
Santa Fe River

Riparian Vegetation Monitoring



Report 2003



Santa Fe River Riparian Vegetation Monitoring¹

Report 2003

Elizabeth Milford, Esteban Muldavin, Yvonne Chauvin, Amanda Browder
and Stacey Sekscienski

Natural Heritage New Mexico, Biology Department
University of New Mexico, Albuquerque, New Mexico, 87131

June 2004

ABSTRACT

The Taos Field Office of the Bureau of Land Management (BLM) has initiated a riparian vegetation monitoring program, in cooperation with Natural Heritage New Mexico, for its lands along the lower Santa Fe River just west of La Cienega, New Mexico. The intent of this program is to detect long-term trends in riparian plant communities within a two-mile reach of the river that has been recently excluded from livestock grazing. Nine monitoring transects were established in September of 2003. Sampling was focused on riparian and wetland vegetation within the active floodplain. Transects averaged 26 meters in length but varied dependant on the width of the floodplain. All transects started on the terrace above the river channel and the active floodplain and extended perpendicularly across the river and up onto the opposite terrace, with 3-5 meters of terrace included per transect on either side of the active channel. Vegetation cover was measured using 20 x 50 cm quadrat frames laid lengthwise end to end along the upstream side of each transect starting at the first stake (rebar 1, at 0 m) and continuing until there was no longer room for a complete quadrat along the line. In each quadrat, canopy cover of all species was evaluated to the nearest percent and average height for each species was measured to the nearest cm. Additionally, the start and end points of the major vegetation zones were recorded for each transect. The transects were hierarchically classified into five zones and 12 subzones (excluding water) as defined by their dominant species or species complex. The active floodplain was divided into four zones, Water, Aquatic Vegetation, Herbaceous Wetland and Sparse Vegetation, while the rarely flooded terraces were partitioned into Woody Riparian and Arroyo Riparian zones. A total of 77 plant species were identified along the transects in 2003. The majority of woody cover was from exotic species and over half of all herbaceous cover was also comprised of exotics. In all vegetation zones the average height of herbaceous vegetation (grasses and forbs) was ten centimeters or less, reflecting the high livestock utilization throughout the reach. In succeeding years this monitoring system, with the removal of livestock, will provide an opportunity to accurately gauge the response of the riparian system to the absence of grazing and its implications for wildlife and fisheries habitat.

¹ Final report Cooperative agreement No. GDA-010009, Task Order No. 7

Table of Contents

Abstract	i
Introduction.....	1
Methods.....	1
Study area.....	1
Sampling design.....	4
Results	5
Vegetation zones.....	5
Species diversity	13
Discussion.....	16
Appendix A.....	A-1
Appendix B.....	B-1
Appendix C	C-1

Tables

Table 1. Summary temperature and precipitation data from 1972 through 2003 for weather station Santa Fe 2 (298085)	3
Table 2. Riparian vegetation zone and subzones along river cross-sections of the BLM Santa Fe River ACEC	6
Table 3. Herbaceous Wetland, Sparse Vegetation, and Aquatic Vegetation summary tables.....	7
Table 4. Woody Riparian and Arroyo Riparian zone vegetation summary tables	10
Table 5. Transect, bar, active channel and terrace lengths.	12
Table 6: Transect 03SF001 species list with average cover	B-4
Table 7: Transect 03SF002 species list with average cover	B-7
Table 8: Transect 03SF003 species list with average cover	B-10
Table 9: Transect 03SF005 species list with average cover	B-13
Table 10: Transect 03SF006 species list with average cover	B-16
Table 11: Transect 03SF007 species list with average cover	B-19
Table 12: Transect 03SF008 species list with average cover	B-22
Table 13: Transect 03SF009 species list with average cover	B-25
Table 14: Transect 03SF010 species list with average cover	B-28

Figures

Figure 1. Study Area	2
Figure 2. Average monthly discharge of the Santa Fe River near Santa Fe (Gage Station 08316000).	3
Figure 3. Photo of Transect 6.....	5
Figure 4. Photo of Transect 7.....	9
Figure 5. Widths of vegetation types within the active floodplain.	12
Figure 6. Percentage of active floodplain occupied by vegetation types.....	13

Figure 7. Average Woody (a), Graminoid (b), and Forb (c) cover by origin and vegetation zone.	14
Figure 8. Species richness by origin for graminoids (a) and forbs (b) within each vegetation zone.	15
Figure 9. Average height of herbaceous vegetation by lifeform and vegetation zone.	16
Figure 10: Transect 03SF001, 20m upstream of rebar 3 at 36 degrees looking downstream....	B-2
Figure 11: Transect 03SF001, at 5m looking to 26m	B-2
Figure 12: Diagram of transect 03SF001	B-3
Figure 13: Transect 03SF002, 25m upstream from 13m at 128 degrees looking downstream..	B-5
Figure 14: Transect 03SF002, from 0m looking to 23.4m	B-5
Figure 15: Diagram of transect 03SF002	B-6
Figure 16: Transect 03SF003, 20m upstream of rebar 2 at 44 degrees looking downstream....	B-8
Figure 17: Transect 03SF003, from 0m looking to 25m	B-8
Figure 18: Diagram of transect 03SF003	B-9
Figure 19: Transect 03SF005, 25m upstream at 30 degrees from 4m looking downstream	B-11
Figure 20: Transect 03SF005, from 0m looking to 23.1m	B-11
Figure 21: Diagram of transect 03SF005	B-12
Figure 22: Transect 03SF006, 25m upstream at 78 degrees from 10.5m looking downstream	B-14
Figure 23: Transect 03SF006, from 0m looking to 25.2m	B-14
Figure 24: Diagram of transect 03SF006.....	B-15
Figure 25: Transect 03SF007, 25m upstream at 14 degrees from rebar 3 looking downstream	B-17
Figure 26: Transect 03SF007, from 2m looking to 28.3m	B-17
Figure 27: Diagram of transect 03SF007	B-18
Figure 28: Transect 03SF008, 20m upstream of rebar 3a at 108 degrees looking downstream	B-20
Figure 29: Transect 03SF008, from 1m looking to 38.2m	B-20
Figure 30: Diagram of transect 03SF008	B-21
Figure 31: Transect 03SF009, 20m upstream of rebar 2 at 90 degrees looking downstream..	B-23
Figure 32: Transect 03SF009, from 3m looking to 28.4m	B-23
Figure 33: Diagram of transect 03SF009	B-24
Figure 34: Transect 03SF010, 20m upstream of 6m at 34 degrees looking downstream.....	B-26
Figure 35: Transect 03SF010, from 0m looking to 16.8m	B-26
Figure 36: Diagram of transect 03SF010.....	B-27

Introduction

The Taos Field Office of the Bureau of Land Management (BLM) has initiated a riparian vegetation monitoring program for its lands along the lower Santa Fe River just west of La Cienega. The intent of this program is to detect long-term trends in riparian plant communities within a two-mile reach of the river that has been recently excluded from livestock grazing. Historically, the allotment was subject to livestock grazing year round, which continued through the spring of 2004. In 2003, we established a set of vegetation transects to determine baseline conditions under grazing for comparison to later surveys after livestock removal. The vegetation sampling was designed in the context of breeding bird surveys that were begun within the same riparian zone in 2002, with the intent of providing data on the relationship between bird densities and vegetation structure and composition through time². We report here on the project design, methodologies, and the first year of data. This baseline survey provides the foundation for future monitoring and also details current vegetation information for use in the development or revision of the allotment management plan.

Methods

Study area

The study area is within the lower portion of the Santa Fe River Area of Critical Environmental Concern (ACEC) managed by the BLM located 26 km (16 miles) south of Santa Fe (Figure 1). Elevation ranges from 5700 ft (1737 m) to 5800 ft (1768 m). The river in this reach is constrained within a deep canyon, bounded by mesas capped with ancient basalt lava flows. The floodplain averages only about 100 m in width and the stream gradient is gentle at 1%. The river has a perennial flow sustained by a combination of natural discharge from a drainage basin of 45.5 km² (18.20 sq. miles) and from the city of Santa Fe sewage treatment facility south of town. Stream flow peaks in May following snowmelt at 21 ft³/s (cfs) on average in the post regulation period after 1926 (Figure 2). Yearly peak daily discharges have averaged over 80 cfs in recent decades (1980-1999) with a maximum of 119 cfs on 7/18/1992. The majority of the local precipitation arrives during late summer and early fall (Table 1), and hence, in a given year, there can be secondary peaks in stream flow between August and September in response to large monsoonal rainstorms. In contrast, winter time precipitation is low and monthly base flows typically dip to below 5 cfs. At the same time average temperatures are below freezing through the winter months, and the growing season typically does not begin until late March and concludes by the end of September.

The study area has a long history of human use as evidenced by numerous archeological sites within the canyon. Over the past century, livestock grazing has been the primary land use, typically on a year-round basis, and the site is part of an active BLM grazing allotment. At the time of sampling, cattle had been heavily utilizing the site through the summer season since forage elsewhere in the allotment was in short supply due to drought conditions.

² Hawks Aloft of Albuquerque, NM is conducting the breeding bird surveys on behalf of the Bureau of Land Management.

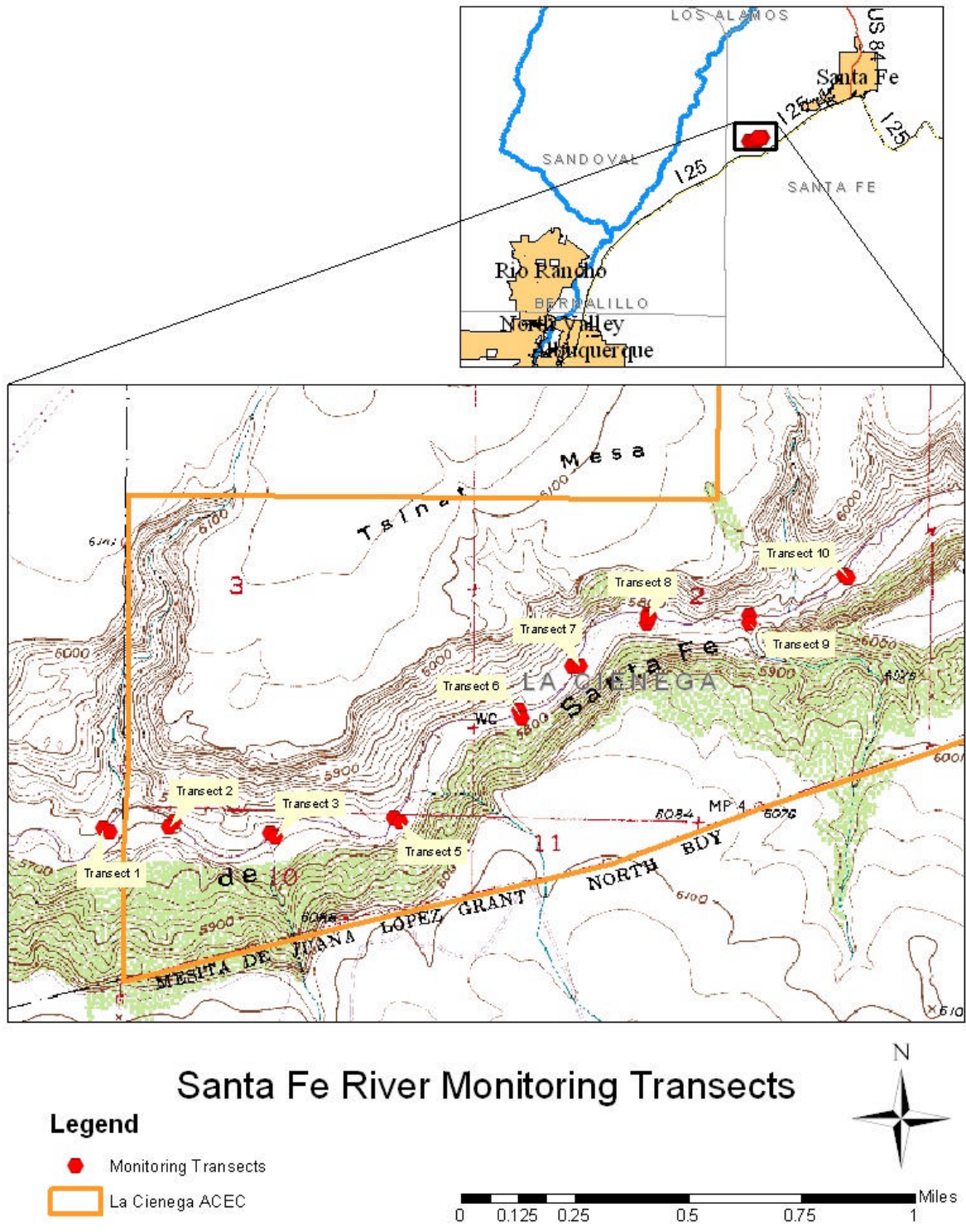


Figure 1. Study Area

Table 1. Summary temperature and precipitation data from 1972 through 2003 for weather station Santa Fe 2 (298085), approximately 20 km north of the study area (source: www.wrcc.dri.edu/).

	Temperature Averages (° F)			Precipitation (in)		
	Max.	Min.	Mean	Mean	High	Low
Winter	44.9	20	32.4	1.77	5.24	0.18
Spring	64.2	34.2	49.2	2.78	7.4	0.13
Summer	84.2	53.6	68.9	5.41	10.66	2.04
Fall	65.6	36.8	51.2	3.83	7.71	0.78
Annual	64.7	36.2	50.4	13.79	20.09	7.23

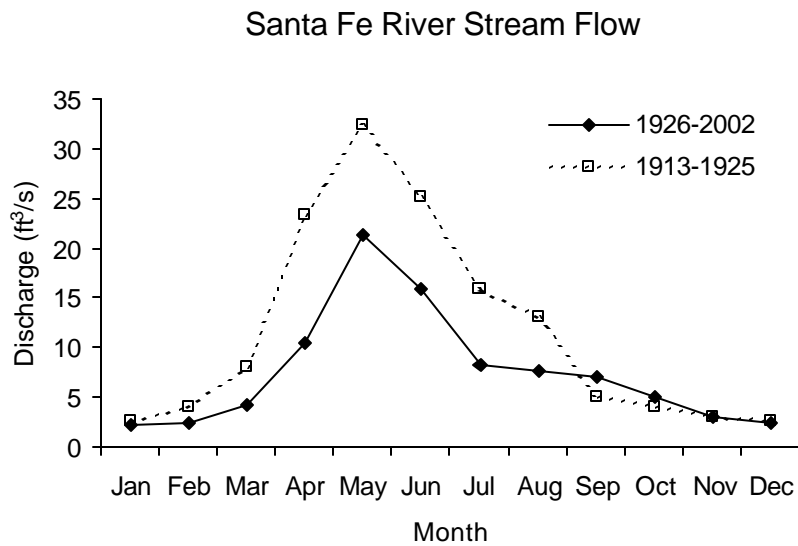


Figure 2. Average monthly discharge of the Santa Fe River near Santa Fe (Gage Station 08316000). The years 1913-1925 represent pre-regulation and 1926-2002 post-regulation flows (source: US Geological Survey at <http://waterdata.usgs.gov/nm/nwis/peak>)

Sampling design

Nine monitoring transects were established in September of 2003 along the lower two-mile stretch of the Santa Fe River within the ACEC. Sampling was focused on riparian and wetland vegetation within the active floodplain with the intent of detecting major changes in species composition and structure. Hence, transects were more or less evenly distributed along the reach and generally across straight reaches between river bends where the widest zones of riparian vegetation occurred.

