

VEGETATION DIVERSITY WITHIN NATIVE AND RECLAIMED COAL MINE SITES:
ENVIRONMENTAL FACTORS AND SEASONAL VARIABILITY¹

by

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Abstract Within arid and semiarid environments of western North America, vegetation composition, i.e., quantity and quality of plant species, can be highly variable on native lands and reclaimed coal mine sites. Therefore, we examined the vegetation composition within 23 native and 79 reclaimed plots at two active coal mines in the Powder River Basin, Wyoming. Cool season, warm season and annual grasses, annual and perennial forbs, and half and full shrubs were inventoried and sampled once in 1991 and twice during 1992 and 1993. Seasonal variation was determined based on site data and plant sampling during early (May) and late (July and August) growth stages. General conclusions drawn from vegetation cover results, i.e., species composition, diversity, and trends, suggest the following relations. Based on age of reclaimed areas, species composition changed from early successional plants to longer-lived individuals. Diversity of the seeded areas reflected actual seed mixes with some invasion based on reclamation method such as direct haul topsoil versus stockpiled topsoil and post-management techniques (e.g. livestock grazing). On native areas, lifeform category cover percentages, e.g., annual grasses and forbs, varied with climate factors such as precipitation and temperature. Such factors had a strong influence on the presence of certain plant species. Due to the extreme variability in weather conditions over the three-year project, we can only conclude that much of the vegetation variability was due to weather conditions.

Additional Key Words: Species Composition, Diversity, Trends, Life-forms, Grasses, Forbs, Shrubs, Weather, Native, Reclaimed

Introduction

The Powder River Basin (PRB) coal region currently contains twenty-one active or proposed coal mines on a north-south trend within a 700 square

mile area surrounding the towns of Gillette and Wright, Wyoming. Based on funding from the Abandoned Coal Mine Lands Research Program (ACMLRP), an intensive three-year study was conducted from 1991 to 1993 to determine the relationship between soil Se levels and plant uptake levels at native and reclaimed areas at two active coal mines within the PRB.

The main objective of this three-year study was to identify possible plant and soil Se relationships. A secondary role of that project was to determine differences in Se uptake between species growing on either native or reclaimed areas.

¹Paper presented at the 1996 National Meeting of the American Society for Surface Mining and Reclamation, Knoxville, Tennessee, May 18-23, 1996.

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This paper presents results of the 1991 through 1993 vegetation sampling programs. Results presented are preliminary as detailed statistical analysis of the specific vegetation encountered during the sampling has not been completed.

Methodology

Fieldwork was conducted on two active mines south of Gillette, Wyoming, within the PRB coal region of northeastern Wyoming. These two mines were ARCO's Black Thunder Mine (BTM), approximately 55 miles southeast of Gillette, and Coal Creek Mine (CCM), approximately 30 miles southeast of Gillette. Vegetation sampling was conducted in 1991 through 1993. Vegetation was sampled once in 1991 and twice in 1992 and 1993; the dual sampling in 1992/1993 was conducted to determine seasonal differences, i.e., May to late July/August.

Twenty-three native area (13 from BTM and 10 from CCM) sample locations were sampled during all three years. Reclaimed area sampling locations were: 79 (71 from BTM and 8 from CCM) in 1991 and 1993, and 52 (44 from BTM and 8 from CCM) in 1992. Within native areas, sample locations were randomly chosen to represent all vegetation types present on the active mine permit areas.

Sample locations were placed among reclaimed areas ranging from 2 to 10 years since revegetation. Sample locations were marked with steel metal fence posts, which were located 7.5 m south of the actual sample location, to prevent any deleterious effects on the vegetation from grazing animals.

Vegetation sampling was conducted at each of the 79 sample locations in 1991 and 1993; questionable vegetation analysis reduced the number of original 1991 sample locations. According to the original purpose of the study, a five to ten gram vegetation sample for selenium content was collected within a 3.5 m radius from the center of the site. Sampled plants included

the dominant four species, based on a visual determination of relative site cover, and a composite grass sample designed to simulate herbivore grazing. General plant cover was visually estimated using a system that grouped plants into the following gross cover percent categories: <1, 1-10, 11-25, 26-50, 51-75, 76-100. It is this vegetation cover from which species composition and diversity were derived and are summarized in this paper.

