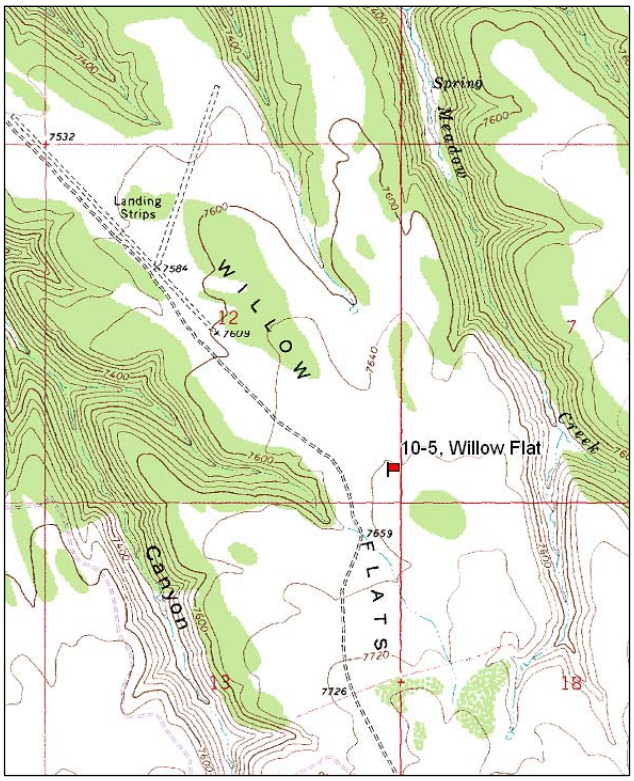
WILLOW FLAT - TREND STUDY NO. 10-5-10

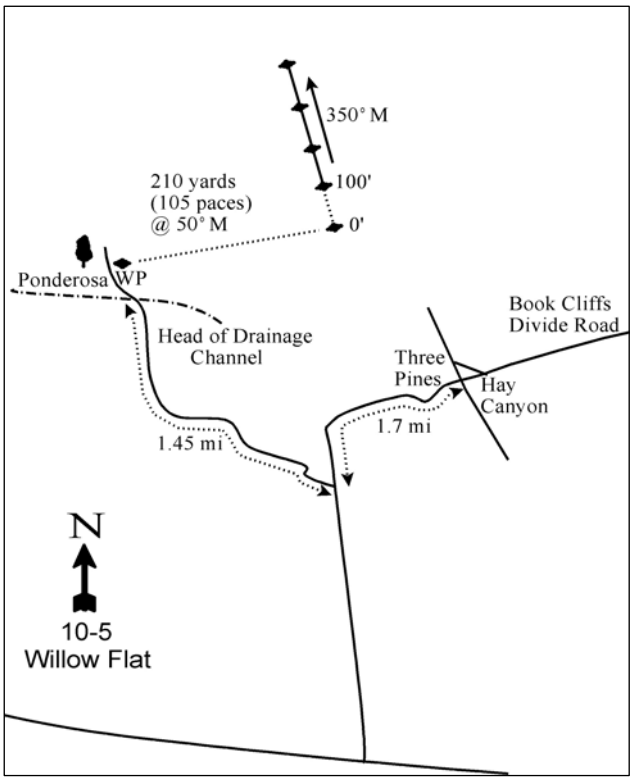
Vegetation Type: Mountain Big Sagebrush
Range Type: Crucial Deer Summer (Fawning habitat), Crucial Elk Summer (Calving habitat)
NRCS Ecological Site Description: Upland Loam (Wyoming Big Sagebrush), R034XY306UT
Land Ownership: SITLA
Elevation: 7680 ft. (2341 m)
Aspect: North
Slope: 2%
Transect bearing: 350° magnetic
Belt placement: line 1 (11 & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft).

