RECLAMATION

Managing Water in the West

VEGETATION QUANTIFICATION OF SOUTHWESTERN WILLOW FLYCATCHER NEST SITES

RIO GRANDE FROM LA JOYA TO ELEPHANT BUTTE RESERVOIR DELTA, NEW MEXICO – 2004-2006

U.S. Department of the Interior
Bureau of Reclamation
Fisheries and Wildlife Resources
Denver, Colorado

March 2007

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.

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prepared for

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U.S. Department of the Interior
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Introduction

The Bureau of Reclamation (Reclamation) has been conducting studies of the endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus* - SWFL) along several reaches of the Middle Rio Grande since 1995. Currently, breeding SWFLs are concentrated in suitable habitat within the conservation pool of Elephant Butte Reservoir and in a few isolated areas upstream including the Pueblo of Isleta, La Joya State Wildlife Area (SWA), Sevilleta National Wildlife Refuge (NWR), and the reach between Bosque del Apache NWR and San Marcial. During the past eight years, the SWFL population in the pool of Elephant Butte Reservoir has increased dramatically by dispersing into new, primarily native riparian habitat.

To facilitate recovery of this endangered subspecies in the Middle Rio Grande, it is necessary to understand habitat relationships and features selected by breeding SWFLs. This will assist us to effectively protect, maintain, create, restore, and/or enhance riparian habitats in this area. This report summarizes our efforts to characterize vegetation features of selected SWFL nest sites documented during presence/absence surveys and nest monitoring between 2004 and 2006.

Methods

Study Area

A total of 498 SWFL nests have been monitored by Reclamation between 2004 and 2006 in the Middle Rio Grande. Table 1 details the number of nests monitored and selected for this study by river reach during this period. For this study, an attempt was made to select study nests proportionally to represent the habitat selection and reaches occupied by breeding SWFLs.

Table 1. Nests monitored and quantified in this study by river reach between 2004 and 2006.

Reach	Nests Monitored (% of total)	Quantification Nests (% of total)
Sevilleta/La Joya	49 (9.8)	12 (10.7)
Bosque del Apache	3 (0.6)	2 (1.8)
Tiffany	16 (3.2)	8 (7.1)
San Marcial	428 (85.9)	90 (80.4)
Total	498	112

Study Design

To determine methodology for this study, we consulted with an interagency work group in August 2003 consisting of biologists from Reclamation, U.S. Fish and Wildlife Service, New Mexico Natural Heritage Program, and University of New Mexico (UNM). Methods were adapted from BBIRD protocol (Martin et al. 1997), similar studies conducted by the New Mexico Natural Heritage Program along the Rio Grande (DeRagon et al 1995), Ahlers and White (1997), Stoleson and Finch (1999), and University of New Mexico (Peter Stacey, pers. comm.). During the late summer and early fall of 2003, we conducted a pilot study to test the methodology. As a result, we refined certain methods which were incorporated into subsequent data collection.

Vegetation and habitat data were collected at nest sites in the Middle Rio Grande from late August to early October following the SWFL breeding seasons of 2004, 2005, and 2006. At selected nest locations, an 11.35-meter radius plot (0.04 hectare BBIRD-type plot) was centered below the nest and an identical plot was located at a random distance and direction between 50 and 100 meters (m) from the nest plot (Figure 1). All trees within the plot were tallied by species and DBH class and densities, species composition, and percentage of dead trees were computed. Tree stems had a diameter at breast height (DBH) of greater than 5 centimeters (cm) and were divided into three DBH classes: Class I consists of trees greater than 5 cm to 10 cm DBH, Class II consists of trees greater than 10 cm to 20 cm DBH, and Class III consists of trees greater than 20 cm. Shrubs were measured in four 1 x 4 m subplots located at random distances less than 7.35 m from the plot center along each of four radii in cardinal directions. Shrub stems were defined as having a DBH between 0.5 cm and 5 cm. All shrub stems within each subplot were counted by species and densities, species composition, and percentage of dead were computed. In cases with exceptional stem densities, shrub stems where measured in four 1 x 2 m subplots. Nest-centered data were recorded within the 11.35 m radius center plot including: nest substrate species, height, and DBH, distance to substrate edge, distance to clump edge, distance to riparian edge, hydrology, distance to water, distance to road, ground cover, and canopy height.