Results

Based on a review of the compilation of the total number of species encountered during sampling by mine, type, and sampling period (Table 1), some conclusions can be drawn. One observation is the extremes in diversity between native and reclaimed areas. The number of species encountered on reclaimed areas at the Coal Creek Mine were approximately 50 to 70% of the number encountered during sampling of native areas. For the Black Thunder Mine, only 50 to 80% of the total number of species observed on native areas were determined in surveys of reclaimed areas. This is primarily due to the reduced number of species within a seed mix, but is also likely a product of topsoil stripping and placement, i.e., direct haul versus stockpiled material. The direct haul material is not stored and would contain a much greater source of viable seeds from recently stripped areas. Perennial forb reduction was noticeable at both Black Thunder and Coal Creek Mines.

In addition to the change in the number of species encountered during sampling, lifeforms generally changed as well. Prior to disturbance, the major lifeform categories at the Black Thunder Mine in terms of number of species encountered were cool season grasses, annual forbs, and perennial forbs. Annual forbs were conspicuously limited at the Coal Creek Mine, which may indicate less disturbance either from oilfield activity, grazing

Table 1. Number of different species encountered by lifeform category for each sampling period. Note: 1991 Black Thunder data based on selenium sampling, not cover estimates, which were done in 1992 and 1993.

Sampling Date	Mine	Type	CSG	WSG	AG	AF	PF	HS	FS	SUC	TOTAL
1991	BTM	N	4	0	0	0	2	1	1	0	8
		R	11	5	5	16	11	3	5	1	57
	CCM	N	19	1	3	10	33	4	3	1	74
		R	16	4	3	14	11	2	2	1	53
Early	BTM	N	15	2	1	17	37	4	2	1	79
1992	BTM	R	14	4	3	16	14	3	4	1	59
		CCM	N	14	1	2	2	35	5	3	1
		R	16	2	1	7	8	2	1	0	39
Late	BTM	N	14	4	2	11	33	3	2	1	70
1992	BTM	R	13	6	4	13	11	3	4	1	55
		CCM	N	15	1	3	3	39	5	3	1
		R	14	2	2	7	9	2	2	0	38
Early	BTM	N	14	2	3	13	38	3	1	1	75
1993	BTM	R	12	4	3	17	17	3	4	1	61
		CCM	N	16	1	3	7	44	5	4	1
		R	16	3	2	9	15	3	3	1	52
Late	BTM	N	19	5	3	19	42	4	1	1	94
1993	BTM	R	11	5	3	12	11	3	4	1	50
		CCM	N	11	1	1	3	20	4	3	1
		R	10	1	1	4	9	2	2	0	29

MINE: BTM = Black Thunder Mine; CCM = Coal Creek Mine

TYPE: N = Native; R = Reclaimed

LIFEFORM: CSG = Cool Season Grass; WSG = Warm Season Grass; AG = Annual Grass; AF = Annual Forb; PF = Perennial Forb; HS = Half Shrub; FS = Full Shrub; SUC = Succulent; TOTAL = Total Species

pressure, or roads. Cool season grasses were also a significant part of the overall numbers of species at the Coal Creek Mine. Curiously, the number of warm season grasses went up on the reclaimed areas versus native areas at the Coal Creek Mine; however, cover percentages were not similar to

native areas.

Weather patterns played a significant role in the distribution of lifeform category numbers during the sampling years. During 1991, late spring rains and cooler temperatures favored cool season grass and annual forb growth. During 1992, temperature

Table 2. Examples of vegetation diversity and percent cover on old (reclaimed >5 years from time of sampling) and young (reclaimed <5 years from time of sampling) areas. Note: 1991 Black Thunder data based on selenium sampling, not cover estimates, which were done in 1992 and 1993.

