Trend Study 21B-6-08

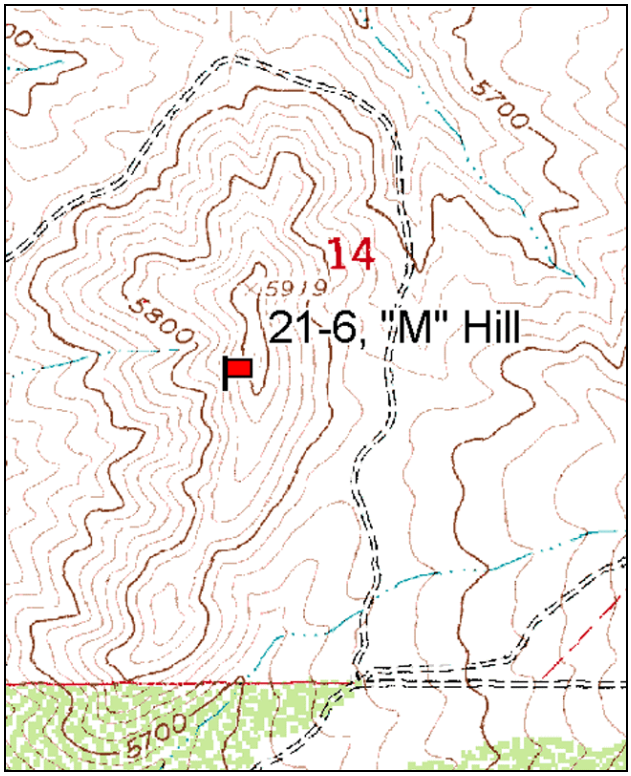
Study site name: 'M' Hill . Vegetation type: Mtn. Brush Chaining .

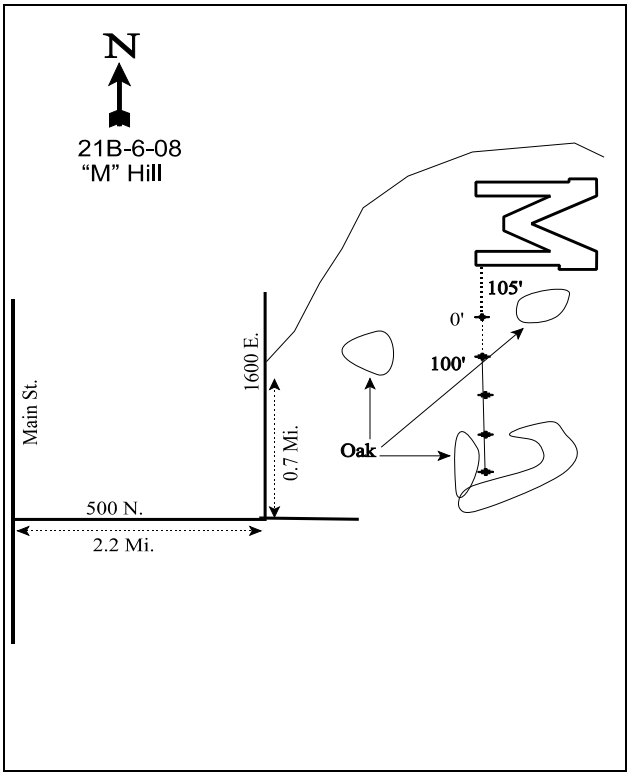
Compass bearing: frequency baseline 180 degrees magnetic.

Frequency belt placement: line 1 (11 & 95ft), line 2 (34ft), line 3 (59ft), line 4 (71ft). No rebar.

LOCATION DESCRIPTION

This transect is located near the 'M' on the hill northeast of Fillmore. Starting at the junction of 500 North and Main Street in Fillmore, go east 2.2 miles to the base of 'M' Hill. The road that goes to the top of 'M' Hill has been closed. Turn left (north) at the gun range and drive 0.7 miles to the closed road. Hike to the 'M'. The frequency baseline starts 105 feet true south of the bottom of the south leg of the concrete 'M'. The baseline is marked by 2 ½ foot tall steel rebar. The 0-foot baseline stake is tagged #7112.





