Summer bird/vegetation associations in Tamarisk and native habitat along the Pecos River, southeastern New Mexico

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Abstract.-The middle Pecos River lies in the short-grass prairie ecotype and lacked a substantial woodland community prior to tamarisk (Tamarisk *chinensis*) invasion. Tamarisk control is a concern for land managers on the Pecos River and other Southwestern riparian systems. Our research is part of a long term study investigating hydrological and wildlife response to tamarisk removal on the Pecos river in Eddy County, New Mexico. Our objectives were to collect baseline data and describe avian/vegetation associations at the treatment site and two non-treatment (control) sites prior to herbicide application. In 1994 and 1995, we estimated bird mean abundance and species richness in tamarisk and grassland habitats, described vegetational structure and species composition, and compared bird species abundance, richness, and composition. The treatment site and control site 1 (Brantley Wildlife Management Area [BWMA]) had expansive monotypic stands of tamarisk. Control site 2 (Bitter Lake National Wildlife Refuge [BLNWR]) had expansive areas of grassland. Bird mean abundance was significantly higher at the treatment site and BWMA in 1994 than 1995. BWMA was similar to the treatment site in vegetation, but consistently had higher bird abundance and species richness. BLNWR had minimal vegetational structure and consistently had the lowest bird abundance and species richness values. Factors including vegetation structure, grazing, habitat patchiness, and human disturbance are offered to explain differences in bird community patterns between sites.

Tamarisk or saltcedar (*Tamarix chinensis)* was introduced to North America in mid-1800's from Eurasia as an ornamental and later for erosion control (Robinson 1965). This exotic has escaped cultivation and spread throughout Southwestern riparian ecosystems to encompass 15,688 ha along the lower Colorado River (Ohmart et al. 1977), and 28,800 ha along the Pecos River in New Mexico, and 87,200 ha in Texas (Hunter et al. 1985). Tamarisk out competes native vegetation in three ways:

- Secretes a salty exudate raising soil salinitv above other species' tolerance,
- Creates a fire prone ground cover by shedding its leaves and sprouts vigorously after fire, and
- Creates a dense over-story which shades out other species (Sisneros 1991). As a consequence of its competiveness, tamarisk creates monotypic stands.

The middle Pecos Valley lies in the shortgrass prairie ecotype (Dick-Peddie 1993) and lacked a substantial woodland community prior to tamarisk invasion (Hildebrandt and Ohmart 1982). Historically, cottonwood (*Populus fremontii* var *wislizeni*)

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gallery forest was restricted to localized, narrow bands adjacent to the river (e.g. Ft. Sumner, NM). Primary vegetation types were Chihuahuan grassland and Chihuahuan shrub (Dick-Peddie 1993).

Several studies have compared bird use of tamarisk versus native woodland vegetation. Results from that work indicated bird/tamarisk associations varied between geographic location. Negative associations were detected along the lower Colorado River and lower Rio Grande (Anderson et al. 1977, Engel-Wilson and Ohmart 1978, Anderson and Ohmart 1984). However, other studies have indicated positive associations along the Pecos River and Rio Grande for at least some species (Hunter et al. 1985, Hunter et al. 1988, Leal 1994, Ellis 1995). Only one study to date has compared bird use of tamarisk and native grassland vegetation (Hildebrandt and Ohmart 1982). Additional knowledge of tamarisk encroachment impacts on grassland birds is needed.

Our research is part of a long term study investigating hydrological and wildlife response to tamarisk removal on a privately owned 2000 ha plot adjoining to the Pecos river in Eddy County, New Mexico. Tamarisk is being killed with a Arsenal/Rodeo (Imazapyr/Glyphosate) mixture (SCS 1994). Our objectives were to collect baseline data and describe avian/vegetation associations at the treatment site and two non-treatment (control) sites prior to herbicide application. We estimated bird mean abundance and species richness in tamarisk and grassland habitats, described vegetational structure and species composition at the three sites, and compared bird species abundance, richness, and composition among dominant vegetation types.