Transects averaged 26 meters in length but varied dependant on the width of the channel from 16.8 to 38.2 meters. All transects started on the right (northern) bank terrace above the river channel and the active floodplain, and extended perpendicularly across the river and up onto the left bank terrace. Three to five meters of terrace were included in the transects on either side of the active channel. Rebar stakes tagged with oblong aluminum tags were used to monument both ends of the transect on the terraces, with two additional tagged stakes located along the transect within the active floodplain to improve repeatability. The locations of the end point stakes were recorded with a Garmin GPS with an accuracy of +/- 3 m (Appendix A). Four monitoring photographs were taken along each transect: one from the start stake to end stake and vice-versa, then two more photographs, one looking upstream and one looking downstream, were taken from a point upstream of the transect at a distance measured and recorded off the right bank floodplain stake. Appendix B contains diagrams for each transect along with two of the monitoring photographs.

Vegetation cover was measured using 20 x 50 cm quadrat frames laid lengthwise end to end along the upstream side of each transect starting at the first stake (rebar 1, at 0 m) and continuing until there was no longer room for a complete quadrat along the line. (i.e., if the transect line ended at 23.4m, the last quadrat was from 22.5 to 23m.). In each quadrat, canopy cover of all species was evaluated to the nearest percent and with some smaller-sized species, to one tenth of a percent . In addition, average height for each species was measured to the nearest cm. Ground cover components of litter, exposed soil, gravel, rock, water, cryptogams and total herbaceous canopy cover were also recorded to the nearest percent. Vascular aquatic vegetation was identified to species and measured as canopy cover whether it was submerged or emergent. However algae, which was not identified to species, was measured as part of the ground cover components and was only measured when not-submerged (i.e.: submerged algae was not recorded and was simply part of the total area assigned to water for quadrats in which it occurred.). Additionally, the start and end points of the major vegetation zones were recorded for each transect.

Vouchers of all plant species were taken, identified, and have been archived at the herbarium of the University of New Mexico Museum of Southwest Biology. The vegetation data was entered using Microsoft Access into the NHNM's Ecology database with tables specifically designed for this project. Over the past decade the NHNM ecology database has been developed and populated with over 5000 plot records from around the state and Southwest. Accordingly, there is a set of data entry protocols that have been implemented that ensure data quality including independently proofreading the data for accuracy.

For the first year baseline analysis, we classified the quadrats by dominant species into zones and subzones along with channel location and then reported the respective zone mean values on species composition, abundance and height. In subsequent years the data will be taken in the same way and subjected to more sophisticated temporal statistical analysis (e.g., repeated measures ANOVA and sliding window boundary analysis). All of the raw data has been made available in an Access database form on compact disk along with appropriate exported ASCII files of the data, photo point files, and this report.

Results

Vegetation zones

The transects were hierarchically classified into five zones and 12 subzones (excluding water) as defined by their dominant species or species complex (Table 2). The active channel was broken into an Open Water zone with little or no vegetation and an Aquatic Vegetation zone dominated by rooted vascular aquatic species such as the exotic watercress (*Rorippa nasturtium-aquaticum*), and native water speedwell (*Veronica anagallis-aquatica*) (Figure 3; Table 3).



Figure 3. Typically, vegetation zones extend laterally from the open water of the channel through a narrow Aquatic Vegetation zone to Herbaceous Wetlands on the adjacent bars. The upper terraces support a Woody Riparian zone (dominated by Russian olive on the left side of the photo) or an Arroyo Riparian zone (the rubber rabbitbush on the right side of the photo) [photo: Transect 6 2003].

The Herbaceous Wetland and Sparse Vegetation zones are found intermixed on the alluvial bars adjacent to the active channel where they flood frequently (typically on an annual basis). In the Herbaceous Wetland zone, the predominant subzone was the Bentgrass-Knotgrass (*Agrostis stolonifera-Paspalum distichum*) Herbaceous Wetland. Bentgrass is an introduced European pasture grass, and knotgrass is a native obligate wetland species found across the southern United States. Besides the two characteristic dominants, this relatively luxuriant subzone had a wide assortment of other grass-like species (graminoids) and forbs among which the most common were tall fescue (*Festuca arundinaceae*), barnyardgrass (*Echinochloa crus-galli*) and strawberry clover (*Trifolium fragiferum*). The Common Threesquare (*Schoenoplectus pungens*) Sparse Herbaceous Wetland occurred on sandier soils and was less species rich and lower in overall vegetative cover. Common threesquare, also an obligate wetland species, had an average cover of 30% in this subzone with only a scattering of other graminoids and forbs. The Alkali Muhly-Inland Saltgrass (*Muhlenbergia asperifolia-Distichlis spicata*) Herbaceous Wetland was a minor subzone that occurred on drier sites within the current floodplain. Lastly, channel side bars also had subzones of Sparse Gravel with scattered forbs and little graminoid cover, and Sparse Grass scattered patches of grass and few forbs (Figure 4).

Table 2. Riparian vegetation zone and subzones along river cross-sections of the BLM Santa Fe River ACEC. Codes are NHNM acronyms for the scientific names or physical elements of the subzone name. Channel location refers to the primary landscape position of the subzones. Active Channel is the location of the current river and is usually filled with water; the Floodplain adjacent to the channel is typically flooded every one to two years up to ten; the Terrace is upper alluvial terraces that are only rarely flooded (> 10 years return interval).

Vegetation Zone	Vegetation Subzone	Code	Channel Location
Water	Open Water-No Vegetation	OPEN WATER	Active Channel
Aquatic Vegetation	Watercress-Veronica Aquatic Vegetation (<i>Rorippa nasturtium-aquaticum</i> - <i>Veronica anagallis-aquatica</i>)	RORAQU-VERANA	Active Channel
Herbaceous Wetland	Bentgrass-Knotgrass Herbaceous Wetland (<i>Agrostis stolonifera</i> - <i>Paspalum distichum</i>)	AGRSTO-PASDIS	Floodplain
	Alkali Muhly-Inland Saltgrass Herbaceous Wetland (<i>Muhlenbergia asperifolia</i> - <i>Distichlis spicata</i>)	MUHASP-DISSPI	Floodplain
	Common Threesquare Sparse Herbaceous Wetland (<i>Schoenoplectus pungens</i>)	SCHPUN	Floodplain
Sparse Vegetation	Sparse Grassland	SPARSE GRASS	Floodplain
	Sparse Gravel	SPARSE GRAVEL	Floodplain
Woody Riparian	Russian Olive Riparian Woodland (<i>Elaeagnus angustifolia</i>)	ELAANG	Terrace
	Russian Olive/Oneseed Juniper Riparian Woodland (<i>Elaeagnus angustifolia</i> - <i>Juniperus monosperma</i>)	ELAANG-JUNMON	Terrace
	Russian Olive/Rubber Rabbitbush Riparian Woodland (<i>Elaeagnus angustifolia</i> / <i>Chrysothamnus nauseosus</i>)	ELAANG/CHRNAU	Terrace
	Russian Olive/Yerba Mansa Riparian Woodland (<i>Elaeagnus angustifolia</i> / <i>Anemopsis californica</i>)	ELAANG/ANECAL	Terrace
Arroyo Riparian	Rubber Rabbitbush Riparian Shrubland (<i>Chrysothamnus nauseosus</i>)	CHRNAU	Terrace
	Saltcedar/Rubber Rabbitbush Riparian Shrubland (<i>Tamarix ramosissima</i> / <i>Chrysothamnus nauseosus</i>)	TAMRAM/CHRNAU	Terrace

Table 3. Herbaceous Wetland, Sparse Vegetation, and Aquatic Vegetation summary tables (see Table 2 for full names of subzones). Cov = average percent cover over n quadrats; Ht = average height over n quadrats.

Subzone	Herbaceous Wetland						Sparse Vegetation				Aquatic Vegetation	
	MUHASP- DISSPI (n=2)		AGRSTO- PASDIS (n=160)		SCHPUN (n=12)		SPARSE GRASS (n=6)		SPARSE GRAVEL (n=14)		RORNAS- VERANA (n=36)	
	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)
Scientific Name												
Trees												
Elaeagnus angustifolia			9.22	991								
Elaeagnus angustifolia - seedling			0.02	5								
Juniperus monosperma												
Shrubs												
Chrysothamnus nauseosus			1.58	82			2.50	50				
Salix exigua											0.01	12
Tamarix ramosissima			0.08	40	0.08	2			5.57	40		
Tamarix ramosissima - seedling											0.53	4
Gutierrezia sarothrae												
Graminoids												
Agrostis stolonifera			22.19	5	2.08	6					8.92	7
Bouteloua barbata												
Bouteloua gracilis												
Bromus catharticus			0.42	5								
Bromus japonicus												
Bromus tectorum												
Carex occidentalis			0.28	6								
Cenchrus spinifex			0.16	4								
Cynodon dactylon			0.28	3								
Cyperus spp.												
Distichlis spicata	25.00	9	0.80	8	0.42	6						
Echinochloa crus-galli			3.03	6	0.42	4					5.08	10
Eleocharis spp.			1.61	6							0.61	10
Eragrostis pectinacea			0.36	7			0.08	3			0.33	8
Festuca arundinacea			7.95	7	0.42	6	5.35	9				
Hordeum murinum ssp. glaucum			0.03	6			0.02	7				
Juncus arcticus var. balticus											0.01	15
Muhlenbergia asperifolia	15.00	6	4.54	7	1.25	4	8.33	7				
Munroa squarrosa												
Pascopyrum smithii			0.03	19								
Paspalum distichum			8.51	8	0.25	3			0.51	5	15.06	11
Poa annua			0.39	6								
Schoenoplectus pungens	7.50	10	9.09	10	25.17	9	0.83	10			0.60	9
Sporobolus airoides												
Sporobolus cryptandrus			0.20	15								
Unidentified grass			0.01	2								
Vulpia octoflora												
Forbs												
Almutaster pauciflorus	5.00	4	0.01	3	0.17	4						
Amaranthus hybridus			0.01	2								
Ambrosia acanthicarpa			0.08	7					3.21	16		
Anemopsis californica	5.00	1	0.16	3								
Argentina anserina			0.33	3							0.14	4

Table 3. Herbaceous Wetland, Sparse Vegetation, and Aquatic Vegetation summary tables (continued).

Subzone	Herbaceous Wetland						Sparse Vegetation				Vegetation	
	MUHASP- DISSPI (n=2)		AGRSTO- PASDIS (n=160)		SCHPUN (n=12)		SPARSE GRASS (n=6)		SPARSE GRAVEL (n=14)		RORNAS- VERANA (n=36)	
	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)
Forbs cont.												
			0.01	5							0.42	4
			0.01	1								
			0.01	4								
			0.04	3								
					1.25	10			0.93	9		
									0.04	4		
					0.01	7						
			0.03	8								
		5.00	7	0.57	4	0.08	3		0.07	5		
			0.01	9								
			0.01	6								
			0.06	6							2.00	3
			0.26	7	3.33	3			3.11	3	0.08	3
			0.07	13							0.78	15
			0.13	2				0.17	2			
			0.01	3							0.18	3
			0.08	2								
			0.81	6							35.38	5
			0.01	3					0.71	8	0.42	14
			0.11	5								
											0.14	6
			0.49	2					0.14	5		
			0.08	3				0.02	1			
			17.60	3	0.42	3			0.64	5	1.14	5
											5.11	6
			1.17	11	2.67	8	2.67	11	0.36	4		

The rarely flooded terraces were characterized by Woody Riparian and Arroyo Riparian zones. The former was dominated by Russian olive (*Elaeagnus angustifolia*) and the latter by rubber rabbitbush (*Chrysothamnus nauseosus*) terrace). The Russian Olive zone was distinguished into four subzones based on canopy dominance and understory composition (Table 4). The Russian Olive Riparian Woodland subzone was characterized by dense monotypic stands of Russian olive with little understory vegetation. The Russian Olive/Oneseed Juniper (*Elaeagnus angustifolia*-*Juniperus monosperma*) Riparian Woodland also had a closed canopy, but was co-dominated by the coniferous oneseed juniper. The Russian Olive/Rubber Rabbitbush (*Elaeagnus angustifolia*/*Chrysothamnus nauseosus*) Riparian Woodland subzone had an open canopy and a shrubby understory of rubber rabbitbush along with a diverse compliment of grasses and forbs. This was a drier type as indicated by abundant alkali muhly (*Muhlenbergia asperifolia*) and sand dropseed (*Sporobolus cryptandrus*). In contrast, the Russian Olive/Yerba Mansa (*Elaeagnus angustifolia*/*Anemopsis californica*) Riparian Woodland subzone was more mesic in character despite its open canopy and had a greater cover of grasses.



Figure 4. A Sparse Vegetation zone is often found on the side channel bars particularly on sandy and gravelly substrates. [photo: Transect 7 2003].

The width of channel and bar that make up the active floodplain varied among transects (Table 5). The average active floodplain width was 15.54 m, but ranged from as much as 30m and to as little as 10 m, and the ratio of bar to channel also varied from 8:1 to 1:1. The width of the terraces is arbitrarily set by the transect end points, but changes in this measurement will still serve as an index for evaluating channel morphology change over time. Along with the differences in active floodplain widths comes corresponding differences in vegetation zone width and ratios (Figures 5 & 6). Herbaceous Wetland was the most prevalent zone (58%) corresponding to the channel side bar locations. The Aquatic Vegetation zone averaged 13%, while Open Water accounted for 18%. The Sparse Vegetation zone averaged 7% and occurred on only three of the transects while the Arroyo Riparian zone, occasionally found on high bars within the active floodplain (Transect 7), averaged 5%.

