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Managing Water in the West

2007 Baseline Monitoring Report for Treatment of Saltcedar (*Tamarix spp*.) and Other Invasive Nonnative Vegetation – Orilla Verde Recreation Area

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Environmental Services Division
Fisheries and Wildlife Resources Group
Denver, Colorado

April 2008

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

2007 Baseline Monitoring Report for Treatment of Saltcedar (*Tamarix spp.*) and Other Invasive Nonnative Vegetation

Orilla Verde Recreation Area

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Introduction

Bureau of Land Management (BLM) is implementing a program to eliminate saltcedar and other invasive species along the Rio Grande River within the Orilla Verde Recreation Area (OVRA; USDI 2006). Bureau of Reclamation (Reclamation) conducted baseline vegetation monitoring at sites within the treatment area in June of 2006 and in October of 2007.

Treatments have begun at the northern (upstream) end of the OVRA reach and will continue south over time. Initial treatments were implemented in sites where vegetative cover is comprised of mostly native species and saltcedar is fairly sparse and can be removed by hand. Reclamation monitored four polygons in the upper reaches (Appendix A). Hand removal of saltcedar occurred in one of the transects in one of these polygons in the spring of 2007. No other treatments were carried out at the monitoring sites prior to data collection this year.

Methods

Monitoring was conducted within two types of polygons: treatment and reference.

Treatment Polygons (1 and 3)

The two treatment polygons were located in those areas with sparse saltcedar as described above. Two types of permanent transects were established in the treatment polygons. Two treatment transects were located in areas where the saltcedar was the most dense, and two reference transects were located in areas dominated by native species in which potential future conditions (post-treatment) exist for that polygon. The treatment and reference transects within each polygon were statistically compared to determine if conditions were similar over the 2-year monitoring period.

Reference Polygons (2 and 4)

The two reference (control) polygons were located in healthy native willow communities with no saltcedar. Data from two transects in each of these polygons were collected to examine trends in untreated sites and were statistically compared over time. These sites could potentially serve as reference areas of future desired conditions for those polygons that are dominated by saltcedar and treated later in the project.

Vegetative cover and woody stem density were measured in five 1-meter square (m^2) plots along a 25-meter (m) transect. The percent cover by species was estimated for the herbaceous and shrub layer, and the number of woody plants by species was counted within each plot. Plots were located along the transect at 0-1 m, 5-6 m, 10-11 m, 15-16 m, and 20-21 m. The first plot was placed on the upstream (north) end of the transect; plots were alternated on each side of the tape, starting with the first plot on the right (west) of the transect, the second plot left (east), the third right, and so on. In the treatment transects within the treatment polygons, the number of saltcedar within 1 m on the west side of the 25-m tape was also counted.

Statistical analyses included the relative cover of native species (i.e., the percent of native species relative to the total cover of native and introduced plant species), and the total cover of plant, litter, and bare ground within the herbaceous layer. The total shrub cover and the stem density were statistically evaluated within the overstory layer. These analyses compared data between the treatment and reference transects within the treatment polygons and compared data between years for all polygons. The Student's t-test of means was used to statistically compare normally distributed data, and the Mann-Whitney nonparametric test of medians was used to compare data that were not normally distributed.

Canopy cover was estimated using a densiometer and taking four readings—two at each direction parallel to the transect and two at each direction perpendicular to the transect—at the end point of each of the transects. These four readings were averaged to get one value for each point, or two values per transect, which were then averaged to get a canopy cover estimate for the transect.

Photos were taken from each end of the transects to visually document changes in the vegetation over time and in response to treatment. A permanent photo station was established in association with each polygon (either within the polygon or from a distance) to capture overall conditions of the site.

Results

Treatment Polygons

Polygon 1; Transects T1 (treatment) and R1 (reference)

The total percent cover by individual plant, lifeform, and cover type for the two treatment polygons is shown in Table 1. The values given for the herbaceous and shrub layers are an average of the 10 plots measured in the 2 transects within each type of polygon/

Table 1. Total percent cover by individual plant, lifeform, and cover type for treatment polygons 1 and 3 in 2006 and 2007; OVRA, Rio Grande, New Mexico

			Total Percent Cover - Treatment Polygons					
	2006				**2007**			
	Polygon 1		**Polygon 3**		**Polygon 1**		**Polygon 3**	
	Treatment transects	**Reference transects**	**Treatment transects**	**Reference transects**	**Treatment transects**	**Reference transects**	**Treatment transects**	**Reference transects**
Herbaceous layer								
Shrub seedlings								
Cottonwood	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Coyote willow	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Native shrubs	0.6	0.0	0.0	0.3	0.0	0.0	0.0	0.1
Saltcedar	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Siberian elm	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Introduced shrubs	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0
Graminoids								
Sedge	0.0	2.1	0.0	3.3	0.0	8.6	0.0	7.4
Canada wildrye	0.0	0.0	0.0	0.0	0.0	1.6	0.1	0.4
Slender wheatgrass	9.5	2.6	0.2	0.0	47.0	19.6	3.0	3.4
Alkali muhly	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Marsh muhly	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
Reed canary grass	0.0	0.0	0.0	1.0	0.0	0.2	0.0	3.0
Kentucky bluegrass	0.0	0.4	0.2	0.0	0.0	23.5	3.8	0.0
Sand dropseed	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
Native grasses	9.5	5.2	0.4	4.3	47.0	53.5	7.3	14.7
Redtop	0.0	0.0	0.0	0.7	0.0	0.0	0.0	10.4
Smooth brome	0.0	0.0	0.1	0.8	0.0	0.0	0.0	4.6
Japanese brome	0.6	0.1	0.0	0.0	0.5	0.0	3.0	0.0
Cheatgrass	3.5	0.0	0.6	0.0	7.2	0.0	40.4	1.2
Tall fescue	0.0	0.0	0.0	0.0	0.0	7.8	0.0	0.0
Introduced grasses	4.1	0.1	0.7	1.5	7.7	7.8	43.4	16.2
Forbs								
Common yarrow	0.0	0.0	0.1	0.0	0.0	0.0	1.6	0.0
Annual ragweed	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
Dogbane	0.0	2.4	0.0	0.2	0.0	0.2	0.0	0.1
Silverweed cinquefoil	0.0	0.3	0.0	0.0	0.0	0.2	0.0	0.0
Carruth's sagewort	0.0	0.0	0.0	0.0	0.0	0.1	2.2	0.0
White sagebrush	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Swamp milkweed	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.5
Aster	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4
Spearleaf rabbitbrush	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
Canadian horseweed	0.2	0.9	0.2	0.2	5.0	6.1	1.5	0.5
Field horsetail	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Smooth scouringrush	0.0	0.1	0.6	0.6	0.0	0.1	0.9	0.4