STUDY AREA

We conducted the study in Eddy and Chaves counties, southeastern New Mexico. The treatment site was south of U.S. Highway 82 and north of the Rio Penasco on the west side of the Pecos River, near Artesia, New Mexico. Control site 1 was five km south of the treatment site situated within the state managed, 15,390 ha Brantley Wildlife Management Area (BWMA). Dominant woodland vegetation was tamarisk, dominant grassland vegetation was alkali sacaton (*Sporobolus aeroides*) with mixed shrubs of honey mesquite (*Prosopsis glandulosa*) and tamarisk. Kochia (*Kochia scoparia*) was present in expansive fields interspersed with tamarisk stands. Tamarisk density and distribution was variable, but decreased in density away from the river. Year-round grazing occurred at the treatment site; no grazing has occurred at BWMA for four years. Chihuahuan desert shrub bordered the east side of the river. Control site 2 was approximately 80 km north of the treatment site on the west side of the Pecos river at Bitter Lake National Wildlife Refuge (BLNWR). BLNWR was sampled only in 1995. Dominant riparian vegetation was alkali sacaton with scattered seep willow (*Baccharis spp.*) shrubs. Tamarisk was limited to small patches in oxbow lakes, areas proximate to the river and management impoundments, and scattered throughout grassland vegetation. All sites were located within the Pecos River floodplain. No grazing has occurred at BLNWR since the 1930's. Elevation of the study sites ranged from 997 to 1006 m at the treatment site and BWMA, and 1058 to 1074 m at BLNWR. Average annual temperature was 16 C, with extremes of -31 C in winter and 44 C in summer, and average annual precipitation from 1958 to 1994 was 32 cm. Most rainfall occurrs in July and August (Agr. Sci. Cen. at Artesia).

METHODS

We randomly placed eight line-transects (Buckland et al. 1993) at each site. Four transects were in tamarisk (habitat 1), and four transects were in mixed-shrub grassland (habitat 2) at the treatment site and at BWMA. At BLNWR, four transects were in habitat 2 and four were in grassland devoid of tamarisk (habitat 3). Habitat 3 was only present at BLNWR. Habitat 1 did not occur at BLNWR. All transects within a site were >200 m apart to ensure independence of bird surveys. All transects were 600 m long.

We counted birds along each transect three times from mid-May through the first week of July 1994 and 1995. Counts began one-quarter hour before sunrise and continued for two hours (Anderson and Ohmart 1977). We recorded all birds heard or seen within a distance of 100 m perpendicular to the transect. No surveys were conducted during rain or in winds >10 km/hour (Skirvin 1981). We began surveys after a two minute acclimation period.

We sampled tamarisk density (trees/ha) using 5 X 100 m belt-transects. Six belt-transects were established perpendicular to each bird-transect at 100 m intervals. All tamarisk plants ≥ 1 m in height were counted as trees, tamarisk plants <1 m were counted as shrubs. We established points at 15 m and 50 m from the bird-transect within each belt-transect in habitat 1. We chose four trees systematically using the Point Centered-Quarter method (Cottam and Curtis 1956) at each point. Measurements for each tree included distance from point, height, and number of stems. In habitat 2, five trees were randomly chosen within each belt-transect for height measurements and stem counts. We sampled all available trees when less than five were present. We quantified shrub and herbaceous vegetation using a line-intercept method (Canfield 1941) in all three habitat types. Twelve 15 m lines were randomly located for measuring herbaceous vegetation and shrubs at 100 m intervals and on each side of a bird-transect. Grass and shrub height was measured every three meters along the line.