Table 4. Woody Riparian and Arroyo Riparian zone vegetation summary tables (see Table 2 for full names of subzones). Cov = average percent cover over n quadrats; Ht = average height over n quadrats.

Subzone	Woody Riparian								Arroyo Riparian			
	ELAANG		ELAANG-JUNMON		ELAANG-CHRNAU		ELAANG-ANECAL		TAMRAM-CHRNAU		CHRNAU	
	(n=15)		(n=4)		(n=30)		(n=15)		(n=15)		(n=102)	
Scientific Name	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)
Trees												
Elaeagnus angustifolia	96.33	1080	77.50	1000	30.63	715	24.67	1000			9.00	921
Elaeagnus angustifolia - seedling												
Juniperus monosperma			61.25	400			1.33	400				
Shrubs												
Chrysothamnus nauseosus					14.60	112	0.80	74	20.00	115	24.43	85
Salix exigua												
Tamarix ramosissima									48.00	700	1.57	300
Tamarix ramosissima - seedling												
Gutierrezia sarothrae			0.03	7					0.33	12	0.03	13
Graminoids												
Agrostis stolonifera					2.00	5			2.67	5	0.03	17
Bouteloua barbata					0.02	2	0.01	1			0.03	2
Bouteloua gracilis											0.27	5
Bromus catharticus											0.01	11
Bromus japonicus											0.05	6
Bromus tectorum			0.13	6	0.14	9	0.04	5	2.67	8	0.42	9
Carex occidentalis												
Cenchrus spinifex											0.01	4
Cynodon dactylon											0.01	2
Cyperus spp.					0.18	11						
Distichlis spicata	5.27	9	0.75	10	0.37	11	5.53	9			1.55	9
Echinochloa crus-galli					0.17	5			0.67	10	0.28	5
Eleocharis spp.												
Eragrostis pectinacea					0.01	2					0.01	4
Festuca arundinacea	0.37	6	0.25	7	2.07	7	0.73	9	1.67	9	0.50	8
Hordeum murinum ssp. glaucum	0.01	6	0.30	7							0.02	6
Juncus arcticus var. balticus			1.25	20								
Muhlenbergia asperifolia	0.10	9			5.73	8	7.53	6			2.97	7
Munroa squarrosa											0.01	1
Pascopyrum smithii	0.10	11	1.13	22	2.02	13	0.40	7	0.27	29	0.33	19
Paspalum distichum											0.13	4
Poa annua											0.02	9
Schoenoplectus pungens					1.47	9	0.73	11	0.33	12	0.58	10
Sporobolus airoides							8.33	8				
Sporobolus cryptandrus			5.25	13	3.45	12	1.40	6	3.47	12	2.90	12
Unidentified grass											0.05	1
Vulpia octoflora											0.04	4
Forbs												
Almutaster pauciflorus												
Amaranthus hybridus					0.06	2	0.05	3	0.07	1	0.47	3
Ambrosia acanthicarpa					1.87	10					0.48	6
Anemopsis californica			18.88	3	1.50	3	60.67	3				
Argentina anserina												

Table 4. Woody Riparian and Arroyo Riparian zone vegetation summary tables (continued).

Subzone	Woody Riparian								Arroyo Riparian			
	ELAANG		ELAANG-JUNMON		ELAANG-CHRNAU		ELAANG-ANECAL		TAMRAM-CHRNAU		CHRNAU	
	(n=15)	(n=4)	(n=30)	(n=15)	(n=15)	(n=15)	(n=15)	(n=102)				
Scientific Name	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)	Cov (%)	Ht (cm)
Forbs cont.												
Calibrachoa parviflora												
Chamaesyce serpyllifolia			0.03	2	0.03	1	0.03	2	2.01	3	0.12	1
Chamaesyce serrula					0.01	1					0.01	1
Chenopodium incanum					0.13	2	1.34	4			0.02	7
Cirsium vulgare												
Conyza canadensis					0.05	4						
Croton texensis					0.02	1						
Cryptantha minima											0.01	1
Euphorbia exstipulata												
Fabaceae					0.07	8						
Gaura parviflora											0.02	0
Grindelia nuda var. aphanactis									0.20	4		
Ipomoea spp.					0.10	4						
Ipomopsis longiflora					0.01	3						
Kallstroemia spp.											0.01	1
Kochia scoparia	7.54	5	0.13	4	3.77	5	1.81	4			4.23	7
Lactuca serriola												
Machaeranthera pinnatifida											0.35	5
Malva neglecta			0.03	3								
Melilotus officinalis											0.01	8
Mimulus glabratus												
Polygonum aviculare					0.33	5	0.10	10			0.14	6
Polygonum persicaria					0.17	10						
Portulaca oleracea	0.01	1	1.28	3	0.45	1	0.01	1	0.01	1	0.40	1
Ranunculus cardiophyllus												
Ranunculus cymbalaria												
Ratibida tagetes											0.23	11
Rorippa nasturtium-aquaticum												
Rumex crispus												
Salsola tragus			0.25	8			0.07	6			0.19	6
Schkuhria multiflora					0.04	4						
Scorzonera laciniata												
Solanum elaeagnifolium					0.10	4						
Sonchus asper												
Taraxacum officinale												
Tribulus terrestris			0.15	4	0.03	5	0.03	3			1.61	3
Trifolium fragiferum					0.40	5			0.13	2		
Unidentified forb			0.03	3			0.05	4				
Verbascum thapsus											0.15	13
Veronica anagallis-aquatica												
Xanthium strumarium					0.03	6					0.56	12

Table 5. Transect, bar, active channel and terrace lengths.

Transect	Total Length	Bar	Active Channel	Terrace*
1	26.20	10.70	3.30	12.20
2	23.40	6.30	7.90	9.20
3	24.94	7.68	4.24	13.01
5	23.10	6.60	6.00	10.50
6	25.15	10.90	5.70	8.55
7	28.30	6.00	7.10	15.20
8	38.20	26.55	3.35	8.30
9	28.40	14.70	3.70	10.00
10	16.80	5.45	3.75	7.60
Average	26.05	10.54	5.00	10.51

*terrace is not total length, just the amount of terrace included in the transect

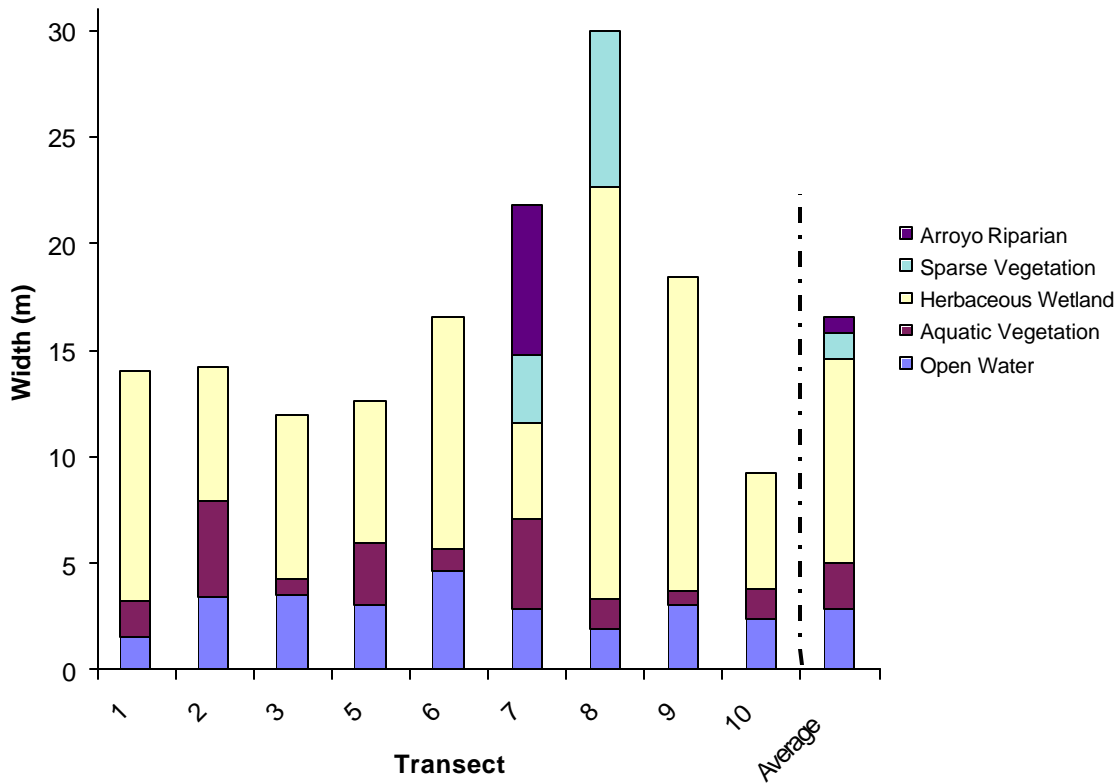


Figure 5. Widths of vegetation types within the active floodplain.

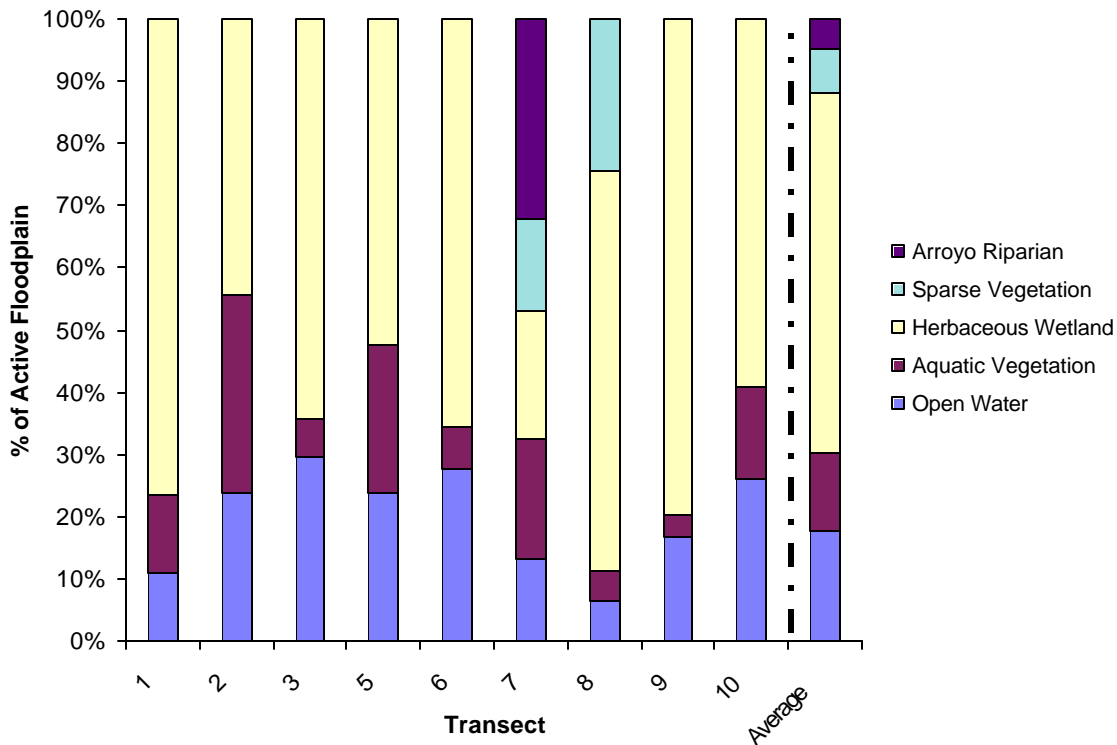


Figure 6. Percentage of active floodplain occupied by vegetation types.

Species diversity

A total of 77 plant species were identified along the transects in 2003 (Appendix C). Russian olive and oneseed juniper were the only trees recorded on the transects, although widely scattered mature Rio Grande cottonwoods (*Populus deltoides* var. *wislizeni*) occurred in the reach. There were four shrubs; the native rubber rabbitbush, coyote willow (*Salix exigua*), and broom snakeweed (*Gutierrezia sarothrae*), and exotic saltcedar (*Tamarix ramosissima*). With the exception of rubber rabbitbush dominance in the Arroyo Riparian zone, exotic Russian olive and saltcedar dominate the woody species in the reach (Figure 7a). The majority of the woody cover in the Herbaceous Wetland zone came from over-hanging Russian olives, while the woody cover in the Sparse and Aquatic Vegetation zones was mostly comprised of saltcedar seedlings. The native coyote willow was almost completely absent from the reach, with only one seedling being recorded on transect 2.

Graminoid diversity was moderate at 26 species with natives outnumbering exotics 17 to nine (Figure 8a). But in the Herbaceous Wetland zone exotic cover was higher than native cover (Figure 7b). Most of this exotic cover was due to introduced European pasture grasses including creeping bentgrass (*Agrostis stolonifera*), tall fescue, and barnyardgrass (*Echinochloa crus-galli*). In contrast, the Woody Riparian and Arroyo Riparian zones are dominated by native upland grasses such as alkali sacaton (*Sporobolus airoides*), sand dropseed (*Sporobolus cryptandrus*), and western wheatgrass (*Pascopyrum smithii*), along with alkali muhly, and inland saltgrass.