	Total Percent Cover – Treatment Polygons							
	2006				2007			
	Polygon 1		Polygon 3		Polygon 1		Polygon 3	
	Treatment transects	Reference transects	Treatment transects	Reference transects	Treatment transects	Reference transects	Treatment transects	Reference transects
Curlycup gumweed	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Mountain sneezeweed	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Rough bugleweed	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Wild mint	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
Hooker's evening primrose	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0
Pricklypear cactus	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Cottonbatting cudweed	0.0	0.0	0.0	0.8	0.0	0.1	0.0	0.3
White-panicle aster	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Unknown forb	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Native forbs	0.2	4.8	1.0	3.5	5.0	7.5	9.0	4.2
Canada thistle	3.3	2.6	0.0	0.6	0.7	3.2	0.0	1.8
Bull thistle	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Houndstongue	0.2	0.0	0.1	0.0	1.0	0.0	0.0	0.0
Perennial pepperweed	0.6	0.1	0.1	0.0	0.0	0.0	0.1	0.0
White sweetclover	0.0	0.0	0.0	0.0	0.0	4.4	0.0	1.4
Virginia creeper	0.2	0.0	0.0	0.0	2.0	0.0	0.0	0.0
Narrowleaf plantain	0.0	0.0	0.0	0.0	0.6	0.8	0.0	0.2
Curly dock	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Dandelion	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
Red clover	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
Mullein	0.0	0.0	1.1	0.0	6.8	0.3	5.5	1.4
Introduced forbs	4.3	2.8	1.3	0.7	11.4	8.7	5.7	5.1
Total vegetative cover	18.7	13.0	3.5	10.3	71.1	77.5	65.5	40.3
Basal area of shrubs	8.2	15.6	13.3	14.8	3.3	1.0	13.5	7.5
Litter	62.5	43.1	58.2	36.2	22.6	14.5	18.5	37.7
Bare	10.6	28.3	25.0	38.7	3.0	7.0	2.5	14.5
Total herbaceous cover	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Shrub layer								
New Mexico olive	13.5	0.2	0.0	0.0	13.7	0.0	0.0	0.2
Coyote willow	26.0	48.0	20.5	53.5	23.0	45.5	19.5	48.5
Native shrubs	39.5	48.2	20.5	53.5	36.7	45.5	19.5	48.7
Saltcedar	7.5	0.0	19.3	0.0	8.0	0.0	23.1	0.0
Introduced shrubs	7.5	0.0	19.3	0.0	8.0	0.0	23.1	0.0
Total shrub cover	47.0	48.2	39.8	53.5	44.7	45.5	42.6	48.7
Canopy cover	72.1	24.2	62.2	0.7	30.0	30.6	66.4	22.5

transect. Scientific names for the plants detected within all transects are shown in Appendix B.

Thirty-two species were detected within the T1 and R1 transects over the 2 years of monitoring. In 2006, the most abundant species based on percent cover in the treatment transects were slender wheatgrass, cheatgrass, and Canada thistle. In 2007, the most common species were slender wheatgrass, cheatgrass, and mullein in these same transects. In the reference transects, the most common species in 2006 were slender wheatgrass, Canada thistle, and dogbane, which shifted to Kentucky bluegrass, slender wheatgrass, and sedge in 2007.

The relative cover of plant types detected in all polygons by transect is shown in Table 2. In Polygon 1, there was a significantly lower percentage of native plants—which means conversely a significantly higher percentage of introduced plants—in the treatment transects (42 percent) than in the reference transects (72.6 percent) in 2006 (see statistical results and P-values for treatment polygons in Table 3). Relative cover of native species in the treatment transects increased to levels of the reference transects in 2007. No other statistical differences were detected between transects or years for the relative cover of native plants in this polygon.

Graphs in Figures 1 and 2 provide a visual representation of the total cover of plant, litter, and bare ground in the herbaceous layer for all polygons in 2006 and 2007. When comparing the total cover of plant, litter, and bare ground between the treatment and reference transects in Polygon 1, the only statistical differences were in 2006 when an average litter cover of 62.5 percent in the treatment transects was significantly greater than the 43.1 percent litter cover in the reference transects. This same year bare ground was significantly greater in the reference transects, at 28.3 percent, than in the treatment transects, at 10.6 percent.

In comparisons between the 2 years of monitoring, total plant cover was significantly lower in 2006 than in 2007 for both the treatment (18.7 vs. 71.1 percent) and reference (13.0 vs. 77.5 percent) transects, while total litter cover and bare ground were significantly higher in 2006 in both transect types. Litter cover averaged 62.5 percent in 2006 and 22.6 percent in 2007 in the treatment transects and 43.1 percent in 2006 and 14.5 percent in 2007 in the reference transects. Bare ground averaged 10.6 percent in 2006 and 3.0 percent in 2007 in the treatment transects and 28.3 percent in 2006 and 7.0 percent in 2007 in the reference transects.

The reasons for significantly higher plant cover (and thus lower litter and bare ground cover) in the second year of monitoring are unknown. Monitoring was conducted during June in 2006 and in October in 2007, and the differing seasons may have had some effect on the data. Late summer monsoonal rains may have contributed to the higher plant cover in October. Annual precipitation was similar between the 2 years—17.3 inches during the 2006 hydrologic year and 18.6 inches in 2007—but by June of 2006, only 5.3 inches of precipitation had fallen (Table 4).

