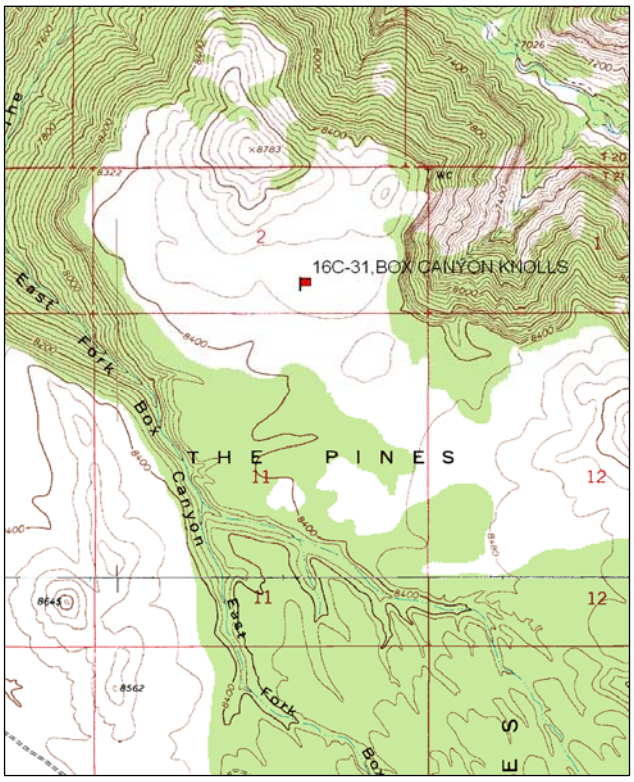
BOX CANYON KNOLLS - TREND STUDY NO. 16C-31-09

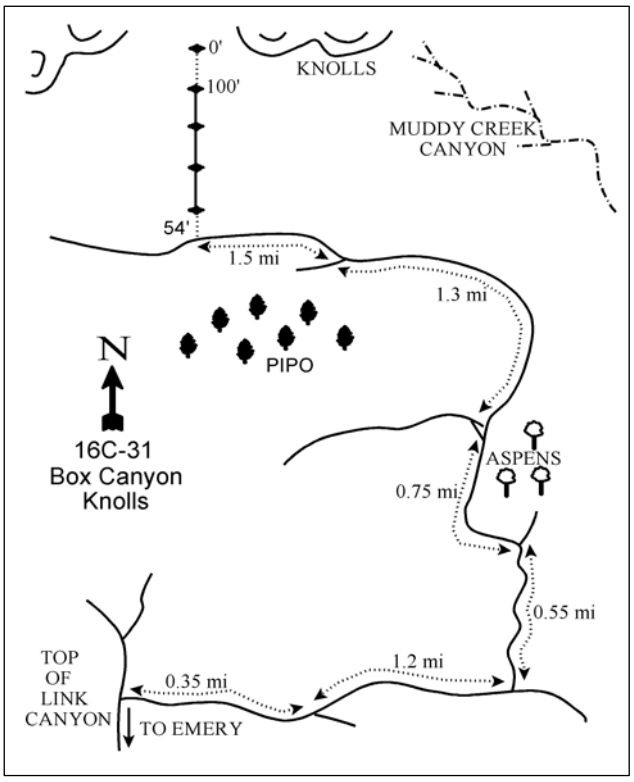
Vegetation Type: Black Sagebrush
Range Type: Crucial Deer Winter, Substantial Elk Winter
NRCS Ecological Site Description: Not Available
Land Ownership: USFS
Elevation: 8,500 ft (2,591 m)
Aspect: South
Slope: 0%-2%
Transect bearing: 180 degrees magnetic.
Belt placement: line 1 (11 & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft)

Directions:
From Center Street in the town of Emery, continue south on Highway 10 for 1.2 miles. Turn right onto a dirt road and go 0.6 miles. Turn left and travel up Link Canyon 7 miles (4WD road) to the top. Turn right at the fork and proceed 0.35 miles. Bear left and continue 1.2 miles. Turn left off the jeep trail and go 0.55 miles to a faint fork. Bear left onto F.S. Road #28 and go 0.75 miles to a junction. Bear right and continue northwest 1.3 miles to another fork. Stay right on F.S. #278. Travel 1.5 miles and stop just past a lone limber pine. In the sage flat on the right side of the road, the study is marked by short fenceposts. The 400-foot baseline stake is 54 feet north of the road. The 0-foot baseline stake is 400 feet further north, and is marked by browse tag #9028.

