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**1996 MONITORING
REPORT FOR THE
GUNNISON, COLORADO,
WETLANDS MITIGATION PLAN**

December 1996

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**1996 MONITORING REPORT FOR THE GUNNISON, COLORADO,
WETLANDS MITIGATION PLAN**

December 1996

**Prepared for
U.S. Department of Energy
Environmental Restoration Division
UMTRA Project Team
Albuquerque, New Mexico**

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LIST OF ACRONYMS AND ABBREVIATIONS

<u>Acronym/Abbreviation</u>	<u>Definition</u>
ac	acre(s)
BLM	U.S. Bureau of Land Management
cm	centimeter
CSU	Colorado State University
DOE	U.S. Department of Energy
ft	foot(feet)
ha	hectare(s)
in.	inch(es)
m	meter(s)
SPI	Standard Precipitation Index
UMTRA	Uranium Mill Tailings Remedial Action
USACE	U.S. Army Corps of Engineers

CHANGE HISTORY

Document version	Date	Pages/comments
Rev. 0, Ver. 1	06/15/95	Initial version.

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) administers the Uranium Mill Tailings Remedial Action (UMTRA) Project to clean up uranium mill tailings and other surface contamination at 24 abandoned uranium mill sites in 10 states. One of these abandoned mill sites was near the town of Gunnison, Colorado. Surface remediation and the environmental impacts of remedial action are described in the Gunnison environmental assessment (DOE, 1992); surface remediation was completed at the Gunnison site in December 1995. Remedial action resulted in the elimination of 4.3 acres (ac) (1.7 hectares [ha]) of wetlands and mitigation of this loss is through the enhancement of 17.8 ac (7.2 ha) of riparian plant communities in six spring-fed areas on U.S. Bureau of Land Management (BLM) land (mitigation sites) (Figure 1.1). The description of the impacted and mitigation wetlands is provided in the *Mitigation And Monitoring Plan for Impacted Wetlands at the Gunnison UMTRA Project Site, Gunnison, Colorado* (DOE, 1994).

The six mitigation sites were fenced in the fall of 1993 to exclude livestock grazing. Prior to fencing, baseline grazed conditions at the riparian plant communities were measured during the summer of 1993 (DOE, 1994). A five-year monitoring program was then implemented to document the response of vegetation and wildlife to the exclusion of livestock. Results for the first two years of monitoring appear in the 1994 and 1995 monitoring report (DOE, 1996). This report provides the results of the third year of the monitoring program.

Figure 1.1 Location of six wetland mitigation sites in Gunnison and Saguache Counties, Colorado

2.0 METHODS AND STUDY SITES

The boundaries of the U.S. Army Corps of Engineers (USACE) jurisdictional wetlands and other plant communities were determined in 1993 (DOE, 1994). At that time, it was predicted that the wetlands would likely expand as a result of excluding cattle. The USACE wetlands were remapped in 1996 and the *Corps of Engineers Wetlands Delineation Manual* (USACE, 1987) (the Federal Manual) was used to determine the wetlands boundaries. According to the Federal Manual, an area must meet the hydrophytic vegetation, hydric soils, and wetland hydrology criteria before it can be considered a USACE wetland. The delineation of wetlands at sites with no clear boundary was accomplished by digging holes and using the Federal Manual to determine the wetland boundary. See the Mitigation And Monitoring Plan (DOE, 1994) for more details regarding the methods used.

Quantitative vegetation sampling was conducted at the mitigation sites in August 1996 (TAC, 1996a). Data was collected using the Daubenmire Method (Daubenmire, 1959) as described in Rangeland Monitoring Trend Studies (BLM, 1985). A detailed description of these methods is in the Mitigation and Monitoring Plan (DOE, 1994). Plant species identification was based on Barrell (1969), Cronquist et al. (1972), Harrington (1954), and Weber (1987).

Wildlife surveys at the mitigation sites were conducted in June 1996 (TAC, 1996b) and consisted of traversing the sites and recording all wildlife. At least one early morning survey was conducted at each site. In addition, all wildlife observed during other site visits were recorded (TAC, 1996a, c).

3.0 RESULTS

This section describes the moisture conditions at the mitigation sites in 1996 and the results of the wildlife surveys, wetlands delineations, and vegetation sampling. It also compares the 1996 results to grazed conditions in 1993 (DOE, 1994) and to the monitoring data collected in 1994 and 1995 (DOE, 1996).

3.1 MOISTURE CONDITIONS

The first two years of this study (1993 and 1994) took place during drought conditions which represented a continuation of a five-year drought in the Gunnison Basin (Hays, A.; 1996). The Palmer Drought Index for 1988 through 1994 showed mild to extreme drought conditions existed (CSU, 1995). It has been observed that prolonged drought can result in reduced flow from springs. For example, extreme drought conditions occurred during 1990 and springs, which had produced water for at last 20 years (Hays, A.; 1996), dried up. During the first year of this study (1993), mild drought conditions occurred; 1994 had moderate to severe drought conditions. The mitigation sites were noticeably drier in 1994 than 1993; this may have been the result of these drought conditions.

In 1995, the seven-year drought ended and precipitation was above average (Hays, A.; 1996). The response of the vegetation at the six mitigation sites was dramatic (DOE, 1996). Although there was adequate moisture in the winter and spring of 1996, the drought returned during the summer of 1996 and conditions were very dry. The Palmer Drought Index has been replaced by the Standard Precipitation Index (SPI). The SPI for June, July, and August 1996 for the Gunnison area was -1.27, indicative of moderate drought conditions (CSU, 1996). The BLM collects soil moisture data from an upland location near the Prospector Spring site. In early June 1996, the percent available moisture at a 0- to 3-inch (in.) (0 to 8-centimeter [cm]) depth was 50 to 75 percent, while at greater depths the soil was at or near field capacity. The soil dried out and by August 1, 1996, was at 0- to 25-percent available moisture to a depth of 16 in. (41 cm) (Hays, S.; 1996).

Prospector Spring

Moisture conditions were good at the Prospector Spring site in late April 1996 (TAC, 1996c). There was water in the stock pond at the south end, and standing water along part of transect 1, all of transect 2, and in the stream at the north end of the site. In addition, the soil was damp on the surface up to the estimated maximum wetland boundary (Figure 3.1) (TAC, 1996c). Moisture conditions in late May 1996 were similar, with water along transect 2 and the drainage at the north end of the site. Surface soils were damp above the 1993 wetlands boundary (Figure 3.1) (TAC, 1996b). By August 1996, the site had dried out and the only area of standing water was in the sedge plant community (Figure 3.1) (TAC, 1996a).

Houston Gulch

As part of the wetlands mitigation at the Houston Gulch site, a stock tank was constructed outside the fenced area and the overflow entered the site via a pipe. Water was flowing over the side of the tank in early May 1996, and some water was also

**Figure 3.1 Riparian plant communities at Prospector Spring, Gunnison County,
Colorado**

**Figure 3.1 Riparian plant communities at Prospector Spring, Gunnison County,
Colorado (Concluded)**

flowing into the site (TAC, 1996c). During the June and August 1996 site visits, water was entering the site as designed (TAC, 1996a,b).

Moisture conditions at this site were good during the spring of 1996. Water was flowing into the site and there was no sign of grazing within the exclosure. There was standing water in the sedge plant community, all of transect 3, and along most of the stream that drains the site (TAC, 1996b, c). In August 1996, water was still flowing into the site from the stock tank and the lower part of transect 3 had some standing water. Transect 2 was dry although the vegetation was still green. Transect 1 was very dry and much of the vegetation was dead; the results of the summer drought were very apparent along this transect (Figure 3.2).

Upper Longs Gulch

In late April and May 1996, standing water was observed in the sedge wetland plant communities and in the drainage in the area of transect 2 (Figure 3.3) (TAC, 1996b, c). Also, in late April 1996, damp soil was observed in the remaining riparian zone and into the surrounding sagebrush plant community; surface soil was damp in much of the riparian plant communities in late May 1996. By August 1996, the soil was dry except for the sedge wetland plant communities. Conditions in the upper riparian grassland plant community in August were very dry and most of the vegetation had died and turned brown (TAC, 1996a).

Lower Longs Gulch

During all three site visits to the Lower Longs Gulch site, there was a good flow of water entering the site from a stock tank. This water flowed through most of the stand of willows but did not reach the riparian grassland plant community below the willows (Figure 3.4) (TAC, 1996a, b, c). This riparian grassland has been dry since the site was fenced and the stock tank was moved south of the site, and has been remapped as the upper riparian grassland plant community. During the August 1996 site visit, the willows at the eastern end of the site were losing their leaves early and may not be receiving enough water. The willows west of where the overflow pipe enters the site were also apparently suffering from a lack of water (Figure 3.4).

Sage Hen Spring

The flow of water into the Sage Hen Spring site was normal in late April 1996 but the outflow pipe was partially clogged in late May 1996 (TAC, 1996b, c); the pipe was unclogged and flow into the site returned to normal. Flow into the site was normal in August 1996 (TAC, 1996a). As in 1994 and 1995, there was no water in the transect 3 area; this site has been dry for the last three years and has been designated as an upper riparian grassland plant community (Figure 3.5). During the August 1996 site visit, the upper riparian plant community was very dry and the vegetation had died and turned brown.

Camp Kettle Spring

Observations in late April 1996 showed standing water in the sedge plant community and in the drainage to the west including the transect 3 area (Figure 3.6). In addition, soil was wet on the surface in the lower riparian plant community (TAC, 1996c).

Figure 3.2 Riparian plant communities at Houston Gulch, Gunnison County, Colorado

**Figure 3.3 Riparian plant community types in Upper Longs Gulch Spring,
Saguache County, Colorado**

**Figure 3.4 Riparian plant communities in Lower Longs Gulch Spring,
Saguache County, Colorado**

FIGURE 3.5
RIPARIAN PLANT COMMUNITIES IN SAGE HEN SPRING
SAGUACHE COUNTY, COLORADO

**Figure 3.5 Riparian plant communities in Sage Hen Spring, Saguache County,
Colorado**

**Figure 3.6 Riparian plant communities at Camp Kettle Spring, Saguache
County, Colorado**

Moisture conditions were similar in late May 1996 except that soil moisture in the lower riparian plant community was reduced. By August 1996, standing water was still in the sedge plant community, but most of the drainage and the rest of the site was dry.

3.2 TERRESTRIAL WILDLIFE OBSERVATIONS

Wildlife observations were made during the three site visits in 1996 (TAC, 1996a, b, c). The bulk of these observations occurred during the late May 1996 visit when early morning observations for breeding birds took place (TAC, 1996b).

Prospector Spring

Surveys of breeding birds in 1996 indicated that the mountain bluebird, western meadowlark, northern mockingbird, green-tailed towhee, sage thrasher, Brewer's sparrow, grasshopper sparrow, and vesper sparrow may nest in or near this site (Table 3.1). Six western meadowlarks and one grasshopper sparrow were singing from the riparian zone on-site, one American robin was feeding in the area, and the other species were in the sagebrush plant community near the site. The American crow, Brewers blackbirds, and northern rough-winged swallow flew over the site but probably do not nest in the site area. The grasshopper sparrow, Brewers blackbird, and northern rough-winged swallow are new species recorded from the mitigation sites (TAC, 1996b).

During August 1996, three sage grouse were flushed from the willows in the small enclosure just south of the Prospector Spring site. As these birds flushed, a golden eagle appeared and remained stationary over the site for a short period. One loggerhead shrike was observed at this same location on August 12, 1996, and two more were seen within the Prospector Spring site on August 13, 1996. One was perched on the vegetation in the sedge plant community and was apparently catching insects from this perch. The loggerhead shrike is a Federal candidate species and this is the first observation at any of the mitigation sites. This species was not observed in June 1996 so the shrikes observed in August 1996 likely do not nest in the area but were migrants or post-breeding dispersal. The common snipe was observed in the wet area below the outflow pipe; this is the first observation of this species at any of the mitigation sites (TAC, 1996a).

