Trend Study 16C-3-07

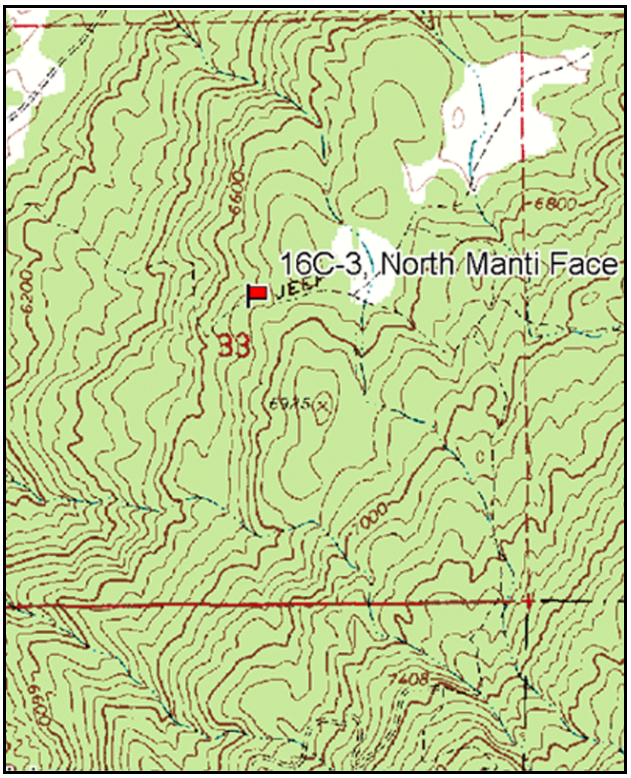
Study site name: North Manti Face . Vegetation type: Big Sagebrush - Grass .

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).

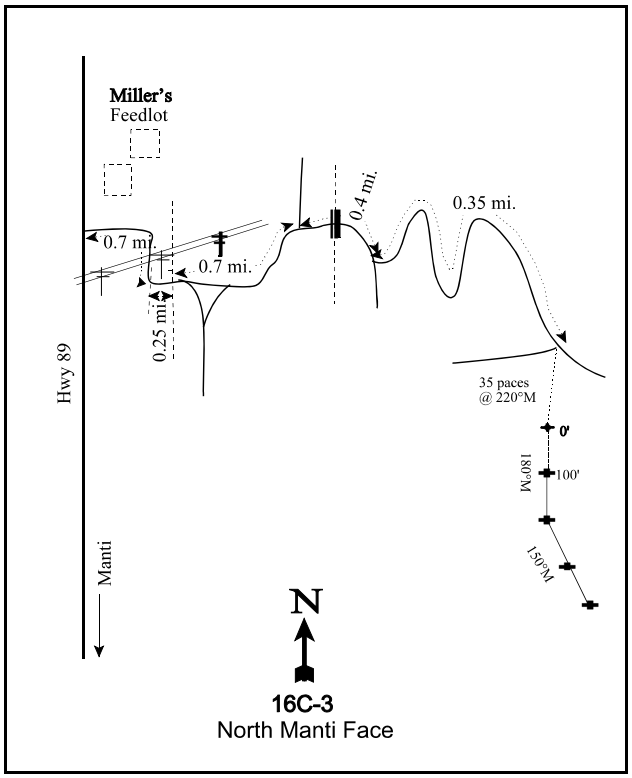
LOCATION DESCRIPTION

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

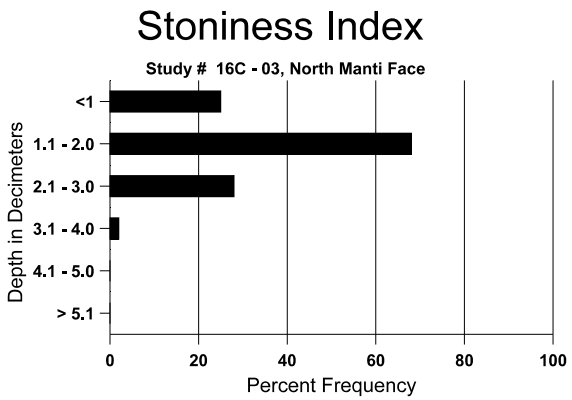
Average diameter (in)	
'02	'07
6.0	7.8

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