.01
F	Sisymbrium altissimum (a)	-	-	$_{a}$6	$_{a}$3	-	.07	.03	-
F	Taraxacum officinale	-	-	-	1	-	-	.03	-
F	Tragopogon dubius	$_{a}$2	$_{ab}$17	$_{c}$93	$_{b}$31	$_{ab}$10	.76	.36	.05
F	Unknown forb-annual (a)	-	-	96	-	-	2.63	-	-
F	Verbascum thapsus	$_{a}$2	$_{a}$7	$_{a}$6	-	-	.39	-	-
F	Vicia americana	-	$_{a}$10	-	-	$_{a}$3	-	-	.00
F	Viguiera multiflora	$_{a}$6	$_{c}$78	$_{b}$31	$_{a}$3	$_{ab}$7	.36	.04	.09
F	Zigadenus paniculatus	-	$_{a}$3	$_{a}$-	-	$_{a}$1	.00	-	.00
Total for Annual Forbs		0	0	398	285	359	4.98	3.16	7.27
Total for Perennial Forbs		24	161	214	167	196	2.68	8.99	6.71
Total for Forbs		24	161	612	452	555	7.66	12.15	13.99

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

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

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Artemisia tridentata vaseyana	37	60	51	8.92	18.89	15.18
B	Chrysothamnus viscidiflorus viscidiflorus	1	2	2	-	.03	.00
B	Gutierrezia sarothrae	44	31	12	2.31	1.21	.27
B	Purshia tridentata	3	10	9	.45	2.61	2.14
B	Quercus gambelii	31	23	22	7.17	5.42	4.88
Total for Browse		116	126	96	18.86	28.18	22.49

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

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	24.61	24.60
Chrysothamnus viscidiflorus viscidiflorus	.28	-
Gutierrezia sarothrae	1.93	.43
Purshia tridentata	5.21	4.86
Quercus gambelii	8.11	9.91

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

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.6	1.2
Purshia tridentata	3.4	2.4

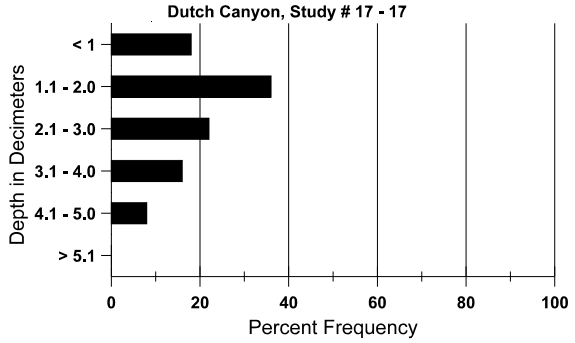
BASIC COVER --
Management unit 17 , Study no: 17

Cover Type	Average Cover %				
	'83	'89	'96	'02	'07
Vegetation	0	3.25	34.90	50.00	44.14
Rock	5.00	2.25	2.64	2.45	2.12
Pavement	6.00	11.50	2.76	2.95	3.27
Litter	67.25	78.50	71.23	58.48	65.83
Cryptogams	.25	0	.10	.30	.22
Bare Ground	21.50	4.50	2.18	11.38	6.58

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 17, Dutch Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
19.7	49.3 (17.5)	6.9	48.2	25.4	28.4	2.5	32.9	160.0	.5

Stoniness Index



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

Type	Quadrat Frequency		
	'96	'02	'07
Sheep	1	-	-
Rabbit	6	8	7
Horse	-	-	1
Elk	-	2	8
Deer	25	24	28
Cattle	-	1	-

Days use per acre (ha)	
'02	'07
-	-
-	-
-	-
9 (23)	25 (63)
65 (160)	62 (152)
-	-

BROWSE CHARACTERISTICS --
Management unit 17 , 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												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	60	0	0	-	-	0	22/28
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Artemisia tridentata vaseyana												
83	**2798**	-	866	1266	666	-	17	1	24	-	0	22/40
89	**1366**	100	300	466	600	-	22	5	44	2	2	23/22
96	**1380**	60	220	940	220	1060	0	0	16	10	10	23/43
02	**2380**	-	60	1960	360	940	15	2	15	3	10	27/44
07	**1680**	20	-	1280	400	860	62	12	24	12	29	30/47

		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)
Chrysothamnus viscidiflorus viscidiflorus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**20**	-	-	20	-	-	0	0	-	-	0	19/40
02	**60**	-	-	60	-	-	0	0	-	-	0	20/32
07	**60**	-	-	60	-	-	0	0	-	-	0	21/37
Gutierrezia sarothrae												
83	**499**	366	133	366	-	-	0	0	0	-	0	9/11
89	**4565**	100	33	4166	366	-	0	0	8	-	0	11/13
96	**2740**	-	20	2100	620	500	0	0	23	2	2	8/13
02	**1660**	-	-	1500	160	140	0	0	10	6	6	9/11
07	**300**	-	-	280	20	-	0	0	7	7	7	9/11
Purshia tridentata												
83	**66**	-	-	66	-	-	0	100	-	-	0	13/25
89	**100**	-	-	100	-	-	33	67	-	-	0	15/31
96	**80**	-	-	80	-	-	75	25	-	-	0	19/87
02	**220**	-	20	200	-	-	9	73	-	-	0	17/76
07	**240**	-	20	220	-	40	8	83	-	-	0	22/73
Quercus gambelii												
83	**1533**	533	1333	100	100	-	37	0	7	-	0	39/21
89	**2832**	433	1666	800	366	-	42	1	13	-	0	30/13
96	**2200**	240	840	1280	80	340	2	0	4	-	0	58/50
02	**2600**	-	720	1540	340	380	28	8	13	13	16	34/25
07	**1800**	140	360	1240	200	200	17	6	11	6	30	52/34

Trend Study 17-19-07

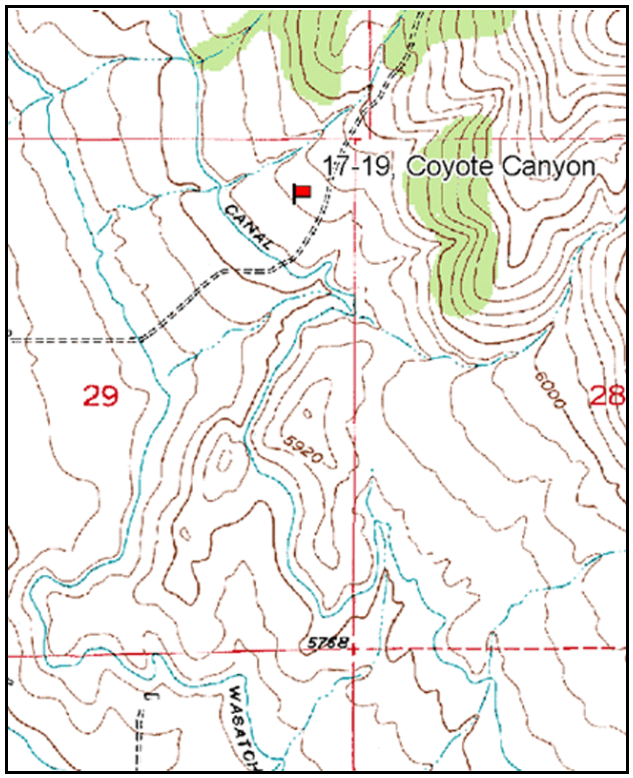
Study site name: Coyote Canyon . Vegetation type: Big Sagebrush .

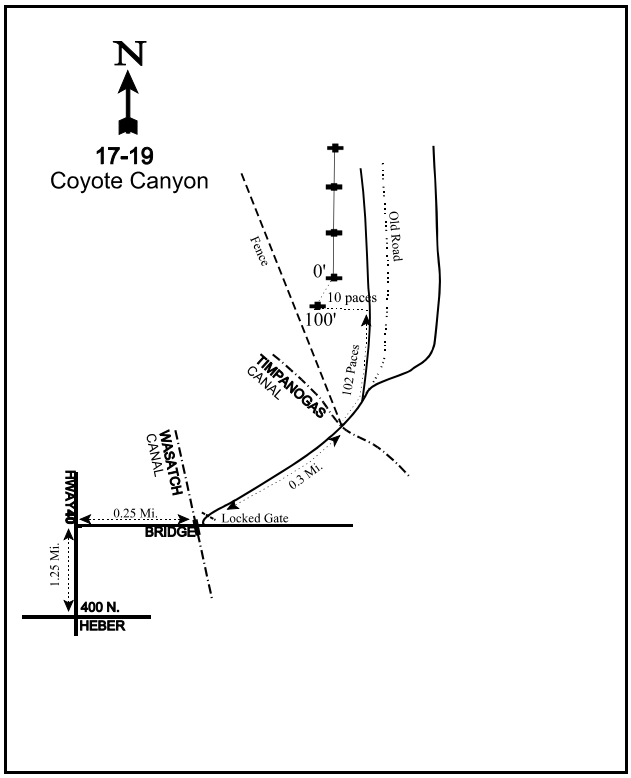
Compass bearing: frequency baseline 187 degrees magnetic.

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

LOCATION DESCRIPTION

From 400 North and Highway 40 (Main) in Heber, travel north for 1.25 miles and turn right onto a paved road. Proceed east for 0.25 miles to a left turn just past the Wasatch Canal (will need a key or combination to pass thru locked gate). Follow this road 0.3 miles to a fork immediately past Timpanogos Canal (locked gate with two combo locks). From the canal, take a left and walk 102 paces up the road. From this point, walk 10 paces west from the edge of the road to the 100-foot baseline stake. The 0-foot baseline stake is marked by a red browse tag. The baseline runs 187 degrees magnetic. The rest of the baseline runs off the 0-foot baseline stake in a direction of 345 degrees magnetic.





Map Name: Heber

Diagrammatic Sketch

Township 3S , Range 5E , Section 29

GPS: NAD 83, UTM 12T 466328 E 4487184 N

DISCUSSION

Coyote Canyon - Trend Study No. 17-19

Study Information

Prior to 2002, this study was known as Northeast of Heber. It is located on the northeast side of the Heber Valley [elevation: 5,900 feet (1,798 m), slope: 6%, aspect: south to southwest). In 1996, the 100 foot stake had to be moved approximately 25 feet (7.6 m) to the west to avoid sampling on a newly built road. Some seeded grasses and forbs, which were planted along the road, occur in several of the belts. It was also noted in 1996 that new homes had been built approximately 1000 feet (305 m) to the south and west. The nearest source of perennial water is Timpanogos Canal, 600 feet (183 m) to the southwest. From the pellet group transect, there were 166 deer days use/acre (410 ddu/ha) in 2002 and 47 deer days use/acre (116 ddu/ha) in 2007. Elk use was estimated at 21 days use/acre (53 edu/ha) in 2002 and 55 days use/acre (136 edu/ha) in 2007. Sheep use in 2002 was estimated at 21 days use/acre (51 sdu/ha). There was 1 horse day use/acre (3 hdu/ha) in 2007. Part of a deer skeleton was observed near the baseline in 2007.

Soil

This study is located within the Bezzant soil series, which consists of very deep, well-drained, moderately permeable soils. These soils formed in alluvium, colluvium, and residuum from mixed sedimentary rocks. The soil is classified as loamy-skeletal, mixed, superactive, frigid Typic Calcixerolls (USDA-NRCS 2007). Specifically at the study, the soil texture is a sandy clay loam with a slightly acidic reactivity (pH of 6.4). The relative bare ground cover has ranged from a low of 10% in 1996 to a high of 28% in 2002. Between 25% 50% of the surface litter has been recently translocated and redeposited against shrubs, and 5% to 10% of an onsite gully is actively eroding. As a result, the erosion condition was classified as slight in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species. Sagebrush canopy cover decreased from 22% in 2002 to 14% in 2007. The density was estimated at 6,866 plants/acre (16,995 plants/ha) in 1984, and decreased to 3,820 plants/acre (9,455 plants/ha) in 1996. The density increased to 4,180 plants/acre (10,347 plants/ha) in 2002, and decreased to3,240 plants/acre (8,020 plants/ha) in 2007. Seedling plants were sampled in 1996 and 2007 at a density of 400 seedlings/acre (990 seedlings/ha). Young plants were not sampled in 1984, but accounted for 18% of the population in 1996, and 8% in 2002 and 2007. Decadence is high, ranging from 22% to 42% of the population, and was highest in 1984 and 2002 when the population was largest. Since 1996, the density of dead plants has ranged from 1,160 plants/acre (2,870 plants/ha) to 1,580 plants/acre (3,910 plants/ha). Between 2% and 23% of the plants have exhibited poor vigor, and most of those have been classified as dying since 1996. The sagebrush defoliator moth (*Aroga websteri*) had infected half of the population in 2007. However, moth infestations elsewhere have been episodic, and infested populations may recover (Hsiao 1986). The average annual leader growth was 2.4 inches (6.1 cm) in 2002 and 1.5 inches (3.9 cm) in 2007. Browse use has varied from light-moderate to moderate-heavy, and was heaviest in 2002.

Other shrubs that are present, but less dominant, include rubber rabbitbrush (*Chrysothamnus nauseosus*), pricklypear cactus (*Opuntia* sp.), and antelope bitterbrush (*Purshia tridentata*). The bitterbrush population is comprised mostly of mature plants, and the density has been 80 plants/acre (200 plants/ha) since 1996. Browse use on bitterbrush has been moderate and heavy.

Herbaceous Understory

The herbaceous understory largely consists of annual species. Annual grass cover was 21% in 1996, 3% in 2002, and 20% in 2007. Although it was not recorded until 1996, cheatgrass (*Bromus tectorum*) has dominated the understory since 1984. Cheatgrass was sampled in every quadrat in 1996 and 2007. Perennial grass cover has averaged 2% cover since 1996. They are sparsely scattered throughout the study with most

being found beneath sagebrush plants or along the nearby road. Crested wheatgrass (*Agropyron cristatum)* and bottlebrush squirreltail (*Sitanion hystrix*) are the most common perennial species.

The forb component is dominated by weedy species and comprises a very little ground cover. Annual species account for more cover than perennial species. Annual forb cover has averaged 2%, and perennial forb cover has been 1% or less since 1996. Pale alyssum (*Alyssum alyssoides*) is the most abundant species.

1996 TREND ASSESSMENT

The browse trend is slightly down. Although the density of sagebrush decreased 44%, the decrease was partly attributed to the larger area sampled. The browse trend was determined from other parameters. For example, the density of seedlings increased from 0 to 400 seedlings/acre (990 seedlings/ha), and young plants increased from 0 to 680 plants/acre (1,685 plants/ha). In addition to the increase in reproduction and recruitment, decadence decreased from 42% to 22% of the population. Although 1,440 dead plants/acre (3,565 plants/ha) were sampled, it is not known if this is an increase or a decrease from 1984 because data on dead plants were not collected in 1984. The proportion of plants exhibiting poor vigor decreased from 9% to 2%, and browse use remained light-moderate. The grass trend is stable. Although the sum of nested frequency of perennial grasses increased 54%, they occurred at a very low frequency. Cheatgrass was sampled in 100% of the quadrats. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased approximately eight-fold, but forb frequency remained low. The trend was determined to be slightly up because the number of perennial species increased from one to seven. Lewis flax (*Linum lewisii*) was the most abundant perennial forb, and was sampled in 11 quadrats. The Desirable Components Index (DCI) score was poor. The high browse cover was countered by the low perennial grass and forb cover, and high annual grass cover.

winter range condition (DCI) - very poor (30) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is slightly down. The cover of mountain big sagebrush was stable, and sagebrush density increased 9%. However, all other parameters indicate that the population was in decline. No seedling plants were sampled, and young plants decreased from 18% to 8% of the population. Decadence increased to 38%, and 16% of the population was classified as dying. The density of dead plants increased 10% to 1,580 plants/acre (3,910 plants/ha). Plants with poor vigor increased from 2% to 23% of the population. Browse use shifted from light-moderate to moderate-heavy, with 48% of the plants exhibiting heavy use. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased 30%, but they remained infrequent. There was a significant increase in the nested frequency of crested wheatgrass, and a significant decrease in that of cheatgrass. Cheatgrass cover decreased from 21% to 3%, but quadrat frequency only decreased from 100% to 89%. Domestic sheep had grazed most of the crested wheatgrass plants. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 67%, but again, perennial forbs were a small component of the vegetation community. The DCI score improved to very poor-poor due to an increase in browse cover and a decrease in the annual grass cover.

winter range condition (DCI) - very poor-poor (35) Mid-level potential scale
browse - slightly down (-1) grass - slightly up (+1) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is down. Sagebrush cover decreased from 20% to 12% of the total ground cover, and the density decreased 22%. Seedling plants were sampled again at a density of 400 plants/acre (990 plants/ha). Even though the density of young plants decreased, the young age class still comprised 8% of the population. Decadence decreased to 31%, and dying plants decreased to 9% of the population. The density of dead plants decreased to 1,160 plants/acre (2,870 plants/ha). Half of the population was infested by the sagebrush

defoliator moth (*Aroga websteri*). Browse use shifted once again to light-moderate, and 16% of the plants exhibited heavy use. The grass trend is slightly down. The sum of nested frequency of perennial grasses decreased 13%. Cheatgrass increased significantly in nested frequency, and its average cover increased from 3% to 20%. All of the perennial species exhibited heavy grazing use. The forb trend is stable. The sum of nested frequency of perennial forbs increased more than two-fold, but perennial forbs remain a very small vegetative component. Pale alyssum increased significantly in nested frequency and comprised 75% of the total forb cover. The DCI score decreased to very poor due to the decrease in browse cover and increase in annual grass cover.

winter range condition (DCI) - very poor (15) Mid-level potential scale
browse - down (-2) grass - slightly down (-1) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 19

Type	Species	Nested Frequency				Average Cover %		
		'84	'96	'02	'07	'96	'02	'07
G	Agropyron cristatum	-	a24	b40	ab32	1.26	1.95	1.17
G	Agropyron intermedium	-	a-	b6	ab3	.06	.04	.03
G	Agropyron spicatum	a8	a7	-	-	.06	-	-
G	Bromus japonicus (a)	-	a2	a8	-	.00	.04	-
G	Bromus tectorum (a)	-	c368	a236	b353	21.32	2.78	19.87
G	Oryzopsis hymenoides	-	-	-	2	.03	-	.03
G	Poa secunda	-	-	-	12	-	-	.07
G	Sitanion hystrix	a33	a31	a32	a21	.66	.17	.47
G	Stipa comata	-	a1	a4	a1	.03	.03	.03
Total for Annual Grasses		0	370	244	353	21.33	2.82	19.87
Total for Perennial Grasses		41	63	82	71	2.12	2.21	1.81
Total for Grasses		41	433	326	424	23.45	5.03	21.69
F	Agoseris glauca	-	6	-	-	.01	-	-
F	Allium acuminatum	a6	a11	a6	-	.03	.01	-
F	Alyssum alyssoides (a)	-	a92	b133	c314	.81	.64	3.16
F	Allium sp.	-	-	-	16	-	-	.06
F	Calochortus nuttallii	-	-	-	3	-	-	.00
F	Collomia linearis (a)	-	a13	-	a36	.04	-	.07
F	Collinsia parviflora (a)	-	a2	a3	b20	.01	.01	.06
F	Epilobium brachycarpum (a)	-	b23	-	a2	.06	-	.00
F	Erodium cicutarium (a)	-	-	-	18	-	-	.25
F	Gayophytum ramosissimum(a)	-	-	b29	a5	-	.09	.01
F	Grindelia squarrosa	-	-	-	10	-	-	.09
F	Hedysarum boreale	-	2	-	-	.00	-	-
F	Holosteum umbellatum (a)	-	-	-	1	-	-	.00

Type	Species	Nested Frequency				Average Cover %		
		'84	'96	'02	'07	'96	'02	'07
F	Lappula occidentalis (a)	-	-	-	1	-	-	.00
F	Lactuca serriola	-	$_{a}$-	-	$_{a}$5	.00	-	.03
F	Linum lewisii	-	25	-	-	.49	-	-
F	Madia glomerata (a)	-	9	-	-	.03	-	-
F	Medicago sativa	-	$_{a}$1	$_{a}$1	-	.03	.00	-
F	Microsteris gracilis (a)	-	$_{ab}$8	$_{a}$7	$_{b}$19	.02	.01	.07
F	Orthocarpus sp. (a)	-	38	-	-	1.05	-	-
F	Phlox longifolia	-	$_{a}$5	$_{a}$4	$_{a}$2	.02	.01	.00
F	Polygonum douglasii (a)	-	$_{b}$46	$_{a}$5	$_{a}$8	.09	.01	.01
F	Ranunculus testiculatus (a)	-	-	$_{a}$1	$_{b}$15	-	.00	.10
F	Schoencrambe linifolia	-	-	3	-	-	.00	-
F	Sisymbrium altissimum (a)	-	-	4	-	-	.01	-
F	Sphaeralcea coccinea	-	-	-	1	-	-	.00
F	Tragopogon dubius	-	$_{a}$2	$_{a}$3	$_{a}$3	.01	.00	.00
F	Trifolium sp.	-	-	-	2	-	-	.00
Total for Annual Forbs		0	231	182	439	2.12	0.78	3.77
Total for Perennial Forbs		6	52	17	42	0.60	0.03	0.22
Total for Forbs		6	283	199	481	2.73	0.82	3.99

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

BROWSE TRENDS --
Management unit 17 , Study no: 19

Type	Species	Strip Frequency			Average Cover %		
		'96	'02	'07	'96	'02	'07
B	Artemisia tridentata vaseyana	89	88	83	18.38	20.00	11.68
B	Chrysothamnus nauseosus	0	0	2	-	-	.15
B	Opuntia sp.	30	19	16	1.27	.52	.21
B	Purshia tridentata	4	4	4	.21	.30	.53
Total for Browse		123	111	105	19.87	20.82	12.56

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 19

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	21.50	14.35
Opuntia sp.	.60	5.41
Purshia tridentata	.11	.18

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 19

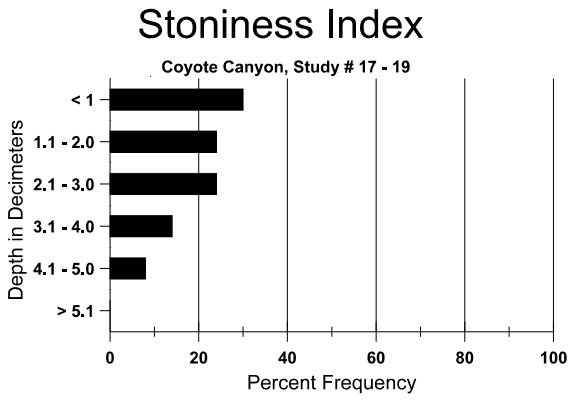
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.4	1.5

BASIC COVER --
Management unit 17 , Study no: 19

Cover Type	Average Cover %			
	'84	'96	'02	'07
Vegetation	2.00	39.08	25.59	39.96
Rock	6.25	8.19	8.55	9.02
Pavement	3.50	.35	.54	.65
Litter	71.00	56.29	48.02	41.11
Cryptogams	1.75	.43	.45	.36
Bare Ground	15.50	11.37	32.95	23.32

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 19, Coyote Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
11.7	61.0 (12.7)	6.4	46.2	26.1	27.7	3.6	34.4	160.0	.5



PELLET GROUP DATA --
Management unit 17 , Study no: 19

Type	Quadrat Frequency		
	'96	'02	'07
Sheep	-	12	2
Rabbit	11	14	21
Horse	-	-	2
Elk	5	3	17
Deer	47	58	44
Cattle	-	1	2

Days use per acre (ha)	
'02	'07
21 (51)	-
-	-
-	-
21 (53)	55 (136)
166 (410)	47 (116)
-	-

BROWSE CHARACTERISTICS --
Management unit 17 , 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 vaseyana												
84	**6866**	-	-	4000	2866	-	35	4	42	1	9	26/32
96	**3820**	400	680	2300	840	1440	35	2	22	2	2	23/41
02	**4180**	-	320	2260	1600	1580	20	48	38	16	23	20/31
07	**3240**	400	260	1960	1020	1160	29	16	31	9	9	26/36
Chrysothamnus nauseosus												
84	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**120**	-	60	60	-	20	0	0	-	-	0	11/7
Opuntia sp.												
84	**1133**	-	333	800	-	-	0	0	0	-	0	5/12
96	**1020**	80	80	880	60	40	0	0	6	4	8	5/13
02	**560**	-	20	480	60	-	0	4	11	11	11	6/12
07	**400**	20	-	280	120	-	0	0	30	25	25	6/16
Purshia tridentata												
84	**266**	-	-	133	133	-	50	50	50	-	50	17/22
96	**80**	-	-	60	20	-	100	0	25	-	0	15/31
02	**80**	-	-	60	20	-	0	100	25	-	0	14/41
07	**80**	-	-	80	-	-	0	100	0	-	0	24/37

Trend Study 17-24-07

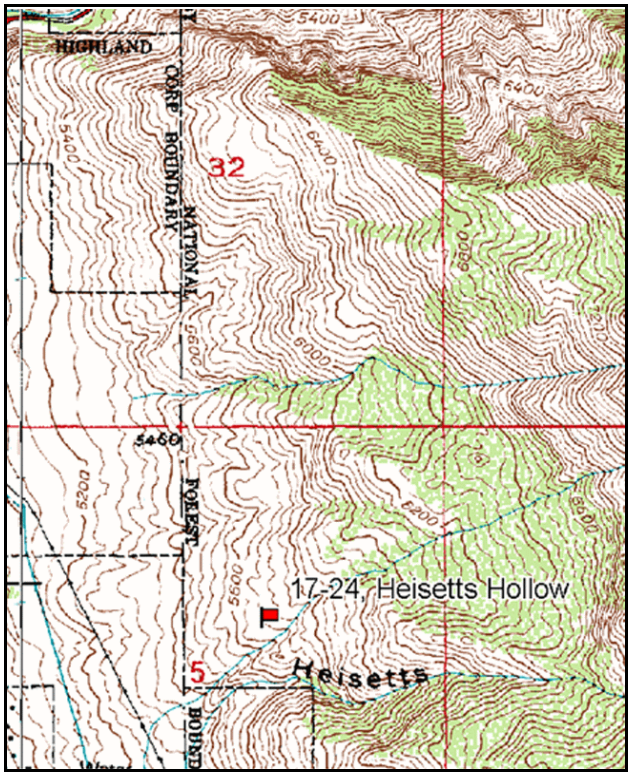
Study site name: Heisetts Hollow . Vegetation type: Big Sagebrush-Grass .

Compass bearing: frequency baseline 136 degrees magnetic (lines 2-4 @ 28°M).

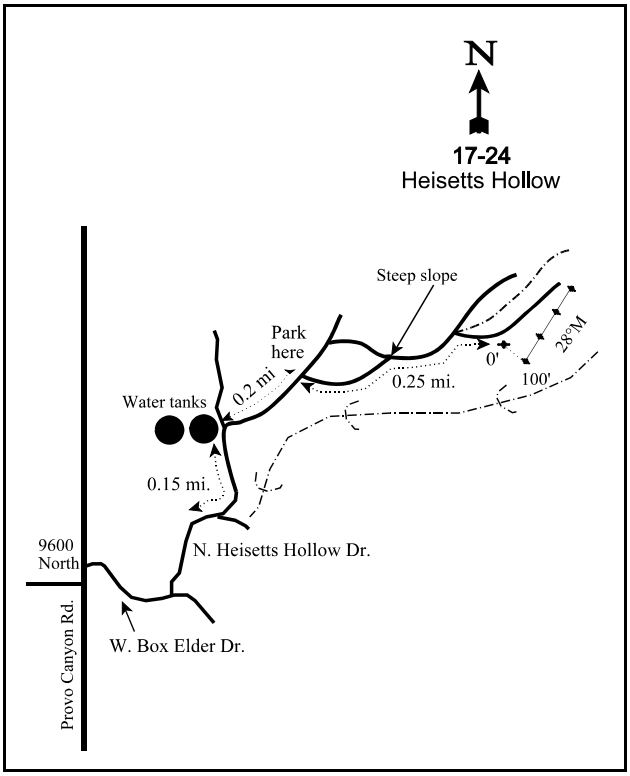
Frequency belt placement: line 1 (11 & 95ft), line 2 (59ft), line 3 (34ft), line 4 (71ft). Rebar: belt 1 on 18 ft., belt 3 on 2ft.

LOCATION DESCRIPTION

North of Pleasant Grove, turn east off Canyon Road (Rt 146) onto West Box Elder Drive. Take the next left onto North Heisetts Hollow Drive. Follow this road to a couple of large water tanks (about 0.15 miles). Continue 0.2 miles to a level parking area. There will be signs indicating that vehicle are not permitted beyond this point. From here, walk up the road 0.25 miles to the 0-foot baseline stake, staying to the right. You will pass numerous forks and trails, and a GPS unit will help you navigate to the study.



Map Name: Timpanogos Cave



Diagrammatic Sketch

Township 5S , Range 2E , Section 5

GPS: NAD 83, UTM 12T 437051 E 4474127 N

DISCUSSION

Heisetts Hollow - Trend Study No. 17-24

Study Information

This study is located on the upper Lake Bonneville terrace near the mouth of Heisetts Hollow and uphill from the Salt Lake Aqueduct [elevation: 5,600 feet (1,710 m), slope: 5-22%, aspect: southwest]. This entire area is critical deer winter range. An old browse transect is located in the immediate area. The nearest perennial source of water is Heisetts Hollow, and is approximately 550 feet (170 m) to the south. Deer and elk use have been both light and moderate. From the pellet group transect, there were an estimated 65 deer days use/acre (160 ddu/ha) in 2002 and 78 deer days use/acre (193 ddu/ha) in 2007. All of the deer pellet groups appeared to be from winter use. Elk use was estimated at 3 days use/acre (8 edu/ha) in 2002 and increased to 43 days use/acre (106 edu/ha) in 2007. There was also 1 bighorn sheep days use/acre (2 sdu/ha) in 2007.

Soil

The soil texture is a clay loam, and contains a moderate amount of rock in the profile. Phosphorous is low at only 5.7 ppm. Values less than 6 ppm may limit normal plant growth and development (Tiedemann and Lopez 2004). The steeper slopes are somewhat terraced and there are pedestals around plants. Some soil movement is evident on a foot trail located directly north of the site. There did not appear to be any significant erosion occurring recently; the erosion condition was classified as stable in 2002 and 2007.

Browse

The main key browse component is a sparse population of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Sagebrush canopy cover was less than 1% in 2002, and increased to 5% in 2007. The density increased from approximately 865 plants/acre (2,141 plants/ha) in 1983 and 1989 to 1,120 plants/acre (2,772 plants/ha) in 1997. The density decreased to 920 plants/acre (2,277 plants/ha) in 2002 and 640 plants/acre (1,585 plants/ha) in 2007. There have been few seedlings or young plants sampled in any year. Percent decadence has oscillated between increasing and decreasing in alternate sample years, and was lowest in 1983 (19%) and highest in 1989 (46%). Dead plants were not sampled in 1983 or 1989, but have averaged 247 plants/acre (610 plants/ha) since 1997. Plants exhibiting poor vigor decreased from 34% in 1983 to 4% in 1989, and then increased to 25% by 2007. Since 1989, the majority of the plants in poor vigor were classified as dying. The average annual leader growth was 1.9 inches (4.8 cm) in 2002 and 1.5 inches (3.8 cm) in 2007. Browse use on sagebrush has been moderate and heavy.

Other preferred browse occur in small numbers and include true mountain mahogany (*Cercocarpus ledifolius*), white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), and Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*). Browse use on mahogany has been moderate-heavy. The few cliffrose on the site are tall and mostly unavailable to browsing.

Herbaceous Understory

Perennial grasses are the dominant herbaceous understory component. Perennial grasses provided 37% cover in 1997, 35% in 2002, and 30% in 2007. Bluebunch wheatgrass *(Agropyron spicatum*) and bulbous bluegrass (*Poa bulbosa*) are the most abundant species. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) are present, but are a much smaller component of the understory. Bulbous bluegrass has a phenology similar to cheatgrass (Stewart and Hull 1949), and may be suppressing the growth of other perennial and annual species.

Forbs are relatively diverse but occur infrequently. The total forb cover has averaged less than 3% since 1997. The more common perennial species include northern sweetvetch (*Hedysarum boreale*), longleaf phlox (*Phlox longifolia*), and yellow salsify (*Tragopogon dubius*). Pale alyssum (*Alyssum alyssoides*) and storksbill (*Erodium cicutarium*) are the most common annual species.

1989 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush, and the proportion of the population in the young age class remained stable. Although decadence increased from 19% to 46%, the proportion of plants exhibiting poor vigor decreased from 35% to 4% of the population. Browse use shifted from moderate-heavy to heavy. The grass trend is slightly up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 89%. There were significant decreases in the nested frequencies of thickspike wheatgrass (*Agropyron dasystachyum*) and bulbous bluegrass. Sandberg bluegrass (*Poa secunda*) was sampled for the first time and had a quadrat frequency of 95%. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased 85%, and most of the increase was due to western ragweed (*Ambrosia psilostachya*). This species has a low forage value, so the increase is less significant.

browse - stable (0) grass - slightly up (+1) forb - slightly up (+1)

1997 TREND ASSESSMENT

The browse trend is up. The density of sagebrush increased 29%. Seedling plants were sampled for the first time, and the young age class increased from 4% to 7% of the population. The density of mature plants increased from 433 plants/acre (1,070 plants/ha) to 780 plants/acre (1,930 plants/ha). Additionally, decadence decreased to 23%. However, the density of dead plants increased from 0 to 240 plants/acre (595 plants/ha). Plants with poor vigor increased from 4% to 13%, and all of those plants were classified as dying. Browse use shifted from heavy to moderate and the average crown width increased by 18 inches (46 cm). The grass trend is stable. Even though the sum of nested frequency of perennial grasses, excluding bulbous bluegrass, decreased 43%, there was a favorable shift in frequency of the individual species. There was a significant increase in the nested frequency of bluebunch wheatgrass, which is more robust and provides more forage than either bulbous or Sandberg bluegrass. Sandberg bluegrass significantly decreased and bulbous bluegrass significantly increased. It is possible that there has been some misidentification of these two species in years past. Both are small and dry early in the growing season. The forb trend is up. The sum of nested frequency of perennial forbs increased 67%, including significant increases in yellow salsify and longleaf phlox. The Desirable Components Index (DCI) score was fair due to the moderate browse cover and high perennial grass cover.

winter range condition (DCI) - fair (55) Mid-level potential scale
browse - up (+2) grass - stable (0) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 18%, and most of the decrease was attributed to fewer mature plants. No seedlings were sampled. The density of young plants decreased, but young plants continued to comprise 7% of the population. Decadence increased to 41% of the population, and the density of dead plants increased to 300 plants/acre (743 plants/ha). The proportion of plants with poor vigor increased to 24%, and the majority of those plants were classified as dying. Browse use shifted to heavy. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 4%. Bluebunch wheatgrass and cheatgrass significantly decreased in nested frequency. Kentucky bluegrass (*Poa pratensis*) was sampled for the first time. The forb trend is down. The sum of nested frequency of perennial forbs decreased 27%, including significant decreases in western ragweed and yellow salsify. The DCI score decreased to poor-fair due to an increase in browse decadence.

winter range condition (DCI) - poor-fair (49) Mid-level potential scale
browse - down (-2) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 30%. No seedling or young plants were sampled. Decadence decreased to 34% of the population, and the density of dead plants decreased to 200

plants/acre (495 plants/ha). Plants with poor vigor comprised 25% of the population, and 16% of the population was classified as dying. Browse use shifted to moderate-heavy. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 31%, including significant decreases in Kentucky and Sandberg bluegrass. Although bulbous bluegrass decreased significantly in nested frequency, there was a significant increase in that of cheatgrass. Japanese brome was also sampled for the first time. None of the grasses had been grazed. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 28%. The number of perennial species sampled decreased from 15 to 10. Yellow salsify plants were heavily grazed. The DCI score decreased to poor due to a decrease in browse cover.

winter range condition (DCI) - poor (45) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - slightly down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 24

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	a9	a7	-	-	a3	-	-	.03
G	Agropyron dasystachyum	b86	a8	-	a2	a3	-	.00	.06
G	Agropyron spicatum	a196	a237	c289	b254	b210	20.39	13.22	14.84
G	Bromus japonicus (a)	-	-	-	-	13	-	-	.05
G	Bromus tectorum (a)	-	-	b133	a39	b101	1.51	.19	1.18
G	Poa bulbosa	bc284	a120	cd307	d303	b241	16.68	19.25	15.22
G	Poa pratensis	-	-	-	b42	a6	-	.59	.06
G	Poa secunda	-	c299	b28	b32	a7	.17	1.48	.07
Total for Annual Grasses		0	0	133	39	114	1.51	0.19	1.23
Total for Perennial Grasses		575	671	624	633	470	37.25	34.56	30.29
Total for Grasses		575	671	757	672	584	38.76	34.76	31.53
F	Alyssum alyssoides (a)	-	-	b128	a87	ab123	.49	.18	.47
F	Allium sp.	-	-	3	-	-	.00	-	-
F	Ambrosia psilostachya	-	c52	b35	a4	a10	.18	.06	.10
F	Artemisia ludoviciana	a3	a2	-	-	-	-	-	-
F	Arabis perennans	-	-	2	-	-	.03	-	-
F	Astragalus sp.	-	a2	-	b17	-	-	.35	-
F	Astragalus utahensis	-	-	a3	a6	a6	.15	.06	.18
F	Castilleja chromosa	a7	a1	a2	a5	a2	.00	.04	.03
F	Calochortus nuttallii	a7	a1	-	a4	-	-	.01	-
F	Cirsium undulatum	-	a2	b11	ab12	ab11	.19	.09	.10
F	Comandra pallida	a4	a8	a3	-	-	.01	-	-
F	Collinsia parviflora (a)	-	-	-	-	2	-	-	.00
F	Crepis acuminata	-	-	a5	a7	a8	.01	.04	.06

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Descurainia pinnata (a)	-	-	-	5	-	-	.01	-
F	Draba sp. (a)	-	-	-	-	12	-	-	.01
F	Erodium cicutarium (a)	-	-	$_{a}$44	$_{a}$55	$_{a}$29	.26	1.37	.18
F	Helianthus annuus (a)	-	$_{a}$17	-	$_{a}$14	-	-	.03	-
F	Hedysarum boreale	$_{a}$12	$_{a}$11	$_{a}$26	$_{a}$4	$_{a}$10	.71	.16	.99
F	Lappula occidentalis (a)	-	-	-	23	-	-	.05	-
F	Lactuca serriola	-	-	$_{a}$1	$_{a}$5	-	.00	.01	-
F	Lithospermum ruderale	-	$_{a}$3	$_{a}$3	-	-	.01	-	-
F	Lygodesmia sp.	-	-	-	$_{a}$13	$_{a}$7	-	.12	.15
F	Oenothera sp.	$_{a}$2	-	$_{a}$5	$_{a}$1	-	.33	.00	-
F	Orobanche sp.	5	-	-	-	-	-	-	-
F	Phlox longifolia	$_{a}$3	$_{ab}$6	$_{c}$28	$_{bc}$21	$_{ab}$8	.08	.08	.04
F	Sedum lanceolatum	-	-	-	1	-	-	.00	-
F	Sphaeralcea coccinea	$_{a}$8	$_{a}$7	$_{a}$6	$_{a}$13	$_{a}$9	.03	.03	.05
F	Tragopogon dubius	$_{a}$2	-	$_{b}$31	$_{a}$7	$_{ab}$16	.24	.10	.04
F	Unknown forb-perennial	-	3	-	-	-	-	-	-
Total for Annual Forbs		0	17	172	184	166	0.76	1.64	0.68
Total for Perennial Forbs		53	98	164	120	87	2.00	1.19	1.75
Total for Forbs		53	115	336	304	253	2.76	2.84	2.44

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

BROWSE TRENDS --
Management unit 17 , Study no: 24

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	35	32	28	8.28	6.99	4.79
B	Atriplex confertifolia	1	1	1	.03	.15	-
B	Cercocarpus montanus	1	1	2	.15	.41	.53
B	Chrysothamnus nauseosus albicaulis	4	2	1	.15	.03	-
B	Cowania mexicana stansburiana	0	0	0	-	.15	-
B	Gutierrezia sarothrae	72	6	18	3.59	.01	.22
B	Quercus gambelii	0	0	1	-	-	-
Total for Browse		113	42	51	12.21	7.75	5.55

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

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	.20	4.83
Cercocarpus montanus	-	1.08
Cowania mexicana stansburiana	-	.08
Gutierrezia sarothrae	-	1.03

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

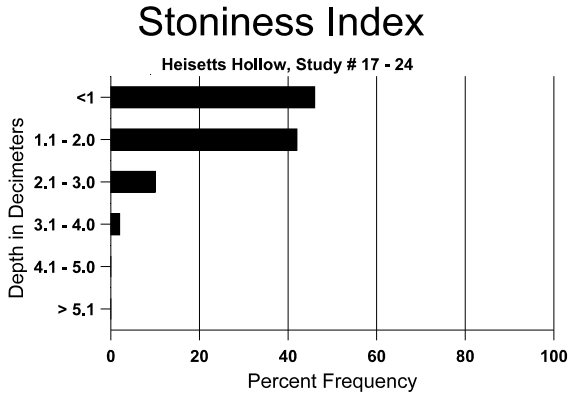
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	1.9	1.5

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

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	7.00	22.25	53.82	49.99	41.43
Rock	3.00	4.50	4.96	7.68	2.88
Pavement	6.75	19.75	6.84	8.94	6.31
Litter	72.50	41.00	39.14	31.17	31.23
Cryptogams	.25	0	.59	.22	.06
Bare Ground	10.50	12.50	7.46	14.68	9.37

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 24, Heisetts Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
24.3	49.6 (17.7)	7.1	32.0	35.4	32.6	3.8	5.7	105.6	.6



PELLET GROUP DATA --
Management unit 17 , Study no: 24

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	-	-
Rabbit	1	3	13
Elk	1	1	34
Deer	43	46	12

Days use per acre (ha)	
'02	'07
-	1 (2)
-	-
3 (8)	43 (106)
65 (160)	78 (193)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 24

		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												
83	**33**	-	-	33	-	-	0	100	-	-	100	30/35
89	**33**	-	-	33	-	-	0	100	-	-	100	28/31
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Artemisia tridentata vaseyana												
83	**865**	-	33	666	166	-	35	54	19	31	35	22/28
89	**866**	-	33	433	400	-	15	85	46	4	4	24/29
97	**1120**	60	80	780	260	240	54	30	23	13	13	25/47
02	**920**	-	60	480	380	300	11	85	41	22	24	22/35
07	**640**	-	-	420	220	200	28	50	34	16	25	24/39
Atriplex confertifolia												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	100	0	0	-	0	15/27
02	**40**	-	-	20	20	-	0	100	50	-	0	6/16
07	**40**	-	-	40	-	-	0	0	0	-	0	8/16
Cercocarpus montanus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**33**	-	33	-	-	-	0	100	-	-	0	-/-
97	**20**	20	-	20	-	-	0	100	-	-	0	70/127
02	**40**	-	-	40	-	-	100	0	-	-	0	89/113
07	**60**	-	20	40	-	-	67	33	-	-	0	83/89

		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)
Chrysothamnus nauseosus albicaulis												
83	**33**	-	-	33	-	-	0	0	0	-	0	20/24
89	**66**	-	-	66	-	-	0	0	0	-	0	26/26
97	**80**	-	-	80	-	-	0	0	0	-	0	28/48
02	**40**	-	-	20	20	-	50	50	50	-	0	27/44
07	**40**	-	-	40	-	20	0	0	0	-	0	33/55
Cowania mexicana stansburiana												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	38/48
02	**0**	-	-	-	-	-	0	0	-	-	0	66/57
07	**0**	-	-	-	-	-	0	0	-	-	0	66/75
Gutierrezia sarothrae												
83	**1233**	4100	733	500	-	-	0	0	0	-	0	11/8
89	**1433**	-	-	733	700	-	0	0	49	7	44	9/8
97	**10300**	8900	4280	5980	40	20	0	0	0	-	0	6/7
02	**120**	-	40	80	-	-	0	0	0	-	17	7/7
07	**660**	-	80	560	20	-	3	0	3	-	3	9/10
Quercus gambelii												
83	**133**	-	33	100	-	-	25	75	-	-	50	33/35
89	**366**	-	200	166	-	-	0	91	-	-	0	59/33
97	**0**	-	-	-	-	-	0	0	-	-	0	52/43
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	37/24

Trend Study 17-25-07

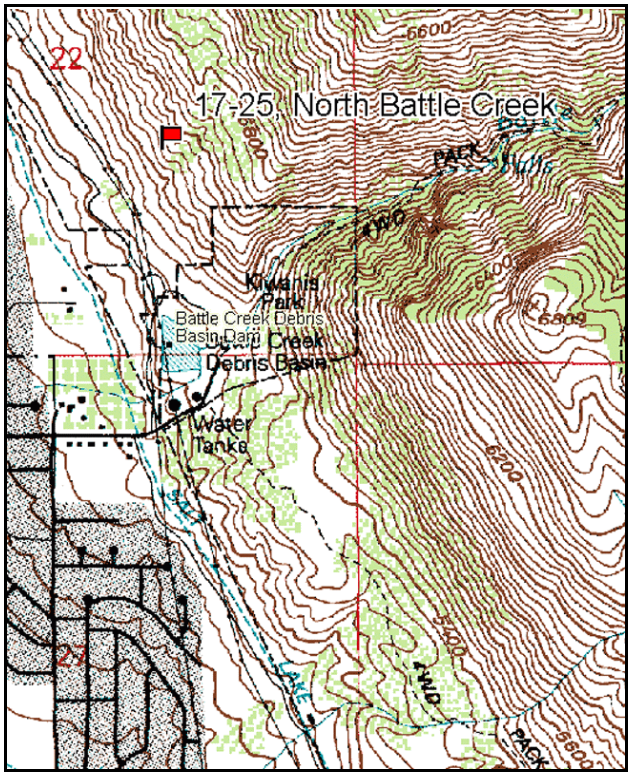
Study site name: North Battle Creek . Vegetation type: Stansbury Cliffrose .

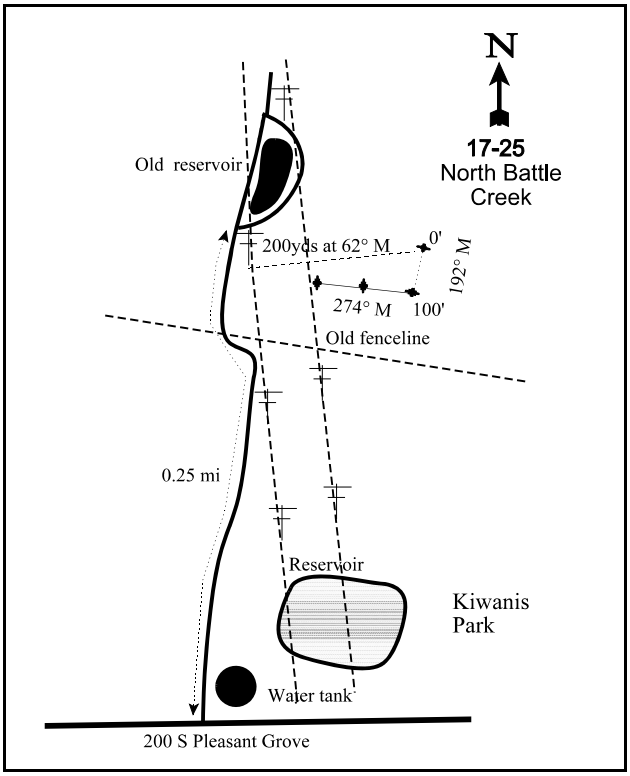
Compass bearing: frequency baseline 192 degrees magnetic (lines 2 & 3 @ 274°M).

Frequency belt placement: line 1 (11 & 95ft), line 2 (59ft), line 3 (34 & 71ft). Rebar: None on site.

LOCATION DESCRIPTION

From Pleasant Grove, go up 200 South towards Battle Creek Canyon. The paved road ends at a water tank. Follow one of the many dirt roads north along the base of the foothill under the powerlines. From the water tank, go about 1/4 mile to a 2nd reservoir. Stop on the south end. From the powerline pole on the south end of the old reservoir, the 0-foot stake is about 200 yards at 62 degrees magnetic. The study samples the first face or slope below the second terrace, in a fairly dense cliffrose type, just north of a small drainage. A red browse tag, #3988, is attached to the 0-foot stake.





Map Name: Orem

Diagrammatic Sketch

Township 5S , Range 2E , Section 22

GPS: NAD 83, UTM 12T 440346 E 4468842 N

DISCUSSION

North Battle Creek - Trend Study No. 17-25

Study Information

This study is located north of Battle Creek above the city of Pleasant Grove [elevation: 5,500 feet (1,676 m), slope: 65%, aspect: southwest]. The study is typical of the severe winter range in this area. The Battle Creek and Grove Creek debris basins, which act as small reservoirs in the spring, are located below the site to the north and south. Otherwise, the nearest perennial source of water is Grove Creek, which is located 0.7 miles (1.1 km) to the northwest. Residential subdivisions have been constructed up to the base of the hill just below the site. The area is moderately browsed by deer. From the pellet group transect, there were an estimated 44 deer days use/acre (109 ddu/ha) in 2002 and 72 deer days use/acre (177 ddu/ha) in 2007. There was one elk pellet group in 2002. Bighorn sheep use was estimated at 11 days use/acre (26 sdu/ha) in 2007. All pellet groups appeared to be from winter use. Three deer skeletons were found on the study in 2007.

Soil

The soil has a clay loam texture, a neutral reaction (pH of 7.1), and formed from limestone. The concentration of phosphorous is relatively low (6.4 ppm) and potassium is low (38.4 ppm). Values less than 6 ppm for phosphorus and 60 ppm for potassium may limit normal plant growth and development (Tiedemann and Lopez 2004). Rock cover is high on the lower half of the transect where the baseline crosses a talus slope. Relative rock and vegetation cover have each averaged 25% since 1997. The erosion condition was classified as slight in 2002 and improved to stable in 2007.

Browse

The dominant browse species is Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*). Cliffrose canopy cover increased from less than 1% in 2002 to 13% in 2007. The density of cliffrose increased from 332 plants/acre (822 plants/ha) in 1983 to 800 plants/acre (1,980 plants/ha) by 1997, then decreased to 640 plants/acre (1,584 plants/ha) by 2007. Few seedling or young plants have been sampled, and the population has consisted predominantly of mature plants. Decadence has ranged from 6% to 33% of the population and was highest in 1989 and 2002. Dead plants were first sampled in 1997, and have averaged 60 plants/acre (149 plants/ha). The proportion of plants exhibiting poor vigor was highest in 1983 (40%), but has been lower in successive sample years (0%-11%). The average annual leader growth was 1.1 inches (2.8 cm) in 2002 and 2.7 inches (6.8 cm) in 2007. Browse use has been moderate and heavy.

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) provides some additional forage. Since 2002, canopy cover has been 1% or less. Prior to 1997, sagebrush was the dominant shrub and had an estimated density of approximately 1,000 plants/acre (2,475 plants/ha). When the sample area increased in 1997, the estimated density decreased to 220 plants/acre (545 plants/ha). In 2002 and 2007, the density was 120 plants/acre (297 plants/ha). No seedling or young plants have been sampled since 1989. Decadence increased from 0% in 1983 to 20% in 1989, decreased to 17% by 2002, and decreased to 0% in 2007. Vigor has been good, except in 1997 when 18% of the population was in poor vigor. The average annual leader growth was 2 inches (5.1 cm) in 2007. Browse use has ranged from light to moderate-heavy.

Herbaceous Understory

The herbaceous understory comprises approximately two-thirds of the vegetative ground cover. Perennial grasses provided 4% cover in 1997 and 2002, and decreased to 1% in 2007. Bluebunch wheatgrass (*Agropyron spicatum*) is the dominant perennial species. It has steadily declined in quadrat frequency from 46% in 1983 to 15% in 2007. Cheatgrass (*Bromus tectorum*) is the dominant annual species. It provided 3% cover in 1997, less than 1% in 2002, and 7% in 2007. Quadrat frequency decreased from 59% in 1997 to 18% in 2002, then increased to 72% in 2007. Other grasses that have been sampled at low frequencies include crested wheatgrass (*Agropyron cristatum*), Japanese brome (*Bromus japonicus*), bulbous bluegrass (*Poa*

bulbosa), Sandberg bluegrass (*Poa secunda*), and winter rye (*Secale cereale*).

Perennial forb cover decreased from 6% in 1997 to 4% in 2002, and 1% in 2007. The forb component is dominated by the annual species storksbill (*Erodium cicutarium*), catchweed bedstraw (*Galium aparine*), and bur buttercup (*Ranunculus testiculatus*). Bonneville pea (*Lathyrus brachycalyx*) and northern sweetvetch (*Hedysarum boreale*) have been the dominant perennial species. However, it is likely that these two species have been misidentified as they are difficult to distinguish without the flower. Two noxious weed species have been sampled; yellow starthistle (*Centaurea solstitialis*) and field bindweed (*Convolvulus arvensis*).