Directions:
From the intersection of the Seep Ridge and Book Cliff Divide road, proceed west along the divide for 9.4 miles to the major Three Pines-Hay Canyon intersection. Continue straight for 1.7 miles to a road on the right to Willow Flat. Turn right here and go 1.45 miles until you see a large ponderosa pine (*Pinus ponderosa*) (with other conifers at the head of a small canyon) on the left side of the road and a witness post on the right side. From the witness post, walk 210 yards at 50°M to the 0-foot baseline stake.

Map Name: Cedar Camp Canyon



Diagrammatic Sketch:



Township: 16S Range: 22E Section: 12

GPS: NAD 83, UTM 12S 634969 E 4365004 N

Site Information

Site Description: The study samples sagebrush flat on Willow Flats located on state owned land. This area was sprayed to kill sagebrush sometime prior to 1982. The area was treated again with the herbicide Spike (tebuthiuron) at 5 lbs. active ingredient per acre over 225 acres in the area in 2005 to rejuvenate the sagebrush stand. There was also a lop-and-scatter treatment to remove pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees less than 10 inches in diameter that occurred just prior to the reading in 2010 as part of the Cedar Camp Lop and Scatter (WRI Project #1337). The area is administered by the Utah State Institutional Trust Lands Administration (SITLA) with grazing occurring within the Bureau of Land Management (BLM) Bookcliffs Pasture allotment. The area is used by deer, elk and livestock during the summer and elk may use it during mild winters. Pellet group data has estimated elk use to be moderate since 2000. Estimated deer use was light in 2000 and 2005, but more moderate in 2010. Estimated cattle use has been light since 2000 (Table - Pellet Group Data). Wild horses also use this area with several adults and a colt seen near the site in 2010.

Browse: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species on the site, even after being sprayed in the early 1980's and retreated in 2005. When the study was established in 1982, there was a high percentage of dead sagebrush from the original spraying treatment, but the population rebounded quickly with high recruitment of young plants from 1982 to 2000 (Table - Browse Characteristics) and a steady increase of cover from 1995 to 2005. By 2005, it appears that the population had to become overly mature with increases in decadence and decreases in recruitment. Following the treatment in 2005, density of sagebrush decreased markedly with a large increase in the number of dead plants sampled. Recruitment also increased substantially indicating the population may rebound quickly again. Utilization of sagebrush has been mostly light with some moderate use over the course of the study. The only other abundant browse species is dwarf rabbitbrush (*Chrysothamnus depressus*), which has a mostly mature population and light to moderate use (Table - Browse Characteristics). Other browse species encountered on the site less frequently include: rubber rabbitbrush (*Chrysothamnus nauseosus*), low rabbitbrush (*C. viscidiflorus*), broom snakeweed (*Gutierrezia sarothrae*) and snowberry (*Symphoricarpos oreophilus*).

Prior to the lop-and-scatter treatment in 2010, pinyon and juniper trees were beginning to encroach into the sagebrush flat, though trees were still relatively sparse. This can be seen by comparing photos from 1988 and 2005. Point-center quarter data also showed an increase in the density of pinyon and juniper from 1995 to 2005, but only one juniper tree was sampled in 2010 (Table - Point-Quarter Tree Data).

Herbaceous Understory: Grasses are abundant, but only marginally diverse on the site. The most abundant grasses include: thickspike wheatgrass (*Agropyron dasystachyum*), mutton bluegrass (*Poa fendleriana*), Sandberg bluegrass (*P. secunda*), prairie junegrass (*Koeleria cristata*) and needle-and-thread (*Stipa comata*). Forbs are abundant and diverse on the site. Forty-three forb species, most of which are perennial, have been sampled in at least one reading since 1988.

Soil: Soils at the site are a clay loam texture with a neutral soil reaction (pH 7.1). Phosphorus has limited availability for plant growth and development at just 1.8 ppm (Tiedemann and Lopez 2004) (Table - Soil Analysis Data). Bare ground cover has been moderate to high over the course of the study with most protective ground cover provided by vegetation and litter cover (Table - Basic Cover). Most of the shrub interspaces are bare while the majority of the preferred herbaceous species are protected under shrub crowns. Erosion appeared to be slight with some evidence of pedestaling and overland flow being noted in 2000. The erosion condition was classified as slight in 2005 due to pedestaling and rills up to one inch deep. The erosion condition was classified as stable in 2010.