During August 1996, up to seven pronghorn antelope were observed on three occasions within the Prospector Spring site. Trails and droppings were also observed on-site and it appears that the pronghorn antelope is using the Prospector Spring site on a consistent basis. Other mammals observed include a porcupine in the willows in the small enclosure south of the site, and extensive ground squirrel activity in the upper riparian grassland plant community on-site. Garter snakes were observed during late May and August 1996.

Houston Gulch

Nine species of birds were recorded at Houston Gulch in 1996 (Table 3.1). The western meadowlark was recorded for the first time from the riparian plant communities on-site. Species that nested in the surrounding sagebrush were the sage thrasher,

Table 3.1 Birds observed at or near the six mitigation wetlands sites, during the nesting season (except where otherwise noted), Gunnison and Saguache Counties, Colorado

[illegible]

Table 3.1 Birds observed at or near the six mitigation wetlands' sites, during the nesting season (except where otherwise noted), Gunnison and Saguache Counties, Colorado

Table 3.1 Birds observed at or near the six mitigation wetlands sites, during the nesting season (except where otherwise noted), Gunnison and Saguache Counties, Colorado (Concluded)

Species	Mitigation site																	
	Prospector Spring			Houston Gulch			Upper Longs Gulch			Lower Longs Gulch			Sage Hen Spring			Camp Kettle Spring		
	1994	1995	1996	1994	1995	1996	1994	1995	1996	1994	1995	1996	1994	1995	1996	1994	1995	1996
Western meadowlark	2	3	6			1										1		
Brewers blackbird			2															
Red-winged blackbird														1				
Brown-headed cowbird								3			2			1				
Black-headed grosbeak									1									
Pine siskin								8			3							
Cassin's finch								1			5							
Lark bunting						6 ^a												

^aObserved in August.

^bSage grouse sign observed only.

^cFeathers and nest observed.

**Table 3.1 Birds observed at or near the six mitigation wetlands sites, during the nesting season (except where otherwise noted), Gunnison and Saguache Counties, Colorado
(Concluded)**

northern mockingbird, green-tailed towhee, and Brewers sparrow. The mountain bluebird was observed on-site and may nest in the nearby conifers (TAC, 1996b).

During August 1996, the following species were flushed from the site; sage thrasher, northern mockingbird, lark bunting, vesper sparrow, lark sparrow, and Brewers sparrow. The lark bunting and lark sparrow are new species. The sites are within the nesting range of the lark sparrow but not the lark bunting. It is assumed that the lark buntings were early migrants. One loggerhead shrike was observed in August 1996 but, as with the Prospector Spring site, it probably does not nest there (TAC, 1996). Numerous ground squirrel diggings were seen in the upper riparian grassland plant community.

Upper Longs Gulch

Twelve species of birds were recorded at Upper Longs Gulch in 1996 (Table 3.1). The broad-tailed hummingbird, northern flicker, black-billed magpie, mountain bluebird, and American robin likely nest on-site because the willows provide nesting habitat. The sage grouse, sage thrasher, northern mockingbird, green-tailed towhee, vesper sparrow, and Brewers sparrow nest in the surrounding sagebrush. However, these species, including sage grouse with their broods, forage in riparian plant communities.

Two pronghorn antelope were observed in the site area in late May 1996; one of these animals remained on the east-facing slope near the site and periodically gave a snorting sound. A coyote was heard howling near the site on May 30, 1996 (TAC, 1996b)

Lower Longs Gulch

Fourteen species of birds were observed at the Lower Longs Gulch site in 1996 (Table 3.1). The yellow warbler, white-crowned sparrow, and western tanager were recorded for the first time and are assumed to be late migrants. One short-eared owl was flushed from the willows and is another new species. Two were observed at this site in early July by Ken Heil of Ecosphere Environmental Services (TAC, 1996c). The short-eared owl may have nested at the Lower Longs site in 1996. The broad-tailed hummingbird, northern flicker, and American robin were observed in the willows for the third year and are considered nesting species. The mourning dove, mountain bluebird, and black-billed magpie may also nest at this site. Nesting species recorded from the nearby sagebrush were the sage thrasher, green-tailed towhee, vesper sparrow, and Brewers sparrow.

Sage Hen Spring

Nine species of birds were observed at or near the Sage Hen Spring site in 1996 (Table 3.1). The broad-tailed hummingbird was recorded for the third year in a row from willows on-site. The mourning dove, northern flicker, black-billed magpie, and mountain bluebird may nest on-site or, along with the mountain chickadee, nest in the conifer woods above the site. Nesting birds recorded from the sagebrush habitat were the northern mockingbird, green-tailed towhee, and Brewers sparrow.

A herd of 26 mule deer were observed near the site on April 30, 1996 (TAC, 1996c). In addition, deer and elk droppings were very common in the riparian plant communities at this site. Ground squirrel digging were common in the upper riparian plant community.

Camp Kettle Spring

Eleven species of birds were observed at the Camp Kettle site in 1996 (Table 3.1). The mourning dove, northern flicker, mountain bluebird, and American robin were observed on-site; these species likely nest in the nearby conifers because appropriate nesting habitat is lacking on-site. Nesting species recorded from the sagebrush habitat were the northern mockingbird, green-tailed towhee, vesper sparrow, and Brewers sparrow. The violet-green swallow and cliff swallow were observed flying overhead and it is assumed that these two species use the site area for foraging.

Elk droppings were very common, especially in the lower riparian plant community (TAC, 1996c). As with most of the other sites, ground squirrel diggings were common in the upper riparian grassland plant community.

3.3 WETLANDS DELINEATION

The plant communities at the mitigation sites were mapped in 1993 which represents grazed conditions (DOE, 1994). Three wetland and one upper riparian plant communities were mapped; wetlands boundaries were determined from the Federal Manual as described in section 2.0. There were 8.8 ac (3.6 ha) of wetlands and 9.6 ac (3.9 ha) of upper riparian grassland habitat at the six sites in 1993. The boundaries of the USACE wetlands were redelineated in 1996. It was determined that the 1.5 ac (0.6 ha) of lower riparian grassland plant community reported for Camp Kettle Spring in 1993 was wrong and the total should have been 0.7 ac (0.3 ha). The changes in the riparian plant communities are reported for each site below.

Prospector Spring

The number of acres of riparian plant communities at Prospector Spring remained at 8.7 ac (3.5 ha) in 1996 (Table 3.2). During this investigation, holes were dug in four locations during the mapping process (TAC, 1996a) and the area of the USACE wetlands was expanded. Water was encountered at a depth of 8 to 20 in. (20 to 51 cm) in most of the holes in the expanded wetlands. The vegetation in the expanded wetlands was lush and green which indicated that these plants were rooted in ground water. The size of the USACE wetlands increased approximately 50 percent to 5.4 ac (2.2 ha) (Figure 3.1, Table 3.2). This increase took place in the lower riparian grassland type; the size of the sedge wetlands remained approximately the same.

Houston Gulch

There are 3.8 ac (1.5 ha) of riparian plant communities at the Houston Gulch site (Table 3.2). Holes were dug on the south side of the site and it was determined that the USACE wetlands had increased by 0.2 ac (0.1 ha) (Figure 3.2) over 1993. In addition, expansion of the upper riparian grassland by 0.1 ac (<0.1 ha) was noted on the north side of the site.

Upper Longs Gulch

There are 1.7 ac (0.7 ha) of riparian plant communities at the Upper Longs Gulch site (Table 3.2). Holes were dug near the sedge wetland at the north end of the site as well

Table 3.2 **Number of acres (hectares in parenthesis) of wetland and upper riparian plant communities at six wetlands mitigation sites in 1996 in Gunnison and Saguache Counties, Colorado**

Mitigation site	Plant community types					
	Wetland				Nonwetland	
	Lower riparian grassland	Sedge	Willow	Total	Upper riparian grassland	Total
Prospector Spring	4.8 (1.9)	0.6 (0.2)	--	5.4 (2.2)	3.3 (1.3)	8.7 (3.5)
Houston Gulch	2.0 (0.8)	0.3 (0.1)	--	2.3 (.09)	1.5 (0.6)	3.8 (1.5)
Upper Longs Gulch	0.6 (0.2)	0.2 (0.1)	0.1 <0.1	0.9 (0.4)	0.8 (0.3)	1.7 (0.7)
Lower Longs Gulch	0.1 (<0.1)	--	0.2 (0.1)	0.3 (0.1)	0.2 (0.1)	0.5 (0.2)
Sage Hen Spring	0.1 (<0.1)	0.1 (<0.1)	0.1 (<0.1)	0.3 (0.1)	0.7 (0.3)	1.0 (0.4)
Camp Kettle Spring	0.7 (0.3)	0.4 (0.2)	--	1.1 (0.5)	1.0 (0.4)	2.1 (0.9)
Total	8.3 (3.4)	1.6 (0.6)	0.4 (0.2)	10.3 (4.2)	7.5 (3.0)	17.8 (7.2)

Note: Dash indicates this plant community type does not occur at this site.

as at the south end of the site; a 29-percent increase (0.2 ac [0.1 ha]) in the USACE wetlands was documented (Table 3.2 and Figure 3.3). Numerous willow seedlings were observed in the sedge wetland plant community at the south end of the site.

Lower Longs Gulch

A reduction in the size of the USACE wetlands was observed at the Lower Longs Gulch site. In 1993, the lower riparian grassland occurred at the east and west end of the site (Figure 3.4). The transect was established in this plant community at the east end in 1993; standing water occurred in this area and the vegetation was a dark green. In 1994, the stock tank was moved south of the site and the overflow reentered the wetland about 100 feet (ft) (30 meters [m]) east of the spring (Figure 3.4). Subsequently, the willow and lower riparian plant communities between the spring and the new outlet began to dry out. In addition, the lower riparian grassland plant community in the area the transect also dried out and was very dry during vegetation sampling from 1994 through 1996. These two areas are no longer considered USACE wetlands because of the lack of water and are now mapped as upper riparian grassland plant communities (Figure 3.4). In addition, the willows at the east end of the site were showing signs of stress in 1996. There was an estimated 0.3 ac (0.1 ha) of USACE wetlands at this site in 1996 (Table 3.2) which is a decrease of 0.1 ac (<0.1 ha) from previous years.

Sage Hen Spring

A reduction of 0.1 ac (<0.1 ha) in USACE wetlands was also observed at the Sage Hen Spring site in 1996. This reduction took place along the drainage at the north end of the site (location of transect 3) which, in 1993, had been mapped as lower riparian grassland plant community because standing water and/or wet soils were observed (Figure 3.5). During the three year monitoring period, this area became dryer and, during the drought of 1996, all vegetation had died and turned brown (see Photographic Series 1 and 2 in Appendix B). The only enhancement feature at this site was the construction of a fence in 1993; the stock tank and spring development remained as it had been. The reason for the reduced water flow into this area is not clear although the long-term drought may have contributed to reduced flow. The return of normal precipitation patterns may result in increased flow into the area. However, given the lack of water, this area has been redesignated as upper riparian grassland plant community.

Camp Kettle Spring

There are 2.1 ac (0.9 ha) of riparian plant communities at the Camp Kettle Spring site (Table 3.2). Comparing 1993 with 1996, the number of ac of lower riparian grassland plant community remained the same (0.7 ac (0.3 ha)), the sedge wetlands increased from 0.2 ac (0.1 ha) to 0.4 ac (0.2 ha), and the upper riparian grassland plant community decreased from 1.2 ac (0.5 ha) to 1.0 ac (0.4 ha). This represents a 22-percent increase in USACE wetlands.