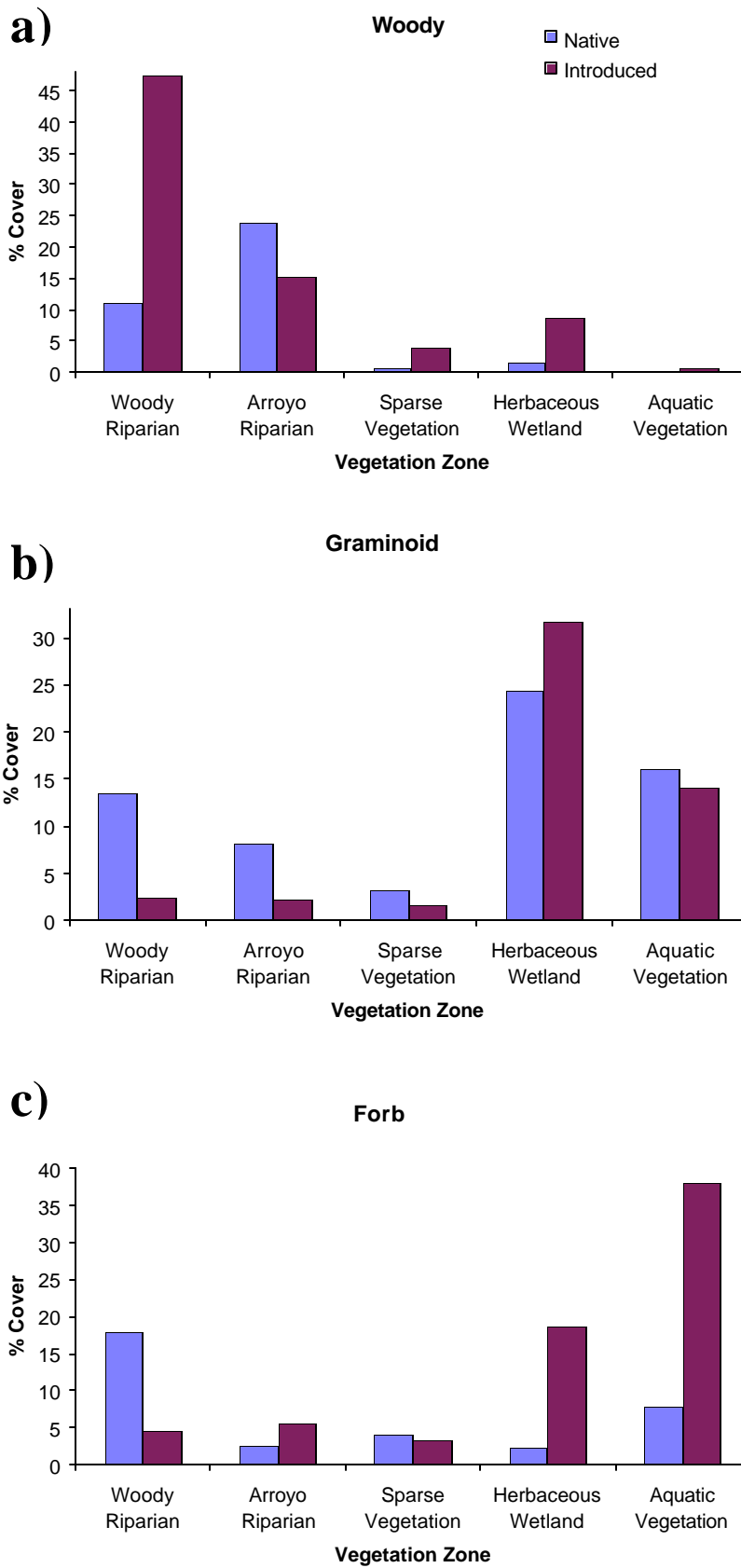


Figure 7. Average Woody (a), Graminoid (b), and Forb (c) cover by origin and vegetation zone.

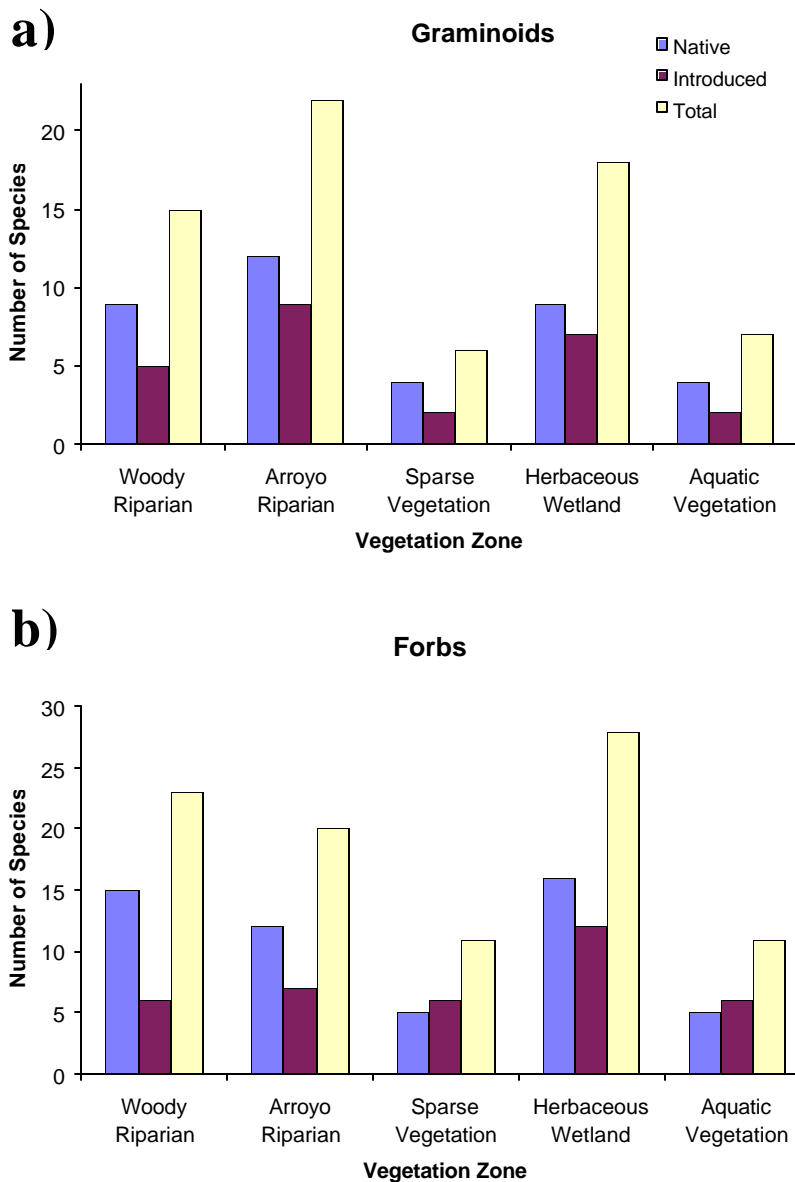


Figure 8. Species richness by origin for graminoids (a) and forbs (b) within each vegetation zone.

There were 45 forb species with the most (27) found in the Herbaceous Wetland zone (Figure 8b). While the number of native species generally exceeds exotic in most zones, exotic herbaceous cover was clearly dominant in the Herbaceous Wetland and Aquatic zones led by strawberry clover and watercress respectively (Figure 7c). The dominance of native forb cover within the Russian olive terrace vegetation zone was due to large patches of yerba mansa (*Anemopsis californica*).

In all vegetation zones the average height of herbaceous vegetation (grasses and forbs) was ten centimeters or less (Figure 9). With the exception of aquatic graminoids (which were measured from the base of the channel) average graminoid height averaged between 5 and 8 cm across vegetation zones while average forb height was generally lower. Many of the grasses and forbs in these zones have the capacity to reach anywhere from 30 to 100 cm.

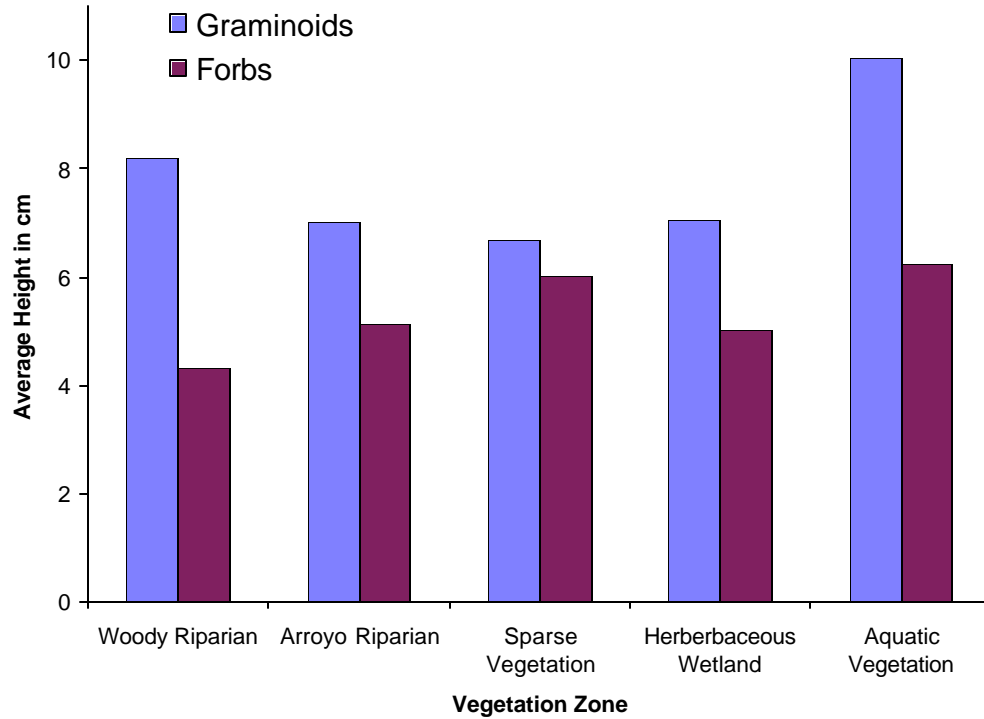


Figure 9. Average height of herbaceous vegetation by lifeform and vegetation zone.

Discussion

Throughout the reach livestock grazing impacts were readily apparent. For example, given a potential herbaceous height of anywhere from 30 to 100 cm, the current average height below 10 cm represents a 60% to 90% cropping of the available forage. In addition, the large number and abundance of exotic herbaceous species is likely driven by long-term grazing where natives are selectively removed and exotics brought in by the grazers. While factors in the success of Russian olive invasion of southwestern riparian ecosystems are many, grazing likely plays a significant role, particularly through the removals of native tree reproduction.

With the removal of livestock in succeeding years we will have an opportunity to accurately gauge the response of the riparian system in the absence of intense grazing pressure. The sampling system that has been installed should allow the detection of changes in species composition and abundance, major shifts in vegetation zones, and the restructuring of the floodplain. One expectation is that wetland and riparian vegetation zones will expand and enhance wildlife and fisheries habitat. Regardless, continued monitoring of this system is vital to establishing a good baseline of information on the current state of the system that will allow for clear and statistically defensible statements about change to support effective adaptive management.

Appendix A

UTM coordinates for the end point rebar of all the transects.

UTM locations for transect end point rebars

Datum: NAD27 Zone: 13

Transect	Rebar #	Easting	Northing
03SF001	1	392051	3934550
03SF001	4	392073	3934538
03SF002	1	392302	3934572
03SF002	4	392286	3934558
03SF003	1	392643	3934534
03SF003	4	392662	3934518
03SF005	1	393083	3934587
03SF005	4	393102	3934574
03SF006	1	393524	3934969
03SF006	4	393532	3934941
03SF007	1	393711	3935125
03SF007	4	393739	3935123
03SF008	1	393982	3935310
03SF008	2b	393984	3935298
03SF008	3a	393981	3935293
03SF008	4	393979	3935275
03SF009	1	394340	3935302
03SF009	4	394339	3935279
03SF010	1	394674	3935447
03SF010	4	394688	3935437

Appendix B

Site Diagrams, photos and species lists with average cover for all transects.

Santa Fe River Monitoring 2003
Transect 03SF001



Figure 10: Transect 03SF001, 20m upstream of rebar 3 at 36 degrees looking downstream