We summarized vegetation variables within each site for grassland and tamarisk dominated habitats. A multivariate analysis of variance procedure with orthogonal contrast statements (SAS 1990, p.905) was used to detect differences among sites and within sites between habitat types for tree variables. We expressed bird species mean abundance values as average number of detections for each species from three surveys at a transect. Bird species richness was expressed as total number of species enumerated along each transect for three surveys. Whittaker's Coefficient of Community was used to determine similarity of species between sites and habitat types (CC):CC = 2Sab/(Sa + Sb), where Sab is the number of species in common between two habitats, and Sa and Sb are the numbers of species in each of the two habitats, respectively (Whittaker 1975, Farley et al. 1995).

We tested all data for normality and used non-parametric tests when needed. We performed paired comparison t-tests to detect differences among years for bird mean abundance and species richness. We used a general linear model with orthogonal contrast statements to detect differences among sites and among habitat types within sites for bird mean abundance and species richness (SAS 1990, p.372, 618, 905). We considered differences significant at $P \leq 0.05$.

RESULTS

Vegetational characteristics

Mean values for tamarisk tree density, stem density, and average height were not different between the treatment site and BWMA in habitat 1 ($F=0.8593$; 3,48 df; $p=0.4687$) and in habitat 2 ($F=0.7757$; 3,43 df; $p=0.5140$) (Table 1). Mean values were different between the treatment site and BLWNR ($F=18.2484$; 3,43 df; $p=0.0001$) and between BWMA and BLNWR in habitat 2 ($F=12.9386$; 3,43 df; $p=0.0001$). At individual sites, differences existed in vegetation structure among habitat types (treatment: $F=57.0500$; 6,86 df; $p=0.0001$ and BWMA: $F=55.0130$; 6,78 df; $p=0.0001$).

Line intercept data showed a large percentage of leaf and woody debris in habitat 1 at the treatment site (66%) and BWMA (65%) (Table 2). Bare ground was prevalent (234%) at all sites in habitats 2 and 3. The primary herbaceous plant in habitats 2 and 3 was alkali sacaton. Few herbaceous ($\leq 10\%$) and no shrub species were present in habitat 1. The dominant shrub in habitat 2 at the treatment site and BWMA was honey mesquite. Dominant shrubs in habitats 2 and 3 at BLNWR were iodine bush

Table 1. Means and standard deviations for tamarisk variables measured at three sites in summer 1994 and 1995, southeastern New Mexico.

Site	Tree/ha		Stem/ha		Tree height(m)	
habitat'	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Treatment						
1	2,781	76	25,965	7,336	2.7	1.0
2	393	21	4,902	1,271	2.8	1.1
BWMA						
1	2,664	83	25,451	9,899	3.2	1.0
2	81	5	1,211	834	2.5	0.8
BLNWR						
2	155	9	1,619	1,019	1.9	1.0
3	0	0	0	0	0	0

[1] Habitat I=Tamarisk dominated (only sampled at treatment site and B WMA), 2=Grassland with mixed shrubs, 3=Grassland devoid of tamamrisk (only sampled at BLNWR).

(*Allenrolfea occidentalis)* and seep willow (*Baccharis* spp.), respectively. Average grass height was lowest at the treatment site, intermediate at BWMA, and highest at BLNWR. Average shrub height was not available for the treatment site, and was lower at BWMA than BLNWR (Table 2).

Bird species mean abundance, richness, and composition

A total of 3,472 observations were made of 49 species for 1994 and 1995 combined. We excluded species with fewer than seven observations, resulting in 22 species for analyses (Table 3). More birds were detected in 1994 when data were pooled across sites ($t=9.2741$; 15 df; $p=0.0001$) and at each individual site (treatment: $t=7.4464$; 7 df; $p=0.0001$ and BWMA: $t=5.8665$; 7 df $p=0.0004$). We therefore performed separate analyses for each year.