3.4 VEGETATION ANALYSIS

As indicated in the Mitigation and Monitoring Plan (DOE, 1994), the DOE is conducting a monitoring program to quantitatively document the enhancement in vegetation structure that is taking place after the exclusion of livestock from the six mitigation sites. In that report, it was predicted that there would be an increase in plant height, a decrease in percent bare ground, a change in plant species composition, and an increase in willows at the sites which contain willows. Performance criteria were established for plant height (12 in. [30 cm] or greater) and bare ground (15 percent bare ground or less). The monitoring program will last up to five years and if the sites meet the performance criteria before the end of the five years and the USACE and BLM agree, the monitoring period could be shortened to as little as three years. A field inspection of the six sites was conducted by the DOE, USACE, and BLM in September 1996 to determine if any of the sites could be transferred from the DOE to the BLM. Based on the results of three years of monitoring, it was agreed by all parties that Prospector Spring, Upper Longs Gulch, and Camp Kettle Spring had met the performance criteria and would likely continue to do so over the long term. Therefore, the responsibility for these sites will be transferred to the BLM, and the DOE will discontinue monitoring these sites. The DOE will continue to monitor the remaining sites for at least one more year.

The results of the vegetation sampling from 1993 through 1996 are analyzed in this section. The 1993 vegetation monitoring data represents grazed conditions and is considered the baseline condition (DOE, 1994). Data collected in 1994 and 1995 (DOE, 1996) and 1996 represent the first three years of monitoring at the sites. Vegetation data were collected along 16 permanent transects at the six mitigation wetland sites from 1993 to 1996.

Environmental and site-specific factors that influenced plant growth, including percent bare ground and average plant height, at the mitigation sites in 1996 include the following.

1. As indicated above, drought conditions prevailed in the Gunnison area during the summer of 1996. Drought conditions had a pronounced effect in the upper riparian grassland plant community where most of the vegetation had died and turned brown by the time it was sampled in August (TAC, 1996a). The ground water in the upper riparian grassland zone is apparently too deep for most plants to access. Vegetation growth is influenced more by annual precipitation patterns than vegetation in the wetland plant communities.

Photographic series 3 (see Appendix B) shows the vegetation in the upper grassland plant community at Houston Gulch (Transect 1). The vegetation growing here was very short when grazed (1993) and during the drought years (1994 and 1996). Growth in 1995 was much greater as a result of the normal precipitation levels.

Photographic series 1 and 2 show the effects of the 1996 drought at the Sage Hen Spring site. Also, a decrease in spring-fed water flow into Sage Hen Spring may have contributed to the reduction of plant growth. The lower riparian grassland, sedge wetlands, and willow plant communities had access to ground water and were healthy in 1996. In general, vegetation in these three plant communities has improved during the monitoring period (see Photographic series 4 and 5 of Upper Longs Gulch and 6 and 7 of Camp Kettle Spring in Appendix B).

2. A reduced flow of spring fed water into Lower Longs Gulch and Sage Hen Spring may have contributed to the reduction in USACE wetlands as discussed above. Photographic series 1 and 2 show how transect 3 at the Sage Hen Spring site has dried out. Drought conditions in 1994 and 1996 also contributed to the dry conditions. Another indication of the dry conditions at the Sage Hen Spring site is that there was less bare ground in transect 3 under grazed conditions (1993) than for the three years after the site was fenced (Table 3.3).

3. In August 1996, it was apparent that cattle had grazed inside the Houston Gulch site. According to BLM personnel, up to 60 head of cattle grazed the site intermittently from June 7 to June 20, 1996. This grazing was considered light to moderate (Hays, S.; 1996). Although the vegetation at the site had not been grazed down to heights comparable to 1993 and before, there was noticeably less vegetation in all three transects than in 1995. The effects of this grazing can be seen in Photographic series 8 and 9 which shows the vegetation in lower riparian grassland transects 2 and 3 (See Appendix B). When the photographs for 1995 and 1996 are compared, the reduction in vegetation is obvious. Based on plant growth at other lower riparian grassland plant communities (see Photographic Series 4 through 7), it is concluded that the drought would have resulted in little reduction in vegetation growth in transects 2 and 3 at Houston Gulch, and the reduction is mainly the result of grazing.

3.4.1 Percent bare ground

The percent bare ground increased in all of the transects but one in 1994, which is the year after the sites were fenced (Table 3.3). In 1995, a decrease in percent bare ground was calculated for all transects except transect 3 at Camp Kettle Spring that remained at zero (Table 3.3). With the return of drought conditions in 1996, the percent bare ground increased in most of the upper riparian grassland transects to levels at or above the bare ground performance criteria of 15 percent. The percent bare ground also increased at some of the lower riparian grassland transects but tended to remain well below the performance criteria.

The average percent bare ground for transects in the upper and lower riparian grassland plant communities was above the 15-percent bare ground criteria in 1993 and 1994 but fell below in 1995 (Figure 3.7). In 1996, the lower riparian grassland plant communities stayed well below the performance criteria while the upper riparian plant communities exceeded criteria. This suggests that over the long term, the percent bare ground in the upper riparian grassland plant communities will tend to fluctuate with the long-term precipitation patterns. The percent bare ground in the lower riparian grassland plant communities and other wetland plant communities will be more stable over the long term due to the availability of ground water. If long-term drought conditions persist, the vegetation growth in these wetland communities could be reduced. For example, 1994 was a drought year and drought conditions had occurred for the previous six years. Much less water was observed in the mitigation sites that year than any other year and an increase in bare ground was noted in both the upper and lower riparian grassland plant communities (Figure 3.7).

Table 3.3 Percent bare ground at six wetlands mitigation sites near Gunnison, Colorado

Wetland mitigation site	Transect 1				Transect 2				Transect 3			
	1993	1994	1995	1996	1993	1994	1995	1996	1993	1994	1995	1996
Prospector Spring	9	13	0.4	6 ^a	21	23	2	2 ^a	4	5	0.4	3 ^a
Houston Gulch	10	37	11	17 ^b	23	32	8	14 ^a	30	40	3	2 ^a
Upper Longs Gulch	39	42	13	15 ^b	21	27	6	10 ^{a,c}	17	36	6	15 ^{b,d}
Lower Longs Gulch	22	31	26	14 ^b	--	--		--	--	--	--	--
Sage Hen Spring	38	61	4	13 ^b	44	60	0	17 ^b	10	36	17	21 ^b
Camp Kettle Spring	28	40	16	22 ^b	3	44	6	1 ^a	41	0	0	0 ^a

- Notes: 1. Bare ground also includes ground covered with rocks and wood.
 2. 1993 results are from DOE, 1994; 1994 and 1995 results are from DOE, 1996.
^aLower riparian grassland transect.
^bUpper riparian grassland transect.
^cPercent bare ground = 0.1% - rest is rock and dead wood.
^dPercent bare ground = 5% - rest is rock and dead wood.

Figure 3.7 Average percent bare ground for upper and lower riparian grassland plant communities at six wetland mitigation sites, Gunnison, Colorado

Figure 3.8 Average plant height for upper and lower riparian grassland plant communities at six wetland mitigation sites, Gunnison, Colorado

Figure 3.7 Average percent bare ground for upper and lower riparian grassland plant communities at six wetland mitigation sites, Gunnison, Colorado

Figure 3.8 Average plant height for upper and lower riparian grassland plant communities at six wetland mitigation sites, Gunnison, Colorado

3.4.2 Plant height

The height of most plant species was measured along each transect from 1993 through 1996. In 1993, the vegetation was grazed so heavily that little height stratification of

plant species was observed. In 1994 through 1996, stratification of the plant species was noted with various species of grasses, *Carex*, and *Juncus* growing above the lower-lying species such as common dandelion and Rocky Mountain aster. The average plant height for each transect was determined by averaging the height of the dominant overstory species. The species used for this calculation in this report are footnoted in the tables in Appendices A and B for 1994 and 1995, respectively (DOE, 1996), and in the tables in Appendix A for 1996. For 1993, overstory species with vegetative cover of 20 percent or greater were used to calculate average plant height. The one exception to this is transect 2 at Houston Gulch where fowl bluegrass and spreading bentgrass, each with 10-percent vegetative cover, were used. The 1993 plant height data appears in the Mitigation and Monitoring Plan (DOE, 1994).

The average height of the dominant overstory plant species increased in all transects from 1993 to 1994, except transect 3 at Sage Hen Spring where it remained the same (Table 3.4). In 1995, the average height increased in all transects compared to 1994. In 1996, average plant height in the lower riparian grassland plant community increased or remained the same in four transects, and decreased in four transects when compared to those in 1995. Two transects where a decrease was observed were grazed transects 2 and 3 at Houston Gulch. Photographic series 4 through 7 shows how plant height in the lower riparian grassland plant communities was similar to 1995 results.

Average plant height for 1996 in the upper riparian grassland plant communities decreased in all eight transects when compared to 1995. Photographic series 1 through 3 shows the decrease in plant height in the upper riparian grassland plant community. Overall, the average plant height in the upper riparian grassland plant communities dipped below the performance criteria of 12 inches in 1996, while the lower riparian grassland plant communities remained well above the performance criteria (Figure 3.8).

3.4.3 Plant species composition

The vegetation data collected along the transects were converted to percent canopy coverage and species composition. All plant species sampled in 1996 are listed in Table 3.5 and data used in this analysis appear in DOE (1994, 1996) and Appendix A of this report. The dominant species in terms of percent species composition in each transect by year are listed in Table 3.6. All species that had over five-percent species composition are listed. Changes in plant species composition in the lower riparian grassland plant communities were analyzed in terms of the wetland status such as obligate, facultative-wet, and facultative (Reed, 1988). See footnotes to Table 3.5 for definitions of these wetland status categories.

Table 3.4 Average plant height in inches (centimeters in parentheses) of dominant overstory plant species at six wetlands mitigation sites near Gunnison, Colorado

Wetland mitigation site	Transect 1				Transect 2				Transect 3			
	1993	1994	1995	1996	1993	1994	1995	1996	1993	1994	1995	1996
Prospector Spring	9 (23)	10 (25)	17 (43)	18 (46) ^a	4 (10)	11 (28)	21 (53)	23 (58) ^a	7 (18)	12 (30)	15 (38)	15 (38) ^a
Houston Gulch	1 (3)	6 (15)	10 (25)	7 (18) ^b	5 (13)	9 (23)	22 (56)	13 (33) ^a	12 (30)	13 (33)	28 (71)	21 (53) ^a
Upper Longs Gulch	2 (5)	5 (3)	19 (48)	12 (30) ^b	3 (8)	14 (36)	26 (66)	22 (56) ^a	2 (5)	7 (18)	15 (38)	11 (28) ^b
Lower Longs Gulch	2 (5)	5 (13)	14 (36)	9 (23) ^b	--	--	--	--	--	--	--	--
Sage Hen Spring	1 (3)	3 (8)	18 (46)	8 (20) ^b	1 (3)	8 (20)	31 (79)	20 (51) ^b	10 (25)	10 (25)	17 (43)	8 (20) ^b
Camp Kettle Spring	3 (8)	7 (18)	11 (28)	7 (18) ^b	3 (8)	9 (23)	18 (46)	17 (43) ^a	4 (10)	13 (33)	16 (41)	19 (48) ^a

^aLower riparian grassland transect

^bUpper riparian grassland transect

Table 3.5 Plant species observed along 16 transects in six wetlands, Gunnison and Saguache Counties, Colorado