Trend Assessments

Browse:

- **1982 to 1988 - up (+2):** There was a substantial increase in the density of the key browse species, mountain big sagebrush, due to a marked increase in the recruitment of young sagebrush plants.
- **1988 to 1995 - stable (0):** Differences in density may be related to the larger sample area used in 1995; therefore, trend was determined using other parameters. There was no change in decadence or vigor of sagebrush. Recruitment of young sagebrush plants decreased, but remained excellent at 43%.
- **1995 to 2000 - slightly up (+1):** The density of mountain big sagebrush increased 14% from 8,840 plants/acre to 10,060 plants acre and cover increased from 16% to 20%. There was also, however, an increase in decadence from 1% to 15% and recruitment decreased, but is still good, to 29%.
- **2000 to 2005 - stable (0):** The mountain big sagebrush stand appears to be maturing as density decreased by 21% to 7,940 plants/acre, but cover increased to 25%. Recruitment of young sagebrush plants also decreased to 7% of the population.
- **2005 to 2010 - down (-2):** A herbicide treatment in 2005, after that years reading, reduced the density of sagebrush by 69% to 2,480 plants/acre and reduced cover to 4%. There was a large increase in the number of dead plants sampled, as well. Recruitment of young plants increased and comprised 37% of the population, so it appears the population may reestablish quickly, as it did previously.

Grass:

- **1982 to 1988 - no trend (NT):** Only quadrat frequency data for grasses are available from 1982, so no trend was given.
- **1988 to 1995 - down (-2):** There was a 21% decrease in the nested frequency of perennial grasses with a significant decrease in the nested frequency of thickspike wheatgrass and sedge (*Carex sp.*).
- **1995 to 2000 - stable (0):** The sum of nested frequency and cover of perennial grasses changed little.
- **2000 to 2005 - slightly down (-1):** The perennial grass sum of nested frequency decreased by 24%, but cover increased to 10%. The increase in cover was due to an increase in cover of prairie junegrass and Sandberg bluegrass.
- **2005 to 2010 - stable (0):** There was little change in the sum of nested frequency of perennial grasses, but composition changed slightly with a significant decrease in the nested frequency of prairie junegrass and a significant increase in nested frequency of thickspike wheatgrass and needle-and-thread. Cover increased to 15% with a large increase in the cover of thickspike wheatgrass and needle-and-thread, as well.

Forb:

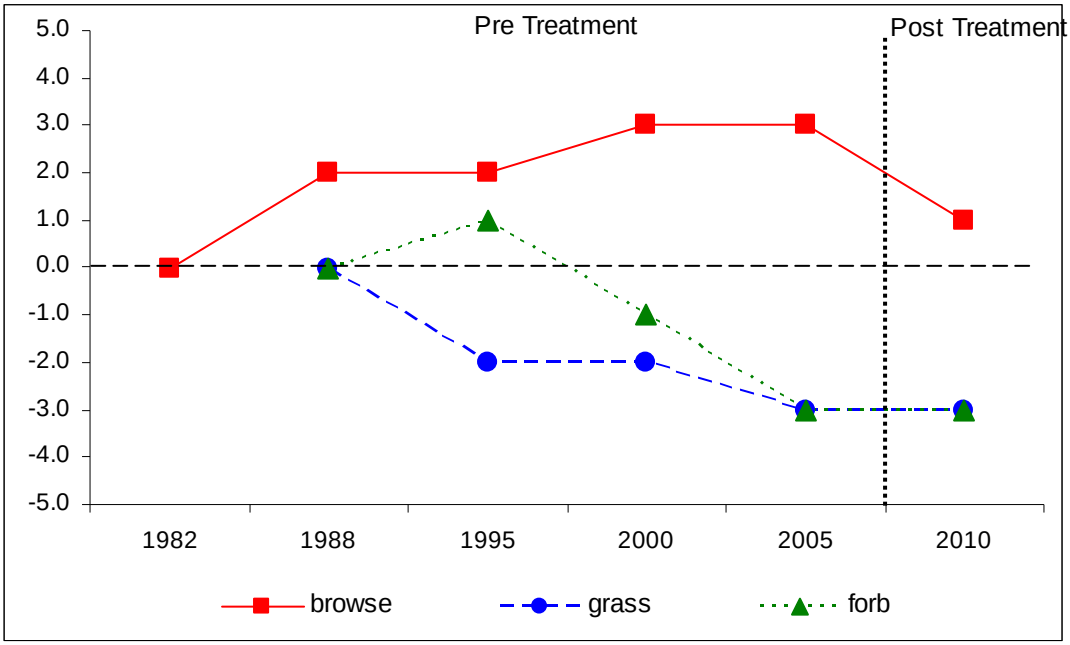
- **1982 to 1988 - no trend (NT):** Only quadrat frequency data for forbs are available from 1982, so no trend was given.
- **1988 to 1995 - slightly up (+1):** The sum of nested frequency of perennial forbs increased by 16%.
- **1995 to 2000 - down (-2):** The perennial forb sum of nested frequency decreased by 29% and cover decreased from 13% to 7%.
- **2000 to 2005 - down (-2):** There was a 27% decrease in the sum of nested frequency of perennial forbs and cover decreased to 5%.
- **2005 to 2010 - stable (0):** The sum of nested frequency of perennial forbs decreased slightly, but cover increased to 9%.

DEER DESIRABLE COMPONENTS INDEX - MID-LEVEL POTENTIAL SCALE --
Management unit 10, study no: 5

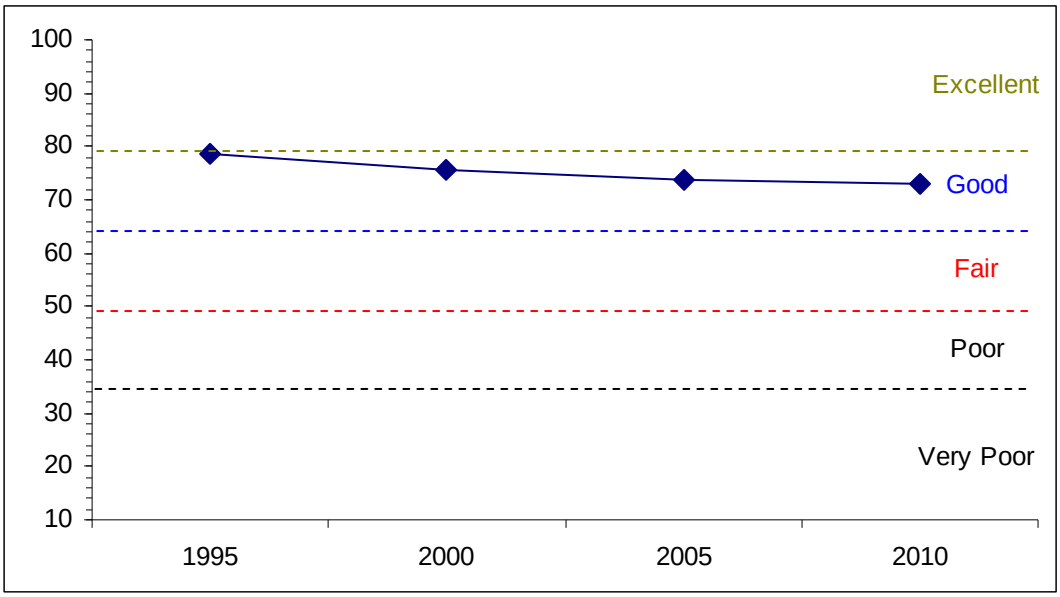
Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	**Total Score**	Ranking
95	24.3	14.8	15.0	14.5	0.0	10.0	0.0	**78.5**	Good-Excellent
00	28.0	10.7	13.7	13.5	0.0	10.0	0.0	**75.8**	Good
05	30.0	9.7	3.3	20.7	0.0	10.0	0.0	**73.8**	Good
10	8.4	13.1	11.5	30.0	0.0	10.0	0.0	**73.0**	Good