To gain insight into canopy cover and plant densities by canopy layer, three additional plots, each with a 5 m radius, were established adjacent to each center plot (Figure 1). From the center point of each smaller plot, point-centered quarter measurements were taken for plants in three canopy classes (shrub, mid-canopy, and upper canopy). Canopy layers were classified beginning with the lowest. Thus, some sites had all three layers (Figure 2) but most only had a shrub and mid-canopy layer (Figure 3). From these data, stem densities were calculated for the respective canopy layers. Canopy cover visual estimates were made within each of three canopy layers (0 to 3 m, 3 to 6 m, and >6 m) within the 5 m radius plots. Estimates were made using a Daubenmire ranking of 0 to 6 where 0 equals 0 percent cover, 1 equals 1 to 10 percent, 2 equals 11 to 25 percent, 3 equals 26 to 50 percent, 4 equals 51 to 75 percent, 5 equals 76 to 90 percent, and 6 equals greater than 90 percent cover.

For data analysis, habitat parameters were pooled for each plot type (nest and random) and statistically analyzed to determine significant differences ($\alpha = 0.05$). T-tests were used to compare sample means if data were normally distributed. Mann-Whitney tests were used for data with non-normal distributions. Due to the fact that the SWFL population in the delta of Elephant Butte Reservoir is the largest population within our study area and appears to occupy the best habitat, these data were first considered separately. Then, in order to gain insight into the full range of habitat that SWFLs occupy in the Middle Rio Grande, all data were considered together.