Map Name: Flagstaff Peak



Diagrammatic Sketch:



Township: 21S, Range: 5E, Section: 2

GPS: NAD 83, UTM 12S 471967 E 4318207 N

BOX CANYON KNOLLS - TREND STUDY NO. 16C-31

Site Information

Site Description: The study is located in a remote area on the south side of the steep Muddy Creek Canyon. The study site is located in the open black sagebrush (*Artemisia nova*) and perennial grass community that covers most the flats. The area is managed by the Forest Service as part of the Emery cattle allotment. Pellet group data has estimated heavy elk and light deer use since 1999. Estimated cattle use has been light to moderate since 1999 (Table - Pellet Group Data).

Browse: The most abundant preferred browse species is a low-growing, dense population of black sagebrush. Black sagebrush densities decreased dramatically from 1999 to 2004, but rebounded in 2009. The decrease is attributed to drought conditions. The black sagebrush population is mostly healthy with low decadence, good vigor, and excellent recruitment of young plants in all sample years except for 2004. The majority of the black sagebrush plants have displayed light hedging over the study period. A small population of stunted mountain big sagebrush (*Artemisia tridentata* ssp *vaseyana*) also occurs on the site and also had a substantial decrease in density in 2004, but did not recover in 2009. Mountain big sagebrush plants displayed moderate to heavy use in 2009 (Table - Browse Characteristics). The dominant species in cover on the site is stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*) which is extremely abundant on the site (Table - Browse Trends). Rabbitbrush density also decreased markedly in 2004, but increased to the highest rate sampled in 2009. These shrubs are small, in good vigor, have low decadence, and have high recruitment of young plants. Other species on the site include an increasing population of winterfat (*Ceratoides lanata*) and small numbers of Utah serviceberry (*Amelanchier utahensis*), fringed sagebrush (*Artemisia frigida*), dwarf rabbitbrush (*Chrysothamnus depressus*), and gray horsebrush (*Tetradymia canescens*) (Table - Browse Characteristics).

Herbaceous Understory: Grasses are fairly diverse and abundant on the site, but there has been a change in composition over the length of the study. Pinewoods needlegrass (*Stipa pinetorum*) was the dominant grass species at the outset of the study in 1988 with sheep fescue (*Festuca ovina*) being common. Both species have decreased significantly in nested frequency and sheep fescue was rare in 2009. There may have been some problems differentiating western wheatgrass (*Agropyron smithii*) and slender wheatgrass (*A. trachycaulum*). Mutton bluegrass (*Poa fendleriana*) and western wheatgrass were the dominant grass species in cover in 2009 with pinewoods needlegrass also being common. Perennial forbs are diverse on the site and have steadily increased in cover since 1994. Some of the most common perennial forb species include redroot eriogonum (*Eriogonum racemosum*), Eaton fleabane (*Erigeron eatonii*), and mat penstemon (*Penstemon caespitosus*).

Soil: Soil texture is a clay loam with a neutral pH (Table - Soil Analysis Data). The surface of the clay loam soil shows expansion and/or contraction cracking which would indicate the presence of shrink/swell clays. Soil parent material appears to be limestone. Bare ground cover has been moderately low over the sample years except for 2004, when it was high. Most of the protective ground cover is provided by litter and herbaceous vegetation cover (Table - Basic Cover). There is some pedestaling of plants, but the soil erosion condition was classified as stable in 2004 and 2009.