Trend Summary

CUMULATIVE RANGE TREND ASSESSMENT--
Management unit 10, Study no: 5



DEER DESIRABLE COMPONENTS INDEX TREND, MID-LEVEL POTENTIAL--
Management unit 10, Study no: 5



HERBACEOUS TRENDS--
Management unit 10, Study no: 5

Type	Species	Nested Frequency					Average Cover %			
		'88	'95	'00	'05	'10	'95	'00	'05	'10
G	Agropyron dasystachyum	$_{d}$195	$_{b}$131	$_{bc}$147	$_{a}$69	$_{cd}$179	.78	.84	.29	3.86
G	Carex sp.	$_{b}$52	$_{a}$11	$_{a}$4	$_{a}$3	$_{a}$3	.05	.00	.00	.03
G	Koeleria cristata	$_{c}$159	$_{bc}$115	$_{ab}$79	$_{bc}$122	$_{a}$67	1.95	.84	3.05	1.61
G	Poa fendleriana	$_{b}$126	$_{b}$135	$_{b}$154	$_{a}$78	$_{a}$42	1.93	2.50	2.10	.62
G	Poa nevadensis	$_{a}$-	$_{a}$-	$_{b}$25	$_{c}$52	$_{a}$-	-	.35	1.26	-
G	Poa pratensis	$_{a}$-	$_{a}$1	$_{a}$-	$_{a}$-	$_{b}$13	.00	-	-	.46
G	Poa secunda	$_{b}$142	$_{ab}$120	$_{ab}$130	$_{ab}$100	$_{a}$93	1.89	1.56	3.06	1.50
G	Stipa comata	$_{bc}$73	$_{bc}$75	$_{ab}$55	$_{a}$29	$_{c}$92	.60	.64	.57	6.99
Total for Annual Grasses		0	0	0	0	0	0	0	0	0
Total for Perennial Grasses		747	588	594	453	489	7.23	6.75	10.37	15.08
Total for Grasses		747	588	594	453	489	7.23	6.75	10.37	15.08
F	Agoseris glauca	$_{a}$-	$_{ab}$6	$_{ab}$2	$_{b}$8	$_{ab}$6	.02	.04	.03	.01
F	Allium sp.	-	2	-	-	-	.00	-	.00	-
F	Androsace septentrionalis (a)	-	$_{c}$79	$_{a}$10	$_{b}$39	$_{ab}$32	.23	.20	.20	.35
F	Antennaria rosea	$_{c}$203	$_{c}$163	$_{b}$102	$_{a}$46	$_{a}$31	4.20	1.38	.32	1.54
F	Arabis drummondi	$_{a}$-	$_{b}$10	$_{ab}$2	$_{ab}$8	$_{a}$-	.02	.00	.01	-
F	Artemisia dracunculus	-	-	-	-	1	-	-	-	.00
F	Aster sp.	$_{b}$92	$_{b}$77	$_{a}$41	$_{a}$10	$_{a}$39	.87	.27	.09	.67
F	Astragalus convallarius	5	15	15	4	5	.18	.10	.04	.01
F	Astragalus miser	12	23	28	8	14	.39	.42	.06	.27
F	Astragalus spatulatus	-	8	2	5	-	.21	.03	.03	-
F	Astragalus utahensis	-	-	7	3	3	-	.04	.03	.00
F	Calochortus nuttallii	$_{a}$-	$_{b}$17	$_{a}$-	$_{b}$17	$_{ab}$3	.03	-	.08	.00
F	Castilleja flava	$_{bc}$58	$_{c}$85	$_{ab}$39	$_{a}$-	$_{a}$13	.63	.34	-	.17