Reclamation	Vegetation Species	1991	Early 1992	Late 1992	Early 1993	Late 1993
----- % Vegetation Cover -----						
Old	Agrdas	0-1	10-25	1-10	1-10	10-25
	Agrsmi	10-25	1-10	10-25	10-25	10-25
	Agrtra	0-1			1-10	
	Stivir	0-1	1-10	1-10	1-10	1-10
Young	Agrcri		0-1	0-1	0-1	0-1
	Agrdas	1-10	1-10	1-10	1-10	1-10
	Agrsmi	1-10	1-10	1-10	1-10	1-10
	Agrtra	1-10	1-10	10-25	10-25	1-10
	Oryhym	0-1	0-1	0-1	1-10	0-1
	Sticom		0-1		1-10	
	Bougra	0-1	1-10	0-1	0-1	
	Medsat	1-10	1-10	0-1	10-25	1-10
	Ratcol	0-1	0-1	0-1	1-10	0-1
	Cerlan	0-1	1-10	0-1	0-1	0-1
	Atrcan	0-1	0-1	0-1	1-10	0-1
	Opupol	0-1	0-1	0-1	0-1	0-1

and moisture averages for June and July were reversed, which resulted in reduced growth of cool season grasses and a greater abundance of warm season grasses. During 1993, higher amounts of moisture were noted in the earlier part of the growing season, which resulted in increased cool season grass and perennial forb growth for that year.

Species diversity within reclaimed areas generally reflect the seed mix used in revegetation practices specific to the different mines and to age of

reclamation. This was especially apparent in older reclaimed areas, i.e., greater than 5 years old at the time of sampling, which generally reflect less diverse seed mixes or a lack of innovative reclamation practices such as dual seeding of cool season grasses separate from shrubs and warm season grasses (Table 2). For example, at the Black Thunder Mine, the number of species encountered in one sampling period ranged from approximately 10 in older seeded areas to approximately 30 in newer seeded areas.

Table 3. Comparison of Big Sagebrush Grasslands at Black Thunder and Coal Creek Mines. Note: no cover estimates were done in 1991 at the Black Thunder Mine.

Mine	Vegetation Species	1991	Early 1992	Late 1992	Early 1993	Late 1993
----- % Vegetation Cover -----						
Black Thunder NATIVE	Agrsmi		0-1	1-10	1-10	0-1
	Carste		1-10		0-1	0-1
	Koemac		0-1	0-1	1-10	1-10
	Stivir		0-1	1-10	1-10	1-10
	Bougra		0-1	1-10	1-10	1-10
	Gaucoc		1-10	0-1	1-10	0-1
	Vicame		0-1	0-1	1-10	0-1
	Arttri		1-10	1-10	10-25	1-10
Coal Creek NATIVE	Agrdas	1-10	1-10	1-10	1-10	0-1
	Agrsmi		1-10	0-1	0-1	0-1
	Carfil		0-1	0-1	0-1	
	Koemac	1-10	1-10	1-10	1-10	0-1
	Stivir	1-10	1-10	1-10	1-10	1-10
	Bougra			0-1	0-1	0-1
	Oxylam	1-10	1-10	0-1	1-10	0-1
	Artfri		1-10	1-10	1-10	0-1
Arttri	1-10	1-10	1-10	1-10	1-10	

The two mines sampled in this study varied greatly in their overall plant species composition. Soils at the Black Thunder Mine tend to be sandier; historically high grazing pressure has resulted in an increase in pricklypear cactus and warm season grasses. Soils at the Coal Creek Mine are heavier, i.e., clayier; grazing pressure at Coal Creek has favored increased sagebrush cover. Table 3 is a comparison of the plots, one at each mine, that were located in the same native vegetation type, i.e., Big

Sagebrush Grassland.

Plant cover percentages varied both between years and seasons. Cool season grass cover declined from the early to late sampling periods while warm season grass cover increased. Overall, annual forb and annual grass cover declined also over that same time interval, although this was species specific, especially with forbs. Perennial forb cover also generally declined over a season due to reduced leaf area.

Yearly variations were primarily due to differences in amount and timing of precipitation. Differences in later growth season precipitation such as found in 1992 was due not only to regional weather patterns but to thunderstorm placement as well. This could create large differences between the two mines, even though they are only approximately 20 miles apart. Weather within the Powder River Basin during 1991 was unusually cool and wet during April and May and extended to the end of June. During 1992, April and May were above normal for temperature and provided little or no precipitation while June and July were below normal for temperature and above average for precipitation. In many respects, the spring and summer sampling periods were practically reversed during 1992 despite the calendar months.