Site comparisons for bird mean abundance and species richness yielded significant differences in several instances (Table 4). In all cases where differences were detected, BWMA had highest bird mean abundance and species richness, the treatment site had intermediate values, and BLNWR had lowest values (Table 3). Mean abundance and species richness were not different between habitat types at any of the sites in either year. All similarity values exceeded 0.52 for between site comparisons. BWMA and the treatment site had the highest similarity for all comparisons (0.70) in habitat 1 in 1994; they were least similar for all comparisons for habitat 2 in 1994 (0.52). Similarity values between habitat 1 and 2 were highest in 1994 (0.80) at BWMA and were lowest in 1995 (0.52) at BWMA.

Seven species were most commonly detected across all sites and habitats for both years. Mourning Dove was the most abundant species in habitat 1 for both years and was detected in all habitats and sites (Fig. 1 and Table 3). Also, it was the most frequently detected species in habitat 2 at the treatment site for both years and at BWMA in 1995. Northern Mockingbird and Brown-headed Cowbird were the next abundant species in habitat 1. Northern Mockingbird was absent only at BLNWR in habitat 3. Brown-headed Cowbird was detected at all sites and habitats. Cassin's Sparrow was most abundant in habitat 2 at BWMA in 1994, but did not occur at the treatment site in either year. Eastern and Western Meadowlarks were most commonly detected in habitats 2 and 3 at BLNWR and occurred at all sites. Lark Sparrow was absent in habitat 1 at the treatment site and habitat 3 at BLNWR (Fig. 1).

Table 2. Percent ground cover for three sites in summer 1994 and 1995, southeastern New Mexico.

	Site											
	Treatment				BWMA				BLNWR			
	Habitat 1[1]		Habitat 2		Habitat 1		Habitat 2		Habitat 2		Habitat 3	
Ground cover type	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Herbaceous plants[2]	10	9.1	30	15.0	9	4.7	46	14.8	39	15.6	51	13.3
Grass Height (cm)			16	5.8			29	9.1	37	36.8	37	12.6
Shrubs[3]			4	3.5			5	a.8	4	4.2	1	1.6
Shrub Height (cm)			-[4]				54	23.0			76	15.9
Bare Ground	28	16.4	62	10.6	32	16.8	45	4.6	45	18.8	34	22.8
Leaf and Wood Debris	66	19.6	7	5.7	65	21.0	5	3.6	18	10.2	16	10.4
Species Richness	3		5		2		5		6		5	

[1] *Habitat 1 =Tamarisk dominated, 2=Grassland with mixed shrubs, 3=Grassland devoid of tamarisk*

[2] *Grass and forb species in order of overall abundance: Alkali sacaton, Common Purslane* (Portulaca oleacea), *Kochia, Inland Saltgrass (*Distichlis spicata), *Gal/eta (*Hilaria jamesii), *Jimmy-weed (*Isocoma wrightii)

[3] *Shrub species in order of overall abundance.. honey mesquite, lodine Bush (*Allenrolfea occidentalis) *Tamarisk, seep willow.*