Trend Assessments

Browse:

- **1988 to 1994 - slightly up (+1):** Differences in density may be related to the larger sample area used in 1994; therefore, trend was determined using other parameters. Decadence of the primary browse species, black sagebrush, decreased from 34% to 7%.
- **1994 to 1999 - up (+2):** There was a 23% increase in the density of black sagebrush from 10,260 plants/acre to 12,680 plants/acre and cover increased from 6% to 9%. Decadence of black sagebrush

increased slightly, but is still low at 14%. There was also a 25% increase in the density of mountain big sagebrush, but decadence increased from 2% to 25%.

- **1999 to 2004 - down (-2):** There was a 75% decrease in the density of black sagebrush to 3,220 plants/acre and cover decreased to 3%. Recruitment of young black sagebrush plants decreased to 1% of the population. Mountain big sagebrush density and cover also decreased substantially.
- **2004 to 2009 - up (+2):** The density of black sagebrush increased five-fold to 16,940 plants/acre and cover increased to 6%. However, stickyleaf low rabbitbrush also increased in cover and density, but mountain big sagebrush did not recover.

Grass:

- **1988 to 1994 - stable (0):** There was little change in the sum of nested frequency of perennial grasses.
- **1994 to 1999 - stable (0):** Perennial grass sum of nested frequency changed little, but cover decreased from 14% to 11%. Pinewoods needlegrass and slender wheatgrass decreased significantly in nested frequency and sheep fescue increased significantly.
- **1999 to 2004 - down (-2):** The sum of nested frequency of perennial grasses decreased by 52% and cover decreased to 6%. There was a significant decrease in the nested frequency of sheep fescue, mutton bluegrass, and pinewood needlegrass.
- **2004 to 2009 - up (+2):** Perennial grass sum of nested frequency increased by 63% and cover increased to 8%. Mutton bluegrass and pinewood needlegrass increased significantly in nested frequency.

Forb:

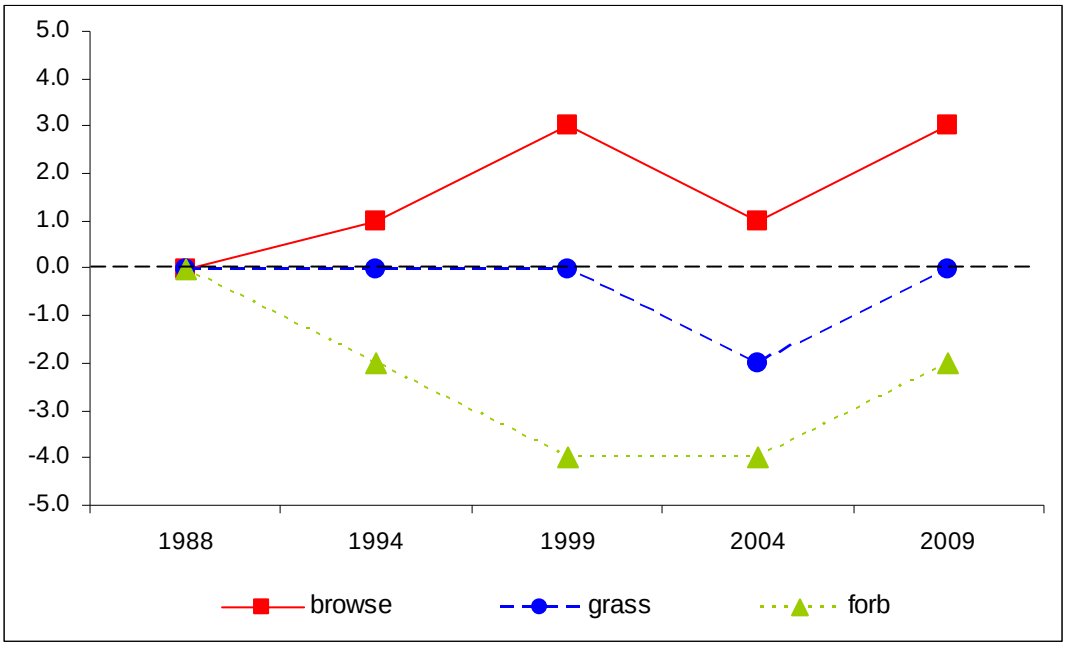
- **1988 to 1994 - down (-2):** Perennial forb sum of nested frequency decreased by 32%.
- **1994 to 1999 - down (-2):** The sum of nested frequency of perennial forbs decreased by 20%, but cover increased from 2% to 3%.
- **1999 to 2004 - stable (0):** There was little change in the sum of nested frequency of perennial forbs, but cover increased to 4%. There was also a large increase in the sum of nested frequency and cover of annual forbs.
- **2004 to 2009 - up (+2):** The sum of nested frequency of perennial forbs increased 58% and cover increased to 5%. There was a substantial decrease in the sum of nested frequency and cover of annual forbs.