Overall plant species observed for each mine, type, and sampling period are found in Table 4. Some of the differences described above are evident in this table. For example, the following observations are based on the number of species encountered (not cover percentages). More cool season grasses and warm season grasses were observed in Coal Creek reclaimed than Coal Creek native sites. Annual forbs were limited in Coal Creek native, while annual grasses were more numerous in Coal Creek native versus reclaimed sites. The diversity of perennial forbs and half shrubs is higher on the Coal Creek native sites. Full shrubs were also more dominant on Coal Creek native lands.

At the Black Thunder Mine the diversity in cool season grasses and annual forbs between native and reclaimed areas was mixed; however, diversity of warm season grasses increased on Black Thunder reclaimed sites. Annual grasses were slightly more predominant on Black Thunder reclaimed sites. The number of perennial

forbs encountered increased on native sites with time. With the exception of broom snakeweed, half shrubs were generally equal between Black Thunder native and reclaimed sites; however, full shrubs increased on Black Thunder reclaimed sites.

Discussion

The previously described results indicate the importance of seasonality on collecting vegetation data within a given year and overall weather conditions between years. It is extremely important to note weather patterns, especially temperature and monthly precipitation amounts and distribution. This is true, not only in sampling for selenium content of vegetation, but also for overall species diversity and composition.

In addition to the selenium information derived from this project, some useful trend information was documented. Trend information is highly useful to mining personnel and regulators who ultimately must decide on bond release criteria. Longterm vegetation composition data, for three or more consecutive years (as was done in this project) or for three years spread over a ten year bonding period, is extremely important in indicating overall vegetation patterns. Successes and failures can be documented and management strategies adjusted accordingly.

Acknowledgement

This work was supported in part by the Abandoned Coal Mine Lands Research Program at the University of Wyoming. This support was administered by the Land Quality Division of the Wyoming Department of Environmental Quality from funds returned to Wyoming from the Office of Surface Mining of the U.S. Department of the Interior.

Table 4. Plant species observed on native and reclaimed areas at Coal Creek and Black Thunder Mines during 1991 to 1993. Note: 1991 Black Thunder data based on selenium sampling, not cover estimates, which were done in 1992 and 1993.

Code	Scientific Name	Common Name	Coal Creek Native					Coal Creek Reclaimed					Black Thunder Native					Black Thunder Reclaimed				
			1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993
Cool Season Grasses																						
Agrcri	<i>Agropyron cristatum</i>	Crested Wheatgrass					X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Agrdas	<i>Agropyron dasystachyum</i>	Thickspike Wheatgrass	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Agrine	<i>Agropyron inerme</i>	Beardless Wheatgrass	X					X	X	X									X	X		X
Agrint	<i>Agropyron intermedium</i>	Intermediate Wheatgrass						X		X	X											
Agrsmi	<i>Agropyron smithii</i>	Western Wheatgrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Agrspi	<i>Agropyron spicatum</i>	Bluebunch Wheatgrass	X	X	X	X	X		X	X	X	X							X	X	X	X
Agrtra	<i>Agropyron trachycaulum</i>	Slender Wheatgrass	X					X	X	X	X	X							X	X	X	X
Agrtri	<i>Agropyron trichophorum</i>	Pubescent Wheatgrass																	X	X	X	
Broine	<i>Bromus inermis</i>	Smooth Brome						X	X	X	X	X							X	X	X	X
Carfil	<i>Carex filifolia</i>	Threadleaf Sedge	X	X	X	X	X							X	X	X	X					
Carste	<i>Carex stenophylla</i>	Elk Sedge	X	X	X	X								X	X	X	X					
Disspi	<i>Distichlis spicata</i>	Inland Saltgrass	X	X	X	X	X									X	X					
Elycin	<i>Elymus cinearum</i>	Basin Wildrye	X						X	X	X											
Horjub	<i>Hordeum jubatum</i>	Foxtail Barley	X					X											X	X		
Koemac	<i>Koeleria macrantha</i>	Prairie Junegrass	X	X	X	X	X	X	X	X	X		X	X	X	X			X		X	
Oryhym	<i>Oryzopsis hymenoides</i>	Indian Ricegrass	X	X	X	X	X	X	X	X	X		X	X		X			X	X	X	X
Poaamp	<i>Poa ampla</i>	Big Bluegrass	X	X	X	X	X	X	X	X	X		X			X						
Poacan	<i>Poa canbyi</i>	Canby Bluegrass	X	X	X	X							X	X	X	X					X	X
Poacus	<i>Poa cusickii</i>	Cusick Bluegrass						X	X		X		X									
Poafen	<i>Poa fendleriana</i>	Fendler Bluegrass											X		X	X						
Poajun	<i>Poa juncifolia</i>	Alkali Bluegrass	X	X	X	X																
Poapra	<i>Poa pratensis</i>	Kentucky Bluegrass	X		X	X		X					X			X						
Poasan	<i>Poa sandbergii</i>	Sandberg Bluegrass	X	X	X	X							X	X	X	X			X		X	
Poasp	<i>Poa sp.</i>	Bluegrass				X		X			X	X	X	X	X	X				X		
Schpan	<i>Schedonnardus paniculatus</i>	Tumblegrass												X	X	X						
Sticom	<i>Stipa comata</i>	Needle and Thread	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X
Stivir	<i>Stipa viridula</i>	Green Needlegrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X