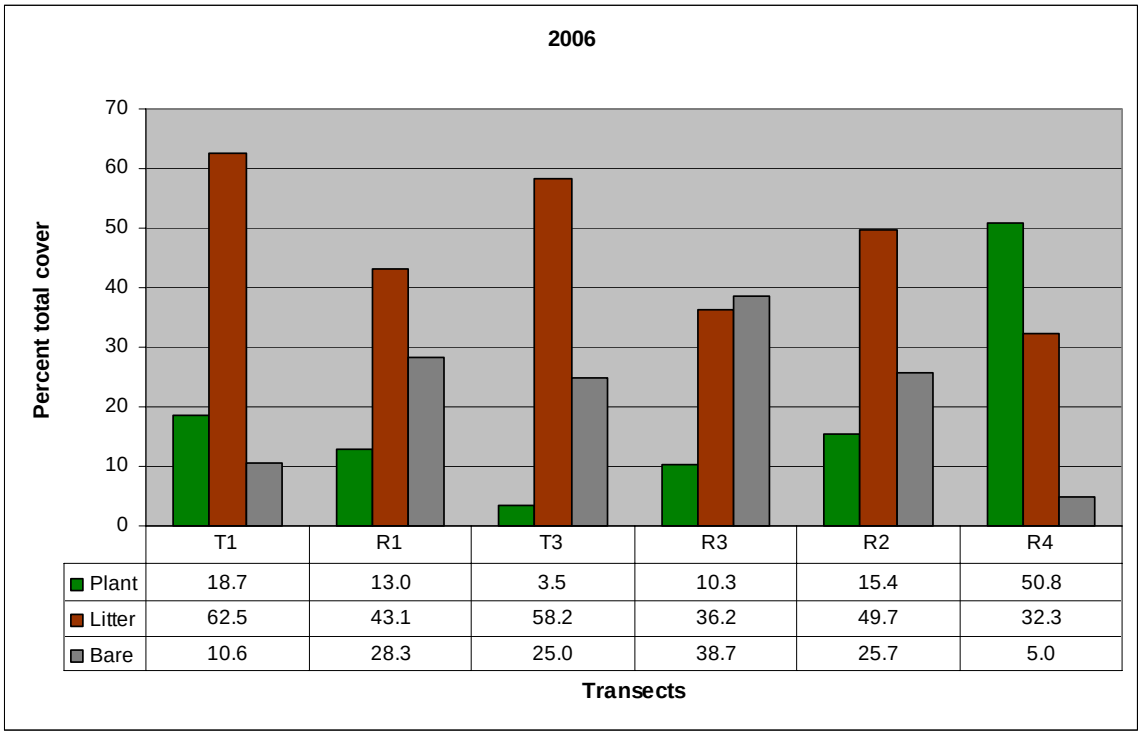
Table 2. Relative percent cover of native or introduced plants by lifeform in the herbaceous layer; OVRA, Rio Grande, New Mexico

	Percent Relative Cover by Lifeform							
Transect	**Native shrub**	**Intro shrub**	**Native grass**	**Intro grass**	**Native forb**	**Intro forb**	**Total native spp.**	**Total intro spp.**
2006								
T1	5.0	0.0	36.0	34.1	1.0	23.9	42.0	58.0
R1	0.0	1.0	40.3	3.8	32.3	22.6	72.6	27.4
R2	1.2	0.0	23.0	18.7	45.3	11.9	69.4	30.6
T3	0.0	0.9	13.3	21.5	42.2	22.1	55.5	44.5
R3	1.4	0.0	15.8	52.7	24.5	5.5	41.8	58.2
R4	0.2	0.0	47.5	9.2	41.6	1.6	89.2	10.8
2007								
T1	0.0	0.0	56.1	17.5	7.7	18.6	63.9	36.1
R1	0.0	0.0	68.8	9.5	10.0	11.8	78.8	21.2
R2	0.0	0.0	24.1	37.8	23.9	14.2	48.0	52.0
T3	0.0	0.1	11.3	62.0	17.8	8.8	29.1	70.9
R3	1.4	0.0	38.4	35.2	9.7	15.3	49.5	50.5
R4	0.0	0.0	27.2	40.6	20.7	11.6	47.9	52.1

Table 3. Statistical comparisons between treatment and reference transects and between years for the transects within the treatment polygons; OVRA, Rio Grande, New Mexico. Alpha=0.05