Map Name: Fillmore

Diagrammatic Sketch

Township 21S , Range 4W , Section 14

GPS: NAD 83, UTM 12S 389814 E, 4315807 N

DISCUSSION

'M' Hill - Trend Study No. 21B-6

Study Information

This trend study is located on DWR land on the first large hill east of Fillmore [elevation: 5,800 feet (1,768 m), slope: 30%-35%, aspect: west]. Further east, there are approximately two miles of rolling juniper-covered foothills below the 7,000-foot (2,134-m) winter range limit. The study was chained more than 30 years ago and has since been dominated by a mixture of shrubs. Cattle grazing was heavy in the past, but has decreased. Deer use appeared to be moderate to heavy when the site was established, but has also lessened in subsequent years. From the pellet group transect data, deer use was estimated at 23 days use/acre (57 ddu/ha) in 1998, 50 days use/acre (124 ddu/ha) in 2003, and 23 days use/acre (56 ddu/ha) in 2008. Elk use was estimated at 6 days use/acre (15 edu/ha) in 1998, 7 days use/acre (17 edu/ha) in 2003, and 3 days use/acre (8 edu/ha) in 2008. Cattle pats were only sampled in 1998, and use was estimated at 6 days use/acre (15 cdu/ha). There is ample thermal cover available in the area from Utah juniper (*Juniperus osteosperma*).

Soil

The soil is classified within the Borvant series (USDA-NRCS 2008). 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 is a loam with a neutral reaction (pH 6.9). Phosphorus is 8.4 ppm, which is marginal for normal plant development (Tiedemann and Lopez 2004). Since 1998, the relative vegetation cover has been 24%-30%. Rock and pavement are abundant on the surface with relative combined cover values ranging from 19% to 29%. In 2008, rock and pavement provided 27% of the relative cover. Rock and gravel are also common throughout the profile. There is some soil movement downslope, as evidenced by pedestalling around the base of shrubs and bunchgrasses, but erosion is not severe. The erosion condition was classified as stable in 2003 and 2008.

Browse

The browse community is diverse. Gambel oak (*Quercus gambelii*), Utah juniper, and true mountain mahogany (*Cercocarpus montanus*) are the dominant species. Gambel oak occurs in dense, scattered patches and had an estimated density of about 3,000 stems/acre in both 1998 and 2003. In 2008, the density had increased to 4,700 stems/acre. The average canopy cover of Gambel oak has increased from 6% in 1998 to 13% in 2008. The young and mature age classes have been abundant in all years, with low decadence. Mature oak stems have averaged 3-5 feet (0.9-1.5 m) in height, and use of oak is mostly light. A portion of the oak population was noted as being severely defoliated by grasshoppers in 1985. Herbaceous understory species and mountain mahogany were also heavily impacted by grasshoppers that year.

From the point-centered quarter data, the juniper density was estimated at 121 trees/acre in 1998, 132 trees/acre in 2003, and 136 trees/acre in 2008. Juniper canopy cover has ranged from 8%-11% since 1998. The mean tree diameter has decreased from 7 inches (18 cm) in 1998 to 4.7 inches (12 cm) in 2008.

True mountain mahogany density has ranged from 200 plants/acre to 300 plants/acre since 1985. Canopy cover of mahogany has been 5%-6% since 2003. The population has consisted mostly of young and mature plants, however, young plants decreased from 54% of the population in 1998 to 10% in 2008. Decadent plants increased to 30% of the population in 2008. Browse use on mahogany was light-moderate from 1985 to 1998, and increased to moderate-heavy in 2003. In 2008, browse use had returned to light-moderate. Mature mahogany plants averaged over 6 feet (1.8 m) in height since 2003, and are becoming more unavailable to browsing deer. The average annual leader growth was 2.6 inches (6.6 cm) in 2003 and 1.1 inches (2.8 cm) in 2008.