Scientific name (abbreviation)	Common name	Wetland status ^a
<i>Achillea lanulosa</i> (Acla)	Common yarrow	FACU
<i>Agropyron smithii</i> (Agsm)	Western wheatgrass	FACU
<i>Agropyron</i> sp. (Agsp)	Wheatgrass sp.	NA
<i>Agropyron trachycaulum</i> (Agtr)	Slender wheatgrass	FACU
<i>Agrostis stolonifera</i> (Agst)	Spreading bentgrass	FACW
<i>Alopecurus geniculatus</i> (Alge)	Water foxtail	OBL
<i>Artemisia frigida</i> (Arfr)	Fringed sagebrush (fringed wormwood)	UPL
<i>Artemisia tridentata</i> (Artr)	Big sagebrush	UPL
<i>Aster occidentalis</i> (Asoc)	Rocky Mountain aster	FAC
<i>Astragalus agrestis</i> (Asag)	Field milkvetch	FAC
<i>Astragalus lentiginosus</i> (Aslen)	Specklepod milkvetch	NA
<i>Astragalus leptaleus</i> (Asle)	Park milkvetch	NA
<i>Astragalus pattersonii</i> (Aspa)	Patterson milkvetch	NA
<i>Astragalus</i> sp. (Assp)	Milkvetch	NA
<i>Brachyactis frondosa</i> (Brfr)	Gray riparian aster	NA
<i>Bromus catharticus</i> (Brca)	Rescue Grass	NA
<i>Campanula parryi</i> (Capa)	Bellflower	FACU
<i>Carex occidentalis</i> (Caoc)	Western sedge	OBL
<i>Carex nebraskensis</i> (Cane)	Nebraska sedge	OBL
<i>Carex utriculata</i> (Caut)	Beaked sedge	OBL
<i>Carex xerantica</i> (Caxe)	Golden sedge	OBL
<i>Carex</i> sp. (Casp)	Sedge	NA
<i>Chrysothamnus viscidiflorus</i> (Chvi)	Green rabbitbrush	NA
<i>Cirsium arizonicum</i> (Ciar)	Canada thistle	FACU
<i>Cirsium</i> sp. (Cisp)	Thistle	NA
<i>Crepis acuminata</i> (Crac)	Hawksbeard	NA
<i>Deschampsia caespitosa</i> (Deca)	Tufted hairgrass	FACW
<i>Eleocharis palustris</i> (Elpa)	Creeping spikerush	OBL
<i>Epilobium adenocaulon</i> (Epad)	Willow-herb	OBL(?)
<i>Equisetum arvense</i> (Eqar)	Field horsetail	FAC+
<i>Glyceria elata</i> (Glel)	Tall mannagrass	OBL
<i>Glyceria</i> sp. (Glsp)	Mannagrass	OBL
<i>Glyceria striata</i> (Glst)	Fowl Mannagrass	OBL
<i>Hordeum brachyantherum</i> (Hobr)	Meadow barley	FACW
<i>Hordeum jubatum</i> (Hoju)	Foxtail barley	FAC
<i>Hordeum vulgare</i> (Hovu)	Common barley	NA
<i>Iris missouriensis</i> (Irm)	Rocky Mountain iris	OBL
<i>Juncus balticus</i> (Juba)	Baltic rush	FACW
<i>Lappula occidentalis</i> (Laoc)	Stickseed	NA

Table 3.5 Plant species observed along 16 transects in six wetlands, Gunnison and Saguache Counties, Colorado (Concluded)

Scientific name (abbreviation)	Common name	Wetland status ^a
<i>Lepidium montanum</i> (Lemo)	Peppergrass (mountain pepperweed)	FACW
<i>Lupinus argenteus</i> (Luar)	Silvery lupine	NA
<i>Mentha arvensis</i> (Mear)	Field mint	FACW
<i>Muhlenbergia filiformis</i> (Mufi)	Pull-up muhly	FACW
<i>Nasturtium officinale</i> (Naof)	True watercress	OBL
<i>Panicum capillare</i> (Paca)	Witchgrass	FACU
<i>Panicum millifolium</i> (Pami)	Panicum	NA
<i>Phleum pratense</i> (Phpr)	Timothy	OBL
<i>Phleum</i> Sp. (Phsp)	Timothy	FACU
<i>Plagiobothrys scouleri</i> (Plsc)	Scouler popcorn flower	FACU
<i>Poa agassizensis</i> (Poag)	Bluegrass	NA
<i>Poa palustris</i> (Popa)	Fowl bluegrass	FACW
<i>Poa pratensis</i> (Popr)	Kentucky bluegrass	FACU
<i>Poa</i> sp. (Posp)	Bluegrass sp.	NA
<i>Polygonum aviculare</i> (Poav)	Prostrate knotweed	NA
<i>Potentilla anserina</i> (Poan)	Silverweed	OBL
<i>Potentilla</i> sp. (Potsp)	Cinquefoil	NA
<i>Ranunculus macounii</i> (Rama)	Buttercup	OBL
<i>Ranunculus repens</i> (Rare)	Creeping buttercup	FACW
<i>Ribes inerme</i> (Riin)	Whitestem gooseberry	FAC
<i>Rorippa islandica</i> (Rois)	Yellow cress	OBL
<i>Rosa woodsii</i> (Rowo)	Woods rose	FAC-
<i>Rumex crispus</i> (Rucr)	Curly dock	FACW
<i>Salix geyeriana</i> (Sage)	Geyer willow	OBL
<i>Sisymbrium altissimum</i> (Sial)	Tumble mustard	UPL
<i>Sisyrinchium idahoense</i> (Siid)	Blue-eyed grass	OBL
<i>Taraxacum officinale</i> (Taof)	Common dandelion	FACU
<i>Trifolium</i> sp. (Trsp)	clover	NA
<i>Trifolium repens</i> (Trre)	White clover	FACU

^aFrom *National List of Plant Species That Occur in Wetlands: Intermountain (Region 8)* (Reed, 1988).

- OBL = Obligate plant species that occur in wetlands 99 percent of the time.
 FACW = Facultative wetland plant species that usually occur in wetlands (67 to 99 percent of the time).
 FAC = Facultative plant species that are equally likely to occur in wetlands or nonwetlands.
 FACU = Facultative upland plant species that usually occur in nonwetlands (67 to 99 percent of the time).
 UPL = Upland plant species that occur in uplands (nonwetlands) 99 percent of the time.
 NA = Not given in Reed (1988); probably UPL species because Reed (1988) does not list all UPL species.
 + species tends toward the next wettest category.
 - species tends toward the next driest category.
 ? status unknown.

Table 3.6 Dominant plant species by percent species composition (percents in parentheses) at six wetlands mitigation sites near Gunnison, Colorado (1993 through 1996)

	Transect 1				Transect 2				Transect 3			
	1993	1994	1995	1996	1993	1994	1995	1996	1993	1994	1995	1996
Prospector Spring	Juba (43) ^a Hoju (30) Popa (13)	Juba (47) Hoju (22) Popa (8) Hobr (7)	Hoju (35) Popa (29) Juba (26)	Juba (56) Caxe (13)	Elpa (54) Caut (11) Popa (10) Dece (8)	Elpa (26) Caut (22) Juba (22) Poan (9) Glst (7)	Caut (22) Poan (17) Elpa (15) Glst (13) Dece (13) Juba (9)	Caut (40) Juba (19) Dece (18) Poan (8) Elpe (8)	Juba (63) Taof (10) Asle (8)	Juba (54) Aslen (9) Cado (7) Agtr (7) Taof (6)	Hoju (30) Juba (12) Agtr (11) Acla (10) Taof (6) Popa (6)	Juba (27) Asoc (15) Taof (11) Acla (10) Caxe (6)
Houston Gulch	Popa (66) Taof (12) Trre (12) Juba (6)	Juba (39) Muan (18) Popa (10) Taof (13) Asoc (8)	Popa (33) Juba (24) Asoc (13) Hoju (9) Taof (6)	Popa (59) Juba (25) Asoc (12)	Agst (21) Popa (21) Dece (15) Taof (13) Trre (11) Hoju (6)	Glst (21) Popa (18) Dece (16) Hoju (11) Taof (9)	Popa (31) Hoju (25) Dece (12) Acla (9) Hobr (7) Taof (6)	Popa (28) Alca (16) Juba (12) Caut (9) Dece (7)	Dece (54) Popa (11)	Glst (43) Juba (17) Hoju (14) Poav (7)	Glst (37) Hoju (24) Hobr (12) Asoc (9)	Dece (29) Juba (26) Asoc (16) Poan (7) Acla (7)
Upper Longs Gulch	Popa (80) Taof (10) Asoc (10)	Popa (37) Asoc (34) Taof (10) Agsm (8)	Popa (55) Asoc (15) Agsm (15) Taof (8)	Popa (58) Agst (14) Asoc (13)	Popa (46) Caut (20) Asoc (15)	Caut (32) Popa (17) Agal (9) Elpa (7) Poan (7) Juba (7)	Caut (21) Popa (16) Glst (14) Juba (9) Asoc (7) Poan (6)	Caut (37) Glst (18) Juba (15) Poan (7) Hobr (7) Popa (6)	Popa (59) Taof (14) Trre (11)	Popa (41) Juba (19) Taof (14) Asoc (12) Acla (6)	Trre (42) Popa (37) Taof (7) Asoc (6)	Popa (27) Asoc (23) Juba (20) Trre (14) Toaf (7)
Lower Longs Gulch	Popa (65) Sage (12) Taof (9)	Popa (63) Sage (10) Alae (8) Juba (6) Taof (6)	Popa (50) Juba (14) Taof (12) Sage (6)	Popa (67) Juba (21) Taof (6)	--	--	--	--	--	--	--	--
Sage Hen Spring	Popa (74) Asoc (16)	Popa (35) Asoc (29) Agsm (20) Juba (6)	Asoc (28) Popa (24) Lede (20) Chbe (11) Agsm (6)	Popa (39) Asoc (17) Agsm (10) Juba (10)	Poav (49) Arfr (15) Popa (10) Ciar (7)	Arfr (31) Laoc (31) Caro (14) Ciar (8)	Lede (34) Depi (14) Hoju (12) Ciar (10) Chbe (10) Laoc (7)	Ciar (39) Laoc (18) Caut (14) Sial (14)	Popa (62) Hoju (16) Juba (10)	Popa (52) Juba (23) Caro (13)	Popa (57) Hoju (29)	Popa (78) Juba (16)
Camp Kettle Spring	Posp (54) Asoc (16) Juba (9) Taof (8)	Asoc (26) Juba (24) Popa (22)	Posp (32) Asoc (16) Taof (13) Juba (11) Hoju (6)	Posp (49) Juba (14) Asoc (13) Chvi (8)	Popa (53) Poan (15) Taof (15)	Popa (20) Juba (20) Dece (16) Hoju (14) Casp (14) Asoc (6)	Dece (21) Popa (20) Hoju (19) Taof (17) Juba (11)	Juba (32) Posp (22) Asoc (13) Caxe (12) Glst (10)	Cane (75) Popa (10)	Cane (83)	Cane (58) Trre (16) Glst (10)	Cane (83)

See Table 3.5 for definitions of plant abbreviations.

Table 3.6 Dominant plant species by percent species composition (percents in parentheses) at six wetlands mitigation sites near Gunnison, Colorado (1993 through 1996)

Prospector Spring

From 1993 through 1995, transects 1 and 3 were in the upper riparian grassland plant community at the Prospector Spring site. Based on the wetlands delineation in 1996, these transects now occur in the lower riparian plant community (see Figure 3.1). In addition, the vegetation in the area of these two transects remained healthy and green throughout the summer indicating they had access to ground water. The trends in the dominant plant species were similar at these two transects. Foxtail barley (Hoju), which had been the dominate species in both of these transects in 1995 (Table 3.6), was much reduced in 1996 accounting for 2.5 percent of the species composition in transect 1 and 3.6 percent composition in transect 3 (see tables A-2 and A-5 in Appendix A). Baltic rush (Juba), which had been much reduced in both transects in 1995 when compared to 1993 and 1994, was again the dominate plant species in both transects in 1996 (Table 3.6). Also, golden sedge (Caxe), which had not been previously recorded from either transect, was a subdominant in both transects in 1996. Facultative-wet species dominated transect 1 during the four years of study while facultative species decreased to zero and obligate species increased in 1996 (Figure 3.9). The wetland status of plants in transect 3 indicates somewhat dryer conditions than in transect 1. For example, in 1995, facultative-up species had a higher percent species composition than facultative-wet species. This was reversed in 1996 when percent plant species composition was again dominated by facultative-wet species (Figure 3.10).