[4] *Data unavailable*

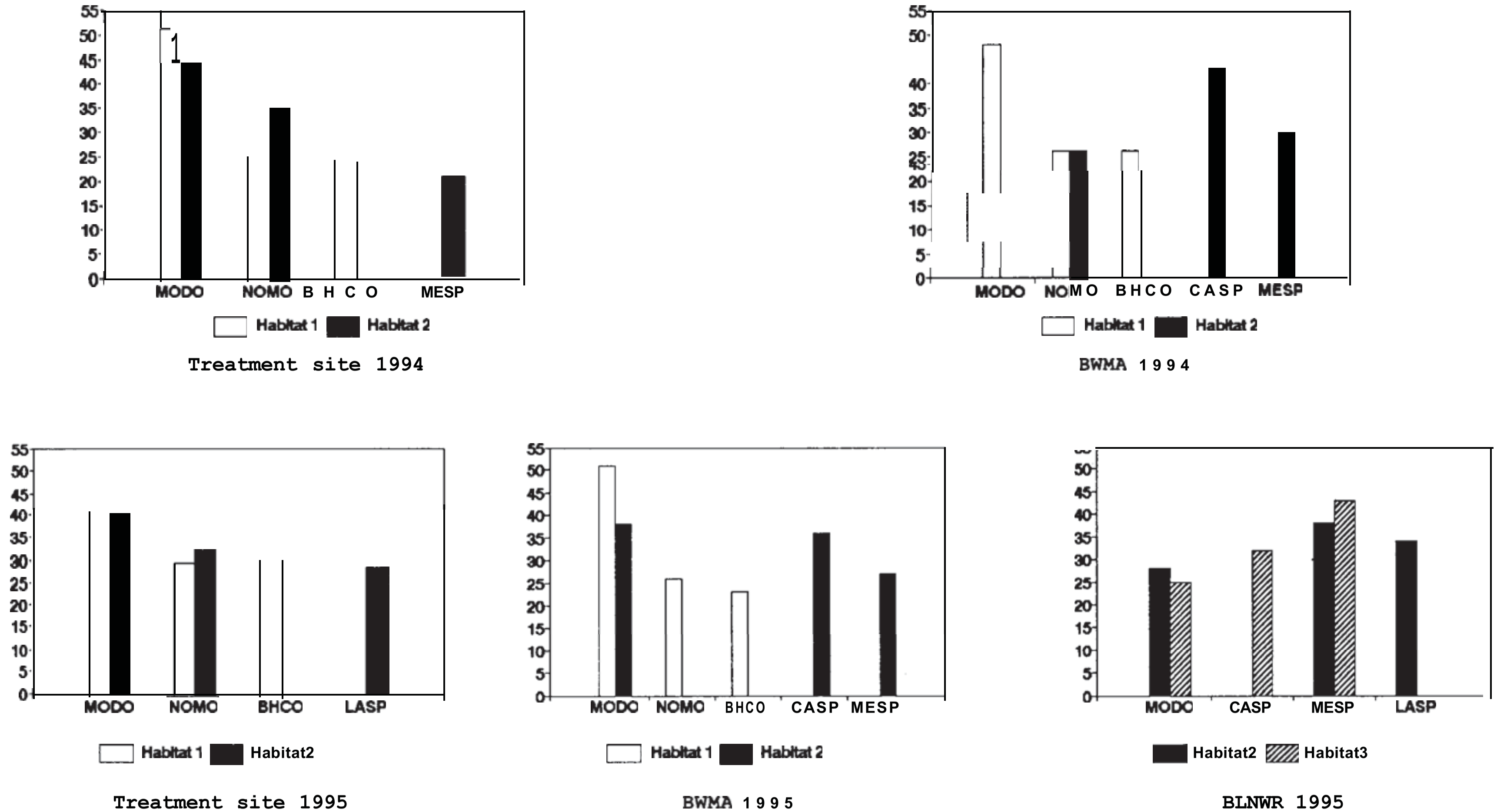

Figure 1. Dominant species for three sites by habitat in 1994 and 1995. Alpha codes: BHCO=Brown-headed Cowbird, CASP=Cassin's Sparrow, LASP=Lark Sparrow, MESP=Meadowlark spp, MODO=Mourning Dove, NOMO=Northern Mockingbird.

Table 3. Bird species mean abundance for three sites in summer 1994 (row top value) and 1995 (row bottom value), southeastern New Mexico.