Other preferred browse species that are present include Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), Utah serviceberry (*Amelanchier utahensis*), and mountain big sagebrush (*Artemisia tridentata*

ssp. *vaseyana*). Collectively, the canopy cover of these species has been 2% or less. Cliffrose density has decreased from an estimated 160 plants/acre in 1998 to 120 plants/acre in 2003 and 60 plants/acre in 2008. No young cliffrose plants have been sampled, and decadent plants have comprised 33%-83% of the population. The average annual leader growth of cliffrose was 2.0 inches (5.1 cm) in 2003 and 0.7 inches (1.8 cm) in 2008. Browse use on cliffrose was moderate in 1998, heavy in 2003, and light in 2008. Serviceberry was not sampled in the density strips but was present, measuring an average 8 feet (2.4 m) in height in 2003. The density of sagebrush has declined from 220 plants/acre in 1998 to 60 plants/acre by 2008. Browse use on sagebrush has been light in all sample years. Two less preferred species, prickly phlox (*Leptodactylon pungens*) and broom snakeweed (*Gutierrezia sarothrae*), both showed large decreases in density between 1998 and 2003. Although the prickly phlox density decreased further in 2008, the snakeweed density recovered partially.

Herbaceous Understory

The herbaceous understory is diverse and moderately abundant. Perennial grass cover increased from 9% in 1998 to 13% in 2008. Bluebunch wheatgrass (*Agropyron spicatum*) is the dominant grass species, and increased from 72% of the grass cover in 1998 to 93% by 2008. Other perennial grasses that have been sampled include Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Oryzopsis hymenoides*), bulbous bluegrass (*Poa bulbosa*), mutton bluegrass (*Poa fendleriana*), and bottlebrush squirreltail (*Sitanion hystrix*). Collectively, these other species provided less than 1% cover in 2008. Two annual grass species, cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*), have been sampled. Cheatgrass cover was 2% in 1998, but has been less than 1% since.

Total forb cover decreased from 8% in 1998 to 2% in 2003, and increased to 4% in 2008. There has been a moderate number of forb species sampled, though most species provide little cover. The dominant forbs have poor forage value and include pale alyssum (*Alyssum alyssoides*), rock goldenrod (*Petradoria pumila*), and desert phlox (*Phlox austromontana*). There are few desirable forbs present, although penstemon (*Penstemon* sp.), lobeleaf groundsel (*Senecio multilobatus*), and heartleaf twistflower (*Streptanthus cordatus*) receive some use from wildlife.

1991 TREND ASSESSMENT

The browse trend is stable. The density of Gambel oak decreased 5% to 7,932 plants/acre, and decadent plants increased from 0% of the population to 6%. However, the average height and crown measurements nearly doubled to 60 inches (1.5 m) and 33 inches (0.8 m), respectively. Browse use remained light. The population of mountain mahogany did not change, though plants with poor vigor decreased from 25% of the population to 0%. Mountain mahogany height and crown also increased but browse use increased from light to moderate. The grass trend is slightly up. The sum of nested frequency of perennial grasses increased by 14%. Two additional perennial grass species were sampled, but at low frequencies. The forb trend is up. The sum of nested frequency of perennial forbs increased approximately 60% and the number of perennial species sampled increased from seven to 12. There were significant increases in the nested frequency of hoary aster (*Machaeranthera canescens*) and desert phlox.

browse - stable (0) grass - slightly up (+1) forb - up (+2)