1989 TREND ASSESSMENT

The browse trend is stable. The densities of cliffrose and sagebrush remained fairly stable. Cliffrose decadence increased from 20% to 33%, but the proportion of plants exhibiting poor vigor decreased from 40% to 0%. The young age class of sagebrush decreased from 20% to 0% of the population, and decadence increased from 0% to 20%. Browse use on sagebrush shifted from light to moderate. The grass trend is stable. The sum of nested frequency of perennial grasses decreased 7%. The forb trend is down. The sum of nested frequency of perennial forbs decreased 24%.

browse - stable (0) grass - stable (0) forb - down (-2)

1997 TREND ASSESSMENT

The browse trend is slightly down. The density of cliffrose increased two-fold, yet that of sagebrush decreased 78%. These changes in density were attributed to the larger area sampled in 1997. Therefore, trend was determined from other parameters. Cliffrose decadence decreased to 10% and vigor remained good. Browse use on cliffrose shifted from moderate to heavy. Sagebrush decadence decreased slightly to 18% of the population, but all of these plants were classified as dying. Browse use on sagebrush shifted from moderate to moderate-heavy. The grass trend is down. The sum of nested frequency of perennial grasses decreased 47%, including a significant decrease in bluebunch wheatgrass. The forb trend is up. The sum of nested frequency of perennial forbs increased more than two-fold. The number of perennial forb species sampled increased from five to 12. However, field bindweed, a noxious weed, was sampled for the first time. The Desirable Components Index (DCI) score was very poor-poor due to the low preferred browse cover and recruitment, low perennial grass and forb cover, and the presence of one noxious weed species.

winter range condition (DCI) - ver poor-poor (37) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is slightly down. The density of cliffrose decreased 10%, and decadence increased to 31% of the population. Cliffrose plants with poor vigor increased to 11%, and all of those plants were classified as dying. The proportion of plants showing heavy use decreased from 90% of the population to 58%. The density of sagebrush decreased 45%, and most of the decrease was attributed to fewer mature plants. Decadence remained stable at 17%, yet plants with poor vigor decreased from 18% to 0% of the population. All of the sagebrush plants had moderate browse use. The grass trend is slightly up. Excluding bulbous bluegrass which was sampled for the first time, the sum of nested frequency of perennial grasses increased 4%. There was a significant decrease in the nested frequency of cheatgrass. The forb trend is stable. Excluding field bindweed, the sum of nested frequency of perennial forbs increased 6%. There were significant decreases in the nested frequencies of western ragweed (*Ambrosia psilostachya*), storksbill, Bonneville pea, prickly lettuce (*Lactuca serriola*), and bur buttercup. There was a significant increase in the nested frequency of wild onion (*Allium* sp.). The DCI score remained very poor-poor.

winter range condition (DCI) - very poor-poor (35) Mid-level potential scale
browse - slightly down (-1) grass - slightly up (+1) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is stable. The density of cliffrose decreased 11%. Young plants were sampled for the first time and comprised 3% of the population. The density of mature plants increased, while decadence decreased from 31% of the population to 6%. All of the decadent plants were classified as dying. Browse use on cliffrose shifted to light-moderate, and heavily browsed plants decreased from 58% of the population to 13%. The density of sagebrush remained stable, and all of the plants were mature and had good vigor. Browse use shifted to light-moderate. The grass trend is down. The sum of nested frequency of perennial grasses decreased 46%, and bluebunch wheatgrass was the only perennial species sampled. Cheatgrass increased significantly in nested frequency, and its average cover increased from less than 1% to 7%. Japanese brome was sampled for the first time, and had a quadrat frequency of 1%. The forb trend is down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 73%. Most of the decrease was attributed to the significant decrease in wild onion. There were significant increases in the nested frequencies of storksbill and pale alyssum (*Alyssum alyssoides*). A second noxious weed species, yellow starthistle, was sampled for the first time. The DCI score decreased to very poor due to a decrease in perennial grass and forb cover, an increase in annual grass cover, and the presence of an additional noxious weed species.

winter range condition (DCI) - very poor (20) Mid-level potential scale
browse - stable (0) grass - down (-2) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 25

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	-	-	$_{a}$1	$_{a}$7	-	.00	.18	-
G	Agropyron spicatum	$_{bc}$128	$_{c}$117	$_{ab}$65	$_{ab}$71	$_{a}$42	3.48	3.71	1.42
G	Bromus japonicus (a)	-	-	-	-	3	-	-	.00
G	Bromus tectorum (a)	-	-	$_{b}$159	$_{a}$38	$_{c}$216	2.51	.24	7.43
G	Poa bulbosa	-	-	-	2	-	-	.00	-
G	Poa secunda	$_{a}$15	$_{a}$13	$_{a}$6	-	-	.18	-	-
G	Secale cereale (a)	-	-	$_{a}$2	-	$_{b}$37	.00	-	.88
G	Unknown grass - perennial	-	$_{a}$3	$_{a}$3	-	-	.03	-	-
Total for Annual Grasses		0	0	161	38	256	2.51	0.24	8.31
Total for Perennial Grasses		143	133	75	80	42	3.70	3.90	1.42
Total for Grasses		143	133	236	118	298	6.22	4.14	9.74
F	Alyssum alyssoides (a)	-	-	$_{a}$81	$_{a}$60	$_{b}$140	.30	.30	.84
F	Allium sp.	$_{a}$20	$_{a}$6	$_{a}$16	$_{b}$121	$_{a}$2	.08	.86	.00
F	Ambrosia psilostachya	-	-	$_{b}$13	$_{a}$1	$_{a}$4	.21	.00	.18
F	Artemisia ludoviciana	-	-	5	-	-	.30	-	-
F	Astragalus sp.	-	-	-	1	-	-	.03	-
F	Camelina microcarpa (a)	-	-	-	-	7	-	-	.01
F	Centaurea solstitialis	-	-	-	-	12	-	-	.07
F	Cirsium undulatum	-	-	$_{a}$1	$_{a}$2	-	.00	.03	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Convolvulus arvensis	-	-	$_{a}$11	$_{ab}$14	$_{b}$19	.36	.49	.16
F	Descurainia pinnata (a)	-	-	-	-	2	-	-	.00
F	Epilobium brachycarpum (a)	-	-	$_{a}$4	$_{a}$7	-	.01	.02	-
F	Erodium cicutarium (a)	-	-	$_{b}$213	$_{a}$91	$_{b}$196	6.43	1.01	3.82
F	Galium aparine (a)	-	-	$_{b}$59	$_{c}$99	$_{a}$31	.84	2.61	.55
F	Grindelia squarrosa	-	-	-	-	-	-	-	.03
F	Hackelia patens	-	-	$_{a}$14	$_{a}$10	$_{a}$7	.05	.07	.04
F	Hedysarum boreale	$_{b}$57	$_{b}$52	-	$_{a}$7	$_{a}$3	-	.01	.03
F	Lathyrus brachycalyx	-	-	$_{b}$111	$_{a}$58	$_{a}$28	4.23	2.51	.25
F	Lactuca serriola	-	-	$_{b}$17	$_{a}$1	$_{a}$7	.16	.00	.03
F	Machaeranthera canescens	$_{a}$2	$_{a}$1	-	-	-	-	-	.00
F	Medicago sativa	-	-	3	-	-	.03	-	-
F	Oenothera latifolia	2	-	-	-	-	-	-	-
F	Phlox longifolia	$_{a}$6	$_{a}$13	$_{a}$11	$_{a}$9	-	.05	.05	-
F	Ranunculus testiculatus (a)	-	-	$_{b}$166	$_{a}$124	$_{a}$89	1.64	.95	.68
F	Sisymbrium altissimum (a)	-	-	$_{a}$3	$_{a}$4	$_{a}$1	.00	.01	.03
F	Stanleya pinnata	$_{a}$24	$_{a}$12	-	-	-	-	-	-
F	Taraxacum officinale	-	-	$_{a}$6	$_{a}$2	-	.07	.03	-
F	Tragopogon dubius	-	-	$_{a}$18	$_{a}$16	$_{a}$10	.11	.08	.04
F	Unknown forb-annual (a)	-	-	$_{a}$1	$_{b}$44	-	.15	1.33	-
Total for Annual Forbs		0	0	527	429	466	9.38	6.26	5.95
Total for Perennial Forbs		111	84	226	242	92	5.66	4.19	0.86
Total for Forbs		111	84	753	671	558	15.05	10.46	6.82

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

BROWSE TRENDS --
Management unit 17 , Study no: 25

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	8	5	6	.83	.36	.60
B	Celtis reticulata	0	0	1	-	-	-
B	Chrysothamnus nauseosus albicaulis	2	2	1	.78	.38	-
B	Cowania mexicana stansburiana	32	26	25	7.41	8.80	6.78
B	Gutierrezia sarothrae	12	6	4	.56	.39	-
B	Purshia tridentata	0	4	0	-	.30	-
Total for Browse		54	43	37	9.59	10.23	7.38

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 25

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	.21	1.39
Chrysothamnus nauseosus albicaulis	-	-
Cowania mexicana stansburiana	.16	12.71
Gutierrezia sarothrae	-	.21

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 25

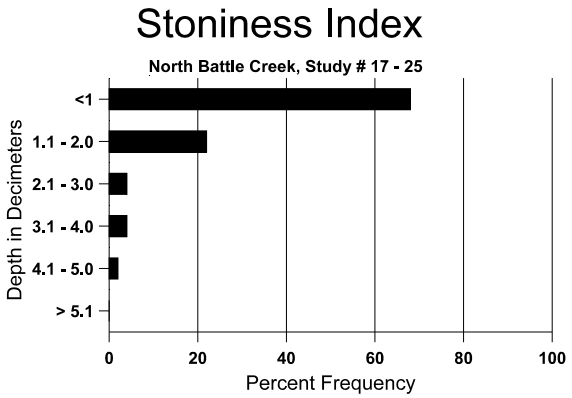
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	-	2.0
Cowania mexicana stansburiana	1.1	2.7

BASIC COVER --
Management unit 17 , Study no: 25

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	3.50	7.00	30.84	26.16	26.63
Rock	8.75	20.50	28.40	32.22	22.88
Pavement	20.25	26.00	11.94	9.89	19.18
Litter	48.75	30.50	19.88	15.82	25.24
Cryptogams	.75	.25	.01	.04	0
Bare Ground	18.00	15.75	16.89	27.09	20.08

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 25, North Battle Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
12.7	52.3 (15.4)	7.1	28.0	33.4	38.6	2.9	6.4	38.4	.6



PELLET GROUP DATA --
Management unit 17 , Study no: 25

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	-	-
Rabbit	-	-	2
Elk	-	1	3
Deer	47	18	22

Days use per acre (ha)	
'02	'07
-	11 (26)
-	-
1 (2)	-
44 (109)	72 (177)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 25

		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												
83	**1066**	-	200	866	-	-	0	0	0	-	0	20/35
89	**1000**	-	-	800	200	-	100	0	20	-	7	22/26
97	**220**	-	-	180	40	80	36	55	18	18	18	26/40
02	**120**	-	-	100	20	80	100	0	17	-	0	28/46
07	**120**	-	-	120	-	120	67	0	0	-	0	31/53
Celtis reticulata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	20	-	-	-	0	0	-	-	0	-/-
Chrysothamnus nauseosus albicaulis												
83	**66**	-	-	66	-	-	0	0	0	-	0	23/30
89	**66**	-	-	66	-	-	100	0	0	-	0	20/37
97	**60**	-	-	20	40	-	0	0	67	67	67	22/30
02	**40**	-	20	-	20	20	0	0	50	50	50	18/33
07	**20**	-	-	-	20	-	0	0	100	100	100	27/38
Cowania mexicana stansburiana												
83	**332**	-	-	266	66	-	60	40	20	-	40	50/60
89	**399**	-	-	266	133	-	83	17	33	-	0	58/59
97	**800**	-	-	720	80	40	10	90	10	3	3	50/57
02	**720**	20	-	500	220	80	11	58	31	11	11	54/63
07	**640**	-	20	580	40	60	56	13	6	6	9	59/66
Gutierrezia sarothrae												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**860**	-	120	740	-	-	0	0	0	-	0	9/11
02	**140**	-	-	60	80	200	0	0	57	43	43	7/15
07	**80**	-	-	80	-	-	0	0	0	-	0	14/15

		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)
Purshia tridentata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**80**	40	20	60	-	-	25	50	-	-	0	13/8
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 17-26-07

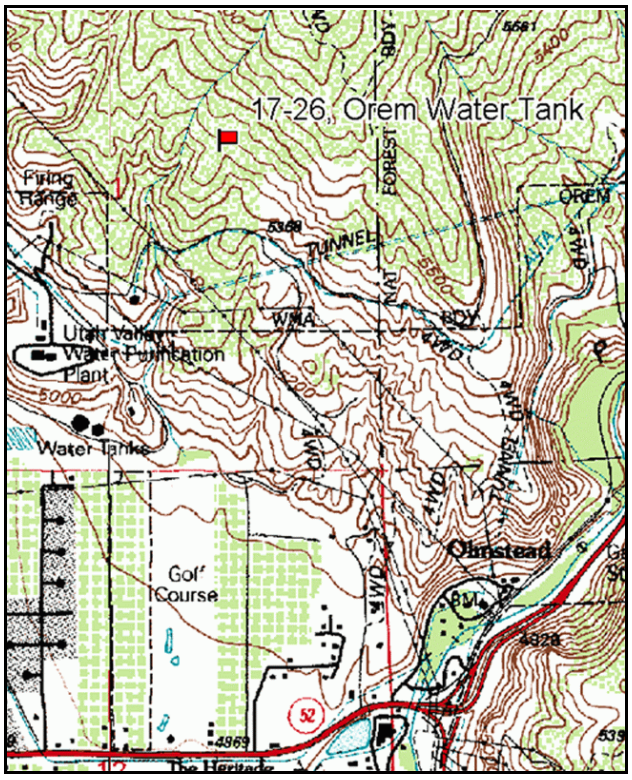
Study site name: Orem Water Tank . Vegetation type: Oak/Seeding .

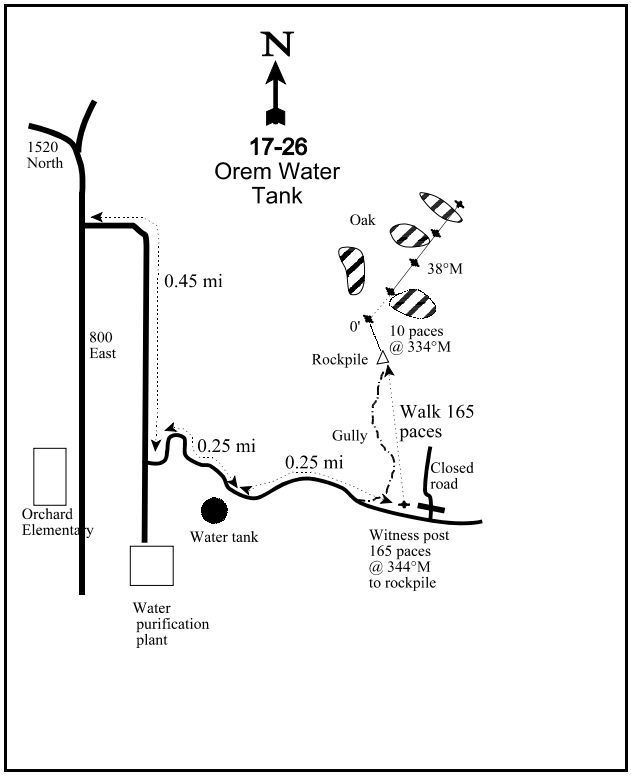
Compass bearing: frequency baseline 38 degrees magnetic.

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

LOCATION DESCRIPTION

You will need a key from Orem City to access this site. On the north side of Orem, go east up 1600 North (which turns into 1520 North) to 800 East. Just south of this intersection on 800 East, turn up the road towards the water purification plant. Go 0.45 miles, turn left and go 0.25 miles to a water tank. Continue on this road 0.25 miles and park. The old road towards the study site is closed, but a witness post should mark the junction. From there, walk about 165 paces (275 yards) to a rock pile at the head of a small drainage or gully. From the rockpile, walk north 10 paces at 334 degrees magnetic to the 0-foot baseline stake at the edge of the oakbrush. It is marked by a red browse tag #3913.





Map Name: Orem

Township 6S , Range 2E , Section 1

Diagrammatic Sketch

GPS: NAD 83, UTM 12T 443622 E 4464321 N

DISCUSSION

Orem Water Tank - Trend Study No. 17-26

Study Information

This study was established in 1983 on a burned and seeded oakbrush community immediately north of the Orem Water Treatment Plant [elevation: 5,500 feet (1,676 m), slope: 8% at base and 30% near top, aspect: south]. The nearest source of perennial water is found in the residential area 0.5 miles (0.8 km) to the southwest. In the summer of 1996, a fire burned through the area again, and consumed what browse had come back from the previous fire. Resprouting browse plants, such as Gambel oak (*Quercus gambelii*), are the exception. Deer use has been heavy in the past, but only light hedging has been noted since 1997. Deer pellet groups were frequent with some scattered elk pellet groups. Livestock are excluded to protect watershed quality. In 1983, grasshopper damage was apparent on the oak, but not enough to impact vigor. From the pellet group transect, there were 49 deer days use/acre (121 ddu/ha) in 2002 and 8 deer days use/acre (20 ddu/ha) in 2007. Elk use was estimated at 60 days use/acre (147 edu/ha) in 2002 and 88 days use/acre (217 edu/ha) in 2007. Most of the deer and elk use appeared to be from winter and spring in 2002, and winter and fall in 2007. Deer carcasses were found near the study in 2007.

Soil

This study is located within the Dry Creek soil series, which consists of very deep, well-drained, slowly permeable soils. This series formed in alluvium and colluvium from sedimentary rocks and are located on pre-Bonneville fans and lower mountainsides. The soil is classified as fine, smectitic, mesic Typic Palexerolls (USDA-NRCS 2007). Specifically at the study, the soil has a clay loam texture with a neutral soil reaction (pH of 6.7). Except in 1997, bare ground cover has been very low, and the ground is covered by an abundance of vegetation and litter. Bare ground cover was high in 1997 because of the 1996 wildfire. The erosion condition was classified as stable in 2002 and 2007.

Browse

Gambel oak has been the dominant browse species since the study was established. Oak canopy cover was 25% in 2002 and increased to 38% in 2007. The density decreased from 15,333 stems/acre (37,953 stems/ha) in 1983 to 10,560 stems/acre (26,140 stems/ha) in 1997, and increased to 19,340 stems/acre (47,870 stems/ha) by 2007. Seedling density increased from 1,400 seedlings/acre (3,465 seedlings/ha) in 1983 to 4,580 seedlings/acre (11,335 seedlings/ha) in 1997, and few seedlings have been sampled since. Of these seedlings, it is expected that the majority are the result of clonal sprouting. Recruitment has been moderate and high, young plants have comprised between 16% and 77% of the population. Decadence has been low at 0%-13%. Dead plants were first sampled in 1997 at a density of 8,280 plants/acre (20,495 plants/ha), and decreased to approximately 1,470 plants/acre (3,639 plants/ha). The proportion of plants exhibiting poor vigor has been low at 0%-7%. Browse use was moderate in 1983, and has been light in subsequent years.

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) had a low density of only 333 plants/acre (825 plants/ha) in 1989. All sagebrush plants were consumed by the 1996 fire, and none have been sampled since. Fourwing saltbush (*Atriplex canescens*) was seeded, but not sampled in the density strips in any reading.

Herbaceous Understory

Collectively, perennial and annual grasses have comprised an average 31% cover since 1997; perennial grass cover has averaged 21%. Smooth brome (*Bromus inermis*) is the dominant perennial grass in the oak understory, while intermediate wheatgrass (*Agropyron intermedium*) and crested wheatgrass (*Agropyron cristatum*) are dominant in the interspaces. Annual grass cover increased from 3% in 1997 to 16% by 2007. Cheatgrass (*Bromus tectorum*) is the dominant annual species and quadrat frequency has increased from 38% in 1997 to 70% in 2007. Bulbous bluegrass (*Poa bulbosa*), a perennial with a phenology that is similar to annual grasses (Stewart and Hull 1949), is present, but has comprised less than 1% cover.

Perennial forb cover was 13% in 1997, 8% in 2002, and 6% in 2007. Alfalfa (*Medicago sativa*) has been the dominant species, and has been healthy and robust despite animal use. Other perennial forbs were seldom sampled. Dalmatian toadflax (*Linaria dalmatica*), a noxious weed, has been sampled in a small, but increasing number of quadrats since 1997.

1989 TREND ASSESSMENT

The browse trend is slightly down. The density of Gambel oak decreased 7%. There were large increases in the densities of seedlings and young plants, but there was also a large decrease in the density of mature plants. Decadence increased from 1% to 13% of the population, and plants with poor vigor increased from 0% to 7%. Browse use on oak shifted from moderate to light. In addition to the changes in the oak population, the sagebrush population was in decline. The density decreased 17%, and all of the sampled plants were classified as decadent. Plants with poor vigor comprised 60% of the sagebrush population. Browse use shifted from exclusively heavy to moderate-heavy. The grass trend is stable. The sum of nested frequency of perennial grasses increased 6%, including a significant increase in smooth brome. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 48%, but perennial forb frequency was already low. There was a significant decrease in the nested frequency of segolily (*Calochortus nuttallii*), and northern sweetvetch (*Hedysarum boreale*) was not sampled.

browse - slightly down (-1) grass - stable (0) forb - slightly down (-1)

1997 TREND ASSESSMENT

The browse trend is slightly down. The 1996 fire consumed all of the browse species. Even though Gambel oak resprouted, the sagebrush population appeared to be lost. The density of oak decreased 26%, but the resprouting plants were predominantly vigorous. Young plants comprised 77% of the population, and there were no decadent plants. As a result of the wildfire, the density of dead oak plants increased from 0 to 8,280 plants/acre (20,495 plants/ha). Browse use remained light. The grass trend is slightly down. The sum of nested frequency of perennial grasses decreased 13%. Most of the decrease was attributed to intermediate wheatgrass and smooth brome. However, there was a significant increase in crested wheatgrass. The forb trend is up. The sum of nested frequency of perennial forbs increased more than three-fold. There were significant increases in segolily and alfalfa. Dalmatian toadflax was sampled for the first time, but was only found in one quadrat. The Desirable Components Index (DCI) score was good due to the moderate browse cover, low browse decadence, high browse recruitment, and high perennial grass and forb cover.

winter range condition (DCI) - good (73) Mid-level potential scale
browse - slightly down (-1) grass - slightly down (-1) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is up. The density of oak increased 78%, and cover increased from 8% to 17%. The age class distribution shifted towards a mature stand. No seedling plants were sampled, and the young age class decreased to 16% of the population. Decadence remained stable at 0%, and the density of dead plants decreased to 1,320 plants/acre (3,267 plants/ha). Plants with poor vigor comprised less than 1% of the population. The average crown height increased from 13 inches (33 cm) to 31 inches (79 cm). Browse use on oak remained light. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency decreased 4%. In addition to bulbous bluegrass being sampled for the first time, there were significant increases in the nested frequencies of cheatgrass and Japanese brome (*Bromus japonicus*). Additionally, cheatgrass cover increased from 2% to 9%, and quadrat frequency increased from 38% to 51%. The forb trend is stable. Excluding dalmatian toadflax, the sum of nested frequency of perennial forbs increased 6%. There was a significant decrease in segolily, and a significant increase in alfalfa. Although alfalfa frequency increased, cover decreased from 12% to 8%. The DCI score remained good.

winter range condition (DCI) - good (70) Mid-level potential scale
browse - up (0) grass - stable (0) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is stable. The density of oak increased 3%, and cover increased from 17% to 23%. Young plants increased to 23% of the population. Decadence remained very low; increasing from 0% to 1%. Vigor also remained good, and browse use remained light. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 6%. There was a significant increase in the nested frequencies of cheatgrass and bulbous bluegrass. Cheatgrass cover increased from 9% to 16%, and it was sampled in 70% of the quadrats. Annual grass cover was approximately equal to perennial grass cover. The forb trend is slightly down. Excluding dalmatian toadflax, the sum of nested frequency of perennial forbs decreased 14%. There were significant increases in storksbill (*Erodium cicutarium*) and catchweed bedstraw (*Galium aparine*). The DCI score remained good.

winter range condition (DCI) - good (75) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - slightly down (-1)

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

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{a}$8	$_{a}$1	$_{b}$41	$_{ab}$18	$_{a}$17	1.68	.45	1.44
G	Agropyron intermedium	$_{a}$173	$_{a}$166	$_{a}$103	$_{a}$121	$_{a}$111	4.96	6.98	4.75
G	Bromus inermis	$_{a}$235	$_{b}$268	$_{ab}$232	$_{ab}$224	$_{a}$202	13.45	18.14	11.19
G	Bromus japonicus (a)	-	-	$_{a}$37	$_{b}$60	-	.86	1.03	-
G	Bromus tectorum (a)	-	-	$_{a}$105	$_{b}$161	$_{c}$254	2.49	9.32	16.13
G	Poa bulbosa	-	-	-	$_{a}$3	$_{b}$18	-	.18	.19
G	Poa pratensis	-	$_{a}$3	-	$_{a}$1	-	-	.00	-
G	Poa secunda	$_{a}$3	$_{a}$7	$_{a}$10	$_{a}$6	$_{a}$18	.06	.04	.22
G	Vulpia octoflora (a)	-	-	$_{a}$2	$_{a}$3	$_{a}$12	.00	.00	.21
Total for Annual Grasses		0	0	144	224	266	3.36	10.36	16.34
Total for Perennial Grasses		419	445	386	373	366	20.17	25.80	17.82
Total for Grasses		419	445	530	597	632	23.54	36.16	34.16
F	Alyssum alyssoides (a)	-	-	$_{b}$101	$_{ab}$79	$_{a}$55	.73	.46	.16
F	Astragalus sp.	-	2	-	-	-	-	-	-
F	Calochortus nuttallii	$_{b}$20	$_{a}$1	$_{b}$14	$_{a}$1	-	.04	.00	-
F	Collomia linearis (a)	-	-	-	1	-	-	.00	-
F	Comandra pallida	-	-	-	-	4	-	-	.03
F	Descurainia pinnata (a)	-	-	$_{a}$10	$_{a}$5	$_{a}$10	.02	.01	.03
F	Draba sp. (a)	-	-	-	-	7	-	-	.01
F	Epipactis gigantea	-	-	2	-	-	.00	-	-
F	Erodium cicutarium (a)	-	-	$_{ab}$28	$_{a}$16	$_{b}$34	.21	.51	1.17

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Eriogonum racemosum	$_{a}$5	$_{a}$3	$_{a}$5	-	-	.03	-	-
F	Galium aparine (a)	-	-	$_{a}$6	$_{a}$4	$_{b}$42	.04	.01	1.02
F	Hedysarum boreale	22	-	-	-	-	-	-	-
F	Holosteum umbellatum (a)	-	-	$_{a}$2	$_{b}$14	$_{b}$18	.00	.04	.04
F	Lappula occidentalis (a)	-	-	7	-	-	.02	-	-
F	Lactuca serriola	-	-	2	-	-	.18	-	-
F	Linaria dalmatica	-	-	$_{a}$3	$_{a}$4	$_{a}$13	.03	.01	.26
F	Medicago sativa	$_{a}$14	$_{a}$22	$_{b}$99	$_{c}$140	$_{bc}$110	12.19	7.60	5.55
F	Phlox longifolia	-	-	-	-	1	-	-	.00
F	Polygonum douglasii (a)	-	-	2	-	-	.00	-	-
F	Sphaeralcea coccinea	$_{a}$6	$_{a}$8	$_{a}$6	$_{a}$-	$_{a}$5	.04	.00	.03
F	Tragopogon dubius	$_{a}$1	-	$_{a}$5	-	-	.06	-	-
F	Zigadenus paniculatus	$_{a}$1	-	-	-	$_{a}$1	-	-	.03
Total for Annual Forbs		0	0	156	119	166	1.04	1.04	2.46
Total for Perennial Forbs		69	36	136	145	134	12.59	7.62	5.92
Total for Forbs		69	36	292	264	300	13.64	8.67	8.38

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

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

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Chrysothamnus nauseosus albicaulis	1	0	0	-	-	-
B	Quercus gambelii	57	59	57	7.65	16.63	23.18
Total for Browse		58	59	57	7.65	16.63	23.18

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

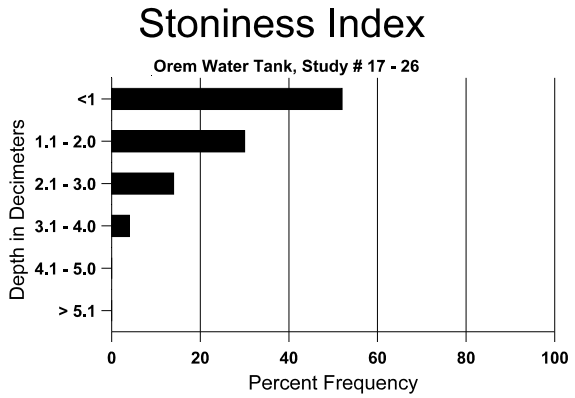
Species	Percent Cover	
	'02	'07
Quercus gambelii	24.86	38.26

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

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	1.50	3.00	42.85	59.75	65.31
Rock	.50	1.00	3.87	.69	.87
Pavement	.75	1.00	1.99	.11	.05
Litter	95.50	91.50	34.48	72.68	60.89
Cryptogams	.25	0	.00	.00	.04
Bare Ground	1.50	3.50	23.51	1.08	.48

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 26, Orem Water Tank

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.0	58.2 (14.3)	6.7	33.8	38.4	27.8	2.9	15.9	198.4	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 26

Type	Quadrat Frequency		
	'97	'02	'07
Elk	7	15	14
Deer	36	11	5

Days use per acre (ha)	
'02	'07
60 (147)	88 (217)
49 (121)	8 (20)

BROWSE CHARACTERISTICS --
Management unit 17 , 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 vaseyana												
83	**399**	66	-	133	266	-	0	100	67	-	0	31/26
89	**333**	-	-	-	333	-	40	60	100	-	60	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	-/-
Atriplex canescens												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	16/13
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	20	-	-	-	0	100	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
83	**133**	-	-	-	133	-	0	0	100	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**0**	-	-	-	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	11/17
Quercus gambelii												
83	**15333**	1400	4200	10933	200	-	92	1	1	-	0	40/15
89	**14333**	2666	9000	3533	1800	-	13	0	13	1	7	46/19
97	**10560**	4580	8160	2400	-	8280	0	0	0	-	2	13/10
02	**18820**	-	2940	15860	20	1320	6	0	0	.10	.10	31/16
07	**19340**	20	4460	14600	280	1620	6	0	1	.31	.31	40/21

Trend Study 17-30-07

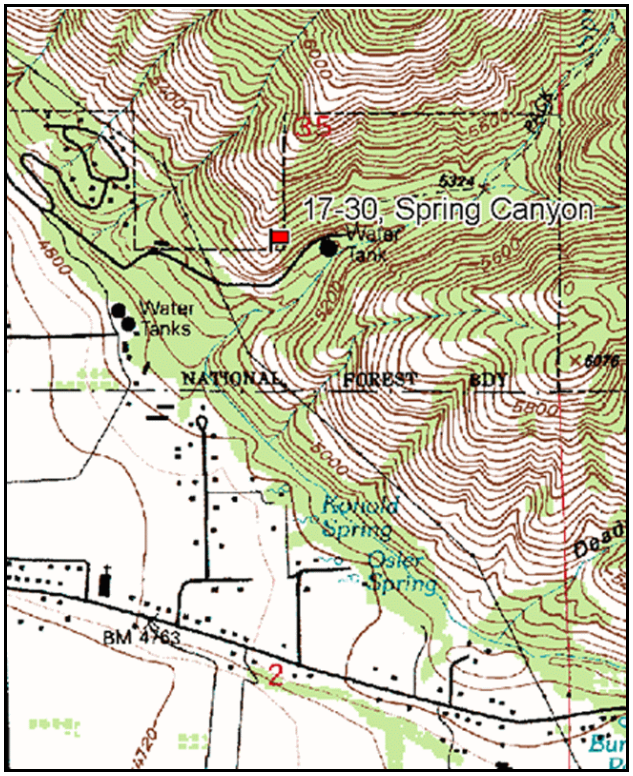
Study site name: Spring Canyon . Vegetation type: Stansbury Cliffrose .

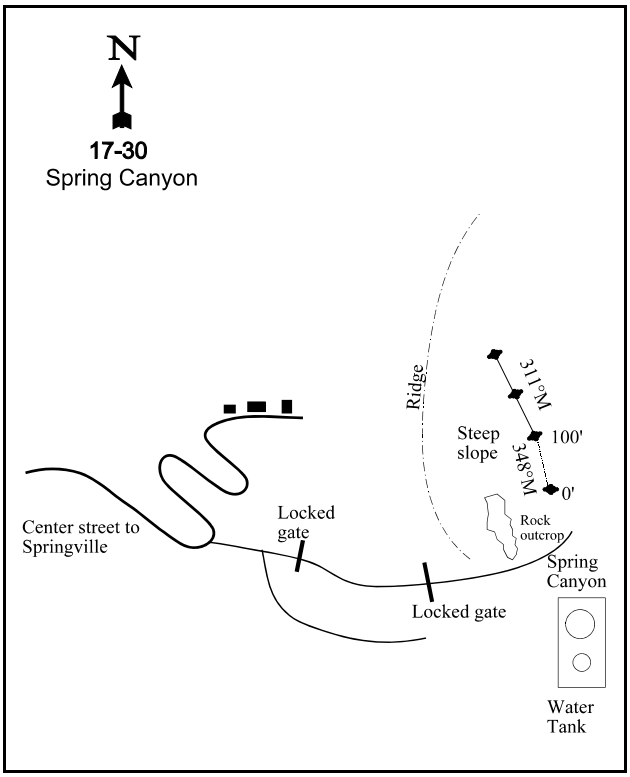
Compass bearing: frequency baseline 348 degrees magnetic (line 2-3 @ 311°M).

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

LOCATION DESCRIPTION

Follow Center Street in Springville easterly toward the mountain. From the first switchback where the main road goes up to houses on the bench north of Spring Canyon, continue towards the canyon mouth to the first gate. Continued development may alter the approach to the canyon. In 1989, you could walk 1/2 mile from the first locked gate to another gate up in the canyon. From this gate, continue 119 paces east up Spring Canyon. Uphill to the northwest (azimuth 271 degrees) there is a conspicuous group of rock outcroppings. Walk up the side hill to the uppermost rock near the top of the ridge. The 0-foot baseline stake, marked with a red browse tag #177, is north of the rock.





Map Name: Springville

Diagrammatic Sketch

Township 7S , Range 3E , Section 35

GPS: NAD 83, UTM 12T 451466 E 4446006 N

DISCUSSION

Spring Canyon - Trend Study No. 17-30

Study Information

This severe winter range study is located near the mouth of Spring Canyon [elevation 5,200 feet (1,585 m), slope: 60%-65%, aspect: south]. This is an area of critical importance, but also one which is seriously depleted. During the winter, the area is intensively used by deer and may also be used by elk. From the pellet group transect, there were 42 deer days use/acre (104 ddu/ha) in 2002 and 9 deer days use/acre (22 ddu/ha) in 2007. Elk use was estimated at 3 days use/acre (8 edu/ha) in 2002 and 60 days use/acre (147 edu/ha) in 2007. All pellet groups appeared to be from winter use.

Soil

The soil is exceptionally loose, rocky, and easily moved down the steep slope. The soil has a sandy loam texture and a neutral soil reaction (pH of 7.0). Both phosphorous and potassium levels are low at 5.9 ppm and 57.6 ppm, respectively. Levels less than 6 ppm for phosphorus and 60 ppm for potassium can limit normal plant growth and development (Tiedemann and Lopez 2004). No soil profile or horizon development was detectable. Surface rock is variable in size and appears to be limestone. The soil erosion condition was classified as slight in 2002 and 2007 due to moderate levels of surface litter movement, flow patterns, and rills.

Browse

The dominant browse species is Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*). Canopy cover of cliffrose increased from less than 1% in 2002 to 6% in 2007. The density of cliffrose was estimated at 266 plants/acre (658 plants/ha) in 1983 and increased to 365 plants/acre (903 plants/ha) in 1989. In 1997, the density had decreased to 180 plants/acre (445 plants/ha), and increased to 380 plants/acre (940 plants/ha) by 2007. Because there were no dead plants sampled in 1997, the decrease in density between 1989 and 1997 was attributed to the larger area sampled. The population has consisted largely of mature plants all sample years. Seedlings were sampled at low densities in 1989 and 1997. The young age class has comprised between 0% and 18% of the population. Less than 10% of the population was classified as decadent, except in 1997 (22%) and 2007 (21%). With the exception of 1983, when 63% of the plants exhibited poor vigor, the population has had good vigor. Annual leader growth averaged 0.8 inches (2.1 cm) in 2002 and 1.1 inches (2.8 cm) in 2007. Browse use has ranged from moderate-heavy to heavy.

Though not a preferred species, broom snakeweed (*Gutierrezia sarothrae*) has the highest density of the browse species. The density has ranged from 580 plants/acre (1,435 plants/ha) to 2,760 plants/acre (6,830 plants/ha). The fluctuations in density have been attributed to changes in precipitation (Utah Climate Summaries 2007). A short distance up the canyon, there are a few patches of Gambel oak (*Quercus gambelii*), netleaf hackberry (*Celtis reticulata*), and Rocky Mountain smooth sumac (*Rhus glabra*).

Herbaceous Understory

Grasses are the dominant component of the vegetation cover. Since 1997, grass cover has averaged 36%. However, species diversity of perennial grasses is low. Bulbous bluegrass (*Poa bulbosa*) is the most abundant grass, comprising an average 23% cover since 1997. Bulbous bluegrass has a phenology similar to annual grasses (Stewart and Hull 1949) and may be limiting the establishment of other species. Bluebunch wheatgrass (*Agropyron spicatum*) is also present and has averaged 6% of the total ground cover since 1997. Cheatgrass (*Bromus tectorum*) cover has steadily increased from 3% in 1997 to 14% by 2007. In 2007, cheatgrass cover was similar to bulbous bluegrass cover, and both species have been sampled in over 90% of the quadrats since 1997.

The forbs present in the understory have a low forage value. Forb cover averaged 3% in 1997 and 2002, and increased to 7% in 2007. Much of the increase was attributed to storksbill (*Erodium cicutarium*) and pale

alyssum (*Alyssum alyssoides*). Otherwise, the dominant perennial forbs include cudweed sagewort (*Artemisia ludoviciana*) and shortstem wild buckwheat (*Eriogonum brevicaule*).

1989 TREND ASSESSMENT

The browse trend is up. The density of cliffrose increased 37%. Seedlings were sampled for the first time, though still at a low density. Young plants increased from 12% to 18% of the population. Although decadence increased from 0% to 9%, plants with poor vigor decreased from 63% to 0% of the population. The average crown width decreased 17 inches (43 cm). Browse use on cliffrose shifted from moderate-heavy to heavy. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 38%. There was a significant decrease in the nested frequency of bluebunch wheatgrass. The forb trend is down. The sum of nested frequency of perennial forbs decreased 21%. Species composition remained low.

browse - up (+2) grass - down (-2) forb - down (-2)

1997 TREND ASSESSMENT

The browse trend is stable. The density of cliffrose decreased 51%. However, this decrease was attributed to the larger area sampled, and trend was determined from other parameters. For example, even though the density of seedlings increased more than two-fold, there were no young plants sampled. Additionally, decadence increased from 9% to 22% of the population. No plants had poor vigor, but browse use was exclusively heavy. The average height and crown measurements increased 21 inches (53 cm) and 19 inches (48 cm), respectively. The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 73%. There was a significant increase in bluebunch wheatgrass nested frequency, and quadrat frequency increased from 45% to 68%. There was also a significant increase in the nested frequency of bulbous bluegrass. The forb trend is stable. The sum of nested frequency of perennial forbs increased 4%, and the number of perennial forb species that were sampled increased from four to nine. The Desirable Components Index (DCI) score was very poor due to the low preferred browse cover, low perennial grass cover (excluding bulbous bluegrass), and low perennial forb cover.

winter range condition (DCI) - very poor (17) Mid-level potential scale
browse - stable (0) grass - up (+2) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is up. The density of cliffrose increased 33%. No seedlings were sampled, but young plants increased to 8% of the population. Decadence decreased to 8% of the population. No plants were classified as having poor vigor or dying. The proportion of plants with heavy browse use decreased from 100% to 58% of the population. The grass trend is slightly down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 11%. There was no significant decrease of any one species. The forb trend is stable. The sum of nested frequency of perennial forbs did not change. There was a significant increase in the nested frequency of storksbill, and a significant decrease in that of pale alyssum. The DCI score remained very poor.

winter range condition (DCI) - very poor (19) Mid-level potential scale
browse - up (+2) grass - slightly down (-1) forb - stable (0)

2007 TREND ASSESSMENT

The browse trend is up. The density of cliffrose increased 58%, and most of the increase was attributed to the mature age class. However, there were no seedling or young plants sampled. Decadence increased to 21% of the population, and the density of dead plants increased from 0 to 20 plants/acre (50 plants/ha). Plants with poor vigor comprised 11% of the population, and 5% of the population was classified as dying. Heavy browse use increased to 89% of the sampled plants. The grass trend is stable. Excluding bulbous bluegrass, the sum

of nested frequency of perennial grasses did not change. There was a significant increase in the nested frequency of cheatgrass, and a significant decrease in that of bulbous bluegrass. Cheatgrass cover increased from 6% to 14%, and bulbous bluegrass cover decreased from 27% to 17%. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased 13%, and the number of perennial species that were sampled increased from seven to 12. There were significant increases in the nested frequencies of pale alyssum and storksbill. The DCI score remained very poor.

winter range condition (DCI) - very poor (16) Mid-level potential scale
browse - up (+2) grass - stable (0) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 30

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{b}$157	$_{a}$97	$_{b}$162	$_{b}$148	$_{b}$139	3.85	5.75	5.75
G	Aristida purpurea	-	-	-	-	2	-	-	.15
G	Bromus tectorum (a)	-	-	$_{a}$288	$_{a}$295	$_{b}$344	3.47	6.02	14.17
G	Poa bulbosa	$_{a}$294	$_{ab}$320	$_{c}$348	$_{c}$345	$_{b}$314	24.68	26.57	17.18
G	Poa secunda	-	-	$_{a}$6	$_{a}$1	$_{a}$8	.18	.00	.19
Total for Annual Grasses		0	0	288	295	344	3.47	6.02	14.17
Total for Perennial Grasses		451	417	516	494	463	28.73	32.32	23.28
Total for Grasses		451	417	804	789	807	32.20	38.35	37.46
F	Alyssum alyssoides (a)	-	-	$_{b}$53	$_{a}$17	$_{c}$131	.14	.04	.53
F	Ambrosia psilostachya	-	-	-	-	17	-	-	.40
F	Amsinckia tessellata	-	-	-	-	2	-	-	.01
F	Artemisia ludoviciana	$_{a}$39	$_{a}$28	$_{a}$27	$_{a}$29	$_{a}$35	.28	.39	1.12
F	Aster sp.	-	-	-	3	-	-	.03	-
F	Astragalus utahensis	-	-	$_{a}$6	$_{a}$2	$_{a}$4	.06	.03	.01
F	Cirsium undulatum	$_{a}$8	$_{a}$15	$_{a}$16	-	$_{a}$4	.59	-	.05
F	Cryptantha sp.	-	-	-	$_{a}$3	$_{a}$1	-	.00	.01
F	Descurainia pinnata (a)	-	-	-	-	8	-	-	.01
F	Epilobium brachycarpum (a)	-	-	-	-	4	-	-	.03
F	Eriogonum brevicaule	$_{b}$89	$_{ab}$64	$_{ab}$52	$_{ab}$72	$_{a}$36	1.88	2.33	2.31
F	Erodium cicutarium (a)	-	-	$_{a}$4	$_{b}$30	$_{c}$88	.01	.17	2.35
F	Erigeron pumilus	-	-	-	-	-	-	-	.00
F	Eriogonum racemosum	-	-	-	1	-	-	.03	-
F	Galium aparine (a)	-	-	-	-	-	-	-	.03
F	Gilia sp. (a)	-	-	-	14	-	-	.03	-
F	Heterotheca villosa	-	-	$_{a}$2	$_{a}$-	$_{a}$6	.03	.00	.04
F	Lappula occidentalis (a)	-	-	-	$_{b}$17	$_{a}$2	-	.04	.03
F	Lactuca serriola	-	-	-	-	7	-	-	.02

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Lomatium sp.	-	-	2	-	-	.00	-	-
F	Machaeranthera canescens	-	$_a$1	$_a$3	-	-	.04	-	-
F	Oenothera caespitosa	-	-	-	-	-	-	-	.00
F	Penstemon sp.	-	-	$_a$3	-	$_a$1	.03	-	.15
F	Phlox longifolia	-	-	-	-	6	-	-	.01
F	Sisymbrium altissimum (a)	-	-	-	-	4	-	-	.01
F	Tragopogon dubius	$_a$1	-	$_a$1	$_a$2	$_a$8	.03	.00	.04
Total for Annual Forbs		0	0	57	78	237	0.15	0.29	3.00
Total for Perennial Forbs		137	108	112	112	127	2.97	2.83	4.19
Total for Forbs		137	108	169	190	364	3.12	3.13	7.20

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

BROWSE TRENDS --
Management unit 17 , Study no: 30

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Celtis reticulata	0	0	0	.03	.53	.41
B	Chrysothamnus nauseosus albicaulis	1	1	0	.00	.38	-
B	Cowania mexicana stansburiana	9	10	17	2.66	3.34	3.57
B	Gutierrezia sarothrae	48	22	26	1.89	.09	.19
B	Purshia tridentata	0	4	1	-	.03	-
B	Quercus gambelii	1	1	1	1.03	1.23	.79
Total for Browse		59	38	45	5.63	5.61	4.97

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 30

Species	Percent Cover	
	'02	'07
Celtis reticulata	-	.26
Cowania mexicana stansburiana	.25	6.40
Gutierrezia sarothrae	-	.80
Quercus gambelii	.20	2.50

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 30

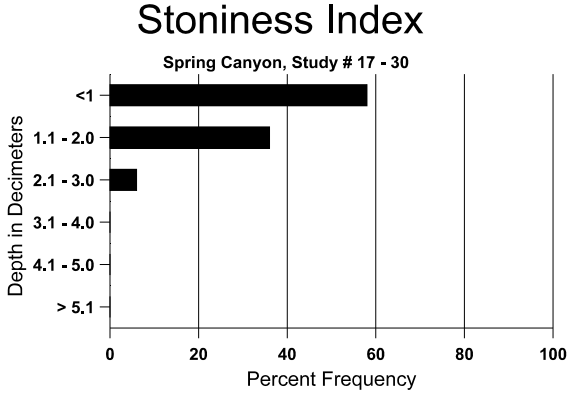
Species	Average leader growth (in)	
	'02	'07
Cowania mexicana stansburiana	0.8	1.1

BASIC COVER --
Management unit 17 , Study no: 30

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	4.50	8.25	39.04	48.04	48.13
Rock	14.00	12.50	13.13	16.63	17.46
Pavement	45.00	56.25	28.82	28.96	18.38
Litter	31.00	14.25	17.02	15.57	22.85
Cryptogams	.75	0	.43	0	.30
Bare Ground	4.75	8.75	10.95	2.64	9.08

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 30, Spring Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
10.6	55.8 (12.6)	7.0	61.8	22.4	15.8	2.0	5.87	57.6	.6



PELLET GROUP DATA --
Management unit 17 , Study no: 30

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	1	-
Elk	22	2	17
Deer	38	32	47

Days use per acre (ha)	
'02	'07
-	-
3 (8)	60 (147)
42 (104)	9 (22)

BROWSE CHARACTERISTICS --
Management unit 17 , 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)
Celtis reticulata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**33**	-	-	33	-	-	100	0	-	-	0	46/67
97	**0**	-	-	-	-	-	0	0	-	-	0	24/104
02	**0**	-	-	-	-	-	0	0	-	-	0	26/103
07	**0**	-	-	-	-	-	0	0	-	-	0	42/96
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	0	100	0	-	0	17/41
02	**20**	-	-	-	20	-	100	0	100	100	100	13/31
07	**0**	-	-	-	-	-	0	0	0	-	0	28/30
Cowania mexicana stansburiana												
83	**266**	-	33	233	-	-	38	63	0	-	63	52/81
89	**365**	33	66	266	33	-	18	82	9	-	0	55/64
97	**180**	80	-	140	40	-	0	100	22	-	0	76/83
02	**240**	-	20	200	20	-	8	58	8	-	0	65/87
07	**380**	-	-	300	80	20	0	89	21	5	11	61/75
Gutierrezia sarothrae												
83	**899**	-	533	366	-	-	0	0	0	-	0	11/14
89	**866**	-	100	633	133	-	0	0	15	4	15	6/5
97	**2760**	300	800	1960	-	20	0	0	0	-	0	8/11
02	**580**	20	160	240	180	520	3	0	31	3	10	5/7
07	**1140**	-	140	980	20	20	2	4	2	2	2	8/11
Purshia tridentata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**100**	-	20	80	-	-	40	60	-	-	0	38/9
07	**20**	-	-	20	-	-	0	100	-	-	0	6/11

		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)
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	94/114
02	**60**	20	-	60	-	-	0	0	-	-	0	65/76
07	**40**	140	-	40	-	-	0	0	-	-	0	119/148

Trend Study 17-31-07

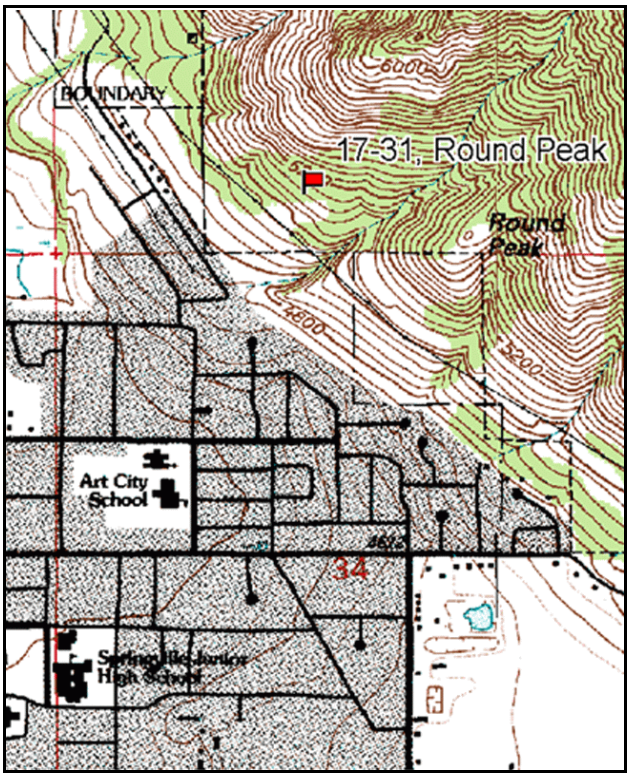
Study site name: Round Peak Vegetation type: Smooth Sumac .

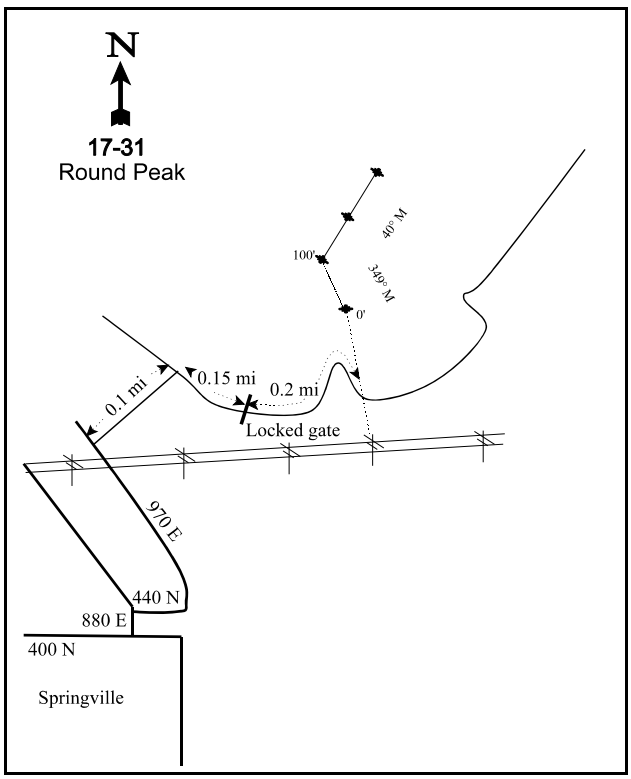
Compass bearing: frequency baseline 349 degrees magnetic (line 2-3 @ 40°M).

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

LOCATION DESCRIPTION

From the town of Springville, take 440 North and 970 East to an intersection at the end of the paved road. Turn right and proceed 0.1 miles to an intersection. Turn right and go southeast along the foothills for 0.15 miles to a locked gate. Walk 0.2 miles along the road and stop even with 2 power poles which are 50 yards south of the road. From the power poles, the 0-foot baseline stake is 95 paces north (343 degrees) marked with browse tag #419.





Map Name: Springville Diagrammatic Sketch

Township 75 , Range 3E , Section 27 GPS: NAD 83, UTM 12T 449748 E 4447396 N

DISCUSSION

Round Peak - Trend Study No. 17-31

Study Information

This severe winter range study is located in the Uinta National Forest to the east of Springville [elevation: 5,100 feet (1,555 m), slope: 25-45%, aspect: southwest]. The nearest source of perennial water is the Spring Creek wetland 0.8 miles (1.2 km) to the northwest. Like the Spring Canyon study (17-30), this site is typical of the depleted foothills north of Hobble Creek. Vegetative composition consists of grasses, annual forbs, and isolated patches of shrubs. In the summer of 1989, several fawn carcasses were found, most likely winter-killed from the deep snows of the 1988-89 winter. In 2007, a deer skeleton was found on the baseline, and there were several game trails traversing the study. Deer pellet quadrat frequency has been 11%-20% since 1997, while that for elk has been 8%-24%. From the pellet group transect, there were an estimated 44 deer days use/acre (107 ddu/ha) in 2002 and 74 deer days use/acre (184 ddu/ha) in 2007. Elk use was estimated at 9 days use/acre (23 edu/ha) in 2002 and 36 days use/acre (89 edu/ha) in 2007. All but one of the pellet groups appeared to be from winter use, and the exception was from the summer of 2007.

Soil

The soil has a clay loam texture and a neutral soil reaction (pH of 7.2). Bare ground cover has been low in all sample years, and has ranged from 1% to 3% of the total ground cover. The soil layer is thin, and there is an abundance of rock in the profile. Rock cover is relatively high, and has averaged 20% of the relative ground cover since 1997. A talus slide occupies the northern one-third of the study, and is composed of rocks too large to be transported by runoff. However, erosion and soil compaction are evident on the many trails interconnecting the area. The erosion condition was classified as stable in 2002 and 2007.

Browse

Browse cover is low and has averaged 6% since 1997. Browse use has been highest on Rocky Mountain smooth sumac (*Rhus glabra* ssp. *cismontana*), which is an increaser/invader plant. Sumac canopy cover was 6% in 2007. Sumac density increased from 1,433 stems/acre (3,547 stems/ha) in 1983 to 2,299 stems/acre (5,890 stems/ha) in 1989. The density was estimated at approximately 1,120 stems/acre (2,772 stems/ha) in 1997 and 2002, and decreased to 740 stems/acre (1,830 stems/ha) in 2007. The young age class has comprised 7%-22% of the population. Decadence increased from 0% of the population in 1983 to 24% in 1997, then decreased to 5% by 2007. Dead plants were first sampled in 1997, and since then, the density of dead plants has ranged from 200 stems/acre (495 stems/ha) to 300 stems/acre (743 stems/ha). Sumac vigor has been good, except in 1997 and 2002 when 4% and 11% of the population, respectively, was classified as dying. Browse use has ranged from light to heavy.

The most numerous browse species is broom snakeweed (*Gutierrezia sarothrae*). Snakeweed density has fluctuated each sample year and has ranged from 1,032 plants/acre (2,555 plants/ha) to 3,820 plants/acre (9,455 plants/ha). Changes in snakeweed density have been attributed to precipitation patterns (Utah Climate Summaries 2007). Other shrubs found on the site include netleaf hackberry (*Celtis reticulata*), skunkbush sumac (*Rhus trilobata*), and Gambel oak (*Quercus gambelii*).

Herbaceous Understory

The herbaceous understory is dominated by perennial grasses. Perennial grasses provided 24% cover in 1997, 30% in 2002, and 20% in 2007. The two perennial grass species present are bulbous bluegrass (*Poa bulbosa*) and bluebunch wheatgrass (*Agropyron spicatum*). Bulbous bluegrass has accounted for slightly more cover than bluebunch wheatgrass since 1997. Additionally, bulbous bluegrass has a phenology similar to that of annual grasses (Stewart and Hull 1949), and may be limiting the establishment of other species. Annual grasses are present and include wildoat (*Avena fatua*), cheatgrass (*Bromus tectorum*), rattlesnake brome (*Bromus brizaeformis*), and Japanese brome (*Bromus japonicus*). Since 1997, annual grass cover has averaged

2%. Cheatgrass quadrat frequency has increased from 44% in 1997 to 76% in 2007.

Perennial forbs provided 8% cover in 1997, 5% in 2002, and 6% in 2007. Most of the species present have low forage value, and perennial forbs are more abundant than annual forbs. The dominant perennial forbs include western ragweed (*Ambrosia psilostachya*), cudweed sagewort (*Artemisia ludoviciana*), and Bonneville pea (*Lathyrus brachycalyx*). Storksbill (*Erodium cicutarium*) and pale alyssum (*Alyssum alyssoides*) are the most abundant annual species.