Table 4. Continued

Code	Scientific Name	Common Name	Coal Creek Native					Coal Creek Reclaimed					Black Thunder Native					Black Thunder Reclaimed				
			1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993
Warm Season Grasses																						
Andsco	<i>Andropogon scoparius</i>	Little Bluestem						X			X				X			X	X	X	X	X
Boucur	<i>Bouteloua curtipendula</i>	Sideoats Grama						X	X	X	X	X						X		X		X
Bougra	<i>Bouteloua gracilis</i>	Blue Grama	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X
Callon	<i>Calamovilfa longifolia</i>	Prairie Sandreed						X									X	X	X	X	X	X
Spoair	<i>Sporobolus airoides</i>	Alkali Sacaton													X	X	X			X		
Spocry	<i>Sporobolus cryptandrus</i>	Sand Dropseed												X			X	X	X	X	X	X
Annual Grasses																						
Brojap	<i>Bromus japonicus</i>	Japanese Brome	X	X	X	X	X	X		X	X				X	X	X	X	X	X	X	X
Brotec	<i>Bromus tectorum</i>	Cheatgrass Brome	X	X	X	X		X				X		X	X	X	X	X	X	X	X	X
Fescot	<i>Festuca occidentalis</i>	Sixweeks Fescue	X		X	X										X	X	X				
Triaes	<i>Triticum aestivum</i>	Cultivated Wheat						X	X	X	X							X	X		X	
Annual Forbs																						
Alydes	<i>Alyssum desertorum</i>	Desert Alyssum	X					X			X						X	X				
Alyaly	<i>Alyssum alyssoides</i>	Pale Alyssum						X		X	X				X	X	X				X	X
Alyspp	<i>Alyssum spp.</i>	Alyssum						X	X										X			
Cammic	<i>Camelina microcarpa</i>	Littleseed Falseflax	X			X	X	X		X	X	X		X	X	X	X	X	X	X	X	X
Chealb	<i>Chenopodium album</i>	Lambsquarters						X	X	X	X			X			X		X	X	X	X
Chelep	<i>Chenopodium leptophyllum</i>	Chenopodium												X			X		X			
Chensp.	<i>Chenopodium sp.</i>	Chenopodium						X							X			X		X	X	
Cirsium	<i>Cirsium sp.</i>	Thistle					X							X	X							
Cirvul	<i>Cirsium vulgare</i>	Bull Thistle	X			X								X	X	X	X					
Despin	<i>Descurainia pinnata</i>	Pinnate Tansymustard						X	X	X	X	X		X		X	X	X	X	X	X	
Dessop	<i>Descurainia sophia</i>	Tansymustard	X																X		X	X
Gnapal	<i>Gnaphalium palustre</i>	Cudweed												X		X	X					