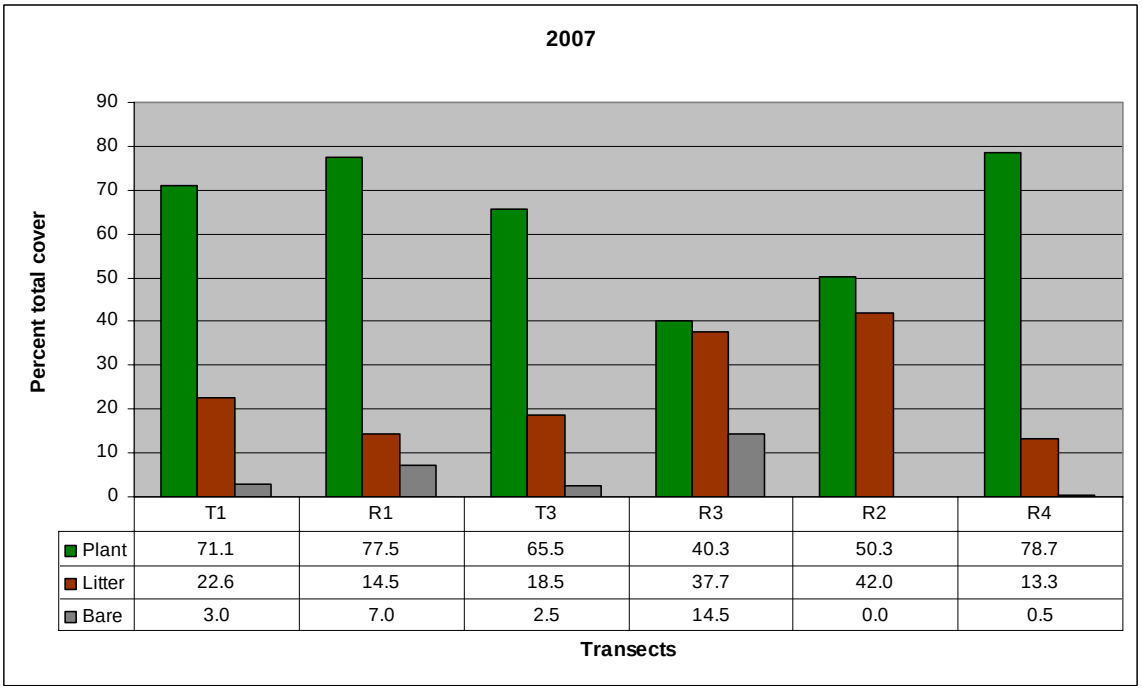
	T1 vs R1		**T3 vs R3**		**2006 vs 2007**					
	2006	**2007**	**2006**	**2007**	**T1**	**R1**	**T3**	**R3**	**R2**	**R4**
Understory herbaceous layer										
Native species relative cover	T1<R1 P=0.035[1]	T1=R1 P=0.251[1]	T3=R3 P=0.454[1]	T3=R3 P=0.186[1]	06=07 P=0.167[1]	06=07 P=0.558[1]	06=07 P=0.087[1]	06=07 P=0.675[1]	06=07 P=0.108[1]	06>07 P=0.004[2]
Plant total cover	T1=R1 P=0.303[2]	T1=R1 P=0.507[1]	T3=R3 P=0.117[1]	T3>R3 P=0.029[1]	06<07 P=0.001[2]	06<07 P<0.001[1]	06<07 P<0.001[1]	06<07 P=0.004[1]	06<07 P<0.001[1]	06<07 P=0.005[2]
Litter total cover	T1>R1 P=0.018[1]	T1=R1 P=0.252[2]	T3>R3 P=0.001[1]	T3<R3 P=0.023[1]	06>07 P<0.001[1]	06>07 P=0.002[2]	06>07 P<0.001[1]	06=07 P=0.826[1]	06=07 P=0.219[1]	06>07 P=0.001[1]
Bare ground total cover	T1<R1 P<0.003[2]	T1=R1 P=0.544[2]	T3=R3 P=0.068[1]	T3=R3 P=0.125[2]	06>07 P=0.033[2]	06>07 P<0.001[1]	06>07 P<0.001[1]	06>07 P=0.015[2]	No bare ground in 07	06>07 P=0.003[2]
Overstory shrub layer										
Total shrub cover	T1=R1 P=0.916[1]	T1=R1 P=0.952[1]	T3=R3 P=0.195[1]	T3=R3 P=0.637[1]	06=07 P=0.859[1]	06=07 P=0.823[1]	06=07 P=0.801[1]	06=07 P=0.695[1]	06=07 P=0.576[1]	06=07 P=0.353[1]
Total stem density	T1=R1 P=0.425[1]	T1<R1 P=0.009[2]	T3<R3 P=0.009[1]	T3<R3 P=0.032[1]	06=07 P=0.745[1]	06=07 P=0.391[1]	06=07 P=0.588[1]	06=07 P=0.608[1]	06=07 P=0.625[1]	06=07 P=0.850[2]

Highlighted boxes indicate a significant difference at the 95 percent confidence level.



	T1	R1	T3	R3	R2	R4
Plant	18.7	13.0	3.5	10.3	15.4	50.8
Litter	62.5	43.1	58.2	36.2	49.7	32.3
Bare	10.6	28.3	25.0	38.7	25.7	5.0

Figure 1. Total plant, litter, and bare cover for treatment and reference transects in 2006; OVRA, Rio Grande, New Mexico.



	T1	R1	T3	R3	R2	R4
Plant	71.1	77.5	65.5	40.3	50.3	78.7
Litter	22.6	14.5	18.5	37.7	42.0	13.3
Bare	3.0	7.0	2.5	14.5	0.0	0.5

Figure 2. Total plant, litter, and bare cover for treatment and reference transects in 2007; OVRA, Rio Grande, New Mexico.

Table 4. Annual precipitation as recorded at the USFS Truchas weather station for the hydrologic year from October 1 to September 30 in 2006 and 2007

Annual Precipitation (in)		
Month	**2006**	**2007**
October	2.57	1.73
November	0.16	0.19
December	0.10	0.82
January	0.38	0.59
February	0.04	1.26
March	1.05*	0.80
April	0.62	1.05*
May	0.40	2.24
June	0.71	1.55
July	4.12	3.46
August	4.33	1.77
September	2.79	3.11
Total	17.27	18.57

*No reading available; zone average listed

There were no statistically significant differences in the total percent of overstory shrub cover between the treatment and reference transects or between years in Polygon 1.

Table 5 shows the average number of woody stems per m^2 for the four polygons. The values listed are an average of the 10 plots that were measured in the 2 transects within each polygon/transect type. In 2007, density in the treatment transects of Polygon 1 was 16.2 stems/m^2, which was significantly less than 29.8 stems/m^2 in the reference transects. No other differences in stem density were detected.

Table 6 shows the number of saltcedar per 25 m^2 for the treatment polygons and transects and is an average of the two transects within each polygon. The number of saltcedar in the 25 m^2 transects in Polygon 1 more than doubled from 2006 to 2007. One of the treatment transects fell within an area in which saltcedar was removed by hand cutting in the spring of 2007. No follow-up treatments were used, and the large increase in saltcedar stems could be attributed to resprouting of the cut stems. This increase in stems was not detected through density measurements at the 1-m plot level, however, as described above.