Transect 2 is in the lower riparian grassland plant community and creeping spikerush (Elpa) was the dominant species in 1993; this species has decreased every year while beaked sedge (Caut) has increased every year. When compared to 1995, Juba and tufted hairgrass (Dece) showed an increase in 1996 while silverweed (Poan) decreased and mannagrass (Glst) was not recorded (Table 3.6). Obligate plant species have dominated the plant cover in transect 2 and for every increase or decrease in percent species composition of obligate species, there has been an opposite increase or decrease in facultative-wet species (Figure 3.11).

Houston Gulch

Transect 1 is in the upper riparian grassland plant community at the Houston Gulch site. Fowl bluegrass (Popa) was clearly the dominant species in 1996 as it was in 1995 (Table 3.6). Juba and Rocky Mountain aster (Asoc) were the subdominant species as they were in 1995.

Transect 2 is in the lower riparian grassland plant community and Popa was the dominate species as was observed in 1995. Subdominant species observed both years were common yarrow (Acla) and Dece; Juba and Caut were subdominants recorded in 1996 but not 1995. Hoju decreased to a low level (five-percent species composition) in 1996. There is an inverse relationship between the percent species composition of obligate and facultative-wet species; as one goes up, the other goes down and vice versa (Figure 3.12). The combined percent species composition of obligate and facultative-wet species has been between 50 and 57 percent during the four years of study.

Transect 3 is also in the lower riparian grassland plant community. Glst gave way to Dece as the dominate species in 1996; the former species was dominant in 1995. Other common species along this transect in 1996 were Juba and Asoc (Table 3.6). Hoju showed a marked decrease in transect 3 in 1996 (4 percent species composition) when

Figure 3.9 Percent species composition of wetland plants from 1993 through 1996 in Transect 1 at Prospector Spring, Gunnison, Colorado

Figure 3.10 Percent species composition of wetland plants from 1993 through 1996 in transect 3 at Prospector Spring, Gunnison, Colorado

**Figure 3.9 Percent species composition of wetland plants from 1993 through 1996 in
Transect 1 at Prospector Spring, Gunnison, Colorado**

**Figure 3.10 Percent species composition of wetland plants from 1993 through 1996 in
Transect 2 at Prospector Spring, Gunnison, Colorado**

Figure 3.11 Percent species composition of wetland plants from 1993 through 1996 in transect 2 at Prospector Spring, Gunnison, Colorado

Figure 3.12: Percent species composition of wetland plants from 1993 through 1996 in transect 2 at Houston Gulch, Gunnison, Colorado

**Figure 3.11 Percent species composition of wetland plants from 1993 through 1996 in
Transect 3 at Prospector Spring, Gunnison, Colorado**

**Figure 3.12 Percent species composition of wetland plants from 1993 through 1996 in
Transect 2 at Houston Gulch, Gunnison, Colorado**

compared with 1995. The percent species composition of obligate plant species declined from 1993 to 1995 and then stabilized. The percent composition of facultative-wet species has shown an overall increase from 1993 through 1996. Facultative species increased through 1995 but had a substantial decrease with the reduction in Hoju in 1996 (Figure 3.13).

Upper Longs Gulch

Transect 1 is in the upper riparian plant community at the Upper Longs Gulch site, and Popa remained the dominate species as it has been for the four years of study. Asoc has been a subdominant during this study and common dandelion (Taof) decreased to a low level in 1996 (0.7 percent species composition) when compared to the previous three years. Western wheatgrass (Agam) also decreased in 1996 (four percent species composition) while spreading bentgrass (Agst) showed a significant increase over 1995 levels (0.5-percent species composition) to 13 percent in 1996 (Table 3.6).

Transect 2 is in the lower riparian grassland plant community and Popa was the dominant species in 1993 while Caut was the dominant species from 1994 through 1996. Popa continued to decrease reaching a four-year low of six-percent species composition in 1996 (Table 3.6). Gist and Juba, which first appeared in the transect in 1995, increased to 18- and 15-percent species composition, respectively, in 1996. This transect is dominated by wetland obligate and facultative-wet species; the percent species composition of obligate species has increased while facultative-wet species have decreased over time (Figure 3.14).

Transect 3 is along a drainage in the upper riparian grassland plant community. Popa was the dominant species in 1993 and 1994 but gave way to white clover (Trre) in 1995. In 1995, Trre and Popa formed a two-tiered plant community with Trre forming a dense ground cover and Popa forming an overstory. Popa was once again the dominate species in 1996 although Asoc and Juba were almost as dominant (Table 3. 6). Trre was much less dominate in 1996 then 1995 and this may be due to the drought conditions in 1996.

Lower Longs Gulch

The one transect in Lower Longs Gulch is in the upper riparian grassland plant community and Popa was the dominant species for all four years. Taof and Juba were other species commonly encountered along this transect (Table 3.6).

Sage Hen Spring

Transect 1 at Sage Hen Spring is in the upper riparian grassland plant community; most of the vegetation had died and turned brown. Popa was the dominant species in 1996. Asoc, Juba, and Agsm were also common (Table 3.6).

Transect 2 is in an area that was previously considered a wetland. It is currently dominated by weedy plant species indicating this area is drier and therefore is no longer a wetland. Canada thistle (Ciar) attained the highest percent species composition in 1996 followed by stickseed (Laoc), Caut, and tumble mustard (Sial) (Table 3.6).

Transect 3 is in the upper riparian grassland plant community along a drainage downgradient of the sedge plant community. The ground along this transect was

Figure 3.13 Percent species composition of wetland plants from 1993 through 1996 in transect 3 at Houston Gulch, Gunnison, Colorado

Figure 3.14 Percent species composition of wetland plant species from 1993 through 1996 in Transect 2 at Upper Longs Gulch, Gunnison, Colorado

Figure 3.13 Percent species composition of wetland plants from 1993 through 1996 in
Transect 3 at Houston Gulch, Gunnison, Colorado

Figure 3.14 Percent species composition of wetland plants from 1993 through 1996 in
Transect 2 at Upper Longs Gulch, Gunnison, Colorado

completely dry and most of the vegetation had died and turned brown. Popa was the dominant species during the four-year sampling period. Juba was a subdominant species in 1996 (Table 3.6).

Camp Kettle Spring

Transect 1 is in the upper riparian plant community and bluegrass sp. (Posp) was the dominate species as it was in 1995. Juba, Asoc, and green rabbitbrush (Chvi) were subdominant species.

Transect 2 is in the lower riparian grassland plant community. In 1996, Juba showed a substantial increase in percent species composition compared to previous years. The percent species composition of Posp has remained fairly constant over the last three years (Table 3.6). Asoc, Caxe, and Glst were subdominants in 1996 while Hoju and Taof both dipped below five-percent species composition in 1996. The percent species composition of obligate and facultative-wet species decreased from 1994 to 1995 but increased in 1996 (Figure 3.15).

Transect 3 is in the lower riparian grassland plant community and has been dominated by Nebraska sedge (Cane) all four years. In 1996, no other plant species exceeded five-percent species composition (Table 3.6). Plant species that exceeded one-percent species composition were Poan, Glst, Juba, Asoc, Acla, and Dece (see Table A.32 in Appendix A). Obligate plant species have clearly been dominant in this transect (Figure 3.16).

Wetland species composition

The percent species composition at the 16 transects was analyzed in terms of plant species wetland status (Reed, 1988). For the purpose of this analysis, the lower riparian grassland transects were divided based on moisture conditions. Transects 2 at Prospector Spring and Upper Longs Gulch, and transect 3 at Camp Kettle Spring are the wettest and are called sedge wetlands. The remaining lower riparian grassland transects are drier and are lumped into a second group. The upper riparian grassland transects comprise the third group.

Sampling over the four year period in transects 2 at Prospector Spring and Upper Longs Gulch showed that the percent species composition of Caut and Juba increased while Popa decreased. Elpa, which is an obligate wetland species, also decreased. Elpa grows in the open and the development of a dense stand of sedge may have shaded it out (Figure 3.17).

Trends in plant growth in the lower riparian grassland plant communities (transects 1 at Prospector Spring, 2 and 3 at Houston Gulch, and 2 at Camp Kettle) show that Juba has increased from 1993 to 1996 at all four transects (see Table 3.6). Popa has decreased in three of the four transects and Hoju showed a substantial decrease in all four transects in 1996. These changes are consistent with observations at Valdez Spring, a cattle exclosure that was fenced 12 to 14 years ago (DOE, 1994). At this site, the plant community above the sedge type was dominated by Juba and grasses such as Popa and Hoju were uncommon.

Figure 3.15 Percent species composition of wetland plants from 1993 through 1996 in transect 2 at Camp Kettle Spring, Gunnison, Colorado

Figure 3.16 Percent species composition of wetland plants from 1993 through 1996 in transect 3 at Camp Kettle Spring, Gunnison, Colorado

Figure 3.15 Percent species composition of wetland plants from 1993 through 1996 in Transect 2 at Camp Kettle Spring, Gunnison, Colorado

Figure 3.16 Percent species composition of wetland plants from 1993 through 1996, Gunnison, Colorado

Figure 3.17 Percent species composition of common plant species in Prospector Spring transect 2 (P2) and Upper Longs Gulch transect 2 (ULG2) from 1993 to 1996, Gunnison, Colorado

**Figure 3.17 Percent species composition of common plant species in
Prospector Spring Transect 2 (P2) and Upper Longs Gulch Transect 2 (ULG2) from
1993 through 1996, Gunnison, Colorado**

Analysis of the percent species composition of the common plant species in the upper riparian plant communities (transects 1 at Houston Gulch, 1 and 3 at Upper Longs Gulch, 1 at Sage Hen Spring, and 1 at Camp Kettle Spring) showed no clear trends over time (Table 3.6). Pops is typically the most common species at these sites. Other common species include *Asoc*, *Taof*, and *Juba*.

Using data in the *National List of Plant Species That Occur in Wetlands: Intermountain (Region 8)* (Reed, 1998), the average plant species composition for obligate, facultative-wet, facultative, and facultative-up was determined for the upper and lower riparian grassland and sedge wetlands plant communities. From this data, it was determined that the sedge wetlands are dominated by obligate plant species, the lower riparian grassland type is dominated by facultative-wet and obligate species, and the upper riparian grassland type is dominated by facultative-wet species (Figure 3.18). The upper riparian grassland plant community also has the highest average percent species composition of facultative and facultative-up species.

3.4.4 Willow growth

Willow plant communities occur at the Upper and Lower Longs Gulch and Sage Hen Spring sites. Numerous willow seedlings were observed growing in the sedge plant community at the south end of the Upper Longs Gulch site. In addition, willow seedlings are growing in the sedge plant community at the spring at the Sage Hen site. No expansion of the willow plant community was observed at the Lower Longs Gulch site because the appropriate conditions for willow growth do not occur outside the willow plant community itself. It is likely that the willow plant community will continue to invade the sedge plant communities at the Upper Longs Gulch and Sage Hen Spring sites. Willows have not been observed at the Prospector Spring, Houston Gulch, or Camp Kettle Spring sites; these sites did not contain a willow plant community before they were fenced. However, willow seedlings were observed in the sedge plant community at the small enclosure just south of the Prospector Spring site. It is expected that willows will likely invade these sites over the next few years.

3.4.5 Summary

As discussed in the sections on percent bare ground (3.3.1) and plant height (3.3.2), the significant improvement in the recovery of vegetation at the six mitigation sites observed in 1995 was maintained in the sedge wetland and lower riparian plant communities in 1996. Due to drought conditions, an increase in percent bare ground and a decrease in average plant height was noted for the upper riparian grassland plant communities. Figures 3.7 and 3.8 show that the lower riparian grassland plant communities continued to meet the performance criteria for percent bare ground and average plant height whereas the upper riparian grassland plant communities did not.

In September 1996, an inspection of the six mitigation sites was performed by personnel from the DOE, BLM, and USACE. It was agreed by all parties that the Prospector Spring, Upper Longs Gulch, and Camp Kettle Spring sites had met the performance criteria and would likely continue to over the long-term. It was further agreed that the responsibility for maintaining these sites will be handed over to the BLM and that the DOE had met its obligations under the Gunnison UMTRA site USACE 404 Permit. The DOE will continue to monitor the Houston Gulch, Lower Longs Gulch, and Sage Hen Spring sites for at least one more year.