Table 4. Continued

Code	Scientific Name	Common Name	Coal Creek Native					Coal Creek Reclaimed					Black Thunder Native					Black Thunder Reclaimed				
			1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993
Lupinus	Lupinus sp.	Lupine												X	X	X	X					
Lyggjun	Lygodesmia juncea	Skeletonweed												X	X	X	X					
Macgri	Macaeranthera grindelioides	Machaeranthera												X		X	X					
Medsat	Medicago sativa	Alfalfa				X	X	X	X	X	X	X						X	X	X	X	X
Musdiv	Musineon divaricatum	Biscuitroot	X	X	X	X										X	X	X				
Oencae	Oenothera caespitosa	Primrose	X	X	X	X															X	
Oenosp.	Oenothera sp.	Primrose												X		X	X					
Onovic	Onobrychis viciifolia	Sanfoin						X	X	X	X	X						X	X	X	X	X
Oxylam	Oxytropis lambertii	Lambert Locoweed		X	X	X	X										X					
Oxytropis	Oxytropis sp.	Locoweed												X		X	X					
Penalb	Penstemon albus	White Beardtongue		X	X	X									X	X	X		X		X	
Peneri	Penstemon eriantherus	Beardtongue		X	X	X					X			X	X	X	X					
Petsp	Petalostemon sp.	Petalostemon												X	X		X					
Phlhoo	Phlox hoodii	Hood's Phlox	X	X	X	X	X							X	X	X	X					
Picopp	Picrodeniopsis oppositifolia	Picrodeniopsis	X	X	X	X	X	X	X	X	X	X		X	X	X	X					
Psoarg	Psoralea argophylla	Silverleaf Scurfpea				X								X	X	X	X					
Psoralea	Psoralea sp.	Scurfpea														X	X		X			
Psoesc	Psoralea esculenta	Indian Beardroot	X	X	X																	
Ratcol	Ratibida columnifera	Prairie Coneflower						X		X	X	X						X	X	X	X	X
Sencan	Senecio canus	Senecio	X	X	X	X																
Solmis	Solidago missouriensis	Prairie Goldenrod	X	X	X	X																
Sphcoc	Sphaeralcea coccinea	Scarlet Globemallow	X	X	X	X	X						X	X	X	X	X	X	X		X	
Taroff	Taraxacum officinale	Dandelion	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X
Therho	Thermopsis rhombifolia	Yellow Pea	X	X	X	X								X	X	X	X				X	X
Tradub	Tragapogon dubius	Yellow Salsify	X	X	X	X	X	X				X		X	X		X	X	X	X	X	X

Table 4. Continued

Code	Scientific Name	Common Name	Coal Creek Native					Coal Creek Reclaimed					Black Thunder Native					Black Thunder Reclaimed				
			1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993	1991	Early 1992	Late 1992	Early 1993	Late 1993
Trirep	<i>Trifolium repens</i>	Clover						X	X	X	X											
Vicame	<i>Vicia americana</i>	American Vetch	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	
Half Shrub																						
Artfri	<i>Artemisia frigida</i>	Fringed Sagewort	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Atrgar	<i>Atriplex gardneri</i>	Gardner's Saltbush	X	X	X	X	X				X			X	X	X	X	X	X	X	X	X
Cerlan	<i>Ceratoides lanata</i>	Winterfat												X			X	X	X	X	X	X
Gutsar	<i>Gutierrezia sarothrae</i>	Broom Snakeweed	X	X	X	X	X	X		X	X	X		X	X	X	X					
Xylgla	<i>Xylorrhiza glabriuscula</i>		X	X	X	X	X															
Full Shrub																						
Arttri	<i>Artemisia tridentata</i>	Big Sagebrush	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Artcan	<i>Artemisia cana</i>	Silver Sagebrush	X	X		X	X											X	X	X	X	X
Atrcan	<i>Atriplex canescens</i>	Fourwing Saltbush	X		X	X	X	X	X	X	X							X	X	X	X	X
Chrnau	<i>Chrysothamnus nauseosus</i>	Rubber Rabbitbrush									X							X	X	X	X	X
Roswoo	<i>Rosa woodsii</i>	Wood's Rose		X	X	X												X				
Symocc	<i>Symphoricarpos occidentalis</i>	Western Snowberry												X	X							
Succulent																						
Opupol	<i>Opuntia polyacantha</i>	Plains Pricklypear	X	X	X	X	X	X	X		X			X	X	X	X	X	X	X	X	X