DEER DESIRABLE COMPONENTS INDEX - MID-LEVEL POTENTIAL SCALE --
Management unit 16C, study no: 31

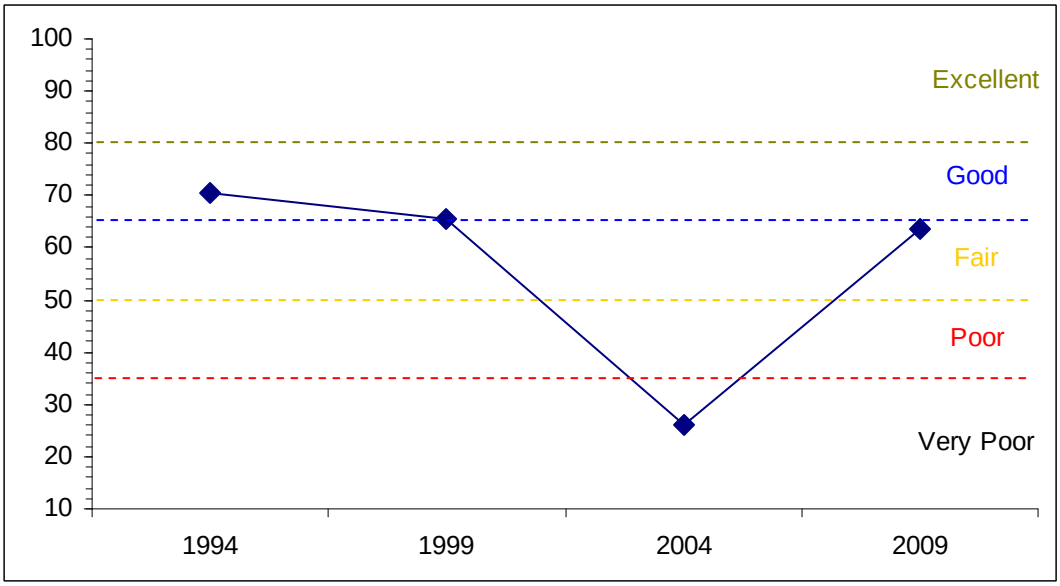
Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	**Total Score**	Ranking
94	9.4	13.3	14.7	29.0	0.0	3.9	0.0	**70.4**	Good
99	14.0	10.3	13.3	21.9	0.0	6.2	0.0	**65.6**	Fair-Good
04	4.4	0.0	0.0	12.9	0.0	8.5	0.0	**25.9**	Very Poor
09	8.7	13.2	15.0	16.9	0.0	9.9	0.0	**63.7**	Fair-Good

Trend Summary

CUMULATIVE RANGE TREND ASSESSMENT--
Management unit 16C Study no: 31



DEER DESIRABLE COMPONENTS INDEX TREND, MID-LEVEL POTENTIAL
Management unit 16C, Study no:31