1998 TREND ASSESSMENT

The browse trend is stable. True mountain mahogany density remained low. Decadence slightly increased from 0% of the population to 8%, and young recruitment increased from 25% of the population to 54%. Stansbury cliffrose was sampled for the first time at a density of 160 plants/acre. Decadence was high at 38% of the population, and no young plants were sampled. Mountain big sagebrush was also sampled for the first time at a density of 220 plants/acre). The population was largely mature, with 18% decadence. The Gambel oak population remained stable with low decadence and high recruitment. The trend for grasses is stable. The sum of nested frequency for perennial grasses changed little. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little. Rock goldenrod decreased significantly in nested frequency. The

winter range condition, determined by the Desirable Components Index (DCI), was rated as good due to moderate preferred browse cover with low decadence and high recruitment, as well as high perennial grass and forb cover.

winter range condition (DCI) - good (72) Mid-level potential scale
browse - stable (0) grass - stable (0) forb - stable (0)

2003 Trend Assessment

The trend for browse is stable. True mountain mahogany density changed little, and decadence remained relatively stable at 7% of the population. Young recruitment decreased from 54% of the population to 20%. Stansbury cliffrose density also remained relatively stable, although decadence increased from 38% of the population to 83%. Mountain big sagebrush density decreased 64%, and decadence increased from 18% of the population to 25%. Gambel oak density remained stable, while decadence increased from 1% of the population to 10%. However, young recruitment remained high at 38% of the population. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. Bulbous bluegrass was sampled for the first time, but was only found in 2% of the quadrats and provided little cover. Cheatgrass decreased significantly in nested frequency. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 56%. Pale alyssum, milkvetch (*Astragalus sp*.), shrubby bedstraw (*Galium multiflorum*), rock goldenrod, and desert phlox decreased significantly in nested frequency. The DCI rating remained good, with an increase in perennial grass cover and a decrease in perennial forb cover.

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

2008 Trend Assessment

The browse trend is slightly down. True mountain mahogany density decreased 33%, and decadence increased from 7% of the population to 30%. Young recruitment decreased from 20% of the population to 10%. Stansbury cliffrose density decreased 50%, and decadence also decreased from 83% of the population to 33%. The mountain big sagebrush population remained stable at a low density. Gambel oak density increased 53%, and decadence decreased from 10% of the population to 4%. Young recruitment decreased from 38% of the population to 13%. The trend for grass is stable. The sum of nested frequency for perennial grasses changed little. The trend for forbs is stable. The sum of nested frequency for perennial forbs decreased slightly. Pale alyssum increased significantly in nested frequency. The DCI rating declined to fair due to a decrease in preferred browse cover and young recruitment, and an increase in browse decadence.

winter range condition (DCI) - fair (62) Mid-level potential scale
browse - slightly down (-1) grass - stable (0) forb - stable (0)