The overall canopy cover of treatment transects in Polygon 1, as measured with a densiometer and shown in Table 1, decreased substantially from 2006 to 2007—from 72.1 to 30.0 percent. This could also be due to the cutting of saltcedar in the treatment transect. Although the number of saltcedar stems may have increased, the upper canopy would have decreased with removal of tall saltcedar trees. Prior to removal, the treatment transects had a much higher canopy cover than the reference transects, as well.

Table 5. The average number of stems per meter squared for woody species within treatment and reference transect plots; OVRA, Rio Grande, New Mexico

	Avg. # of stems /m^2							
	2006				2007			
	Coyote willow	New Mexico olive	Salt-cedar	Total shrub	Coyote willow	New Mexico olive	Salt-cedar	Total shrub
Treatment polygons								
T1	11.2	4.3	2.1	17.6	10.3	4.1	1.8	16.2
R1	22.8	0.1	0	22.9	29.8	0	0	29.8
T3	11.2	0	7.9	19.1	10.5	0.2	6.6	17.3
R3	37	0	0	37	31.7	0.5	0	32.2
Reference polygons								
2	32.1	0	0	32.1	36.1	0	0	36.1
4	21	0	0	21	19.5	0	0	19.5

Table 6. The average number of saltcedar stems per 25 meters squared within the treatment transects in treatment polygons; OVRA, Rio Grande, New Mexico

	Avg. # saltcedar/25 m^2	
Treatment polygon/transect	**2006**	**2007**
Polygon 1	20	49.5
Polygon 3	86.5	83

Photos taken from the end points of each transect and of each polygon are shown in Appendix C.

Polygon 3; Transects T3 (treatment) and R3 (reference)

Refer to Table 1 for the total percent cover by individual plant, lifeform, and cover type for transects in Polygon 3. There was a total of 41 species of plants identified in transects T3 and R3. Mullein, cheatgrass, and smooth scouring rush were the most abundant species in the treatment transects in 2006. Common species were similar—cheatgrass, mullein, and Kentucky bluegrass—in 2007. In the reference transects, the most abundant species were sedge, canary reedgrass, and swamp milkweed in 2006 and redtop, sedge, and smooth brome in 2007.

No statistical differences were detected between the treatment and reference transects, or between years, regarding the relative cover of native plants in this polygon (see Tables 2 and 3).

Total plant cover was significantly higher in the treatment transects, at 65.5 percent, than in the reference transects, at 40.3 percent, in 2007 (see Table 3 and Figures 1 and 2). Total litter cover was significantly higher in the treatment transects than in the reference transects (58.2 vs. 36.2 percent) in 2006, and significantly lower in the treatment transects than in the reference transects (18.5 vs. 37.7 percent) in 2007.

When comparing total cover between years, plant cover was significantly lower in 2006 than in 2007 for both types of transects, which is consistent with results in Treatment Polygon 1. Total plant cover increased considerably from 3.5 to 65.5 percent in the treatment transects and from 10.3 to 40.3 percent in the reference transects between the 2 years. In the treatment transects, litter cover decreased significantly from 58.2 percent in 2006 to 18.5 percent in 2007. Total cover of bare ground decreased significantly in both the treatment (from 25.0 to 2.5 percent) and the reference (from 38.7 to14.5 percent) transects between 2006 and 2007. As discussed above, the different time of year that monitoring was conducted may have been a factor in these changes between years.

There were no differences identified in the total cover of overstory shrubs between transects and years in Polygon 3. Stem density, however, was significantly lower in the treatment transects than in the reference transects in both 2006 and 2007. The density of all shrubs in the treatment transects, which were comprised of coyote willow and saltcedar, was 19.1 stems/m^2 in 2006 and 17.3 stems/m^2 in 2007 (Table 5). The total density of shrubs in the reference transects, which were comprised primarily of coyote willow, was 37 stems/m^2 in 2006 and 32.2 stems/m^2 in 2007. Treatment transects included saltcedar, which had a larger diameter than willow in this stand. This could explain fewer stems than the reference transects which were dominated by willow of smaller diameter. The number of saltcedar/25 m^2 was similar over time (Table 6).

Canopy cover was much higher in the treatment transects than in the reference transects both years (Table 1), and percent cover was similar from year to year within the treatment transects. The canopy cover within the reference transects, however, increased from 0.7 percent in 2006 to 22.5 percent in 2007. Although no height measurements were taken, willow within the reference transects appeared to be taller in 2007 based on photographs (see Transects 3-1A and B and 3-3A and B in Appendix C). Willow may have reached heights that were captured in the densiometer in 2007.

Reference Polygons

Polygon 2; Transects R2

Table 7 shows the total percent cover by individual plant, lifeform, and cover type for transects in Polygon 2. There was a total of 26 species of plants detected in transects R2 during the monitoring period. Sedge, redtop, and dogbane were the most abundant species based on total plant cover in 2006. Common plants in 2007 were redtop, sedge, and smooth scouringrush.

Table 7. Total percent cover by individual plant, lifeform, and cover type for treatment polygons 1 and 3 in 2006 and 2007; OVRA, Rio Grande, New Mexico