HERBACEOUS TRENDS--
Management unit 16C, Study no: 31

Type	Species	Nested Frequency					Average Cover %			
		'88	'94	'99	'04	'09	'94	'99	'04	'09
G	Agropyron smithii	a-	a-	a-	b63	c164	-	-	1.36	3.41
G	Agropyron trachycaulum	c121	c128	b72	a39	a7	1.15	.84	1.56	.12
G	Festuca ovina	b26	b15	c110	b18	a-	.10	2.92	.07	-
G	Poa fendleriana	a130	b157	b140	a79	b177	2.85	2.59	2.28	3.87
G	Poa pratensis	-	-	-	3	-	-	-	.15	-
G	Sitanion hystrix	b27	a1	ab19	b28	a-	.00	.13	.57	-
G	Stipa comata	-	-	-	3	-	-	-	.15	-
G	Stipa pinetorum	d236	d281	c208	a32	b84	10.37	4.43	.31	1.04
Total for Annual Grasses		0	0	0	0	0	0	0	0	0
Total for Perennial Grasses		540	582	549	265	432	14.49	10.93	6.47	8.45
Total for Grasses		540	582	549	265	432	14.49	10.93	6.47	8.45
F	Androsace septentrionalis (a)	-	a-	b33	c66	a-	-	.15	.36	-
F	Antennaria parvifolia	5	16	18	1	10	.65	.84	.03	.16
F	Arabis sp.	b18	a-	a3	a4	a3	-	.00	.01	.00
F	Artemisia frigida	-	2	-	-	-	.00	-	-	-
F	Astragalus agrestis	abc8	bc16	c19	a1	ab3	.03	.17	.00	.00
F	Astragalus convallarius	-	3	2	6	-	.01	.00	.09	.00
F	Calochortus nuttallii	b20	a-	ab8	a3	a2	-	.02	.00	.00
F	Castilleja linariaefolia	b46	a3	a7	a-	a-	.00	.10	-	-
F	Chaenactis douglasii	b21	a-	a1	a-	a3	-	.00	-	.00
F	Chenopodium sp. (a)	-	a-	a-	b186	a5	-	-	2.72	.01
F	Crepis acuminata	ab11	a5	ab4	a4	b13	.01	.06	.06	.09
F	Cryptantha sp.	-	2	-	-	-	.00	-	-	-
F	Descurainia pinnata (a)	-	-	-	2	-	-	-	.00	-
F	Erigeron eatonii	d197	c141	b67	a2	b92	.54	.59	.00	1.19
F	Erigeron pumilus	a7	b22	a5	a-	a-	.21	.04	-	-
F	Eriogonum alatum	-	3	3	-	1	.00	.03	-	.03
F	Eriogonum racemosum	a72	a64	a70	b133	b163	.25	.92	2.25	1.76
F	Eriogonum umbellatum	ab24	b33	ab16	ab12	a6	.15	.09	.23	.18
F	Hymenoxys richardsonii	9	7	3	2	-	.02	.00	.15	-
F	Lappula occidentalis (a)	-	-	-	3	-	-	-	.00	-
F	Linum lewisii	-	-	-	1	-	-	-	.03	-
F	Lupinus argenteus	3	-	9	1	1	-	.08	.03	.00
F	Lupinus sp.	a-	a-	a-	b15	a-	-	-	.10	-
F	Machaeranthera canescens	9	-	-	-	3	-	-	-	.00
F	Penstemon caespitosus	b31	a7	a-	a4	b47	.04	-	.04	1.14
F	Penstemon carnosus	-	1	10	2	2	.00	.05	.18	.00
F	Polygonum douglasii (a)	-	a1	a-	b52	a3	.00	-	.11	.00
F	Senecio multilobatus	a-	a3	a8	b38	b30	.00	.04	.86	.28
F	Sphaeralcea coccinea	-	-	2	1	3	-	.00	.03	.03
F	Taraxacum officinale	-	-	-	3	-	-	-	.03	-
F	Townsendia incana	1	-	-	-	-	-	-	-	-
F	Tragopogon dubius	2	-	6	11	3	-	.01	.11	.00