HERBACEOUS TRENDS --
Management unit 21B, Study no: 6

Type	Species	Nested Frequency					Average Cover %		
		'85	'91	'98	'03	'08	'98	'03	'08
G	Agropyron spicatum	169	207	198	180	200	8.30	10.81	12.62
G	Bromus japonicus (a)	-	-	$_{b}$14	$_{a}$-	$_{b}$10	.19	-	.02
G	Bromus tectorum (a)	-	-	$_{b}$175	$_{a}$28	$_{a}$55	1.99	.13	.22
G	Oryzopsis hymenoides	-	1	2	2	1	.38	.18	.21
G	Poa bulbosa	-	-	-	7	2	-	.04	.00
G	Poa fendleriana	-	-	-	-	-	.00	-	-
G	Poa secunda	$_{ab}$33	$_{a}$17	$_{ab}$37	$_{b}$67	$_{ab}$56	.52	1.03	.36
G	Sitanion hystrix	-	5	7	1	4	.06	.01	.06
Total for Annual Grasses		0	0	189	28	65	2.18	0.12	0.25
Total for Perennial Grasses		202	230	244	257	263	9.28	12.09	13.26
Total for Grasses		202	230	433	285	328	11.47	12.22	13.51
F	Agoseris glauca	-	-	7	-	-	.01	-	-
F	Alyssum alyssoides (a)	-	-	$_{b}$234	$_{a}$3	$_{b}$213	1.81	.03	1.68
F	Arabis sp.	-	3	1	-	1	.01	-	.00
F	Astragalus sp.	-	$_{b}$22	$_{b}$19	$_{a}$2	$_{a}$2	.16	.00	.06
F	Calochortus nuttallii	-	-	-	-	2	-	-	.00
F	Cirsium sp.	-	-	3	1	4	.06	.00	.00
F	Collinsia parviflora (a)	-	-	-	3	4	-	.00	.01
F	Cryptantha sp.	$_{b}$12	$_{b}$14	$_{ab}$6	$_{a}$3	$_{a}$3	.08	.03	.00
F	Descurainia pinnata (a)	-	-	24	11	3	.07	.08	.01
F	Draba sp. (a)	-	-	3	-	-	.00	-	-
F	Erodium cicutarium (a)	-	-	1	-	3	.01	-	.00
F	Galium multiflorum	$_{a}$-	$_{a}$-	$_{b}$44	$_{a}$10	$_{a}$7	.50	.18	.15
F	Gilia sp. (a)	-	-	-	3	-	-	.00	-
F	Holosteum umbellatum (a)	-	-	-	-	3	-	-	.00
F	Lactuca serriola	$_{a}$-	$_{ab}$1	$_{b}$11	$_{ab}$-	$_{ab}$-	.05	-	-
F	Linum lewisii	-	5	4	-	-	.06	-	-
F	Machaeranthera canescens	3	24	-	-	-	.00	-	-
F	Microsteris gracilis (a)	-	-	$_{b}$26	$_{a}$-	$_{a}$-	.12	-	-
F	Penstemon sp.	$_{b}$9	$_{ab}$5	$_{a}$9	$_{ab}$4	$_{a}$-	.05	.01	-
F	Petradoria pumila	$_{c}$110	$_{c}$119	$_{b}$70	$_{a}$39	$_{a}$32	2.92	1.22	1.67
F	Phlox austromontana	$_{a}$13	$_{b}$53	$_{b}$40	$_{a}$28	$_{a}$27	1.94	.64	.74
F	Physaria chambersii	-	-	4	-	-	.03	-	-
F	Phlox longifolia	$_{a}$-	$_{a}$-	$_{b}$22	$_{ab}$15	$_{a}$5	.14	.17	.01
F	Ranunculus testiculatus (a)	-	-	8	-	-	.01	-	-

Type	Species	Nested Frequency					Average Cover %		
		'85	'91	'98	'03	'08	'98	'03	'08
F	Senecio multilobatus	$_{b}$10	$_{a}$-	$_{a}$-	$_{ab}$5	$_{a}$3	-	.01	.03
F	Streptanthus cordatus	6	9	14	3	14	.21	.01	.05
F	Tragopogon dubius	-	2	-	3	-	.00	.03	-
F	Unknown forb-perennial	-	2	-	-	-	-	-	-
Total for Annual Forbs		0	0	296	20	226	2.03	0.11	1.71
Total for Perennial Forbs		163	259	254	113	100	6.26	2.32	2.75
Total for Forbs		163	259	550	133	326	8.29	2.44	4.46

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

BROWSE TRENDS --
Management unit 21B, Study no: 6

Type	Species	Strip Frequency			Average Cover %		
		'98	'03	'08	'98	'03	'08
B	Amelanchier utahensis	0	0	0	-	.38	-
B	Artemisia tridentata vaseyana	8	3	3	1.05	.03	.84
B	Cercocarpus montanus	11	9	9	3.50	3.92	2.95
B	Cowania mexicana stansburiana	8	6	3	1.56	1.09	.09
B	Gutierrezia sarothrae	23	11	20	1.33	.10	.51
B	Juniperus osteosperma	8	12	10	6.07	3.24	3.42
B	Leptodactylon pungens	19	7	1	1.27	.21	.00
B	Opuntia sp.	0	0	1	-	-	.00
B	Purshia tridentata	0	0	1	-	-	.00
B	Quercus gambelii	24	25	27	8.83	6.56	6.94
Total for Browse		101	73	211	23.63	15.53	14.77