Total Percent Cover - Reference Polygons				
	2006		**2007**	
	Polygon 2	**Polygon 4**	**Polygon 2**	**Polygon 4**
Herbaceous layer				
Shrub seedlings				
Coyote willow	0.2	0.1	0.0	0.0
Native shrubs	0.2	0.1	0.0	0.0
Graminoids				
Sedge	5.3	16.4	10.7	16.0
Canada wildrye	0.0	0.0	0.1	0.0
Slender wheatgrass	0.0	3.4	0.5	0.0
Reed canary grass	0.2	2.8	1.8	4.8
Kentucky bluegrass	0.0	0.1	0.0	0.0
Native grasses	5.5	22.7	13.1	20.8
Redtop	3.7	0.0	20.3	20.8
Tall fescue	0.0	5.4	0.0	13.4
Introduced grasses	3.7	5.4	20.3	34.2
Forbs				
Dogbane	1.5	0.2	2.6	0.5
Silverweed cinquefoil	0.8	0.0	0.4	0.0
Carruth's sagewort	0.0	0.0	0.3	0.0
Aster	0.0	0.0	0.0	0.1
Spearleaf rabbitbrush	0.0	21.2	0.2	15.3
Canadian horseweed	0.2	0.0	0.7	0.0
Field horsetail	0.2	0.0	0.1	0.0
Smooth scouringrush	1.0	0.0	3.6	0.0
Wild licorice	0.0	0.1	0.0	0.0
Mountain sneezeweed	0.0	0.0	0.2	0.0
Rough bugleweed	0.0	0.2	0.0	0.0
Wild mint	0.3	0.0	0.0	0.0
Hooker's evening primrose	0.0	0.0	0.3	0.0
Norwegian cinquefoil	0.7	0.0	0.0	0.0
Cottonbatting cudweed	0.0	0.0	0.9	0.0
Unknown forb	0.0	0.0	0.2	0.0
Native forbs	4.6	21.7	9.5	15.9
Canada thistle	1.3	0.9	2.9	7.8
Prickly lettuce	0.0	0.0	0.1	0.0
White sweetclover	0.0	0.0	1.0	0.0

Total Percent Cover - Reference Polygons				
	2006		2007	
	Polygon 2	Polygon 4	Polygon 2	Polygon 4
Narrowleaf plantain	0.0	0.0	1.3	0.0
Dandelion	0.0	0.0	0.3	0.0
Red clover	0.1	0.0	0.2	0.0
Mullein	0.0	0.0	1.6	0.0
Introduced forbs	1.4	0.9	7.4	7.8
Total vegetative cover	15.4	50.8	50.3	78.7
Basal area of shrubs	9.2	11.9	7.7	7.5
Litter	49.7	32.3	42.0	13.3
Bare	25.7	5.0	0.0	0.5
Total herbaceous cover	100.0	100.0	100.0	100.0
Shrub layer				
Coyote willow	61.5	64.5	68.5	52.5
Native shrubs	61.5	64.5	68.5	52.5
Total shrub cover	61.5	64.5	68.5	52.5
Canopy cover	63.3	93.0*	72.1	72.9

*based on one point; too windy to get accurate reading at other points

Statistical analyses for the reference polygons compared the 2 years of monitoring. There was not a statistically significant difference in the relative cover of native plants between years in Polygon 2 (Tables 2 and 3).

As with the other transects, total plant cover was significantly lower in 2006, at 15.4 percent, than in 2007 at 50.3 percent (see Figures 1 and 2). Total cover of litter and bare ground remained statistically unchanged over time.

The overstory layer in the reference polygons includes only coyote willow. No statistical differences were found between years for the total cover or for the stem density of overstory willow in Polygon 2. Canopy cover was also relatively similar between 2006 and 2007 (Table 7).

Polygon 4; Transects R4

Refer to Table 7 for the total cover of plant species in Polygon 4. Thirteen plant species were identified within transects in this polygon. Abundant species were spearleaf rabbitbrush, sedge, and tall fescue in 2006 and redtop, sedge, and spearleaf rabbitbrush in 2007.

Relative cover of native plant species was 89.2 percent in 2006, which was significantly greater than 47.9 percent in 2007 (Tables 2 and 3). There was a considerable increase in

the cover of introduced grasses (i.e., redtop and tall fescue) in 2007, which probably caused the decrease in cover of native plants this year.

Total herbaceous plant cover in Polygon 4 was significantly lower in 2006, at 50.8 percent, than in 2007, at 78.7 percent (see Figures 1 and 2), which is consistent with all other polygons. Subsequently, the total percent cover of litter and bare ground was significantly higher in the first year of monitoring. Litter cover was 32.3 percent in 2006 and 13.3 percent in 2007. Total cover of bare ground was 5.0 percent in 2006 and 0.5 percent in 2007.

In the overstory layer, no statistical differences were detected between the 2 years for the total cover or for the stem density of willow. Canopy cover is not comparable between years since the 2006 readings were unrepresentative due to windy weather.

Conclusions and Recommendations

Two years of baseline data have been collected within the project area. Results from analysis of these data sets should be considered in future comparisons of post-treatment and baseline data.

In comparisons between the treatment and reference transects within the treatment polygons, results were fairly consistent over the 2 years of monitoring. With a few exceptions, the treatment and reference transects were equal for most variables, which provides some level of uniformity within the baseline data. Stem density was greater in the reference transects than in the treatment transects in most cases, which should be taken into account in future analysis.

The total cover of herbaceous plants was significantly lower in 2006 than in 2007 across all polygons. As a result, the total cover of litter and bare ground was generally higher in 2006. This outcome could be attributed to data collection during different times of the year; June in 2006 and October in 2007. Total cover and stem density of shrub overstory were always statistically equal between years.

Reclamation recommends continuing data collection in October, which should provide some consistency from 2007 onward. BLM intends to treat invasive species in Polygons 1 and 3 prior to the next monitoring period, which will likely create changes in data within the treatment transects. The reference transects within all polygons should be unaffected and will therefore provide information regarding trends in the amount of vegetation cover over time. These data should indicate if the documented increases in cover are due to the timing of monitoring or if these changes were based on other unidentified factors in 2006 or 2007.