	Treatment				BWMA				BLNWR[1]			
	Habitat 1[2]		Habitat 2		Habitat 1		Habitat 2		Habitat 2		Habitat 3	
Species	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*
Mallard					0	0.0						
Anas platyrhynchos					2	0.0					2	0.3
Northern Bobwhite							1	0.5				
Colinus virginianus							1	0.5				
Ring-necked Pheasant	2	0.5			2	0.7						
Phasianus colchicus	2	0.7			2	0.3						
Mourning Dove	40	6.4	25	2.1	52	4.8	12	1.3				
Zenaida macroura	23	3.4	13	2.1	40	3.1	6	0.7	5	1.0	3	0.5
Yellow-billed Cuckoo	1	0.2			5	0.6						
Coccyzus americanus	0	0.0			4	0.3						
Greater Roadrunner	1	0.5			0	0.0						
Geococcyx americanus	0	0.0			2	0.3			1	0.0		
Common Nighthawk					1	0.0	2	0.4				
Chordeiles minor					0	0.0	1	0.0				
Ladder-backed Woodpecker			1	0.0			1	0.2				
Picoides scalaris			0				0	0.0				
Western Kingbird			3	0.8	8	2.6	12	1.2				
Tyrannus verticalis			6	0.2	6	1.7	9	2.0				
Ash-throated Flycatcher					2	0.4	2	0.2				
Myiarchus cinerascens					0	0.0	0	0.0				
Western Wood Pewee			1	0.2	0	0.0						
Contopus sordidulus			1	0.0	1	0.5						
Bewick's Wren			0	0.0	4	0.7						
Thyomanes bewickii			2	0.4	2	0.4						
Northern Mockingbird	24	2.1	20	0.9	19	0.6	19	0.6				
Mimus polyglottos	16	0.5	14	0.7	20	4.1	15	0.3	4	0.9		
Curve-billed Thrasher	1	0.0			3	0.5						
Toxostoma curvirostre	1	0.2			1	0.2						
Yellow-breasted Chat	1	0.0	1	0.0	6	1.0						
Icteria virens	1	0.2	0	0.0	6	1.3						
Blue Grosbeak	17	1.3	10	0.1	12	0.6	5	0.8				
Guiraca caerulea	16	1.8	8	1.5	14	2.0	3	0.3	4	1.0		
Cassin's Sparrow					2	0.0	33	3.9				
Aimophilia cassinii					0	0.0	14	0.8			6	1.8
Rufous-sided Towhee	4	0.7			6	0.8						
Pipilo erythrophthalmus	3	0.5			7	1.1						
Lark Sparrow			11	2.0	1	0.0	7	1.8				
Chondestes grammacus			7	1.4	0	0.0	8	0.8	6	0.7		
Meadowlark spp.	1	0.0	12	1.9	2	0.2	18	2.2	-			
Sturnella spp.	1	0.0	4	0.8	1	0.0	13	3.0	9	1.4	8	1.1
Brown-headed Cowbird	23	2.1	12	1.6	24	2.8	5	0.9	-			
Molothrus ater	17	1.7	9	1.3	17	1.2	4	0.7	3	1.4	2	0.0
Northern Oriole					1	0.0	1	0.0				
Icterus galbula					0	0.0	1	0.0				
Total Mean Abundance	116		96		150		118					
	81		64		123		75		32		21	
Species Richness	11		10		17		14					
	8		9		15		11		7		5	

[1] *Only surveyed in 1995.*

[2] *Habitat 1 =Tamarisk dominated, 2=Grassland with mixed shrubs, 3=Grassland devoid of tamarisk.*

Table 4. Results from analysis of variance site comparisons for bird mean abundance and species richness in Summer 1994 and 1995, southeastern New Mexico. *Indicates significant difference at 0.05 level.

Site comparison[1]	Variable	Habitat[2]	1994 p-value	1995 p-value
1 vs 2	Mean Abundance	Pooled	0.0180*	0.1289
		1	0.0163*	0.0330*
		2	0.0535	0.5393
	Species Richness	Pooled	0.0289*	0.0124*
		1	0.0877	0.0401*
		2	0.2347	0.6123
1 vs 3	Mean Abundance	Pooled	-[3]	0.0466*
		1		
		2		0.0138*
	Species Richness	Pooled	-	0.0303*
		1		
		2		0.1951
2 vs 3	Mean Abundance	Pooled	-	0.0026*
		1		
		2		0.0050*
	Species Richness	Pooled	-	0.0001*
		1		
		2		0.0864