1989 TREND ASSESSMENT

The browse trend is up. The density of sumac increased 60%, and much of the increase was attributed to the young and mature age classes. Young stems increased from 7% to 22% of the population. Decadence increased from 0% to 6%. There continued to be no sumac plants that were classified as having poor vigor. Browse use shifted from heavy to light-moderate. The grass trend is stable. The nested frequency of bluebunch wheatgrass increased 4%. Although the frequency of bulbous bluegrass appears to have been 0 in 1983, it was assumed from the stable frequencies of bluegrass in subsequent years that bulbous bluegrass was present, but was not recorded in 1983. This is more likely than having such an abundant population become established so quickly. The forb trend is up. The sum of nested frequency of perennial forbs increased 44%, and most of the increase was attributed to narrowleaf gromwell (*Lithospermum incisum*).

browse - up (+2) grass - stable (0) forb - up (+2)

1997 TREND ASSESSMENT

The browse trend is down. The density sumac decreased 52%, but most of this decrease was the result of the increased sample area. Young stems decreased to 15% of the population. Decadence increased to 24%, and the density of dead stems increased from 0 to 200 stems/acre (495 stems/ha). The proportion of stems exhibiting poor vigor increased to 4%, all of which were classified as dying. Additionally, the average crown height decreased 17 inches (43 cm). Browse use on sumac shifted to moderate-heavy. The grass trend is slightly up. The nested frequency of bluebunch wheatgrass increased 11%, and the nested frequency of bulbous bluegrass decreased 16%. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased 19%, and the number of perennial species present increased from seven to 12. However, most of the increase in frequency and species richness are from species with poor forage value. The Desirable Components Index (DCI) score was

winter range condition (DCI) - very poor (35) Mid-level potential scale
browse - down (-2) grass - slightly up (+1) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is stable. The density of sumac increased 4%. Young stems comprised 16% of the population, and decadence decreased to 19%. The density of dead sumac increased to 300 stems/acre (743 stems/ha). Dying stems increased to 11% of the population. Additionally, the average crown height decreased 18 inches (46 cm). Forty-five percent of the population showed light use, while 44% displayed heavy use. The grass trend is down. The nested frequency of bluebunch wheatgrass decreased 26%, and the nested frequency of bulbous bluegrass increased 20%. The forb trend is slightly down. The sum of nested frequency of perennial forb species decreased 58%. The majority of the decrease was attributed to western ragweed and wavyleaf thistle (*Cirsium undulatum*), both of which have poor forage value. The DCI score improved slightly to very poor-poor due to an increase in bluebunch wheatgrass.

winter range condition (DCI) - very poor-poor (35) Mid-level potential scale
browse - stable (0) grass - down (-2) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is down. The density of sumac decreased 35%, and most of the decrease was from the mature age class. Young stems comprised 22% of the population, and decadence decreased to 5% of the population. The density of dead stems decreased to 240 stems/acre (595 stems/ha). No stems were classified with poor vigor. The average crown height and width increased 14 inches (36 cm) and 19 inches (48 cm), respectively. Browse use on sumac shifted to light. The grass trend is slightly down. Although there was a 28% decrease in the nested frequency of bulbous bluegrass, the nested frequency of bluebunch wheatgrass decreased 15%, and cheatgrass increased significantly in nested frequency. Bluebunch wheatgrass had low vigor. Cheatgrass quadrat frequency increased from 47% to 76%. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased more than two-fold. There were significant increases in the nested frequencies of western ragweed, Beckwith milkvetch (*Astragalus beckwithii*), and narrowleaf gromwell. As mentioned above, two of these species have poor forage values. Yellow salsify (*Tragopogon dubius*) plants had been heavily grazed. The DCI score decreased slightly to very poor due to a decrease in bluebunch wheatgrass cover, and an increase in annual grass cover.

winter range condition (DCI) - very poor (27) Mid-level potential scale
browse - down (-2) grass - slightly down (-1) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 31

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{b}$214	$_{b}$223	$_{b}$247	$_{a}$184	$_{a}$156	11.68	12.51	8.71
G	Avena fatua (a)	-	$_{b}$119	-	$_{ab}$139	$_{a}$75	-	.85	.69
G	Bromus brizaeformis (a)	-	$_{a}$1	$_{b}$23	-	$_{a}$-	.12	-	.00
G	Bromus japonicus (a)	-	-	$_{a}$21	$_{a}$9	$_{a}$6	.09	.02	.01
G	Bromus tectorum (a)	-	-	$_{a}$121	$_{a}$128	$_{b}$221	.59	.76	3.70
G	Poa bulbosa	-	$_{b}$304	$_{ab}$257	$_{ab}$307	$_{a}$220	12.75	17.63	10.84
Total for Annual Grasses		0	120	165	276	302	0.80	1.63	4.40
Total for Perennial Grasses		214	527	504	491	376	24.43	30.15	19.54
Total for Grasses		214	647	669	767	678	25.23	31.78	23.95
F	Alyssum alyssoides (a)	-	-	$_{b}$132	$_{a}$28	$_{b}$118	.35	.06	.46
F	Allium sp.	-	-	$_{a}$4	$_{a}$1	-	.00	.00	-
F	Ambrosia psilostachya	-	-	$_{c}$126	$_{a}$2	$_{b}$104	2.98	.06	3.37
F	Artemisia ludoviciana	$_{c}$54	$_{bc}$36	$_{ab}$20	$_{a}$17	$_{abc}$36	.15	.15	.50
F	Astragalus beckwithii	-	-	$_{a}$2	$_{a}$2	$_{b}$35	.15	.38	.68
F	Aster sp.	-	-	$_{a}$3	$_{a}$4	-	.38	.01	-
F	Calochortus nuttallii	-	-	-	1	-	-	.00	-
F	Cirsium undulatum	$_{a}$1	$_{ab}$11	$_{b}$28	$_{a}$5	-	.58	.04	-
F	Cryptantha nana	$_{a}$1	-	-	-	$_{a}$6	-	-	.15
F	Cruciferae	-	10	-	-	-	-	-	-
F	Cymopterus sp.	-	-	$_{b}$17	$_{a}$6	$_{a}$2	.49	.33	.00

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Draba sp. (a)	-	-	-	-	1	-	-	.00
F	Epilobium brachycarpum (a)	-	-	$_{b}$5	-	$_{a}$2	.01	-	.03
F	Erodium cicutarium (a)	-	-	$_{a}$13	$_{b}$56	$_{b}$63	.05	.41	.41
F	Erigeron divergens	$_{a}$1	-	$_{a}$-	-	$_{a}$2	.00	-	.03
F	Eriogonum racemosum	-	-	-	3	-	-	.01	-
F	Galium aparine (a)	-	-	$_{b}$37	$_{a}$15	$_{a}$14	.18	.04	.13
F	Grindelia squarrosa	-	-	-	14	-	-	.25	-
F	Helianthus annuus (a)	-	$_{b}$19	$_{a}$3	-	-	.01	-	-
F	Heterotheca villosa	-	-	-	-	3	-	-	.03
F	Holosteum umbellatum (a)	-	-	$_{a}$32	$_{a}$26	-	.07	.05	-
F	Lathyrus brachycalyx	$_{ab}$54	$_{b}$62	$_{b}$57	$_{b}$54	$_{a}$22	3.20	3.63	.31
F	Lappula occidentalis (a)	-	-	$_{a}$1	$_{b}$25	-	.00	.05	-
F	Lithospermum incisum	$_{ab}$18	$_{c}$105	$_{ab}$8	$_{a}$6	$_{b}$29	.22	.01	.17
F	Lithospermum ruderale	$_{ab}$5	$_{b}$16	$_{a}$10	-	$_{ab}$7	.01	-	.93
F	Macheranthera commixta	3	-	-	-	-	-	-	-
F	Phlox longifolia	$_{a}$4	$_{a}$5	$_{a}$11	$_{a}$2	$_{a}$8	.02	.06	.02
F	Taraxacum officinale	-	-	-	2	-	-	.00	-
F	Tragopogon dubius	$_{b}$29	-	$_{a}$5	$_{a}$3	$_{ab}$18	.04	.01	.19
Total for Annual Forbs		0	19	223	150	198	0.68	0.63	1.05
Total for Perennial Forbs		170	245	291	122	272	8.25	4.98	6.42
Total for Forbs		170	264	514	272	470	8.94	5.61	7.47

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

BROWSE TRENDS --
Management unit 17 , Study no: 31

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Celtis reticulata	3	2	6	1.88	2.36	3.40
B	Gutierrezia sarothrae	31	24	41	1.57	1.61	.75
B	Rhus glabra cismontana	35	30	24	2.25	1.10	2.33
B	Rhus trilobata	0	0	1	-	-	-
Total for Browse		69	56	72	5.71	5.08	6.48

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 31

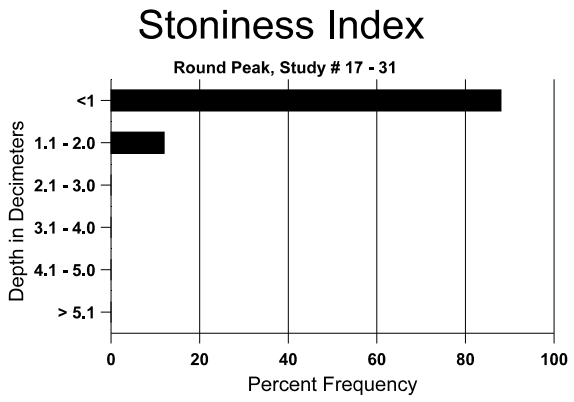
Species	Percent Cover	
	'02	'07
Celtis reticulata	-	6.58
Gutierrezia sarothrae	-	.78
Rhus glabra cismontana	-	6.06

BASIC COVER --
Management unit 17 , Study no: 31

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	.75	9.00	39.23	46.85	43.36
Rock	30.25	26.50	22.02	22.23	20.86
Pavement	22.00	24.50	12.78	14.84	16.57
Litter	44.00	37.50	29.04	24.94	29.02
Cryptogams	.50	0	.37	.02	.00
Bare Ground	2.50	2.50	3.45	.62	3.30

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 31, Round Peak

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
17.1	53.8 (17.7)	7.3	36.9	38.4	24.7	2.0	14.2	256.0	1.0



PELLET GROUP DATA --
Management unit 17 , Study no: 31

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	3	-	-
Elk	22	8	24
Deer	19	20	11

Days use per acre (ha)	
'02	'07
-	-
9 (23)	36 (89)
44 (107)	74 (184)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 31

		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)
Celtis reticulata												
83	**33**	-	-	33	-	-	0	0	0	-	0	39/26
89	**33**	-	33	-	-	-	0	0	0	-	100	-/-
97	**60**	140	20	40	-	-	0	0	0	-	0	80/225
02	**40**	20	-	20	20	-	0	0	50	-	50	28/53
07	**300**	-	-	280	20	40	0	0	7	7	7	36/39
Gutierrezia sarothrae												
83	**1800**	366	1000	800	-	-	0	0	0	-	0	7/4
89	**1032**	-	166	733	133	-	0	0	13	-	19	8/10
97	**3280**	880	1340	1940	-	-	0	0	0	-	8	9/15
02	**1400**	-	20	1260	120	220	0	0	9	-	0	9/11
07	**3820**	-	180	3640	-	200	0	0	0	-	.52	8/9
Mahonia repens												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	3/4
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	20	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	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)
Rhus glabra cismontana												
83	**1433**	33	100	1333	-	-	19	79	0	-	0	50/34
89	**2299**	-	500	1666	133	-	45	16	6	-	0	66/41
97	**1100**	-	160	680	260	200	60	29	24	4	4	49/37
02	**1140**	-	180	740	220	300	11	44	19	11	11	31/23
07	**740**	20	160	540	40	240	3	11	5	-	0	45/42
Rhus trilobata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	20	0	0	-	-	0	38/73

Trend Study 17-34-07

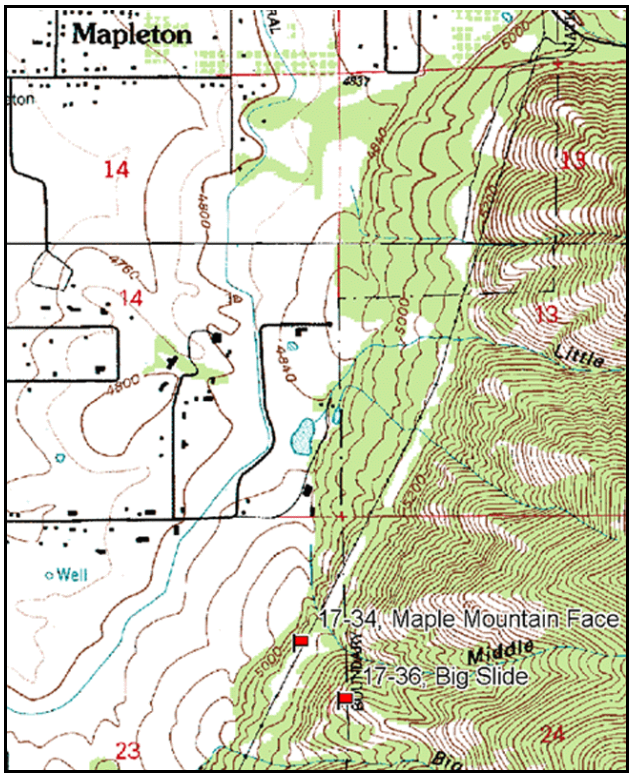
Study site name: Maple Mountain Face . Vegetation type: Big Sagebrush-Grass .

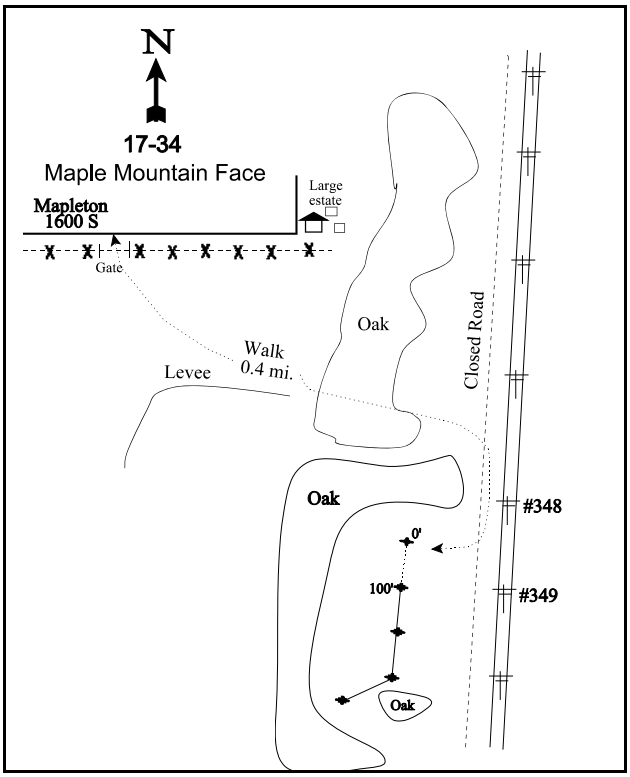
Compass bearing: frequency baseline 192 degrees magnetic.

Frequency belt placement: line 1 (11 & 95ft), line 2 (34ft), line 3 (59ft), line 4 (87ft).

LOCATION DESCRIPTION

Drive up 1600 South in Mapleton to the end of road. Park and hike east for 0.4 miles to the old road that runs parallel to power lines. A small sagebrush clearing west of the road is where the site is located. The 0-foot baseline stake is in the north end of the clearing, 33 paces from power pole #349 at an azimuth of 342 degrees magnetic. The 0-foot stake has browse tag #442 attached. The study stakes are 12-18" tall green fenceposts.





Map Name: Spanish Fork Peak

Diagrammatic Sketch

Township 8S , Range 3E , Section 23

GPS: NAD 83, UTM 12T 452132 E 4440284 N

DISCUSSION

Maple Mountain Face - Trend Study No. 17-34

Study Information

This study samples a sagebrush-grass range community. It is one of the few remaining severe winter ranges of its kind that is located on the upper lake terrace southeast of Mapleton [elevation: 5,100 feet (1,555 m), slope: 2%, aspect: northwest]. The nearest source of perennial water is a canal located 0.4 miles (0.6 km) to the west. A fire burned through the study prior to the 1997 sampling. In addition to being used by deer and elk in the winter, the study has been occasionally grazed in the spring by cattle. An old road to the north of the trail was being used as an ATV and horse trail in 2007. From the pellet group transect, there were 4 deer days use/acre (10 ddu/ha) in 2002 and 41 deer days use/acre (101 ddu/ha) in 2007. Elk use was estimated at 2 days use/acre (5 edu/ha) in 2002, which increased to 28 days use/acre (69 edu/ha) in 2007. Cattle use was estimated at 19 days use/acre (47 cdu/ha) in 2002 and 1 day use/acre (2 cdu/ha) in 2007. There were an estimated 10 horse days use/acre (24 hdu/ha) in 2007. There was also a housing development being constructed 0.5 miles (0.8 km) to the west in 2007.

Soil

This study is located within the Cleverly soil series, which consists of deep, well-drained soils that formed in alluvium. The soils are classified as coarse-loamy, mixed, superactive, mesic Typic Haploxerolls (USDA-NRCS 2007). Specifically at the study, the soil has a loam texture and a slightly acidic soil reaction (pH of 6.3). The parent material appears to be limestone. Rock, pavement, and bare ground cover are low, and collectively have averaged 9% of the relative ground cover since 1997. Vegetation cover is relatively high and has comprised an average 67% of the relative ground cover since 1997. The erosion condition was classified as stable in 2002 and 2007.

Browse

The preferred browse species that are present include mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*). Sagebrush canopy cover was 9% in 2007. The estimated sagebrush decreased from 500 plants/acre (1,238 plants/ha) in 1983 to 432 plants/acre (1,069 plants/ha) in 1989. As a result of the pre-1997 wildfire, the density decreased further to 220 plants/acre (545 plants/ha) in 1997. Since then, the density increased to 580 plants/acre (1,435 plants/ha) by 2007. Seedlings were present at moderate densities in 1997 and 2002, and a high density in 2007. The age distribution of the sagebrush population has widely fluctuated in each sample year. Young plants were only sampled in 1997 and 2007, and accounted for 100% and 24% of the population, respectively. Decadent plants accounted for 40% of the population in 1983 and increased to 85% in 1989, but decadence was low in subsequent sample years. Dead plants were only sampled in 1997, and those were plants that had died in the pre-1997 wildfire. There have been no plants with poor vigor, except in 1989 when 15% of the plants were chlorotic. The average annual leader growth was 4.0 inches (10.2 cm) in 2002 and 1.9 inches (4.9 cm) in 2007. Browse use has ranged from light to light-moderate.

Antelope bitterbrush canopy cover was 4% in 2007. Bitterbrush was not sampled prior to the 1997 wildfire. However, it is probable that bitterbrush was present but was not sampled until the baseline was extended in 1997, which increased the sample area. The presence of dead plants in the 1997 reading support this hypothesis. Since 1997, the density has been fairly stable at approximately 130 plants/acre (322 plants/ha). Young plants were only sampled in 1997 and comprised 83% of the population. There have been few or no decadent plants in any of the sample years, and no bitterbrush have exhibited poor vigor. The average annual leader growth was 4.0 inches (10.2 cm) in 2002 and 1.9 inches (4.9 cm) in 2007. Browse use on bitterbrush has been light-moderate to moderate-heavy.

Gambel oak (*Quercus gambelii*) clones surround the study site, but they do not exhibit signs of any hedging. Skunkbush sumac (*Rhus trilobata*) is present at low densities, and the few plants have exhibited moderate and heavy use. There was also some curl-leaf mountain mahogany (*Cercocarpus ledifolius*) planted after the burn but it has not been sampled in the density strips.

Herbaceous Understory

The herbaceous understory is dominated by perennial grasses and forbs. The grass component is abundant and has included between one and 10 perennial species. Cover for perennial species was 46% in 1997, 60% in 2002, and 49% in 2007. The dominant perennial grass species is bulbous bluegrass (*Poa bulbosa*). It has comprised an average 92% of the grass cover and 48% of the total ground cover since 1997. Bulbous bluegrass has a phenology similar to that of annual grasses (Stewart and Hull 1949), and may be limiting the establishment of other species. Non-dominant, but still common, perennial grasses include orchardgrass (*Dactylis glomerata*), and Sandberg bluegrass (*Poa secunda*). Annual grasses were reported to be very abundant before the wildfire. Since 1997, cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), and rattlesnake brome (*Bromus brizaeformis*) have been sampled. Annual grass cover has averaged less than 1% since 1997.

The forb component is also abundant and diverse, but has declined. Since 1997, the perennial forb cover has steadily decreased from 39% to 18%. Much of the decrease in forb cover is attributed to decreasing arrowleaf balsamroot (*Balsamorhiza sagittata*) cover, which was the dominant forb through 2002. The other dominant perennial species are spreading fleabane (*Erigeron divergens*) and curlycup gumweed (*Grindelia squarrosa*). Annual forb cover has averaged less than 1% since 1997. Field bindweed (*Convolvulus arvensis*), a noxious weed, was first sampled in 1989, but frequency and cover have remained low.

1989 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 14%. No seedling or young plants were sampled, and decadence increased from 40% to 85% of the population. Plants exhibiting poor vigor increased from 0% to 15% of the population. Additionally, the average height and crown measurements decreased 10 inches (25 cm) and 16 inches (41 cm), respectively. The grass trend is down. Bulbous bluegrass nested frequency significantly increased, and all other perennial species that had been sampled in 1983, were not sampled in 1989. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 12%, and field bindweed was sampled for the first time. Grasshopper use on forbs was abundant, and arrowleaf balsamroot had been grazed by deer.

browse - down (-2) grass - down (-2) forb - slightly down (-1)

1997 TREND ASSESSMENT

The browse trend is stable. Although the 1996 wildfire consumed the browse component, browse diversity increased as a result of the post-fire reseeding. The density of sagebrush decreased 49%, but the new population was comprised of young, vigorous plants. In addition to the young plants, there were 200 seedlings/acre (495 seedlings/ha). The average height and crown measurements of the new population were approximately equal to those of the population that was consumed in the fire. Browse use on sagebrush was exclusively light. The additional browse species that were sampled included bitterbrush, Gambel oak, and skunkbush sumac (*Rhus trilobata*). Browse use was moderate on bitterbrush, and light on the other two species. The grass trend is up. The number of perennial grass species that were sampled increased from one to four, but the cover of seeded grasses was less than 1%. There was a significant increase in the nested frequency of Sandberg bluegrass. The forb trend is up. The sum of nested frequency of perennial forbs increased more than four-fold, and the number of perennial species increased from five to 17. There were significant increases in the nested frequencies of arrowleaf balsamroot and spreading fleabane. Alfalfa (*Medicago sativa)* and small burnet (*Sanguisorba minor*) established well. The Desirable Components Index (DCI) score was very poor due to the low preferred browse cover, low perennial grass cover (excluding

bulbous bluegrass), and the presence of a noxious weed.

winter range condition (DCI) - very poor (18) Mid-level potential scale
browse - stable (0) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is slightly up. Although the density of sagebrush increased two-fold, the estimated density remained relatively low. The age class distribution shifted from young to mature plants. Decadence and poor vigor remained stable at 0%. Browse use on sagebrush remained light. The density of bitterbrush increased 17%. Like sagebrush, the bitterbrush population shifted from young to mature plants, and decadence and poor vigor remained stable at 0%. Browse use on bitterbrush shifted from moderate to moderate-heavy. The grass trend is slightly down. Although the number of perennial species increased from four to nine, the sum of nested frequency of perennial grasses decreased 19% (excluding bulbous bluegrass). There were significant decreases in the nested frequencies of orchard grass and Sandberg bluegrass. The forb trend is down. Excluding field bindweed, the sum of nested frequency of perennial forbs decreased 53%, including significant decreases of four species. There was heavy animal use on alfalfa and yellow salsify (*Tragopogon dubius*). The DCI score remained very poor.

winter range condition (DCI) - very poor (17) Mid-level potential scale
browse - slightly up (+1) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is up. The density of sagebrush increased 32%. There was a large increase in reproduction; the density of seedlings increased from 20 seedlings/acre (50 seedlings/ha) to 1,600 seedlings/acre (3,960 seedlings/ha). There were also 140 young plants/acre (345 plants/ha), and young plants comprised 24% of the population. Decadence increased to 3%, but there were no plants with poor vigor. The average height and crown measurements increased 10 inches (25 cm) and 25 inches (64 cm), respectively. Browse use on sagebrush remained light. The density of bitterbrush remained stable. Decadence increased to 14% of the population. Although no plants were classified as having poor vigor, it was noted that the plants were producing fewer and smaller leaves than normal. The average height and crown measurements increased 20 inches (51 cm) and 32 inches (81 cm), respectively. Browse use on bitterbrush shifted from moderate-heavy to light-moderate. The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 30%. Sandberg bluegrass increased significantly in nested frequency, while bluebunch wheatgrass decreased significantly in nested frequency. Although there were significant increases in the nested frequencies of rattlesnake brome and Japanese brome, annual grasses comprised 1% of the total ground cover. The forb trend is up. Excluding field bindweed, the sum of nested frequency of perennial forbs increased 70%. There was a shift in dominance as arrowleaf balsamroot decreased n cover from 29% to 4%, and spreading fleabane and curlycup gumweed increased in cover. Yellow salsify had been heavily grazed, and grasshoppers had denuded the alfalfa plants. The DCI score increased to poor-fair due to the increase in preferred browse cover, which surpassed the 5% minimal cover threshold.

winter range condition (DCI) - poor-fair (49) Mid-level potential scale
browse - up (+2) grass - up (+2) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 34

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	-	-	-	a15	a10	-	.11	.63
G	Agropyron intermedium	-	-	a4	-	a8	.03	-	.76
G	Agropyron spicatum	-	-	-	b21	a1	-	.17	.03
G	Aristida purpurea	-	-	-	a-	b5	-	.00	.09
G	Bromus brizaeformis (a)	-	-	-	a3	b49	-	.00	.26
G	Bromus japonicus (a)	-	-	-	a12	b35	-	.05	.20
G	Bromus tectorum (a)	-	-	a83	a48	a60	.55	.15	.94
G	Dactylis glomerata	-	-	b66	a22	a21	.75	.64	1.00
G	Elymus glaucus	a2	-	-	a2	-	-	.03	-
G	Melica bulbosa	-	-	-	a17	a22	-	.11	.42
G	Poa bulbosa	a360	c395	bc372	bc387	b378	41.55	58.08	44.19
G	Poa pratensis	b61	-	-	a5	a1	-	.03	.03
G	Poa secunda	a24	-	b124	a62	b120	3.67	.78	1.52
G	Sporobolus cryptandrus	-	-	-	a13	a16	-	.21	.36
Total for Annual Grasses		0	0	83	63	144	0.55	0.21	1.40
Total for Perennial Grasses		447	395	566	544	582	46.02	60.18	49.07
Total for Grasses		447	395	649	607	726	46.56	60.39	50.47
F	Allium sp.	-	-	a1	-	a1	.00	-	.00
F	Astragalus sp.	-	-	b5	a-	-	.04	.00	-
F	Balsamorhiza sagittata	a103	a99	c248	b156	a82	34.34	28.52	4.27
F	Calochortus nuttallii	a5	-	a15	a2	a4	.03	.01	.01
F	Cirsium sp.	-	-	a3	a2	a1	.00	.00	.15
F	Convolvulus arvensis	-	a1	a3	a7	a3	.18	.09	.03
F	Collinsia parviflora (a)	-	-	3	-	-	.00	-	-
F	Cruciferae	-	-	3	-	-	.03	-	-
F	Epilobium brachycarpum (a)	-	-	a3	-	a3	.00	-	.00
F	Eriogonum brevicaule	-	-	-	1	-	-	.00	-
F	Erodium cicutarium (a)	-	-	a3	a9	b46	.00	.02	1.16
F	Erigeron divergens	a7	a1	b59	-	c119	1.50	-	8.25
F	Galium aparine (a)	-	-	a3	a4	a1	.00	.01	.03
F	Grindelia squarrosa	-	-	-	-	96	-	-	3.28
F	Helianthus annuus (a)	-	a5	-	a7	-	-	.02	-
F	Lathyrus brachycalyx	ab4	ab6	b8	a1	ab4	.09	.01	.03
F	Lactuca serriola	-	b15	ab10	a-	-	.04	.00	-
F	Linum lewisii	-	-	8	-	-	.02	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Medicago sativa	-	-	$_{a}$28	$_{a}$29	$_{a}$34	.67	.64	1.36
F	Phlox longifolia	-	-	$_{a}$9	$_{ab}$13	$_{b}$23	.04	.05	.18
F	Plantago patagonica (a)	-	-	-	-	12	-	-	.02
F	Polygonum douglasii (a)	-	-	-	4	-	-	.01	-
F	Sanguisorba minor	-	-	$_{b}$98	$_{a}$21	$_{a}$26	2.21	.48	.49
F	Sisymbrium altissimum (a)	-	-	15	-	-	.10	-	-
F	Sphaeralcea coccinea	-	-	-	-	-	-	.00	-
F	Taraxacum officinale	-	-	3	-	-	.03	-	-
F	Tragopogon dubius	$_{a}$18	-	$_{a}$4	$_{a}$12	$_{a}$12	.06	.09	.11
F	Unknown forb-perennial	1	-	-	-	-	-	-	-
F	Verbascum thapsus	-	-	1	-	-	.15	-	-
F	Zigadenus paniculatus	-	-	-	-	1	-	-	.03
Total for Annual Forbs		0	5	27	24	62	0.12	0.07	1.22
Total for Perennial Forbs		138	122	506	244	406	39.47	29.92	18.23
Total for Forbs		138	127	533	268	468	39.60	29.99	19.46

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

BROWSE TRENDS --
Management unit 17 , Study no: 34

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	6	15	23	.18	1.69	5.39
B	Gutierrezia sarothrae	0	0	2	-	-	.00
B	Purshia tridentata	6	7	7	.00	.93	1.07
B	Quercus gambelii	2	1	2	1.48	1.48	.91
B	Rhus trilobata	2	2	1	.06	.15	.00
Total for Browse		16	25	35	1.73	4.26	7.38

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 34

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	8.96
Purshia tridentata	-	3.63
Quercus gambelii	.10	1.79

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 34

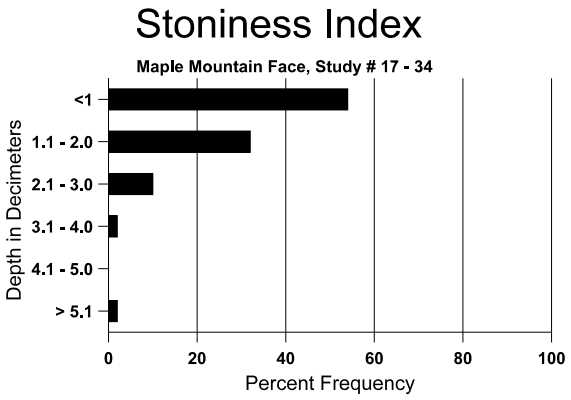
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	4.0	1.9
Purshia tridentata	4.0	1.9

BASIC COVER --
Management unit 17 , Study no: 34

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	4.00	50.75	68.12	80.30	74.11
Rock	.75	.75	1.31	.59	.46
Pavement	3.00	6.75	6.49	2.96	1.87
Litter	91.00	28.75	18.82	24.19	29.54
Cryptogams	0	0	3.25	1.59	.55
Bare Ground	1.25	13.00	9.97	2.82	3.34

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 34, Maple Mountain Face

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
27.4	51.2 (17.7)	6.3	45.8	30.4	23.8	2.2	13.6	188.8	.5



PELLET GROUP DATA --
Management unit 17 , Study no: 34

Type	Quadrat Frequency		
	'97	'02	'07
Horse	-	-	3
Elk	4	-	10
Deer	1	2	16
Cattle	9	12	-

Days use per acre (ha)	
'02	'07
-	10 (24)
2 (5)	28 (69)
4 (10)	41 (101)
19 (47)	1 (2)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 34

		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												
83	**500**	-	-	300	200	-	60	20	40	-	0	23/32
89	**432**	-	-	66	366	-	0	15	85	-	15	13/16
97	**220**	200	220	-	-	60	0	0	0	-	0	13/18
02	**440**	20	-	440	-	-	5	0	0	-	0	20/27
07	**580**	1600	140	420	20	-	0	0	3	-	0	30/52
Cercocarpus ledifolius												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	10/16
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
83	**33**	-	-	33	-	-	0	0	0	-	0	14/28
89	**166**	-	33	33	100	-	0	0	60	-	0	14/15
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**0**	-	-	-	-	-	0	0	0	-	0	13/19
07	**40**	20	20	20	-	-	0	0	0	-	0	11/14
Purshia tridentata												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**120**	-	100	20	-	60	83	0	0	-	0	10/11
02	**140**	-	-	140	-	-	57	43	0	-	0	17/38
07	**140**	-	-	120	20	-	29	29	14	-	0	37/70

		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)
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**280**	-	280	-	-	-	0	0	-	-	0	-/-
02	**360**	-	120	240	-	-	0	0	-	-	0	45/40
07	**180**	340	-	180	-	-	56	0	-	-	0	51/37
Rhus trilobata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	-	0	0	-	-	0	-/-
02	**40**	-	20	20	-	-	50	50	-	-	0	14/30
07	**20**	-	-	20	-	-	0	100	-	-	0	26/60

Trend Study 17-39-07

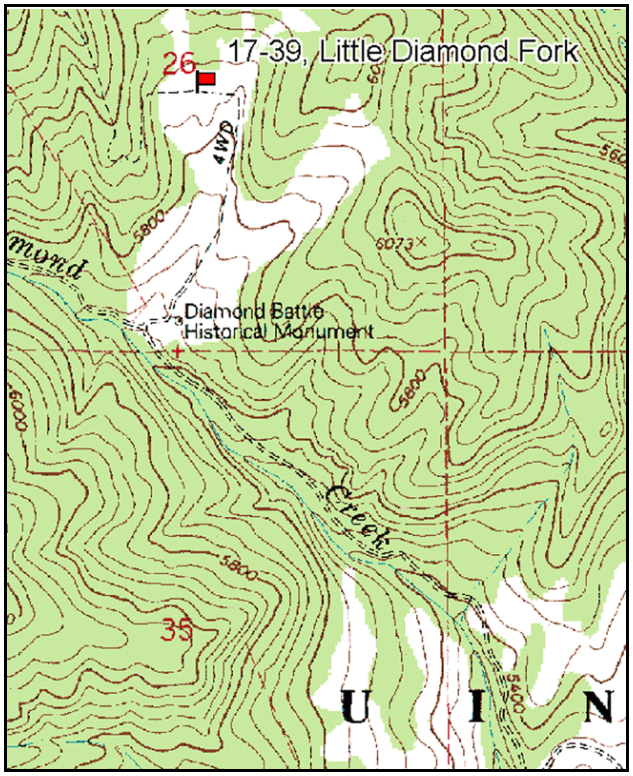
Study site name: Little Diamond Fork . Vegetation type: Big Sagebrush-Grass .

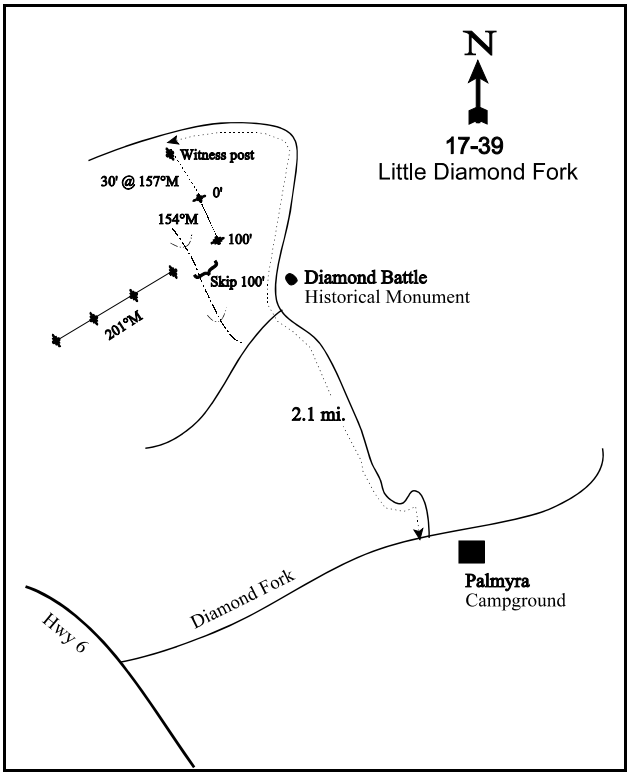
Compass bearing: frequency baseline 154 degrees magnetic (line 2-4 @ 201°M).

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

LOCATION DESCRIPTION

From the intersection of Highway 6 and Diamond Fork Canyon proceed northeasterly up Diamond Fork to Palmyra Campground. From Palmyra Campground take the road to the northwest 2.10 miles up Little Diamond Creek to a distinct sagebrush-grass plateau, and a witness post. From the witness post road, walk 30 feet at 157 degrees magnetic to the 0-foot baseline stake. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height. A red browse tag, number 3923, is attached to the 0-foot baseline stake.





Map Name: Billies Mountain

Diagrammatic Sketch

Township 9S , Range 4E , Section 26

GPS: NAD 83, UTM 12T 461515 E 4437712 N

DISCUSSION

Little Diamond Fork - Trend Study No. 17-39

Study Information

This study samples an important deer and elk winter range located approximately 0.5 miles (0.8 km) north of the Diamond Battle Historical Monument in Little Diamond Creek drainage. This was part of the Forest Service's 1,500 acre (607 ha) Lower Diamond Revegetation Project [elevation: 5,850 feet (1,785 m), slope: 5-10%, aspect: south]. The study was chained and aerially seeded with four perennial grass species in 1969. The nearest source of perennial water is Little Diamond Creek, located 0.5 miles (0.8 km) to the south. Since the study was established in 1983, the principal foragers have been cattle. The cattle grazing period has varied from early summer to early fall. Deer and elk use have been relatively lighter and occur in the fall and winter. From the pellet group transect, there were 29 deer days use/acre (73 ddu/ha) in 2002 and 15 deer days use/acre (38 ddu/ha) in 2007. Elk use was estimated at 16 days use/acre (40 edu/ha) in 2002, which decreased to 1 day use/acre (3 edu/ha) in 2007. Cattle use was estimated at 41 days use/acre (101 cdu/ha) in 2002 and 40 days use/acre (99 cdu/ha) in 2007.

Soil

The soil has a sandy clay loam texture with a moderately acidic soil reaction (pH of 5.9). Since 1997, bare ground has comprised an average of 8% of the relative ground cover. The soil surface is hard and appears to have been compacted from grazing animals. Vegetation and litter have dominated the ground cover since 1997. The relative vegetation cover has steadily increased from 55% in 1997 to 71% in 2007. For the same period, relative litter cover has decreased from 35% to 21%. An ephemeral channel runs through the middle of the valley, cutting a 10-15 foot (3-5 m) deep gully through the sagebrush flat. There is no accelerated erosion apparent. Nearby gullies have become re-vegetated. The erosion condition was classified as stable in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *tridentata*) is the dominant preferred browse species. Sagebrush canopy cover was 8% in 2002 and 13% in 2007. The density of sagebrush increased from 665 plants/acre (1,643 plants/ha) in 1983 to 1,520 plants/acre (3,756 plants/ha) in 2002, and decreased to 1,400 plants/acre (3,459 plants/ha) in 2007. Seedling plants were not sampled prior to 1997, and since then the density has ranged from 20 seedlings/acre (50 seedlings/ha) in 2002 to 220 seedlings/acre (545 seedlings/ha) in 2007. Young plants have comprised 0%-15% of the population. Decadence increased from 20% of the population in 1983 to a high of 57% in 1989, then decreased to 11% by 2007. Since 1997, the density of dead plants has decreased from 660 plants/acre (1,635 plants/ha) to 180 plants/acre (445 plants/ha). The proportion of plants with poor vigor has been low, except in 1997 when 25% of the plants were classified as dying. The average annual leader growth was approximately 2.5 inches (6.4 cm) in 2002 and 2007. Browse use has varied from light to light-moderate.

Other browse species that are present include Utah serviceberry (*Amelanchier utahensis*), white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), broom snakeweed (*Gutierrezia sarothrae*), and Woods' rose (*Rosa woodsii*). Utah serviceberry and white rubber rabbitbrush are the only species with any browse use, and these species occur at a very low density.

Herbaceous Understory

The herbaceous understory is dominated by perennial grasses and forbs. Since 1997, perennial grass cover has increased from 39% to 55%. The most abundant species is bulbous bluegrass, which has comprised an average 71% of the grass cover since 1997. Bulbous bluegrass has a phenology that is similar to annual grasses (Stewart and Hull 1949), and may be limiting the establishment of other species. Three of the four species that were aerially seeded in 1969, intermediate wheatgrass (*Agropyron intermedium*), western

wheatgrass (*Agropyron smithii*), and smooth brome (*Bromus inermis*), have accounted for the majority of the remaining grass cover. The fourth seeded species, orchard grass (*Dactylis glomerata*), has never been sampled. Identification of the perennial grasses has been difficult when sampling was preceded by cattle grazing. The only annual species present is cheatgrass (*Bromus tectorum*), which was sampled for the first time in 2007 and had a quadrat frequency of 1%.

Since 1997, perennial forb cover has steadily decreased from 21% to 12%. The most abundant species have included Western aster (*Aster chilensis*), spreading fleabane (*Erigeron divergens*), and silvery lupine (*Lupinus argenteus*). Musk thistle (*Carduus nutans*) and houndstongue (*Cynoglossum officinale*), two noxious weed species, have also been sampled. Annual forb cover has been less than 1% since 1997. The composition of the forb species is indicative of the heavy cattle grazing.

1989 TREND ASSESSMENT

The browse trend is slightly up. Although the density of sagebrush increased 40%, other changes in the population countered the increase in density. For example, young plants decreased from 10% to 0%, and decadence increased from 20% to 57% of the population. Although there continued to be no plants that were classified as having poor vigor, the average crown height and crown width decreased by 8 inches (20 cm) and 16 inches (41 cm), respectively. Browse use shifted from light-moderate to light. The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 82%. The species composition appeared to have partially changed. In 1983, the only wheatgrass sampled was western wheatgrass. In 1989, intermediate wheatgrass was the only wheatgrass sampled. This change was probably the result of misidentification. There was also a significant decrease in the nested frequency of bulbous bluegrass. The forb trend is down. The sum of nested frequency of perennial forbs decreased 27%. There was a significant decrease in the nested frequency of silvery lupine, and American vetch (*Vicia americana*) quadrat frequency decreased from 23% to 0%. Additionally, houndstongue was sampled for the first time.

browse - slightly up (+1) grass - up (+2) forb - down (-2)

1997 TREND ASSESSMENT

The browse trend is slightly up. The density of sagebrush increased 28%. Some of the change in density was attributed to the larger area sampled in 1997, and trend was determined from other parameters. Seedling plants were sampled for the first time, and young plants increased to 15% of the population. The density of decadent plants remained stable, but since the overall density increased, decadence decreased to 43% of the population. The density of dead plants increased from 0 to 660 plants/acre (1,635 plants/ha), but since the density of decadent plants remained stable, it appeared that the increase in dead plants was a result of the larger sample area. Plants with poor vigor increased to 25% of the population, and all of those plants were classified as dying. Browse use on sagebrush remained light. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 35%. There were significant decreases in the nested frequencies of intermediate wheatgrass and Sandberg bluegrass, and significant increases in the nested frequencies of smooth brome and bulbous bluegrass. The forb trend is up. Excluding houndstongue, the sum of nested frequency of perennial forbs increased 88%. There were significant increases in the nested frequencies of bigflower agoseris (*Agoseris grandiflora*), spreading fleabane, silvery lupine, and yellow salsify (*Tragopogon dubius*). However, there were also significant, though smaller increases in the nested frequencies of wavyleaf thistle (*Cirsium undulatum*) and houndstongue. The Desirable Components Index (DCI) score was poor-fair due to the moderate preferred browse cover, high browse decadence, moderate browse recruitment, high perennial grass and forb cover, the absence of annual grasses, and the presence of one noxious weed species.

winter range condition (DCI) - poor-fair (48) Mid-level potential scale
browse - slightly up (+1) grass - down (-2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is up. The density of sagebrush increased 27%. There was a decrease in the density of seedlings and young plants sampled, and young plants comprised 7% of the population. Decadence decreased to 16% of the population, and the density of dead plants decreased to 400 plants/acre (990 plants/ha). The proportion of plants exhibiting poor vigor/dying decreased to 3% of the population. Browse use on sagebrush remained light. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 2%. There was a significant increase in the nested frequency of smooth brome, and a significant decrease in that of Kentucky bluegrass (*Poa pratensis*). Bulbous bluegrass continues to be the dominant grass. The forb trend is down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 37%, much of which was due to significant decreases in the nested frequencies of spreading fleabane and silvery lupine. Houndstongue was not sampled, but musk thistle was sampled in 2 quadrats. The DCI score increased to fair due to an increase in preferred browse cover, a decrease in browse decadence, and an increase in perennial grass cover.

winter range condition (DCI) - fair (62) Mid-level potential scale
browse - up (+2) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush decreased 8%. The densities of both seedling and young plants increased, and young plants comprised 13% of the population. Decadence decreased further to 11% of the population, and the density of dead plants decreased to 180 plants/acre (445 plants/ha). The proportion of plants exhibiting poor vigor increased to 6%, and all of these plants were classified as dying. Browse use remained light. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 27%. There was a significant decrease in the nested frequency of western wheatgrass, and three bluegrass species that had been sampled previously, were not this year. Bulbous bluegrass continued to dominate the understory. Additionally, cheatgrass was sampled for the first time, but only in one quadrat. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 27%, which would normally correspond to a down trend. However, no noxious weeds were sampled. There was a significant decrease in the nested frequency of bigflower agoseris. The DCI score increased to good due to an increase in browse recruitment and perennial grass cover, and the absence of noxious weeds.

winter range condition (DCI) - good (71) Mid-level potential scale
browse - stable (0) grass - down (-2) forb - slightly down (-1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 39

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron intermedium	-	$_{b}$267	$_{a}$57	$_{a}$64	$_{a}$64	2.35	4.18	3.54
G	Agropyron sp.	-	-	7	-	-	.41	-	-
G	Agropyron smithii	$_{c}$227	-	$_{b}$105	$_{b}$99	$_{a}$31	.89	1.46	1.05
G	Bromus inermis	$_{a}$3	$_{a}$13	$_{b}$89	$_{c}$127	$_{c}$151	5.55	8.04	12.58
G	Bromus tectorum (a)	-	-	-	-	2	-	-	.00
G	Poa bulbosa	$_{c}$364	$_{a}$240	$_{b}$321	$_{bc}$351	$_{c}$369	28.03	34.79	37.54
G	Poa fendleriana	$_{a}$2	$_{a}$7	$_{a}$2	$_{a}$8	-	.00	.01	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Poa pratensis	$_{b}$49	$_{ab}$25	$_{b}$58	$_{a}$15	-	.95	.22	-
G	Poa secunda	-	$_{b}$189	$_{a}$12	$_{a}$25	-	.47	.30	-
G	Stipa lettermani	-	10	-	-	-	-	-	-
Total for Annual Grasses		0	0	0	0	2	0	0	0.00
Total for Perennial Grasses		645	751	651	689	615	38.69	49.03	54.72
Total for Grasses		645	751	651	689	617	38.69	49.03	54.73
F	Agoseris grandiflora	$_{a}$8	$_{a}$3	$_{b}$23	$_{b}$22	$_{a}$3	.24	.11	.00
F	Antennaria rosea	-	4	-	-	-	-	-	-
F	Arabis sp.	-	$_{a}$1	$_{a}$3	-	$_{a}$3	.03	-	.00
F	Artemisia ludoviciana	-	-	$_{a}$3	$_{a}$8	$_{a}$9	.85	.33	.59
F	Aster chilensis	$_{a}$185	$_{a}$198	$_{a}$165	$_{a}$160	$_{a}$166	9.25	10.82	8.17
F	Astragalus convallarius	$_{a}$9	$_{a}$6	$_{a}$15	$_{b}$37	$_{ab}$21	.75	.60	.58
F	Astragalus sp.	-	-	$_{a}$1	$_{a}$2	-	.00	.03	-
F	Brodiaea douglasii	2	-	-	-	-	-	-	-
F	Carduus nutans (a)	-	-	-	5	-	-	.38	-
F	Cirsium undulatum	$_{a}$10	$_{a}$4	$_{b}$32	$_{a}$12	-	.93	.26	-
F	Collomia linearis (a)	-	-	$_{a}$10	$_{a}$13	$_{a}$9	.02	.03	.04
F	Collinsia parviflora (a)	-	-	$_{a}$15	$_{a}$5	$_{a}$5	.02	.01	.01
F	Crepis acuminata	-	-	-	$_{a}$1	$_{a}$3	-	.00	.03
F	Cynoglossum officinale	-	$_{a}$6	$_{b}$24	-	-	.27	-	-
F	Descurainia pinnata (a)	-	-	3	-	-	.00	-	-
F	Epilobium brachycarpum (a)	-	-	$_{a}$3	$_{a}$14	$_{a}$8	.01	.03	.02
F	Erodium cicutarium (a)	-	-	1	-	-	.00	-	-
F	Erigeron divergens	$_{b}$49	$_{b}$44	$_{c}$143	$_{a}$1	$_{a}$16	2.08	.03	.41
F	Eriogonum racemosum	$_{a}$7	$_{a}$4	$_{a}$3	-	-	.00	-	-
F	Eriogonum umbellatum	-	-	$_{a}$4	$_{a}$3	-	.03	.03	-
F	Galium aparine (a)	-	-	2	-	-	.00	-	-
F	Gilia sp. (a)	-	-	-	2	-	-	.00	-
F	Holosteum umbellatum (a)	-	-	-	3	-	-	.00	-
F	Lactuca serriola	-	-	$_{a}$7	$_{a}$3	$_{a}$3	.07	.00	.01
F	Lupinus argenteus	$_{b}$100	$_{a}$42	$_{b}$115	$_{a}$61	$_{a}$31	5.40	3.80	1.37
F	Medicago sativa	-	-	3	-	-	.00	-	-
F	Microsteris gracilis (a)	-	-	-	1	-	-	.00	-
F	Oenothera sp.	-	-	$_{a}$16	$_{a}$20	-	.11	.13	-
F	Polygonum douglasii (a)	-	-	$_{b}$42	$_{a}$5	-	.12	.01	-
F	Taraxacum officinale	-	-	$_{b}$27	$_{a}$8	-	.27	.05	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Tragopogon dubius	$_{ab}$62	$_{a}$41	$_{b}$78	$_{ab}$60	$_{a}$37	.71	.51	.73
F	Unknown forb-annual (a)	-	-	1	-	-	.00	-	-
F	Unknown forb-perennial	-	2	-	-	-	-	-	-
F	Verbascum thapsus	$_{a}$4	$_{a}$2	-	$_{a}$3	$_{a}$2	-	.03	.00
F	Vicia americana	$_{b}$50	-	$_{a}$18	$_{a}$23	$_{a}$12	.16	.32	.07
F	Zigadenus paniculatus	$_{a}$3	$_{a}$1	$_{a}$5	-	-	.03	-	-
Total for Annual Forbs		0	0	77	48	22	0.20	0.48	0.06
Total for Perennial Forbs		489	358	685	424	306	21.23	17.07	12.00
Total for Forbs		489	358	762	472	328	21.44	17.56	12.07

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

BROWSE TRENDS --
Management unit 17 , Study no: 39

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	0	1	1	-	-	-
B	Artemisia tridentata vaseyana	48	45	46	6.21	8.78	8.55
B	Chrysothamnus nauseosus albicaulis	1	1	1	-	.03	.15
B	Chrysothamnus viscidiflorus viscidiflorus	2	2	2	.00	-	-
B	Gutierrezia sarothrae	15	19	13	.96	.49	.71
B	Opuntia sp.	3	4	2	-	.16	.03
B	Rosa woodsii	4	4	4	.15	.44	.56
Total for Browse		73	76	69	7.33	9.90	10.00

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 39

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	-	.05
Artemisia tridentata vaseyana	8.16	13.38
Chrysothamnus nauseosus albicaulis	-	.31
Chrysothamnus viscidiflorus viscidiflorus	-	.03
Gutierrezia sarothrae	.93	.70
Opuntia sp.	.10	-
Rosa woodsii	-	.41

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 39

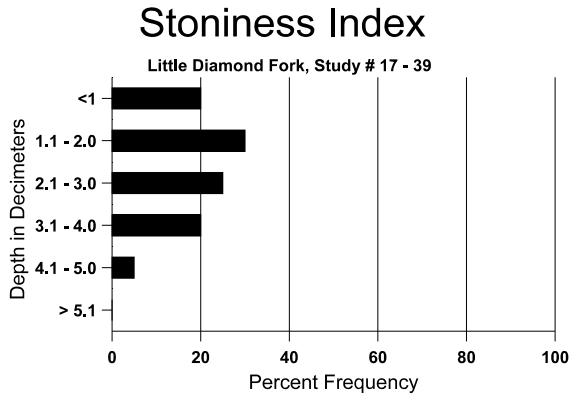
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.5	2.6

BASIC COVER --
Management unit 17 , Study no: 39

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	2.50	16.00	56.77	69.70	75.70
Rock	0	.25	.25	.50	.39
Pavement	0	.75	.84	1.20	.26
Litter	82.50	66.50	36.25	37.31	22.00
Cryptogams	.25	.25	.78	.22	.33
Bare Ground	14.75	16.25	8.65	11.30	7.35

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 39, Little Diamond Fork

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
14.8	51.0 (16.2)	5.9	55.4	24.7	19.8	2.4	25.7	579.2	.4



PELLET GROUP DATA --
Management unit 17 , Study no: 39

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	1	-
Rabbit	-	-	1
Elk	3	-	2
Deer	3	12	3
Cattle	2	14	12

Days use per acre (ha)	
'02	'07
-	-
-	-
16 (40)	1 (3)
29 (73)	15 (38)
41 (100)	40 (99)

BROWSE CHARACTERISTICS --
Management unit 17 , 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												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	22/27
02	**20**	-	-	20	-	-	100	0	-	-	0	24/23
07	**40**	-	-	40	-	-	100	0	-	-	0	24/22
Artemisia tridentata vaseyana												
83	**665**	-	66	466	133	-	60	0	20	-	0	30/41
89	**933**	-	-	400	533	-	21	0	57	-	0	22/25
97	**1200**	80	180	500	520	660	7	0	43	25	25	25/37
02	**1520**	20	100	1180	240	400	18	0	16	3	3	22/32
07	**1400**	220	180	1060	160	180	10	3	11	6	6	29/41

		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)
Chrysothamnus nauseosus albicaulis												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	100	0	-	-	0	42/59
02	**20**	-	-	20	-	-	0	100	-	-	0	26/36
07	**20**	-	-	20	-	-	0	0	-	-	0	21/33
Chrysothamnus viscidiflorus viscidiflorus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**60**	-	-	60	-	-	0	0	-	-	0	12/14
02	**60**	-	-	60	-	-	0	0	-	-	0	15/26
07	**60**	-	-	60	-	-	0	0	-	-	0	15/19
Gutierrezia sarothrae												
83	**1399**	-	1133	266	-	-	0	0	0	-	0	11/13
89	**3066**	-	133	2600	333	-	0	0	11	-	0	10/7
97	**1580**	180	500	1080	-	-	0	0	0	-	0	10/11
02	**1820**	-	-	1800	20	-	0	0	1	-	0	8/11
07	**900**	-	20	860	20	-	0	0	2	2	2	8/8
Opuntia sp.												
83	**466**	-	-	466	-	-	0	0	0	-	0	7/16
89	**600**	200	400	200	-	-	0	0	0	-	0	7/23
97	**440**	-	-	440	-	-	0	0	0	-	0	7/13
02	**300**	-	-	40	260	-	0	0	87	80	80	6/19
07	**40**	-	-	40	-	-	0	0	0	-	0	7/21
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	37/14
07	**0**	-	-	-	-	-	0	0	-	-	0	55/44
Rosa woodsii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**280**	20	260	20	-	-	0	0	-	-	0	23/21
02	**280**	-	-	280	-	-	0	0	-	-	0	9/14
07	**420**	-	220	200	-	-	0	0	-	-	0	11/9

		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)
Symphoricarpos oreophilus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	18/19
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 17-40-07

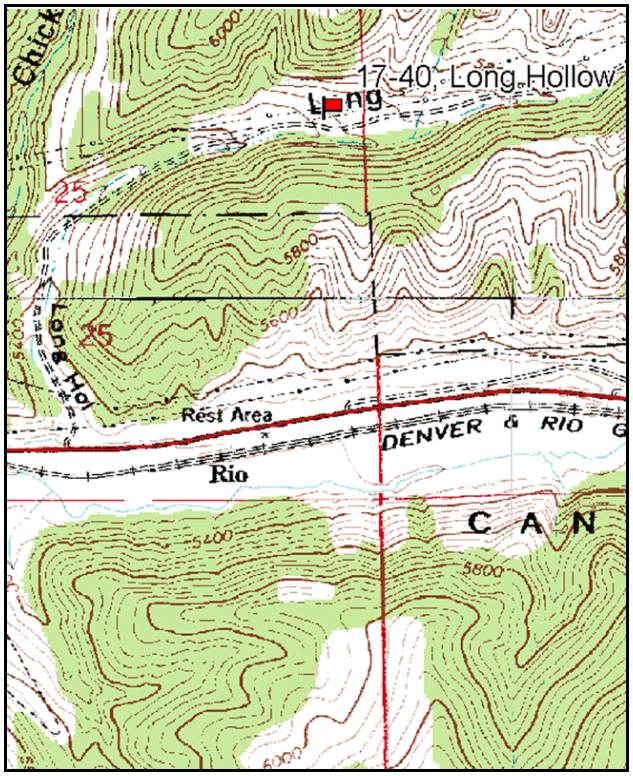
Study site name: Long Hollow . Vegetation type: Big Sagebrush-Grass .

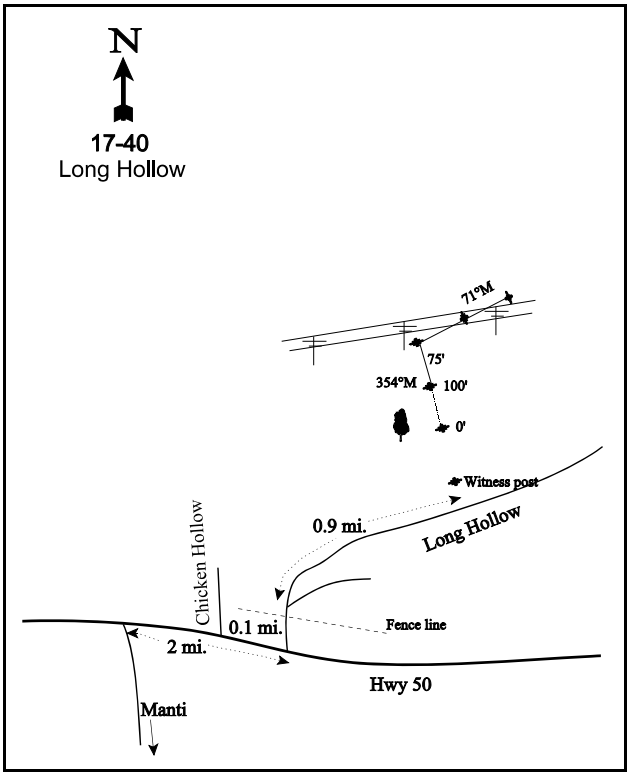
Compass bearing: frequency baseline 354 degrees magnetic (line 3-4 @ 71°M).

Frequency belt placement: line 1 (11 & 95 ft), line 2 [only 75 ft. long] (34 ft), line 3 (59 ft), line 4 (71 ft).
Rebar: belt 2 on 1ft.

LOCATION DESCRIPTION

Beginning at the intersection of Highway 6 and Long Hollow Road, proceed northerly up Long Hollow for 0.10 miles to a fork. At the fork, stay to the left and proceed an additional 0.90 miles up Long Hollow, to a green steel "T" fencepost on the left side of the road. From the stake, the 0-foot marker of the baseline is 15 feet to the north, near a juniper. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height. A red browse tag, number 3946, is attached to the 0-foot baseline stake. High tension power lines run above the study site.





Map Name: Billies Mountain

Diagrammatic Sketch

Township 9S , Range 5E , Section 25

GPS: NAD 83, UTM 12T 463842 E 4428342 N

DISCUSSION

Long Hollow - Trend Study No. 17-40

Study Information

This study samples critical deer and elk winter range located in Long Hollow, a narrow canyon draining directly into the Spanish Fork River [elevation: 5,760 feet (1,755 m), slope: 5-10%, aspect: south]. The nearest perennial source of water is Soldier Creek and is approximately 1 mile (1.6 km) to the south. A portion of the baseline passes beneath a high-tension powerline. Long Hollow has been used by deer and elk in the winter, and has been grazed by cattle in the summer. From the pellet group transact, there were 87 deer days use/acre (215 ddu/ha) in 2002 and 31 deer days use/acre (76 ddu/ha) in 2007. Elk use was estimated at 23 days use/acre in 2002, which increased to 49 days use/acre (121 edu/ha) in 2007. Cattle use was estimated at 10 days use/acre (25 cdu/ha) in 2002 and 6 days use/acre (14 cdu/ha) in 2007. Three winter-killed deer were found on the site in 1983.