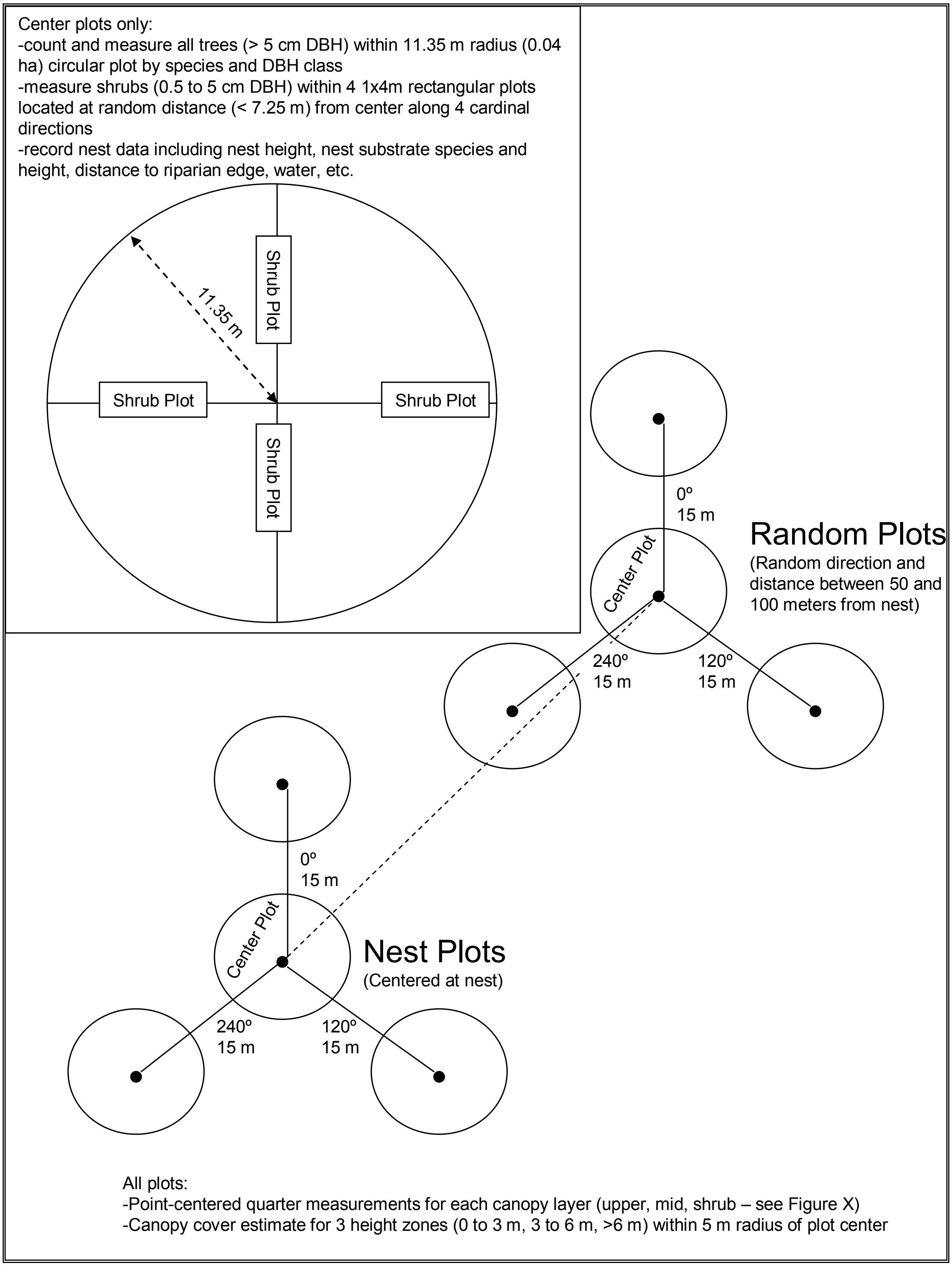

Figure 1. SWFL habitat vegetation quantification study plot layout.