Figure 11: Transect 03SF001, at 5m looking to 26m

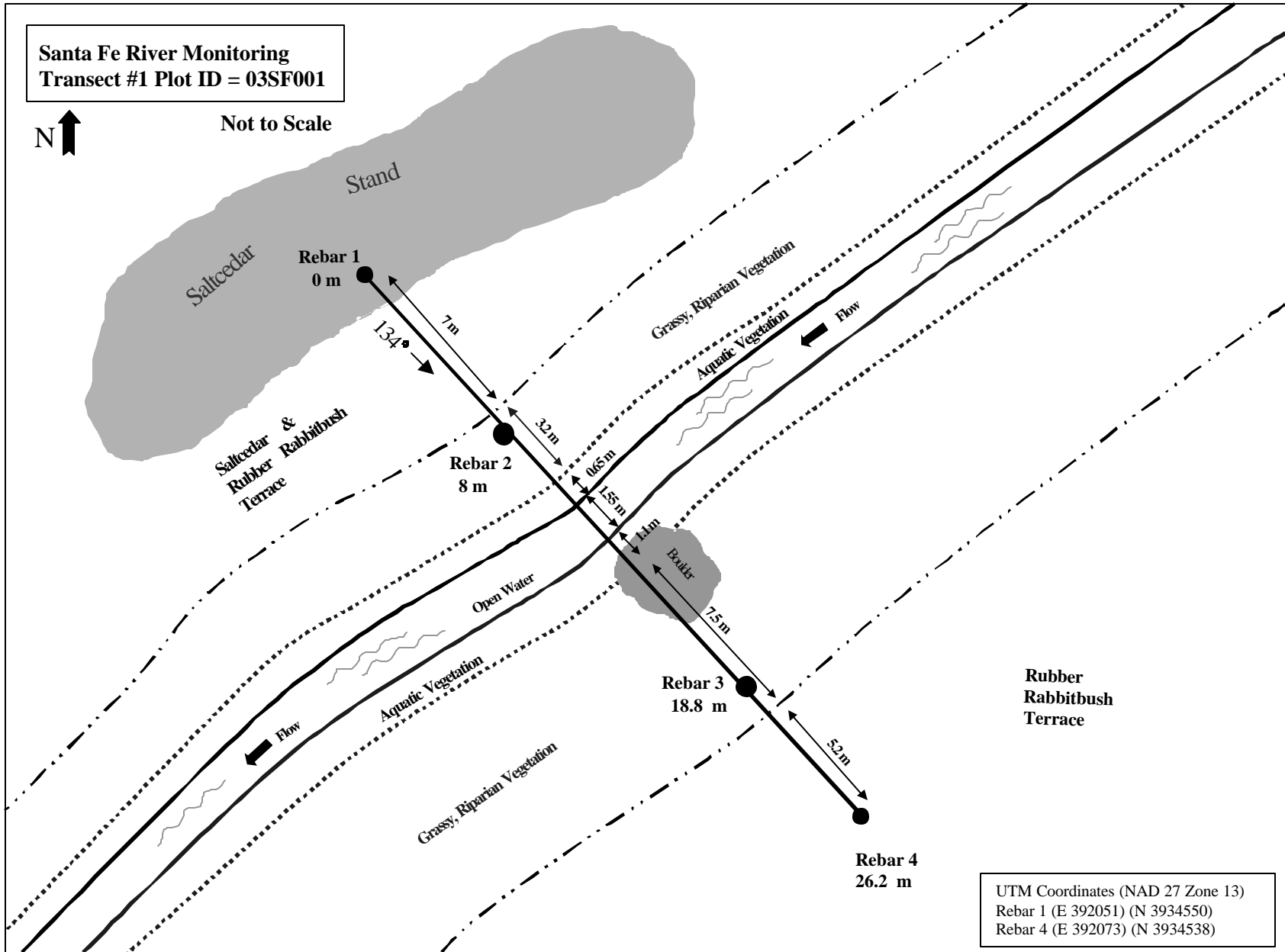


Figure 12: Diagram of transect 03SF001

Table 6: Transect 03SF001 species list with average cover

Transect 03SF001. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	11.826
Tamarix ramosissima	saltcedar	I	FACW	14.076
Sub-shrubs				
Gutierrezia sarothrae	broom snakeweed	N	NI	0.096
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	8.673
Bromus catharticus	rescuegrass	I	NI	0.009
Bromus tectorum	cheatgrass	I	NI	1.365
Cenchrus spinifex	sandbur	N	NI	0.028
Cynodon dactylon	bermudagrass	I	FACU	0.576
Distichlis spicata	inland saltgrass	N	FACW	0.355
Echinochloa crus-galli	barnyardgrass	I	FACW-	0.884
Festuca arundinaceae	tall fescue or K-31	I	NA	7
Muhlenbergia asperifolia	alkali muhly	N	FACW	0.384
Pascopyrum smithii	western wheatgrass	N	FAC-	0.5
Paspalum distichum	knotgrass	N	OBL	4.076
Schoenoplectus pungens	common threesquare	N	OBL	4.213
Sporobolus cryptandrus	sand dropseed	N	FACU-	2.136
Forbs				
Amaranthus hybridus	slim amaranth	N		0.019
Ambrosia acanthicarpa	flatspine burr ragweed	N		0.211
Chamaesyce serpyllifolia	thymeleaf sandmat	N	NI	0.701
Gaura parviflora	velvetweed	N	UPL	0.038
Grindelia nuda var. aphanactis	curlytop gumweed	N		0.057
Melilotus officinalis	yellow sweetclover	I	FACU+	0.019
Portulaca oleracea	common purslane	N	FAC	0.005
Rorippa nasturtium-aquaticum	watercress	I	OBL	1.367
Taraxacum officinale	common dandelion	I	FACU	0.096
Tribulus terrestris	puncturevine	I	NI	0.484
Trifolium fragiferum	strawberry clover	I	NI	6.54
Xanthium strumarium	rough cocklebur	N	FAC	0.386

Santa Fe River Monitoring 2003
Transect 03SF002



Figure 13: Transect 03SF002, 25m upstream from 13m at 128 degrees looking downstream



Figure 14: Transect 03SF002, from 0m looking to 23.4m

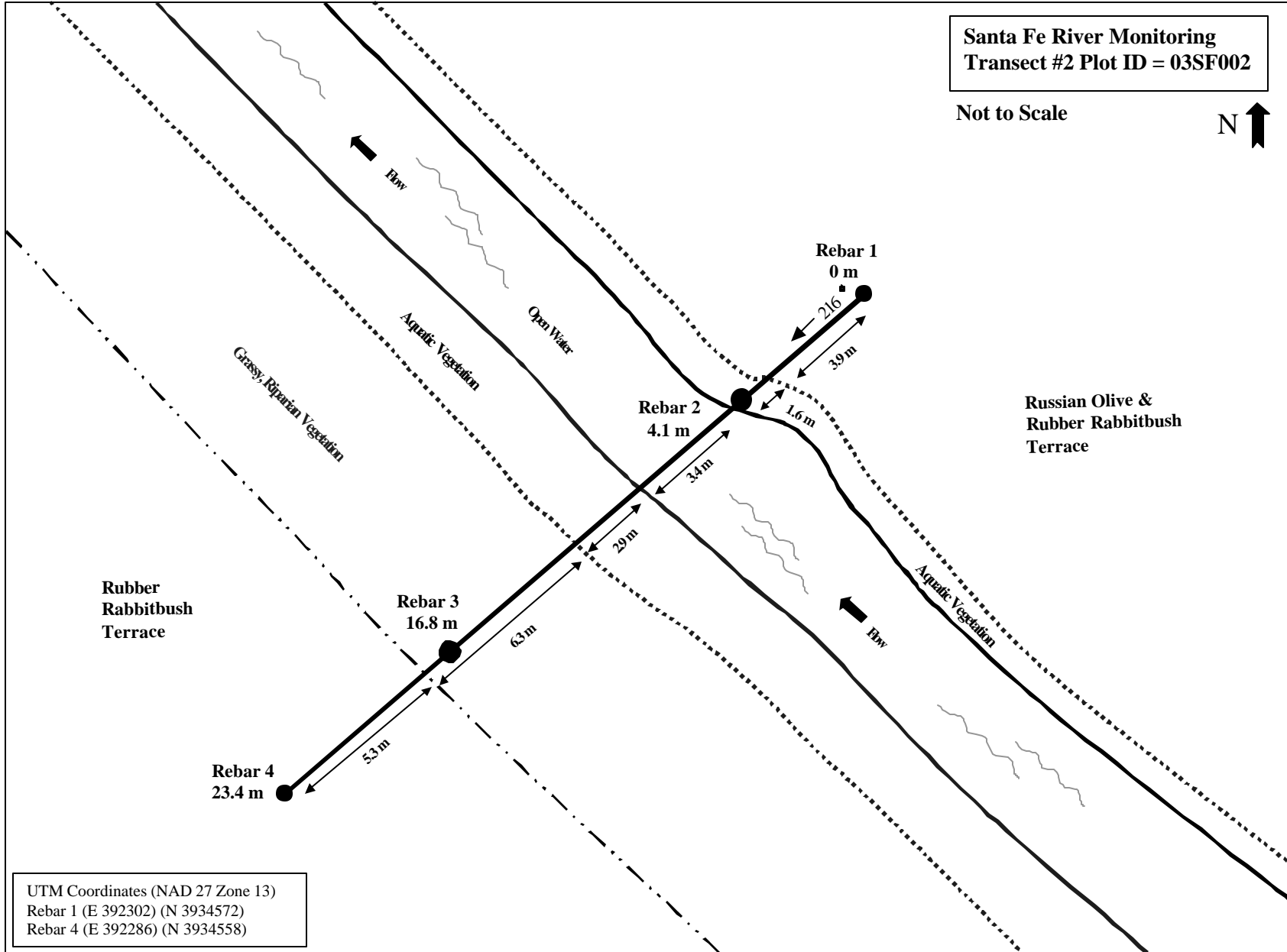


Figure 15: Diagram of transect 03SF002

Table 7: Transect 03SF002 species list with average cover

Transect 03SF002. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Trees				
Elaeagnus angustifolia	Russian olive	I	FACW-	8.26
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	4.239
Salix exigua	coyote willow	N	OBL	0.01
Tamarix ramosissima - seedling	saltcedar	I	FACW	0.413
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	17
Bouteloua barbata	sixweeks grama	N	NI	0.06
Cyperus spp.	flatsedge			0.108
Distichlis spicata	inland saltgrass	N	FACW	0.523
Echinochloa crus-galli	barnyardgrass	I	FACW-	4.173
Eragrostis pectinacea	tufted lovegrass	N		0.154
Festuca arundinaceae	tall fescue or K-31	I	NA	1.163
Muhlenbergia asperifolia	alkali muhly	N	FACW	6.586
Munroa squarrosa	false buffalograss	N		0.002
Pascopyrum smithii	western wheatgrass	N	FAC-	0.967
Paspalum distichum	knotgrass	N	OBL	2.804
Schoenoplectus pungens	common threesquare	N	OBL	4.521
Sporobolus cryptandrus	sand dropseed	N	FACU-	2.304
Forbs				
Amaranthus hybridus	slim amaranth	N		0.017
Ambrosia acanthicarpa	flatspine burr ragweed	N		0.002
Argentina anserina	silverweed cinquefoil	N	OBL	0.108
Calibrachoa parviflora	seaside petunia	N		0.326
Chamaesyce serpyllifolia	thymeleaf sandmat	N	NI	0.023
Kochia scoparia	common kochia	I	FAC	0.021
Mimulus glabratus	roundleaf monkeyflower	N	OBL	1.565
Polygonum aviculare	prostrate knotweed	I	FACW	0.097
Polygonum persicaria	Lady's thumb	I	FACW+	0.391
Portulaca oleracea	common purslane	N	FAC	0.178
Ranunculus cardiophyllus	heartleaf buttercup	N		0.108
Rorippa nasturtium-aquaticum	watercress	I	OBL	4.347
Rumex crispus	curly dock	I	FACW	0.326
Solanum elaeagnifolium	silverleaf nightshade	N	NI	0.021
Sonchus asper	spiny sowthistle	I	FACW	0.108
Tribulus terrestris	puncturevine	I	NI	0.232
Trifolium fragiferum	strawberry clover	I	NI	2.369
Veronica anagallis-aquatica	water speedwell	N	OBL	2.76
Xanthium strumarium	rough cocklebur	N	FAC	0.054

Santa Fe River Monitoring 2003
Transect 03SF003



Figure 16: Transect 03SF003, 20m upstream of rebar 2 at 44 degrees looking downstream