Soil

The soil was deposited as alluvium and colluvium, and is coarse and well-drained. The soil texture is a sandy clay loam with a neutral soil reaction (pH 7.2). Cobblestones and gravel are distributed throughout the soil profile and on the surface. Rock cover is relatively high, and has averaged 15% of the total ground cover since 1997. Conversely, bare ground cover has been less than 3% since 1997. The study is traversed by dormant gullies and flow patterns, which resulted in a slight erosion condition classification in 2002 and 2007.

Browse

The preferred browse species that are present include basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), and fourwing saltbush (*Atriplex canescens*). In 1983 and 1989, all sagebrush was classified as mountain big sagebrush. In subsequent sample years, sagebrush were split into the two subspecies. Mountain sagebrush has continued to be the more abundant of the two subspecies. Mountain big sagebrush canopy cover was 4% in 2007. Since the two subspecies were differentiated in 1997, the density of mountain big sagebrush was estimated at 880 plants/acre (2,180 plants/ha) in 1997, 1,240 plants/acre (3,070 plants/ha) in 2002, and 940 plants/acre (2,327 plants/ha) in 2007. There have been few to no seedlings, and since 1997 young plants have comprised 2% to 13% of the population. Decadence was low in 1997 (7%), increased in 2002 (47%), and decreased in 2007 (28%). The density of dead plants has ranged from 100 plants/acre (247 plants/ha) to 260 plants/acre (643 plants/ha). Vigor has been good, except in 2002 and 2007, when 15% and 32% of the population had poor vigor. The average annual leader growth was 2.4 inches (6.1 cm) in 2002 and 1.7 inches (4.4 cm) in 2007. Browse use has been predominantly light and light-moderate.

The density of basin big sagebrush has decreased from 460 plants/acre (1,140 plants/ha) in 1997 to 40 plants/acre (99 plants/ha) in 2007. No seedling plants have been sampled. Young plants were only sampled in 1997, and comprised 9% of the population. Decadent plants were only sampled in 1997 and 2002, and comprised 17% and 100% of the population, respectively. The density of dead plants has steadily decreased from 140 plants/acre (347 plants/ha) in 1997 to 40 plants/acre (99 plants/ha) in 2007. Plants with poor vigor have comprised between 9% and 89% of the population. All of the plants with poor vigor were classified as dying in 1997 and 2002. Browse use has been light to light-moderate.

Fourwing saltbush was first sampled in 1997, and the density has ranged from 140 plants/acre (347 plants/ha) to 280 plants/acre (693 plants/ha). No seedlings have been sampled, and young plants were only sampled in 1997. Decadence has ranged from 0% to 50% of the population. Plant vigor has been good, except for in 2002, when 21% of the population was classified as dying. Browse use has varied from light-moderate to heavy. Other species that are present include pricklypear cactus (*Opuntia* sp.), broom snakeweed (*Gutierrezia sarothrae*), and white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*). There was some

moderate browse use on rabbitbrush in 1997 and 2002.

Herbaceous Understory

The herbaceous understory is dominated by perennial grass and forb species. Perennial grass has increased from 23% in 1997 to 32% in 2002, and 36% in 2007. The dominant grass species has been bulbous bluegrass (*Poa bulbosa*), which has comprised an average 62% of the perennial grass cover since 1997. Bulbous bluegrass has a phenology that is similar to annual grasses (Stewart and Hull 1949), and may be limiting the establishment of other species. The remaining grass cover is largely comprised of crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), bluebunch wheatgrass (*Agropyron spicatum*), and sand dropseed (*Sporobolus cryptandrus*). Crested and intermediate wheatgrass were seeded around the powerline towers after the powerline was constructed. Cheatgrass (*Bromus tectorum*) cover was 8% in 1997, and decreased to less than 1% in 2002 and 2007.

On average, the forb component has accounted for 10% of the total ground cover since 1997. Cudweed sagewort (*Artemisia ludoviciana*), whitetop (*Cardaria draba*), spotted stickseed (*Hackelia patens*), and scarlet globemallow (*Sphaeralcea coccinea*) have been the dominant perennial species. With the exception of scarlet globemallow, these species have a low forage value. Two noxious weed species have been sampled: whitetop and houndstongue (*Cynoglossum officinale*).

1989 TREND ASSESSMENT

The browse trend is stable. The combined density of basin and mountain big sagebrush increased 3%. The density of seedling plants increased from 0 plants/acre to 533 plants/acre (1,320 plants/ha). Young plants decreased from 51% to 41% of the population. Decadence increased from 12% to 18%, and plants with poor vigor increased from 0% to 3% of the population. Browse use remained light. The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 71%. There were significant increases in the nested frequencies of crested wheatgrass and Sandberg bluegrass (*Poa secunda*). The forb trend is stable. There was a significant decrease in the nested frequency of yellow salsify (*Tragopogon dubius*), and a significant increase in that of spotted stickseed.

browse - stable (0) grass - up (+2) forb - stable (0)

1997 TREND ASSESSMENT

The browse trend is stable. As mentioned, a distinction was made between basin and mountain big sagebrush beginning in 1997. Although the collective density of both species decreased 72%, the decrease was attributed to the larger area sampled. Trend was determined from other parameters. For example, fewer mountain big sagebrush seedling plants were sampled, and young plants decreased to 9% of the population. However, decadence also decreased and comprised only 7% of the population. Browse use on mountain big sagebrush shifted from light to light-moderate. The basin big sagebrush population was found to consist predominantly of mature, healthy, lightly browsed plants. Fourwing saltbush was also sampled for the first time. The saltbush population was mostly mature, healthy, and heavily browsed. The grass trend is slightly down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 8%. There were significant decreases in the nested frequencies of crested wheatgrass and Sandberg bluegrass. Bulbous bluegrass nested frequency increased significantly, and quadrat frequency increased from 8% to 66%. Cheatgrass was also found in 86% of the quadrats, and comprised 8% cover. The forb trend is slightly up. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased 29%. There were significant increases in the nested frequencies of segolily (*Calochortus nuttallii*), spotted stickseed, scarlet globemallow, and yellow salsify. Additionally, the number of perennial species increased from 14 to 19. Conversely, whitetop and houndstongue were sampled for the first time. The Desirable Components Index (DCI) score was poor due to moderate browse cover, low browse recruitment, high annual grass cover, and the presence of two noxious weed species.

winter range condition (DCI) - poor (48) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is down. The density of mountain big sagebrush increased 41%. Although no seedlings were sampled, young plants increased to 13% of the population. However, decadence increased to 47%, the dying portion of population increased to 15%, and the density of dead plants increased from 100 plants/acre (247 plants/ha) to 260 plants/acre (642 plants/ha). Browse use on mountain big sagebrush remained light-moderate. The basin big sagebrush density decreased 61%. All basin big sagebrush were decadent, and those classified as dying increased to 89% of the population. The density of fourwing saltbush increased 40%. Half of the population was decadent, and 21% of the population was classified as dying. Browse use on saltbush shifted to light-moderate. The increases in decadent and dying browse plants was attributed to drought conditions (Utah Climate Summaries 2007). The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 32%. Although there was a significant increase in the nested frequency of bulbous bluegrass, there was a significant decrease in that of cheatgrass. Bulbous bluegrawss cover increased from 14% to 23%, while cheatgrass cover decreased from 8% to 1%. There was also a significant increase in the nested frequency of Sandberg bluegrass. The forb trend is down. Excluding whitetop, the sum of nested frequency of perennial forbs decreased 37%. There were significant decreases in the nested frequencies of segolily, spotted stickseed, and yellow salsify. There was also a significant decrease in the nested frequency of storksbill (*Erodium cicutarium*). Houndstongue was not sampled. The DCI score remained poor.

winter range condition (DCI) - poor (42) Mid-level potential scale
browse - down (-2) grass - up (+2) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of mountain big sagebrush decreased 24%. Very few seedlings were sampled, and young plants decreased to 2% of the population. Decadence decreased to 28% of the population, and the proportion of plants exhibiting poor vigor increased to 32%. Browse use on mountain big sagebrush remained light-moderate. The density of basin big sagebrush decreased 78%. All of the remaining plants were mature, though half had poor vigor. The average crown width of basin big sagebrush increased 32 inches (81 cm). The density of fourwing saltbush decreased 50%. No young plants were sampled, but decadence decreased to 14%. No saltbush plants had poor vigor, and the average height and crown measurements increased 22 inches (56 cm) and 44 inches (112 cm), respectively. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 2%. Despite the stable frequency, perennial grass cover increased from 9% to 17% of the total ground cover. There were significant increases in the nested frequencies of intermediate and bluebunch wheatgrasses. The forb trend is slightly up. Excluding whitetop, the sum of nested frequency of perennial forbs increased 7%. Whitetop nested frequency decreased significantly, and was only sampled in 1% of the quadrats. There was also a significant increase in the nested frequency of cudweed sagewort. The DCI score improved to fair due to decreased browse decadence and increased perennial grass cover

winter range condition (DCI) - fair (57) Mid-level potential scale
browse - down (-2) grass - stable (0) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 40

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	a27	b50	a26	ab35	ab47	2.00	1.41	3.16
G	Agropyron intermedium	-	-	a36	a50	b74	2.80	3.67	9.74
G	Agropyron spicatum	a18	ab21	ab35	b36	c67	1.68	2.25	2.74
G	Bromus japonicus (a)	-	-	-	a6	a11	-	.04	.02
G	Bromus tectorum (a)	-	-	b285	a96	a129	7.91	.67	.76
G	Festuca sp.	-	-	12	-	-	.02	-	-
G	Oryzopsis hymenoides	-	a3	-	-	a1	-	-	.03
G	Poa bulbosa	a6	a16	b229	c306	c293	14.18	23.46	19.14
G	Poa pratensis	a1	a2	ab16	b21	-	.25	.11	-
G	Poa secunda	a1	b40	a6	b35	ab20	.01	.39	.50
G	Sitanion hystrix	a3	a8	-	a3	a6	-	.15	.06
G	Sporobolus cryptandrus	ab76	b91	ab67	ab81	a52	1.89	.87	1.00
Total for Annual Grasses		0	0	285	102	140	7.91	0.71	0.78
Total for Perennial Grasses		132	231	427	567	560	22.87	32.32	36.38
Total for Grasses		132	231	712	669	700	30.79	33.04	37.18
F	Alyssum alyssoides (a)	-	-	b69	-	a1	.22	-	.00
F	Allium sp.	-	-	b11	-	a3	.03	-	.00
F	Arabis sp.	-	a1	-	a2	a1	-	.00	.00
F	Artemisia dracunculus	a7	a5	a3	a4	a3	.00	.01	.15
F	Artemisia ludoviciana	ab101	b140	a86	a76	b123	2.83	2.37	4.36
F	Aster sp.	-	a8	-	-	a1	-	-	.03
F	Astragalus sp.	-	-	4	-	-	.01	-	-
F	Astragalus utahensis	a4	a6	a3	-	a1	.15	-	.00
F	Cardaria draba	-	-	ab24	b31	a3	2.36	1.01	.03
F	Castilleja linariaefolia	-	-	a1	a1	-	.03	.00	-
F	Calochortus nuttallii	ab10	a1	b18	a1	ab7	.06	.00	.63
F	Cirsium sp.	a14	a26	a10	a15	a5	.46	.50	.12
F	Collinsia parviflora (a)	-	-	-	-	4	-	-	.00
F	Cymopterus sp.	-	-	a2	a2	a2	.00	.01	.03
F	Cynoglossum officinale	-	-	a1	-	a-	.15	-	.00
F	Descurainia pinnata (a)	-	-	-	-	2	-	-	.00
F	Draba sp. (a)	-	-	2	-	-	.00	-	-
F	Epilobium brachycarpum (a)	-	-	1	-	-	.00	-	-
F	Erodium cicutarium (a)	-	-	b64	a7	a15	.63	.04	.13
F	Erigeron divergens	-	-	a16	a2	a13	.37	.01	.39

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Eriogonum racemosum	$_{a}$3	$_{a}$5	$_{a}$2	$_{a}$3	$_{a}$4	.03	.04	.16
F	Hackelia patens	$_{a}$20	$_{b}$51	$_{c}$105	$_{ab}$44	$_{a}$27	2.51	.77	1.27
F	Helianthus annuus (a)	-	$_{b}$26	$_{a}$2	$_{a}$1	-	.00	.00	-
F	Lactuca pulchella	-	$_{ab}$8	$_{b}$20	-	$_{a}$6	.07	-	.01
F	Lactuca serriola	50	-	-	-	-	-	-	-
F	Lithospermum ruderale	-	$_{b}$4	$_{a}$-	$_{a}$-	$_{a}$-	.03	.03	.15
F	Medicago sativa	-	-	$_{a}$2	$_{a}$5	$_{a}$5	.45	.79	.44
F	Oenothera sp.	-	-	-	-	-	.00	-	-
F	Phlox longifolia	-	$_{b}$15	$_{ab}$9	$_{ab}$8	$_{a}$1	.02	.02	.00
F	Polygonum douglasii (a)	-	-	9	-	-	.01	-	-
F	Ranunculus testiculatus (a)	-	-	$_{a}$5	$_{a}$3	-	.03	.00	-
F	Sisymbrium altissimum (a)	-	-	3	-	-	.03	-	-
F	Solidago sp.	16	-	-	-	-	-	-	-
F	Sphaeralcea coccinea	$_{a}$44	$_{ab}$69	$_{c}$106	$_{c}$109	$_{bc}$89	3.06	2.75	.74
F	Tragopogon dubius	$_{c}$68	$_{a}$1	$_{b}$40	$_{a}$3	$_{a}$3	.36	.15	.00
F	Vicia americana	-	-	-	$_{a}$1	$_{a}$1	-	.00	.03
F	Zigadenus paniculatus	1	-	-	-	-	-	-	-
Total for Annual Forbs		0	26	155	11	22	0.95	0.04	0.14
Total for Perennial Forbs		338	340	463	307	298	13.04	8.50	8.61
Total for Forbs		338	366	618	318	320	14.00	8.55	8.76

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

BROWSE TRENDS --
Management unit 17 , Study no: 40

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata tridentata	15	6	2	3.11	1.21	1.00
B	Artemisia tridentata vaseyana	25	34	31	4.18	7.35	3.93
B	Atriplex canescens	7	6	4	.19	.21	.06
B	Chrysothamnus nauseosus albicaulis	30	27	22	3.86	1.90	3.02
B	Chrysothamnus viscidiflorus viscidiflorus	1	2	1	-	-	-
B	Gutierrezia sarothrae	45	57	63	.97	1.93	3.35
B	Juniperus osteosperma	0	1	1	1.00	2.67	-
B	Opuntia sp.	6	9	8	.04	.06	-
Total for Browse		129	142	132	13.37	15.36	11.38

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 40

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	4.38
Atriplex canescens	-	.66
Chrysothamnus nauseosus albicaulis	-	3.11
Gutierrezia sarothrae	-	1.56
Juniperus osteosperma	.30	-

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 40

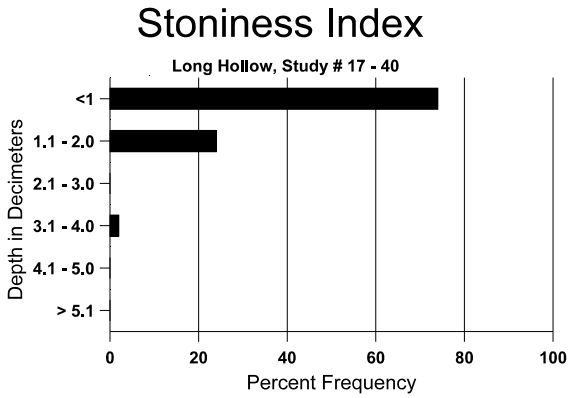
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.4	1.7

BASIC COVER --
Management unit 17 , Study no: 40

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	.50	7.25	48.81	57.68	55.28
Rock	25.50	24.00	17.10	17.57	19.40
Pavement	1.50	4.25	2.41	1.37	1.60
Litter	64.25	59.00	49.95	37.77	31.20
Cryptogams	1.00	1.00	3.50	2.16	.45
Bare Ground	7.25	4.50	1.49	2.09	2.72

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 40, Long Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
12.7	49.2 (14.3)	7.2	51.4	26.7	21.8	2.8	10.6	166.4	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 40

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	-	1
Elk	63	15	15
Deer	32	51	38
Cattle	-	2	10

Days use per acre (ha)	
'02	'07
-	-
23 (58)	49 (121)
87 (215)	31 (76)
10 (25)	6 (14)

BROWSE CHARACTERISTICS --
Management unit 17 , 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)
Artemisia tridentata tridentata												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**460**	-	40	340	80	140	13	0	17	9	9	34/42
02	**180**	-	-	-	180	80	44	0	100	89	89	59/45
07	**40**	-	-	40	-	40	50	0	0	-	50	59/77
Artemisia tridentata vaseyana												
83	**4599**	-	2333	1733	533	-	16	4	12	-	0	26/15
89	**4732**	533	1933	1933	866	-	6	3	18	-	3	23/18
97	**880**	80	80	740	60	100	59	0	7	-	0	26/42
02	**1240**	-	160	500	580	260	34	16	47	15	15	26/35
07	**940**	20	20	660	260	220	30	6	28	9	32	26/38
Atriplex canescens												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**200**	-	20	180	-	-	0	90	0	-	0	31/33
02	**280**	-	-	140	140	-	29	7	50	21	21	18/22
07	**140**	-	-	120	20	-	43	0	14	-	0	40/66
Chrysothamnus nauseosus albicaulis												
83	**1532**	-	-	666	866	-	0	0	57	-	0	25/21
89	**1000**	-	-	400	600	-	7	0	60	-	7	27/31
97	**1060**	-	100	820	140	160	36	19	13	9	11	34/35
02	**900**	-	80	320	500	200	38	2	56	33	33	19/22
07	**680**	-	20	540	120	20	3	0	18	9	12	25/29
Chrysothamnus viscidiflorus viscidiflorus												
83	**200**	-	-	200	-	-	0	0	0	-	0	20/26
89	**400**	-	-	200	200	-	0	0	50	-	17	13/14
97	**20**	-	-	20	-	-	0	0	0	-	0	14/19
02	**40**	-	-	20	20	-	0	0	50	50	50	14/17
07	**20**	-	-	20	-	-	0	0	0	-	0	15/22

		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)
Gutierrezia sarothrae												
83	**2999**	-	66	2933	-	-	0	0	0	-	0	13/9
89	**4999**	-	400	4466	133	-	0	0	3	-	0	13/13
97	**3840**	200	2080	1640	120	20	0	0	3	.52	.52	11/10
02	**4620**	-	100	3720	800	520	0	0	17	5	5	8/9
07	**4720**	-	480	4080	160	20	0	0	3	.42	.42	10/12
Juniperus osteosperma												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	20	20	-	-	50	0	-	-	0	-/-
07	**20**	-	20	-	-	-	0	0	-	-	0	-/-
Opuntia sp.												
83	**732**	-	266	466	-	-	0	0	-	-	36	6/10
89	**533**	-	533	-	-	-	0	0	-	-	0	-/-
97	**180**	-	40	140	-	-	0	0	-	-	0	7/10
02	**240**	-	20	220	-	-	0	0	-	-	0	5/14
07	**180**	20	40	140	-	-	0	0	-	-	22	6/13
Rhus trilobata												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	50/76

Trend Study 17-41-07

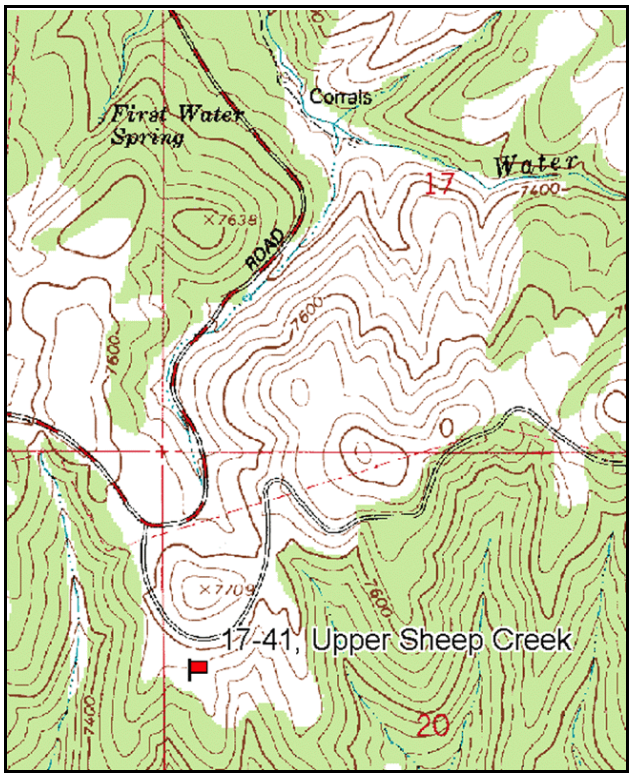
Study site name: Upper Sheep Creek . Vegetation type: Mountain Brush .

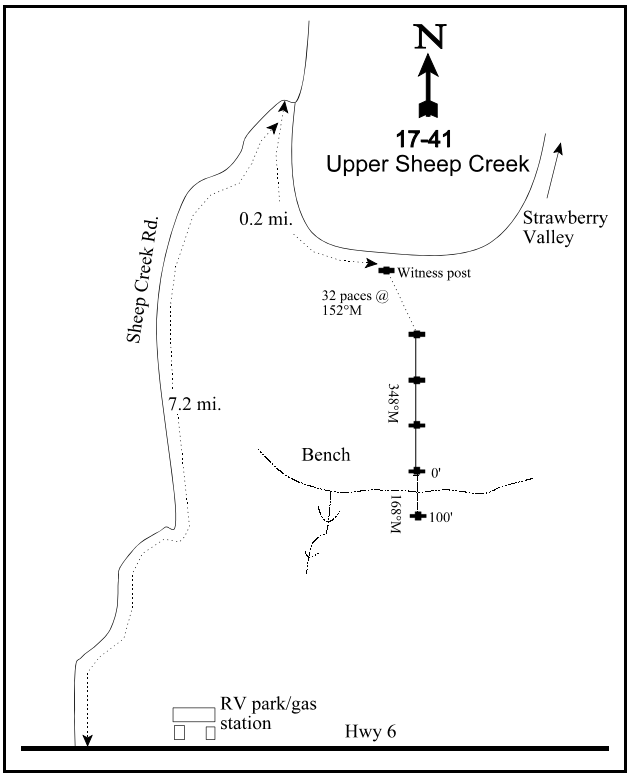
Compass bearing: frequency baseline 168 degrees magnetic.

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

LOCATION DESCRIPTION

Beginning at the intersection of Sheep Creek Road and Rays Valley, proceed northerly up Rays Valley Road for 7.2 miles to an intersection (0.20 miles past a cattle guard). Turn right at the intersection and proceed easterly for 0.60 miles to another intersection. Turn right at the intersection and proceed 0.10 miles to a "Y" in the road. Take the left side of the "Y" and proceed another 0.10 miles to a faint road to the right. Turn right on the faint road and proceed 0.10 miles to a green steel "T" fencepost to the left. From the stake, the 0-foot stake of the baseline is 32 paces away at an azimuth of 152 degrees magnetic. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height.





Map Name: Ray's Valley

Diagrammatic Sketch

Township 9S , Range 5E , Section 20

GPS: NAD 83, UTM 12T 476139 E 4430595 N

DISCUSSION

Upper Sheep Creek - Trend Study No. 17-41

Study Information

This study is located near the upper limit of deer and elk winter range above US-6 in Spanish Fork Canyon [elevation: 7,500 feet (2,285 m), slope: 12-40%, aspect: south]. The elevation makes it unlikely in most winters that any big game are using this area after mid-November. Some early spring use probably occurs as the snow melts. Wildlife are likely more concentrated near the edge of the ridge where the sun and wind can help keep the snow at a more shallow depth. The study area drains into Sheep Creek, but is near the divide with First Water Creek. Both creeks are located within 1.1 miles (1.8 km) of the study. From the pellet group transect, there were 46 deer days use/acre (114 ddu//ha) in 2002 and 66 deer days use/acre (162 ddu/ha) in 2007. Elk use was estimated at 3 days use/acre (7 edu/ha) in 2002 and 11 days use/acre (28 edu/ha) in 2007. Cattle use was estimated at 13 days use/acre (32 cdu/ha) in 2002 and 12 days use/acre (29 cdu/ha) in 2007. Deer and elk pellet groups appeared to be from fall and spring use, while all cattle pats were from the summer.

Soil

The soil has a clay texture and a neutral soil reaction (pH of 7.2). The parent material appears to be limestone or shale. Since 1997, relative bare ground cover has averaged 11%. Vegetation and litter cover have been the dominant cover types and have comprised approximately 80% of the relative ground cover since 1997. Because of the disparity in slope and the evidences of erosion that exist along the baseline, the erosion condition was classified in two parts in 2007. For the steeper portion of the baseline, the erosion condition was classified as slight in 2007 , due to evidence of surface litter and rock movement, pedestalling, and flow patterns. For the remainder of the baseline, the erosion condition was classified as stable in 2002 and 2007.

Browse

The browse component has dominated this mountain brush community. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) canopy cover was 17% in 2002 and 11% in 2007. The density of sagebrush increased from 1,133 plants/acre (2,804 plants/ha) in1983 to 2,160 plants/acre (5,347 plants/ha) in 1997. Most of this increase was the result of the increased area sampled in beginning in 1997. In 2002, the density was estimated at 2,200 plants/acre (5,445 plants/ha), and it decreased to 1,940 plants/acre (4,802 plants/ha) in 2007. Few or no seedling plants have been sampled, and young plants have comprised 10% or less of the population. Decadence has increased from12% of the population in 1983 to 32% in 2007. Dead plants were first sampled in 1997, and the density of dead plants has been fairly stable, ranging from 160-200 plants/acre (396-495 plants/ha). The proportion of plants exhibiting poor vigor has ranged from 7% to 41% of the population. No dying plants were sampled in 1983, and in subsequent years dying plants have comprised 7%-19% of the population. The average annual leader growth was 1.6 inches (4.1 cm) in 2002 and 1.9 inches (4.7 cm) in 2007. Browse use on sagebrush has been light to light-moderate.

Antelope bitterbrush (*Purshia tridentata*) canopy cover was 19% in 2002 and 7% in 2007. Bitterbrush density has steadily increased from 1,066 plants/acre (2,640 plants/ha) in 1983 to 1,700 plants/acre (4,210 plants/ha) in 2007. Few or no seedlings have been sampled, and the young age class has accounted for 0%-11% of the population. Decadence has been low and has ranged from 0% to 8% of the population. Until 2007, no plants classified as dying or having poor vigor were. In 2007, 5% of the population had poor vigor. The average annual leader growth on bitterbrush was 0.9 inches (2.3 cm) in 2002 and 2.2 inches (5.5 cm) in 2007.

Serviceberry (*Amelanchier alnifolia*) cover has been 2% or less of the total ground cover. The density of serviceberry has ranged from 540 plants/acre (1,335 plants/ha) to 1,466 plants/acre (3,630 plants/ha). Between 6% and 35% of the population has consisted of young plants, and decadent plants have comprised 10% or less of the population. The proportion of plants exhibiting poor vigor has ranged from 0% to 14% of the population. In 2007 the average annual leader growth was 3.0 inches (7.6 cm). Browse use on serviceberry

has been light-moderate to moderate.

Other browse species that are present include stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), Wyeth eriogonum (*Eriogonum heracleoides*), Woods' rose (*Rosa woodsii*), and snowberry (*Symphoricarpos oreophilus*). Browse use has been predominantly light on these species. There were some moderately browsed snowberry plants in 1983, and Wyeth eriogonum plants in 2007.

Herbaceous Understory

The herbaceous understory is diverse, but is not very abundant. The grass component has comprised approximately 10% of the total ground cover since 1997. The dominant perennial species are bluebunch wheatgrass (*Agropyron spicatum*), smooth brome (*Bromus inermis*), and mutton bluegrass (*Poa fendleriana*). Ten other perennial grass species have been sampled at low frequencies. Cheatgrass (*Bromus tectorum*) is the only annual species present, but quadrat frequency has been 5% or less.

On average, forb cover has been 9% since 1997. Perennial species, including wild onion (*Allium* sp.), Western aster (*Aster chilensis*), arrowleaf balsamroot (*Balsamorhiza sagittata*), and penstemon (*Penstemon* sp.), have accounted for most of the total forb cover. Houndstongue (*Cynoglossum officinale*), a noxious weed, was sampled in one quadrat in 2002. Otherwise, there have been no noxious weeds sampled.

1997 TREND ASSESSMENT

The browse trend is up. The collective density of the preferred browse species increased 17%. The density of sagebrush increased 91%, and as mentioned previously, most of this increase was attributed to the larger area sampled. The young age class increased from 0% to 10% of the population, and decadence remained stable at 13%. The proportion of sagebrush plants exhibiting poor vigor decreased from 41% to 7%, and browse use remained light. The density of bitterbrush increased 50%, and the population continued to consist largely of mature, healthy plants. The proportion of heavily browsed bitterbrush plants increased from 0% to 30%. Serviceberry was the only preferred browse species that decreased in density. Most of the decrease was attributed to the mature age class. Since there were no decadent and few dead plants sampled, the decrease in density was attributed to the larger area sampled. The grass trend is up. The sum of nested frequency of perennial grasses increased more than three-fold. There was a significant increase in the nested frequencies of bluebunch wheatgrass, and a significant decrease in that of Sandberg bluegrass. Additionally, the number of perennial species sampled increased from five to 12. The forb trend is up. The sum of nested frequency of perennial forbs increased nearly six-fold. There were significant increases in the nested frequencies of three perennial species, and the number of perennial species sampled increased from 12 to 23. The Desirable Components Index (DCI) score was good-excellent due to the high browse cover, low browse decadence, low annual grass cover, and moderately high perennial grass and forb cover.

winter range condition (DCI) - good-excellent (80) Mid-level potential scale
browse - up (+2) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is stable. The collective density of the preferred browse species increased 8%. The density of sagebrush increased 2%. Although there were few seedlings sampled, the young age class decreased to 3% of the population. Decadence increased to 30%, and 10% of the population had poor vigor. The increase in decadence was attributed to drought conditions (Utah Climate Summaries 2007). Browse use on sagebrush remained light. The density of bitterbrush also increased 2%. Young plants increased to 11% of the population, and there were no decadent plants sampled. Browse use on bitterbrush remained moderate, and 28% of the plants had been heavily browsed. The serviceberry density increased 48%. Young plants increased to 35% of the population, and 10% was comprised of decadent plants. Serviceberry plants in poor vigor increased to 5% of the population, and browse use remained light-moderate. The grass trend is slightly down. The sum of nested frequency of perennial grasses decreased 11%. There was a significant decrease in

the nested frequency of mutton bluegrass, and a significant increase in that of Kentucky bluegrass (*Poa pratensis*). The forb trend is down. The sum of nested frequency of perennial forbs decreased 35%, including significant decreases in six perennial species. Houndstongue was sampled for the first time, but only in one quadrat. The DCI score decreased to good due to the decrease in perennial grass cover and the presence of a noxious weed species.

winter range condition (DCI) - good (76) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is slightly down. The collective density of preferred browse species decreased 8%. The density of sagebrush decreased 12%. The young age class comprised 2% of the population, and decadence increased to 32%. The proportion of plants exhibiting poor vigor increased to 25%, and 19% of the population was classified as dying. Browse use on sagebrush increased to light-moderate. The density of bitterbrush increased 4%. Few seedlings and no young plants were sampled. Decadent plants increased to 8% of the population, and 5% had poor vigor. Browse use shifted to moderate-heavy, with 55% of the plants exhibiting heavy browse use. The density of serviceberry decreased 23%. This decrease was not expected because of the large number of young plants sampled in 2002. Both the young and decadent age classes decreased to 6% of the population. Although browse use remained light-moderate, heavily browsed plants increased to 26% of the sampled plants. The grass trend is stable. The sum of nested frequency of perennial grasses increased 6%, and there were no significant changes of individual species. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased 11%, including significant increases in two species. Additionally, houndstongue was not sampled. The DCI score remained good.

winter range condition (DCI) - good (74) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 41

Type	Species	Nested Frequency				Average Cover %		
		'83	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	$_{a}$84	$_{b}$164	$_{b}$178	$_{b}$149	5.03	5.61	3.49
G	Bromus inermis	-	$_{a}$45	$_{a}$50	$_{a}$52	1.74	2.26	2.16
G	Bromus tectorum (a)	-	$_{a}$6	$_{a}$3	$_{a}$9	.01	.03	.07
G	Carex sp.	$_{a}$2	$_{a}$1	-	$_{a}$4	.03	-	.04
G	Koeleria cristata	-	$_{a}$2	$_{ab}$4	$_{b}$17	.03	.03	.36
G	Melica bulbosa	-	$_{b}$12	-	$_{a}$3	.15	-	.00
G	Oryzopsis hymenoides	$_{a}$2	$_{ab}$4	$_{ab}$4	$_{b}$16	.16	.05	.54
G	Phleum pratense	-	9	-	-	.16	-	-
G	Poa fendleriana	-	$_{b}$107	$_{a}$53	$_{a}$66	3.47	.88	2.15
G	Poa pratensis	-	$_{a}$13	$_{b}$26	$_{ab}$26	.45	.75	.96

Type	Species	Nested Frequency				Average Cover %		
		'83	'97	'02	'07	'97	'02	'07
G	Poa secunda	$_{b}$19	$_{a}$1	$_{a}$3	$_{ab}$14	.00	.03	.76
G	Sitanion hystrix	1	-	-	-	-	-	.00
G	Stipa comata	-	9	-	-	.36	-	-
G	Stipa lettermani	-	$_{a}$15	$_{a}$24	$_{a}$14	.22	.62	.12
Total for Annual Grasses		0	6	3	9	0.00	0.03	0.07
Total for Perennial Grasses		108	382	342	361	11.82	10.25	10.62
Total for Grasses		108	388	345	370	11.83	10.28	10.69
F	Achillea millefolium	-	$_{a}$5	$_{a}$3	$_{a}$3	.04	.00	.03
F	Agoseris glauca	-	$_{b}$32	$_{a}$6	$_{ab}$15	.16	.04	.20
F	Alyssum alyssoides (a)	-	-	11	-	-	.04	-
F	Allium sp.	$_{a}$1	$_{c}$107	$_{b}$49	$_{c}$109	1.06	.14	.51
F	Androsace septentrionalis (a)	-	2	-	-	.00	-	-
F	Arabis sp.	-	-	3	-	-	.06	-
F	Astragalus beckwithii	-	$_{a}$10	$_{b}$31	$_{ab}$27	.22	.63	.74
F	Aster chilensis	$_{a}$9	$_{a}$19	$_{a}$34	$_{a}$16	.63	1.17	.33
F	Astragalus convallarius	-	-	$_{a}$1	$_{a}$2	-	.03	.03
F	Aster sp.	-	$_{a}$8	-	$_{a}$17	.04	-	.28
F	Astragalus sp.	-	48	-	-	1.56	-	-
F	Balsamorhiza sagittata	$_{a}$7	$_{a}$14	$_{a}$8	$_{a}$16	1.12	1.13	1.51
F	Castilleja linariaefolia	-	$_{a}$2	-	$_{a}$1	.15	-	.03
F	Calochortus nuttallii	-	18	-	-	.08	-	-
F	Chaenactis douglasii	$_{b}$13	-	$_{a}$3	-	-	.00	-
F	Cirsium sp.	$_{a}$3	$_{a}$9	$_{a}$4	$_{a}$2	.16	.04	.00
F	Comandra pallida	$_{a}$16	$_{b}$37	$_{a}$15	$_{b}$47	.22	.08	.77
F	Collinsia parviflora (a)	-	$_{a}$87	$_{a}$92	$_{b}$128	.27	.39	.72
F	Cynoglossum officinale	-	-	1	-	-	.00	-
F	Eriogonum ovalifolium	-	-	$_{a}$6	$_{a}$2	-	.01	.00
F	Eriogonum umbellatum	$_{a}$9	$_{a}$3	$_{a}$1	$_{a}$6	.15	.03	.06
F	Galium aparine (a)	-	$_{b}$17	$_{ab}$7	$_{a}$2	.08	.01	.03
F	Hackelia patens	$_{a}$3	$_{b}$14	$_{ab}$5	$_{ab}$4	.37	.04	.03
F	Lappula occidentalis (a)	-	-	$_{a}$5	$_{a}$3	-	.03	.00
F	Lygodesmia sp.	-	-	4	-	-	.03	-
F	Machaeranthera canescens	$_{a}$6	$_{a}$4	$_{a}$2	$_{a}$13	.01	.01	.13
F	Orobanche fasciculata	-	30	-	-	.64	-	-
F	Orthocarpus tolmiei (a)	$_{a}$12	$_{b}$55	$_{b}$57	$_{a}$4	1.28	.37	.01
F	Penstemon humilis	$_{a}$7	$_{a}$7	$_{b}$28	$_{ab}$25	.09	.59	.43

Type	Species	Nested Frequency				Average Cover %		
		'83	'97	'02	'07	'97	'02	'07
F	Penstemon sp.	$_{a}$21	$_{ab}$43	$_{b}$62	$_{b}$53	1.00	1.81	1.91
F	Phlox longifolia	-	$_{a}$38	$_{a}$58	$_{a}$35	.15	.30	.29
F	Polygonum douglasii (a)	-	49	-	-	.16	-	-
F	Senecio integerrimus	-	$_{b}$58	$_{a}$23	$_{a}$8	.48	.25	.07
F	Sphaeralcea coccinea	-	-	3	-	-	.15	-
F	Streptanthus cordatus	$_{a}$1	-	$_{a}$4	$_{a}$1	-	.06	.00
F	Stanleya pinnata	-	1	-	-	.00	-	-
F	Viola sp.	-	$_{b}$41	$_{a}$7	-	.13	.04	-
F	Zigadenus paniculatus	-	$_{b}$14	$_{a}$2	-	.08	.03	-
Total for Annual Forbs		12	210	172	137	1.81	0.86	0.76
Total for Perennial Forbs		96	562	363	402	8.61	6.75	7.39
Total for Forbs		108	772	535	539	10.43	7.61	8.16

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

BROWSE TRENDS --
Management unit 17 , Study no: 41

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier alnifolia	23	24	26	1.68	2.04	1.10
B	Artemisia tridentata vaseyana	72	64	57	12.18	17.21	11.17
B	Chrysothamnus depressus	0	1	1	-	-	-
B	Chrysothamnus viscidiflorus viscidiflorus	73	74	67	7.76	9.29	7.07
B	Eriogonum heracleoides	26	27	23	1.19	1.06	.87
B	Juniperus osteosperma	1	3	2	.00	1.63	1.26
B	Mahonia repens	31	41	28	1.91	1.44	.90
B	Purshia tridentata	53	54	54	12.17	14.23	10.17
B	Rosa woodsii	14	19	18	.99	.69	.85
B	Symphoricarpos oreophilus	68	78	72	6.60	7.40	8.42
Total for Browse		361	385	348	44.53	55.04	41.84

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 41

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	2.38	.80
Artemisia tridentata vaseyana	17.29	10.94
Chrysothamnus viscidiflorus viscidiflorus	9.51	10.23
Eriogonum heracleoides	.61	1.03
Juniperus osteosperma	2.28	3.90
Mahonia repens	1.73	1.25
Purshia tridentata	18.75	7.18
Rosa woodsii	.55	1.10
Symphoricarpos oreophilus	7.43	12.80

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 41

Species	Average leader growth (in)	
	'02	'07
Amelanchier alnifolia	-	3.0
Artemisia tridentata vaseyana	1.6	1.9
Purshia tridentata	0.9	2.2

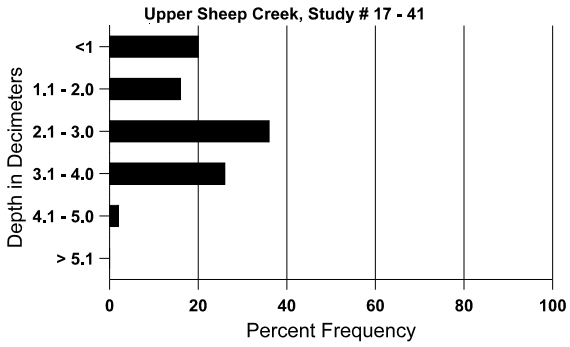
BASIC COVER --
Management unit 17 , Study no: 41

Cover Type	Average Cover %			
	'83	'97	'02	'07
Vegetation	4.25	55.15	59.53	54.45
Rock	7.50	2.80	4.45	3.19
Pavement	16.50	4.88	2.00	3.29
Litter	53.50	54.82	47.53	36.46
Cryptogams	0	.18	.04	.00
Bare Ground	18.25	10.18	13.63	16.87

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 41, Upper Sheep Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
12.8	41.6 (16.0)	6.6	31.4	22.7	45.8	4.3	17.6	384.0	.5

Stoniness Index



PELLET GROUP DATA --
Management unit 17 , Study no: 41

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	-	2	6
Elk	5	3	2
Deer	33	23	23
Cattle	6	2	1

Days use per acre (ha)	
'02	'07
-	-
3 (7)	11 (28)
46 (114)	66 (162)
13 (32)	12 (29)

BROWSE CHARACTERISTICS --
Management unit 17 , 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)
Amelanchier alnifolia												
83	**1466**	-	133	1333	-	-	77	14	0	-	14	30/20
97	**540**	140	80	460	-	40	30	4	0	-	0	30/35
02	**800**	-	280	440	80	-	43	13	10	5	5	33/33
07	**620**	40	40	540	40	-	35	26	6	-	0	31/27
Artemisia tridentata vaseyana												
83	**1133**	-	-	1000	133	-	18	0	12	-	41	29/35
97	**2160**	-	220	1660	280	200	22	5	13	7	7	31/41
02	**2200**	20	60	1480	660	160	21	4	30	9	10	31/37
07	**1940**	20	40	1280	620	160	40	12	32	19	25	30/37
Cercocarpus montanus												
83	**66**	-	-	66	-	-	100	0	-	-	0	67/77
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	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)
Chrysothamnus depressus												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	-	20	-	-	0	0	-	-	0	6/15
07	**20**	-	-	20	-	-	0	0	-	-	0	5/13
Chrysothamnus viscidiflorus viscidiflorus												
83	**3000**	-	-	3000	-	-	0	0	0	-	0	18/18
97	**5000**	-	100	4900	-	-	0	0	0	-	0	13/19
02	**8720**	20	160	8100	460	20	.91	0	5	2	2	12/15
07	**7220**	-	200	7020	-	-	0	0	0	-	0	11/16
Eriogonum heracleoides												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**840**	20	60	780	-	-	0	0	-	-	0	6/11
02	**1620**	-	80	1540	-	-	0	0	-	-	0	8/11
07	**1020**	-	-	1020	-	-	27	0	-	-	0	6/11
Juniperus osteosperma												
83	**199**	-	66	133	-	-	0	0	-	-	0	55/41
97	**20**	-	20	-	-	-	0	0	-	-	0	115/105
02	**60**	-	20	40	-	-	0	0	-	-	0	-/-
07	**40**	-	20	20	-	-	0	0	-	-	0	-/-
Mahonia repens												
83	**932**	-	66	866	-	-	0	0	0	-	0	4/6
97	**3640**	20	580	3060	-	-	0	0	0	-	0	4/6
02	**5480**	-	80	5300	100	40	0	0	2	.72	3	3/5
07	**4640**	-	400	4200	40	-	0	0	1	.86	.86	3/3
Purshia tridentata												
83	**1066**	-	-	1066	-	-	50	0	0	-	0	19/26
97	**1600**	100	60	1500	40	20	34	30	3	-	0	20/43
02	**1640**	-	180	1460	-	-	55	28	0	-	0	23/52
07	**1700**	20	-	1560	140	-	38	55	8	2	5	20/41
Rosa woodsii												
83	**3732**	-	3466	266	-	-	0	0	0	-	18	30/10
97	**840**	20	280	540	20	-	0	0	2	-	5	11/12
02	**700**	-	120	580	-	-	0	0	0	-	0	14/15
07	**1180**	-	-	1180	-	-	0	0	0	-	0	8/8

		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)
Symphoricarpos oreophilus												
83	**6066**	-	933	5133	-	-	14	0	0	-	3	19/17
97	**4380**	60	560	3800	20	-	0	.45	0	.45	.45	15/23
02	**5420**	-	700	4640	80	-	1	0	1	-	0	14/20
07	**4280**	-	460	3820	-	-	.46	0	0	-	0	15/23

Trend Study 17-42-07

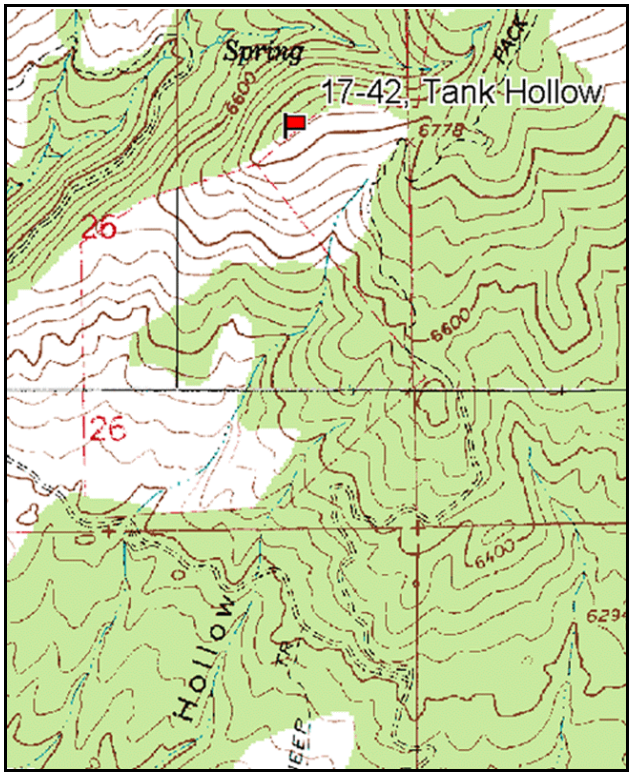
Study site name: Tank Hollow . Vegetation type: Mountain Brush .

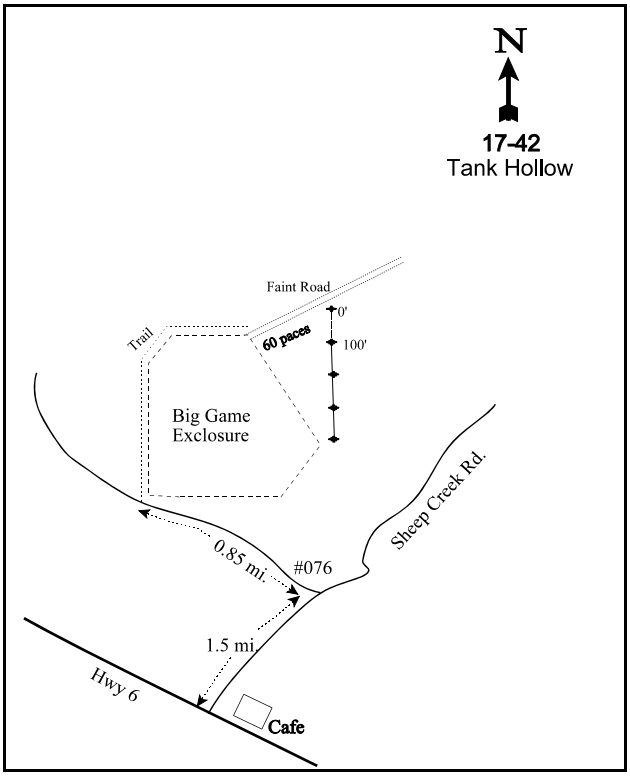
Compass bearing: frequency baseline 191 degrees magnetic.

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

LOCATION DESCRIPTION

Turn north off of Highway US-6 (near mile post 195) onto the new Sheep Creek Road. Go 1.5 miles on the paved road to an intersection with Forest Service road #076. Turn left and go west 0.8 miles to a fence. Continue 0.05 miles on the road to the southwest corner of a large exclosure. Park here, and follow the trail along the outside of the exclosure to the northeast corner. Continue 60 paces northeast along an old road, the 0-foot stake is 3 paces off the right side of the road. The study runs south. The 0-foot stake is marked by browse tag #176.





Map Name: Ray's Valley

Diagrammatic Sketch

Township 9S , Range 5E , Section 26

GPS: NAD 83, UTM 12T 471440 E 4428455 N

DISCUSSION

Tank Hollow - Trend Study No. 17-42

Study Information

This mountain brush study is located upslope of the Tank Hollow big game exclosure [elevation: 6,800 feet (2,073 m), slope: 20%, aspect: southeast]. The nearest perennial source of water is a spring located 1,000 feet (305 m) to the northwest, on the opposite side of the ridge. Both deer and elk use have been moderate-high in the past, which at this elevation, is indicative of mild winters. From the pellet group transect data, deer use was estimated at 155 days use/acre (384 ddu/ha) in 2002 and 21 days use/acre (53 ddu/ha) in 2007. Elk use was estimated at 49 days use/acre (121 edu/ha) in 2002 and 46 days use/acre (114 edu/ha) in 2007. Most of the deer and elk pellet groups were from winter use. Cattle use was estimated at 5 days use/acre (13 cdu/ha) in 2002 and 2 days use/acre (5 cdu/ha) in 2007. The fence of the nearby exclosure is compromised in several places and big game and livestock have used the area inside the exclosure.

Soil

The soil has a clay loam texture and a neutral reactivity (pH 7.1). There is little rock or pavement on the surface. However, there are rocks throughout the profile. The B horizon is located about 30 inches (76 cm) below the surface. The concentration of phosphorous in the soil is 6.8 ppm, and that of potassium is 64 ppm. Both concentrations are near the threshold of low availability (6 ppm for phosphorous and 60 ppm for potassium) that would limit plant growth (Tiedemann and Lopez 2004). The soil appears to be relatively stable. A combination of abundant vegetation and litter cover, along with the moderate slope, helps limit erosion. Some slight soil movement was reported in the past, but the erosion condition was classified as stable in 2002 and 2007.

Browse

Serviceberry (*Amelanchier alnifolia*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), true mountain mahogany (*Cercocarpus montanus*), and antelope bitterbrush (*Purshia tridentata*) are the dominant browse species. Mountain big sagebrush canopy cover was 6% in 2002 and 2007. The sagebrush density was estimated at 2,399 plants/acre (5,938 plants/ha) in 1983, which increased to 2,999 plants/acre (7,423 plants/ha) in 1989. The density decreased to 1,720 plants/acre (4,257 plants/ha) in 1997, and some of this decrease resulted from the increased sample area. The density increased to 1,780 plants/acre (4,406 plants/ha) in 2002, and decreased to 1,080 plants/acre (2,673 plants/ha) in 2007. Sagebrush reproduction and recruitment have been low. Decadence has been high, and the decadent proportion of the population has oscillated between increasing and decreasing in alternate sample years. Decadence was lowest in 1983 (28%) and highest in 2002 (65%). In 2007, 50% of the population was decadent. Dead plants were first sampled in 1997, and have increased from 360 plants/acre (891 plants/ha) in 1997 to 980 plants/acre (2,426 plants/ha) in 2007. Plants with poor vigor increased from 0% of the population in 1983 to 44% in 2002, and decreased to 28% in 2007. Since 1997, the majority of the plants with poor vigor were classified as dying. The average annual leader growth was 2.0 inches (5.1 cm) in 2002 and 1.3 inches (3.2 cm) in 2007. Browse use has ranged from moderate to heavy, and was heaviest in 2002.

Bitterbrush canopy cover was 3% in 2002 and 2007. The bitterbrush density was stable at approximately 2,000 plants/acre (4,950 plants/ha) from 1983 to 2002, and decreased to 1,020 plants/acre (2,525 plants/ha) in 2007. Seedling plants were only sampled in 1997. Few young plants were sampled in 1989 and 2002, but young plants have comprised 10%-16% of the population otherwise. Decadence has been highly variable. There were no decadent plants in 1983 or 1997, but decadent plants accounted for 23% of the population in 1989, 85% in 2002, and 18% in 2007. The density of dead plants increased from 100 plants/acre (248 plants/ha) in 2002 to 220 plants/acre (545 plants/ha) in 2007. Vigor has been good, except in 2002 when 48% of the population had poor vigor and was classified as dying. Average annual leader growth was 1.7 inches (4.3 cm) in 2002 and 3.1 inches (7.9 cm) in 2007. Browse use was light in 1983, moderate-heavy in 1989,

1997, and 2007, and heavy in 2002.

True mountain mahogany plants were first sampled in 1997. Canopy cover was 1% in 2002 and 2007. The estimated density increased from 320 plants/acre (792 plants/ha) in 1997 to 380 plants/acre (941 plants/ha) in 2002, and decreased to 180 plants/acre (446 plants/ha) in 2007. Few seedling or young plants have been sampled. There were no decadent plants in 1997, but decadent plants comprised 68% of the population in 2002, and 11% in 2007. Plants with poor vigor and classified as dying accounted for 58% of the population in 2002 and 11% in 2007. The average annual leader growth on mahogany was 2.0 inches (5.1 cm) in 2002 and 2.9 inches (7.4 cm) in 2007. Browse use was heavy in 1997 and 2002, and moderate-heavy in 2007.

Canopy cover of serviceberry was less than 1% in 2002 and 2007. The serviceberry density increased from 66 plants/acre (163 plants/ha) in 1983 to 200 plants/acre (495 plants/ha) in 1997, and decreased to 160 plants/acre (396 plants/ha) by 2007. Few seedlings have been sampled, but young plants have comprised 25%-44% of the population since 1997. There were no decadent plants in 1983 or 1997, but decadent plants accounted for 50% of the population in 1989, 56% in 2002, and 25% in 2007. Browse use has ranged from light-moderate to heavy. Other species that are present include broom snakeweed (*Gutierrezia sarothrae*), stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), snowberry (*Symphoricarpos oreophilus*), Gambel oak (*Quercus gambelii*), Oregon grape (*Mahonia repens*), and pricklypear cactus (*Opuntia* sp.). Gambel oak was infested with insects in 2007.

Utah juniper (*Juniperus osteosperma*) density has increased from 22 trees/acre (54 trees/ha) in 1997 to 59 trees/acre (146 trees/ha) in 2007. The average diameter increased from 4.8 inches (12.2 cm) in 1997 to 5.6 inches (14.2 cm) in 2002, and decreased to 5.2 inches (13.2 cm) in 2007. Juniper canopy cover increased from 1% in 2002, to 4% in 2007.

Herbaceous Understory

The herbaceous understory is dominated by perennial grasses, and between seven and nine perennial species have been sampled. Perennial grass cover increased from 11% in 1997 to 16% in 2007. The dominant perennial species are crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), bluebunch wheatgrass (*Agroyron spicatum*), and Sandberg bluegrass (*Poa secunda*). Bulbous bluegrass (*Poa bulbosa*) was first sampled in 2002, but quadrat frequency has been 5% or less. This perennial species is of interest because it has a phenology that is similar to annual grasses (Stewart and Hull 1949). Cheatgrass is scattered throughout the study and quadrat frequency was 27% in 1997, 19% in 2002, and 33% in 2007. Cheatgrass cover has been 1% or less since 1997.

Perennial forb cover decreased from 16% in 1997 to 3% in 2002 and 2007. Between 16 and 24 perennial species have been sampled. Common perennial forbs include western aster (*Aster chilensis*), thistle (*Cirsium* sp.), spotted stickseed (*Hackelia patens*), Lewis flax (*Linum lewisii*), longleaf phlox (*Phlox longifolia*), and American vetch (*Vicia americana*). Annual forb cover decreased from 2% in 1997 to less than 1% in 2002 and 2007. Bur buttercup (*Ranunculus testiculatus*), an allelopathic annual (Buchanan et al. 1978), was first sampled in 2007, and had a quadrat frequency of 4%.