Reclamation recommends removing saltcedar by hand cutting in Polygon 1. Some saltcedar were inadvertently cut down in the spring of 2007. We recommend treating the

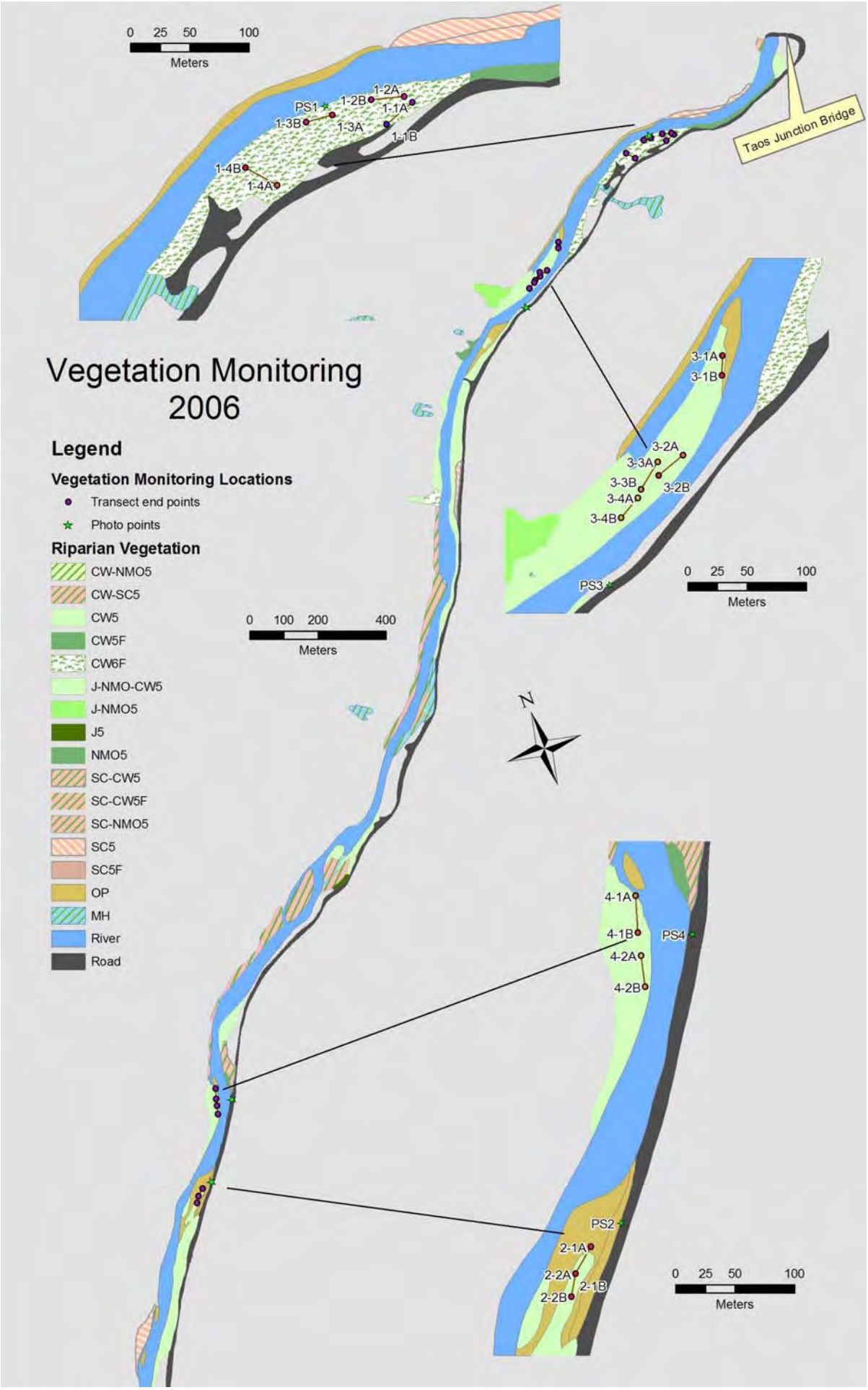
entire area, re-cutting in those areas where saltcedar was previously removed. Polygon 3 should be treated using the cut stump method. This entails removing the saltcedar by hand cutting and following up with an herbicide application to the stump.

Literature Cited

USDI - BLM, August 2006. Treatment of Saltcedar (Tamarix sp) and Other Invasive Non-Native Vegetation in Orilla Verde Recreation Area. NM-220-05-054.

Appendix A

Baseline Vegetation Monitoring Locations


Vegetation Monitoring
2006
Legend
Vegetation Monitoring Locations
Transect end points
Photo points
Riparian Vegetation
CW-NMO5
CW-SC5
CW5
CW5F
CW6F
J-NMO-CW5
J-NMO5
J5
NMO5
SC-CW5
SC-CW5F
SC-NMO5
SC5
SC5F
OP
MH
River
Road
0 100 200 400
Meters
0 25 50 100
Meters
N
Taos Junction Bridge
PS1
1-1A
1-1B
1-2A
1-2B
1-3A
1-3B
1-4A
1-4B
PS3
3-1A
3-1B
3-2A
3-2B
3-3A
3-3B
3-4A
3-4B
PS4
4-1A
4-1B
4-2A
4-2B
PS2
2-1A
2-1B
2-2A
2-2B

Appendix B

Common and Scientific Names of Plants
Detected in Treatment and Reference Transects