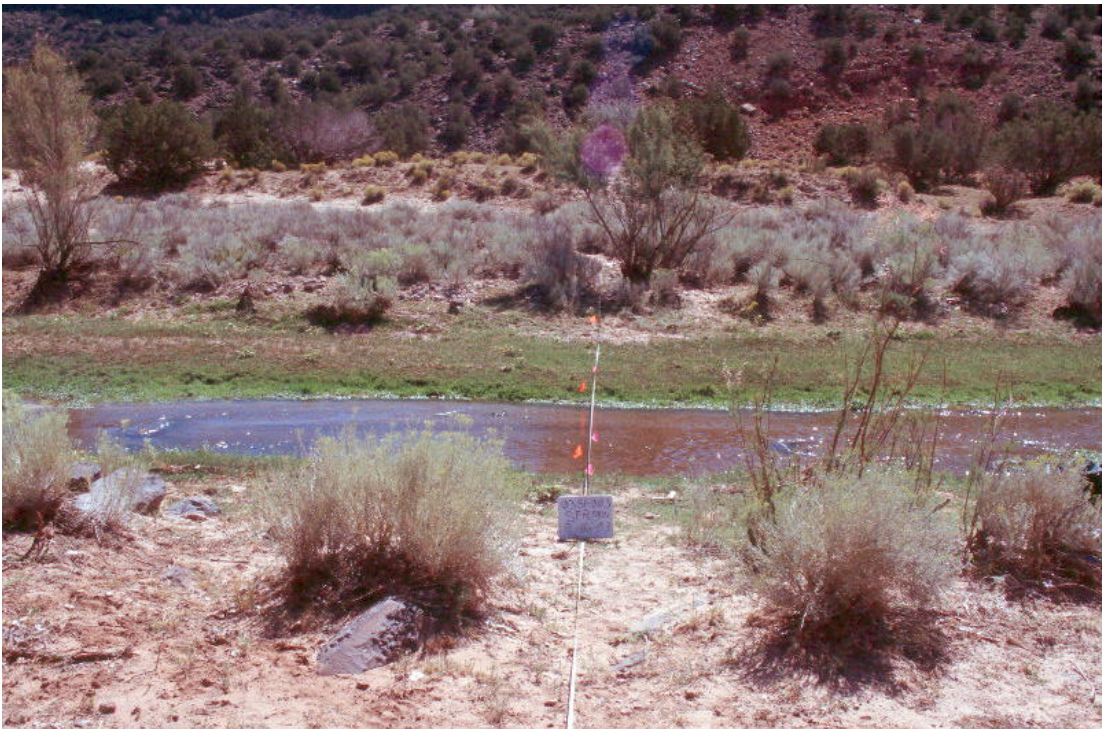


Figure 17: Transect 03SF003, from 0m looking to 25m

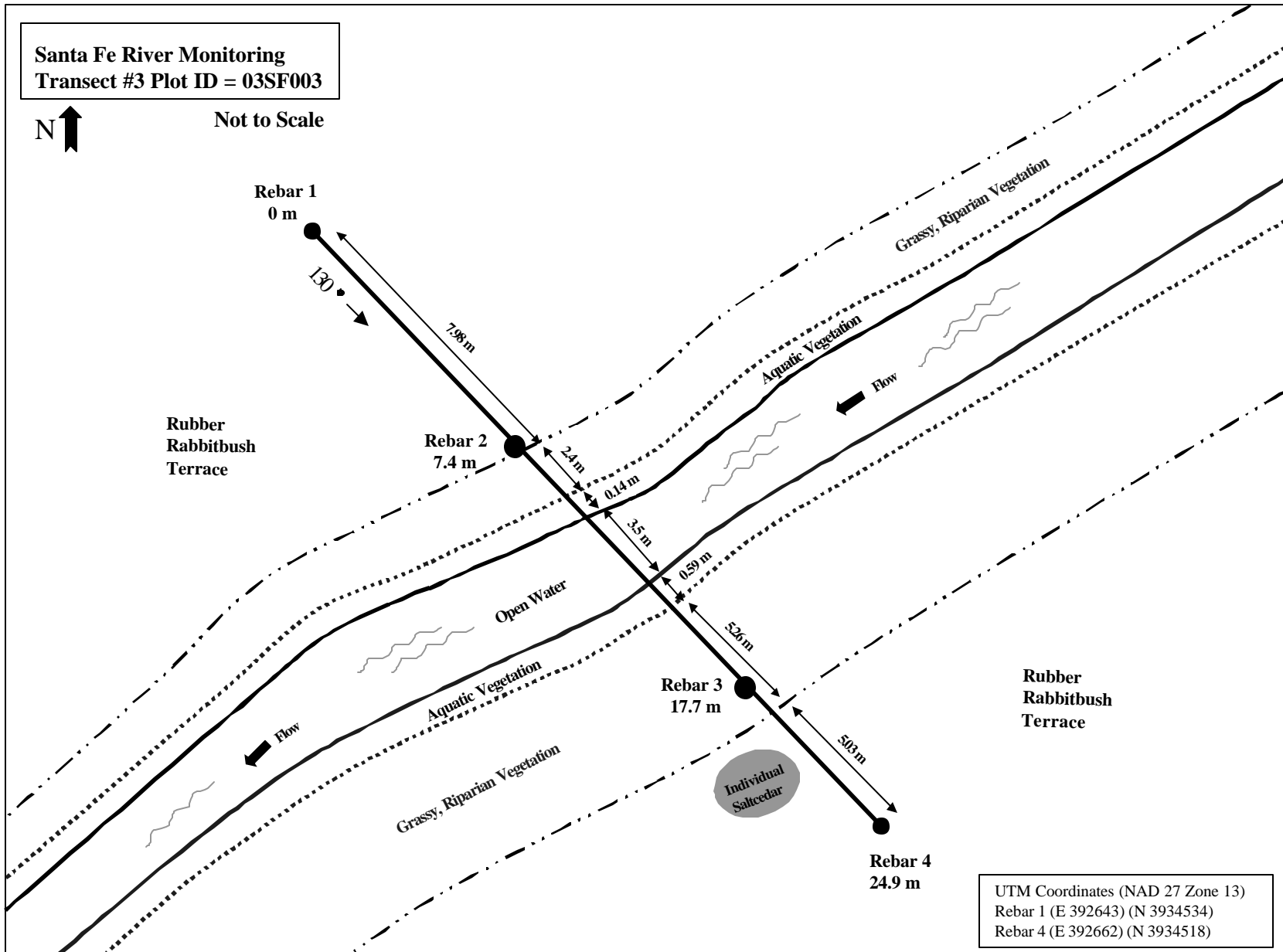


Figure 18: Diagram of transect 03SF003

Table 8: Transect 03SF003 species list with average cover

Transect 03SF003. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	2.348
Tamarix ramosissima	saltcedar	I	FACW	3.265
Sub-shrubs				
Gutierrezia sarothrae	broom snakeweed	N	NI	0.061
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	3.877
Bouteloua gracilis	blue grama	N	NI	0.553
Bromus japonicus	Japanese brome	I	FACU	0.104
Cenchrus spinifex	sandbur	N	NI	0.489
Cynodon dactylon	bermudagrass	I	FACU	0.326
Distichlis spicata	inland saltgrass	N	FACW	0.673
Echinochloa crus-galli	barnyardgrass	I	FACW-	0.979
Eleocharis spp.	spikerush			1.326
Festuca arundinaceae	tall fescue or K-31	I	NA	1.387
Muhlenbergia asperifolia	alkali muhly	N	FACW	0.469
Munroa squarrosa	false buffalograss	N		0.002
Paspalum distichum	knotgrass	N	OBL	4.367
Schoenoplectus pungens	common threesquare	N	OBL	2.438
Sporobolus cryptandrus	sand dropseed	N	FACU-	2.177
Unidentified grass				0.114
Vulpia octoflora	sixweeks fescue	N		0.053
Forbs				
Amaranthus hybridus	slim amaranth	N		0.859
Ambrosia acanthicarpa	flatspine burr ragweed	N		0.418
Chamaesyce serrula	sawtooth sandmat	N		0.02
Chenopodium incanum	mealy goosefoot	N		0.04
Cryptantha minima	little cryptantha	N		0.022
Kallstroemia spp.	caltrop			0.03
Kochia scoparia	common kochia	I	FAC	0.063
Machaeranthera pinnatifida	lacy tansyaster	N		0.726
Melilotus officinalis	yellow sweetclover	I	FACU+	0.01
Mimulus glabratus	roundleaf monkeyflower	N	OBL	0.002
Polygonum aviculare	prostrate knotweed	I	FACW	0.244
Portulaca oleracea	common purslane	N	FAC	0.926
Ratibida tagetes	green prairie coneflower	N	NI	0.469
Rorippa nasturtium-aquaticum	watercress	I	OBL	1.877
Salsola tragus	prickly Russian thistle	I		0.387
Tribulus terrestris	puncturevine	I	NI	1.42
Trifolium fragiferum	strawberry clover	I	NI	6.04
Xanthium strumarium	rough cocklebur	N	FAC	1.142

Santa Fe River Monitoring 2003
Transect 03SF005



Figure 19: Transect 03SF005, 25m upstream at 30 degrees from 4m looking downstream



Figure 20: Transect 03SF005, from 0m looking to 23.1m

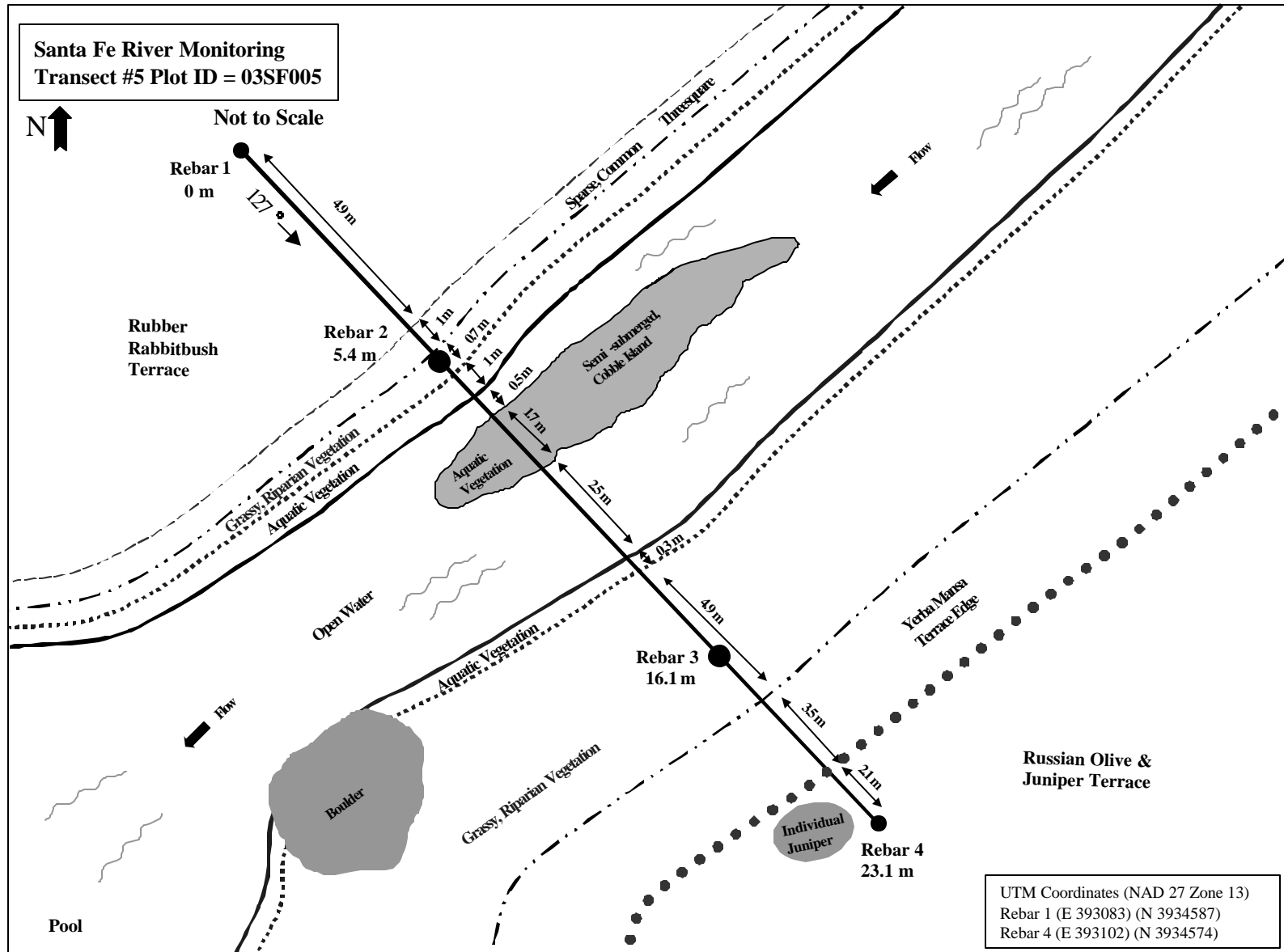


Figure 21: Diagram of transect 03SF005

Table 9: Transect 03SF005 species list with average cover

Transect 03SF005. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Trees				
Elaeagnus angustifolia	Russian olive	I	FACW-	8.695
Juniperus monosperma	oneseed juniper	N		5.76
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	4.608
Sub-shrubs				
Gutierrezia sarothrae	broom snakeweed	N	NI	0.002
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	8.847
Bouteloua barbata	sixweeks grama	N	NI	0.013
Bromus tectorum	cheatgrass	I	NI	0.023
Distichlis spicata	inland saltgrass	N	FACW	4.173
Echinochloa crus-galli	barnyardgrass	I	FACW-	0.478
Eleocharis spp.	spikerush			0.045
Festuca arundinaceae	tall fescue or K-31	I	NA	0.543
Hordeum murinum ssp. glaucum	smooth barley	I		0.026
Juncus arcticus var. balticus	Baltic rush	N	OBL	0.108
Muhlenbergia asperifolia	alkali muhly	N	FACW	4.043
Pascopyrum smithii	western wheatgrass	N	FAC-	0.228
Paspalum distichum	knotgrass	N	OBL	2.565
Schoenoplectus pungens	common threesquare	N	OBL	5.434
Sporobolus airoides	alkali sacaton	N	FAC	1.239
Sporobolus cryptandrus	sand dropseed	N	FACU-	2.719
Forbs				
Almutaster pauciflorus	alkali marsh aster	N		0.26
Amaranthus hybridus	slim amaranth	N		0.058
Anemopsis californica	yerba mansa	N	OBL	8.271
Chamaesyce serpyllifolia	thymeleaf sandmat	N	NI	0.1
Kochia scoparia	common kochia	I	FAC	1.265
Malva neglecta	common mallow	N		0.002
Polygonum aviculare	prostrate knotweed	I	FACW	0.141
Portulaca oleracea	common purslane	N	FAC	0.16
Rorippa nasturtium-aquaticum	watercress	I	OBL	5.478
Salsola tragus	prickly Russian thistle	I		0.043
Tribulus terrestris	puncturevine	I	NI	1.297
Trifolium fragiferum	strawberry clover	I	NI	7.869
Unidentified	unidentified			0.017
Veronica anagallis-aquatica	water speedwell	N	OBL	0.717
Xanthium strumarium	rough cocklebur	N	FAC	0.021

Santa Fe River Monitoring 2003
Transect 03SF006



Figure 22: Transect 03SF006, 25m upstream at 78 degrees from 10.5m looking downstream



Figure 23: Transect 03SF006, from 0m looking to 25.2m

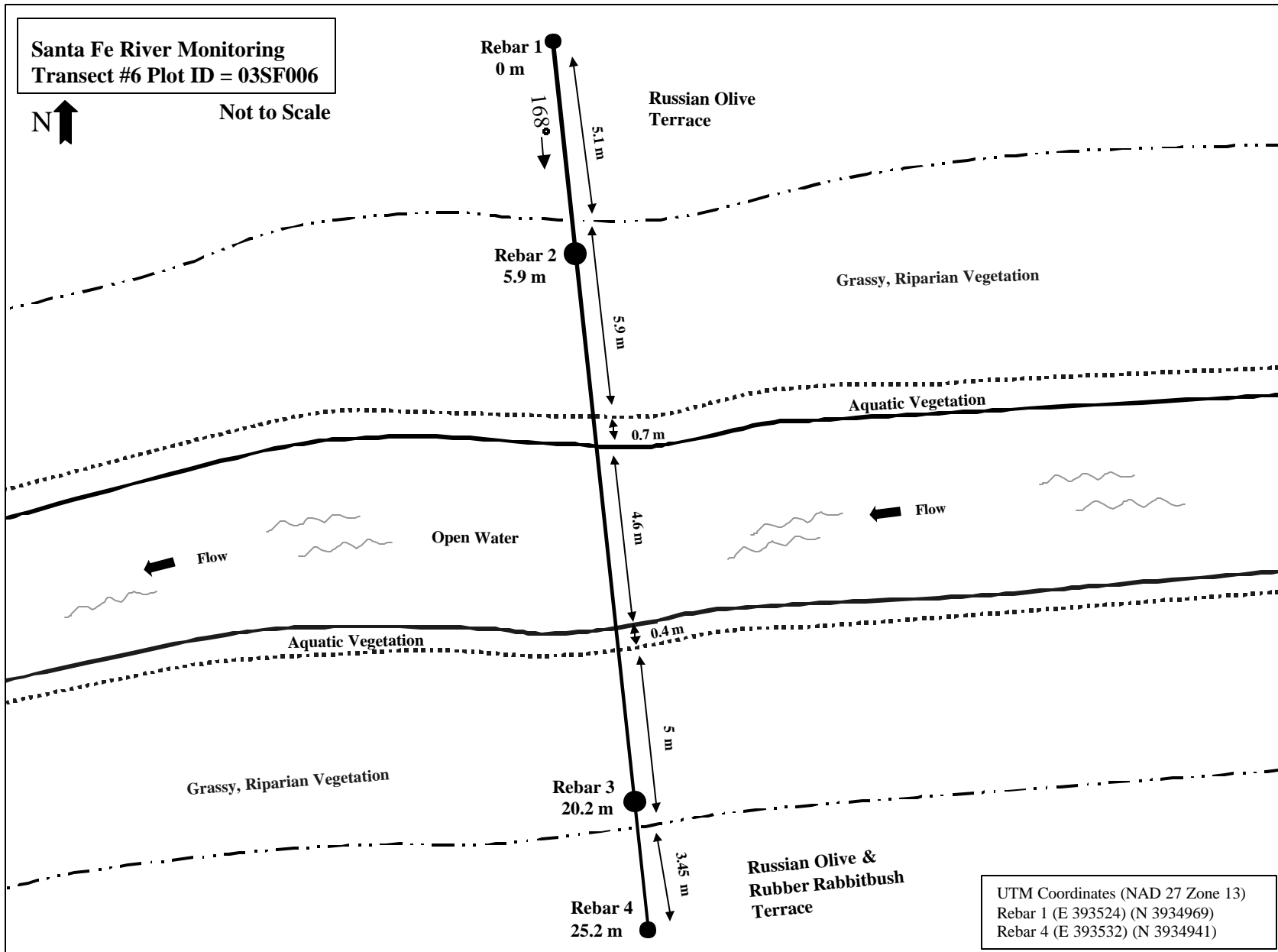


Figure 24: Diagram of transect 03SF006

Table 10: Transect 03SF006 species list with average cover

Transect 03SF006. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Trees				
Elaeagnus angustifolia	Russian olive	I	FACW-	33.64
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	3.1
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	23.68
Bromus tectorum	cheatgrass	I	NI	0.002
Distichlis spicata	inland saltgrass	N	FACW	1.52
Echinochloa crus-galli	barnyardgrass	I	FACW-	0.1
Festuca arundinaceae	tall fescue or K-31	I	NA	1.61
Muhlenbergia asperifolia	alkali muhly	N	FACW	1.3
Pascopyrum smithii	western wheatgrass	N	FAC-	0.55
Paspalum distichum	knotgrass	N	OBL	9.84
Schoenoplectus pungens	common threesquare	N	OBL	3.326
Sporobolus cryptandrus	sand dropseed	N	FACU-	0.01
Forbs				
Anemopsis californica	yerba mansa	N	OBL	0.06
Kochia scoparia	common kochia	I	FAC	3.002
Polygonum aviculare	prostrate knotweed	I	FACW	0.06
Portulaca oleracea	common purslane	N	FAC	0.2
Ranunculus cardiophyllus	heartleaf buttercup	N		0.002
Rorippa nasturtium-aquaticum	watercress	I	OBL	2.54
Taraxacum officinale	common dandelion	I	FACU	0.002
Trifolium fragiferum	strawberry clover	I	NI	4.75