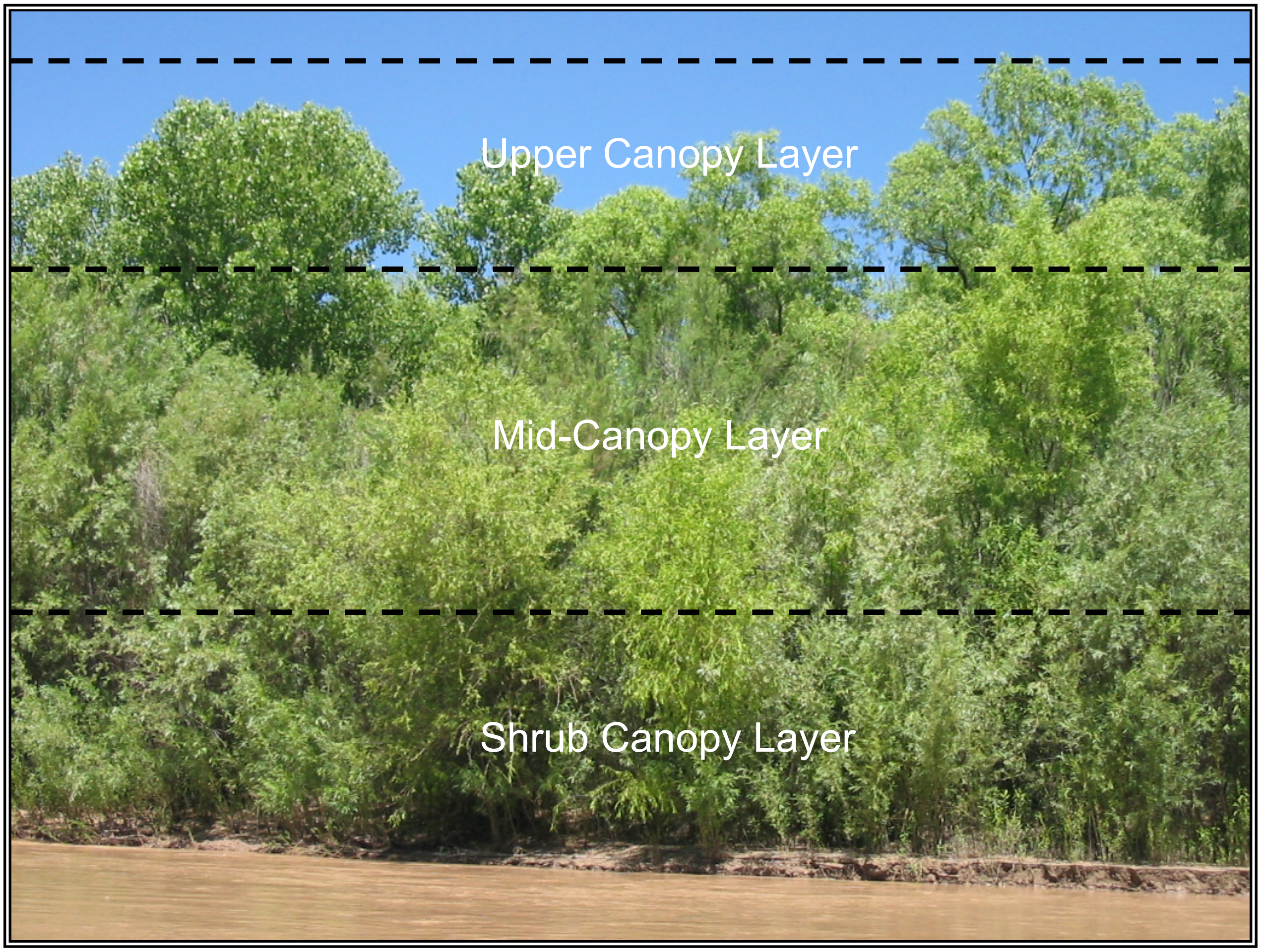

Figure 2. Riparian habitat showing three different canopy layers.

Results

Elephant Butte Reservoir Delta

It can be assumed that, because it is by far the most highly occupied SWFL site within the Middle Rio Grande, habitat within the Elephant Butte Reservoir delta is the highest quality SWFL breeding habitat in the study area. Therefore, data from this site will be considered separately first in our analysis (Tables 1 and 2). Overall, both shrub and tree stem composition was dominated by willow species in nest plots and random plots. There was not a statistical difference in shrub stem density in the nest plots versus the random plots ($W = 3{,}133$, $P = 0.955$), but tree stem density was significantly higher in the nest plots ($t = 4.61$, $P < 0.001$). Forty percent of the shrubs in the nest plots were dead, which probably is a result of understory thinning. There was a significantly lower percentage of saltcedar (*Tamarix sp.*) tree stems in the nest plots than in random plots ($W = 3{,}363.5$, $P = 0.043$). Cottonwood (*Populus deltoides*) stems were a minor element of the tree component in our Elephant Butte plots with a mean value of