Figure 3.18 Percent species composition of obligate (OBL), facultative-wet (FACW), facultative (FAC), and facultative-up (FACU) plant species in three riparian plant community types

Figure 3.18 **Percent species composition of obligate (OBL), facultative (FAC),
and facultative-up (FACU) plant species in three riparian plant community types**

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APPENDIX A

**TRANSECT DATA COLLECTED IN
AUGUST 1996**

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APPENDIX A

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Table A.1 Plant species observed along 16 transects in six wetlands, Gunnison and Saguache Counties, Colorado

Scientific name (abbreviation)	Common name	Wetland status ^a
<i>Achillea lanulosa</i> (Acla)	Common yarrow	FACU
<i>Agropyron smithii</i> (Agsm)	Western wheatgrass	FACU
<i>Agropyron</i> sp. (Agsp)	Wheatgrass sp.	NA
<i>Agropyron trachycaulum</i> (Agtr)	Slender wheatgrass	FACU
<i>Agrostis stolonifera</i> (Agst)	Spreading bentgrass	FACW
<i>Alopecurus geniculatus</i> (Alge)	Water foxtail	OBL
<i>Artemisia frigida</i> (Arfr)	Fringed sagebrush (fringed wormword)	UPL
<i>Artemisia tridentata</i> (Artr)	Big sagebrush	UPL
<i>Aster occidentalis</i> (Asoc)	Rocky Mountain aster	FAC
<i>Astragalus agrestis</i> (Asag)	Field milkvetch	FAC
<i>Astragalus lentiginosus</i> (Aslen)	Specklepod milkvetch	NA
<i>Astragalus leptaleus</i> (Asle)	Park milkvetch	NA
<i>Astragalus pattersonii</i> (Aspa)	Patterson milkvetch	NA
<i>Astragalus</i> sp. (Assp)	Milkvetch	NA
<i>Brachyactis frondosa</i> (Brfr)	Gray riparian aster	NA
<i>Bromus catharticus</i> (Brca)	Rescue Grass	NA
<i>Campanula parryi</i> (Capa)	Bellflower	FACU
<i>Carex occidentalis</i> (Caoc)	Western sedge	OBL
<i>Carex nebraskensis</i> (Cane)	Nebraska sedge	OBL
<i>Carex utriculata</i> (Caut)	Beaked sedge	OBL
<i>Carex xerantica</i> (Caxe)	Golden sedge	OBL
<i>Carex</i> sp. (Casp)	Sedge	NA
<i>Chrysothamnus viscidiflorus</i> (Chvi)	Green rabbitbrush	NA
<i>Cirsium arizonicum</i> (Ciar)	Canada thistle	FACU
<i>Cirsium</i> sp. (Cisp)	Thistle	NA
<i>Crepis acuminata</i> (Crac)	Hawksbeard	NA
<i>Deschampsia caespitosa</i> (Deca)	Tufted hairgrass	FACW
<i>Eleocharis palustris</i> (Elpa)	Creeping spikerush	OBL
<i>Epilobium adenocaulon</i> (Epad)	Willow-herb	OBL(?)
<i>Equisetum arvense</i> (Eqar)	Field horsetail	FAC+
<i>Glyceria elata</i> (Glel)	Tall mannagrass	OBL
<i>Glyceria</i> sp. (Glsp)	Mannagrass	OBL
<i>Glyceria striata</i> (Glst)	Fowl Mannagrass	OBL
<i>Hordeum brachyantherum</i> (Hobr)	Meadow barley	FACW
<i>Hordeum jubatum</i> (Hoju)	Foxtail barley	FAC
<i>Hordeum vulgare</i> (Hovu)	Common barley	NA
<i>Iris missouriensis</i> (Irmis)	Rocky Mountain iris	OBL
<i>Juncus balticus</i> (Juba)	Baltic rush	FACW

Table A.1 Plant species observed along 16 transects in six wetlands, Gunnison and Saguache Counties, Colorado (Concluded)

Scientific name (abbreviation)	Common name	Wetland status ^a
<i>Lappula occidentalis</i> (Laoc)	Stickseed	NA
<i>Lepidium montanum</i> (Lemo)	Peppergrass (mountain pepperweed)	FACW
<i>Lupinus argenteus</i> (Luar)	Silvery lupine	NA
<i>Mentha arvensis</i> (Mear)	Field mint	FACW
<i>Muhlenbergia filiformis</i> (Mufi)	Pull-up muhly	FACW
<i>Nasturtium officinale</i> (Naof)	True watercress	OBL
<i>Panicum capillare</i> (Paca)	Witchgrass	FACU
<i>Panicum millifolium</i> (Pami)	Panicum	NA
<i>Phleum pratense</i> (Phpr)	Timothy	OBL
<i>Phleum</i> Sp. (Phsp)	Timothy	FACU
<i>Plagiobothrys scouleri</i> (Plsc)	Scouler popcorn flower	FACU
<i>Poa agassizensis</i> (Poag)	Bluegrass	NA
<i>Poa palustris</i> (Popa)	Fowl bluegrass	FACW
<i>Poa pratensis</i> (Popr)	Kentucky bluegrass	FACU
<i>Poa</i> sp. (Posp)	Bluegrass sp.	NA
<i>Polygonum aviculare</i> (Poav)	Prostrate knotweed	NA
<i>Potentilla anserina</i> (Poan)	Silverweed	OBL
<i>Potentilla</i> sp. (Potsp)	Cinquefoil	NA
<i>Ranunculus macounii</i> (Rama)	Buttercup	OBL
<i>Ranunculus repens</i> (Rare)	Creeping buttercup	FACW
<i>Ribes inerme</i> (Riin)	Whitestem gooseberry	FAC
<i>Rorippa islandica</i> (Rois)	Yellow cress	OBL
<i>Rosa woodsii</i> (Rowo)	Woods rose	FAC-
<i>Rumex crispus</i> (Rucr)	Curly dock	FACW
<i>Salix geyeriana</i> (Sage)	Geyer willow	OBL
<i>Sisymbrium altissimum</i> (Sial)	Tumble mustard	UPL
<i>Sisyrinchium idahoense</i> (Siid)	Blue-eyed grass	OBL
<i>Taraxacum officinale</i> (Taof)	Common dandelion	FACU
<i>Trifolium</i> sp. (Trsp)	clover	NA
<i>Trifolium repens</i> (Trre)	White clover	FACU

^aFrom National List of Plant Species That Occur in Wetlands: Intermountain (Region 8) (Reed, 1988).

- OBL = Obligate plant species that occur in wetlands 99 percent of the time.
 FACW = Facultative wetland plant species that usually occur in wetlands (67 to 99 percent of the time).
 FAC = Facultative plant species that are equally likely to occur in wetlands or nonwetlands.
 FACU = Facultative upland plant species that usually occur in nonwetlands (67 to 99 percent of the time).
 UPL = Upland plant species that occur in uplands (nonwetlands) 99 percent of the time.
 NA = Not given in Reed (1988); probably UPL species because Reed (1988) does not list all UPL species.
 + species tends toward the next wettest category.
 - species tends toward the next driest category.
 ? status unknown.

Table A.2 Plant species percent cover in 40 sample plots in transect 1 at Prospector Spring in Gunnison County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Juba		7	11	18	2		45	56.4
Caxe		6	7	1			10	12.5
Asoc	6	6	4				6	7.5
Taof	12	8					4	5.0
Hobr	1	4	2				3	3.8
Alge		6	1				3	3.8
Cisp	1		2				2	2.5
Hoju	3	4					2	2.5
Dece	2	2					1	1.3
Acla	2	3					1	1.3
Posp	3	2					1	1.3
Poan	7						0.4	0.5
Glst		1					0.4	0.5
Siid	5						0.3	0.4
Popa	3						0.2	0.3
Brca	3						0.2	0.3
Trsp	1						0.1	0.1
Paca	1						0.1	0.1
Brfr	2						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	79.8	100.2
Dead vegetation		8	3	1	2		12	
Bare ground	1	11	2				6	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.2 Plant species percent cover in 40 sample plots in transect 1 at Prospector
Spring in Gunnison County, Colorado, August 1996**

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Table A.3 Plant species frequency of occurrence and plant height in 40 sample plots in transect 1 at Prospector Spring in Gunnison County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Plant Height (inches)		
		Sample Size	Range	Mean
Juba	95	38	10-23	18 ^c
Taof	50	20	4-12	7
Asoc	40	16	2-16	9
Caxe	35	14	5-22	17 ^c
Popa & Posp	21	7	10-19	14
Hoju	18	7	11-17	14
Hobr	18	13	7-21	13
Poan	18	8	8-12	9
Alge	18	7	15-29	19
Acla	13	5	1-8	5
Siid	13	5	10-14	12
Dece	10	2	—	—
Brca	8	5	6-23	16
Cisp	8	3	—	—
Brfr	5	2	—	—
Paca	3	1	—	—
Trsp	3	1	—	—
Glst	3	3	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.4 Plant species percent cover in 40 sample plots in transect 2 at Prospector Spring in Gunnison County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Caut		7	14	7	1		29	40.1
Juba	4	20	7				14	19.4
Dece	9	24	2	1			13	17.9
Poan	16	12	1				6	8.3
Elpa	6	5	4				6	8.3
Poag	6	3	1				2	2.8
Caxe	5	1					1	1.4
Hoju	5						0.3	0.4
Asoc	4						0.3	0.4
Hobr	2						0.1	0.1
Rare	1						0.1	0.1
Rucr	1						0.1	0.1
Brfr	1						0.1	0.1
Posp	1						0.1	0.1
Acla	1						0.1	0.1
Unknown	1						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	72.3	99.7
Rock		1					0.4	
Dead vegetation	6	23	7				16	
Bare ground	1	1	2				2	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.4 Plant species percent cover in 40 sample plots in transect 2 at Prospector
Spring in Gunnison County, Colorado, August 1996**

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Table A.5 Plant species frequency of occurrence and plant height in 40 sample plots in transect 2 at Prospector Spring in Gunnison County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Dece	90	36	5-41	26 ^c
Juba	78	31	7-36	20 ^c
Poan	73	31	3-25	9
Caut	73	29	10-35	23 ^c
Elpa	38	13	6-15	11
Poag	25	10	13-23	19
Caxe	15	6	10-21	15
Hoju	13	5	5-21	14
Asoc	10	4	—	—
Hobr	5	2	—	—
Rare	3	1	—	—
Rucr	3	1	—	—
Acla	3	1	—	—
Brfr	3	1	—	—
Posp	3	1	—	—
Unknown	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.6 Plant species percent cover in 41 sample plots in transect 3 at Prospector Spring in Gunnison County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Juba	2	20	16				22	26.7
Asoc	8	14	5		1		12	14.5
Taof	9	23					9	10.9
Acla	5	15	2				8	9.7
Caxe	2	11	1				5	6.1
Cisp	5	4	3				5	6.1
Asle		6	2				4	4.8
Agtr	10	2	3				4	4.8
Hoju	7	3	2				3	3.6
Paca	7	1					1	1.2
Popa	4	2					1	1.2
Brtr	12	2					1	1.2
Casp	3	3					1	1.2
Siid			1				1	1.2
Crac	3	2					1	1.2
Agsp		2					1	1.2
Pami	10						1	1.2
Poan	2	1					0.5	0.6
Aslen		1					0.4	0.5
Alge	1	1					0.4	0.5
Mufi		1					0.4	0.5
Trsp	4						0.2	0.2
Poag	4						0.2	0.2
Rare	1						0.1	0.1
Dece	1						0.1	0.1
Hobr	2						0.1	0.1
Elpa	1						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	82.5	99.6
Dead vegetation	5	20	11				18	
Bare ground	3	2	2				2.7	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.5, Plant species percent cover in 40 sample plots in transect 3 at Prospector
Spring in Gunnison County, Colorado, August 1996**