1989 TREND ASSESSMENT

The browse trend is stable. The density of preferred browse plants increased or remained stable, but there were also increases in decadence, poor vigor, and heavy browse use. Specifically, the density of sagebrush increased 25%, but decadence increased from 28% of the population to 56%. Sagebrush plants with poor vigor increased from 0% of the population to 13%, and, heavily browsed plants increased from 36% of the population to 56%. The serviceberry density increased 100%, but decadence increased from 0% of the population to 50%. The bitterbrush density remained stable. However, young bitterbrush plants decreased from 10% of the population to 3%, and decadence increased from 0% to 23%. Heavily browsed plants increased from 13% of the bitterbrush population to 45%. The grass trend is up. The sum of nested frequency

of perennial grasses increased 33%, including a significant increase in the nested frequency of intermediate wheatgrass. The forb trend is stable. The sum of nested frequency of perennial forbs decreased 4%, including significant decreases in the nested frequencies of rockcress (*Arabis* sp.), Douglas chaenactis (*Chaenactis douglasii*), hoary aster (*Machaeranthera canescens*), and yellow salsify (*Tragopogon dubius*). There were significant increases in the nested frequencies of wild onion (*Allium* sp.) and tapertip hawksbeard (*Crepis acuminata*).

browse - stable (0) grass - up (+2) forb - stable (0)

1997 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush decreased 43%. Most of this decrease was from the decadent age class, and as a result, decadence decreased to 31% of the population. However, changes in densities of all the shrubs may also be the result of the increased sample area. Plants with poor vigor increased to 23% of the population, and all of those plants were classified as dying. Heavily browsed sagebrush decreased to 13% of the population, though 57% had been moderately browsed. The serviceberry population increased 52%. Seedling serviceberry plants were sampled for the first time, and young plants increased from 0% of the population to 40%. No decadent serviceberry were sampled. The bitterbrush density decreased 5%. Seedling bitterbrush were also sampled for the first time, and young plants increased to 14% of the population. No decadent bitterbrush were sampled. The average height and crown measurements of all three species increased. Additionally, true mountain mahogany was sampled for the first time. The mahogany population was vigorous despite heavy browse use. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased 15%. Cheatgrass had a quadrat frequency of 27%. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased 15%, including significant increases in the sum of nested frequencies of Lewis flax and American vetch. The number of perennial species increased from 21 to 24. There were significant decreases in the nested frequencies of wild onion, bastard toadflax (*Comandra pallida*), and longleaf phlox. The Desirable Components Index (DCI) score was good due to high browse cover, low decadence, low annual grass cover, and high perennial grass and forb cover.

winter range condition (DCI) - good (77) Mid-level potential scale
browse - stable (0) grass - slightly up (+1) forb - slightly up (+1)

2002 TREND ASSESSMENT

The browse trend is down. The density of sagebrush increased 4%. However, recruitment remained low, and decadence increased to 65% of the population. Sagebrush plants with poor vigor increased to 44% of the population, nearly all of which were classified as dying. Heavily browsed sagebrush increased to 81% of the population. The density of serviceberry decreased 10%, and decadence increased to 56% of the population. Serviceberry plants with poor vigor and classified as dying increased from 0% of the population to 22%, and heavily browsed plants increased from 20% to 78%. The density of bitterbrush increased 9%. However, young plants decreased to 1% of the population, and decadence increased to 85%. Approximately half of the bitterbrush plants had poor vigor and were dying. Heavily browsed bitterbrush plants increased from 36% of the population to 89%. Mahogany density increased 19%. Mahogany decadence increased from 0% of the population to 68%. Dying plants increased from 0% of the mahogany population to 58%, and 95% of the plants had been heavily browsed. The average height and crown measurements of all four of these browse species decreased. The increase in decadence and plants with poor vigor is likely the result of drought conditions (Utah Climate Summaries 2007). Browse use at this study may have increased because of mild winter conditions and little snowfall. The grass trend is slightly up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 20%. There was a significant increase in the nested frequency of crested wheatgrass. However the grass trend was lowered by the presence of bulbous bluegrass, even though it was sampled at a low abundance. The forb trend is down. The sum of nested frequency of perennial forbs decreased 62%, including significant decreases in thistle and tapertip hawksbeard. Lewis flax, which had a quadrat frequency of 61% in 1997, was not sampled, and the number of perennial species sampled

decreased to 16. The DCI score declined to poor due to decreased browse cover, increased browse decadence, and decreased perennial forb cover.

winter range condition (DCI) - poor (46) Mid-level potential scale
browse - down (-2) grass - slightly up (+1) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of all the preferred browse species decreased. Specifically, the density of sagebrush decreased 39%. Seedling sagebrush were sampled for the first time, but young plants continued to comprise 2% of the population. Decadence decreased to 50% of the population, but the density of dead plants increased two-fold to 980 plants/acre (2,426 plants/ha). Sagebrush plants classified as dying decreased to approximately one-fourth of the population. Heavily browsed plants decreased to 46% of the population. The density of serviceberry decreased 11%, but decadence decreased to 25% of the population. Browse use on serviceberry decreased from mostly heavy to light-moderate. The bitterbrush density decreased 52%. Young plants increased to 16% of the population, and decadence decreased to 18%. Dying bitterbrush plants decreased to 6% of the population, and heavily browsed plants decreased to 31% of the population. The density of mahogany decreased 53%. Decadent plants that were classified as dying decreased to 11% of the population. Heavily browsed mahogany plants decreased to 56% of the population. The grass trend is up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 60%. The nested frequencies of crested wheatgrass, bluebunch wheatgrass, and Sandberg bluegrass increased significantly. There was also a significant increase in the nested frequency of cheatgrass. The forb trend is down. The sum of nested frequency of perennial forbs decreased 23%, including a significant decrease in the nested frequency of American vetch. Bur buttercup was sampled for the first time and had a quadrat frequency of 4%. Despite the decrease in browse cover, the DCI score increased to fair. The increase was caused by a decline in browse decadence and an increase in perennial grass cover.

winter range condition (DCI) - fair (54) Mid-level potential scale
browse - down (-2) grass - up (+2) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 42

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{a}$29	$_{ab}$62	$_{b}$80	$_{c}$126	$_{d}$200	5.39	7.13	9.66
G	Agropyron intermedium	$_{a}$37	$_{b}$52	$_{ab}$49	$_{ab}$45	$_{ab}$36	2.48	1.44	.94
G	Agropyron spicatum	$_{a}$48	$_{a}$51	$_{a}$27	$_{a}$24	$_{b}$91	1.02	1.70	2.84
G	Bromus carinatus	$_{a}$6	$_{a}$3	$_{a}$5	$_{a}$6	$_{a}$7	.06	.53	.53
G	Bromus tectorum (a)	-	-	$_{ab}$70	$_{a}$38	$_{b}$86	.93	.17	1.49
G	Oryzopsis hymenoides	$_{a}$6	$_{a}$5	$_{a}$6	$_{a}$9	$_{a}$3	.06	.21	.06
G	Poa bulbosa	-	-	-	$_{a}$11	$_{a}$6	-	.12	.03
G	Poa fendleriana	$_{a}$14	$_{a}$13	$_{a}$3	$_{a}$10	$_{a}$14	.01	.06	.08
G	Poa pratensis	-	-	$_{a}$5	$_{a}$11	$_{a}$6	.66	.10	.30
G	Poa secunda	-	$_{a}$4	$_{ab}$43	$_{b}$30	$_{c}$61	1.38	.63	1.45
G	Sitanion hystrix	3	-	-	-	-	-	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
Total for Annual Grasses		0	0	70	38	86	0.93	0.17	1.49
Total for Perennial Grasses		143	190	218	272	424	11.08	11.94	15.91
Total for Grasses		143	190	288	310	510	12.02	12.11	17.40
F	Agoseris glauca	-	-	$_{a}$-	$_{b}$12	$_{ab}$2	.01	.02	.00
F	Alyssum alyssoides (a)	-	-	-	$_{a}$3	$_{b}$35	-	.01	.09
F	Allium sp.	$_{a}$10	$_{b}$83	$_{a}$19	$_{a}$18	$_{a}$3	.06	.07	.03
F	Arabis sp.	$_{b}$29	$_{a}$4	$_{a}$8	$_{a}$3	-	.04	.00	-
F	Artemisia dracunculus	3	-	-	-	-	-	-	-
F	Astragalus beckwithii	-	-	4	-	-	.21	-	-
F	Aster chilensis	$_{a}$23	$_{a}$17	$_{a}$24	$_{a}$13	$_{a}$10	.93	.15	.12
F	Astragalus convallarius	-	-	10	-	-	.04	-	-
F	Astragalus sp.	-	-	2	-	-	.00	-	-
F	Balsamorhiza sagittata	-	-	$_{a}$1	$_{a}$3	$_{a}$3	.15	.15	.15
F	Castilleja linariaefolia	-	-	4	-	-	.03	-	-
F	Camelina microcarpa (a)	-	-	$_{a}$14	$_{a}$17	$_{b}$53	.05	.25	.20
F	Chenopodium album (a)	-	-	2	-	-	.00	-	-
F	Chaenactis douglasii	$_{b}$62	$_{a}$7	-	-	-	-	-	-
F	Cirsium sp.	$_{b}$55	$_{b}$36	$_{b}$50	$_{a}$2	$_{a}$2	1.75	.01	.38
F	Collomia linearis (a)	-	-	8	-	-	.02	-	-
F	Comandra pallida	$_{ab}$19	$_{b}$27	$_{a}$3	-	-	.02	-	-
F	Collinsia parviflora (a)	-	-	$_{b}$23	$_{ab}$11	$_{a}$1	.04	.02	.00
F	Crepis acuminata	$_{a}$7	$_{b}$45	$_{b}$56	$_{a}$10	$_{a}$1	.57	.23	.03
F	Cryptantha sp.	7	-	-	-	-	-	-	-
F	Cymopterus sp.	-	$_{b}$44	$_{ab}$33	-	$_{a}$24	.24	-	.14
F	Descurainia pinnata (a)	-	-	$_{a}$7	$_{a}$8	$_{a}$6	.01	.06	.01
F	Eriogonum brevicaule	$_{a}$8	$_{a}$9	-	$_{a}$3	$_{a}$4	-	.06	.06
F	Erigeron pumilus	-	-	$_{a}$1	$_{a}$-	-	.00	.00	-
F	Hackelia patens	$_{ab}$58	$_{b}$69	$_{ab}$79	$_{ab}$56	$_{a}$47	3.04	.76	1.10
F	Lappula occidentalis (a)	-	-	5	-	-	.01	-	-
F	Linum lewisii	$_{b}$42	$_{ab}$27	$_{c}$161	-	$_{a}$12	6.36	-	.16
F	Lithospermum ruderale	$_{a}$6	$_{a}$16	$_{a}$5	$_{a}$6	$_{a}$7	.33	.56	.22
F	Machaeranthera canescens	$_{b}$75	$_{a}$3	$_{a}$7	$_{a}$1	$_{a}$1	.06	.03	.00
F	Microsteris gracilis (a)	-	-	$_{a}$5	$_{b}$38	$_{a}$14	.01	.10	.03
F	Penstemon humilis	$_{b}$19	$_{ab}$11	$_{ab}$8	$_{a}$3	-	.06	.03	-
F	Phlox longifolia	$_{b}$86	$_{b}$102	$_{a}$45	$_{a}$40	$_{a}$25	.29	.14	.28
F	Polygonum douglasii (a)	-	-	1	-	-	.00	-	-

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Ranunculus testiculatus (a)	-	-	-	-	7	-	-	.02
F	Senecio multilobatus	a3	a4	a7	-	-	.09	-	-
F	Streptanthus cordatus	a6	a4	a9	a8	a2	.16	.04	.01
F	Taraxacum officinale	-	3	-	-	-	-	-	-
F	Tragopogon dubius	b30	a4	a17	-	a12	.06	-	.06
F	Trifolium sp.	-	-	-	2	-	-	.03	-
F	Veronica biloba (a)	-	-	b155	-	a9	1.44	-	.02
F	Vicia americana	a21	a23	b74	b58	a29	1.54	.44	.20
F	Viola sp.	-	-	3	-	-	.00	-	-
F	Zigadenus paniculatus	a2	a9	-	-	-	-	-	-
Total for Annual Forbs		0	0	220	77	125	1.60	0.44	0.38
Total for Perennial Forbs		571	547	630	238	184	16.13	2.74	2.97
Total for Forbs		571	547	850	315	309	17.74	3.19	3.35

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

BROWSE TRENDS --
Management unit 17 , Study no: 42

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier alnifolia	8	9	8	.56	.57	.18
B	Artemisia tridentata vaseyana	63	62	40	13.34	8.41	4.17
B	Cercocarpus montanus	12	12	7	1.14	1.60	.49
B	Chrysothamnus viscidiflorus viscidiflorus	23	25	23	1.96	2.03	1.93
B	Gutierrezia sarothrae	53	56	54	1.99	1.87	2.16
B	Juniperus osteosperma	4	3	2	2.49	2.99	3.63
B	Mahonia repens	1	0	1	.03	-	.03
B	Opuntia sp.	1	2	4	-	.01	.06
B	Purshia tridentata	55	51	31	9.88	4.64	2.72
B	Quercus gambelii	3	4	3	.41	.15	.06
B	Symphoricarpos oreophilus	25	30	22	2.11	1.64	1.13
Total for Browse		248	254	195	33.94	23.95	16.60

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 42

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	.18	.11
Artemisia tridentata vaseyana	5.88	5.58
Cercocarpus montanus	.81	1.18
Chrysothamnus viscidiflorus viscidiflorus	1.88	1.95
Gutierrezia sarothrae	.60	1.23
Juniperus osteosperma	.83	3.54
Opuntia sp.	-	.06
Purshia tridentata	2.63	3.16
Quercus gambelii	.20	.20
Symphoricarpos oreophilus	1.85	1.18

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 42

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.0	1.3
Cercocarpus montanus	2.0	2.9
Purshia tridentata	1.7	3.1

POINT-QUARTER TREE DATA --
Management unit 17 , Study no: 42

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	33	59

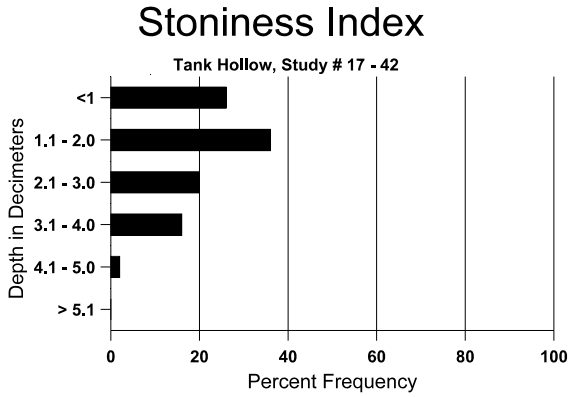
Average diameter (in)	
'02	'07
5.6	5.2

BASIC COVER --
Management unit 17 , Study no: 42

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	1.25	14.00	52.99	38.21	42.77
Rock	4.50	5.75	4.18	3.29	3.54
Pavement	3.25	6.25	1.67	.88	1.62
Litter	61.00	51.25	53.51	50.02	41.36
Cryptogams	0	0	.31	.68	.35
Bare Ground	30.00	22.75	11.94	23.39	24.59

SOIL ANALYSIS DATA --
Herd Unit 17 Study no: 42, Tank Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
16.5	46.4 (17.3)	7.1	25.4	34.7	39.8	3.4	6.9	64.0	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 42

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	1	6	4
Elk	36	20	33
Deer	38	52	31
Cattle	-	4	3

Days use per acre (ha)	
'02	'07
-	-
49 (121)	46 (114)
155 (384)	21 (53)
5 (13)	2 (5)

BROWSE CHARACTERISTICS --
Management unit 17 , 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)
Amelanchier alnifolia												
83	**66**	-	-	66	-	-	100	0	0	-	0	25/17
89	**132**	-	-	66	66	-	50	0	50	-	0	23/15
97	**200**	40	80	120	-	-	20	20	0	-	0	32/33
02	**180**	-	80	-	100	20	11	78	56	22	22	24/21
07	**160**	-	40	80	40	-	50	0	25	13	13	28/24

		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												
83	**2399**	-	-	1733	666	-	50	36	28	-	0	31/37
89	**2999**	-	133	1200	1666	-	27	56	56	11	13	24/43
97	**1720**	-	80	1100	540	360	57	13	31	23	23	30/46
02	**1780**	-	40	580	1160	480	16	81	65	43	44	26/33
07	**1080**	60	20	520	540	980	37	46	50	24	28	28/36
Cercocarpus montanus												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**320**	-	20	300	-	-	19	75	0	-	0	33/40
02	**380**	-	40	80	260	-	0	95	68	58	58	33/32
07	**180**	20	-	160	20	-	44	56	11	11	11	29/27
Chrysothamnus viscidiflorus viscidiflorus												
83	**400**	-	-	400	-	-	0	0	0	-	0	10/17
89	**600**	-	-	600	-	-	0	0	0	-	0	11/13
97	**1460**	20	100	1360	-	-	0	0	0	-	0	12/17
02	**1700**	-	60	1620	20	-	4	1	1	-	0	9/13
07	**1340**	-	20	1300	20	-	0	0	1	-	0	9/16
Gutierrezia sarothrae												
83	**2400**	-	-	2400	-	-	0	0	0	-	0	12/8
89	**3733**	-	-	3200	533	-	0	0	14	7	7	10/10
97	**5420**	400	1200	4200	20	-	0	0	0	-	0	10/10
02	**3840**	20	20	2800	1020	1300	0	0	27	9	9	8/8
07	**3460**	20	100	3180	180	40	0	0	5	2	2	8/9
Juniperus osteosperma												
83	**133**	-	-	133	-	-	0	50	-	-	0	67/12
89	**66**	-	-	66	-	-	0	0	-	-	0	106/79
97	**80**	-	-	80	-	-	0	0	-	-	0	82/79
02	**60**	-	-	60	-	-	0	33	-	-	0	-/-
07	**40**	-	20	20	-	-	0	0	-	-	0	-/-
Mahonia repens												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**80**	-	20	60	-	-	0	0	-	-	0	3/6
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**120**	-	-	120	-	-	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.												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**20**	-	-	20	-	-	0	0	0	-	0	4/5
02	**60**	-	20	20	20	-	0	0	33	33	67	3/7
07	**100**	-	20	80	-	-	0	0	0	-	0	6/9
Purshia tridentata												
83	**2066**	-	200	1866	-	-	13	13	0	-	0	16/19
89	**2065**	-	66	1533	466	-	48	45	23	-	0	15/24
97	**1960**	20	280	1680	-	-	52	36	0	-	0	29/49
02	**2140**	-	20	300	1820	100	7	89	85	48	48	12/26
07	**1020**	-	160	680	180	220	41	31	18	6	6	16/33
Quercus gambelii												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**140**	20	100	40	-	-	0	0	0	-	0	51/35
02	**160**	-	80	-	80	20	0	38	50	50	50	26/27
07	**120**	-	40	80	-	-	0	0	0	-	0	90/57
Ribes sp.												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	19/70
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Symphoricarpos oreophilus												
83	**2266**	66	466	1800	-	-	0	0	0	-	0	19/14
89	**2133**	-	200	1933	-	-	22	0	0	-	50	15/14
97	**1000**	-	100	900	-	-	0	0	0	-	0	18/36
02	**960**	-	200	620	140	40	21	8	15	2	2	12/24
07	**900**	-	620	280	-	100	0	0	0	-	7	13/18

Trend Study 17-44-07

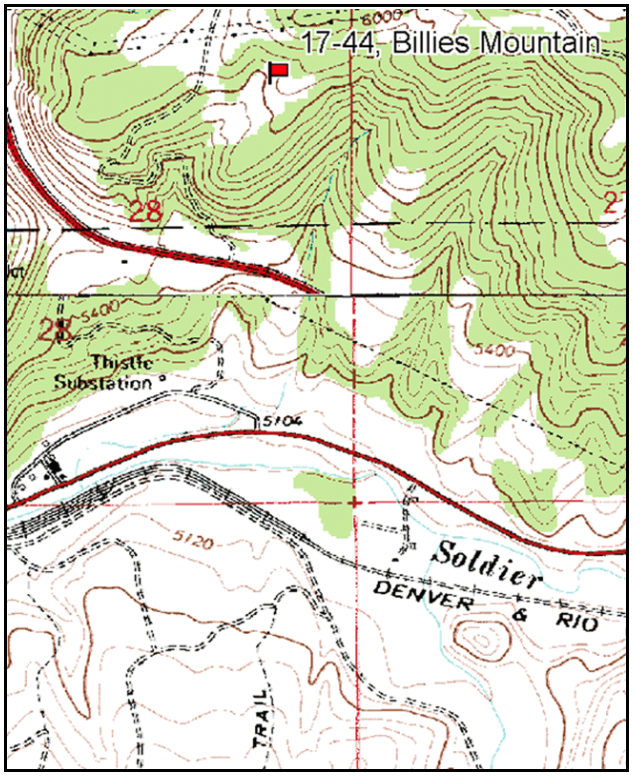
Study site name: Billies Mountain . Vegetation type: Big Sagebrush-Grass .

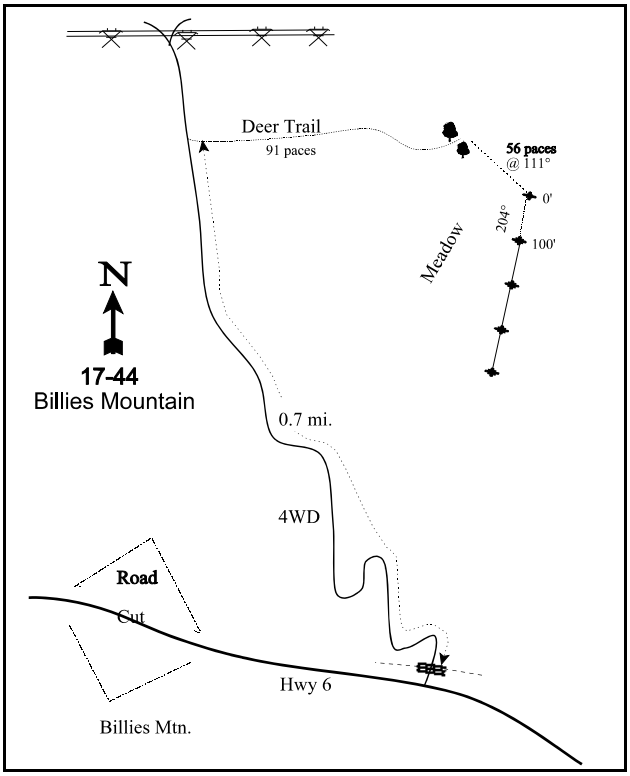
Compass bearing: frequency baseline 204 degrees magnetic.

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

LOCATION DESCRIPTION

On Highway 6 and 89 in Spanish Fork Canyon, east of the new road cut through Billies Mountain and 0.9 miles west of the junction of Route 89 south to Manti and US 6, turn north onto a dirt road. Cross a cattle guard and follow the road up 0.7 miles to where it breaks out into a sagebrush/grass flat. On the right, at the head of a small drainage, a game trial heads east towards a small meadow. Follow this trail approximately 150 yards to 2 large junipers at the edge of the meadow. From the junipers, walk up the near slope 56 paces bearing 111 degrees to the 0-foot baseline stake. This fencepost is marked by browse tag number 3951.





Map Name: Billies Mountain

Diagrammatic Sketch

Township 9S , Range 4E , Section 28

GPS: NAD 83, UTM 12T 458808 E 4428476 N

DISCUSSION

Billies Mountain - Trend Study No. 17-44

Study Information

This winter range study is located east of US-6 near the town of Thistle [elevation: 5,800 feet (1,768 m), slope: 5%-20%, aspect: southwest]. The nearest perennial source of water is Spanish Fork 0.7 miles (1.1 km) to the west, on the far side of US-6. The range type is big sagebrush-grass with a variety of other shrubs interspersed throughout. Deer and elk use has been moderate, and deer use may occur year-round. A cattle allotment overlays the study area, though the allotment was rested in 1989. From the pellet group transect data, deer use was estimated at 36 days use/acre (89 ddu/ha) in 2002 and 29 days use/acre (73 ddu/ha) in 2007. Elk use was estimated at 11 days use/acre (28 edu/ha) in 2002 and 51 days use/acre (126 edu/ha) in 2007. Most of the big game pellet groups appear to be from winter use. Cattle use was estimated at 15 days use/acre (38 cdu/ha) in 2002 and 2 days use/acre (4 cdu/ha) in 2007.

Soil

The soil is relatively deep, grey in color, and has little rock. It has a clay texture and a mildly alkaline reaction (pH of 7.4). Soil phosphorous is quite low at only 4.6 ppm. Values less than 6 ppm have been found to limit plant growth and development (Tiedemann and Lopez 2004). Relative vegetation cover has increased from 39% in 1997 to 49% in 2007, and relative bare ground cover was fairly constant at 12%-17% during that time. The study is located near the head of a small swale, where erosion has been common. However, the erosion condition was classified as stable in 2002 and 2007.

Browse

The study supports a variety of browse species. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant species. In 2007, canopy cover was 4%. The population density increased from 2,333 plants/acre (5,775 plants/ha) in 1983 to 2,433 plants/acre (6,022 plants/ha) in 1989, and decreased to 980 plants/acre (2,426 plants/ha) by 2007. Few seedling plants have been sampled, and young plants have only been sampled since 1997, ranging from 5% to 10% of the population. Decadent plants have accounted for greater than half of the population each sample year, and were most numerous in 1989 when 86% of the population was decadent. The density of dead plants decreased from 860 plants/acre (2,129 plants/ha) in 1997 to 520 plants/acre (1,287 plants/ha) in 2007. The proportion of plants with poor vigor has oscillated between increasing and decreasing in alternate sample years, and was the highest in 1983 (63%) and lowest in 1989 (12%). In 2007, 41% of the population had poor vigor. The average annual leader growth was 2.1 inches (5.3 cm) in 2002 and 1.7 inches (4.4 cm) in 2007. Browse use shifted from moderate-heavy in 1983 and 1989 to light-moderate in 1997. In 2002, browse use increased to moderate-heavy, and in 2007 it decreased to light-moderate. The thick grass understory and heavy winter use may be limiting the establishment of new sagebrush plants. Continued, moderate livestock use in the spring and early summer could help to improve the sagebrush stand by reducing grass competition.

A small population of antelope bitterbrush (*Purshia tridentata*) provides some additional forage. Bitterbrush canopy cover was 3% in 2007. The density increased from 266 plants/acre (658 plants/ha) in 1983 to 540 plants/acre (1,337 plants/ha) in 1997, and decreased to 380 plants/acre (941 plants/ha) in 2002. In 2007, the density increased to 400 plants/acre (990 plants/ha). The population has been largely comprised of mature, healthy plants. Browse use has ranged from light to heavy. It was lightest in 1989, and heaviest in 2002. The average annual leader growth was 1.7 inches (4.3 cm) in 2002 and 2 inches (5.1 cm) in 2007.

Other browse species that are present include serviceberry (*Amelanchier alnifolia*), dwarf rabbitbrush (*Chrysothamnus depressus*), white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), broom snakeweed (*Gutierrezia sarothrae*), chokecherry (*Prunus virginiana*), Woods' rose (*Rosa woodsii*), snowberry (*Symphoricarpos oreophilus*), and

gray horsebrush (*Tetradymia canescens*). These populations have either changed very little since 1983, or have shown little browse use.

Herbaceous Understory

The herbaceous understory is abundant and exceptionally diverse. Perennial grass cover was 24% in 1997, 19% in 2002, and 23% in 2007. Between 12 and 18 perennial species have been sampled. The dominant perennial species is bluebunch wheatgrass (*Agropyron spicatum*), which has had an average cover of 9% since 1997. Other abundant perennial species include crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), western wheatgrass (*Agropyron smithii*), smooth brome (*Bromus inermis*), prairie junegrass (*Koeleria cristata*), bulbous bluegrass (*Poa bulbosa*), Kentucky bluegrass (*Poa pratensis*), and Sandberg bluegrass (*Poa secunda*). Bulbous bluegrass has a phenology that is similar to annual grasses (Stewart and Hull 1949), and has increased in quadrat frequency from 2% in 1983 to 41% in 2007. Cheatgrass (*Bromus tectorum*) is present but has provided less than 1% cover since 1997.

Perennial forb cover was 20% in 1997, and 18% in 2002 and 2007. Between 17 and 23 perennial species have been sampled. The dominant perennial forb is western aster (*Aster chilensis*), which has accounted for an average 9% cover since 1997. Other common perennial species include western yarrow (*Achillea millefolium*), cudweed sagewort (*Artemisia ludoviciana*), thistle (*Cirsium* sp.), rock goldenrod (*Petradoria pumila*), and American vetch (*Vicia americana*). The composition of the dominant forbs is indicative of heavy grazing pressure in the past. Annual forbs are present, but have provided 1% cover or less since 1997. Houndstongue (*Cynoglossum officinale*), a noxious weed, was sampled in 1997 and 2002 in 3% and 2% of the quadrats, respectively.

1989 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush increased 4%, but decadence increased from 53% of the population to 86%. Plants with poor vigor decreased from 63% of the population to 12%. Browse use on sagebrush remained moderate-heavy. The average crown width of sagebrush decreased 14 inches (36 cm). The bitterbrush density increased 13%, and there continued to be no decadent plants. Browse use on bitterbrush shifted from light-moderate to light, and heavily browsed plants decreased from 25% of the population to 0%. No seedling or young plants of either species were sampled. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 11%, including significant decreases in the nested frequencies of two native grasses: mutton bluegrass (*Poa fendleriana*) and Letterman needlegrass (*Stipa lettermani*). There was a significant increase in the nested frequency of Kentucky bluegrass, which is an introduced species. The forb trend is stable. The sum of nested frequency of perennial forbs increased 7%. The nested frequencies of western yarrow and alfalfa (*Medicago sativa*) decreased significantly, while that of wild onion (*Allium* sp.) and longleaf phlox (*Phlox longifolia*) increased significantly.

browse - slightly down (-1) grass - stable (0) forb - stable (0)

1997 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush decreased 48%. However, some of this decrease is likely the result of the larger area sampled beginning in 1997, otherwise the browse trend would have been down. Young sagebrush increased from 0% of the population to 5%, and decadence decreased to 54%. The proportion of plants with poor vigor increased to 40%, and all of those were classified as dying. Browse use on sagebrush shifted to light-moderate, and heavily browsed plants decreased to 2% of the population. The average crown width of sagebrush increased 17 inches (43 cm). The density of bitterbrush increased 80%, and young plants increased to 4% of the population. Decadent plants increased to 7% of the population. Browse use on bitterbrush increased to moderate-heavy, and 56% of the plants had been heavily browsed. The grass trend is slightly up. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 15%. There were significant increases in the nested frequencies of Sandberg bluegrass and bulbous bluegrass,

and a significant decrease in the nested frequency of bottlebrush squirreltail (*Sitanion hystrix*). The forb trend is stable. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased 13%. There was a significant increase in the nested frequency of prickly lettuce (*Lactuca serriola*), and significant decreases in the nested frequencies of western aster and longleaf phlox. The number of perennial species sampled increased from 18 to 23. However, one of the new species was houndstongue, a noxious weed. It had a quadrat frequency of 3%. The Desirable Components Index (DCI) score was fair due to low browse cover and recruitment, high browse decadence, high perennial grass and forb cover, and the presence of one noxious weed species.

winter range condition (DCI) - fair (54) Mid-level potential scale
browse - slightly down (-1) grass - slightly up (+1) forb - stable (0)

2002 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush decreased 8%. Young plants increased to 10% of the sagebrush population, and decadence increased slightly to 57%. The density of dead plants decreased from 860 plants/acre (2,129 plants/ha) to 600 plants/acre (1,485 plants/ha). Dying plants decreased to 29% of the population. Browse use on sagebrush increased to moderate-heavy, and heavily browsed plants increased to 55% of the population. The density of bitterbrush decreased 30%. No seedling or young plants were sampled, and decadent plants increased to 21% of the bitterbrush population. Browse use on bitterbrush increased to heavy; 79% of the plants had been heavily browsed. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 11%. There were significant decreases in the nested frequencies of Kentucky and Sandberg bluegrasses. However, there was a significant increase in the nested frequency of crested wheatgrass, and a significant decrease in that of cheatgrass. There was some difficulty in identifying some grasses due to grazing use and lack of seed heads. The forb trend is slightly down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 17%. There were significant decreases in timber poisonvetch (*Astragalus convallarius*), bastard toadflax (*Comandra pallida*), and American vetch. Houndstongue had a quadrat frequency of 2%. The DCI score remained fair.

winter range condition (DCI) - fair (54) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush decreased 16%. The young and decadent age classes remained fairly stable. The density of dead sagebrush decreased to 520 plants/acre (1,287 plants/ha). Plants with poor vigor increased to 41% of the population, but dying plants continued to comprise 29% of the population. Browse use shifted to light-moderate, and heavily browsed plants decreased to 10% of the population. The bitterbrush density increased 5%. Seedling bitterbrush plants were sampled for the first time, and young plants increased to 10% of the population. The population was comprised entirely of young and mature plants, all of which were vigorous. Browse use on bitterbrush shifted to light-moderate, and heavily browsed plants decreased to 15% of the population. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 13%. There were significant increases in the nested frequencies of western wheatgrass and prairie junegrass. The number of perennial grass species sampled increased from 13 to 18. However, Japanese brome (*Bromus japonicus*) was sampled for the first time and had a quadrat frequency of 25%. Additionally, the quadrat frequency of bulbous bluegrass increased from 28% to 41%. Again, there was some difficulty in identifying some grasses due to lack of seed heads. The forb trend is stable. The sum of nested frequency of perennial forbs changed little, increasing 1%. There was a significant increase in the nested frequency of wayside gromwell (*Lithospermum ruderale*) and a significant decrease in that of longleaf phlox. Houndstongue was not sampled. The DCI score remained fair.

winter range condition (DCI) - fair (58) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 44

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	-	-	a11	b55	b45	.48	1.99	2.62
G	Agropyron intermedium	-	-	-	-	22	-	-	1.26
G	Agropyron smithii	-	a6	a13	a21	b51	.05	.58	1.03
G	Agropyron spicatum	a149	ab182	b202	ab175	ab167	8.94	9.46	8.42
G	Agropyron trachycaulum	a9	a22	-	a13	a26	-	.19	.84
G	Bromus inermis	-	-	a7	a10	a12	.30	.79	1.16
G	Bromus japonicus (a)	-	-	-	-	63	-	-	.20
G	Bromus tectorum (a)	-	-	b60	a4	a19	.87	.01	.35
G	Carex sp.	a6	-	-	-	a2	-	-	.00
G	Elymus glaucus	a9	-	a3	-	-	.63	-	-
G	Elymus junceus	-	-	-	a4	a4	-	.63	.38
G	Koeleria cristata	ab24	a4	ab26	a7	b32	.70	.09	1.20
G	Melica bulbosa	ab14	b24	b38	ab13	a3	1.52	.13	.01
G	Oryzopsis hymenoides	a4	a2	-	-	a2	-	-	.03
G	Poa bulbosa	a5	a7	b58	bc82	c96	1.60	2.79	2.14
G	Poa fendleriana	b37	a16	a13	ab31	a16	.66	.66	.49
G	Poa nevadensis	-	-	-	-	3	-	-	.03
G	Poa pratensis	ab99	c156	bc126	ab97	a66	6.76	1.46	1.83
G	Poa secunda	-	a1	c69	b34	bc68	1.58	.35	1.87
G	Sitanion hystrix	ab16	b23	a7	-	a4	.06	-	.04
G	Stipa lettermani	b44	a22	a10	a8	a4	.31	.07	.03
Total for Annual Grasses		0	0	60	4	82	0.87	0.00	0.55
Total for Perennial Grasses		416	465	583	550	623	23.62	19.21	23.44
Total for Grasses		416	465	643	554	705	24.50	19.22	24.00
F	Achillea millefolium	b89	a32	a33	a41	a47	1.06	.91	1.43
F	Alyssum alyssoides (a)	-	-	a2	-	a1	.00	-	.00
F	Allium sp.	a3	b15	b22	ab12	ab6	.05	.39	.02
F	Antennaria rosea	10	-	-	-	-	-	-	-
F	Artemisia ludoviciana	a37	a55	a42	a45	a58	1.49	1.05	1.91
F	Aster chilensis	bc301	c310	a225	a248	ab245	8.27	10.07	8.68
F	Astragalus convallarius	bc68	c82	bc58	a24	ab40	.78	.34	.57
F	Astragalus sp.	a3	a7	-	-	-	-	-	-
F	Astragalus utahensis	a12	a14	a14	a10	a12	.25	.33	.22
F	Camelina microcarpa (a)	-	-	ab16	a1	b13	.13	.00	.06
F	Calochortus nuttallii	a11	a19	a21	a19	a17	.05	.07	.05

Type	Species	Nested Frequency					Average Cover %		
		'83	'89	'97	'02	'07	'97	'02	'07
F	Cirsium sp.	$_{a}$7	$_{ab}$21	$_{b}$47	$_{b}$36	$_{ab}$31	1.50	.39	.62
F	Collomia linearis (a)	-	-	$_{a}$7	-	$_{a}$1	.02	-	.00
F	Comandra pallida	-	-	$_{b}$11	$_{a}$1	-	.03	.00	-
F	Crepis acuminata	-	-	$_{a}$6	$_{a}$8	$_{a}$11	.02	.09	.30
F	Cymopterus sp.	-	-	$_{a}$9	$_{a}$12	$_{a}$16	.07	.37	.13
F	Cynoglossum officinale	-	-	$_{a}$5	$_{a}$2	-	.01	.01	-
F	Descurainia pinnata (a)	-	-	-	-	20	-	-	.06
F	Epilobium brachycarpum (a)	-	-	$_{c}$81	$_{b}$33	$_{a}$6	.51	.06	.01
F	Eriogonum brevicaule	$_{a}$4	$_{a}$6	$_{a}$11	$_{a}$3	$_{a}$7	.10	.04	.10
F	Eriogonum racemosum	-	-	-	1	-	-	.00	-
F	Eriogonum umbellatum	-	$_{a}$3	$_{a}$5	$_{a}$3	$_{a}$6	.01	.03	.06
F	Galium aparine (a)	-	-	$_{b}$29	$_{ab}$22	$_{a}$6	.56	.19	.01
F	Hackelia patens	$_{ab}$11	$_{ab}$2	$_{b}$12	$_{ab}$4	$_{a}$-	.03	.00	.00
F	Helianthus annuus (a)	1	-	-	-	-	-	-	-
F	Lappula occidentalis (a)	-	-	-	-	3	-	-	.01
F	Lactuca serriola	-	$_{a}$12	$_{b}$33	-	-	.24	-	-
F	Lithospermum ruderale	-	-	$_{a}$1	$_{a}$1	$_{b}$14	.03	.15	.29
F	Medicago sativa	$_{b}$113	$_{a}$10	$_{a}$18	-	$_{a}$13	.35	-	.22
F	Petradoria pumila	-	-	$_{a}$25	$_{ab}$32	$_{b}$37	1.05	1.81	2.49
F	Phlox longifolia	$_{a}$4	$_{c}$128	$_{b}$67	$_{b}$88	$_{a}$15	.21	.66	.05
F	Polygonum douglasii (a)	-	-	$_{a}$2	$_{a}$1	-	.00	.00	-
F	Sphaeralcea coccinea	-	-	-	$_{a}$3	$_{a}$3	-	.00	.00
F	Taraxacum officinale	$_{a}$1	$_{a}$1	-	-	-	-	-	-
F	Tragopogon dubius	$_{a}$12	$_{a}$16	$_{a}$31	$_{a}$9	$_{a}$34	.90	.06	.35
F	Veronica biloba (a)	-	-	-	3	-	-	.00	-
F	Vicia americana	-	-	$_{b}$131	$_{a}$98	$_{ab}$106	2.65	.89	.71
F	Viguiera multiflora	$_{a}$17	$_{a}$22	$_{a}$30	$_{a}$10	-	.56	.04	-
Total for Annual Forbs		1	0	137	60	50	1.23	0.27	0.18
Total for Perennial Forbs		703	755	857	710	718	19.77	17.76	18.25
Total for Forbs		704	755	994	770	768	21.01	18.04	18.43

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

BROWSE TRENDS --
Management unit 17 , Study no: 44

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier alnifolia	2	3	1	.03	-	-
B	Artemisia tridentata vaseyana	50	48	41	4.69	4.34	3.80
B	Chrysothamnus depressus	7	6	6	.03	.03	.06
B	Chrysothamnus nauseosus albicaulis	21	16	14	.48	.54	.54
B	Chrysothamnus viscidiflorus viscidiflorus	24	25	23	1.67	1.21	1.29
B	Gutierrezia sarothrae	17	20	10	.31	.16	.04
B	Juniperus osteosperma	2	2	4	1.78	1.78	2.14
B	Prunus virginiana	1	2	1	.15	-	.15
B	Purshia tridentata	14	12	13	1.89	2.50	1.47
B	Rosa woodsii	3	3	3	.15	.15	.15
B	Symphoricarpos oreophilus	9	10	10	1.16	1.82	1.60
B	Tetradymia canescens	9	9	12	.30	.09	.39
Total for Browse		159	156	138	12.67	12.66	11.67

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 44

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	4.28
Chrysothamnus depressus	-	.18
Chrysothamnus nauseosus albicaulis	-	1.20
Chrysothamnus viscidiflorus viscidiflorus	-	1.21
Gutierrezia sarothrae	-	.13
Juniperus osteosperma	.30	7.18
Prunus virginiana	-	.43
Purshia tridentata	-	2.56
Rosa woodsii	-	.03
Symphoricarpos oreophilus	-	2.78
Tetradymia canescens	-	.35

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 44

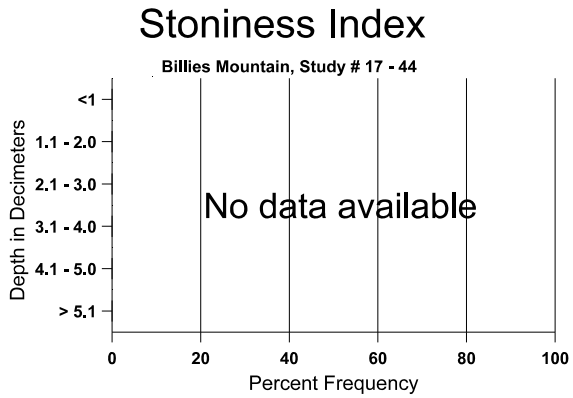
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.1	1.7
Purshia tridentata	-	2.0

BASIC COVER --
Management unit 17 , Study no: 44

Cover Type	Average Cover %				
	'83	'89	'97	'02	'07
Vegetation	5.25	12.50	46.86	54.50	56.66
Rock	.50	.75	.68	.42	.27
Pavement	1.25	4.75	1.09	1.27	2.65
Litter	64.00	58.25	54.79	38.76	38.87
Cryptogams	0	0	1.70	.42	.15
Bare Ground	29.00	23.75	14.87	19.72	16.60

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 44, Billies Mountain

Effective rooting depth (in)	Temp °F (depth)	pH	Clay			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
21.1	49.0 (17.7)	7.4	23.4	20.7	55.8	2.2	4.6	323.2	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 44

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	1	-
Rabbit	-	1	2
Elk	25	18	12
Deer	37	15	33
Cattle	2	9	7

Days use per acre (ha)	
'02	'07
1 (2)	-
-	-
11 (28)	51 (126)
36 (89)	29 (73)
15 (38)	2 (4)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 44

		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												
83	**99**	-	33	66	-	-	33	67	-	-	0	34/40
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**40**	-	-	40	-	-	50	0	-	-	0	21/25
02	**60**	-	20	40	-	-	33	33	-	-	0	23/34
07	**20**	-	-	20	-	-	100	0	-	-	0	34/32
Artemisia tridentata vaseyana												
83	**2333**	100	-	1100	1233	-	54	33	53	-	63	22/34
89	**2433**	-	-	333	2100	-	56	26	86	11	12	24/20
97	**1260**	20	60	520	680	860	52	2	54	40	40	27/37
02	**1160**	-	120	380	660	600	26	55	57	29	29	27/31
07	**980**	-	100	360	520	520	55	10	53	29	41	25/34
Chrysothamnus depressus												
83	**133**	-	-	133	-	-	0	0	0	-	0	9/11
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**460**	-	20	440	-	-	0	0	0	-	0	8/11
02	**180**	-	-	160	20	-	11	0	11	-	0	7/10
07	**220**	-	-	220	-	-	0	0	0	-	0	7/12
Chrysothamnus nauseosus albicaulis												
83	**366**	-	66	300	-	-	36	0	0	-	0	18/13
89	**732**	-	166	333	233	-	5	0	32	-	0	20/17
97	**660**	-	60	600	-	-	3	0	0	-	0	19/19
02	**420**	-	-	280	140	20	19	5	33	-	0	22/30
07	**320**	-	-	280	40	-	13	0	13	-	0	28/33

		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)
Chrysothamnus viscidiflorus viscidiflorus												
83	**833**	-	100	733	-	-	0	0	0	-	0	16/13
89	**1698**	-	366	1166	166	-	0	0	10	-	2	14/16
97	**700**	-	20	660	20	20	0	0	3	-	0	15/18
02	**720**	-	60	660	-	-	0	0	0	-	0	11/17
07	**680**	-	-	640	40	20	0	0	6	-	0	15/22
Gutierrezia sarothrae												
83	**399**	-	66	333	-	-	0	0	0	-	0	9/8
89	**666**	-	-	633	33	-	0	0	5	5	5	9/10
97	**920**	-	280	600	40	-	0	0	4	-	0	9/8
02	**940**	-	-	920	20	-	0	0	2	-	0	8/6
07	**320**	20	-	260	60	-	0	0	19	6	6	9/8
Juniperus osteosperma												
83	**0**	-	-	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**40**	20	-	40	-	-	0	0	0	-	0	-/-
02	**60**	-	-	60	-	-	0	0	0	-	0	-/-
07	**120**	-	80	20	20	-	0	0	17	-	0	-/-
Prunus virginiana												
83	**133**	33	133	-	-	-	100	0	0	-	25	-/-
89	**200**	-	200	-	-	-	0	0	0	-	0	-/-
97	**60**	-	-	60	-	-	0	0	0	-	0	16/16
02	**40**	-	-	20	20	-	0	50	50	-	0	27/23
07	**20**	-	-	20	-	-	0	0	0	-	0	28/35
Purshia tridentata												
83	**266**	-	33	233	-	-	38	25	0	-	0	16/33
89	**300**	-	-	300	-	-	11	0	0	-	0	16/29
97	**540**	-	20	480	40	-	37	56	7	7	7	20/37
02	**380**	-	-	300	80	-	16	79	21	5	5	15/34
07	**400**	20	40	360	-	-	60	15	0	-	0	22/45
Rosa woodsii												
83	**0**	-	-	-	-	-	0	0	-	-	0	-/-
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**100**	-	40	60	-	-	0	0	-	-	0	10/13
02	**160**	-	100	60	-	-	0	0	-	-	0	7/10
07	**180**	-	120	60	-	-	0	0	-	-	0	8/9

		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)
Symphoricarpos oreophilus												
83	**1299**	33	866	433	-	-	18	3	0	-	3	13/14
89	**1332**	-	566	766	-	-	0	0	0	-	0	17/11
97	**320**	20	220	100	-	-	0	0	0	-	0	20/47
02	**680**	-	180	500	-	-	6	0	0	-	0	15/32
07	**520**	-	40	460	20	-	31	27	4	-	0	18/36
Tetradymia canescens												
83	**66**	-	66	-	-	-	0	0	0	-	0	-/-
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**520**	-	120	400	-	-	0	0	0	-	0	10/14
02	**560**	60	80	480	-	-	4	0	0	-	0	8/15
07	**640**	-	60	420	160	-	3	0	25	-	0	9/16

Trend Study 17-45-07

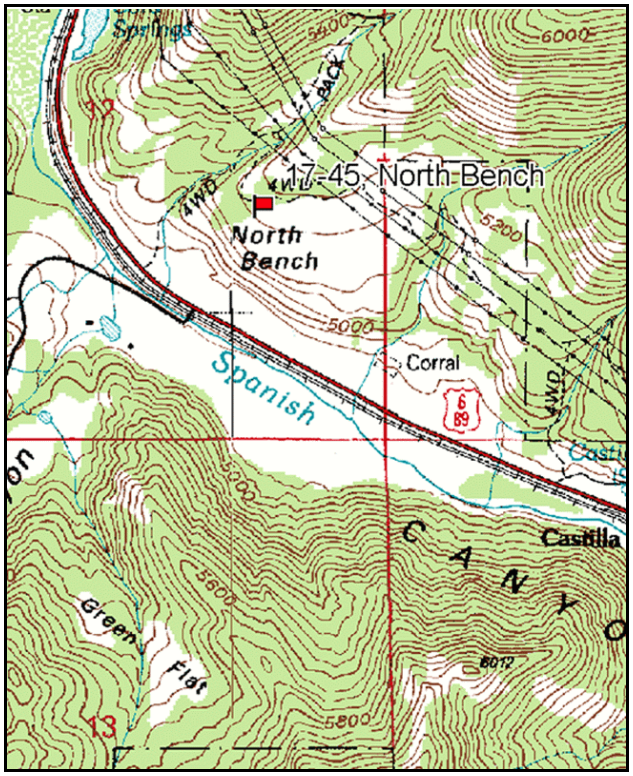
Study site name: North Bench . Vegetation type: Big Sagebrush .

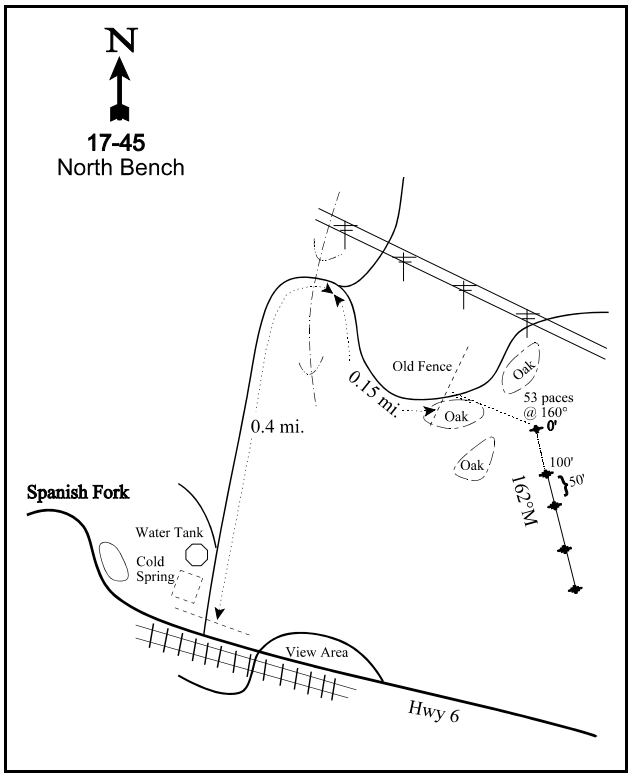
Compass bearing: frequency baseline 162 degrees magnetic.

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

LOCATION DESCRIPTION

From the west side of the view area in lower Spanish Fork Canyon (about 3.5 miles up from the mouth) look for a dirt road going up through a gate and by an old corral. Take this rough road for 0.4 miles to an intersection. Turn right and go 0.15 miles to the top of the bench and an old fence line. From the wood post near the left hand side of the road, walk 53 paces bearing 160 degrees into the sage flat. The first stake marks the 0-foot end of the baseline. The remainder of the study stakes are south at 100 foot intervals.





Map Name: Spanish Fork Peak

Diagrammatic Sketch

Township 9S , Range 3E , Section 12

GPS: NAD 83, UTM 12T 453800 E 4432787 N

DISCUSSION

North Bench - Trend Study No. 17-45

Study Information

This study is located on a 40 acre section of private land in lower Spanish Fork Canyon, and is on the north side of US-6 [elevation: 5,100 feet (1,554 m), slope: 3%-10%, aspect: southwest]. The nearest perennial sources of water are Spanish Fork 0.2 miles (350 m) to the southwest and Cold Springs 0.4 miles (700 m) to the northwest. Spanish Fork is on the opposite side of US-6, but Cold Springs is on the same side, which may make it the primary water source. Deer and elk use has been light in all sample years. From the pellet group transect data, deer use was estimated at 8 days use/acre (20 ddu/ha) in 2002 and 4 days use/acre (10 ddu/ha) in 2007. Elk use was estimated at 4 days use/acre (10 edu/ha) in 2007. Deer and elk pellet groups appear to be from fall and winter use. Cattle use was estimated at 6 days use/acre (14 cdu/ha) in 2002 and 31 days use/acre (77 cdu/ha) in 2007. In 2002, cattle pats were from the previous summer, and in 2007 they were from cattle that were present during sampling. Grasshoppers were abundant in 2002 and some utilization on herbaceous plants was apparent. The slope to the west of the study was being developed when the study was sampled in 2007.

Soil

The soil has a loamy texture with a slightly acidic soil reaction (pH 6.1). Few rocks were encountered in the soil profile, but there is a clay horizon about 10 inches (25 cm) below the soil surface. The soil surface is quite compacted, which has likely been caused by livestock as suggested by the numerous cattle paths crossing the study. Relative vegetation cover increased from 53% in 1997 to 62% in 2002, and decreased to 50% in 2007. Relative bare ground cover decreased from 10% in 1997 to 4% in 2002, and increased to 12% in 2007. The high vegetation cover and gentle slope minimize the erosion potential. The erosion condition was classified as stable in 2002 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant preferred species. Sagebrush canopy cover was 19% in 2007, and it has provided an average 87% of the shrub cover since 1997. The estimated density increased from 2,999 plants/acre (7,423 plants/ha) in 1989 to 5,500 plants/acre (13,614 plants/ha) in 1997, and decreased to 3,380 plants/acre (8,366 plants/ha) by 2007. Seedlings have been present in each sample year, but were most abundant in 1997 at 1,480 seedlings/acre (3,663 seedlings/ha), and least abundant in 2002 at 40 seedlings/acre (99 seedlings/ha). Young plants increased from 2% of the population in 1989 to 56% in 1997, and decreased to 2% by 2007. Decadence was highest in 1989 (58%) and lowest in 1997 (9%). Decadent plants accounted for 14% of the population in 2007. The density of dead plants has decreased from 860 plants/acre (2,129 plants/ha) in 1997 to 400 plants/acre (990 plants/ha) in 2007. Vigor has been good in all sample years. The average annual leader growth was 3.4 inches (8.6 cm) in 2002 and 2.1 inches (5.3 cm) in 2007. Browse use has been light, except in 2007 when it was light-moderate.

Broom snakeweed (*Gutierrezia sarothrae*) is the next dominant shrub species. Canopy cover was 1% in 2007. The density increased from 400 plants/acre (990 plants/ha) in 1989 to 4,800 plants/acre (11,881 plants/ha) in 2002, and decreased to 2,180 plants/acre (5,396 plants/ha) in 2007. Clumps of large, mature Gambel oak (*Quercus gambelii*) occur on the slopes near the bench and dominate the hillsides above, providing escape and thermal cover until leaf drop. There are also scattered white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*) and antelope bitterbrush (*Purshia tridentata*) present.

Herbaceous Understory

The herbaceous understory has accounted for the majority of the vegetation cover since 1997. Perennial grass cover was 46% in 1997, 51% in 2002, and 27% in 2007. Bulbous bluegrass is the dominant perennial species, and provided 32% cover in 1997, 33% in 2002, and 12% in 2007. This perennial species has a phenology

similar to that of annual grasses (Stewart and Hull 1949) and may be limiting the establishment of other species, including sagebrush. Other common perennial grass species include crested wheatgrass (*Agropyron cristatum*) and Kentucky bluegrass (*Poa pratensis*). Cheatgrass (*Bromus tectorum*) was sampled in 1997 in 4% of the quadrats, but has not been sampled since.

Perennial forb cover was 12% in 1997, 16% in 2002, and 14% in 2007. Between seven and 17 perennial species have been sampled, many of which are weedy species. The most abundant species is hairy goldaster (*Heterotheca villosa*), which increased in cover from 4% in 1997 to 10% in 2007. Other common perennial species include curlycup gumweed (*Grindelia squarrosa*), silvery lupine (*Lupinus argenteus*), alfalfa (*Medicago sativa*), dandelion (*Taraxacum officinale*), and yellow salsify (*Tragopogon dubius*). Most of these species indicate past excessive grazing. Annual forb cover has been less than 1% since 1997. Two noxious weed species have been sampled, whitetop (*Cardaria draba*) and houndstongue (*Cynoglossum officinale*). Whitetop was sampled only in 2002, and the quadrat frequency of houndstongue has steadily decreased from 27% in 1997 to 1% in 2007.