[1] Site 1=Treatment, 2=BWMA, 3=BLNWR

[2] Habitat 1 =Tamarisk dominated (only at treatment site and B WMA), 2=Grassland with mixed shrubs, 3=Grassland devoid of tamarisk (only at BLNWR)

[3] Site 3 only sampled in 1995

DISCUSSION

Anderson et al. (1977 and 1978) found negative relationships between species richness and tamarisk abundance on the lower Colorado River. Engel-Wilson and Ohmart (1978) found higher bird density and species diversity in cottonwood-willow than tamarisk along the lower Rio Grande. In contrast, Ellis (1995) reported no difference in species richness between tamarisk and cottonwood vegetation along the middle Rio Grande. Thompson et al. (1994) suggested that tamarisk and the exotic Russian olive (*Elaeagnus angustifolia*) in conjunction with native species may provide structure for Rio Grande avifauna that was historically supplied by cottonwood-willow communities.

Hunter et al. (1988) reported tamarisk habitats surpassed grassland/shrub habitats in overall species richness and densities on the Pecos River. Sparse, short honey mesquite habitat ranked lowest in importance to birds. Hildebrandt and Ohmart (1982) described open grassland habitats on the Pecos as supporting few birds. Our data support these findings for between site comparisons.

Overall, BLNWR had significantly fewer terrestrial birds than the other two sites (Tables 3 and 4). Only 23% and 32% of all species used for analyses occurred in the monotypic grassland and grassland/shrub habitats at BLNWR, respectively. No species was unique to the refuge. Species richness was not different between sites for grassland/shrub habitat, but BLNWR had fewer species when habitats were pooled. Differences were augmented because habitat 3 at BLNWR contained the fewest species. Habitat 3 was characterized as a monotypic grassland of alkali sacaton with minimal shrub composition (Table 2). We attribute the less rich and abundant terrestrial bird community at BLNWR to the lack of vegetational structure when compared to the other two sites. Wiens (1973) described grassland bird communities as consisting of few species, low abundance, and single species dominance, particularly at low rainfall sites. Cody (1985) also described similar grassland avifauna characteristics. We recognize many processes work towards the patterns observed in bird communities (Wiens 1989). However, when differences are as extreme as our data indicate a single factor explanation such as woodland plant density may be justified. Smith (1977) explained a lack of birds in dry forest compared to mesic forest in an Ozark watershed as a result of a moisture gradient. In contrast, Sabo and Holmes (1983) attributed observed differences in the bird communities in contrasting montane habitats to multiple factors including evolutionary and ecological pathways.

Factors which may have contributed to differences in bird community patterns between the treatment site and BWMA are more complex than woodland plant density. The two sites are separated by only five kilometers and are within a continuous strip of tamarisk extending along the river. Vegetation structure was not different between the two sites ($p=0.4687$ for habitat 1, $p=0.5140$ for habitat 2). Grazing is a possible factor; however, bird abundance and species richness were not different between the grazed site (treatment) and non-grazed site (BWMA) in the grass/shrub habitat (Tables 2 and 3). This habitat was more susceptible to grazing when compared to tamarisk areas, which had little forage for cattle to influence. Our study was not designed to evaluate grazing impacts and, therefore, our assumptions are merely speculative. Taylor (1986) found a direct relationship between increased grazing and decreased bird abundance, shrub volume and shrub heights along the Blitzen River in Oregon. Other studies have reported similar results (Klebenow and Oakleaf 1984, Krueper 1992). Bock et al. (1992) reviewed available literature pertaining to grazing impacts on neotropical migratory birds in western North America. They determined that in Southwestern grassland habitat Northern Mockingbird and Lark Sparrow responded positively to grazing, Eastern and Western Meadowlarks responded negatively to heavy grazing, Cassin's Sparrow responded negatively to varied grazing intensity, and Mourning Dove and Brown-headed Cowbird had mixed or uncertain responses to grazing. No clear patterns in mean abundance for Northern Mockingbird and Lark Sparrow were present between sites in our study. Eastern and Western Meadowlarks appeared to be more abundant at the non-grazed sites especially in 1995. Cassin's Sparrows were markedly more abundant at the non-grazed sites. Mourning Dove and Brown-headed Cowbird showed no clear patterns (Table 3).