Code	Scientific name	Common name	Lifeform
ACMI	*Achillea millefolium*	Common yarrow	NF
AGGI	*Agrostis gigantea*	Redtop	IG
AMAR	*Ambrosia artemisifolia*	Annual ragweed	NF
APCA	*Apocynum cannabinum*	Clasping-leaf dogbane	NF
ARAN	*Argentina anserina*	Silverweed cinquefoil	NF
ARCA	*Artemisia carruthii*	Carruth's sagewort	NF
ARLU	*Artemisia ludoviciana*	White sagebrush	NF
ASIN	*Asclepias incarnata*	Swamp milkweed	NF
ASSP	*Aster* sp.	Aster	NF
BRIN	*Bromus inermis*	Smooth brome	IG
BRJA	*Bromus japonicus*	Japanese brome	IG
BRTE	*Bromus tectorum*	Cheatgrass	IG
CAEM	*Carex emoryi*	Sedge	NG
CHLI	*Chrysothamnus linifolius*	Spearleaf rabbitbrush	NF
CIAR	*Cirsium arvense*	Canada thistle	IF
CIVU	*Cirsium vulgare*	Bull thistle	IF
COCA	*Conyza canadensis*	Horseweed	NF
CYOF	*Cynoglossum officianale*	Houndstongue	IF
ELCA	*Elymus canadensis*	Canada wildrye	NG
ELTR	*Elymus trachycaulus*	Slender wheatgrass	NG
EQAR	*Equisetum arvense*	Field horsetail	NF
EQLA	*Equisetum laevigatum*	Smooth scouring rush	NF
FEAR	*Festuca arundinacea*	Tall fescue	IG
FOPU	*Foresteria pubescens*	New Mexico olive	NS
GLLE	*Glycyrrhiza lepidota*	Wild licorice	NF
GRSQ	*Grindelia squarrosa*	Curlycup gumweed	NF
HEAU	*Helenium autumnale*	Mountain sneezeweed	NF
LASE	*Lactuca serriola*	Prickly lettuce	IF
LELA	*Lepidium latifolium*	Perrenial pepperweed	IF
LYAS	*Lycopus asper*	Rough bugleweed	NF
MEAL	*Melilotus albus*	White sweetclover	IF
MEAR	*Mentha arvensis*	Wild mint	NF
MUAS	*Muhlenbergia asperifolia*	Alkali muhly	NG
MURA	*Muhlenbergia racemosa*	Marsh muhly	NG
OEEL	*Oenothera elata*	Hooker's evening primrose	NF
OPSP	*Opuntia* sp.	Pricklypear cactus	NF
PAQU	*Parthenocissus quinquefolia*	Virginia creeper	IF
PLLA	*Plantago lanceolata*	Narrowleaf plantain	IF
PHAR	*Phalaris arundinacea*	Reed canary grass	NG
POPR	*Poa pratensis*	Kentucky bluegrass	NG
PONO	*Potentilla norvegica*	Norwegian cinquefoil	NF
PSST	*Pseudognaphalium stramineum*	Cottonbatting cudweed	NF
PODE	*Populus deltoides*	Cottonwood	NS
RUCR	*Rumex crispis*	Curly dock	IF
SAEX	*Salix exigua*	Coyote willow	NS
SPCR	*Sporobolus cryptandrus*	Sand dropseed	NG
SYLA	*Symphyotrichum lanceolatum*	White-panicle aster	NF
TARA	*Tamarix ramosissima*	Saltcedar	IS
TAOF	*Taraxacum officinale*	Dandelion	IF
TRPR	*Trifolium pratense*	Red clover	IF
ULPU	*Ulmus pumila*	Siberian elm	IS
VETH	*Verbascum thapsus*	Mullein	IF

Appendix C

Photo Stations
June 2006 and October 2007

Transect 1-1A

2006

2007

Transect 1-1B

2006

2007

Transect 1-2A

2006

2007

Transect 1-2B

2006

2007

Transect 1-3A

2006

2007

Transect 1-3B

2006

2007

Transect 1-4A

2006

2007

Transect 1-4B

2006

2007

Transect 2-1A

2006

2007

Transect 2-1B

2006

2007

Transect 2-2A

2006

2007

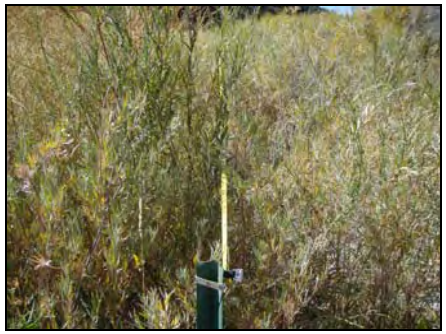
Transect 2-2B

2006

2007

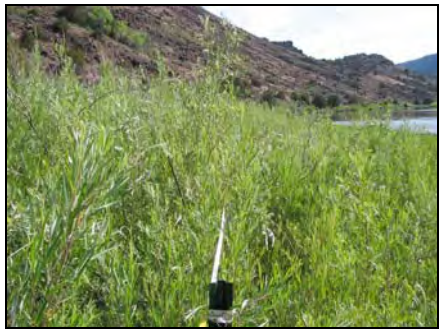
Transect 3-1A

2006



2007

Transect 3-1B



2006

2007

Transect 3-2A

2006

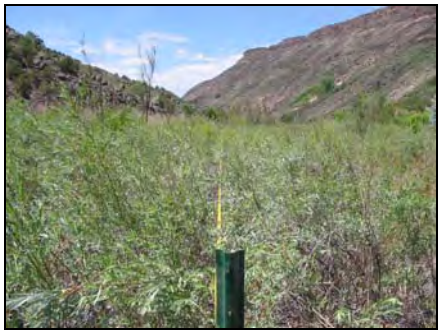
2007

Transect 3-2B

2006

2007

Transect 3-3A



2006

2007

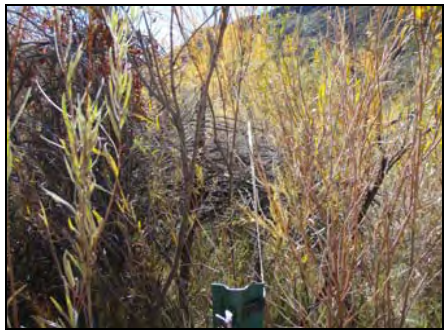
Transect 3-3B

2006

2007

Transect 3-4A

2006



2007

Transect 3-4B

2006

2007

Transect 4-1A

2006

2007

Transect 4-1B

2006

2007

Transect 4-2A

2006

2007

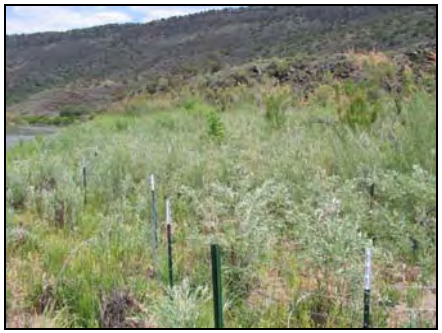
Photo Station 1 – upstream

Transect 4-2B

2006

2007

Photo Station 1 – downstream


2006

2007

2006

2007

Photo Station 2

2006

2007

Photo Station 3

2006

2007

Photo Station 4 – upstream

2006

2007

Photo Station 4 – across

2006

2007

Photo Station 4 – downstream

2006

2007