1997 TREND ASSESSMENT

The browse trend is up. The density of sagebrush increased 83%. However, some of the increase is likely the result of the larger area sampled beginning in 1997. Yet parameters other than density also indicate an up trend. For example, the density of seedling sagebrush plants increased from 266 seedlings/acre (658 seedlings/ha) to 1,480 seedlings/acre (3,663 seedlings/ha), and young plants increased from 2% of the population to 56%. Decadence decreased from 58% of the population to 9%, and vigor remained good. Browse use remained light. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 37%. There was a significant increase in the nested frequency of Kentucky bluegrass. However, there was a significant decrease in the nested frequency of Sandberg bluegrass and a significant increase in that of bulbous bluegrass. Bulbous bluegrass quadrat frequency increased from 55% to 96%. The forb trend is up. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased four-fold, and the number of perennial species sampled increased from seven to 13. There were significant increases in the nested frequencies of low fleabane (*Erigeron pumilus*), curlycup gumweed, and yellow salsify. However, houndstongue was also sampled for the first time. It was sampled in 27% of the quadrats, but accounted for less than 1% cover. The Desirable Components Index (DCI) score was good due to the moderate browse cover, low decadence, high browse recruitment, low annual grass cover, and high perennial grass and forb cover.

winter range condition (DCI) - good (75) Mid-level potential scale
browse - up (+2) grass - down (-2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush decreased 9%. Reproduction and recruitment both decreased. Only 40 seedlings/acre (99 seedlings/ha) were sampled, and young plants decreased to 11% of the population. Decadence increased to 21%, but the density of dead plants decreased from 860 plants/acre (2,128 plants/ha) to 720 plants/acre (1,782 plants/ha). Vigor remained good and browse use remained light. The average crown height and width decreased 17 inches (43 cm) and 19 inches (48 cm), respectively. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses increased 9%. Bulbous bluegrass was sampled in 99% of the quadrats. The forb trend is down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 25%. There were significant decreases in the nested frequencies of thistle (*Cirsium* sp.), annual sunflower (*Helianthus annuus*), dandelion, and yellow salsify. There was a significant increase in hairy goldaster. Whitetop was sampled for the first time and had a quadrat frequency of 12%. However, houndstongue significantly decreased in nested frequency, and quadrat frequency decreased to 11%. The DCI score decreased to fair-good due to a decrease in browse recruitment and an increase in decadence. These changes were somewhat countered by an increase in browse cover.

winter range condition (DCI) - fair-good (67) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 32%. The seedling density increased to 380 seedlings/acre (941 seedlings/ha), and the plants had abundant flowering stalks. Young plants decreased to 2% of the population, but decadence decreased to 14%. The density of dead plants decreased to 400 plants/acre (990 plants/ha). Vigor remained good, but browse use shifted to light-moderate. Some of the oak stems surrounding the study had also been browsed. The grass trend is stable. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 2%, including a significant decrease in the nested frequency of crested wheatgrass. However, the nested frequency of bulbous bluegrass also decreased significantly, quadrat frequency decreased to 80%, and cover decreased from 33% to 12%. Crested wheatgrass, orchardgrass (*Dactylis glomerata*), and Kentucky bluegrass had all been heavily grazed. The forb trend is slightly up. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased 6%. The nested frequencies of curlycup gumweed, hairy goldaster, and silvery lupine significantly increased. Yellow salsify significantly decreased in nested frequency. Alfalfa, yellow sweetclover (*Melilotus officinalis*), and yellow salsify all had been grazed heavily. Whitetop was not sampled, and houndstongue quadrat frequency decreased to 1%. The DCI score remained fair-good.

winter range condition (DCI) - fair-good (65) Mid-level potential scale
browse - down (-2) grass - stable (0) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 45

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	$_{ab}$202	$_{ab}$198	$_{b}$221	$_{a}$176	9.33	12.38	6.34
G	Bromus tectorum (a)	-	14	-	-	.07	-	-
G	Dactylis glomerata	$_{a}$5	$_{a}$12	$_{a}$17	$_{a}$11	.70	.74	.25
G	Poa bulbosa	$_{a}$144	$_{c}$358	$_{c}$368	$_{b}$260	31.65	33.20	12.41
G	Poa pratensis	$_{a}$43	$_{b}$135	$_{bc}$143	$_{c}$185	4.02	4.80	8.17
G	Poa secunda	$_{b}$314	$_{a}$13	$_{a}$9	$_{a}$10	.45	.03	.04
Total for Annual Grasses		0	14	0	0	0.07	0	0
Total for Perennial Grasses		708	716	758	642	46.17	51.15	27.22
Total for Grasses		708	730	758	642	46.24	51.15	27.22
F	Agoseris glauca	-	-	-	1	-	-	.00
F	Antennaria rosea	-	-	-	1	-	-	.03
F	Artemisia ludoviciana	-	$_{a}$3	$_{a}$2	$_{a}$4	.15	.15	.03
F	Aster chilensis	-	$_{a}$4	$_{ab}$6	$_{b}$14	.15	.18	.25
F	Cardaria draba	-	-	29	-	-	.35	-
F	Cirsium sp.	-	$_{b}$25	$_{a}$10	$_{a}$3	.68	.02	.00
F	Collomia linearis (a)	-	-	2	-	-	.00	-
F	Comandra pallida	$_{a}$1	-	$_{b}$8	-	-	.04	-

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Collinsia parviflora (a)	-	2	-	-	.00	-	-
F	Cynoglossum officinale	-	$_{b}$63	$_{a}$19	$_{a}$1	.72	.42	.00
F	Epilobium brachycarpum (a)	-	$_{b}$152	$_{a}$57	$_{a}$34	.40	.20	.11
F	Erigeron pumilus	$_{a}$1	$_{b}$31	-	$_{a}$2	.15	-	.03
F	Grindelia squarrosa	$_{a}$25	$_{c}$80	$_{a}$7	$_{b}$41	1.09	.06	.66
F	Helianthus annuus (a)	$_{b}$35	$_{b}$28	$_{a}$5	$_{a}$2	.25	.01	.03
F	Heterotheca villosa	-	$_{a}$131	$_{b}$193	$_{c}$245	3.53	9.06	9.98
F	Lactuca serriola	$_{a}$6	$_{a}$6	-	$_{a}$3	.01	-	.01
F	Lithospermum sp.	47	-	-	-	-	-	-
F	Lupinus argenteus	-	$_{a}$20	$_{a}$27	$_{b}$46	.95	1.26	2.62
F	Machaeranthera canescens	-	-	-	8	-	-	.04
F	Melilotus officinalis	-	$_{a}$4	$_{a}$1	$_{a}$8	.15	.00	.05
F	Medicago sativa	$_{a}$1	$_{ab}$14	$_{b}$20	$_{ab}$11	.90	1.48	.34
F	Phlox longifolia	-	-	-	5	-	-	.01
F	Polygonum douglasii (a)	-	3	-	-	.00	-	-
F	Taraxacum officinale	-	$_{b}$53	$_{a}$14	$_{a}$5	1.07	.32	.03
F	Tragopogon dubius	$_{a}$61	$_{c}$205	$_{b}$133	$_{a}$61	2.44	2.50	.36
Total for Annual Forbs		35	185	64	36	0.67	0.21	0.15
Total for Perennial Forbs		142	639	469	459	12.02	15.88	14.49
Total for Forbs		177	824	533	495	12.69	16.10	14.64

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

BROWSE TRENDS --
Management unit 17 , Study no: 45

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Artemisia tridentata vaseyana	89	85	80	8.82	13.24	12.17
B	Chrysothamnus nauseosus albicaulis	1	0	1	-	-	.03
B	Gutierrezia sarothrae	27	41	43	1.20	2.37	1.57
B	Purshia tridentata	0	0	1	-	-	-
B	Quercus gambelii	0	0	1	-	-	-
Total for Browse		117	126	126	10.02	15.61	13.77

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 45

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	-	18.68
Chrysothamnus nauseosus albicaulis	-	.08
Gutierrezia sarothrae	-	.73

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 45

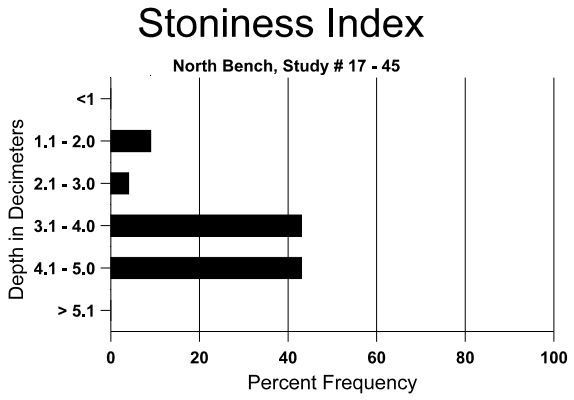
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	3.4	2.1

BASIC COVER --
Management unit 17 , Study no: 45

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	24.00	59.20	71.77	56.59
Rock	.75	.10	.02	0
Pavement	1.25	.28	.14	.03
Litter	58.25	39.26	37.77	42.80
Cryptogams	0	.97	.81	.04
Bare Ground	15.75	10.44	5.02	13.96

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 45, North Bench

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
20.0	44.6 (17.7)	6.1	36.7	36.4	26.8	1.7	27.3	227.2	.4



PELLET GROUP DATA --
Management unit 17 , Study no: 45

Type	Quadrat Frequency		
	'97	'02	'07
Elk	-	1	4
Deer	1	7	4
Cattle	2	5	3

Days use per acre (ha)	
'02	'07
-	4 (10)
8 (20)	4 (10)
6 (14)	31 (77)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 45

		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												
89	**2999**	266	66	1200	1733	-	16	0	58	-	4	29/31
97	**5500**	1480	3100	1920	480	860	3	0	9	4	4	36/42
02	**5000**	40	560	3380	1060	720	10	2	21	6	6	19/23
07	**3380**	380	60	2860	460	400	24	7	14	6	6	21/29
Chrysothamnus nauseosus albicaulis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	27/46
02	**0**	-	-	-	-	-	0	0	-	-	0	19/28
07	**40**	-	-	40	-	-	0	0	-	-	0	27/24
Gutierrezia sarothrae												
89	**400**	466	200	200	-	-	0	0	0	-	0	6/8
97	**3400**	1100	1320	2020	60	20	0	0	2	-	0	6/7
02	**4800**	20	200	4220	380	20	.41	0	8	.41	.41	8/8
07	**2180**	20	100	2060	20	-	7	2	1	.91	.91	9/10
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	-	20	-	-	0	0	-	-	0	-/-
Quercus gambelii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	20	-	-	-	0	0	-	-	0	33/28

		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)
Symphoricarpos oreophilus												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	14/16

Trend Study 17-46-07

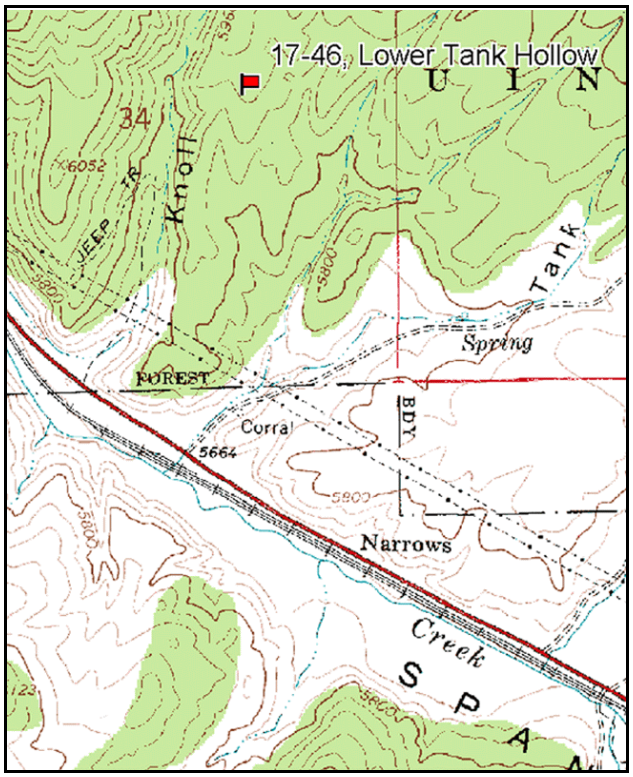
Study site name: Lower Tank Hollow . Vegetation type: Chained, Seeded P-J .

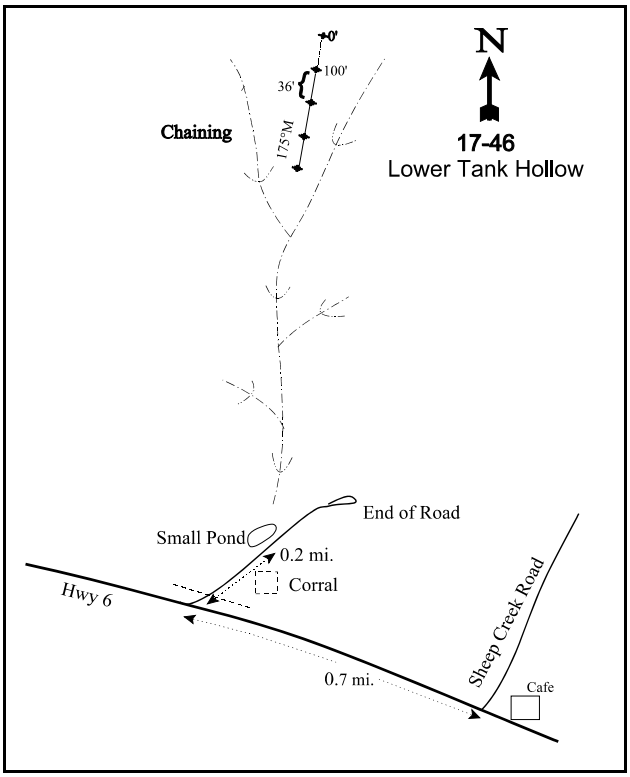
Compass bearing: frequency baseline 175 degrees magnetic.

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

LOCATION DESCRIPTION

In Spanish Fork Canyon, turn north up Tank Hollow, which is 0.7 miles west of the Sheep Creek Road and cafe on Highway 6. Drive about 0.2 miles and stop by a small stock pond in the forks of the drainage. From here, walk north about 1/2 mile up the left fork, and keep left at two other major forks. Where the wash starts to flatten out at the head, there is a chained ridge to the right. The study site is on the ridge, about 20 paces from the center of the drainage. The 0-foot baseline stake is near the highest point on the ridge.





Map Name: Mill Fork

Diagrammatic Sketch

Township 9S , Range 5E , Section 34

GPS: NAD 83, UTM 12S 470019 E 4426679 N

DISCUSSION

Lower Tank Hollow - Trend Study No. 17-46

Study Information

This critical winter study samples a chaining and seeding treatment in Lower Tank Hollow that was completed in 1971 [elevation: 5,900 feet (1,798 m), slope: 10%, aspect: southwest]. The nearest perennial source of water is Soldier Creek 0.7 miles (1.1 km) to the south. There is a stock pond 0.5 miles (0.8 km) to the south that was dry when the study was sampled in 2007. The study is located on a small ridge that is part of the Forest Service Diamond Fork cattle allotment. When not rested, it appears to receive moderate cattle use. There has also been moderate deer use and light elk use. From the pellet group transect data, deer use was estimated at 47 days use/acre (116 ddu/ha) in 2002 and 24 days use/acre (60 ddu/ha) in 2007. Elk use was estimated at 5 days use/acre (13 edu/ha) in 2002 and 12 days use/acre (30 edu/ha) in 2007. Most of the big game use appears to be during the winter. Cattle use was estimated at 7 days use/acre (16 cdu/ha) in 2002 and 8 days use/acre (20 cdu/ha) in 2007. Livestock were present when the study was sampled in 2002, and had only lightly grazed the forage on the study. However, on the lower portions of the chaining down the slope, the grazing had been heavy.

Soil

The soil has a clay loam texture and a neutral soil reaction (pH of 7.2). It is underlain by a layer of shale. Soil phosphorous is moderate (6.8 ppm), but close to the threshold 6 ppm required for normal plant growth and development (Tiedemann and Lopez 2004). Relative vegetation cover has been approximately 31% since 1997. Relative bare ground cover increased from 22% in 1997 to 37% by 2007. There is evidence of substantial past erosion in the form of exposed roots and pedestalled plants, but there has not been evidence of significant erosion since 1989. The erosion condition was classified as slight in 2002 and 2007 due to the abundance of flow paths and soil movement.

Browse

Before the 1971 chaining and seeding, the overstory was dominated by a mature stand of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). The chaining was effective in pulling the trees over, but several of the juniper trees survived. Not all of the population is comprised of chained trees that survived, however, some are trees that have grown since the chaining. In 2002, 35% of the population were trees that had survived the chaining, and in 2007, surviving trees decreased to 15%. The point-quarter tree density increased from 57 trees/acre (141 trees/ha) in 1997 to 74 trees/acre (183 trees/ha) in 2002. In 2007, the density had slightly increased to 75 trees/acre (186 trees/ha). The average diameter has increased from 5.8 inches (14.7 cm) in 1997 to 7.0 inches (17.8 cm) in 2007. Juniper canopy cover was estimated at 6% in 2002 and 13% in 2007.

Preferred browse is somewhat limited. Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and antelope bitterbrush (*Purshia tridentata*) are the most abundant preferred species. The sagebrush canopy cover has been 1% since 2002. The estimated sagebrush density increased from 99 plants/acre (245 plants/ha) in 1989 to 420 plants/acre (1,040 plants/ha) in 1997, and steadily decreased to 220 plants/acre (545 plants/ha) by 2007. No seedling plants have been sampled, and young plants have decreased from 33% of the population in 1989 to 9% in 2007. Decadence decreased from 33% of the population in 1989 to a low of 14% in 1997, and increased to a high of 55% by 2007. The density of dead plants has been stable at 60 plants/acre (149 plants/ha) since 1997. Plants with poor vigor decreased from 33% of the population in 1989 to 10% in 1997, and were approximately 20% in 2002 and 2007. Since 1997, half to all of the plants with poor vigor were classified as dying. In 2007, 45% of the population was infested with the sagebrush defoliator moth (*Aroga websteri*). However, the infestation may not have a long-term effect on the sagebrush population (Hsiao 1986). The average annual leader growth was 1.5 inches (3.8 cm) in 2002 and 1.9 inches (4.9 cm) in 2007. Browse use on sagebrush has ranged from light (1997) to light-moderate (2007) and heavy (1989, 2002). The

changes in decadence and vigor are consistent with changes in precipitation. Drought conditions prevailed in 1989 and 2002, while conditions were wetter than normal in 1997 (Utah Climate Summaries 2007).

The canopy cover of bitterbrush was 2% in 2002 and 2007. The estimated density of bitterbrush has steadily increased from 33 plants/acre (82 plants/ha) in 1989 to 400 plants/acre (990 plants/ha) in 2007. No seedling plants have been sampled, and young bitterbrush were only sampled in 1997, comprising 17% of the population. There were no decadent plants in either 1989 or 1997, but 69% of the population was decadent in 2002, and 5% in 2007. Dead plants were first sampled in 2002 and were present at a density of 20 plants/acre (50 plants/ha). In 2007, the density of dead plants increased to 120 plants/acre (297 plants/ha). Vigor has been good, except in 2002 when 38% of the population had poor vigor and was classified as dying. The average annual leader growth of bitterbrush was 1.6 inches (4.1 cm) in 2002 and 2.3 inches (5.9 cm) in 2007. Browse use has been heavy in all sample years.

Other, low-density populations of browse species include Utah serviceberry (*Amelanchier utahensis*), dwarf rabbitbrush (*Chrysothamnus depressus*), white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), Parry's rabbitbrush (*Chrysothamnus parryi*), Woods' rose (*Rosa woodsii*), and snowberry (*Symphoricarpos oreophilus*). Browse use has been light on all but serviceberry, Parry's rabbitbrush, and snowberry. Stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) is the most abundant browse species, but browse use has been light in all sample years.

Herbaceous Understory

The herbaceous understory is diverse and fairly abundant. Perennial grass cover was 19% in 1997, 16% in 2002, and 19% in 2007. Between six and 10 perennial species have been sampled. Cover of crested wheatgrass, which is the dominant perennial grass, increased from 13% in 1997 to 18% by 2007. Other seeded grasses include intermediate wheatgrass (*Agropyron intermedium*), smooth brome (*Bromus inermis*), and orchardgrass (*Dactylis glomerata*). Cover of these three species has been less than 1%. Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) are the only annual species present, but are not abundant.

Perennial forb cover was 5% in 1997, and 2% in 2002 and 2007. Between 13 and 26 perennial species have been sampled, but none of them are common. Only two perennial species, western aster (*Aster chilensis*) in 1997, and Hood's phlox (*Phlox hoodii*) in 2007, have provided 1% cover or more. Otherwise, individual perennial species have comprised less than 1% cover. Two noxious weeds, whitetop (*Cardaria draba*) and musk thistle (*Carduus nutans*), have been sampled at quadrat frequencies of 13% or less.

1997 TREND ASSESSMENT

The browse trend is slightly up. The density of sagebrush increased more than four-fold. However, much of the increase is likely the result of the larger area sampled beginning in 1997. The density of young plants increased, but the proportion of young plants decreased from 33% of the population to 24%. Likewise, the density of decadent plants increased, but the proportion of decadent plants decreased from 33% of the population to 14%. Dead plants were sampled at a density of 60 plants/acre (147 plants/ha). Plants with poor vigor decreased from 33% of the population to 10%, but whereas there were no dying plants in 1989, all of the plants with poor vigor were classified as dying in 1997. Heavily browsed sagebrush plants decreased from 67% of the population to 5%. The average sagebrush height and crown measurements increased 14 inches (36 cm) and 16 inches (41 cm), respectively. The bitterbrush population increased nearly four-fold. Young plants increased from 0% of the population to 17%, and there continued to be no decadent plants. Bitterbrush vigor remained good, and heavily browsed plants decreased from 100% of the population to 67%. The average bitterbrush crown width increased 20 inches (51 cm). The grass trend is up. The sum of nested frequency of perennial grasses increased 43%. There were significant increases in the nested frequencies of crested wheatgrass and bluebunch wheatgrass (*Agropyron spicatum*). The nested frequencies of smooth brome, Indian ricegrass (*Oryzopsis hymenoides*), and mutton bluegrass (*Poa fendleriana*) significantly decreased. Cheatgrass

was sampled in 14% of the quadrats. The forb trend is up. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased 43%, and the number of perennial species sampled increased from 13 to 26. There were significant increases in the nested frequencies of Douglas chaenactis (*Chaenactis douglasii*) and yellow salsify (*Tragopogon dubius*). The nested frequencies of thistle (*Cirsium* sp.) and shortstem wild buckwheat (*Eriogonum brevicaule*) significantly decreased. Musk thistle was sampled for the first time, and had a quadrat frequency of 13%. The Desirable Components Index (DCI) score was poor due to the low browse cover (less than the 5% threshold), and the presence of one noxious weed species. These factors were countered by the high perennial grass and forb cover.

winter range condition (DCI) - poor (43) Mid-level potential scale
browse - slightly up (+1) grass - up (+2) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush decreased 10%, and young plants decreased to 11% of the population. Decadence increased to 37% of the population, but the density of dead plants remained constant. Sagebrush plants with poor vigor increased to 21% of the population, and approximately half of those plants were classified as dying. Browse use shifted from light to heavy, and heavily browsed plants increased to 68% of the population. The density of bitterbrush increased more than two-fold. However, no young plants were sampled, and decadence increased from 0% of the population to 69%. Dead plants were sampled for the first time and had a density of 20 plants/acre (50 plants/ha). Dying bitterbrush plants increased to 38% of the population. All the bitterbrush plants were heavily browsed. The grass trend is stable. The sum of nested frequency of perennial grasses decreased 11%, including significant decreases in the nested frequencies of bluebunch wheatgrass, Kentucky bluegrass (*Poa pratensis*), and Sandberg bluegrass (*Poa secunda*). However, there was a significant increase in the nested frequency of crested wheatgrass, and a significant decrease in that of cheatgrass. Crested wheatgrass is likely out-competing cheatgrass, and may be negatively affecting the other perennial species as well. The forb trend is down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 66%. There were significant decreases in the nested frequencies of four perennial species, and the number of perennial species sampled declined to 15. Musk thistle was not sampled, but whitetop was sampled in four quadrats. Although browse cover increased above 5%, the DCI score remained poor because of the decrease in perennial forb cover.

winter range condition (DCI) - poor (39) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - down (-2)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 42%, and young plants decreased slightly to 9% of the population. Decadence increased to 55% of the population, but the density of dead plants remained constant. Sagebrush plants with poor vigor decreased slightly to 18% of the population, but all of those plants were classified as dying. As mentioned above, the sagebrush defoliator moth had infested 45% of the population. Browse use on sagebrush shifted to light-moderate, and only 18% of the population was heavily browsed. The density of bitterbrush increased 54%. There were no young plants sampled, but decadence decreased to 5% of the population. All of the plants were vigorous, despite being 100% heavily browsed. However, the average bitterbrush crown width decreased 26 inches (64 cm). The grass trend is slightly down. The sum of nested frequency of perennial grasses decreased 6%, and the number of perennial species sampled decreased from 10 to six. There was a significant increase in the nested frequency of Sandberg bluegrass. Japanese brome was sampled for the first time and had a quadrat frequency of 6%. The forb trend is up. Excluding noxious weeds, the sum of nested frequency of perennial forbs increased 25%, and the number of perennial species sampled increased to 20. There was a significant increase in the nested frequency of timber poisonvetch (*Astragalus convallarius*). Whitetop was not sampled, but musk thistle was sampled in 2 quadrats. The DCI score decreased to very poor-poor because browse cover decreased to less than 5%.

winter range condition (DCI) - very poor-poor (36) Mid-level potential scale
browse - down (-2) grass - slightly down (-1) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 46

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron cristatum	a71	b164	c224	c238	12.57	14.51	17.55
G	Agropyron intermedium	a31	a19	a23	a12	.18	.19	.16
G	Agropyron spicatum	a7	b36	a4	a3	2.79	.03	.06
G	Bromus inermis	b30	a7	-	-	.21	-	-
G	Bromus japonicus (a)	-	-	-	14	-	-	.08
G	Bromus tectorum (a)	-	b29	a6	a9	.51	.01	.04
G	Dactylis glomerata	-	a1	a3	-	.03	.01	-
G	Leucopoa kingii	11	-	-	-	-	-	-
G	Oryzopsis hymenoides	b56	a30	a36	a23	.68	.79	.47
G	Poa fendleriana	b36	a1	a1	-	.03	.00	-
G	Poa pratensis	-	b59	a15	a3	1.44	.33	.00
G	Poa secunda	-	b20	a3	b15	.55	.03	.38
G	Sitanion hystrix	-	-	1	-	-	.00	-
G	Stipa comata	4	-	-	-	-	-	-
G	Stipa lettermani	-	a14	a4	-	.72	.06	-
Total for Annual Grasses		0	29	6	23	0.50	0.00	0.11
Total for Perennial Grasses		246	351	314	294	19.22	15.98	18.63
Total for Grasses		246	380	320	317	19.73	15.99	18.75
F	Achillea millefolium	-	1	-	-	.00	-	-
F	Agoseris glauca	-	a5	-	a2	.01	-	.01
F	Alyssum alyssoides (a)	-	b63	a2	c120	1.16	.01	.55
F	Allium sp.	-	a10	a2	a6	.02	.00	.01
F	Aster chilensis	b100	b93	a22	a9	1.16	.26	.12
F	Astragalus convallarius	a13	b25	a3	b28	.36	.03	.26
F	Astragalus sp.	3	-	-	-	-	-	-
F	Astragalus utahensis	a5	a4	-	a3	.06	-	.01
F	Cardaria draba	-	-	12	-	-	.04	-
F	Castilleja linariaefolia	-	8	-	-	.04	-	-
F	Camelina microcarpa (a)	-	b13	a1	ab3	.03	.00	.01
F	Carduus nutans (a)	-	b22	-	a4	.37	-	.01
F	Calochortus nuttallii	-	a2	-	a1	.01	-	.00
F	Chaenactis douglasii	a2	b19	-	ab4	.12	-	.01

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Cirsium sp.	$_{c}$39	$_{b}$22	$_{ab}$4	$_{a}$3	.45	.06	.00
F	Comandra pallida	-	32	-	-	.40	-	-
F	Crepis acuminata	-	1	-	-	.00	-	-
F	Descurainia pinnata (a)	-	$_{a}$4	-	$_{a}$3	.02	-	.01
F	Epilobium brachycarpum (a)	-	1	-	-	.00	-	-
F	Eriogonum brevicaule	$_{b}$21	$_{a}$10	$_{a}$8	$_{a}$2	.33	.46	.06
F	Erigeron pumilus	$_{b}$27	-	$_{a}$2	-	-	.00	-
F	Hackelia patens	$_{a}$4	$_{a}$4	-	$_{a}$3	.04	-	.03
F	Hedysarum boreale	-	4	-	-	.18	-	-
F	Iva axillaris	-	-	-	17	-	-	.30
F	Lappula occidentalis (a)	-	10	-	-	.19	-	-
F	Lactuca serriola	-	-	-	3	-	-	.00
F	Lithospermum ruderale	-	$_{a}$18	$_{a}$13	$_{a}$4	.46	.28	.04
F	Lomatium sp.	-	3	-	-	.01	-	-
F	Machaeranthera canescens	$_{a}$9	-	-	$_{a}$2	-	-	.03
F	Penstemon caespitosus	-	$_{a}$7	$_{a}$10	$_{a}$4	.33	.04	.03
F	Phlox hoodii	$_{a}$15	$_{a}$16	$_{a}$19	$_{a}$20	.42	.42	.63
F	Phlox longifolia	$_{a}$11	$_{a}$11	$_{a}$18	$_{a}$15	.02	.06	.08
F	Ranunculus testiculatus (a)	-	$_{a}$4	-	$_{a}$8	.01	-	.02
F	Salsola pestifer (a)	8	-	-	-	-	-	-
F	Sphaeralcea coccinea	-	$_{a}$3	$_{a}$5	$_{a}$2	.15	.01	.01
F	Taraxacum officinale	-	$_{a}$2	$_{a}$1	-	.00	.00	-
F	Tragopogon dubius	$_{a}$2	$_{b}$17	$_{a}$4	$_{a}$2	.10	.03	.00
F	Verbascum thapsus	-	5	-	-	.03	-	-
F	Vicia americana	-	$_{b}$35	$_{a}$11	$_{ab}$23	.27	.05	.22
F	Viola sp.	-	3	-	-	.15	-	-
Total for Annual Forbs		8	117	3	138	1.79	0.01	0.60
Total for Perennial Forbs		251	360	134	153	5.19	1.79	1.92
Total for Forbs		259	477	137	291	6.99	1.81	2.52

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

BROWSE TRENDS --
Management unit 17 , Study no: 46

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier utahensis	4	3	2	.78	.53	.41
B	Artemisia tridentata tridentata	17	18	11	1.04	1.73	.36
B	Chrysothamnus depressus	13	3	4	.43	-	.15
B	Chrysothamnus nauseosus albicaulis	3	1	1	.00	-	-
B	Chrysothamnus parryi	0	11	10	-	.40	.40
B	Chrysothamnus viscidiflorus viscidiflorus	34	37	28	1.88	1.71	.85
B	Gutierrezia sarothrae	10	19	5	.36	.07	.04
B	Juniperus osteosperma	10	8	10	6.30	10.64	7.44
B	Opuntia sp.	3	8	6	.18	.01	.18
B	Purshia tridentata	5	10	10	1.49	3.17	2.02
B	Rhus trilobata	0	1	0	-	-	-
B	Rosa woodsii	0	1	0	-	-	.03
B	Symphoricarpos oreophilus	3	5	5	.15	.15	.04
Total for Browse		102	125	92	12.64	18.44	11.94

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 46

Species	Percent Cover	
	'02	'07
Amelanchier utahensis	1.28	.76
Artemisia tridentata tridentata	1.31	.78
Chrysothamnus depressus	.06	.08
Chrysothamnus parryi	.45	.61
Chrysothamnus viscidiflorus viscidiflorus	1.38	.58
Gutierrezia sarothrae	.03	-
Juniperus osteosperma	5.83	13.19
Opuntia sp.	-	.11
Purshia tridentata	2.43	2.34
Symphoricarpos oreophilus	.18	.40

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 46

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata tridentata	1.5	1.9
Purshia tridentata	1.6	2.3

POINT-QUARTER TREE DATA --
Management unit 17 , Study no: 46

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	74	75

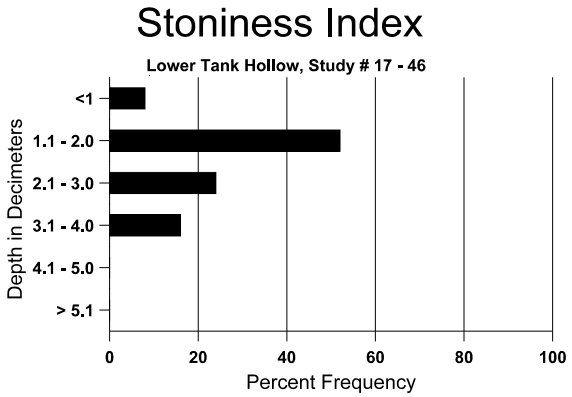
Average diameter (in)	
'02	'07
6.4	7.0

BASIC COVER --
Management unit 17 , Study no: 46

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	6.00	36.93	34.80	33.98
Rock	1.25	.73	1.97	.87
Pavement	9.75	5.83	3.66	4.63
Litter	45.25	41.37	40.40	28.22
Cryptogams	0	1.41	2.48	2.65
Bare Ground	37.75	24.28	35.84	40.81

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 46, Lower Tank Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
13.2	45.8 (15.5)	7.2	40.7	21.4	37.8	3.2	6.8	275.2	.5



PELLET GROUP DATA --
Management unit 17 , Study no: 46

Type	Quadrat Frequency		
	'97	'02	'07
Rabbit	3	8	7
Elk	11	14	4
Deer	30	36	42
Cattle	1	2	5

Days use per acre (ha)	
'02	'07
-	-
5 (13)	12 (30)
47 (116)	24 (60)
7 (16)	8 (20)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 46

		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												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**100**	-	40	60	-	-	0	60	0	-	0	28/36
02	**60**	-	-	40	20	-	0	100	33	33	33	32/38
07	**40**	-	-	40	-	-	50	50	0	-	0	39/41
Artemisia tridentata tridentata												
89	**99**	-	33	33	33	-	0	67	33	-	33	26/22
97	**420**	-	100	260	60	60	10	5	14	10	10	40/38
02	**380**	-	40	200	140	60	16	68	37	11	21	32/32
07	**220**	-	20	80	120	60	45	18	55	18	18	30/25
Chrysothamnus depressus												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**860**	80	80	780	-	-	0	0	0	-	0	6/14
02	**120**	-	-	100	20	-	0	0	17	-	0	4/9
07	**180**	-	-	180	-	-	0	0	0	-	0	7/12
Chrysothamnus nauseosus albicaulis												
89	**33**	-	33	-	-	-	0	0	0	-	0	-/-
97	**60**	-	40	20	-	-	33	0	0	-	0	24/27
02	**20**	-	-	-	20	20	0	0	100	100	100	26/40
07	**40**	-	-	40	-	-	0	0	0	-	0	19/15
Chrysothamnus parryi												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**900**	-	-	740	160	100	60	16	18	11	11	6/13
07	**520**	-	120	400	-	-	23	0	0	-	0	8/11

		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)
Chrysothamnus viscidiflorus viscidiflorus												
89	**3032**	-	233	2533	266	-	0	0	9	5	5	11/12
97	**1320**	-	140	1040	140	20	0	2	11	2	2	14/14
02	**2020**	-	60	1340	620	20	16	5	31	13	18	8/12
07	**1280**	-	160	820	300	-	6	3	23	6	14	9/13
Eriogonum microthecum												
89	**33**	-	-	33	-	-	0	0	-	-	0	4/8
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**480**	60	100	360	20	-	0	0	4	-	0	11/11
02	**680**	-	20	360	300	140	3	3	44	35	41	8/10
07	**160**	-	-	140	20	-	0	0	13	-	0	9/9
Juniperus osteosperma												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**220**	40	80	140	-	40	0	9	-	-	0	74/101
02	**160**	20	20	140	-	40	0	0	-	-	0	-/-
07	**200**	-	40	160	-	20	0	0	-	-	0	-/-
Opuntia sp.												
89	**33**	33	-	33	-	-	0	0	-	-	0	7/9
97	**140**	80	40	100	-	-	0	0	-	-	0	3/15
02	**160**	-	20	140	-	-	0	0	-	-	0	4/12
07	**120**	-	20	100	-	-	0	0	-	-	0	5/11
Purshia tridentata												
89	**33**	-	-	33	-	-	0	100	0	-	0	10/35
97	**120**	-	20	100	-	-	17	67	0	-	0	16/55
02	**260**	-	-	80	180	20	0	100	69	38	38	16/57
07	**400**	-	-	380	20	120	0	100	5	-	0	15/31
Rhus trilobata												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**0**	-	-	-	-	-	0	0	0	-	0	-/-
02	**20**	-	-	-	20	-	0	0	100	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	12/6

		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)
Rosa woodsii												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	20	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	4/7
Symphoricarpos oreophilus												
89	**66**	-	-	33	33	-	50	50	50	-	50	15/17
97	**80**	-	-	80	-	-	0	0	0	-	0	22/35
02	**100**	-	-	80	20	-	20	0	20	-	0	16/22
07	**100**	-	20	80	-	-	40	0	0	-	0	13/17

Trend Study 17-47-07

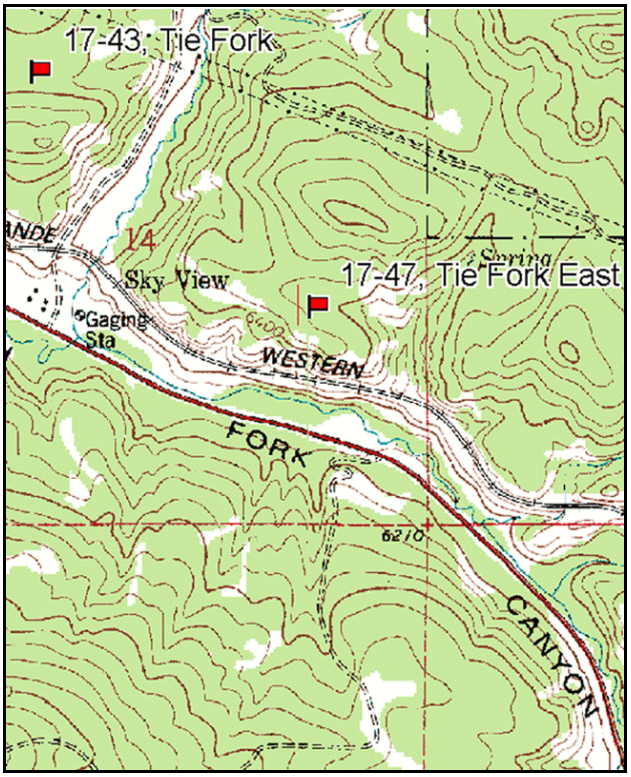
Study site name: Tie Fork East . Vegetation type: Mountain Brush .

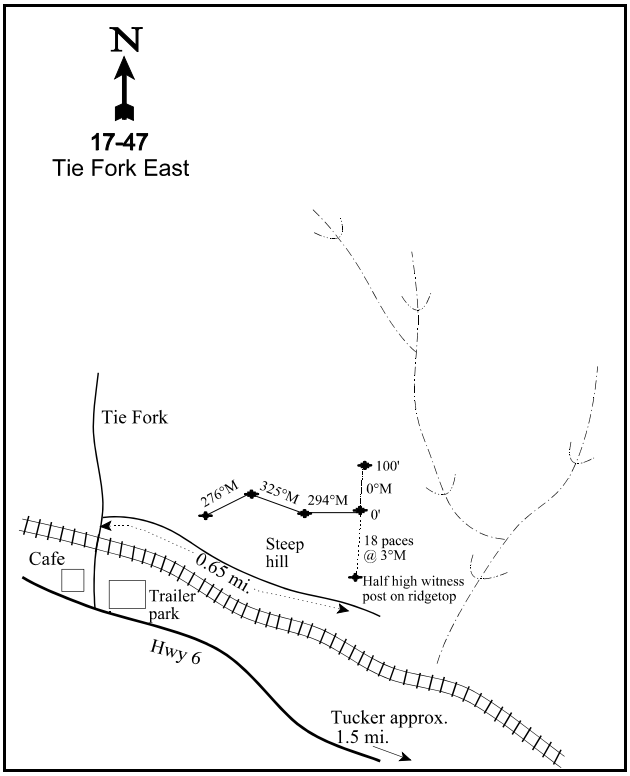
Compass bearing: frequency baseline 0 degrees magnetic (line 2 @ 294°M, line 3 @ 325°M, line 4 @ 286°M).

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

LOCATION DESCRIPTION

From the intersection of Highway U.S. 6 and Tie Fork at Sky View in Spanish Fork Canyon, go north up to the railroad tracks. Cross the tracks and turn right. Follow the road along the railroad tracks for 0.65 miles. Stop at a pullout at the mouth of a small side canyon with a huge pit on the north side of the road. Walk up the ridge to the west 200 yards to a witness post in a small rock outcrop on the bare ridgetop, by some mahogany. From the witness post, walk 18 paces north (3 degrees) to the 0-foot baseline stake.





Map Name: Tucker

Diagrammatic Sketch

Township 10S , Range 6E , Section 14

GPS: NAD 83, UTM 12S 482147 E 4422199 N

DISCUSSION

Tie Fork East - Trend Study No. 17-47

Study Information

This study is located on the north side of US-6, just to the east of the community of Sky View [elevation: 6,400 feet (1,951 m), slope: 15%-25%, aspect: north]. It was established in 1989 and takes the place of the Tie Fork study (17-43). This study is more xeric than Tie Fork, and supports a scattered Utah juniper (*Juniperus osteosperma*) community with a mountain brush understory. The nearest perennial sources of water are Tie Fork 0.4 miles (0.6 km) to the east and Spanish Fork 750 feet (230 m) to the south. However, Spanish Fork is on the opposite side of US-6. No livestock are currently grazed in the area but sheep are thought to trail through. Deer use is heavy and elk use is light-moderate. Quadrat frequency of deer pellet groups was 38% in 1997, 33% in 2002, and 47% in 2007. From the pellet group transect data, deer use was estimated at 76 days use/acre (187 ddu/ha) in 2002 and 66 days use/acre (164 ddu/ha) in 2007. Elk use was estimated at 8 days use/acre (20 edu/ha) in 2002 and 17 days use/acre (43 edu/ha) in 2007. All of the deer and elk pellet groups appear to be from winter use. Quadrat frequency of rabbit pellet groups was 23% in 1997, 21% in 2002, and increased to 37% in 2007.

Soil

The soil has a clay loam texture with a neutral soil reaction (pH of 7.3). Relative bare ground cover increased from14% in 1997 to 24% by 2007. Relative litter cover has decreased from 47% in 1997 to 36% in 2007. There are areas of localized erosion with active gullies forming below the site. The soil erosion condition class was determined to be slight in 2002 and 2007 due to moderate amount of surface litter movement, pedestalling, flow paths, and rills.

Browse

The browse community is a combination of large Utah juniper and pinyon pine (*Pinus edulis*) in association with a shrub understory. Canopy cover of juniper was 4% in 2002 and 15% in 2007. Many of the juniper are largely unavailable to browsing due to height and previous high-lining. Although the average tree height was 4-8 feet (1.2-2.4 m) in 2007, there are numerous trees that are more than 25 feet (7.6 m) tall. From point-center quarter data, density was estimated at 106 trees/acre (262 trees/ha) in 1997, 174 trees/acre (430 trees/ha) in 2002, and 209 trees/acre (517 trees/ha) in 2007. The average diameter of juniper has decreased from 8.9 inches (22.6 cm) in 1997 to 6.3 inches (15.6 cm) in 2007. Pinyon trees are less common, comprising 2% canopy cover in 2002 and 2007. The density increased from 22 trees/acre (54 trees/ha) in 1997 to 30 trees/acre (74 trees/ha) in 2002 and 2007. The average diameter of pinyon decreased from 8.8 inches (22.4 cm) in 1997 to 4.8 inches (12.2 cm) in 2002, and increased to 6.4 inches (16.3 cm) in 2007.

Several preferred forage species occur in the understory including serviceberry (*Amelanchier alnifolia*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), true mountain mahogany (*Cercocarpus montanus*). Serviceberry canopy cover was less than 1% in 2002 and 2007. The estimated density has decreased from 433 plants/acre (1,072 plants/ha) in 1989 to 180 plants/acre (446 plants/ha) in 2007. Seedlings were only sampled in 2007. However, young plants have been abundant, comprising 54% of the population in 1989, 87% in 1997, and approximately 44% in 2002 and 2007. Decadent plants accounted for 23% of the population in 1989, 0% in 1997 and 2002, and 11% in 2007. Dead serviceberry plants were first sampled in 2002, having a density of 20 plants/acre (50 plants/ha). In 2007, the density of dead plants increased to 40 plants/acre (99 plants/ha). Vigor has been good, and browse use has ranged from light to light-moderate.

The canopy cover of sagebrush was less than 1% in 2002 and 2007. The density was 499 plants (1,235 plants/ha) in 1989, which decreased to 160 plants/acre (396 plants/ha) in 1997, and increased to 260 plants/acre (644 plants/ha) in 2002. By 2007, the density had decreased again to 160 plants/acre (396 plants/ha). Seedling plants were only sampled in 1989. Young plants comprised 33% of the population in

1989, 0% in 1997, 15% in 2002, and 38% in 2007. Decadence has been high, ranging from 38% of the population to 50%. Since 1997, the density of dead plants has been greater than the density of live plants. Plants with poor vigor have increased from 7% of the population in 1989 to 25% in 2007, and since 1997, all of the plants with poor vigor have been classified as dying. Browse use was light in 1989 and 2007, and light-moderate in 1997 and 2002.

The canopy cover of true mountain mahogany was 3% in 2002 and 2007. The estimated density of mahogany decreased from 633 plants/acre (1,567 plants/ha) in 1989 to 540 plants/acre (1,337 plants/ha) in 1997, and increased to 700 plants/acre (1,733 plants/ha) in 2002. In 2007, the density decreased to 580 plants/acre (1,436 plants/ha). Seedling mahogany were only sampled in 1989. Young plants comprised 32% of the population in 1989, decreased to 6% by 2002, and increased to 14% in 2007. Decadence decreased from 16% of the population in 1989 to 11% in 1997, and increased to 34% by 2007. Vigor has been good each sample year. The average annual leader growth of mahogany was 1.6 inches (4.1 cm) in 2002 and 1.5 inches (3.8 cm) in 2007. Browse use was moderate-heavy in 1989, 1997, and 2007, and was heavy in 2002.

Snowberry (*Symphoricarpos oreophilus*) is the most abundant shrub species and provided 18% canopy cover in 2002 and 20% in 2007. The estimated density increased from 4,732 plants/acre (11,713 plants/ha) in 1989 to 6,200 plants/acre (15,347 plants/ha) in 2002. In 2007, there were 3,320 plants/acre (8,218 plants/ha). Some of the decrease in 2007 may have been caused by the difficulty in differentiating the individual plants from within the large clumps of snowberry that were present. Snowberry use was light-moderate in 1989, and has been light in subsequent sample years. Gambel oak (*Quercus gambelii*) is also present and provided 2% canopy cover in 2002 and 3% in 2007. Browse use on oak was light-moderate in 1997 and 2002, and decreased to light in 2007. Other scattered browse species include white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), stickyleaf rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), antelope bitterbrush (*Purshia tridentata*), Woods' rose (*Rosa woodsii*), and gray horsebrush (*Tetradymia canescens*).

Herbaceous Understory

Total herbaceous cover is relatively low. Cover of perennial grasses was 8% in 1997, and 5% in 2002 and 2007. Between seven and eight perennial species have been sampled in each sample year. The dominant perennial species include bluebunch wheatgrass (*Agropyron spicatum*), sedge (*Carex* sp.), and Indian ricegrass (*Oryzopsis hymenoides*). Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) have both been sampled. Cheatgrass cover was less than 1% in 1997 and 2002, and increased to 1% in 2007.

Perennial forb diversity is moderate, but most species are not abundant. Perennial forb cover has been approximately 5% since 1997, and between 14 and 20 perennial species have been sampled. The dominant perennial species include Wasatch penstemon (*Penstemon cyananthus*) and spotted stickseed (*Hackelia patens*). Two noxious weeds, musk thistle (*Carduus nutans*) and houndstongue (*Cynoglossum officinale*) are present. Both species have decreased in cover since the study was established and have been scarce since 2002.

1997 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush decreased 68%. However, some of the changes in density are likely the result of the larger area sampled beginning in 1997. Thus, trend was determined from other parameters. For example, no seedling sagebrush were sampled, and young plants decreased from 33% of the population to 0%. Decadence changed little, increasing slightly from 47% to 50%. Dead plants were sampled at a density of 260 plants/acre (644 plants/ha), which was higher than the density of live plants. Browse use on sagebrush shifted from light to light-moderate. Despite the increase in browsing, the average sagebrush crown width increased 22 inches (56 cm). The density of serviceberry decreased 31%, but young plants increased from 54% of the population to 87%, and decadence decreased from 23% to 0%. The estimated density of mahogany decreased 15%. Additionally, no seedling mahogany were sampled, and young plants decreased from 32% of the population to 11%. Although mahogany decadence decreased from

16% of the population to 11%, the population consisted of considerably smaller shrubs. The average height and crown width measurements of mahogany decreased by 34 inches (86 cm) and 50 inches (127 cm), respectively. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased 20%. The nested frequencies of bluebunch wheatgrass and Letterman needlegrass (*Stipa lettermani*) significantly increased, while that of Indian ricegrass significantly decreased. The forb trend is up. Excluding houndstongue, the sum of nested frequency of perennial forbs increased 84%, and the number of perennial species sampled increased from 14 to 20. There was a significant increase in the nested frequency of Wasatch penstemon, and a significant decrease in houndstongue. Musk thistle was sampled for the first time, though it is likely to have been present before 1997, and not recorded because it is an annual species. The Desirable Components Index (DCI) score was fair due to low browse cover, but high browse recruitment and low decadence, as well as moderate perennial grass and forb cover. The presence of two noxious weed species also lowered the score.

winter range condition (DCI) - fair (52) Mid-level potential scale
browse - slightly down (-1) grass - slightly up (+1) forb - up (+2)

2002 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush increased 63%, but abundance continued to be low. Young plants were sampled again, comprising 15% of the population, and decadence decreased to 38%. The density of dead plants increased to 320 plants/acre (792 plants/ha). Dying sagebrush plants increased to 23% of the population. The serviceberry density decreased 7%, and young plants decreased to 43% of the population. No decadent plants were sampled and vigor continued to be good. Heavily browsed serviceberry plants increased from 7% of the population to 29%. The density of mahogany increased 30%. Young plants decreased to 6% of the population, and decadence increased to 23%. Heavily browsed mahogany plants increased to 74% of the population. The grass trend is slightly down. The sum of nested frequency of perennial grasses decreased 23%, including a significant decrease in the nested frequency of bluebunch wheatgrass. However, there was also a significant decrease in the nested frequency of cheatgrass, and quadrat frequency decreased from 38% to 5%. The forb trend is slightly down. Excluding houndstongue, the sum of nested frequency of perennial forbs decreased 29%. There were significant decreases in the nested frequencies of thistle (*Cirsium* sp.) and Wasatch penstemon. However, there was also a significant decrease in the nested frequency of houndstongue. Additionally, the quadrat frequency of houndstongue decreased from 19% to 1%, and cover decreased from 1% to 0%. Quadrat frequency of musk thistle increased from 7% to 11%. The DCI score declined to very poor because browse cover decreased below the threshold of 5%, and perennial grass cover also decreased.

winter range condition (DCI) - very poor (19) Mid-level potential scale
browse - stable (0) grass - slightly down (-1) forb - slightly down (-1)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 38%. Young plants increased to 38% of the population, but decadence increased to 50%. The density of dead plants decreased to 200 plants/acre (495 plants/ha), which was greater than the density of live plants. The proportion of dying sagebrush plants changed little, increasing to 25% of the population, and browse use shifted from light-moderate to light. Heavily browsed plants decreased from 23% of the population to 0%. The density of serviceberry decreased 36%. Young plants comprised 44% of the population, and decadence increased to 11%. All of the decadent plants had poor vigor, were classified as dying, and had been heavily browsed. The density of mahogany decreased 17%. Although young plants increased to 14% of the population, decadence increased to 34%. Mahogany vigor remained good, and browse use shifted from heavy to moderate-heavy. Heavily browsed plants decreased to 41% of the population. The grass trend is slightly down. The sum of nested frequency of perennial grasses changed little, increasing 2%. However, cheatgrass increased significantly in nested frequency, and the quadrat frequency increased from 5% to 33%. Japanese brome was also sampled for the

first time, but only in 1% of the quadrats. The forb trend is up. Excluding houndstongue, the sum of nested frequency of perennial forbs increased 16%. Additionally, both noxious weeds had a low abundance. There was a significant decrease in the nested frequency of musk thistle, and that of houndstongue remained constant. The DCI score remained very poor.

winter range condition (DCI) - very poor (21) Mid-level potential scale
browse - down (-2) grass - slightly down (-1) forb - up (+2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 47

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
G	Agropyron spicatum	a8	b42	a12	a25	2.20	.31	1.20
G	Bromus japonicus (a)	-	-	-	1	-	-	.00
G	Bromus tectorum (a)	-	b101	a11	b89	.48	.03	1.19
G	Carex sp.	a6	ab25	b34	b33	1.14	.78	1.07
G	Oryzopsis hymenoides	b121	a77	a77	a82	3.03	3.55	1.56
G	Poa fendleriana	-	-	4	-	-	.16	-
G	Poa pratensis	a24	a19	a10	a6	.13	.10	.41
G	Poa secunda	-	a6	-	a2	.30	-	.03
G	Sitanion hystrix	a7	a16	a11	a12	.13	.14	.57
G	Stipa columbiana	a10	a7	a8	a3	.41	.04	.15
G	Stipa lettermani	a1	b20	ab8	a4	.67	.21	.18
Total for Annual Grasses		0	101	11	90	0.48	0.03	1.19
Total for Perennial Grasses		177	212	164	167	8.05	5.30	5.17
Total for Grasses		177	313	175	257	8.53	5.33	6.37
F	Achillea millefolium	a5	a6	a4	a6	.18	.01	.18
F	Agoseris glauca	-	a1	a11	-	.00	.02	-
F	Alyssum alyssoides (a)	-	-	-	100	-	-	1.05
F	Antennaria rosea	a7	a7	-	-	.41	-	-
F	Astragalus convallarius	a3	a8	a10	a6	.02	.08	.07
F	Castilleja linariaefolia	a2	a-	a4	a-	.01	.03	.00
F	Carduus nutans (a)	-	ab13	b23	a5	.42	.30	.07
F	Chenopodium album (a)	-	1	-	-	.00	-	-
F	Chaenactis douglasii	a7	a4	-	a3	.03	-	.03
F	Cirsium sp.	ab4	b21	a2	ab15	.28	.03	.32
F	Collinsia parviflora (a)	-	a13	a8	b32	.03	.01	.18
F	Crepis acuminata	-	-	-	3	-	-	.00
F	Cryptantha sp.	a4	a1	a12	a5	.03	.22	.01
F	Cynoglossum officinale	c107	b50	a2	a2	.99	.00	.01

Type	Species	Nested Frequency				Average Cover %		
		'89	'97	'02	'07	'97	'02	'07
F	Delphinium nuttallianum	-	1	-	-	.00	-	-
F	Descurainia pinnata (a)	-	$_{b}$29	$_{a}$2	$_{c}$63	.09	.00	.28
F	Epilobium brachycarpum (a)	-	$_{a}$3	$_{a}$4	-	.00	.03	-
F	Erigeron sp.	-	$_{a}$2	-	$_{a}$5	.01	-	.01
F	Gayophytum ramosissimum(a)	-	-	$_{a}$1	$_{b}$7	-	.03	.04
F	Hackelia patens	-	$_{a}$16	$_{a}$21	$_{a}$29	.41	.44	1.08
F	Lappula occidentalis (a)	-	$_{a}$1	-	$_{a}$9	.00	-	.01
F	Lactuca serriola	-	-	2	-	-	.00	-
F	Lithospermum ruderale	-	-	2	-	-	.06	-
F	Machaeranthera canescens	$_{a}$11	$_{a}$27	$_{a}$9	$_{a}$10	.13	.03	.07
F	Melilotus officinalis	-	1	-	-	.00	-	-
F	Penstemon cyananthus	$_{a}$58	$_{b}$101	$_{a}$69	$_{ab}$78	1.96	2.35	3.26
F	Penstemon humilis	$_{a}$16	-	$_{a}$2	$_{a}$6	-	.03	.15
F	Phlox hoodii	-	-	1	-	-	.00	-
F	Phlox longifolia	$_{a}$3	$_{a}$3	-	$_{a}$4	.01	-	.03
F	Ranunculus testiculatus (a)	-	$_{a}$3	$_{a}$3	$_{a}$5	.00	.00	.03
F	Schoencrambe linifolia	-	$_{b}$16	$_{ab}$9	$_{a}$5	.16	.04	.07
F	Senecio multilobatus	$_{a}$3	$_{a}$2	-	$_{a}$3	.03	-	.01
F	Streptanthus cordatus	-	-	-	-	.00	-	-
F	Taraxacum officinale	-	$_{a}$2	-	$_{a}$10	.00	-	.04
F	Tragopogon dubius	-	$_{a}$6	$_{a}$3	$_{a}$2	.04	.01	.01
F	Unknown forb-perennial	3	-	-	-	-	-	-
F	Verbascum thapsus	-	$_{a}$7	$_{a}$4	$_{a}$1	.07	.18	.00
Total for Annual Forbs		0	63	41	221	0.56	0.39	1.67
Total for Perennial Forbs		233	282	167	193	4.82	3.57	5.41
Total for Forbs		233	345	208	414	5.39	3.97	7.09

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

BROWSE TRENDS --
Management unit 17 , Study no: 47

Type	Species	Strip Frequency			Average Cover %		
		'97	'02	'07	'97	'02	'07
B	Amelanchier alnifolia	13	9	7	.21	.09	.24
B	Artemisia tridentata vaseyana	8	8	7	.45	.36	.12
B	Cercocarpus montanus	22	26	21	2.58	2.12	1.87
B	Chrysothamnus nauseosus albicaulis	1	2	1	-	.00	-
B	Chrysothamnus viscidiflorus viscidiflorus	4	8	5	.06	.06	.00
B	Juniperus osteosperma	10	12	6	2.23	4.59	2.69
B	Mahonia repens	1	1	2	-	-	.00
B	Opuntia sp.	3	1	1	-	-	-
B	Pinus edulis	0	2	0	-	-	.63
B	Purshia tridentata	1	0	0	.01	-	-
B	Quercus gambelii	9	8	10	2.01	1.16	2.01
B	Ribes sp.	0	1	0	-	-	-
B	Rosa woodsii	11	12	4	.57	.22	.03
B	Symphoricarpos oreophilus	58	67	62	11.46	13.06	11.52
B	Tetradymia canescens	2	3	3	-	.15	-
Total for Browse		240	162	136	19.61	21.84	19.14

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 47

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	.08	-
Artemisia tridentata vaseyana	.26	.15
Cercocarpus montanus	2.63	3.38
Chrysothamnus viscidiflorus viscidiflorus	.41	.10
Juniperus osteosperma	4.43	14.50
Pinus edulis	1.61	2.00
Quercus gambelii	1.96	3.08
Rosa woodsii	.06	.10
Symphoricarpos oreophilus	18.33	19.61

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 47

Species	Average leader growth (in)	
	'02	'07
Cercocarpus montanus	1.6	1.5

POINT-QUARTER TREE DATA --
Management unit 17 , Study no: 47

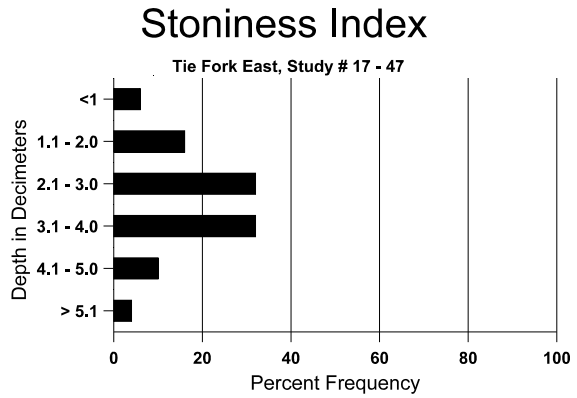
Species	Trees per Acre		Average diameter (in)	
	'02	'07	'02	'07
Juniperus osteosperma	174	209	7.8	6.3
Pinus edulis	30	30	4.8	6.4

BASIC COVER --
Management unit 17 , Study no: 47

Cover Type	Average Cover %			
	'89	'97	'02	'07
Vegetation	7.25	31.06	31.76	33.81
Rock	2.25	4.31	4.36	5.40
Pavement	13.50	4.74	8.36	4.43
Litter	50.50	50.47	48.48	40.59
Cryptogams	0	.70	3.32	.84
Bare Ground	26.50	15.30	24.68	27.17

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 47, Tie Fork East

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
16.1	45.4 (15.4)	7.3	26.7	34.4	38.8	4.5	8.3	112.0	.5



PELLET GROUP DATA --
Management unit 17 , Study no: 47

Type	Quadrat Frequency		
	'97	'02	'07
Sheep	-	1	-
Rabbit	23	21	37
Elk	12	3	-
Deer	38	33	47

Days use per acre (ha)	
'02	'07
-	-
-	-
8 (20)	17 (43)
76 (187)	66 (164)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 47

		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												
89	**433**	-	233	100	100	-	23	8	23	8	8	27/20
97	**300**	-	260	40	-	-	7	7	0	-	0	26/29
02	**280**	-	120	160	-	20	7	29	0	-	0	22/18
07	**180**	40	80	80	20	40	0	11	11	11	11	24/35
Artemisia tridentata vaseyana												
89	**499**	66	166	100	233	-	7	7	47	7	7	20/10
97	**160**	-	-	80	80	260	38	13	50	13	13	27/32
02	**260**	-	40	120	100	320	31	23	38	23	23	23/31
07	**160**	-	60	20	80	200	13	0	50	25	25	29/33
Cercocarpus montanus												
89	**633**	33	200	333	100	-	5	63	16	-	5	67/79
97	**540**	-	60	420	60	20	37	44	11	-	0	33/29
02	**700**	-	40	500	160	20	9	74	23	6	11	31/26
07	**580**	-	80	300	200	-	38	41	34	7	10	32/28
Chrysothamnus nauseosus albicaulis												
89	**199**	-	33	66	100	-	17	33	50	-	0	35/22
97	**20**	-	-	-	20	-	0	0	100	-	0	24/23
02	**40**	-	20	-	20	-	0	0	50	-	0	24/23
07	**20**	-	-	20	-	-	0	0	0	-	0	20/15
Chrysothamnus viscidiflorus viscidiflorus												
89	**1966**	-	1033	700	233	-	0	0	12	-	0	18/24
97	**100**	-	-	100	-	-	0	0	0	-	0	12/12
02	**280**	-	20	260	-	-	29	0	0	-	0	11/16
07	**140**	-	-	140	-	-	0	0	0	-	0	11/14

		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)
Juniperus osteosperma												
89	**99**	33	66	33	-	-	0	33	0	-	0	197/122
97	**220**	-	120	100	-	-	0	0	0	-	0	3/5
02	**280**	40	80	160	40	-	0	0	14	7	29	-/-
07	**120**	60	40	80	-	-	0	0	0	-	17	-/-
Mahonia repens												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	0	0	-	-	0	3/5
02	**20**	-	-	20	-	-	0	0	-	-	0	2/3
07	**40**	-	20	20	-	-	0	0	-	-	0	3/4
Opuntia sp.												
89	**99**	-	33	66	-	-	0	0	0	-	0	5/6
97	**60**	-	20	20	20	20	0	0	33	33	33	5/7
02	**20**	-	-	20	-	-	0	0	0	-	0	6/16
07	**20**	-	20	-	-	-	0	0	0	-	0	5/8
Pinus edulis												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**40**	-	40	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Purshia tridentata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**20**	-	-	20	-	-	100	0	-	-	0	12/24
02	**0**	-	-	-	-	20	0	0	-	-	0	13/33
07	**0**	-	-	-	-	-	0	0	-	-	0	8/18
Quercus gambelii												
89	**0**	33	-	-	-	-	0	0	0	-	0	-/-
97	**820**	40	280	520	20	60	24	0	2	-	0	49/29
02	**1000**	-	120	840	40	160	24	0	4	2	18	33/18
07	**1280**	-	520	680	80	80	6	0	6	-	0	33/16
Rhus trilobata												
89	**0**	-	-	-	-	-	0	0	-	-	0	-/-
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	30/71

		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)
Ribes sp.												
89	**66**	-	-	66	-	-	100	0	-	-	0	18/22
97	**0**	-	-	-	-	-	0	0	-	-	0	-/-
02	**20**	-	20	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Rosa woodsii												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**660**	80	460	180	20	-	0	3	3	-	0	22/14
02	**420**	-	280	120	20	-	0	0	5	5	5	6/6
07	**140**	-	120	20	-	-	0	0	0	-	0	11/7
Symphoricarpos oreophilus												
89	**4732**	33	766	3866	100	-	22	5	2	-	0	20/26
97	**5300**	140	580	4720	-	80	15	4	0	-	0	43/62
02	**6200**	-	240	5640	320	40	5	9	5	2	2	18/35
07	**3320**	-	140	3100	80	60	4	0	2	.60	.60	18/45
Tetradymia canescens												
89	**0**	-	-	-	-	-	0	0	0	-	0	-/-
97	**60**	-	-	60	-	-	100	0	0	-	0	13/11
02	**60**	-	-	60	-	-	0	0	0	-	0	13/16
07	**60**	-	-	20	40	-	33	0	67	-	0	11/14

Trend Study 17-60-07

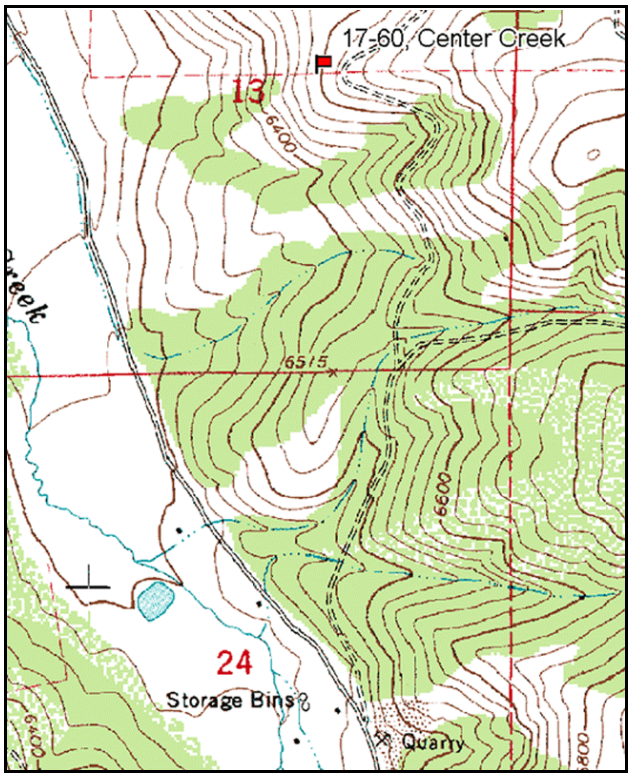
Study site name: Center Creek . Vegetation type: Mountain Big Sage .