Factors contributing to higher bird abundance and species richness in the tamarisk habitat at BWMA may have included habitat juxtaposition and interspersion. A major disparity between the treatment site and BWMA was the latter contained a 0.3 km by 8.0 km mowed strip. The area was created to allow surface flow during high water periods. Vegetation consisted of perennial weeds and annual forbs. It paralleled the river at a distance approximately 1.0 km west. Between the floodway and river were dense tamarisk stands (habitat 1) and west of it were sparse tamarisk stands opening to grassland/shrub areas (habitat 2). This area probably provided many birds foraging habitat. The treatment site lacked an area comparable to the flood-way at BWMA.

The habitat mosaic at BWMA and the treatment site differed in other respects. Alfalfa fields bordering BWMA provided additional foraging habitat. Studies have indicated that riparian bird densities increase when nearby foraging habitat is present (Carothers et al. 1974, Conine et al. 1978, Anderson et al. 1984). Meyer (1995) discussed the positive influences of agricultural fields on riparian bird communities along the Rio Grande in southern New Mexico. At BWMA, honey mesquite areas were more extensive contributing an additional vegetational component to the habitat complex. In contrast, the treatment site's western bordering areas encompassed grazed pasture and human residences. These areas were less structurally diverse than the BWMA western border regions. Moreover, roads fragmented the treatment site extensively. Consequently, the area received heavier amounts of human activity including gas/oil extraction and off-road vehicle use.

Hunter et al. (1987) described five riparian bird species as declining in the Southwest except along the middle Pecos River where numbers were stable. The species were Harris' Hawk (*Parabuteo unicinctus*), Yellow-billed Cuckoo, Vermillion Flycatcher (*Pyrocephalus rubinus*), Summer Tanager (*Piranga ruba*), and Yellow-breasted Chat. These five species were present in the summer months in our study, but only Yellow-billed Cuckoo and Yellow-breasted Chat were abundant enough to include in analyses. Dense tamarisk stands next to the river appeared to be the most important habitat for these two species. Both species were commonly detected in tamarisk dominated areas, but rarely in grassland/shrub areas at BWMA (Table 3). The woodland dependent Rufous-sided Towhee (Ehrlich et al. 1988) was common in tamarisk dominated habitat at the treatment site and BWMA, but absent in grassland/shrub at all sites and monotypic grassland habitat at BLNWR (Table 3). Grassland /shrub and monotypic grassland habitats were most important to Cassin's and Lark Sparrows and Eastern and Western Meadowlarks (Fig. 1). These four species have affinity for open grassland habitat with scattered shrubs (Ehrlich et al. 1988).

CONCLUSIONS AND DESIRED FUTURE CONDITIONS

Our data indicate that floodplain grassland areas on the middle Pecos River are low in bird abundance and species richness when compared to tamarisk habitat. These areas are, however, important to grassland birds including Cassin's and Lark Sparrows, and Eastern and Western Meadowlarks. Removing tamarisk from the Pecos River will provide these species with additional habitat. In contrast, we believe the vegetational structure provided by tamarisk benefits certain bird species. Yellow-billed Cuckoo, Yellow-breasted Chat, and Rufous-sided Towhee will lose essential habitat when tamarisk is removed. In order to prevent population declines for these species on the middle Pecos River the structure provided by tamarisk must be replaced. Establishment of native cottonwood/willow groves should be encouraged where soil and hydrologic conditions are favorable. Preferably, tamarisk removal will proceed at a rate that will leave sufficient structure for populations to persist.

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