Type	Species	Nested Frequency					Average Cover %			
		'88	'95	'00	'05	'10	'95	'00	'05	'10
F	Crepis acuminata	$_{a}$-	$_{b}$37	$_{b}$33	$_{b}$24	$_{b}$26	.28	.30	.23	.49
F	Cruciferae	-	3	-	-	-	.01	-	-	-
F	Cryptantha sp.	$_{b}$57	$_{a}$-	$_{a}$-	$_{a}$-	$_{a}$-	-	-	-	-
F	Delphinium nuttallianum	$_{a}$-	$_{c}$61	$_{a}$1	$_{b}$30	$_{a}$8	.19	.00	.11	.05
F	Erigeron eatonii	$_{d}$145	$_{bc}$84	$_{c}$88	$_{a}$48	$_{ab}$54	1.25	.60	.35	.40
F	Eriogonum alatum	$_{a}$-	$_{b}$14	$_{b}$21	$_{ab}$9	$_{ab}$6	.08	.11	.05	.18
F	Eriogonum racemosum	1	-	-	3	4	-	-	.03	.00
F	Eriogonum umbellatum	18	24	27	34	19	.39	.26	.56	.30
F	Gayophytum ramosissimum(a)	-	$_{a}$-	$_{a}$-	$_{a}$8	$_{b}$44	-	-	.02	.65
F	Ipomopsis aggregata	1	5	-	9	-	.06	-	.02	-
F	Lappula occidentalis (a)	-	-	3	-	7	-	.00	-	.01
F	Lesquerella ludoviciana	$_{a}$19	$_{bc}$62	$_{bc}$65	$_{c}$88	$_{ab}$36	.83	.29	1.25	.58
F	Linum lewisii	7	5	12	4	8	.04	.08	.00	.04
F	Lomatium sp.	-	6	-	1	3	.01	-	.01	.00
F	Lupinus argenteus	$_{ab}$49	$_{b}$60	$_{ab}$43	$_{a}$22	$_{b}$60	1.40	.74	.09	3.41
F	Lygodesmia sp.	-	-	1	-	-	-	.00	-	-
F	Orthocarpus sp. (a)	-	1	1	-	-	.00	.03	-	-
F	Penstemon caespitosus	3	3	6	7	9	.09	.15	.16	.09
F	Penstemon sp.	15	6	10	2	4	.04	.10	.04	.06
F	Phlox austromontana	$_{c}$52	$_{c}$60	$_{a}$-	$_{c}$45	$_{b}$21	1.10	-	.94	.54
F	Phlox longifolia	$_{b}$44	$_{b}$50	$_{b}$101	$_{a}$14	$_{b}$51	.18	1.68	.11	.36
F	Polygonum douglasii (a)	-	$_{d}$227	$_{a}$-	$_{b}$70	$_{c}$125	.80	-	.21	1.31
F	Potentilla gracilis	-	3	4	3	8	.18	.06	.15	.04
F	Sedum lanceolatum	4	5	11	5	2	.03	.02	.06	.01
F	Senecio integerrimus	$_{a}$-	$_{b}$29	$_{a}$1	$_{b}$32	$_{a}$6	.07	.00	.48	.07
F	Senecio multilobatus	-	5	2	-	-	.01	.00	-	-
F	Sphaeralcea coccinea	7	2	-	-	-	.00	-	-	-
F	Taraxacum officinale	$_{b}$20	$_{a}$12	$_{a}$4	$_{a}$2	$_{a}$4	.42	.04	.00	.03
F	Tragopogon dubius	-	-	3	-	1	-	.03	-	.00
F	Zigadenus paniculatus	-	-	-	-	5	-	-	-	.01
Total for Annual Forbs		0	307	14	117	208	1.04	0.23	0.43	2.32
Total for Perennial Forbs		812	942	671	491	450	13.27	7.19	5.39	9.43
Total for Forbs		812	1249	685	608	658	14.32	7.42	5.82	11.75