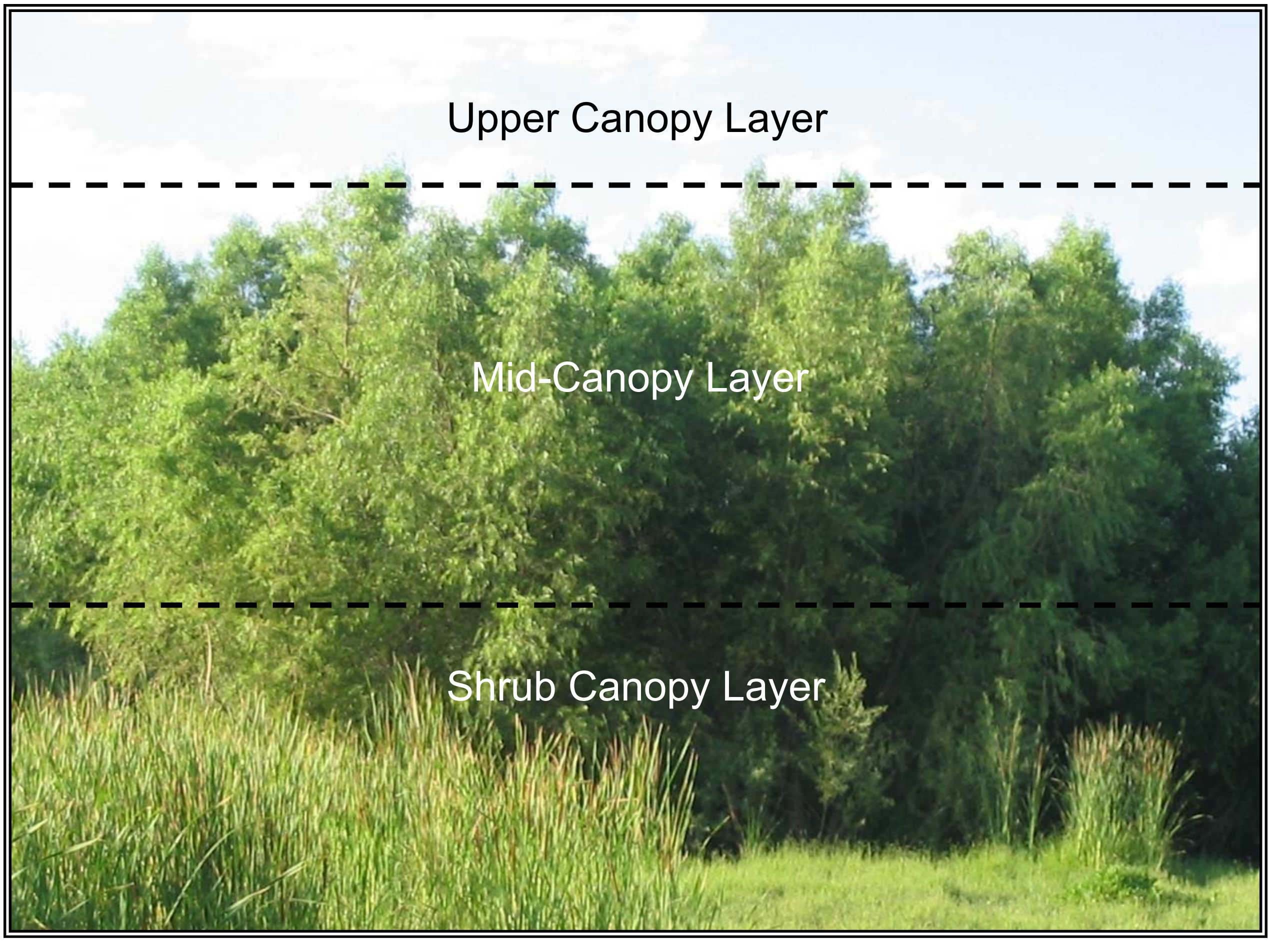

Figure 3. Typical SWFL habitat showing lack of upper canopy layer.

less than 5.3 percent. A significantly higher percentage of trees in the random plots were in DBH Class I (W = 3,941.5, $P = 0.004$). Conversely, a significantly higher percentage of trees in the nest plots were in DBH Class II (W = 2,213.5, $P = 0.002$).

Data gathered in the 5 m subplots revealed that upper canopy is not an important part of SWFL habitat; only 4 of 89 delta nest sites (4.5%) contained measurable trees in the upper canopy layer. Thus, upper canopy measurements are not considered in our delta analyses. The average density (W = 2,501.5, $P = 0.004$) and height (W = 2,042.5, $P < 0.001$) of mid-canopy trees was significantly higher in the nest plots (Table 2). No significant differences were documented in the shrub layer. Significantly higher cover values were measured in the nest plots for both the 3 to 6 m zone (W = 2,361.0, $P < 0.001$) and >6 m zone (W = 1,877.5, $P < 0.001$).