Type	Species	Nested Frequency					Average Cover %			
		'88	'94	'99	'04	'09	'94	'99	'04	'09
Total for Annual Forbs		0	1	33	309	8	0.00	0.15	3.21	0.01
Total for Perennial Forbs		484	328	261	244	385	1.96	3.09	4.26	4.94
Total for Forbs		484	329	294	553	393	1.97	3.24	7.47	4.96

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

BROWSE TRENDS--
Management unit 16C, Study no: 31

Type	Species	Strip Frequency				Average Cover %			
		'94	'99	'04	'09	'94	'99	'04	'09
B	Artemisia frigida	3	4	5	31	.00	.01	.41	.61
B	Artemisia nova	97	94	53	84	5.50	9.05	2.78	5.58
B	Artemisia tridentata vaseyana	22	29	3	3	1.80	1.95	.30	.33
B	Ceratoides lanata	0	1	9	15	.03	.03	.15	.55
B	Chrysothamnus depressus	3	6	2	2	.18	.16	-	-
B	Chrysothamnus nauseosus	0	0	0	1	-	-	-	.03
B	Chrysothamnus viscidiflorus viscidiflorus	93	93	80	89	5.15	7.64	5.67	8.25
B	Gutierrezia sarothrae	8	8	0	0	.04	.09	-	-
B	Tetradymia canescens	6	9	11	7	.18	.24	.53	.54
Total for Browse		232	244	163	232	12.90	19.17	9.86	15.90

CANOPY COVER, LINE INTERCEPT--
Management unit 16C, Study no: 31

Species	Percent Cover	
	'04	'09
Artemisia frigida	.50	.23
Artemisia nova	3.53	5.59
Artemisia tridentata vaseyana	.23	.35
Ceratoides lanata	.25	.46
Chrysothamnus depressus	.40	-
Chrysothamnus viscidiflorus viscidiflorus	5.25	3.59
Tetradymia canescens	.36	.16

KEY BROWSE ANNUAL LEADER GROWTH--
Management unit 16C, Study no: 31

Species	Average leader growth (in)	
	'04	'09
Artemisia nova	2.3	0.6

BASIC COVER--
Management unit 16C, Study no: 31

Cover Type	Average Cover %				
	'88	'94	'99	'04	'09
Vegetation	8.75	35.04	34.84	23.34	33.32
Rock	1.25	1.14	.76	.84	.35
Pavement	.25	.70	1.35	.59	1.33
Litter	35.75	37.44	27.93	26.64	36.97
Cryptogams	.50	.23	.82	.75	.19
Bare Ground	53.50	40.24	39.54	62.15	39.75

SOIL ANALYSIS DATA --
Management unit 16C, Study no: 31, Study Name: Box Canyon Knolls

Effective rooting depth (in)	pH	clay loam			%0M	PPM P	PPM K	ds/m
		%sand	%silt	%clay				
13.8	6.8	42	25.4	32.6	2.9	13.2	137.6	0.4

PELLET GROUP DATA--
Management unit 16C, Study no: 31

Type	Quadrat Frequency			
	'94	'99	'04	'09
Rabbit	16	7	3	2
Elk	62	55	40	68
Deer	11	5	4	8
Cattle	1	7	1	5

Days use per acre (ha)		
'99	'04	'09
-	-	-
108 (267)	87 (215)	44 (109)
5 (12)	-	4 (10)
9 (22)	25 (61)	20 (58)

BROWSE CHARACTERISTICS--
Management unit 16C, Study no: 31

		Age class distribution				Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Amelanchier utahensis									
88	**0**	0	0	-	-	0	0	0	-/-
94	**0**	0	0	-	-	0	0	0	16/20
99	**0**	0	0	-	-	0	0	0	14/36
04	**0**	0	0	-	-	0	0	0	16/38
09	**0**	0	0	-	200	0	0	0	103/164
Artemisia frigida									
88	**0**	0	0	0	-	0	0	0	-/-
94	**80**	0	100	0	-	0	0	0	2/5
99	**100**	40	60	0	-	60	0	0	6/6
04	**160**	0	88	13	360	13	13	0	15/17
09	**3100**	46	54	0	320	12	21	37	5/7