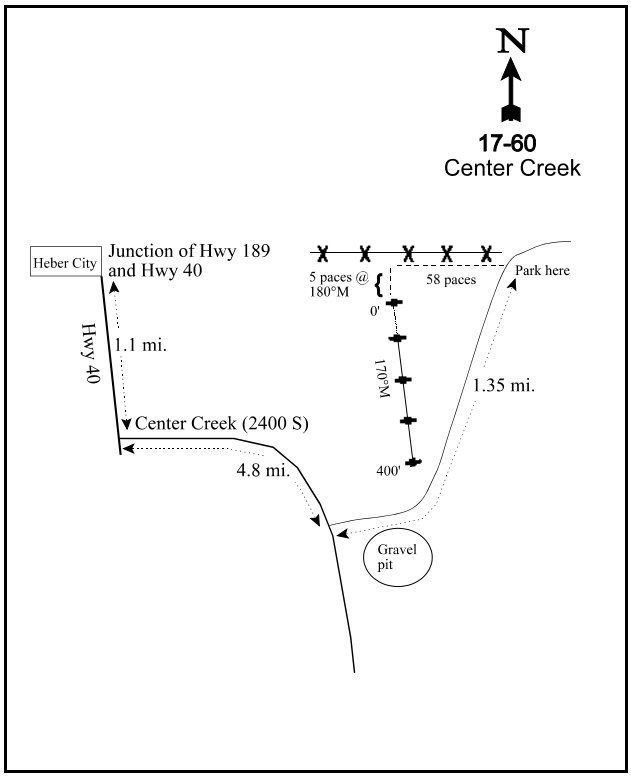
Compass bearing: frequency baseline 170 degrees magnetic.

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

LOCATION DESCRIPTION

From Heber City, proceed on Highway 40 towards Daniel's Canyon for 1.1 miles to Center Creek Road (2400 South). Go 3.0 miles until the road changes to a gravel road. Continue for another 1.8 miles to a gravel pit. Turn left and go 1.35 miles to a fence line, park here. Go 58 paces down the fence line. The 0-foot stake is 25 feet south of the fence line marked by browse tag # 174.





Map Name: Center Creek . Diagrammatic Sketch

Township 4S , Range 5E , Section 13 GPS: NAD 83, UTM 12T 472300 E 4480073 N

DISCUSSION

Center Creek - Trend Study No. 17-60

Study Information

This trend study was established in 2002 to monitor important winter range on the east foothills of the Heber Valley [elevation: 6,600 feet (2,012 m), slope: 25%, aspect: west]. The study is located on private land, and the nearest perennial source of water is Center Creek 0.6 miles (1 km) to the west. Although there is no escape or thermal cover in the immediate area, deer use is moderate-high, and elk use is light-moderate. The quadrat frequency of deer pellets increased from 27% in 2002 to 45% in 2007. From the pellet group transect data, deer use was estimated at 117 days use/acre (289 ddu/ha) in 2002 and 53 days use/acre (131 ddu/ha) in 2007. Elk use was estimated at 5 days use/acre (13 edu/ha) in 2002 and 39 days use/acre (96 edu/ha) in 2007. Most of the deer and elk pellet groups appear to be from winter use, with a few from late winter and early spring. One lone juniper on site showed signs of being a rub tree for deer bucks or elk bulls. In addition, a dead deer carcass was found near the study site baseline in 2002, and another carcass was found on the study in 2007. There was also some sign of horses and cattle using the area. A quarry is located 1 mile (1.6 km) to the south. In 2007, the quarry was active and gravel was being transported on the road that is adjacent to the study.

Soil

This study is located within the Bezzant soil series, which consists of very deep, well-drained, moderately permeable soils. These soils formed in alluvium, colluvium, and residuum from mixed sedimentary rocks. The soil is classified as loamy-skeletal, mixed, superactive, frigid Typic Calcixerolls (USDA-NRCS 2007). Specifically at the study, the soil has a clay loam texture and a neutral reaction (pH of 7.0). Although vegetation and litter are the dominant ground cover classes, pavement and rock cover are comparatively high. The relative pavement cover has averaged 10% since 2002, and relative rock cover has averaged 14%. Relative bare ground cover decreased from 13% in 2002 to 7% in 2007. While taking soil samples, a calcium carbonate layer was found 4-6 inches (10-15 cm) below the surface, and many rocks have a calcium carbonate layer on them. Bare soil is exposed mostly on trails which crisscross the site. The erosion condition class was determined to be slight in 2002 and decreased to stable in 2007. The decrease was the result of a decrease in the density of pedestalled plants.

Browse

The browse component is dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Some of the sagebrush have characteristics of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), and it is apparent that there is some hybridization between these two subspecies. Canopy cover of sagebrush was 21% in 2002 and 19% in 2007. The estimated density decreased from 3,020 plants/acre (7,475 plants/ha) in 2002 to 2,120 plants/acre (5,248 plants/ha) in 2007. No seedling plants have been sampled, and young plants have comprised 2% of the population or less. Decadence has been high, ranging from 28% to 32% of the population. The density of dead plants has also been high, at approximately 1,050 plants/acre (2,600 plants/ha) since 2002. Plants classified as dying decreased from 21% in 2002 to 16% in 2007. The average annual leader growth was 2.7 inches (6.9 cm) in 2002, and 1.6 inches (4.1 cm) in 2007. Browse use on sagebrush has been light-moderate, though an average 25% of the plants have been heavily browsed since 2002.

Other preferred species occur in limited numbers. These include serviceberry (*Amelanchier alnifolia*), Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), and antelope bitterbrush (*Purshia tridentata*). All of these species displayed heavy use and have a hedged growth form on available plants. Collectively, they have accounted for less than 1% of the browse cover. Broom snakeweed (*Gutierrezia sarothrae*) is abundant, though the population decreased from 3,620 plants/acre (8,960 plants/ha) in 2002 to 1,160 plants/acre (2,871 plants/ha) in 2007. Canopy cover of broom snakeweed decreased from 2% in 2002 to less than 1% in 2007.

Herbaceous Understory

The herbaceous understory is diverse, but not particularly productive. Annual grasses, including cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*), are dominant. Cover of these grasses increased from 4% in 2002 to 10% in 2007. Perennial grass cover was also 4% in 2002, but decreased slightly to 3% in 2007. Between eight and nine perennial species have been sampled, and bluebunch wheatgrass (*Agropyron spicatum*) and Indian ricegrass (*Oryzopsis hymenoides*) are the dominant perennial grasses. Bulbous bluegrass (*Poa bulbosa*) is also present, but had a quadrat frequency of only 1% in 2002 and 2007. This perennial species has a phenology that is similar to that of annual grasses (Stewart and Hull 1949), and may limit the establishment of other species.

The forb component is also diverse, but does not provide much forage. Perennial forb cover decreased from 2% in 2002 to 1% in 2007. The dominant perennial forbs include hairy goldaster (*Heterotheca villosa*) and heath aster (*Leucelene ericoides*). Annual forb cover increased from 1% in 2002 to 3% in 2007. With the exception of annual sunflower (*Helianthus annuus*), the annual species that have been sampled are small plants. Pale alyssum (*Alyssum alyssoides*) was the dominant forb in 2002 and 2007, and was sampled in 69% and 92% of the quadrats, respectively. Storksbill (*Erodium cicutarium*), which may limit the establishment of other species (Kimball and Schiffman 2003), is also present. It was the second most abundant forb species in 2007.

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 30%. Although the mature plants had good seed production, there were no seedling plants sampled. Recruitment changed little, slightly decreasing from 2% to 1%. Sagebrush decadence increased from 28% to 32%, and half of the decadent plants were classified as dying. The density of dead plants increased from 1,000 plants/acre (2,475 plants/ha) to 1,100 plants/acre (2,722 plants/ha). Browse use was fairly constant, and heavily browsed plants increased from 23% of the population to 27%. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 38%. The nested frequencies of mutton bluegrass (*Poa fendleriana*), Sandberg bluegrass (*Poa secunda*), and bottlebrush squirreltail (*Sitanion hystrix*) all decreased significantly. Although there was significant decrease in the nested frequency of Japanese brome, there was a significant increase in that of cheatgrass. Cheatgrass cover increased from 3% to 10%. The forb trend is down. The sum of nested frequency of perennial forbs decreased 61%, and the number of perennial species sampled decreased from 18 to 12. There were significant decreases in the nested frequencies of wild onion (*Allium* sp.), spring parsley (*Cymopterus* sp.), hairy goldaster, and longleaf phlox (*Phlox longifolia*). The nested frequency of storksbill significantly increased, and the quadrat frequency increased from 6% to 35%. The 2002 Desirable Components Index (DCI) score was poor because the high browse cover was countered by low recruitment, high annual grass cover, and low perennial grass and forb cover. In 2007, the DCI score decreased to very poor due to a decrease in browse cover and an increase in annual grass cover.

2002 winter range condition (DCI) - poor (44) Mid-level potential scale
2007 winter range condition (DCI) - very poor (27) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 60

Type	Species	Nested Frequency '02	Nested Frequency '07	Average Cover % '02	Average Cover % '07
G	Agropyron dasystachyum	a5	a1	.18	.00
G	Agropyron spicatum	a37	a45	1.02	1.56
G	Bromus japonicus (a)	b185	a93	1.25	.34
G	Bromus tectorum (a)	a217	b382	3.11	9.93
G	Oryzopsis hymenoides	a39	a30	1.65	.97
G	Poa bulbosa	a1	a3	.00	.00
G	Poa fendleriana	b23	a3	.12	.03
G	Poa pratensis	10	-	.09	-
G	Poa secunda	b42	a17	.39	.16
G	Sitanion hystrix	b32	a12	.29	.20
G	Stipa comata	a2	a9	.06	.07
Total for Annual Grasses		402	475	4.36	10.28
Total for Perennial Grasses		191	120	3.84	3.02
Total for Grasses		593	595	8.21	13.30
F	Agoseris glauca	6	-	.03	-
F	Alyssum alyssoides (a)	a175	b353	.76	1.92
F	Allium sp.	b47	a14	.10	.03
F	Antennaria rosea	6	-	.15	-
F	Arabis sp.	1	-	.00	-
F	Artemisia ludoviciana	a3	a1	.01	.00
F	Astragalus convallarius	a3	a4	.00	.02
F	Castilleja linariaefolia	3	-	.06	-
F	Camelina microcarpa (a)	5	-	.01	-
F	Calochortus nuttallii	13	-	.04	-
F	Chaenactis douglasii	4	-	.00	-
F	Chenopodium sp. (a)	3	-	.03	-
F	Cirsium sp.	a7	a7	.07	.16
F	Collomia linearis (a)	a5	a4	.01	.00
F	Collinsia parviflora (a)	-	15	-	.02
F	Cymopterus sp.	b15	a4	.06	.01
F	Epilobium brachycarpum (a)	20	-	.04	-
F	Eriogonum brevicaule	1	-	.00	-
F	Erodium cicutarium (a)	a20	b113	.08	1.17
F	Eriogonum racemosum	a4	a1	.03	.00
F	Gilia sp. (a)	a1	a2	.00	.00

Type	Species	Nested Frequency '02	Nested Frequency '07	Average Cover % '02	Average Cover % '07
F	Helianthus annuus (a)	2	-	.01	-
F	Heterotheca villosa	$_{b}$32	$_{a}$10	.41	.22
F	Leucelene ericoides	$_{a}$19	$_{a}$17	.52	.21
F	Mentzelia sp.	-	2	-	.00
F	Microsteris gracilis (a)	$_{b}$27	$_{a}$3	.13	.00
F	Phlox longifolia	$_{b}$18	$_{a}$1	.06	.00
F	Ranunculus testiculatus (a)	-	1	-	.00
F	Sphaeralcea coccinea	$_{a}$20	$_{a}$17	.28	.09
F	Viguiera multiflora	3	-	.03	-
F	Viola sp.	-	2	-	.03
Total for Annual Forbs		258	491	1.07	3.14
Total for Perennial Forbs		205	80	1.90	0.81
Total for Forbs		463	571	2.98	3.95

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

BROWSE TRENDS --
Management unit 17 , Study no: 60

Type	Species	Strip Frequency '02	Strip Frequency '07	Average Cover % '02	Average Cover % '07
B	Amelanchier alnifolia	7	6	.41	.15
B	Artemisia tridentata vaseyana	76	70	21.50	15.72
B	Chrysothamnus viscidiflorus viscidiflorus	3	1	.15	-
B	Gutierrezia sarothrae	38	30	1.99	.31
B	Mahonia repens	5	9	.45	.25
B	Opuntia sp.	31	32	.28	.35
B	Purshia tridentata	8	9	.30	.38
B	Tetradymia canescens	15	12	.59	1.08
Total for Browse		183	169	25.68	18.25

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 60

Species	Percent Cover	
	'02	'07
Amelanchier alnifolia	.01	.01
Artemisia tridentata vaseyana	20.68	18.60
Chrysothamnus viscidiflorus viscidiflorus	.13	.05
Gutierrezia sarothrae	2.18	.26
Mahonia repens	.33	.61
Opuntia sp.	.15	.18
Purshia tridentata	.51	.11
Tetradymia canescens	.88	1.21

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 60

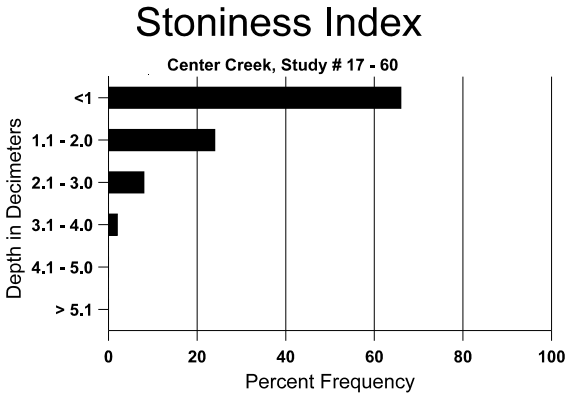
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	2.7	1.6

BASIC COVER --
Management unit 17 , Study no: 60

Cover Type	Average Cover %	
	'02	'07
Vegetation	36.21	42.93
Rock	18.43	12.69
Pavement	12.66	10.21
Litter	33.97	39.47
Cryptogams	.22	0
Bare Ground	15.71	7.41

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 60, Center Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
12.5	67.0 (12.7)	7.0	41.3	24.7	34.0	4.3	16.4	278.4	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 60

Type	Quadrat Frequency '02	Quadrat Frequency '07	Days use per acre (ha) '02	Days use per acre (ha) '07
Rabbit	7	29	-	-
Elk	1	5	5 (13)	39 (96)
Deer	27	45	117 (289)	53 (131)
Cattle	1	1	-	-

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 60

		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												
02	**160**	-	40	120	-	-	13	88	0	-	0	17/27
07	**140**	-	20	100	20	-	0	100	14	-	0	11/14
Artemisia tridentata vaseyana												
02	**3020**	-	60	2100	860	1000	32	23	28	21	21	28/39
07	**2120**	-	20	1420	680	1100	30	27	32	16	16	28/39
Chrysothamnus viscidiflorus viscidiflorus												
02	**60**	-	-	60	-	-	0	0	-	-	33	9/16
07	**20**	-	-	20	-	-	0	0	-	-	0	7/10
Cowania mexicana stansburiana												
02	**0**	-	-	-	-	-	0	0	-	-	0	85/67
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Gutierrezia sarothrae												
02	**3620**	-	-	3420	200	180	0	0	6	3	4	8/10
07	**1160**	360	100	1040	20	-	3	5	2	-	7	8/7

		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)
Mahonia repens												
02	**2260**	-	-	2260	-	-	0	0	-	-	0	3/4
07	**4400**	-	40	4360	-	-	0	0	-	-	1	3/4
Opuntia sp.												
02	**1080**	-	120	940	20	-	0	0	2	2	2	4/8
07	**1000**	20	80	880	40	20	0	0	4	2	6	4/8
Purshia tridentata												
02	**160**	-	-	140	20	-	0	100	13	-	0	9/26
07	**200**	-	20	160	20	-	0	70	10	10	10	9/24
Rhus trilobata												
02	**0**	-	-	-	-	-	0	0	-	-	0	27/51
07	**0**	-	-	-	-	-	0	0	-	-	0	25/56
Tetradymia canescens												
02	**360**	-	-	340	20	-	6	6	6	-	0	10/16
07	**340**	-	-	320	20	-	6	0	6	6	6	11/21

Trend Study 17-61-07

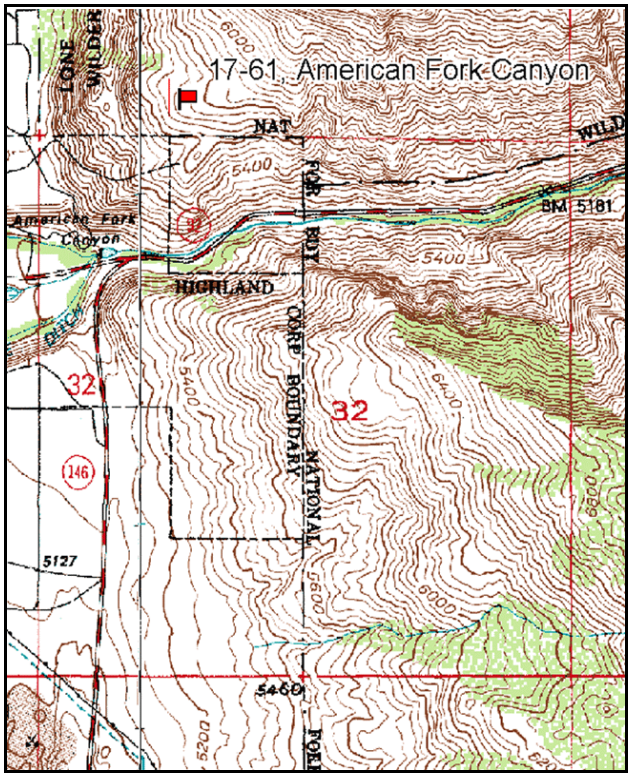
Study site name: American Fork Canyon . Vegetation type: P-J and Big Sagebrush .

Compass bearing: frequency baseline 330 degrees magnetic.

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

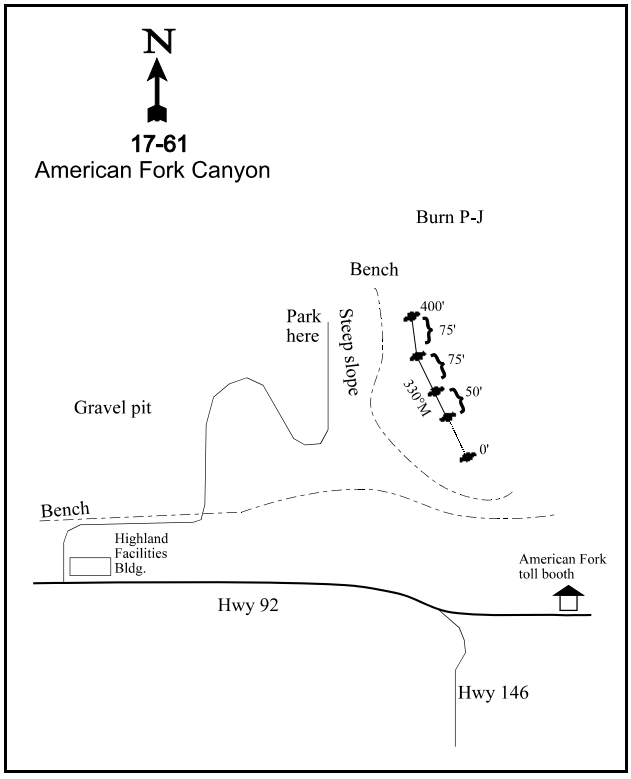
LOCATION DESCRIPTION

Go to American Fork Canyon on Highway 92. Toward the mouth of the canyon, there is a gravel pit on the north side of the road along with Highland Facilities building. Turn left on the road going north just before the buildings. Continue up this road until a steep slope is encountered. The site lies on the first bench of this slope. Park here. Walk east up the steep slope about 1/4 of a mile to another bench that has been burned. The site is just south of the burn. GPS coordinates will be helpful on this site. Development is currently under construction and this route may not be available in the future.



Map Name: Lehi

Township 4S , Range 2E , Section 29



Diagrammatic Sketch

GPS: NAD 83, UTM 12T 436451 E 4476462 N

DISCUSSION

American Fork Canyon - Trend Study No. 17-61

Study Information

This winter range study was established at the mouth of American Fork Canyon and within the boundary of the Lone Peak Wilderness area to monitor Rocky Mountain bighorn sheep use [elevation: 5,700 feet (1,737 m), slope: 25%, aspect: west]. The bighorn sheep were transplanted to the area towards the end of 1999, but the study was not established until 2002. The nearest perennial source of water is American Fork 0.25 miles (0.4 km) to the south. In addition to bighorn sheep, the area has also been used by deer and elk. From the pellet group transect data, deer use was estimated at 29 days use/acre (73 ddu/ha) in 2002 and 23 days use/acre (56 ddu/ha) in 2007. Elk use was estimated at 17 days use/acre (43 edu/ha) in 2002 and 7 days use/acre (17 edu/ha) in 2007. Bighorn sheep use was estimated at 56 days use/acre (137 sdu/ha) in 2002 and 33 days use/acre (81 sdu/ha) in 2007. There was some difficulty distinguishing between deer and bighorn sheep pellets in 2002 and 2007. Most of the big game pellet groups appear to be from winter use. The hillslope below the study area, and abutting the wilderness boundary, was being developed when the study was sampled in 2007. The area immediately north of the study was burned in a wildfire in the late 1990s.

Soil

The soil is shallow and extremely rocky. The parent material is limestone, which is exposed in large bed rock outcrops. The soil has a loam texture and is slightly alkaline (pH of 7.4). Relative bare ground cover has been quite low at 4% in 2002 and 1% in 2007, while the relative rock cover has been high at 18% in 2002 and 15% in 2007. Due to the low bare ground cover and high rock, vegetation, and litter cover, the erosion condition was classified as stable in 2002 and 2007.

Browse

The overstory is dominated by Utah juniper (*Juniperus osteosperma*) with an understory of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), true mountain mahogany (*Cercocarpus montanus*), and Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*). Juniper canopy cover was 15% in 2002, and 16% in 2007. Based on point-quarter density estimates, there were 41 trees/acre (101 trees/ha) in 2002 and 39 trees/acre (97 trees/ha) in 2007. The average diameter increased from 9.1 inches (23.1 cm) in 2002 to 12.5 inches (31.8 cm) in 2007. Several of the trees sampled were highlined.

The canopy cover of sagebrush increased from 4% in 2002 to 7% in 2007. The density has ranged from 1,500 plants/acre (3,713 plants/ha) in 2002 to 1,000 plants/acre (2,475 plants/ha) in 2007, and the population is mostly mature. Seedling plants were sampled in 2007 at a density of 80 plants/acre (198 plants/ha). Few young plants have been sampled, and young plants have comprised 3% of the population or less. Decadence decreased from 25% of the population in 2002 to 12% in 2007, but the density of dead plants increased from 540 plants/acre (1,337 plants/ha) to 640 plants/acre (1,584 plants/ha). Plants classified as dying accounted for 17% of the population in 2002, and decreased to 4% by 2007. The average annual leader growth was 3.1 inches (7.9 cm) in 2002 and 1.4 inches (3.4 cm) in 2007. Browse use shifted from light-moderate in 2002 to moderate-heavy in 2007.

Cliffrose canopy cover decreased from 3% in 2002 to 1% in 2007. The small population has had a stable density of 120 plants/acre (297 plants/ha). The majority of the population consists of decadent plants: 67% in 2002 and 83% in 2007. Plants with poor vigor have comprised 17% of the population since 2002, and all of those plants were classified as dying. The average annual leader growth was 3.8 inches (9.7 cm) in 2002 and 1.9 inches (4.8 cm) in 2007. Browse use on cliffrose has been moderate-heavy. Less palatable shrubs sampled include a few white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), broom snakeweed (*Gutierrezia sarothrae*), and pricklypear cactus (*Opuntia* sp.). The collective canopy cover of these species has been less than 1%.

Herbaceous Understory

The herbaceous understory has low species diversity and is dominated by annual species. Annual grass cover was 41% in 2002 and 38% in 2007. Cheatgrass (*Bromus tectorum*) accounts for most of the annual cover, though Japanese brome (*Bromus japonicus*) was also sampled in 2002 in one quadrat. Perennial grass cover was less than 1% in 2002 and increased slightly to 3% in 2007. Bluebunch wheatgrass (*Agropyron spicatum*) is the dominant perennial species. Bulbous bluegrass (*Poa bulbosa*) is also present, and although it is a perennial species, it has a phenology that is similar to annual grasses (Stewart and Hull 1949) and may limit the establishment of other species.

Annual species also dominate the forb component. The cover of annual forbs increased from 1% in 2002 to 4% in 2007, while that of perennial species was less than 1% in both sample years. The dominant forb species are holosteum (*Holosteum umbellatum*) and storksbill (*Erodium cicutarium*). Storksbill has been found to limit the establishment of other species (Kimball and Schiffman 2003).

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 33%. Although seedling plants were sampled for the first time, they occurred at a low frequency. Young plants decreased slightly from 3% of the population to 2%. However, decadence decreased from 25% of the population to 12%, and plants classified as dying decreased from 17% to 4%. The browse use also shifted from light-moderate to moderate-heavy, and heavily browsed plants increased from 20% of the population to 52%. Decadence and browse use also increased on the few cliffrose plants present. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased considerably, but perennial grasses continued to have low abundance. The nested frequencies of bluebunch wheatgrass and Sandberg bluegrass (*Poa secunda*) significantly increased. However, there was also a significant increase in the nested frequency of cheatgrass. The forb trend is slightly down. The sum of nested frequency of perennial forbs changed little. However, there was a significant increase in the nested frequency of storksbill, and quadrat frequency increased from 10% to 46%. The 2002 Desirable Components Index (DCI) score was very poor because browse cover was less than the 5% threshold, annual grass cover was high, and perennial grass and forb cover were low. In 2007, the DCI score remained very poor.

2002 winter range condition (DCI) - very poor (-15) Mid-level potential scale
2007 winter range condition (DCI) - very poor (-10) Mid-level potential scale
browse - down (-2) grass - slightly up (+1) forb - slightly down (-1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 61

Type	Species	Nested Frequency '02	Nested Frequency '07	Average Cover % '02	Average Cover % '07
G	Agropyron smithii	-	2	-	.00
G	Agropyron spicatum	$_{a}$2	$_{b}$66	.03	1.92
G	Bromus japonicus (a)	3	-	.00	-
G	Bromus tectorum (a)	$_{a}$425	$_{b}$457	41.21	37.77
G	Poa bulbosa	$_{a}$6	$_{a}$14	.01	.44

Type	Species	Nested Frequency		Average Cover %	
		'02	'07	'02	'07
G	Poa secunda	$_{a}$1	$_{b}$46	.00	.38
Total for Annual Grasses		428	457	41.22	37.77
Total for Perennial Grasses		9	128	0.04	2.75
Total for Grasses		437	585	41.27	40.52
F	Alyssum alyssoides (a)	$_{a}$63	$_{a}$54	.18	.17
F	Collinsia parviflora (a)	-	2	-	.01
F	Cryptantha sp.	-	3	-	.01
F	Descurainia pinnata (a)	$_{a}$4	$_{a}$7	.01	.02
F	Draba sp. (a)	$_{a}$4	$_{b}$38	.01	.06
F	Erodium cicutarium (a)	$_{a}$30	$_{b}$134	.56	1.95
F	Heterotheca villosa	1	-	.00	-
F	Holosteum umbellatum (a)	$_{a}$3	$_{b}$199	.01	1.48
F	Lappula occidentalis (a)	-	16	-	.03
F	Ranunculus testiculatus (a)	$_{a}$5	$_{a}$2	.19	.00
F	Salsola iberica (a)	1	-	.00	-
F	Sisymbrium altissimum (a)	$_{a}$5	$_{a}$7	.24	.08
F	Tragopogon dubius	-	1	-	.00
Total for Annual Forbs		115	459	1.21	3.82
Total for Perennial Forbs		1	4	0.00	0.02
Total for Forbs		116	463	1.22	3.84

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

BROWSE TRENDS --
Management unit 17 , Study no: 61

Type	Species	Strip Frequency		Average Cover %	
		'02	'07	'02	'07
B	Artemisia tridentata vaseyana	40	26	3.49	3.37
B	Chrysothamnus nauseosus albicaulis	1	1	-	-
B	Cowania mexicana stansburiana	6	6	.45	.53
B	Gutierrezia sarothrae	0	4	-	.06
B	Juniperus osteosperma	5	5	7.80	4.60
B	Opuntia sp.	4	4	-	-
Total for Browse		56	46	11.74	8.57

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 61

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	4.36	7.19
Cowania mexicana stansburiana	2.59	1.04
Gutierrezia sarothrae	-	.15
Juniperus osteosperma	14.83	15.89
Opuntia sp.	-	.15

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 61

Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	3.1	1.4
Cowania mexicana stansburiana	3.8	1.9

POINT-QUARTER TREE DATA --
Management unit 17 , Study no: 61

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	41	39

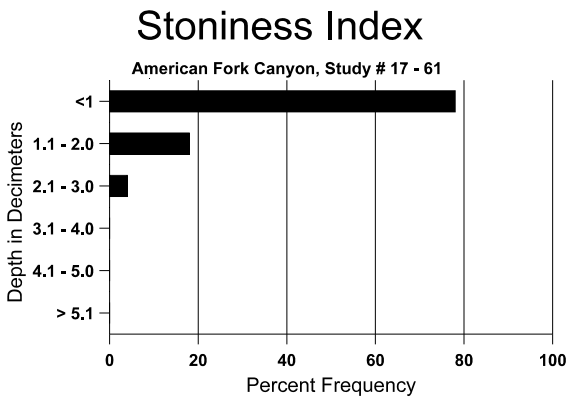
Average diameter (in)	
'02	'07
9.1	12.5

BASIC COVER --
Management unit 17 , Study no: 61

Cover Type	Average Cover %	
	'02	'07
Vegetation	52.60	51.55
Rock	21.68	17.44
Pavement	1.52	.33
Litter	40.96	43.37
Cryptogams	.09	.34
Bare Ground	4.66	1.52

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 61, American Fork Canyon

Effective rooting depth (in)	Temp °F (depth)	pH	Loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
9.8	73.3 (13.0)	7.4	29.3	46.7	24.0	6.3	105.6	313.6	.9



PELLET GROUP DATA --
Management unit 17 , Study no: 61

Type	Quadrat Frequency		Days use per acre (ha)	
	'02	'07	'02	'07
Bighorn Sheep	33	17	56 (137)	33 (81)
Rabbit	18	8	-	-
Elk	7	3	17 (43)	7 (17)
Deer	13	23	29 (73)	23 (56)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 61

		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												
02	**1500**	-	40	1080	380	540	19	20	25	17	17	22/31
07	**1000**	80	20	860	120	640	30	52	12	4	4	24/36
Chrysothamnus nauseosus albicaulis												
02	**20**	-	-	-	20	140	0	0	100	-	0	23/44
07	**20**	-	-	-	20	-	0	0	100	-	0	26/38
Cowania mexicana stansburiana												
02	**120**	-	-	40	80	80	50	50	67	17	17	39/43
07	**120**	-	-	20	100	-	33	67	83	17	17	53/50

		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												
02	**0**	-	-	-	-	60	0	0	-	-	0	-/-
07	**100**	-	-	100	-	-	0	0	-	-	0	8/10
Juniperus osteosperma												
02	**100**	-	-	100	-	20	0	0	-	-	0	-/-
07	**100**	-	-	100	-	20	0	0	-	-	0	-/-
Opuntia sp.												
02	**80**	-	20	60	-	-	0	0	-	-	0	3/5
07	**120**	-	20	100	-	-	0	0	-	-	0	4/15

Trend Study 17-62-07

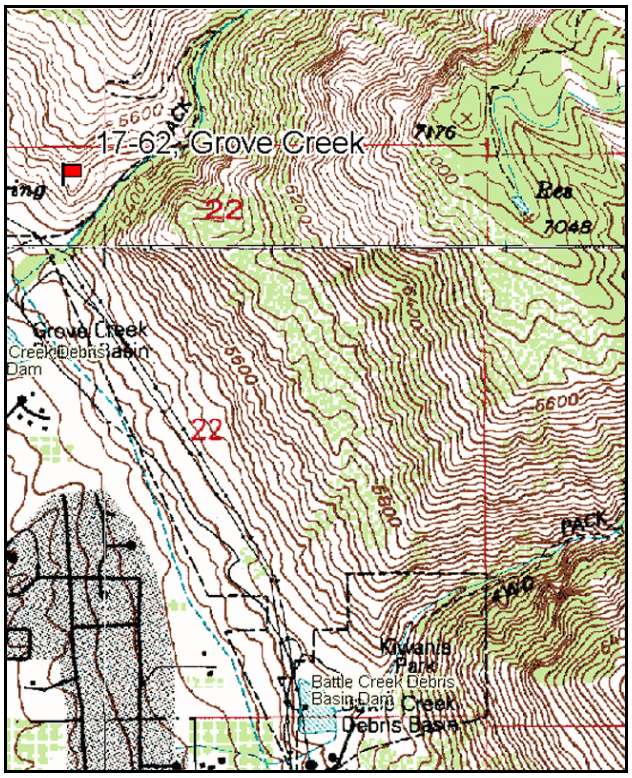
Study site name: Grove Creek . Vegetation type: Stansbury Cliffrose .

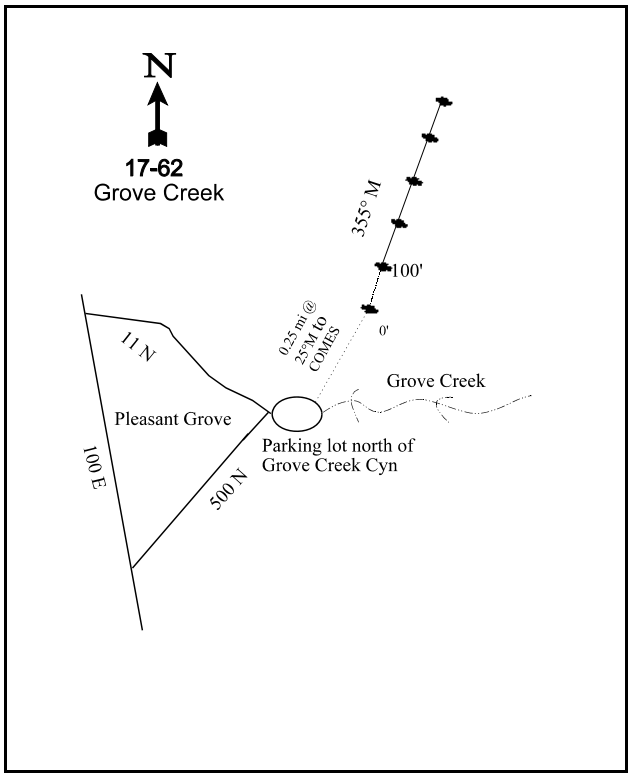
Compass bearing: frequency baseline 355 degrees magnetic.

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

LOCATION DESCRIPTION

From the junction of Highway's 89 (State St.) and 146 in Pleasant Grove, continue on Highway 146 until 500 North, just before the school. Continue on this road until it comes to the parking lot at the mouth of Grove Creek Canyon. From the parking lot, follow the ridge for 0.25 miles at 25 degrees magnetic to the 0-foot stake in the cliffrose.





Map Name: Lehi

Diagrammatic Sketch

Township 4S , Range 2E , Section 29

GPS: NAD 83, UTM 12T 439692 E 4469781 N

DISCUSSION

Grove Creek - Trend Study No. 17-62

Study Information

This study was established in 2002 to monitor deer and bighorn sheep winter range above Pleasant Grove [elevation: 5,340 feet (1,628 m), slope: 40%, aspect: southwest]. Bighorn sheep were transplanted into the area in the late 1990s. The nearest perennial source of water is Grove Creek, which is 400 feet (122 m) to the south. This study has become increasingly important winter range as a result of the expansion of residential development. The only remaining available winter range is found on the steeper slopes on Forest Service land. Deer and bighorn sheep use has been heavy, but elk use has been light. From the pellet group transect data, deer use was estimated at 72 days use/acre (177 ddu/ha) in 2002 and 90 days use/acre (223 ddu/ha) in 2007. Elk use was estimated at 5 days use/acre (12 edu/ha) in 2002 and 1 day use/acre (3 edu/ha) in 2007. Bighorn sheep use was estimated 38 days use/acre (94 sdu/ha) in 2002 and 32 days use/acre (79 sdu/ha) in 2007. It has been difficult to differentiate between the pellet groups of bighorn sheep and those of mule deer.

Soil

The soil is shallow, rocky, and has a clay loam texture. The soil reaction is neutral (pH of 7.3). The parent material is limestone, which is exposed as bedrock and large rock outcrops on the site. Relative rock cover was 8% in 2002 and 6% in 2007. Relative vegetation cover has been stable at approximately 30%, but relative litter cover increased from 27% in 2002 to 44% in 2007. The relative bare ground cover decreased from 20% in 2002 to 9% in 2007. The hillslope is terraced and has numerous game trails and flow paths. Despite these features and the steep slope, the soil erosion condition was classified as slight in 2002 and 2007.

Browse

The dominant browse species are Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). The canopy cover of cliffrose increased from 3% in 2002 to 5% in 2007. The density has ranged from 120 plants/acre (297 plants/ha) in 2002 to 80 plants/acre (198 plants/ha) in 2007. The cliffrose population consists mostly of large, mature plants. No seedling cliffrose have been sampled, and the young age class decreased from 50% of the population in 2002 to 0% in 2007. There were no decadent plants in 2002, but they accounted for 25% of the population in 2007. Vigor was good in 2002, but in 2007 25% of the population had poor vigor and was classified as dying. The average annual leader growth was 3.3 inches (8.4 cm) in 2002 and 4.1 inches (10.4 cm) in 2007. Browse use on cliffrose was light-moderate in 2002, and shifted to moderate in 2007.

The canopy cover of sagebrush was 1% in 2002, and less than 1% in 2007. The density of sagebrush decreased from 380 plants/acre (941 plants/ha) in 2002 to 240 plants/acre (594 plants/ha) in 2007. No seedling or young sagebrush have been sampled. Decadence has been high, ranging from 53% of the population in 2002 to 42% in 2007. There were almost as many dead plants as living in 2002, and an equal number in 2007. Plants with poor vigor accounted for 37% of the population in 2002 and 42% in 2007. The average annual leader growth was 6.3 inches (16.0 cm) in 2002 and 2.0 inches (5.1 cm) in 2007. Browse use on sagebrush has been moderate-heavy.

Herbaceous Understory

The herbaceous understory has low diversity and is dominated by annual species. These annual species are likely to be limiting successful establishment of shrub seedlings. Annual grass cover was 19% in 2002 and 20% in 2007. Cheatgrass (*Bromus tectorum*) accounted for most of the annual grass cover, though Japanese brome (*Bromus japonicus*) is also present. Perennial grass cover was 4% in both 2002 and 2007. The dominant perennial grass is bluebunch wheatgrass (*Agropyron spicatum*). Bulbous bluegrass (*Poa bulbosa*) is present, but has only been sampled in few quadrats. This perennial species has a phenology that is similar to annual grasses (Stewart and Hull 1949) and may limit the establishment of other species.

Annual forbs cover was 4% in 2002 and 6% in 2007. The dominant forb is storksbill (*Erodium cicutarium*), which has also been shown to limit the establishment of other species (Kimball and Schiffman 2003). A second allelopathic annual, bur buttercup (*Ranunculus testiculatus*) is also present, but decreased in average cover from 1% in 2002 to nearly 0% in 2007. Perennial forb cover was 1% in 2002 and less than 1% in 2007. The dominant perennial forb is Bonneville pea (*Lathyrus brachycalyx*). Two noxious weed species were sampled in 2007, yellow starthistle (*Centaurea solstitialis*) and field bindweed (*Convolvulus arvensis*). Both species had a quadrat frequency of 3% or less.

2007 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush decreased 37%. Sagebrush decadence decreased from 53% of the population to 42%, and the density of dead plants decreased 25%. Plants with poor vigor increased from 37% of the population to 42%. Heavily browsed plants increased from 37% of the population to 58%. Animal use on sagebrush was irregular; some plants were heavily hedged while others had not been browsed at all. Cliffrose density decreased 33%. No seedling plants were sampled, and few plants had produced flowers. Young plants decreased from 50% of the population to 0%. Decadence increased from 0% of the population to 25%, and all of the decadent plants were classified as dying. The grass trend is down. Excluding bulbous bluegrass, the sum of nested frequency of perennial grasses decreased 24%. There was a significant decrease in the nested frequency of Sandberg bluegrass (*Poa secunda*) and a significant increase in that of Japanese brome. Additionally, the nested frequency of cheatgrass increased significantly, and cheatgrass was sampled in 100% of the quadrats. The forb trend is down. Excluding noxious weeds, the sum of nested frequency of perennial forbs decreased 32%. However, perennial forbs had already been scarce. There was a significant decrease in the nested frequency of bur buttercup, and a significant increase in that of storksbill. However, the decrease in bur buttercup cover was smaller than the increase in storksbill cover. Additionally, two noxious weed species were sampled, yellow starthistle and field bindweed. The 2002 Desirable Components Index (DCI) score was very poor due to low browse cover, high annual grass cover, and low perennial grass and forb cover. In 2007, the DCI score remained very poor because browse cover was less than the threshold of 5%, and because of the two noxious weed species that were sampled.

2002 winter range condition (DCI) - very poor (22) Mid-level potential scale
2007 winter range condition (DCI) - very poor (-7) Mid-level potential scale
browse - slightly down (-1) grass - down (-2) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 62

Type	Species	Nested Frequency '02	Nested Frequency '07	Average Cover % '02	Average Cover % '07
G	Agropyron spicatum	$_{a}$114	$_{a}$106	3.82	4.14
G	Bromus japonicus (a)	$_{b}$60	$_{a}$9	.25	.02
G	Bromus tectorum (a)	$_{a}$396	$_{b}$432	19.07	20.13
G	Poa bulbosa	$_{a}$6	$_{a}$2	.09	.00
G	Poa fendleriana	1	-	.00	-
G	Poa secunda	$_{b}$37	$_{a}$10	.40	.07
Total for Annual Grasses		456	441	19.32	20.15
Total for Perennial Grasses		158	118	4.31	4.22
Total for Grasses		614	559	23.64	24.37

Type	Species	Nested Frequency		Average Cover %	
		'02	'07	'02	'07
F	Alyssum alyssoides (a)	$_{a}$135	$_{b}$174	.40	.58
F	Ambrosia psilostachya	$_{a}$6	$_{a}$5	.15	.03
F	Antennaria rosea	1	-	.03	-
F	Artemisia ludoviciana	$_{a}$5	$_{a}$2	.03	.00
F	Astragalus utahensis	-	-	.00	-
F	Camelina microcarpa (a)	3	-	.00	-
F	Centaurea solstitialis	-	7	-	.04
F	Convolvulus arvensis	-	2	-	.00
F	Cryptantha sp.	-	1	-	.03
F	Erodium cicutarium (a)	$_{a}$145	$_{b}$281	2.34	5.26
F	Holosteum umbellatum (a)	$_{a}$5	$_{b}$43	.01	.14
F	Lathyrus brachycalyx	$_{a}$28	$_{a}$19	.31	.25
F	Lappula occidentalis (a)	$_{a}$4	$_{a}$1	.18	.00
F	Lactuca serriola	-	3	-	.00
F	Ranunculus testiculatus (a)	$_{b}$154	$_{a}$16	.83	.03
F	Sisymbrium altissimum (a)	$_{a}$7	$_{a}$4	.09	.03
F	Tragopogon dubius	4	-	.00	-
Total for Annual Forbs		453	519	3.88	6.06
Total for Perennial Forbs		44	39	0.54	0.37
Total for Forbs		497	558	4.42	6.44

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

BROWSE TRENDS --
Management unit 17 , Study no: 62

Type	Species	Strip Frequency		Average Cover %	
		'02	'07	'02	'07
B	Artemisia tridentata vaseyana	19	12	1.65	.21
B	Celtis reticulata	0	1	-	-
B	Chrysothamnus nauseosus albicaulis	8	5	1.50	1.01
B	Cowania mexicana stansburiana	6	4	2.70	1.14
B	Gutierrezia sarothrae	2	5	-	.30
B	Rhus trilobata	0	0	.03	.15
Total for Browse		35	27	5.90	2.82

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 62

Species	Percent Cover	
	'02	'07
Artemisia tridentata vaseyana	.75	.25
Celtis reticulata	-	.01
Chrysothamnus nauseosus albicaulis	1.20	.75
Cowania mexicana stansburiana	2.73	4.96

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 62

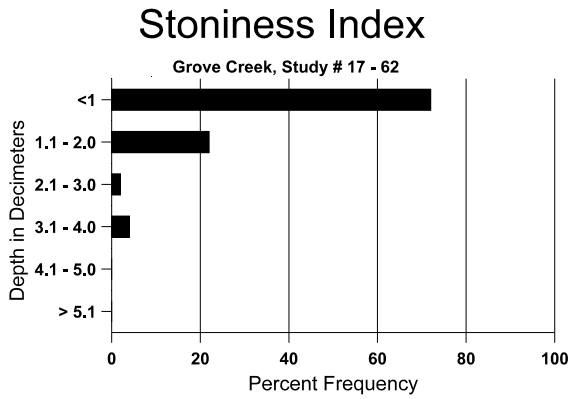
Species	Average leader growth (in)	
	'02	'07
Artemisia tridentata vaseyana	6.3	2.0
Cowania mexicana stansburiana	3.3	4.1

BASIC COVER --
Management unit 17 , Study no: 62

Cover Type	Average Cover %	
	'02	'07
Vegetation	35.56	35.43
Rock	9.63	6.43
Pavement	16.01	12.40
Litter	31.64	51.47
Cryptogams	.21	.22
Bare Ground	22.88	10.94

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 62, Grove Creek

Effective rooting depth (in)	Temp °F (depth)	pH	Clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
8.7	74.6 (8.6)	7.3	33.3	34.7	32.0	3.4	11.4	198.4	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 62

Type	Quadrat Frequency '02	Quadrat Frequency '07	Days use per acre (ha) '02	Days use per acre (ha) '07
Bighorn Sheep	25	-	36 (89)	32 (79)
Rabbit	-	8	-	-
Elk	1	14	5 (12)	1 (3)
Deer	11	36	72 (177)	90 (223)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 62

		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												
02	**380**	-	-	180	200	320	26	37	53	37	37	24/35
07	**240**	-	-	140	100	240	17	58	42	25	42	25/41
Celtis reticulata												
02	**0**	-	-	-	-	-	0	0	-	-	0	-/-
07	**20**	-	20	-	-	-	0	0	-	-	0	42/107
Chrysothamnus nauseosus albicaulis												
02	**180**	-	-	100	80	80	11	0	44	22	22	28/50
07	**140**	-	-	100	40	40	0	0	29	14	14	37/62
Cowania mexicana stansburiana												
02	**120**	-	60	60	-	-	17	17	0	-	0	65/79
07	**80**	-	-	60	20	-	50	25	25	25	25	66/85
Gutierrezia sarothrae												
02	**40**	-	-	40	-	440	0	0	-	-	0	8/12
07	**100**	-	-	100	-	-	20	0	-	-	0	10/14

Trend Study 17-64-07

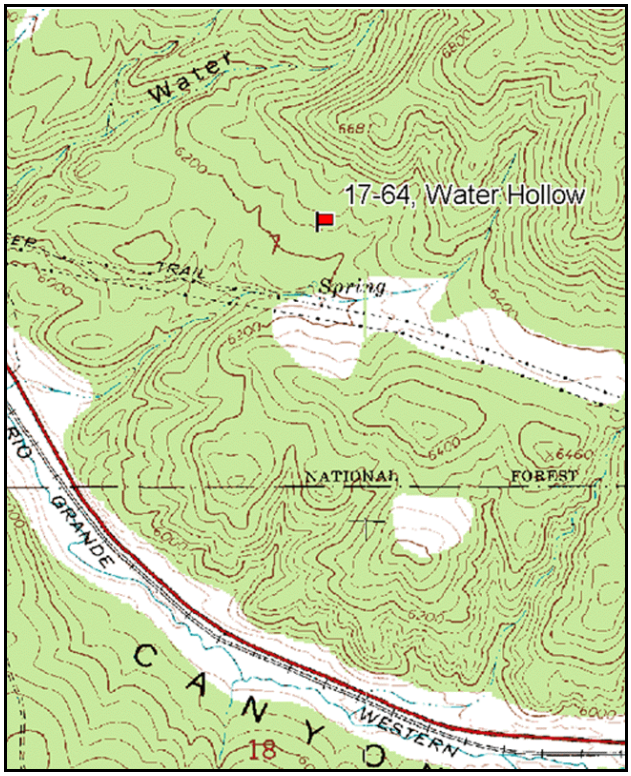
Study site name: Water Hollow . Vegetation type: Chained, Seeded P-J .