CANOPY COVER, LINE INTERCEPT --
Management unit 21B, Study no: 6

Species	Percent Cover		
	'98	'03	'08
Artemisia tridentata vaseyana	-	.21	.66
Cercocarpus montanus	.40	6.06	5.40
Cowania mexicana stansburiana	-	1.64	.88
Gutierrezia sarothrae	-	.51	.56
Juniperus osteosperma	10.60	8.33	9.96
Leptodactylon pungens	-	.01	-
Quercus gambelii	6.00	11.98	13.16

KEY BROWSE ANNUAL LEADER GROWTH --
Management unit 21B, Study no: 6

Species	Average leader growth (in)	
	'03	'08
Cercocarpus montanus	2.6	1.1
Cowania mexicana stansburiana	2.0	0.7

POINT-QUARTER TREE DATA --
Management unit 21B, Study no: 6

Species	Trees per Acre		
	'98	'03	'08
Juniperus osteosperma	121	132	136

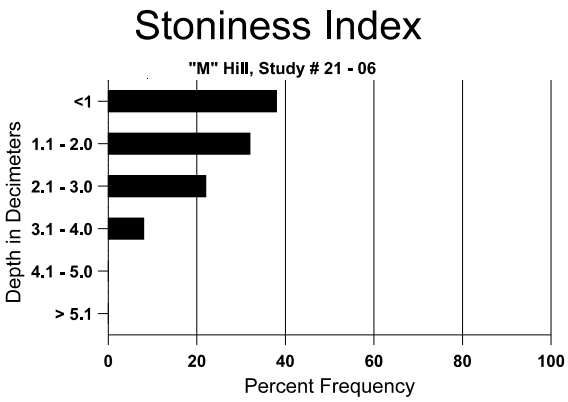
Average diameter (in)		
'98	'03	'08
6.9	5.8	4.7

BASIC COVER --
Management unit 21B, Study no: 6

Cover Type	Average Cover %				
	'85	'91	'98	'03	'08
Vegetation	7.75	6.00	41.14	27.70	32.21
Rock	13.50	14.00	11.11	12.27	13.34
Pavement	15.75	12.75	22.61	9.53	17.14
Litter	43.50	46.75	53.05	46.26	45.62
Cryptogams	0	0	.10	.27	.45
Bare Ground	19.50	20.50	9.09	18.38	4.68

SOIL ANALYSIS DATA --
Management unit 21, Study no: 6, Study Name: “M” Hill

Effective rooting depth (in)	Temp °F (depth)	pH	sandy clay loam			%0M	PPM P	PPM K	ds/m
			%sand	%silt	%clay				
13.9	65.2 (15.4)	6.9	51.2	27.4	21.3	4.0	8.4	89.6	0.7



PELLET GROUP DATA --
Management unit 21B, Study no: 6

Type	Quadrat Frequency		
	'98	'03	'08
Rabbit	16	15	39
Elk	3	1	2
Deer	16	24	27
Cattle	-	-	-

Days use per acre (ha)		
'98	'03	'08
-	-	-
4 (10)	7 (17)	3 (8)
23 (57)	50 (122)	23 (56)
6 (15)	-	-