Santa Fe River Monitoring 2003
Transect 03SF007



Figure 25: Transect 03SF007, 25m upstream at 14 degrees from rebar 3 looking downstream



Figure 26: Transect 03SF007, from 2m looking to 28.3m

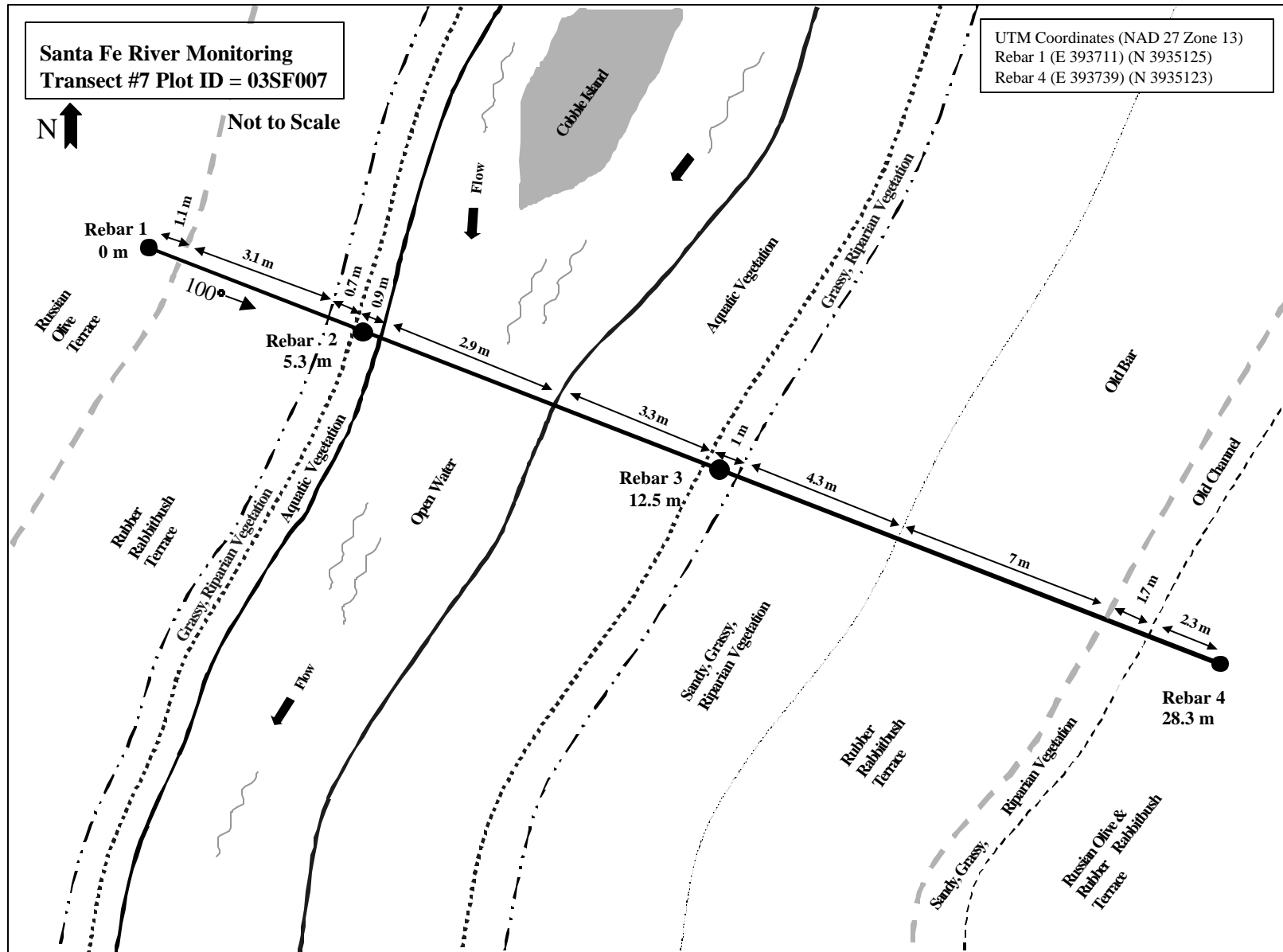


Figure 27: Diagram of transect 03SF007

Table 11: Transect 03SF007 species list with average cover

Transect 03SF007. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Trees				
Elaeagnus angustifolia	Russian olive	I	FACW-	10.232
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	19.017
Tamarix ramosissima	saltcedar	I	FACW	0.017
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	0.357
Bromus tectorum	cheatgrass	I	NI	0.055
Distichlis spicata	inland saltgrass	N	FACW	0.142
Echinochloa crus-galli	barnyardgrass	I	FACW-	0.446
Eragrostis pectinacea	tufted lovegrass	N		0.033
Festuca arundinaceae	tall fescue or K-31	I	NA	0.691
Hordeum murinum ssp. glaucum	smooth barley	I		0.003
Muhlenbergia asperifolia	alkali muhly	N	FACW	2.723
Pascopyrum smithii	western wheatgrass	N	FAC-	0.017
Paspalum distichum	knotgrass	N	OBL	7.392
Schoenoplectus pungens	common threesquare	N	OBL	3.455
Sporobolus cryptandrus	sand dropseed	N	FACU-	0.16
Forbs				
Amaranthus hybridus	slim amaranth	N		0.028
Ambrosia acanthicarpa	flatspine burr ragweed	N		0.428
Chamaesyce serpyllifolia	thymeleaf sandmat	N	NI	0.012
Kochia scoparia	common kochia	I	FAC	1.428
Polygonum aviculare	prostrate knotweed	I	FACW	0.071
Polygonum persicaria	Lady's thumb	I	FACW+	0.446
Portulaca oleracea	common purslane	N	FAC	0.042
Ranunculus cardiophyllus	heartleaf buttercup	N		0.026
Rorippa nasturtium-aquaticum	watercress	I	OBL	7.767
Schkuhria multiflora	manyflower false threadleaf	N		0.017
Taraxacum officinale	common dandelion	I	FACU	0.142
Tribulus terrestris	puncturevine	I	NI	0.019
Trifolium fragiferum	strawberry clover	I	NI	0.392
Veronica anagallis-aquatica	water speedwell	N	OBL	0.428
Xanthium strumarium	rough cocklebur	N	FAC	1.125

Santa Fe River Monitoring 2003
Transect 03SF008



Figure 28: Transect 03SF008, 20m upstream of rebar 3a at 108 degrees looking downstream



Figure 29: Transect 03SF008, from 1m looking to 38.2m

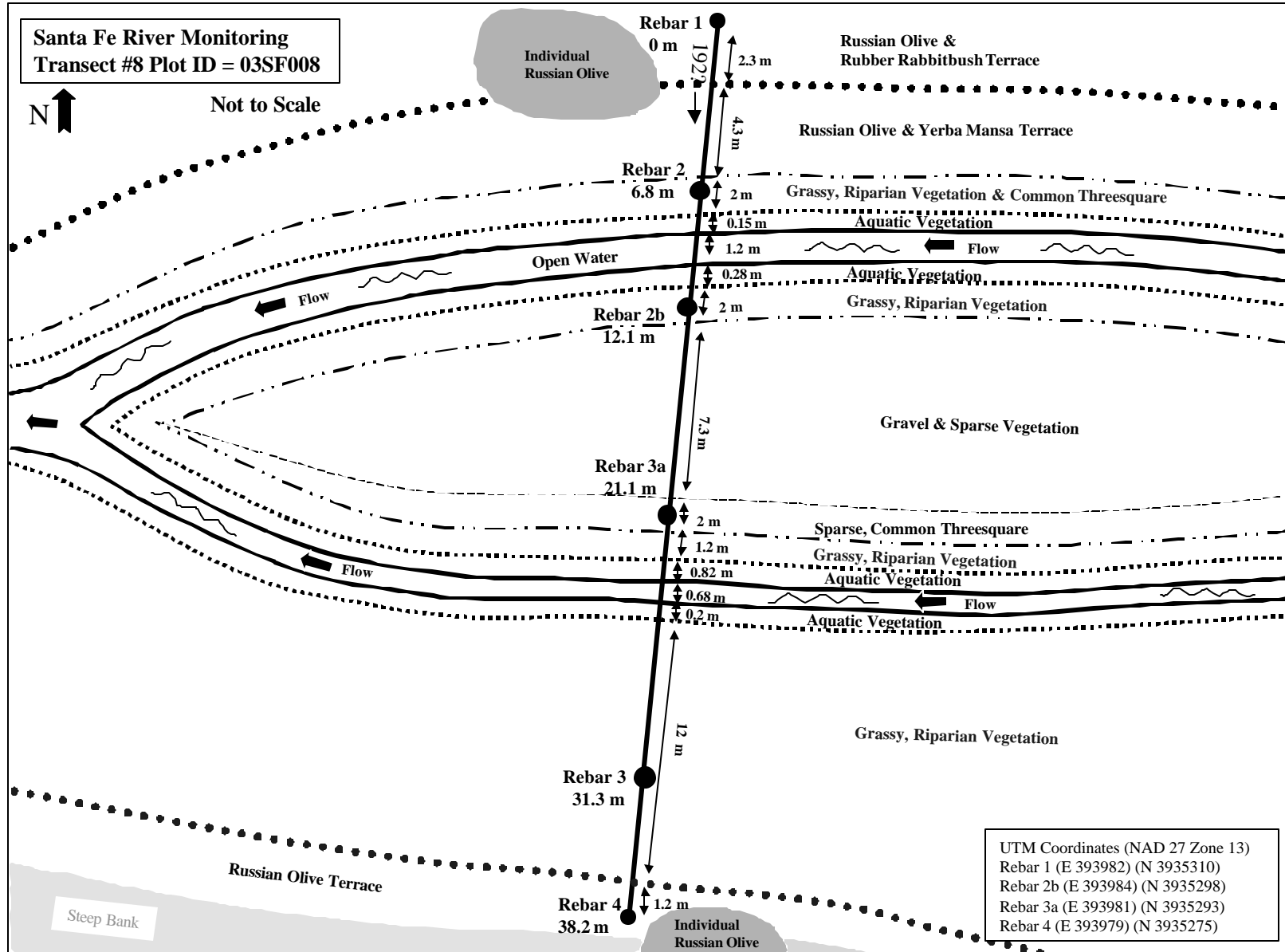


Figure 30: Diagram of transect 03SF008

Table 12: Transect 03SF008 species list with average cover

Transect 03SF008. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Trees				
Elaeagnus angustifolia	Russian olive	I	FACW-	24.019
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	2.934
Tamarix ramosissima	saltcedar	I	FACW	1.027
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	6.355
Carex occidentalis	western sedge	N	NI	0.598
Distichlis spicata	inland saltgrass	N	FACW	1.546
Echinochloa crus-galli	barnyardgrass	I	FACW-	2.276
Eleocharis spp.	spikerush			1.302
Festuca arundinaceae	tall fescue or K-31	I	NA	6.757
Hordeum murinum ssp. glaucum	smooth barley	I		0.056
Juncus arcticus var. balticus	Baltic rush	N	OBL	0.001
Muhlenbergia asperifolia	alkali muhly	N	FACW	6.993
Pascopyrum smithii	western wheatgrass	N	FAC-	0.046
Paspalum distichum	knotgrass	N	OBL	1.896
Schoenoplectus pungens	common threesquare	N	OBL	4.273
Sporobolus airoides	alkali sacaton	N	FAC	0.894
Forbs				
Almutaster pauciflorus	alkali marsh aster	N		0.026
Amaranthus hybridus	slim amaranth	N		0.006
Ambrosia acanthicarpa	flatspine burr ragweed	N		0.592
Anemopsis californica	yerba mansa	N	OBL	8.973
Argentina anserina	silverweed cinquefoil	N	OBL	0.276
Chenopodium incanum	mealy goosefoot	N		0.33
Cirsium vulgare	bull thistle	I	FACU	0.092
Conyza canadensis	Canadian horseweed	N	FACU	0.368
Euphorbia exstipulata	squareseed spurge	N		0.006
Gaura parviflora	velvetweed	N	UPL	0.001
Kochia scoparia	common kochia	I	FAC	1.763
Lactuca serriola	prickly lettuce	I	FAC	0.013
Polygonum aviculare	prostrate knotweed	I	FACW	1.455
Portulaca oleracea	common purslane	N	FAC	0.001
Rorippa nasturtium-aquaticum	watercress	I	OBL	3.223
Rumex crispus	curly dock	I	FACW	0.131
Scorzonera laciniata	cutleaf vipergrass	I		0.223
Solanum elaeagnifolium	silverleaf nightshade	N	NI	0.026
Taraxacum officinale	common dandelion	I	FACU	0.868
Tribulus terrestris	puncturevine	I	NI	0.006
Trifolium fragiferum	strawberry clover	I	NI	6.817
Xanthium strumarium	rough cocklebur	N	FAC	0.947

Santa Fe River Monitoring 2003
Transect 03SF009



Figure 31: Transect 03SF009, 20m upstream of rebar 2 at 90 degrees looking downstream