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Table A.7 Plant species frequency of occurrence and plant height in 41 sample plots in transect 3 at Prospector Spring in Gunnison County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Juba	93	38	11-23	15 ^c
Taof	78	32	1-10	5
Asoc	68	29	3-11	6
Acla	54	22	4-14	8
Agtr	37	15	15-31	21
Caxe	34	14	9-20	14
Brfr	34	14	4-11	7
Hoju	29	11	7-18	11
Cisp	29	12	2-7	5
Pami	24	9	7-18	7
Asle	20	7	1-9	4
Paca	20	8	5-10	8
Popa	15	6	15-22	18
Casp	15	8	6-15	10
Crac	12	3	—	—
Trsp	10	4	—	—
Poag	10	2	—	—
Poan	7	3	—	—
Hobr	5	2	—	—
Alge	5	2	—	—
Agsp	5	2	—	—
Rare	2	1	—	—
Dece	2	1	—	—
Aslen	2	1	—	—
Elpa	2	1	—	—
Siid	2	1	—	—
Mufi	2	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.8 Plant species percent cover in 40 sample plots in transect 1 at Houston Gulch in Gunnison County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa		13	20	5	1		34	59.4
Juba	12	18	7				14	24.5
Asoc	20	12	1				7	12.2
Taof	11	1					1	1.7
Irm	1	1					0.4	0.7
Acla	6						0.4	0.7
Caxe	1						0.1	0.2
Hobr	1						0.1	0.2
Aslen	1						0.1	0.2
Casp	1						0.1	0.2
Total	NA	NA	NA	NA	NA	NA	57.2	100
Cow dung		3					1	
Dead vegetation		6	19	1			22	
Bare ground	5	11	6	2	2		17	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.8 Plant species percent cover in 40 sample plots in transect 1 at Houston Gulch
in Gunnison County, Colorado, August 1996**

Table A.9 Plant species frequency of occurrence and plant height in 40 sample plots in transect 1 at Houston Gulch in Gunnison County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Popa	98	39	1-14	6 ^c
Juba	93	37	3-13	8 ^c
Asoc	83	33	1-3	1
Taof	30	12	1-1	1
Acla	15	6	1-3	1
Irmi	5	2	—	—
Hobr	3	1	—	—
Caxe	3	1	—	—
Aslen	3	1	—	—
Casp	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.10 Plant species percent cover in 40 sample plots in transect 2 at Houston Gulch in Gunnison County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	1	19	8	1			16	28.3
Acla	10	15	3				9	15.9
Juba	4	10	3				7	12.4
Caut	1	3	4				5	8.8
Dece	1	3	3				4	7.1
Hoju	7	7					3	5.3
Caxe	2	6	1				3	5.3
Poan	11	4	1				3	5.3
Glst	2	6					2	3.5
Asoc	8	5					2	3.5
Taof	12	1					1	1.8
Popr		1					0.4	0.7
Cisp		1					0.4	0.7
Rois	1	1					0.4	0.7
Hobr	2						0.1	0.2
Trsp	1						0.1	0.2
Epad	1						0.1	0.2
Total	NA	NA	NA	NA	NA	NA	56.5	99.9
Dead vegetation	9	13	9	3			19	
Bare ground	9	11	8	1			13.8	
Barbed wire	1						0.1	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.10 Plant species percent cover in 40 sample plots in transect 2 at Houston
Gulch in Gunnison County, Colorado, August 1996**

Table A.11 Plant species frequency of occurrence and plant height in 40 sample plots in transect 2 at Houston Gulch in Gunnison County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Plant Height(inches)		
		Sample Size	Range	Mean
Popa	73	29	3-26	13 ^c
Acla	70	29	1-23	5
Juba	43	17	5-25	14
Poan	40	15	1-15	5
Hoju	35	14	5-12	9 ^c
Taof	33	13	1-2	1
Asoc	33	13	1-4	2
Caxe	23	9	3-11	7
Gist	20	8	8-19	13
Caut	20	8	11-21	17
Dece	18	7	14-22	18
Hobr	5	2	—	—
Rois	5	2	—	—
Popr	3	1	—	—
Trsp	3	1	—	—
Cisp	3	1	—	—
Epad	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.12 Plant species percent cover in 40 sample plots in transect 3 at Houston Gulch in Gunnison County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Dece	4	10	14	3			22	28.6
Juba	3	8	15	2			20	26.0
Asoc	5	18	5				12	15.6
Poan	9	6	1	1			5	6.5
Acla	1	2	4				5	6.5
Hoju	4	8					3	3.9
Rois	6	1	1				2	2.6
Epad	15	4					2	2.6
Popa	3	3					1	1.3
Alge	2	1					0.5	0.7
Caoc	2	1					0.5	0.7
Caxe		1					0.4	0.5
Taof	6						0.4	0.5
Mear	1	1					0.4	0.5
Poav	4						0.3	0.5
Hobr	2						0.1	0.1
Plsc	1						0.1	0.2
Total	NA	NA	NA	NA	NA	NA	76.9	99.0
Dead vegetation	1	10	14	3			22	
Cow dung		1					0.4	
Bare ground	5	5					2	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.12 Plant species percent cover in 40 sample plots in transect 3 at Houston
Gulch in Gunnison County, Colorado, August 1996**

Table A.13 Plant species frequency of occurrence and plant height in 40 sample plots in transect 3 at Houston Gulch in Gunnison County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Epad	48	19	3-20	9
Dece	78	31	9-35	23 ^c
Juba	70	28	9-34	18 ^c
Asoc	70	28	2-17	7
Poan	43	17	2-8	5
Hoju	30	12	8-20	13
Rois	20	9	1-7	3
Acla	18	7	1-6	4
Popa	15	6	7-23	17
Taof	15	6	1-4	2
Poav	10	1	—	—
Alge	8	3	—	—
Caoc	8	3	—	—
Hobr	5	2	—	—
Mear	5	2	—	—
Unknown species	5	2	—	—
Caxe	3	1	—	—
Mufi	3	1	—	—
Paca	3	1	—	—
Agsp	3	1	—	—
Plsc	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.14 Plant species percent cover in 40 sample plots in transect 1 at Upper Longs Gulch in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	1	11	20	6			32	57.8
Agst	6	3	1	2	1		8	14.4
Asoc	14	14	1				7	12.6
Juba		2	2				3	5.4
Agsm	5	5					2	3.6
Agtr		3					1	1.8
Luar		2					0.8	1.4
Assp		1					0.4	0.7
Taof	6						0.4	0.7
Acla	1	1					0.4	0.7
Capa	4						0.3	0.5
Potsp	1	3					0.1	0.2
Total	8	NA	NA	NA	NA	NA	55.4	99.8
Dead vegetation	1	17	9	1			16	
Elk droppings			1				0.9	
Rock		1					0.4	
Bare ground	8	11	4	4			15	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.14 Plant species percent cover in 40 sample plots in transect 1 at Upper Longs
Gulch in Saguache County, Colorado, August 1996**

landscape table

Table A.15 Plant species frequency of occurrence and plant height in 40 sample plots in transect 1 at Upper Longs Gulch in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Popa	95	38	4-22	12 ^c
Asoc	73	29	1-13	4
Agst	33	15	5-22	14
Agsm	25	10	7-27	11
Taof	15	7	2-9	3
Juba	10	4	—	—
Capa	10	4	—	—
Agtr	8	1	—	—
Acla	5	2	—	—
Luar	5	2	—	—
Potsp	3	1	—	—
Assp	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.16 Plant species percent cover in 35 sample plots in transect 2 at Upper Longs Gulch in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Caut	1	1	10	5	2		25	37.1
Glst	2	9	4	2			12	17.8
Juba	4	5	5	1			10	14.8
Poan	12	7	1				5	7.4
Hobr	7	8	1				5	7.4
Popa	4	3	2				4	5.9
Asoc	12	4					3	4.5
Elpa	2	3					1	1.5
Rucr	1	1					0.5	0.7
Caoc	1	1					0.5	0.7
Sage	1	1					0.5	0.7
Rowo		1					0.4	0.6
Rare	2						0.1	0.1
Glsp	1						0.1	0.1
Taof	1						0.1	0.1
Casp	1						0.1	0.1
Unknown plant	1						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	67.4	99.6
Dead vegetation	2	16	5				12	
Rock	5	5	2		1		7	
Dead wood		1			1		3	
Bare ground	2						0.1	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.16 Plant species percent cover in 40 sample plots in transect 2 at Upper
Longs Gulch in Saguache County, Colorado, August 1996**

landscape table

Table A.17 Plant species frequency of occurrence and plant height in 35 sample plots in transect 2 at Upper Longs Gulch in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Poan	57	20	5-13	9
Caut	54	19	15-35	24 ^c
Glst	49	18	9-37	21 ^c
Asoc	46	16	1-19	8
Hobr	46	16	4-30	24
Juba	43	15	16-32	21 ^c
Popa	26	9	15-27	22
Elpa	14	5	8-16	12
Rucr	6	2	—	—
Caoc	6	2	—	—
Sage	6	2	—	—
Rare	6	2	—	—
Glsp	3	1	—	—
Taof	3	1	—	—
Casp	3	1	—	—
Rowo	3	1	—	—
Unknown species	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.18 Plant species percent cover in 36 sample plots in transect 3 at Upper Longs Gulch in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	4	15	5	2			15	26.7
Asoc	6	24	2				13	23.2
Juba	5	14	3	1			11	19.6
Trre	6	12	2				8	14.3
Taof	13	7					4	7.1
Acla	17	1					2	3.6
Agst	4	1					0.7	1.0
Hobr	4	1					0.7	1.3
Luar	1	1					0.5	0.9
Agtr		1					0.4	0.7
Asag	6						0.4	0.7
Agsm	1						0.1	0.2
Cisp	1						0.1	0.2
Irmi	1						0.1	0.2
Capa	1						0.1	0.2
Total	NA	NA	NA	NA	NA	NA	56.1	99.9
Elk droppings		1					0.4	
Grouse droppings	1						0.1	
Dead wood	8	3					2	
Rock	2	10	4				8	
Dead Vegetation	1	18	10	1			20	..
Bare ground	3	4	3				5	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.18 Plant species percent cover in 36 sample plots in transect 3 at Upper
Longs Gulch in Saguache County, Colorado, August 1996**

landscape table

Table A.19 Plant species frequency of occurrence and plant height in 36 sample plots in transect 3 at Upper Longs Gulch in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Asoc	89	31	1-8	3
Popa	72	24	3-17	11 ^c
Juba	67	23	8-14	11 ^c
Taof	56	20	1-4	2
Trre	56	19	1-5	2
Acla	50	19	2-8	4
Asag	17	6	1-5	3
Hobr	14	5	10-19	14
Agst	14	4	—	—
Luar	6	2	—	—
Agsm	3	1	—	—
Cisp	3	1	—	—
Irmi	3	1	—	—
Capa	3	1	—	—
Agtr	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.20 Plant species percent cover in 34 sample plots in transect 1 at Lower Longs Gulch in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa		15	6	6	3		32	67.2
Juba	5	9	5				10	21.0
Taof	20	3					3	6.3
Luar	6	2					1	2.1
Riin	1	1					0.5	1.0
Phsp		1					0.4	0.8
Acla	3						0.2	0.4
Lemo	1		1	2			0.1	0.2
Hobr	1						0.1	0.2
Agsm	1						0.1	0.2
Caoc	1						0.1	0.2
Artr	1						0.1	0.2
Asoc	1						0.1	0.2
Total	NA	NA	NA	NA	NA	NA	47.6	100.0
Cow dung	1						0.4	
Rock	1	3					1	
Wood		1					0.4	
Dead vegetation	1	4	14	5	2		34	
Bare ground	5	8	2	1	2		13	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.20 Plant species percent cover in 35 sample plots in transect 1 at Lower
Longs Gulch in Saguache County, Colorado, August 1994**