Table 1. Summary of 2004-2006 nest and random plot shrub and tree stem count data and statistics (α = 0.5) for Elephant Butte Reservoir delta **(boldface = significant difference between nest and random plots)**.

Vegetation parameter	Nest site (n = 90)	Random site (n = 70)
Shrub Stem Density #/m^2 (sd)	3.16 (1.96)	3.28 (2.47) [W = 3,133, *P* = 0.955]
Shrub Stem Species Composition % (sd)		
Salix gooddingii	46.0 (38.1)	37.7 (37.4) [W = 2,625.5, *P* = 0.201]
Salix exigua	35.0 (35.5)	38.3 (35.9) [W = 3,182.0, *P* = 0.470]
Both *Salix* species	81.0 (27.5)	76.1 (29.2) [W = 2,861.5, *P* = 0.656]
Populus deltoides	1.0 (4.3)	0.3 (2.1) [W = 2,740.0, *P* = 0.062]
Tamarix sp.	16.7 (26.3)	22.3 (28.7) [W = 3,181.0, *P* = 0.449]
Eleagnus angustifolia	0	0
Dead Shrubs %	40.0 (21.7)	33.8 (28.9) [W = 2,585.5, *P* = 0.052]
Tree Stem Density #/ha (sd)	**2,840 (1,263)**	**1,980 (1,030) [t = 4.61, *P* < 0.001]**
Tree Stem Species Composition % (sd)		
Salix gooddingii	87.6 (21.1)	83.7 (28.3) [W = 3,130.0, *P* = 0.930]
Salix exigua	6.1 (14.0)	4.5 (12.5) [W = 2,699.0, *P* = 0.097]
Both *Salix* species	93.8 (15.5)	88.2 (22.3) [W = 2,771.0, *P* = 0.219]
Populus deltoides	2.4 (7.7)	5.3 (15.9) [W = 3,034.5, *P* = 0.769]
***Tamarix* sp.**	**2.8 (8.3)**	**6.5 (13.4) [W = 3,591.0, *P* = 0.043]**
Eleagnus angustifolia	0	0
Dead Trees % (sd)	3.1 (5.9)	5.5 (8.5) [W = 3,373.5, *P* = 0.323]
Tree DBH Size Class Composition % (sd)		
Class 1	**67.9 (15.9)**	**75.1 (16.4) [W = 3,941.5, *P* = 0.004]**
Class 2	**31.5 (15.7)**	**23.9 (15.6) [W = 2,213.5, *P* = 0.002]**
Class 3	0.6 (1.6)	1.0 (2.7) [W = 3,216.0, *P* = 0.574]

Table 2. Summary of 2004-2006 nest and random subplot data and statistics (α = 0.5) for Elephant Butte Reservoir delta **(boldface = significant difference between nest and random plots)**.

Vegetation parameter	Nest site (n = 89)	Random site (n = 77)
Shrub Canopy Layer		
Mean Plant Density (sd)	6,480/ha (5,959)	5,105/ha (5,233) [W = 2,977.0, *P* = 0.146]
Mean Plant Height (sd)	2.82 m (0.74)	2.65 m (0.67) [W = 2,999.0, *P* = 0.166]
Mean Plant Crown Width (sd)	1.03 m (0.33)	0.95 m (0.34) [W = 2,978.0, *P* = 0.144]
Mid-Canopy Layer		
Mean Plant Density (sd)	**2,997/ha (2,095)**	**2,083/ha (1,508) [W = 2,501.5, *P* = 0.004]**
Mean Plant Height (sd)	**8.37 m (1.51)**	**7.50 m (1.06) [W = 2,042.5, *P* < 0.001]**
Mean Plant Crown Width (sd)	2.83 m (0.93)	2.70 m (0.79) [W = 3,213.0, *P* = 0.581]
Mean Cover Value (sd)*		
0 – 3 m	26.5% (12.9%)	27.5% (14.9%) [W = 3,458.5, *P* = 0.919]
3 – 6 m	**32.3% (12.3%)**	**26.2% (12.3%) [W = 2,361.0, *P* < 0.001]**
>6 m	**21.4% (12.3%)**	**13.3% (12.6%) [W = 1,877.5, *P* < 0.001]**