Figure 32: Transect 03SF009, from 3m looking to 28.4m

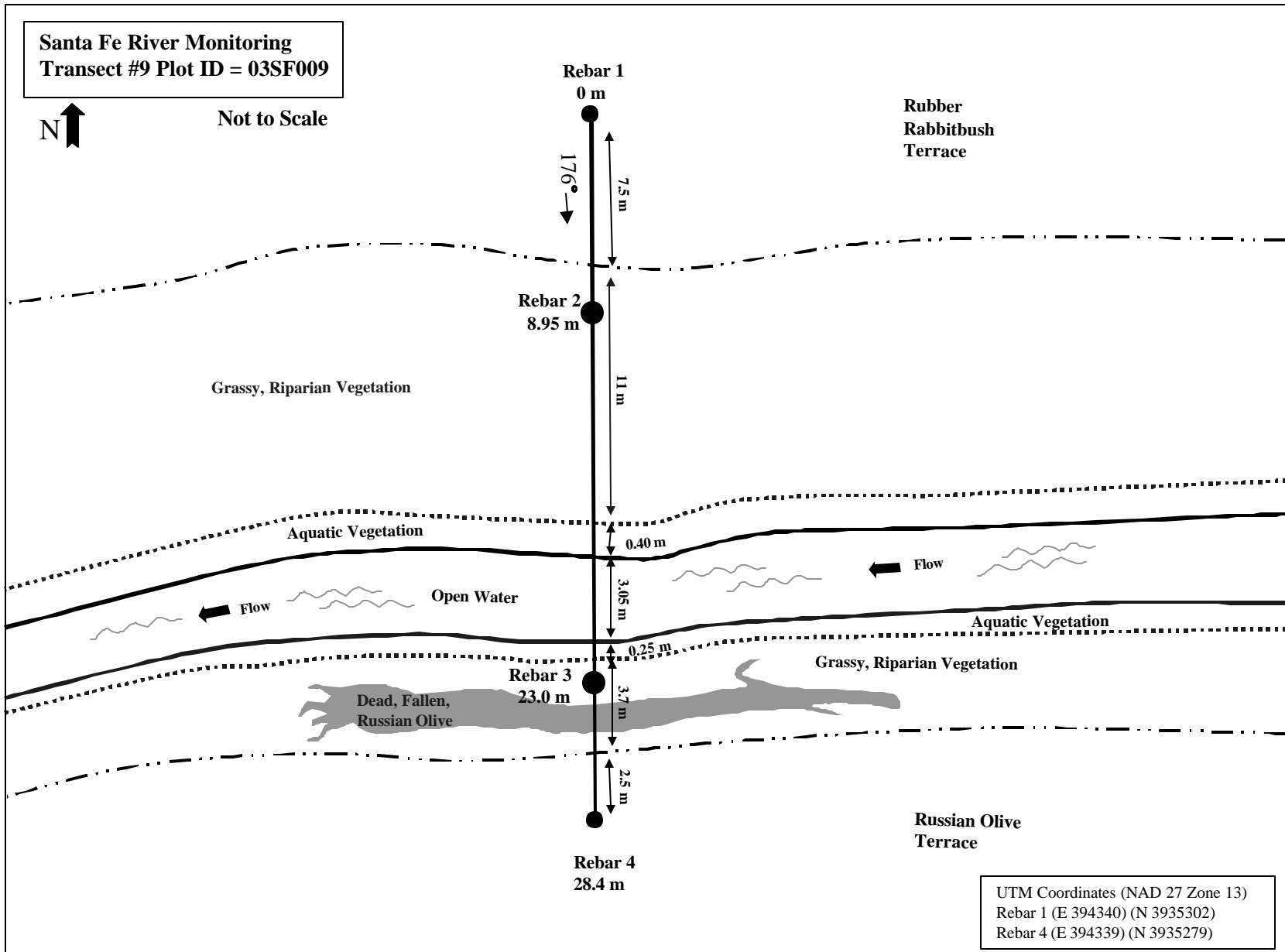


Figure 33: Diagram of transect 03SF009

Table 13: Transect 03SF009 species list with average cover

Transect 03SF009. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Trees				
Elaeagnus angustifolia	Russian olive	I	FACW-	9.785
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	8.214
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	6.571
Bromus catharticus	rescuegrass	I	NI	1.196
Bromus tectorum	cheatgrass	I	NI	0.062
Distichlis spicata	inland saltgrass	N	FACW	0.839
Echinochloa crus-galli	barnyardgrass	I	FACW-	3.232
Eleocharis spp.	spikerush			0.517
Festuca arundinaceae	tall fescue or K-31	I	NA	3.966
Hordeum murinum ssp. glaucum	smooth barley			0.035
Muhlenbergia asperifolia	alkali muhly	N	FACW	1.785
Pascopyrum smithii	western wheatgrass	N	FAC-	0.017
Paspalum distichum	knotgrass	N	OBL	5.035
Poa annua	bluegrass	I		1.142
Schoenoplectus pungens	common threesquare	N	OBL	5.982
Sporobolus cryptandrus	sand dropseed	N	FACU-	0.276
Forbs				
Amaranthus hybridus	slim amaranth	N		0.039
Calibrachoa parviflora	seaside petunia	N		0.017
Chamaesyce serpyllifolia	thymeleaf sandmat	N	NI	0.005
Grindelia nuda var. aphanactis	curlytop gumweed	N		0.089
Kochia scoparia	common kochia	I	FAC	6.464
Mimulus glabratus	roundleaf monkeyflower	N	OBL	0.178
Polygonum aviculare	prostrate knotweed	I	FACW	0.098
Polygonum persicaria	Lady's thumb	I	FACW+	0.008
Portulaca oleracea	common purslane	N	FAC	0.128
Ranunculus cardiophyllus	heartleaf buttercup	N		0.001
Rorippa nasturtium-aquaticum	watercress	I	OBL	1.428
Rumex crispus	curly dock	I	FACW	0.037
Taraxacum officinale	common dandelion	I	FACU	0.017
Tribulus terrestris	puncturevine	I	NI	0.196
Trifolium fragiferum	strawberry clover	I	NI	14.839
Xanthium strumarium	rough cocklebur	N	FAC	1.464

**Santa Fe River Monitoring 2003
Transect 03SF010**



Figure 34: Transect 03SF010, 20m upstream of 6m at 34 degrees looking downstream



Figure 35: Transect 03SF010, from 0m looking to 16.8m

Table 14: Transect 03SF010 species list with average cover

Transect 03SF010. Species List with Average Cover

Species Name	Common Name	Origin	Wetland Status	Average Cover
Trees				
Elaeagnus angustifolia	Russian olive	I	FACW-	0.939
Shrubs				
Chrysothamnus nauseosus	rubber rabbitbrush	N	NI	14.242
Graminoids				
Agrostis stolonifera	creeping bentgrass	I	FACW	5
Bouteloua barbata	sixweeks grama	N	NI	0.015
Bromus tectorum	cheatgrass	I	NI	0.272
Cyperus spp.	flatsedge			0.015
Echinochloa crus-galli	barnyardgrass	I	FACW-	0.727
Eleocharis spp.	spikerush			2.575
Eragrostis pectinacea	tufted lovegrass	N		2.363
Festuca arundinaceae	tall fescue or K-31	I	NA	3
Muhlenbergia asperifolia	alkali muhly	N	FACW	0.909
Paspalum distichum	knotgrass	N	OBL	0.606
Schoenoplectus pungens	common threesquare	N	OBL	3.063
Sporobolus cryptandrus	sand dropseed	N	FACU-	1.545
Vulpia octoflora	sixweeks fescue	N		0.03
Forbs				
Amaranthus hybridus	slim amaranth	N		0.003
Ambrosia acanthicarpa	flatspine burr ragweed	N		1.878
Argentina anserina	silverweed cinquefoil	N	OBL	0.969
Chamaesyce serpyllifolia	thymeleaf sandmat	N	NI	0.012
Chamaesyce serrula	sawtooth sandmat	N		0.003
Conyza canadensis	Canadian horseweed	N	FACU	0.045
Croton texensis	Texas croton	N	NI	0.015
Fabaceae				0.06
Ipomoea spp.	morning glory	N		0.09
Ipomopsis longiflora	flaxflowered gilia	N	NI	0.003
Polygonum aviculare	prostrate knotweed	I	FACW	0.242
Polygonum persicaria	Lady's thumb	I	FACW+	0.03
Portulaca oleracea	common purslane	N	FAC	0.006
Ranunculus cymbalaria	alkali buttercup	N	OBL	0.409
Rorippa nasturtium-aquaticum	watercress	I	OBL	2.121
Salsola tragus	prickly Russian thistle	I		0.003
Schkuhria multiflora	manyflower false threadleaf	N		0.003
Tribulus terrestris	puncturevine	I	NI	0.03
Trifolium fragiferum	strawberry clover	I	NI	5.563
Verbascum thapsus	common mullein	I	NI	0.454
Xanthium strumarium	rough cocklebur	N	FAC	0.03

Appendix C

List of all species observed during Santa Fe River monitoring in 2003.

Scientific Name	Common Name	Origin	Wetland Status
Trees			
<i>Elaeagnus angustifolia</i>	Russian olive	Introduced	FACW-
<i>Juniperus monosperma</i>	oneseed juniper	Native	
Shrubs			
<i>Chrysothamnus nauseosus</i>	rubber rabbitbrush	Native	NI
<i>Salix exigua</i>	coyote willow	Native	OBL
<i>Tamarix ramosissima</i>	saltcedar	Introduced	FACW
Sub-Shrubs			
<i>Gutierrezia sarothrae</i>	broom snakeweed	Native	NI
Graminoids			
<i>Agrostis stolonifera</i>	creeping bentgrass	Introduced	FACW
<i>Bouteloua barbata</i>	sixweeks grama	Native	NI
<i>Bouteloua gracilis</i>	blue grama	Native	NI
<i>Bromus catharticus</i>	rescuegrass	Introduced	NI
<i>Bromus japonicus</i>	Japanese brome	Introduced	FACU
<i>Bromus tectorum</i>	cheatgrass	Introduced	NI
<i>Carex occidentalis</i>	western sedge	Native	NI
<i>Cenchrus spinifex</i>	sandbur	Native	NI
<i>Cynodon dactylon</i>	bermudagrass	Introduced	FACU
<i>Cyperus</i> spp.	flatsedge		
<i>Distichlis spicata</i>	inland saltgrass	Native	FACW
<i>Echinochloa crus-galli</i>	barnyardgrass	Introduced	FACW-
<i>Eleocharis</i> spp.	spikerush		
<i>Eragrostis pectinacea</i>	tufted lovegrass	Native	
<i>Festuca arundinaceae</i>	tall fescue or K-31	Introduced	NA
<i>Hordeum murinum</i> ssp. <i>glaucum</i>	smooth barley	Introduced	
<i>Juncus arcticus</i> var. <i>balticus</i>	Baltic rush	Native	OBL
<i>Muhlenbergia asperifolia</i>	alkali muhly	Native	FACW
<i>Munroa squarrosa</i>	false buffalograss	Native	
<i>Pascopyrum smithii</i>	western wheatgrass	Native	FAC-
<i>Paspalum distichum</i>	knotgrass	Native	OBL
<i>Poa annua</i>	bluegrass	Introduced	
<i>Schoenoplectus pungens</i>	common threesquare	Native	OBL
<i>Sporobolus airoides</i>	alkali sacaton	Native	FAC
<i>Sporobolus cryptandrus</i>	sand dropseed	Native	FACU-
<i>Vulpia octoflora</i>	sixweeks fescue	Native	
Forbs			
<i>Almutaster pauciflorus</i>	alkali marsh aster	Native	
<i>Amaranthus hybridus</i>	slim amaranth	Native	
<i>Ambrosia acanthicarpa</i>	flatspine burr ragweed	Native	
<i>Anemopsis californica</i>	yerba mansa	Native	OBL

Scientific Name	Common Name	Origin	Wetland Status
Forbs continued			
Argentina anserina	silverweed cinquefoil	Native	OBL
Calibrachoa parviflora	seaside petunia	Native	
Chamaesyce serpyllifolia	thymeleaf sandmat	Native	NI
Chamaesyce serrula	sawtooth sandmat	Native	
Chenopodium incanum	mealy goosefoot	Native	
Cirsium vulgare	bull thistle	Introduced	FACU
Conyza canadensis	Canadian horseweed	Native	FACU
Croton texensis	Texas croton	Native	NI
Cryptantha minima	little cryptantha	Native	
Euphorbia exstipulata	squareseed spurge	Native	
Fabaceae			
Gaura parviflora	velvetweed	Native	UPL
Grindelia nuda var. aphanactis	curlytop gumweed	Native	
Ipomoea spp.	morning glory	Native	
Ipomopsis longiflora	flaxflowered gilia	Native	NI
Kallstroemia spp.	caltrop		
Kochia scoparia	common kochia	Introduced	FAC
Lactuca serriola	prickly lettuce	Introduced	FAC
Machaeranthera pinnatifida	lacy tansyaster	Native	
Malva neglecta	common mallow	Native	
Melilotus officinalis	yellow sweetclover	Introduced	FACU+
Mimulus glabratus	roundleaf monkeyflower	Native	OBL
Polygonum aviculare	prostrate knotweed	Introduced	FACW
Polygonum persicaria	Lady's thumb	Introduced	FACW+
Portulaca oleracea	common purslane	Native	FAC
Ranunculus cardiophyllus	heartleaf buttercup	Native	
Ranunculus cymbalaria	alkali buttercup	Native	OBL
Ratibida tagetes	green prairie coneflower	Native	NI
Rorippa nasturtium-aquaticum	watercress	Introduced	OBL
Rumex crispus	curly dock	Introduced	FACW
Salsola tragus	prickly Russian thistle	Introduced	
Schkuhria multiflora	manyflower false threadleaf	Native	
Scorzonera laciniata	cutleaf vipergrass	Introduced	
Solanum elaeagnifolium	silverleaf nightshade	Native	NI
Sonchus asper	spiny sowthistle	Introduced	FACW
Taraxacum officinale	common dandelion	Introduced	FACU
Tribulus terrestris	puncturevine	Introduced	NI
Trifolium fragiferum	strawberry clover	Introduced	NI
Verbascum thapsus	common mullein	Introduced	NI
Veronica anagallis-aquatica	water speedwell	Native	OBL
Xanthium strumarium	rough cocklebur	Native	FAC