		Age class distribution				Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Artemisia nova									
88	**10332**	36	30	34	6133	17	2	9	8/13
94	**10260**	37	56	7	20	14	0	6	6/13
99	**12680**	31	55	14	1140	28	5	2	7/15
04	**3220**	1	89	11	3760	15	0	4	8/13
09	**16940**	62	32	6	24160	9	9	16	6/13
Artemisia tridentata vaseyana									
88	**332**	60	0	40	-	40	0	0	-/-
94	**820**	10	88	2	-	0	0	2	11/18
99	**1060**	8	68	25	60	34	23	4	15/24
04	**140**	0	71	29	-	14	0	14	13/19
09	**160**	0	75	25	140	75	25	0	10/21
Ceratoides lanata									
88	**1264**	16	79	5	66	0	0	0	6/6
94	**0**	0	0	0	-	0	0	0	5/7
99	**40**	0	100	0	-	100	0	0	4/5
04	**2760**	74	26	0	560	34	62	0	4/9
09	**3300**	22	78	0	240	72	13	0	4/5
Chrysothamnus depressus									
88	**0**	0	0	-	-	0	0	0	-/-
94	**100**	0	100	-	-	0	0	0	4/9
99	**160**	13	88	-	-	0	0	0	3/9
04	**40**	0	100	-	-	0	0	0	4/5
09	**40**	0	100	-	-	0	0	0	2/7
Chrysothamnus nauseosus									
88	**0**	0	0	-	-	0	0	0	-/-
94	**0**	0	0	-	-	0	0	0	21/24
99	**0**	0	0	-	-	0	0	0	18/24
04	**0**	0	0	-	-	0	0	0	-/-
09	**20**	100	0	-	-	0	0	0	14/11
Chrysothamnus viscidiflorus viscidiflorus									
88	**32598**	22	64	14	1199	7	0	4	3/6
94	**22420**	36	64	0	-	1	0	0	3/7
99	**19220**	15	81	4	80	3	0	.41	4/8
04	**9420**	7	91	2	75960	1	0	.21	6/10
09	**56440**	41	55	5	3740	.49	0	23	3/7
Gutierrezia sarothrae									
88	**0**	0	0	0	-	0	0	0	-/-
94	**220**	9	91	0	-	0	0	0	3/6
99	**460**	0	91	9	-	0	0	4	4/8
04	**0**	0	0	0	-	0	0	0	-/-
09	**0**	0	0	0	-	0	0	0	-/-

		Age class distribution				Utilization			
Year	Plants per Acre (excluding seedlings)	% Young	% Mature	% Decadent	Seedling (plants/acre)	% moderate	% heavy	% poor vigor	Average Height Crown (in)
Mahonia repens									
88	**0**	0	0	-	-	0	0	0	-/-
94	**0**	0	0	-	-	0	0	0	-/-
99	**0**	0	0	-	-	0	0	0	-/-
04	**0**	0	0	-	-	0	0	0	-/-
09	**0**	0	0	-	-	0	0	0	3/5
Opuntia polyacantha									
88	**133**	0	100	-	-	0	0	0	2/6
94	**0**	0	0	-	-	0	0	0	-/-
99	**0**	0	0	-	20	0	0	0	3/15
04	**0**	0	0	-	-	0	0	0	5/10
09	**0**	0	0	-	-	0	0	0	3/11
Purshia tridentata									
88	**0**	0	0	-	-	0	0	0	-/-
94	**0**	0	0	-	-	0	0	0	-/-
99	**0**	0	0	-	-	0	0	0	-/-
04	**0**	0	0	-	-	0	0	0	-/-
09	**0**	0	0	-	-	0	0	0	2/63
Tetradymia canescens									
88	**0**	0	0	0	-	0	0	0	-/-
94	**160**	13	88	0	-	13	0	0	6/8
99	**240**	0	100	0	-	42	25	0	6/8
04	**300**	0	100	0	-	0	20	0	9/13
09	**140**	0	86	14	20	43	29	0	6/17