BROWSE CHARACTERISTICS --
Management unit 21B, 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												
85	**0**	-	-	-	-	-	0	0	-	-	0	-/-
91	**0**	-	-	-	-	-	0	0	-	-	0	-/-
98	**0**	-	-	-	-	-	0	0	-	-	0	-/-
03	**0**	-	-	-	-	-	0	0	-	-	0	96/104
08	**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												
85	**0**	-	-	-	-	-	0	0	0	-	0	-/-
91	**0**	-	-	-	-	-	0	0	0	-	0	-/-
98	**220**	-	-	180	40	60	9	0	18	-	0	31/38
03	**80**	-	-	60	20	-	0	0	25	-	0	25/39
08	**60**	-	-	60	-	100	0	0	0	-	0	31/43
Cercocarpus montanus												
85	**265**	66	66	199	-	-	25	0	0	-	25	69/35
91	**265**	-	66	199	-	-	75	0	0	-	0	87/70
98	**260**	80	140	100	20	-	0	0	8	-	0	56/55
03	**300**	-	60	220	20	20	27	27	7	-	0	77/89
08	**200**	-	20	120	60	-	60	0	30	10	10	78/85
Chrysothamnus nauseosus hololeucus												
85	**0**	-	-	-	-	-	0	0	-	-	0	-/-
91	**0**	-	-	-	-	-	0	0	-	-	0	-/-
98	**0**	-	-	-	-	-	0	0	-	-	0	12/15
03	**0**	-	-	-	-	-	0	0	-	-	0	-/-
08	**0**	-	-	-	-	-	0	0	-	-	0	-/-
Cowania mexicana stansburiana												
85	**0**	-	-	-	-	-	0	0	0	-	0	-/-
91	**0**	-	-	-	-	-	0	0	0	-	0	-/-
98	**160**	20	-	100	60	40	75	0	38	-	0	53/48
03	**120**	-	-	20	100	20	17	83	83	17	17	66/71
08	**60**	-	-	40	20	-	33	0	33	-	0	50/44
Gutierrezia sarothrae												
85	**66**	-	-	-	66	-	0	0	100	-	0	-/-
91	**265**	-	66	199	-	-	0	0	0	-	0	12/10
98	**1740**	80	220	1520	-	-	0	0	0	-	0	11/11
03	**400**	-	-	380	20	420	0	0	5	-	5	9/12
08	**1000**	20	-	960	40	40	0	0	4	-	0	10/14
Juniperus osteosperma												
85	**133**	66	-	133	-	-	0	0	0	-	0	69/71
91	**133**	66	-	133	-	-	0	0	0	-	0	157/197
98	**160**	-	40	100	20	80	0	0	13	-	0	-/-
03	**260**	20	100	160	-	-	0	0	0	-	0	-/-
08	**200**	40	60	140	-	-	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)
Leptodactylon pungens												
85	**0**	-	-	-	-	-	0	0	0	-	0	-/-
91	**466**	-	-	466	-	-	0	0	0	-	0	8/10
98	**3400**	20	280	2700	420	20	0	0	12	-	0	2/6
03	**380**	-	20	320	40	120	0	0	11	11	11	2/6
08	**20**	-	-	-	20	-	0	0	100	-	100	-/-
Opuntia sp.												
85	**0**	-	-	-	-	-	0	0	-	-	0	-/-
91	**0**	-	-	-	-	-	0	0	-	-	0	-/-
98	**0**	-	-	-	-	-	0	0	-	-	0	7/15
03	**0**	-	-	-	-	-	0	0	-	-	0	6/20
08	**20**	-	-	20	-	-	0	0	-	-	0	5/6
Purshia tridentata												
85	**0**	-	-	-	-	-	0	0	-	-	0	-/-
91	**0**	-	-	-	-	-	0	0	-	-	0	-/-
98	**0**	-	-	-	-	-	0	0	-	-	0	-/-
03	**0**	-	-	-	-	-	0	0	-	-	0	-/-
08	**20**	-	20	-	-	-	0	0	-	-	0	17/18
Quercus gambelii												
85	**8332**	3799	5266	3066	-	-	0	0	0	-	0	35/17
91	**7931**	399	5599	1866	466	-	13	0	6	1	4	60/33
98	**3020**	60	1400	1600	20	660	19	0	1	-	0	51/41
03	**3080**	100	1160	1600	320	320	0	0	10	.64	6	39/30
08	**4700**	260	620	3880	200	540	.85	0	4	.42	.42	42/47