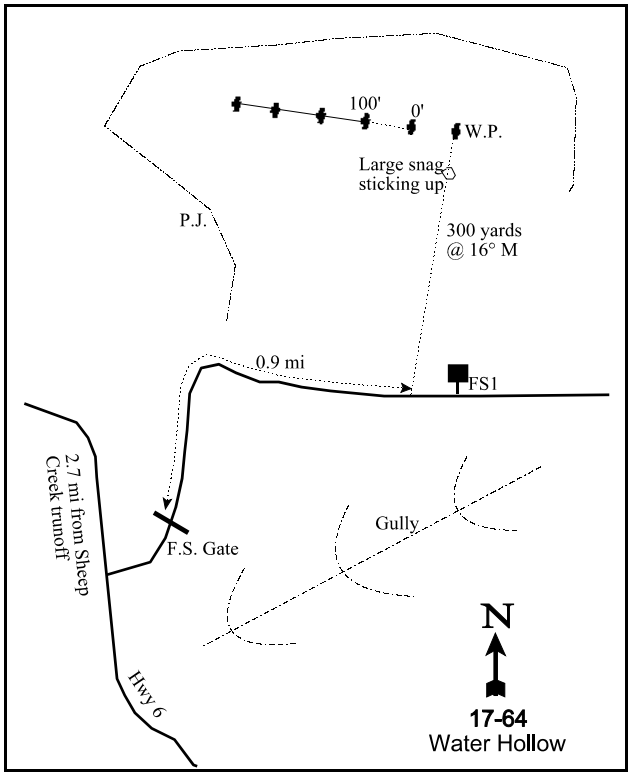
Compass bearing: frequency baseline 277 degrees magnetic.

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

LOCATION DESCRIPTION

From Spanish Fork Canyon, take Highway 6 to the Sheep Creek turnoff. Continue on Highway 6 for 2.2 miles to a road on the north side of the road (left). Turn left again just after exiting highway 6. Follow this road to a Forest Service gate. From the gate, go 0.9 miles to a Forest Service sign. Park here and walk 300 yards at 16 degrees magnetic to the witness post. A large clump of chained P-J is in front of the post. The 0-foot stake is just west of the witness post and is marked with browse tag # 132. Extra rebar and T-posts present on the site from another unrelated study.





Map Name: Mill Fork

Diagrammatic Sketch

Township 10S , Range 6E , Section 7

GPS: NAD 83, UTM 12S 474876 E 4424105 N

DISCUSSION

Water Hollow - Trend Study No. 17-64

Study Information

This winter range study monitors a pinyon-juniper chaining on the north side of US-6 in Spanish Fork Canyon [elevation: 6,240 feet (1,902 m), slope: 11%, aspect: south]. The nearest perennial source of water is Soldier Creek, on the opposite side of US-6, 0.75 miles (1.2 km) to the southwest. The chaining was part of a mosaic of small chaining and seeding treatments that were completed on south-facing slopes in the 1990s. The objective of these treatments was to improve winter range and stabilize the watersheds on the north of US-6. This study is located within a 60-acre (24.3-ha) area that was treated using a smooth chain. Since the treatment, deer use has been moderate and elk use has been heavy. There is evidence that animal use occurs throughout the year, but is highest in the winter. From the pellet group transect data, deer use was estimated at 25 days use/acre (63 ddu/ha) in both 2002 and 2007. Elk use was estimated at 115 days use/acre (284 edu/ha) in 2002 and 110 days use/acre (273 edu/ha) in 2007. Rabbit pellets were sampled in 27% of the quadrats in 2002 and only in 9% in 2007.

Soil

The soil has a sandy clay loam texture and a slightly alkaline reaction (pH of 7.4). There is little rock on the surface or within the profile. The relative rock cover has been 2% or less, and that of pavement was 3% in 2002 and 2007. Relative vegetation cover increased from 22% in 2002 to 34% in 2007. However, the relative bare ground cover has also been high. It was 26% in 2002 and decreased to 21% in 2007. The study lies within the Green River Shale formation. Soils in this formation are highly erodible, and severe erosion is apparent outside of the chained area. The soil erosion condition class was determined to be slight in 2002 and 2007 due to evidence of surface litter and soil movement, and the formation of pedestals and flow patterns. Old, inactive gullies are also present, but it appears that chained trees may have been placed in the gullies to minimize channel erosion.

Browse

Prior to the chaining, this study was dominated by Utah juniper (*Juniperus osteosperma*) and pinyon pine (*Pinus edulis*) trees. There were few shrubs in the understory. From the point-quarter estimates, the density of junipers was 30 trees/acre (74 trees/ha) in 2002 and 39 trees/acre (97 trees/ha) in 2007. In 2002, approximately 75% of the sampled junipers were trees tipped over by the chaining but were still living. The other 25% were small, young trees that either survived the chaining, or became established after the chaining. In 2007, 32% of the sampled junipers were tipped trees, and the remaining 68% were trees that were small enough to survive the chaining or had become established afterwards. The average diameter increased from 4.6 inches (11.7 cm) in 2002 to 5.4 inches (13.7 cm) in 2007. However, the canopy cover of juniper decreased from 2% in 2002 to 1% in 2007. The density of pinyon increased from 7 trees/acre (17 trees/ha) in 2002 to 22 trees/acre (54 trees/ha) in 2007. The average pinyon diameter increased from 2.1 inches (5.3 cm) in 2002 to 3.3 inches (8.4 cm) in 2007.

Fourwing saltbush (*Atriplex canescens*) and antelope bitterbrush (*Purshia tridentata*) were seeded using a dribbler as a part of the treatment. These species are present, but are not abundant. The canopy cover of fourwing saltbush increased from less than 1% in 2002 to 1% in 2007. Fourwing saltbush density was estimated at 40 plants/acre (99 plants/ha) in 2002 and 60 plants/acre (149 plants/ha) in 2007. The population consists only of mature, healthy plants that have been lightly-moderately browsed. The average annual leader growth was 3.4 inches (8.6 cm) in 2002 and 4.1 inches (10.4 cm) in 2007. The canopy cover of bitterbrush was also less than 1% in 2002 and increased to 1% in 2007. Bitterbrush density was estimated at 60 plants/acre (149 plants/ha) in 2002 and 80 plants/acre (198 plants/ha) in 2007. Young plants comprised 67% of the population in 2002, and by 2007 all of the sampled plants were mature. All plants were healthy in both

sample years, despite being heavily browsed. The average annual leader growth of bitterbrush was 4.0 inches (10.2 cm) in 2002 and 2.8 inches (7.1 cm) in 2007. Small numbers of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*), which were included within the aerial seed mix, were also sampled.

Herbaceous Understory

Perennial grasses dominate the herbaceous understory, and provided 21% cover in 2002, and 24% in 2007. Between 11 and 14 perennial species have been sampled, and the dominant species are crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), smooth brome (*Bromus inermis*), and Great Basin wildrye (*Elymus cinereus*). Cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*) are both present, but cover of these species has been less than 1%. However, the quadrat frequency of cheatgrass increased from 3% in 2002 to 27% in 2007, and that of Japanese brome increased from 1% to 14%.

Forbs are rare and provide little forage. Perennial forb cover was less than 1% in both 2002 and 2007. Lewis flax (*Linum lewisii*) and cryptantha (*Cryptantha* sp.) are the most abundant perennial species. Musk thistle (*Carduus nutans*), a noxious weed, was sampled in 2002, but only had a quadrat frequency of 2%.

2007 TREND ASSESSMENT

The browse trend is slightly up. The density of fourwing saltbush increased 50%, but abundance was still low. Only mature, healthy plants were sampled, and browse use remained light-moderate. The average height and crown measurements increased 10 inches (25 cm) and 22 inches (56 cm), respectively. Like fourwing saltbush, the density of bitterbrush increased, but abundance remained low. Young plants decreased from 67% of the population to 0%. The population consisted entirely of mature, healthy plants. Browse use remained heavy, though heavily browsed plants decreased from 100% of the population to 75%. The average height and crown measurements increased 10 inches (25 cm) and 14 inches (36 cm), respectively. No seedlings of either species were sampled. The grass trend is stable. The sum of nested frequency of perennial grasses increased 16%, including a significant increase in the nested frequency of mountain brome (*Bromus carinatus*). However, there was a significant decrease in the nested frequency of orchardgrass (*Dactylis glomerata*), and a significant increases in the nested frequencies of cheatgrass and Japanese brome. The forb trend is slightly up. The sum of nested frequency of perennial forbs increased 53%, but forb abundance remained low. Musk thistle was not sampled, but was still present. Lewis flax had high seed production. The 2002 Desirable Components Index (DCI) score was very poor because browse cover was less than the 5% threshold, perennial forb cover was low, and one noxious weed species was present. The score would have been lower if not for the high perennial grass cover. In 2007, the DCI score remained very poor.

2002 winter range condition (DCI) - very poor (30) Mid-level potential scale
2007 winter range condition (DCI) - very poor (31) Mid-level potential scale
browse - slightly up (+1) grass - stable (0) forb - slightly up (+1)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 64

Type	Species	Nested Frequency '02	Nested Frequency '07	Average Cover % '02	Average Cover % '07
G	Agropyron cristatum	a156	a196	6.66	7.28
G	Agropyron intermedium	a128	a106	3.11	5.44
G	Agropyron smithii	a42	a52	2.02	1.40
G	Agropyron spicatum	a9	a16	.41	1.21
G	Bromus carinatus	a6	b28	.18	.96
G	Bromus inermis	a103	a111	2.67	3.35
G	Bromus japonicus (a)	a3	b40	.00	.12
G	Bromus tectorum (a)	a5	b66	.01	.40
G	Carex sp.	-	-	.00	-
G	Dactylis glomerata	b19	a5	.56	.22
G	Elymus cinereus	a24	a36	3.69	2.94
G	Oryzopsis hymenoides	a13	a6	.93	.19
G	Poa fendleriana	-	5	-	.06
G	Poa pratensis	-	4	-	.18
G	Poa secunda	a12	a24	.02	.58
G	Secale montanum	a-	a7	.00	.18
G	Sitanion hystrix	a7	a7	.21	.16
Total for Annual Grasses		8	106	0.01	0.52
Total for Perennial Grasses		519	603	20.52	24.19
Total for Grasses		527	709	20.54	24.72
F	Alyssum alyssoides (a)	-	21	-	.06
F	Astragalus sp.	2	-	.01	-
F	Camelina microcarpa (a)	-	15	-	.07
F	Carduus nutans (a)	5	-	.01	-
F	Chaenactis douglasii	-	3	-	.03
F	Cirsium sp.	a-	a1	.00	.00
F	Cryptantha sp.	-	1	-	.15
F	Descurainia pinnata (a)	-	9	-	.02
F	Gilia sp. (a)	a4	a10	.03	.05
F	Lappula occidentalis (a)	-	18	-	.05
F	Lactuca serriola	a1	a3	.00	.00
F	Linum lewisii	a18	a26	.28	.18
F	Lithospermum ruderale	a-	a-	.00	.03
F	Medicago sativa	-	-	.00	-
F	Penstemon caespitosus	a1	a7	.03	.04

Type	Species	Nested Frequency '02	Nested Frequency '07	Average Cover % '02	Average Cover % '07
F	Streptanthus cordatus	1	-	.00	-
F	Tragopogon dubius	$_a$9	$_a$8	.02	.04
Total for Annual Forbs		9	73	0.03	0.25
Total for Perennial Forbs		32	49	0.37	0.49
Total for Forbs		41	122	0.40	0.75

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

BROWSE TRENDS --
Management unit 17 , Study no: 64

Type	Species	Strip Frequency '02	Strip Frequency '07	Average Cover % '02	Average Cover % '07
B	Atriplex canescens	2	3	.63	.41
B	Juniperus osteosperma	1	3	1.86	1.86
B	Purshia tridentata	2	2	-	.15
Total for Browse		5	8	2.49	2.42

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 64

Species	Percent Cover '02	Percent Cover '07
Atriplex canescens	.48	.80
Juniperus osteosperma	2.46	1.48
Purshia tridentata	.31	.88

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 64

Species	Average leader growth (in) '02	Average leader growth (in) '07
Atriplex canescens	3.4	4.1
Purshia tridentata	4.0	2.8

POINT-QUARTER TREE DATA --
Management unit 17 , Study no: 64

Species	Trees per Acre	
	'02	'07
Juniperus osteosperma	30	39
Pinus edulis	7	22

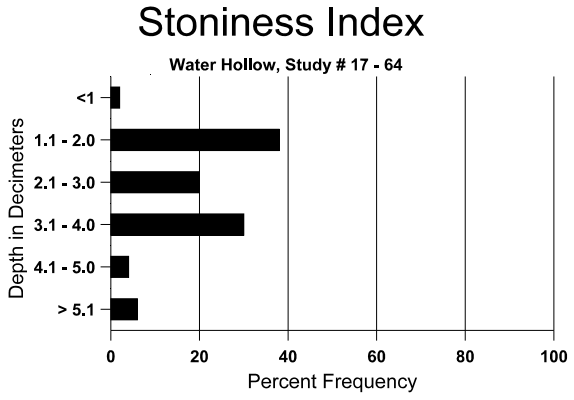
Average diameter (in)	
'02	'07
4.6	5.4
2.1	3.3

BASIC COVER --
Management unit 17 , Study no: 64

Cover Type	Average Cover %	
	'02	'07
Vegetation	25.31	36.94
Rock	1.94	.70
Pavement	3.73	3.69
Litter	56.09	45.00
Cryptogams	.23	.56
Bare Ground	30.10	23.16

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 64, Water Hollow

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
15.4	60.4 (12.8)	7.4	48.7	20.0	31.3	3.4	4.5	236.8	.7



PELLET GROUP DATA --
Management unit 17 , Study no: 64

Type	Quadrat Frequency	
	'02	'07
Rabbit	27	9
Elk	36	31
Deer	14	11

Days use per acre (ha)	
'02	'07
-	-
115 (284)	110 (273)
25 (63)	25 (63)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 64

		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												
02	**0**	-	-	-	-	20	0	0	-	-	0	19/26
07	**0**	-	-	-	-	-	0	0	-	-	0	22/31
Atriplex canescens												
02	**40**	-	-	40	-	-	50	0	-	-	0	45/51
07	**60**	-	-	60	-	-	33	0	-	-	0	55/73
Chrysothamnus nauseosus albicaulis												
02	**0**	-	-	-	-	-	0	0	-	-	0	29/43
07	**0**	-	-	-	-	-	0	0	-	-	0	32/41
Chrysothamnus viscidiflorus viscidiflorus												
02	**0**	-	-	-	-	-	0	0	-	-	0	14/24
07	**0**	-	-	-	-	-	0	0	-	-	0	23/32
Gutierrezia sarothrae												
02	**0**	-	-	-	-	500	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	20/25
Juniperus osteosperma												
02	**20**	-	20	-	-	-	0	0	-	-	0	-/-
07	**60**	-	-	60	-	-	0	0	-	-	0	-/-
Purshia tridentata												
02	**60**	-	40	20	-	-	0	100	-	-	0	17/28
07	**80**	-	-	80	-	-	25	75	-	-	0	27/42
Symphoricarpos oreophilus												
02	**0**	-	-	-	-	-	0	0	-	-	0	12/18
07	**0**	-	-	-	-	-	0	0	-	-	0	14/16

Trend Study 17-68-07

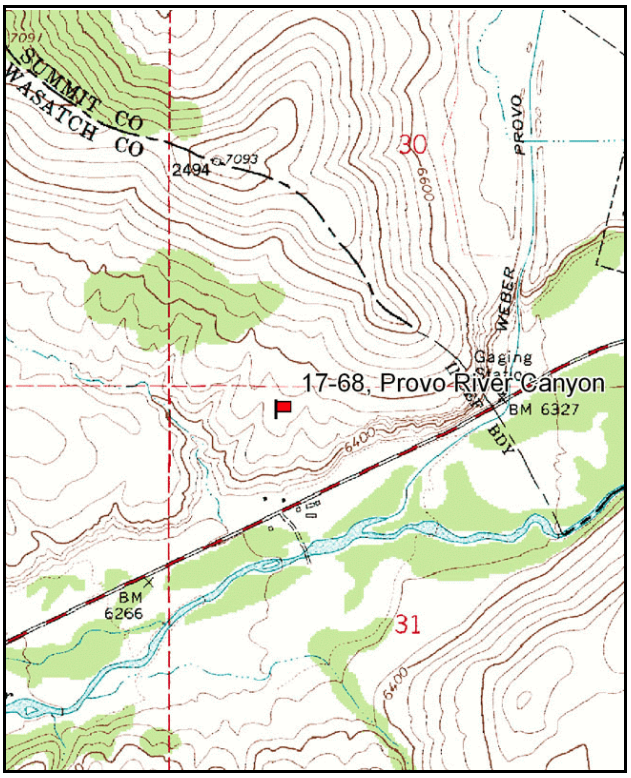
Study site name: Provo River Canyon . Vegetation type: Big Sagebrush-Grass .

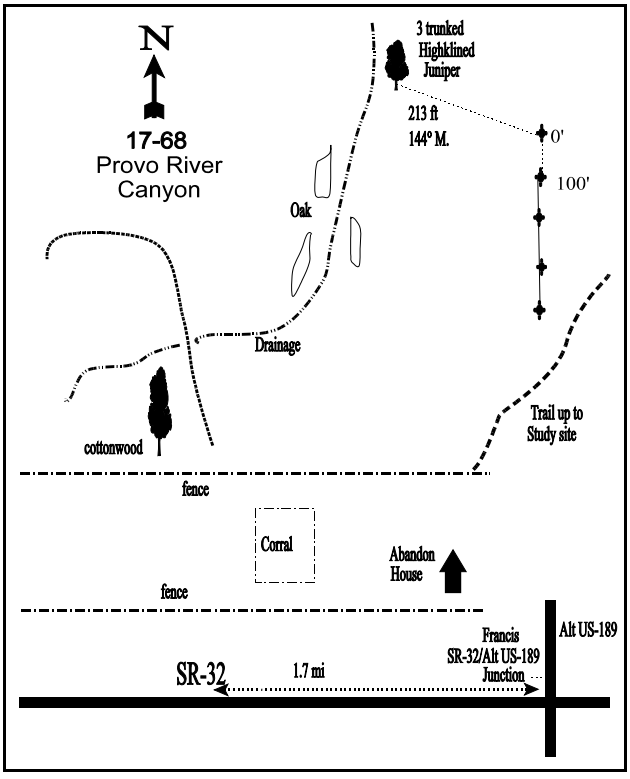
Compass bearing: frequency baseline 160 degrees.

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

LOCATION DESCRIPTION

From the junction of SR-32 and Alt US-189 in Francis, proceed west on Hwy 32 for 1.7 miles and stop at an old corral in a marshy pasture on the right (north) opposite Victory Ranch Club (6480 E. Hwy 32). Walk to the large, narrow-leaf cottonwood northwest of the corral. The tree is at the mouth of a small canyon. Walk up the canyon approximately 500 feet until reaching the first drainage on the right. A drainage begins where the road crosses the creek for the second time. Walk up this drainage past the oak clumps to a point where the gully flattens out. To the right locate a 3-trunked, high-lined juniper. From the juniper, walk 213 feet at 144 degrees magnetic to the 0-foot stake of the baseline, marked with browse tag #7960. The baseline runs in a direction of 160 degrees magnetic.





Map Name: Francis

Diagrammatic Sketch

Township 2S , Range 6E , Section 31

UTM NAD 83, UTM 12T 473377 E 4495437 N

DISCUSSION

Provo River Canyon - Trend Study No. 17- 68

Study Information

This study samples a narrow band of critical deer winter range located on a bluff north of the Provo River and west of Francis on SR-32 [elevation: 6,500 feet (1,981 m), slope: 5%-12%, aspect: south]. The nearest perennial source of water is a spring that is 950 feet (290 m) to the south, near an abandoned house. Deer use has been moderate, and elk use has been light. Even though there is little herbaceous forage, cattle and sheep alternately use the area in the spring-fall period. From the pellet group transect data, deer use was estimated at 35 days use/acre (86 ddu/ha) in 2001 and 30 days use/acre (74 ddu/ha) in 2007. Deer pellet groups were primarily from winter use, but some groups were recent, indicating a few resident deer use the area during the spring and summer. Elk use was estimated at 3 days use/acre (7 edu/ha) in 2001 and 5 days use/acre (13 edu/ha) in 2007. Cattle use was estimated at 1 day use/acre (2 cdu/ha) in 2002 and 11 days use/acre (27 cdu/ha) in 2007, but the pats appeared to be from the fall of 2006. The quadrat frequency of rabbit pellet groups increased from 9% in 1996 to 38% in 2007.

Soil

This study is located within the Little Pole soil series. Soils in this series are shallow and well-drained. They formed in material weathered from intermediate igneous rocks. The Little Pole series is classified as loamy-skeletal, mixed, superactive, frigid Lithic Haploxerolls. Specifically at the study, the soil has a clay loam texture and a neutral soil reaction (pH of 6.6). Relative bare ground cover increased from 6% in 1996 to 14% in 2001, and decreased to 8% in 2007. Relative vegetation cover increased from 41% in 1996 to 50% by 2007, while that of litter has decreased from 48% in 1996 to 39% in 2007. Although the was limited erosion in the past, the erosion condition was classified as stable in 2001 and 2007.

Browse

Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species. It provided 27% canopy cover in 2007. Some plants have characteristics of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), and it is likely that there has been some hybridization between subspecies. Since 1996, mature plants have been tall, averaging 3 feet (0.9 m) in height with a crown width of nearly 4 feet (1.2 m). The population density decreased from 6,332 plants/acre (15,673 plants/ha) in 1984 to 4,120 plants/acre (10,198 plants/ha) in 1996, and increased to 4,280 plants/acre (10,594 plants/ha) in 2001. By 2007, the density decreased to 2,920 plants/acre (7,228 plants/ha). Seedling plants were most abundant in 1984, but few have been sampled in subsequent years. Young plants increased from 5% of the population in 1984 to 14% in 1990, and then decreased to 1% by 2007. Decadence has been high, though it has oscillated between increasing and decreasing in alternate sample years. Decadence was the lowest in 1996 (20%) and highest in 1990 (57%). Decadent plants comprised 50% of the population in 2007. The density of dead plants decreased from 920 plants/acre (2,277 plants/ha) in 1996 to 720 plants/acre (1,782 plants/ha) in 2001, and increased to 1,380 plants/acre (3,416 plants/ha) in 2007. More than 20% of the population had poor vigor in 1990, 2001, and 2007. Otherwise, vigor has been good. The average annual leader growth was 1.5 inches (3.8 cm) in 2007. Browse use on sagebrush was moderate-heavy in 1984, and has been light-moderate in subsequent sample years.

Antelope bitterbrush (*Purshia tridentata*) is also present, but much less abundant. Bitterbrush canopy cover was 2% in 2007. The estimated density decreased from 866 plants/acre (2,144 plants/ha) in 1984 to 180 plants/acre (446 plants/ha) in 1996, and increased to 240 plants/acre (594 plants/ha) in 2001. In 2007, the density decreased to 200 plants/acre (495 plants/ha). No seedling plants have been sampled, and young plants were only sampled in 1990. Decadent plants increased from 77% of the population in 1984 to 88% in 1990, and decreased to 0% by 2001. In 2007, 40% of the population was decadent. The density of dead plants decreased from 100 plants/acre (248 plants/ha) in 1996 to 20 plants/acre (49 plants/ha) in 2001, and increased

to 40 plants/acre (99 plants/ha) in 2007. Vigor has been good, except in 1984 and 1990 when 38% and 75% of the population, respectively, had poor vigor. Browse use on bitterbrush has been moderate-heavy and heavy.

Herbaceous Understory

The herbaceous understory is dominated by cheatgrass (*Bromus tectorum*). Cheatgrass cover was 7% in 1996, 2% in 2001, and 20% in 2007. Japanese brome (*Bromus japonicus*) is also present, but not abundant. These annual species are likely to be limiting the establishment of sagebrush seedlings, as well as perennial herbaceous plants. Perennial grass cover was 7% in 1996 and 9% in both 2001 and 2007. Dominant perennial species include bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass (*Poa secunda*).

Perennial forb cover was less than 1% in 1996, 4% in 2002, and 1% in 2007, and between seven and 10 perennial species have been sampled. Since 2001, silky milkvetch (*Astragalus cibarius*) has been the most abundant perennial species. Several small annual forbs are abundant and include slenderleaf collomia (*Collomia linearis*), blue-eyed Mary (*Collinsia parviflora*), owlclover (*Orthocarpus* sp.), and pale alyssum (*Alyssum alyssoides*).

1990 TREND ASSESSMENT

The browse trend is slightly down. The density of sagebrush changed little, decreasing 4%. Few seedlings were sampled, but young plants increased from 5% of the population to 14%. Decadence increased from 33% of the population to 57%. Plants with poor vigor increased from 12% of the population to 30%, and 14% of the population was classified as dying. Browse use on sagebrush shifted from moderate-heavy to light-moderate, and heavily browsed plants decreased from 36% of the population to 19%. The bitterbrush population density decreased 39%. Young plants increased from 0% of the population to 12%, but the remainder of the population was decadent. Bitterbrush plants with poor vigor increased from 38% of the population to 75%. Browse use shifted from heavy to moderate-heavy, and heavily browsed plants decreased from 92% of the population to 63%. The grass trend is up. The sum of nested frequency of perennial grasses increased 71%. There were significant increases in the nested frequencies of bluebunch wheatgrass and Sandberg bluegrass, and a significant decrease in that of thickspike wheatgrass (*Agropyron dasystachyum*). The forb trend is stable. Although the sum of nested frequency of perennial forbs increased 31%, they continued to have a low abundance.

browse - slightly down (-1) grass - up (+2) forb - stable (0)

1996 TREND ASSESSMENT

The browse trend is slightly up. The density of sagebrush decreased 32%. However, it is likely that much of this decrease resulted from the larger area that was sampled beginning in 1996. Thus, trend was determined from other parameters. Few seedling plants were sampled, and young plants decreased to 3% of the population. The density of mature plants nearly doubled, increasing from 29% of the population to 77%. Decadence decreased to 20% of the population. Dead plants were sampled for the first time and had a density of 920 plants/acre (2,277 plants/ha). Plants with poor vigor decreased to 3% of the population, and only 5% had been heavily browsed. The average crown width increased 24 inches (61 cm). Although there are fewer sagebrush plants, the population now consists of healthier and larger plants. The bitterbrush population decreased 66%. There were no seedling or young bitterbrush sampled, but decadence decreased to 11% of the population. Dead bitterbrush were sampled at a density of 100 plants/acre (248 plants/ha). However, all of the living plants had good vigor, even though 67% of the population had been heavily browsed. The grass trend is slightly down. The sum of nested frequency of perennial grasses decreased 11%. There were significant decreases in the nested frequencies of thickspike wheatgrass and Sandberg bluegrass, and a significant increase in that of bluebunch wheatgrass. Cheatgrass was sampled in 84% of the quadrats. The forb trend is slightly down. The sum of nested frequency of perennial forbs decreased 59%. This decrease was moderated by the already low abundance of perennial forbs. There was a significant decrease in the nested frequency of longleaf phlox (*Phlox longifolia*). The Desirable Components Index (DCI) score was poor-fair because of high browse

cover, low browse recruitment, high annual grass cover, and low perennial forb cover.

winter range condition (DCI) - poor-fair (49) Mid-level potential scale
browse - slightly up (+1) grass - slightly down (-1) forb - slightly down (-1)

2001 TREND ASSESSMENT

The browse trend is stable. The density of sagebrush increased 4%. No seedling plants were sampled, and young plants decreased to 2% of the population. Sagebrush decadence increased to 37% of the population, but dead plants decreased to 720 plants/acre (1,782 plants/ha). Plants with poor vigor increased to 22% of the population, and 9% of the population was classified as dying. Browse use remained light-moderate. The density of bitterbrush increased 33%. All of the sampled plants were mature and healthy, and dead plants decreased to 20 plants/acre (49 plants/ha). Heavily browsed plants decreased to 50% of the population. The grass trend is up. The sum of nested frequency of perennial grasses increased 23%, while that of annual grasses decreased 42%. There was a significant increase in the nested frequency of Sandberg bluegrass, and significant decreases in the nested frequencies of bluebunch wheatgrass and cheatgrass. Japanese brome was sampled for the first time, but only in one quadrat. The forb trend is up. The sum of nested frequency of perennial forbs increased more than seven-fold, and the number of perennial forb species sampled increased from seven to 10. There were significant increases in the nested frequencies of silvery lupine (*Lupinus argenteus*) and longleaf phlox. Silky milkvetch was sampled for the first time, and was the dominant perennial forb. The DCI score increased to fair because annual grass cover decreased and perennial grass and forb cover increased.

winter range condition (DCI) - fair (60) Mid-level potential scale
browse - stable (0) grass - up (+2) forb - up (+2)

2007 TREND ASSESSMENT

The browse trend is down. The density of sagebrush decreased 32%. Few seedlings were sampled and young sagebrush decreased to 1% of the population. Decadence increased to 50% of the population, and the density of dead plants increased to 1,380 plants/acre (3,416 plants/ha). Plants with poor vigor increased to 34% of the population, and all of those plants were classified as dying. Browse use remained light-moderate. The bitterbrush density decreased 17%. No seedling or young bitterbrush were sampled, and decadence increased to 40% of the population. Dead plants increased to a density of 40 plants/acre (99 plants/ha). Plants with poor vigor increased from 0% of the population to 10%, all of which were classified as dying. Browse use shifted to heavy, and 80% of the population had been heavily browsed. The grass trend is down. The sum of nested frequency of perennial grasses decreased 16%, while that of annual grasses increased more than two-fold. There was a significant decrease in the nested frequency of bottlebrush squirreltail (*Sitanion hystrix*) and a significant increase in the nested frequency of cheatgrass. Cheatgrass quadrat frequency increased from 62% to 94%, and cover increased from 2% to 20%. The forb trend is down. The sum of nested frequency of perennial forbs decreased 78%. There were significant decreases in the nested frequencies of silky milkvetch and silvery lupine. The DCI score decreased to very poor due to decreased browse cover, increased decadence, increased annual grass cover, and decreased perennial forb cover.

winter range condition (DCI) - very poor (26) Mid-level potential scale
browse - down (-2) grass - down (-2) forb - down (-2)

HERBACEOUS TRENDS --
Management unit 17 , Study no: 68

Type	Species	Nested Frequency					Average Cover %		
		'84	'90	'96	'01	'07	'96	'01	'07
G	Agropyron cristatum	a8	a13	a10	a19	a20	.68	.48	.63
G	Agropyron dasystachyum	87	34	3	11	17	.00	.08	.26
G	Agropyron spicatum	a25	b79	c124	ab87	ab75	2.71	2.32	3.08
G	Bromus japonicus (a)	-	-	-	a3	a11	-	.00	.02
G	Bromus tectorum (a)	-	-	b276	a157	c330	7.47	1.51	19.54
G	Elymus cinereus	-	-	a7	a-	a3	.03	.00	.03
G	Poa secunda	a38	c141	b84	c169	c146	2.37	5.51	4.55
G	Sitanion hystrix	a13	ab25	b33	b36	a11	.92	.60	.10
Total for Annual Grasses		0	0	276	160	341	7.47	1.51	19.56
Total for Perennial Grasses		171	292	261	322	272	6.72	9.02	8.67
Total for Grasses		171	292	537	482	613	14.19	10.53	28.24
F	Agoseris glauca	-	a9	a2	-	a1	.01	-	.00
F	Allium acuminatum	3	-	-	-	-	-	-	-
F	Alyssum alyssoides (a)	-	-	a18	a20	b163	.04	.07	2.15
F	Allium sp.	-	-	-	a2	a3	-	.00	.00
F	Arabis sp.	-	a1	-	a6	a4	-	.03	.03
F	Astragalus cibarius	-	-	-	b113	a17	-	3.39	.25
F	Astragalus convallarius	a8	a6	a3	a10	a1	.00	.04	.03
F	Astragalus sp.	a2	-	a5	-	-	.01	-	-
F	Calochortus nuttallii	1	-	-	-	-	-	-	-
F	Collomia linearis (a)	-	-	a18	b76	a36	.09	.40	.07
F	Collinsia parviflora (a)	-	-	a15	b103	b81	.02	1.18	.31
F	Crepis acuminata	ab8	b13	ab7	ab6	a2	.06	.06	.15
F	Descurainia pinnata (a)	-	-	-	-	10	-	-	.03
F	Draba sp. (a)	-	-	-	a2	a1	-	.03	.00
F	Epilobium brachycarpum (a)	-	-	1	-	-	.00	-	-
F	Erigeron pumilus	a7	a3	-	-	-	-	-	-
F	Gayophytum ramosissimum(a)	-	-	-	4	-	-	.03	-
F	Holosteum umbellatum (a)	-	-	-	b11	a3	-	.08	.00
F	Lappula occidentalis (a)	-	-	-	-	4	-	-	.01
F	Lomatium triternatum	-	-	a3	a1	-	.00	.00	-
F	Lupinus argenteus	-	-	a2	b19	a1	.15	.14	.03
F	Microsteris gracilis (a)	-	-	-	a13	a11	-	.03	.02
F	Orthocarpus sp. (a)	-	-	a4	b36	-	.08	.42	-
F	Phlox longifolia	-	b23	a2	b23	ab6	.00	.07	.09

Type	Species	Nested Frequency					Average Cover %		
		'84	'90	'96	'01	'07	'96	'01	'07
F	Ranunculus testiculatus (a)	-	-	-	1	-	-	.00	-
F	Senecio integerrimus	-	-	-	2	-	-	.03	-
F	Taraxacum officinale	-	-	-	1	-	-	.03	-
F	Unknown forb-perennial	16	-	-	-	-	-	-	-
F	Vicia americana	-	$_a$4	-	-	$_a$6	-	-	.03
Total for Annual Forbs		0	0	56	266	309	0.23	2.26	2.61
Total for Perennial Forbs		45	59	24	183	41	0.25	3.81	0.64
Total for Forbs		45	59	80	449	350	0.50	6.08	3.25

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

BROWSE TRENDS --
Management unit 17 , Study no: 68

Type	Species	Strip Frequency			Average Cover %		
		'96	'01	'07	'96	'01	'07
B	Amelanchier alnifolia	0	1	0	-	.00	-
B	Artemisia tridentata vaseyana	94	92	81	32.32	31.06	16.57
B	Chrysothamnus viscidiflorus viscidiflorus	1	1	0	.00	.03	-
B	Opuntia sp.	5	3	5	.03	.03	.03
B	Purshia tridentata	9	9	10	1.14	1.87	.50
Total for Browse		109	106	96	33.51	33.00	17.11

CANOPY COVER, LINE INTERCEPT --
Management unit 17 , Study no: 68

Species	Percent Cover	
	'01	'07
Artemisia tridentata vaseyana	-	27.41
Opuntia sp.	-	.05
Purshia tridentata	-	2.38

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 17 , Study no: 68

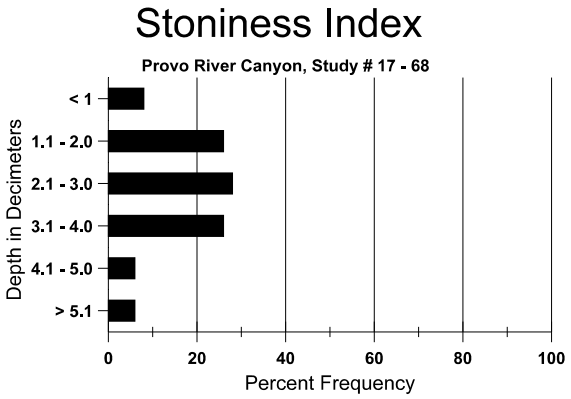
Species	Average leader growth (in)
	'07
Artemisia tridentata vaseyana	1.5

BASIC COVER --
Management unit 17 , Study no: 68

Cover Type	Average Cover %				
	'84	'90	'96	'01	'07
Vegetation	2.00	6.50	50.12	50.18	58.12
Rock	.25	1.25	1.44	1.78	1.41
Pavement	1.75	3.75	.66	1.12	1.40
Litter	69.50	66.25	58.95	50.43	45.04
Cryptogams	13.25	14.00	4.69	7.43	1.22
Bare Ground	13.25	8.25	7.22	18.03	9.65

SOIL ANALYSIS DATA --
Herd Unit 17, Study no: 68, Provo River Canyon

Effective rooting depth (in)	Temp °F (depth)	PH	Clay loam			%0M	PPM P	PPM K	dS/m
			%sand	%silt	%clay				
14.7	55.6 (15.6)	6.6	41.8	27.4	30.7	3.6	23.2	275.2	0.4



PELLET GROUP DATA --
Management unit 17 , Study no: 68

Type	Quadrat Frequency		
	'96	'01	'07
Rabbit	9	31	38
Elk	2	-	-
Deer	30	26	27
Cattle	-	-	5

Days use per acre (ha)	
'01	'07
-	-
3 (7)	5 (13)
35 (86)	30 (74)
1 (3)	11 (27)

BROWSE CHARACTERISTICS --
Management unit 17 , Study no: 68

		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												
84	**0**	-	-	-	-	-	0	0	-	-	0	-/-
90	**0**	-	-	-	-	-	0	0	-	-	0	-/-
96	**0**	-	-	-	-	-	0	0	-	-	0	-/-
01	**0**	20	-	-	-	-	0	0	-	-	0	-/-
07	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Artemisia tridentata vaseyana												
84	**6332**	200	333	3933	2066	-	40	36	33	-	12	33/28
90	**6065**	66	866	1733	3466	-	45	19	57	4	30	30/27
96	**4120**	20	120	3160	840	920	37	5	20	3	3	34/51
01	**4280**	-	80	2600	1600	720	32	7	37	9	22	36/43
07	**2920**	20	40	1420	1460	1380	33	11	50	34	34	37/46
Chrysothamnus viscidiflorus viscidiflorus												
84	**332**	-	66	133	133	-	0	0	40	-	0	11/10
90	**266**	-	-	200	66	-	0	0	25	-	50	12/14
96	**20**	-	20	-	-	-	0	0	0	-	0	-/-
01	**20**	-	-	20	-	-	0	0	0	-	0	-/-
07	**0**	-	-	-	-	-	0	0	0	-	0	10/13
Opuntia sp.												
84	**66**	-	-	66	-	-	0	0	-	-	0	6/21
90	**133**	-	-	133	-	-	0	0	-	-	0	6/7
96	**200**	-	-	200	-	40	10	0	-	-	0	6/22
01	**60**	-	-	60	-	-	0	0	-	-	0	5/18
07	**120**	-	20	100	-	20	0	0	-	-	0	5/9
Purshia tridentata												
84	**866**	-	-	200	666	-	0	92	77	-	38	33/34
90	**532**	-	66	-	466	-	25	63	88	23	75	-/-
96	**180**	-	-	160	20	100	11	67	11	-	0	25/47
01	**240**	-	-	240	-	20	33	50	0	-	0	29/42
07	**200**	-	-	120	80	40	10	80	40	10	10	28/35

SUMMARY

WILDLIFE MANAGEMENT UNIT 17 - WASATCH MOUNTAINS

The Wasatch Mountain unit is large and covers a vast area. The western half of Unit 17 was sampled in 2007. Studies on the Unit are concentrated in three different areas which include the Heber Valley, the Wasatch Front, and Spanish Fork Canyon. The majority of the trend studies were established in 1983 and reread in 1989. The Heber Valley area was reread in 1996 and the rest of the Unit was reread in 1997 and 2002. In 2007, 29 trend studies were reread. No new studies were added, but two studies were suspended: Hobble Creek Bench (17-63) and Hailstone (17-69). Both were suspended because of access problems.

Community Types

Studies have been established on a variety of community types. There are 16 studies that are dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and one that is dominated by basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). There are four mountain brush studies, three Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*) studies, and one Rocky Mountain smooth sumac (*Rhus glabra* ssp. *cismontana*) study. One study is dominated by Gambel oak (*Quercus gambelii*), and two others have a mix of sagebrush and oak. Lastly, there is one study that was chained and seeded which is dominated by perennial grasses.

Precipitation

Both annual and seasonal precipitation play important roles in vegetation trends. Data from four weather stations within the boundaries of Unit 17 were summarized for precipitation patterns over the past two decades. These stations are located at Heber, Deer Creek Dam, Pleasant Grove, and Provo (BYU). The combined average annual precipitation during that time from all four stations is 18.7 inches (47.4 cm). Drought conditions (less than 75% of annual precipitation) occurred in 1988, 2001, and 2002. Precipitation was below normal in 1987-1992, 1994, 1999-2004, and 2006 (Figure 1).

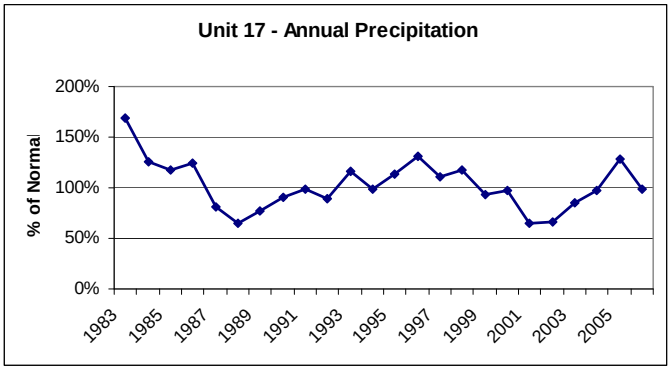


Figure 1. Percent of normal annual precipitation averaged from weather stations in Unit 17 (Utah Climate Summaries 2007).

Seasonal distribution of precipitation (spring vs. fall) may have a larger impact on vegetation trends than total annual precipitation. Analysis of the weather station data showed that spring precipitation was below normal for more than half of the period of record including 1987-1990, 2000-2004, and again in 2007 (Figure 2). Spring precipitation is essential for cool season perennial species to germinate and be productive. Fall precipitation, which benefits cheatgrass (*Bromus tectorum*), was also below normal for more than half of the period of record, and was lowest in 1995 and 1999.

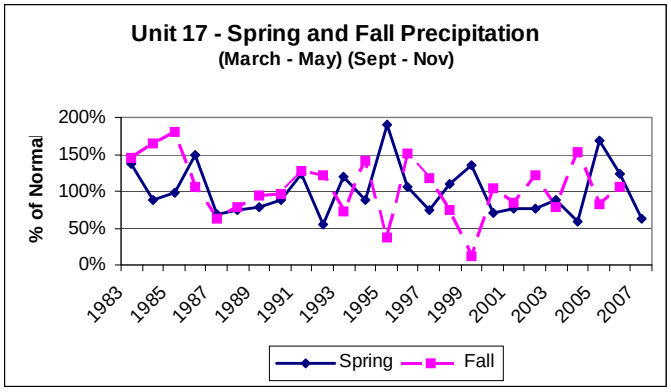


Figure 2. Percent of normal seasonal precipitation averaged from weather stations in Unit 17 (Utah Climate Summaries 2007).

Browse

The cumulative browse trend decreased from 1996 to 2007 (Figure 3). The browse trend was down at 18 studies. Of those 18, 13 were dominated by sagebrush, including Deer Creek Dam (17-5), Wallsburg Turn (17-11), North Wallsburg (17-13), Hoovers Hollow (17-

14), Dutch Canyon (17-17), Coyote Canyon (17-19), Heisetts Hollow (17-24), Long Hollow (17-40), North Bench (17-45), Lower Tank Hollow (17-46), Center Creek (17-60), American Fork Canyon (17-61), and Provo River Canyon (17-68). Trend was down at three of the mountain brush studies: Island Boat Camp (17-15), Tank Hollow (17-42), and Tie Fork East (17-47). Trend was down at one of the sagebrush/oak studies, Lower Big Hollow (17-9), and at the Rocky Mountain smooth Sumac study, Round Peak (17-31).

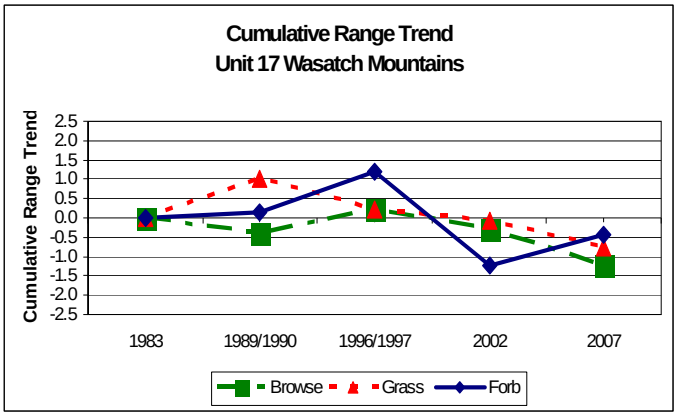


Figure 3. The cumulative range trend for the browse, grass, and forb components from 1983 to 2007 in Unit 17.

The browse trend was slightly down at four studies, two of which were sagebrush dominated: Rainbow Bay (17-16), and Billies Mountain (17-44). Of the remaining two studies, one was dominated by mountain brush, Upper Sheep Creek (17-41), and the other was dominated by cliffrose, Grove Creek (17-62). The browse trend was stable at four studies: North Wallsburg Reseeding (17-12), which is dominated by sagebrush/oak; North Battle Creek (17-25), which is dominated by cliffrose; Orem Water Tank (17-26), which is dominated by oak; and Little Diamond Fork (17-39), which is dominated by sagebrush. The browse trend was slightly up at Water Hollow (17-64), which is dominated by perennial grasses. The browse trend was up at only two studies: Spring Canyon (17-30), a cliffrose community; and Maple Mountain Face (17-34), a sagebrush community.

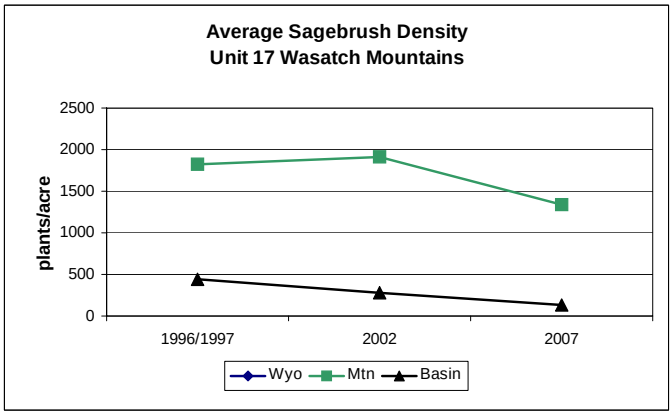


Figure 4. Average sagebrush density of mountain big sagebrush and basin big sagebrush in Unit 17.

The changes in browse trend were largely a product of changes in sagebrush density. The average density of mountain big sagebrush decreased from 1,907 plants/acre (4,720 plants/ha) in 2002 to 1,335 plants/acre (3,304 plants/ha) in 2007, which is a 30% decrease (Figure 4). Basin big sagebrush was sampled at only two studies, and the average density at these studies decreased from 280 plants/acre (693 plants/ha) to 130 plants/acre (322 plants/ha), which is a 54% decrease.

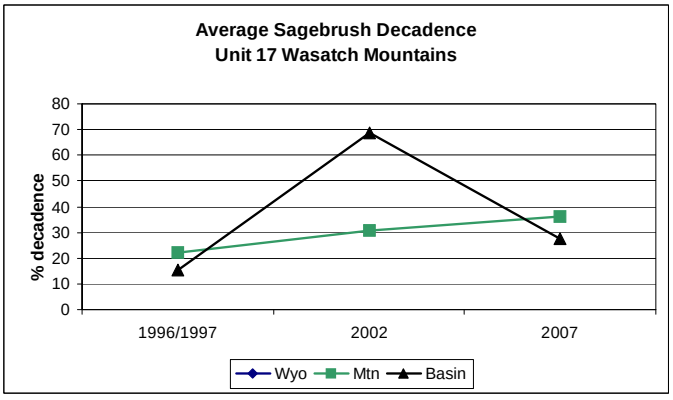
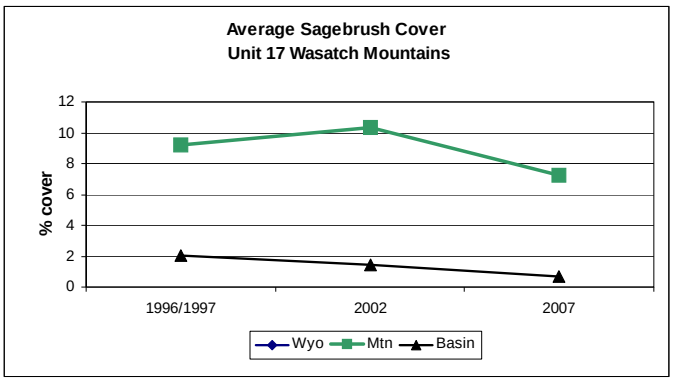


Figure 5. The average percent decadence for mountain big sagebrush and basin big sagebrush in Unit 17.

The unit average percent decadence of mountain big sagebrush increased from 31% of the population in 2002 to 36% in 2007. The majority of the increase in sagebrush decadence occurred in the Heber Valley. The infestation rate of the sagebrush defoliator moth (*Aroga websteri*) in the Heber Valley was also much greater than the rest of the unit. Where present, this moth had infested an average 50% of the plants in the Heber Valley, and 12% in the remainder of Unit 17. It is very likely that the high decadence and high moth infestation rates are related. However, it is difficult to predict the magnitude or duration of the effect that the moth will have on the sagebrush population (Hsiao 1986). The average percent decadence of basin big sagebrush decreased from 69% in 2002 to 28% in

2007. Much of this decrease occurred because the relatively small population of basin big sagebrush at Long Hollow went from 100% decadent in 2002 to 0% in 2007.

The unit average percent cover of mountain big sagebrush decreased from 10% in 2002 to 7% in 2007. Studies where the average cover decreased by more than five percentage points include Deer Creek Dam, Island Boat Camp, Upper Sheep Creek, Center Creek, and Provo River Canyon. At Provo River Canyon, average cover decreased by 14 percentage points. The average cover increased by four percentage points at Maple Mountain Face, the only study to have increased by more than one percentage point.



Fiugre 6. The average percent cover for mountain big sagebrush and basin big sagebrush in Unit 17.

<u>Grass</u>

The unit cumulative grass trend has decreased each sample year since 1989 (Figure 3). The grass trend was down at 10 studies, including Deer Creek Dam, North Wallsburg, Island Boat Camp, Dutch Canyon, Heisetts Hollow, North Battle Creek, Little Diamond Fork, Center Creek, Grove Creek, and Provo River Canyon. The most common reason that the grass trend was down was an increase in cheatgrass abundance. The grass trend was slightly down at six studies, including Lower Big Hollow, Wallsburg Turn, Coyote Canyon, Round Peak, Lower Tank Hollow and Tie Fork East. There were 10 studies with a stable grass trend; North Wallsburg Reseeding, Hoovers Hollow, Rainbow Bay, Orem Water Tank, Spring Canyon, Long Hollow, Upper Sheep Creek, Billies Mountain, North Bench, and Water Hollow. The grass trend was slightly up at American Fork Canyon. At Maple Mountain Face and Tank Hollow, the grass trend was up.

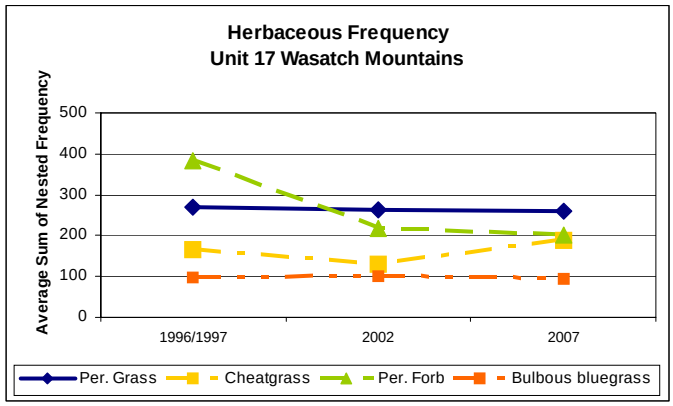


Figure 7. The average sum of nested frequency for the components of the herbaceous understory in Unit 17.

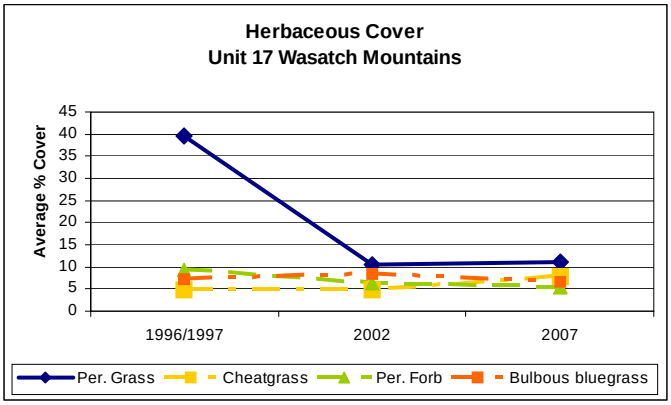


Figure 8. The average percent cover for the components of the herbaceous understory in Unit 17.

The average sum of nested frequency for perennial grasses has changed little since 1997 (Figure 7). Perennial grass cover decreased from an average of 40% in 1997 to approximately 11% in 2002, and remained stable in 2007 (Figure 8). The average nested frequency of cheatgrass decreased from 1997 to 2002, and increased in 2007. Cheatgrass cover was stable at an average 5% in 1997 and 2002, and increased to an average 8% in 2007. Cheatgrass cover decreased at only three studies, and remained stable or increased on the remaining 26 studies. Cheatgrass cover increased by more than seven percentage points at eight studies: Deer Creek Dam, Lower Big Hollow, Coyote Canyon, North Battle Creek, Orem Water Tank, Spring Canyon, Center Creek, and Provo River Canyon. Both the average nested frequency and average cover of bulbous bluegrass (*Poa bulbosa*) increased from 1997 to 2002, and decreased in 2007. This perennial species has a phenology that is similar to annual grasses and may limit the establishment of other species

(Stewart and Hull 1949). There were 11 studies where bulbous bluegrass was sampled in 1997, 20 in 2002, and 21 in 2007. Jointed goatgrass (*Aegilops cylindrica*), a noxious weed, was present at Deer Creek Dam in 2002 and 2007.

Forb

The unit cumulative forb trend increased from 2002 to 2007 (Figure 3). The forb trend was down at nine studies, including Wallsburg Turn, Island Boat Camp, Rainbow Bay, Heisetts Hollow, North Battle Creek, Tank Hollow, Center Creek, Grove Creek, and Provo River Canyon. At five studies, Deer Creek Dam, Dutch Canyon, Orem Water Tank, Little Diamond Fork, and American Fork Canyon, the forb trend was slightly down. The forb trend was stable at five studies, including Lower Big Hollow, North Wallsburg Reseeding, North Wallsburg, Coyote Canyon, and Billies Mountain. The forb trend was slightly up at six studies, including Spring Canyon, Round Peak, Long Hollow, Upper Sheep Creek, North Bench, and Water Hollow. There were four studies: Hoovers Hollow, Maple Mountain Face, Lower Tank Hollow, and Tie Fork East, where the trend was up.

The average sum of nested frequency for perennial forbs decreased 8% from 2002 to 2007 (Figure 7). The average perennial cover decreased from 6% in 2002 to 5% in 2007. (Figure 8). The number of studies with noxious weeds increased from 12 in 1997 to 15 in 2002, and decreased to 11 in 2007. Common noxious forbs have included whitetop (*Cardaria draba*), musk thistle (*Carduus nutans*), field bindweed (*Convolvulus arvensis*), houndstongue (*Cynoglossum officinale*), and dalmatian toadflax (*Linaria dalmatica*). Additionally, leafy spurge (*Euphorbia esula*) was sampled at Dutch Canyon, and yellow starthistle (*Centaurea solstitialis*) was sampled at North Battle Creek and Grove Creek.

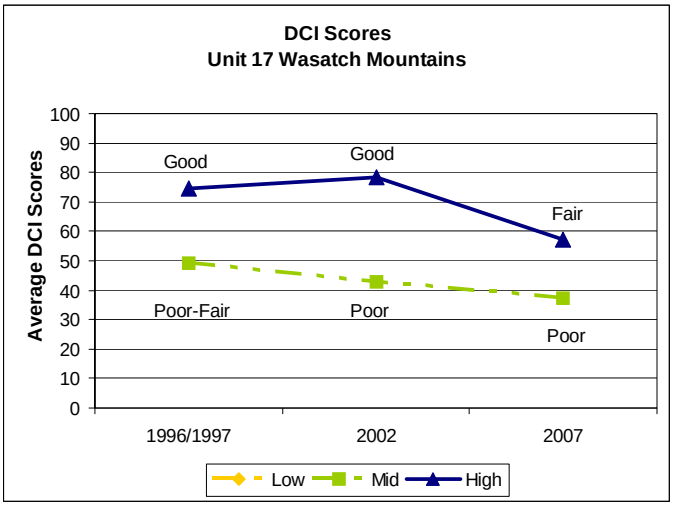


Figure 9. Average DCI scores for Unit 17. The scores are divided into categories based on ecological potential and include: high, mid-level, and low.

Desirable Components Index

The Desirable Components Index (DCI) was calculated for all 29 of the studies that were sampled in 2007. A total of 28 studies are in the mid-level potential category, and one is in the high potential category. For the studies in the mid-level category, the average DCI score decreased from poor-fair in 1997 to poor in 2002, and remained poor in 2007. The DCI continued to be poor because of decreases in browse cover and recruitment, an increase in annual grass cover, and a decrease in perennial forb cover. The DCI score at the high potential study was good in 1997 and 2002, and decreased to fair in 2007. This decrease was the result of a sharp decline in browse cover, and an increase in annual grass cover.

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