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

BROWSE TRENDS--
Management unit 10, Study no: 5

Type	Species	Strip Frequency				Average Cover %			
		'95	'00	'05	'10	'95	'00	'05	'10
B	Artemisia tridentata vaseyana	95	99	94	62	16.11	20.49	25.01	3.87
B	Chrysothamnus depressus	60	66	51	63	3.34	1.88	2.56	2.82
B	Chrysothamnus nauseosus	1	0	1	0	-	-	-	-
B	Chrysothamnus viscidiflorus	17	11	11	15	.02	.18	.36	.03
B	Gutierrezia sarothrae	8	5	6	2	.21	.03	.18	.03
B	Juniperus osteosperma	0	2	1	0	.48	.94	.56	-
B	Pediocactus simpsonii	1	3	7	1	.00	-	.03	-
B	Peraphyllum ramosissimum	0	0	0	1	-	-	-	.00
B	Pinus edulis	0	2	1	0	-	.03	.00	.03
B	Symphoricarpos oreophilus	1	2	2	1	.38	.30	.18	.03
Total for Browse		183	190	174	145	20.54	23.87	28.89	6.81

CANOPY COVER, LINE INTERCEPT--
Management unit 10, Study no: 5

Species	Percent Cover	
	'05	'10
Artemisia tridentata vaseyana	27.58	4.38
Chrysothamnus depressus	1.63	3.75
Chrysothamnus viscidiflorus	-	.30
Gutierrezia sarothrae	.10	.03
Juniperus osteosperma	.73	.05
Symphoricarpos oreophilus	.01	-

KEY BROWSE ANNUAL LEADER GROWTH--
Management unit 10, Study no: 5

Species	Average leader growth (in)	
	'05	'10
Artemisia tridentata vaseyana	1.6	1.2
Peraphyllum ramosissimum	3.5	2.4

POINT-QUARTER TREE DATA--
Management unit 10, Study no: 5

Species	Trees per Acre				Average diameter (in)			
	'95	'00	'05	'10	'95	'00	'05	'10
Juniperus osteosperma	20	27	55	-	4.6	6.0	3.9	-
Pinus edulis	5	7	21	-	2.8	2.7	3.5	-

BASIC COVER--
Management unit 10, Study no: 5

Cover Type	Average Cover %					
	'82	'88	'95	'00	'05	'10
Vegetation	7.50	16.75	40.15	39.23	39.87	38.38
Rock	0	0	.66	.04	.11	.04
Pavement	0	0	.34	.66	1.11	.62
Litter	53.50	46.75	34.04	34.51	22.88	36.18
Cryptogams	.75	1.50	3.01	3.45	.38	.12
Bare Ground	38.25	35.00	34.59	53.58	51.52	40.20

SOIL ANALYSIS DATA --
Management unit 10, Study no: 5, Study Name: Willow Flat

Effective rooting depth (in)	pH	clay loam			%OM	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
12.8	7.1	30.0	40.0	30.0	2.3	1.8	204.8	0.8

PELLET GROUP DATA--
Management unit 10, Study no: 5

Type	Quadrat Frequency			
	'95	'00	'05	'10
Rabbit	3	9	14	3
Horse	-	-	1	1
Elk	14	20	33	13
Deer	7	6	10	19
Cattle	-	2	2	1

Days use per acre (ha)		
'00	'05	'10
-	-	-
-	-	1 (3)
19 (47)	8 (20)	19 (48)
33 (82)	20 (50)	21 (53)
5 (13)	2 (5)	9 (22)

BROWSE CHARACTERISTICS--
Management unit 10, Study no: 5

		Age class distribution				Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Artemisia tridentata vaseyana									
82	**2532**	13	87	0	5199	26	0	0	24/17
88	**16797**	90	8	1	1333	4	0	1	30/22
95	**8840**	43	56	1	1620	9	.45	.22	25/28
00	**10060**	29	55	15	600	22	.39	.39	24/28
05	**7940**	7	74	19	3500	27	3	9	24/28
10	**2480**	37	52	11	180	3	0	7	19/19
Chrysothamnus depressus									
82	**10599**	8	92	0	-	14	3	0	4/9
88	**9598**	48	33	19	533	27	16	7	4/6
95	**5400**	13	87	0	-	0	0	0	5/7
00	**5340**	10	82	8	60	12	0	3	3/8
05	**4660**	3	93	3	20	44	0	2	4/9
10	**4620**	4	96	0	-	1	4	0	5/12