landscape table

Table A.21 Plant species frequency of occurrence and plant height in 34 sample plots in transect 1 at Lower Longs Gulch in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Popa	88	31	2-13	6 ^c
Taof	68	23	1-2	1
Juba	56	19	7-24	11 ^c
Luar	24	8	1-8	5
Acla	9	3	—	—
Riin	6	2	—	—
Lemo	3	1	—	—
Hobr	3	1	—	—
Agsm	3	1	—	—
Caoc	3	1	—	—
Artr	3	1	—	—
Phsp	3	1	—	—
Asoc	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.22 Plant species percent cover in 41 sample plots in transect 1 at Sage Hen Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	2	15	9	2			17	40.4
Asoc	17	8	3				7	16.6
Agsm	1	4	1	1			4	9.5
Juba	6	4	2				4	9.5
Agsp	1	4	2				3	7.1
Sial	3	6	1				3	7.3
Ciar	4	3					1	2.4
Artr		2					0.7	1.7
Taof	4	1					0.6	1.4
Laoc	3	1					0.5	1.2
Acla	1	1					0.4	1.0
Eqar	3						0.2	0.5
Hoju	3						0.2	0.5
Capa	1						0.1	0.2
Potsp	1						0.1	0.2
Chvi	1						0.1	0.2
Casp	1						0.1	0.2
Trsp	1						0.1	0.2
Total	NA	NA	NA	NA	NA	NA	42.1	99.9
Elk droppings	2						0.1	
Deer droppings	1						0.1	
Cow dung		2					0.7	..
Dead vegetation	1	2	9	15	13		59	
Bare ground	14	5	9	1			13	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.22 Plant species percent cover in 41 sample plots in transect 1 at Sage Hen
Spring in Saguache County, Colorado, August 1996**

landscape table

Table A.23 Plant species frequency of occurrence and plant height in 41 sample plots in transect 1 at Sage Hen Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Plant Height (inches)		
		Sample Size	Range	Mean
Popa	68	28	3-21	8 ^c
Asoc	68	29	1-10	2
Juba	29	12	2-16	9
Sial	24	10	6-18	12
Agsm	17	7	5-18	11
Agsp	17	7	7-26	17
Ciar	17	8	1-15	6
Taof	12	5	1-3	2
Laoc	10	4	—	—
Eqar	7	3	—	—
Hoju	7	3	—	—
Acla	5	2	—	—
Artr	5	1	—	—
Potsp	2	1	—	—
Chvi	2	1	—	—
Casp	2	1	—	—
Capa	2	1	—	—
Trsp	2	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.24 Plant species percent cover in 31 sample plots in transect 2 at Sage Hen Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Ciar	2	2	1	3	3		17	39.2
Laoc	6		3	2			8	18.0
Caut	1		1	1	1		6	13.5
Sial	5	5	3				6	13.5
Hoju	1	3					2	4.5
Arfr	3	1	1				0.2	4.5
Popa	1	1					0.6	1.3
Eqar	1	1					0.6	1.3
Agsm	1	1					0.6	1.3
Agsp		1					0.5	1.1
Irmi		1					0.5	1.1
Juba	2						0.2	0.4
Taof	2						0.2	0.4
Artr	2						0.2	0.4
Hovu	1						0.1	0.2
Total	NA	NA	NA	NA	NA	NA	44.5	99.7
Elk droppings	4						0.3	
Deer droppings	1						0.1	
Wood	1						0.1	
Dead vegetation	2	5	11	9	4		45	
Bare ground	5	11	8	1			17	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.24 Plant species percent cover in 31 sample plots in transect 2 at Sage Hen
Spring in Saguache County, Colorado, August 1996**

landscape table

Table A.25 Plant species frequency of occurrence and plant height in 31 sample plots in transect 2 at Sage Hen Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Plant Height (inches)		
		Sample Size	Range	Mean
Sial	42	13	1-24	11
Laoc	35	11	3-12	7
Ciar	35	11	1-31	20 ^c
Arfr	16	5	3-7	4
Caut	13	4	—	—
Hoju	13	4	—	—
Eqar	7	2	—	—
Agsm	7	2	—	—
Popa	6	2	—	—
Juba	6	2	—	—
Taof	6	2	—	—
Artr	6	1	—	—
Agsp	3	1	—	—
Hovu	3	1	—	—
Irmi	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.26 Plant species percent cover in 40 sample plots in transect 3 at Sage Hen Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	1	11	15	5	2		30	77.7
Juba	13	9	2				6	15.5
Hoju	5	1					0.7	1.8
Caxe	2	1					0.5	1.3
Glst		1					0.4	1.0
Hovu		1					0.4	1.0
Casp	4						0.3	0.7
Rowo	1						0.1	0.3
Artr	1						0.1	0.3
Taof	2						0.1	0.3
Total	NA	NA	NA	NA	NA	NA	38.6	99.9
Elk droppings	4	2					1	
Rock			1				0.9	
Dead vegetation			13	12	11	1	57	
Bare ground	9	15	10	3			20	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.26 Plant species percent cover in 40 sample plots in transect 3 at Sage Hen
Spring in Saguache County, Colorado, August 1996**

landscape table

Table A.27 Plant species frequency of occurrence and plant height in 40 sample plots in transect 3 at Sage Hen Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Sample Size	Plant Height (inches)	
			Range	Mean
Popa	85	38	1-25	8 ^c
Juba	60	26	5-16	10
Hoju	15	6	5-9	7
Casp	10	4	—	—
Caxe	8	3	—	—
Taof	5	2	—	—
Glst	3	1	—	—
Rowo	3	1	—	—
Hovu	3	1	—	—
Artr	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.28 Plant species percent cover in 40 sample plots in transect 1 at Camp Kettle Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Posp	3	5	19	8	1		35	49.2
Juba	9	18	3				10	14.0
Asoc	16	8	5				9	12.6
Chvi		2	2	1	1		6	8.4
Asle	1			1			2	2.8
Cisp	9	4					2	2.8
Caxe	5	1	1				2	2.8
Hoju	4		1				1	1.4
Acla	5	1					0.7	1.0
Casp	4	1					0.6	1.0
Aslen	3	1					0.6	0.8
Arfr	2	1					0.5	0.7
Mufi	1	1					0.4	0.6
Paca	1	1					0.4	0.6
Eqar	5						0.3	0.4
Taof	4						0.3	0.4
Poan	2						0.1	0.1
Agtr	1						0.1	0.1
Irmf	1						0.1	0.1
Pami	1						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	71.2	99.9
Elk droppings	2						0.1	
Deer droppings	14						0.9	
Cow dung		1		1			2	
Rock	1						0.1	
Dead vegetation	2	9	13	6	2		29	
Bare ground	11	11	9	6			22	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.28 Plant species percent cover in 40 sample plots in transect 1 at Camp Kettle
Spring in Saguache County, Colorado, August 1996**

landscape table

Table A.29 Plant species frequency of occurrence and plant height in 40 sample plots in transect 1 at Camp Kettle Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Plant Height (inches)		
		Sample Size	Range	Mean
Posp	90	36	2-12	5 ^c
Juba	75	29	4-14	8 ^c
Asoc	73	29	1-9	2
Cisp	33	13	1-7	3
Caxe	18	7	2-7	5
Acla	15	6	1-10	3
Chvi	15	6	8-22	15
Eqar	13	5	1-4	3
Hoju	13	5	6-10	8
Casp	13	5	1-5	2
Aslen	10	4	—	—
Taof	10	4	—	—
Arfr	8	3	—	—
Asle	5	2	—	—
Poan	5	2	—	—
Mufi	5	2	—	—
Paca	5	2	—	—
Agtr	3	1	—	—
Irmi	3	1	—	—
Pami	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.30 Plant species percent cover in 30 sample plots in transect 2 at Camp Kettle Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Juba		7	8	4	2		28	32.3
Posp	2	10	7	2			19	21.9
Asoc	3	4	7				11	12.7
Caxe	2	7	3	1			10	11.5
Glst	3	8	4				9	10.4
Hoju	7	6					4	4.6
Taof	3	5	1				4	4.6
Poan	8	1					1	1.2
Caut			1				1	1.2
Poav	2						0.2	0.2
Hobr	1						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	86.8	100.1
Deer droppings	1						0.1	
Wood	1						0.1	
Dead vegetation	12	10	2	2			13	
Bare ground	2	2					1	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.30 Plant species percent cover in 30 sample plots in transect 2 at Camp Kettle
Spring in Saguache County, Colorado, August 1996**

landscape table

Table A.31 Plant species frequency of occurrence and plant height in 30 sample plots in transect 2 at Camp Kettle Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Plant Height (inches)		
		Sample Size	Range	Mean
Posp	73	22	9-31	17 ^c
Juba	70	21	11-25	18 ^c
Glst	50	15	7-28	17
Asoc	47	14	3-12	9
Hoju	43	13	6-18	12
Caxe	43	13	3-22	15 ^c
Poan	30	9	4-8	6
Taof	30	9	2-8	4
Poav	6	2	—	—
Hobr	3	1	—	—
Caut	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

Table A.32 Plant species percent cover in 39 sample plots in transect 3 at Camp Kettle Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Canopy Cover Classes						Canopy Coverage ^b (%)	Species Composition ^c (%)
	Class 1 1 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Cane		2	3	6	22	6	76	83.4
Poan	19	8					4	4.3
Glst	4	2	1				2	2.2
Acla	6	5					2	2.2
Juba	2	2					1	1.1
Asoc	1	1	1				1	1.1
Unknown plant	2	1					0.5	0.5
Posp	2	1					0.5	0.5
Taof	4						0.3	0.3
Dece	9	5	1				0.3	3.3
Rama	3						0.2	0.2
Hobr	3						0.2	0.2
Rare	2						0.1	0.1
Elpa	1						0.1	0.1
Capa	1						0.1	0.1
Hoju	2						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	91.1	99.7
Dead vegetation	16	6					3	
Bare ground							0	

^aSee list of scientific names for abbreviations.

^b Σ (number of plants in Class 1) (midpoint percent of Class 1 - 2.5 percent) + (number plants in Class 2) (midpoint percent in Class 2 - 15 percent) + ... + (number of plants in Class 6) (midpoint in Class 6 - 97.5 percent)/number of frames sampled.

^cPercent canopy coverage by species/total canopy coverage.

NA - not applicable.

**Table A.32 Plant species percent cover in 39 sample plots in transect 3 at Camp Kettle
Spring in Saguache County, Colorado, August 1996**

landscape table

Table A.33 Plant species frequency of occurrence and plant height in 39 sample plots in transect 3 at Camp Kettle Spring in Saguache County, Colorado, August 1996

Plant Species ^a	Frequency ^b (%)	Plant Height (inches)		
		Sample Size	Range	Mean
Cane	100	39	12-33	19 ^c
Poan	69	28	2-13	9
Dece	38	15	12-45	25
Acla	29	10	3-18	9
Glst	18	7	10-25	17
Juba	10	5	13-17	13
Taof	10	4	—	—
Posp	8	3	—	—
Asoc	8	2	—	—
Hobr	8	3	—	—
Rama	8	3	—	—
Unknown plant	8	3	—	—
Rare	5	2	—	—
Hoju	5	2	—	—
Elpa	3	1	—	—
Capa	3	1	—	—

^aSee list of scientific names for abbreviations.

^b(Number of frames in which a species occurs ÷ number of frames sampled) x 100.

^cUsed to calculate average plant height in Table 3.4.

Dash indicates sample size too small to calculate statistics.

APPENDIX B

**PHOTOGRAPHIC SERIES
AT WETLANDS MITIGATION SITES**

AUGUST 1996

PHOTOGRAPHIC SERIES 1

1996

1995

1994

1993

PHOTOGRAPHIC SERIES 2

1993

1994

1995

1996

PHOTOGRAPHIC SERIES 3

1993

1994

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PHOTOGRAPHIC SERIES 4

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PHOTOGRAPHIC SERIES 8

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PHOTOGRAPHIC SERIES 9

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