		Age class distribution				Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Chrysothamnus nauseosus									
82	**0**	0	0	-	-	0	0	0	-/-
88	**0**	0	0	-	-	0	0	0	-/-
95	**20**	100	0	-	-	0	0	0	-/-
00	**0**	0	0	-	-	0	0	0	-/-
05	**20**	0	100	-	-	0	0	0	7/7
10	**0**	0	0	-	-	0	0	0	-/-
Chrysothamnus viscidiflorus									
82	**1199**	0	100	0	-	56	0	0	9/12
88	**798**	58	25	17	-	33	33	0	8/6
95	**500**	8	92	0	-	0	0	0	8/11
00	**320**	6	75	19	-	0	0	0	7/8
05	**300**	13	80	7	-	0	0	0	8/9
10	**560**	7	93	0	-	0	0	4	10/12
Gutierrezia sarothrae									
82	**0**	0	0	-	-	0	0	0	-/-
88	**133**	0	100	-	-	0	0	0	5/1
95	**360**	17	83	-	-	0	0	0	6/7
00	**120**	17	83	-	-	0	0	0	4/3
05	**220**	0	100	-	-	0	0	0	5/8
10	**60**	0	100	-	-	0	0	0	5/13
Juniperus osteosperma									
82	**0**	0	0	-	-	0	0	0	-/-
88	**0**	0	0	-	-	0	0	0	-/-
95	**0**	0	0	-	-	0	0	0	-/-
00	**40**	100	0	-	-	0	0	0	-/-
05	**20**	100	0	-	-	0	0	0	-/-
10	**0**	0	0	-	40	0	0	0	-/-
Pediocactus simpsonii									
82	**66**	0	100	-	-	0	0	0	1/2
88	**0**	0	0	-	-	0	0	0	-/-
95	**20**	0	100	-	-	0	0	0	-/-
00	**60**	67	33	-	-	0	0	0	-/-
05	**140**	0	100	-	-	0	0	0	1/2
10	**20**	0	100	-	-	0	0	0	3/4
Peraphyllum ramosissimum									
82	**133**	0	100	-	-	0	0	0	30/32
88	**66**	0	100	-	-	0	100	0	28/37
95	**0**	0	0	-	-	0	0	0	19/21
00	**0**	0	0	-	-	0	0	0	19/24
05	**0**	0	0	-	-	0	0	0	-/-
10	**20**	0	100	-	-	0	0	0	21/27

		Age class distribution				Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Pinus edulis									
82	**0**	0	0	-	-	0	0	0	-/-
88	**0**	0	0	-	-	0	0	0	-/-
95	**0**	0	0	-	-	0	0	0	-/-
00	**40**	100	0	-	-	0	0	0	-/-
05	**20**	100	0	-	40	0	0	0	-/-
10	**0**	0	0	-	20	0	0	0	-/-
Symphoricarpos oreophilus									
82	**0**	0	0	-	-	0	0	0	-/-
88	**0**	0	0	-	-	0	0	0	-/-
95	**20**	0	100	-	-	0	0	0	14/35
00	**60**	0	100	-	-	0	0	0	-/-
05	**60**	0	100	-	-	0	0	0	12/23
10	**20**	0	100	-	-	0	0	0	4/17
Tetradymia canescens									
82	**0**	0	0	0	-	0	0	0	-/-
88	**66**	0	0	100	-	0	100	0	-/-
95	**0**	0	0	0	-	0	0	0	-/-
00	**0**	0	0	0	-	0	0	0	-/-
05	**0**	0	0	0	-	0	0	0	-/-
10	**0**	0	0	0	-	0	0	0	-/-