* Values based on mid-point of Daubenmire ranking of 0 to 6: 0 = 0%; 1 = 5%(1-10%); 2 =18%(11-25%); 3 = 38%(26-50%); 4 = 63% (51-75%); 5 = 83%(76-90%); 6 =95%(>90%)

Entire Study Area

When the remaining nests upstream of the Elephant Butte delta were added to the analysis, results were similar (Tables 3 and 4). No significant differences exist in shrub stem counts between nest and random plots. *Salix* species are still dominant in both shrub and tree stem counts, although to a lesser extent given the increase in saltcedar and Russian olive (*Eleagnus angustifolia*). Tree stems are still denser in the nest plots than in random plots ($t = 4.60$, $P < 0.001$). Class II DBH trees composed a higher percentage of total trees in the nest plots than in random plots ($W = 4{,}047.5$, $P = 0.030$). Cottonwoods composed a slightly higher percentage of tree stems than in delta sites but were still less than 8 percent.

Within the 5 m subplots, data for the entire study area were roughly the same as data for delta sites. Density ($W = 4{,}000.0$, $P < 0.001$) and height ($W = 4{,}133.5$, $P = 0.002$) for trees in the mid-canopy layer were still greater in nest plots than in random plots. Canopy cover at the 3 to 6 m ($W = 2{,}361.0$, $P < 0.001$) and greater than 6 m ($W = 1{,}877.5$, $P < 0.001$) zones were both greater in the nest plots than in random plots.

Lastly, when nest-centered data are considered, several differences exist between delta nests and non-delta nests. Nest heights ($W = 1{,}459.0$, $P = 0.001$) and substrate DBH ($W = 1{,}294.0$, $P = 0.026$) are significantly greater in non-delta sites. The distance from nests to the edge of the riparian habitat is greater in delta nests ($W = 647.5$, $P = 0.014$). A Mann-Whitney (Wilcoxon) W test comparing medians showed that distance to water during the early breeding season was greater in non-delta sites than in delta sites ($W = 1{,}070.0$, $P = 0.026$), even though the mean values appear otherwise. And lastly, distance to a main watercourse (channel), be it the Rio Grande or the Low Flow Conveyance Channel, was greater in delta sites than in non-delta sites. Data for delta, non-delta, and all study nests are shown in Table 5.

Discussion

Habitat can loosely be described as the physical and biological aspects of where a species lives. It has been widely acknowledged that habitat loss and degradation is a key, if not the primary, factor in the decline of SWFL populations throughout the subspecies' range (USFWS 2002). On the other hand, few studies have quantified SWFL habitat. This study aims to quantify the vegetation component of SWFL micro-habitat along the Middle Rio Grande for the purpose of future habitat assessments and to act as a guide for restoration efforts aimed at creating SWFL habitat.

For the purpose of data analysis, we first considered nests in the delta of Elephant Butte Reservoir separately. This area contains the largest population of SWFLs in the Middle Rio Grande and is assumed to be the highest quality habitat in the study area. When looking at the data, components that stand out are the preponderance of *Salix* species in both shrub and tree counts and tree and mid-canopy densities.

Table 3. Summary of 2004-2006 nest and non-nest plot shrub and tree stem count data and statistics (α = 0.5) for all nests in study area **(boldface = significant difference between nest and non-nest plots)**.

Vegetation parameter	Nest site (n = 112)	Random site (n = 89)
Shrub Stem Density #/m^2 (sd)	3.64 (2.4)	3.5 (2.6) [W = 4,721.0, *P* = 0.522]
Shrub Stem Species Composition % (sd)		
Salix gooddingii	37.2 (38.6)	31.5 (37.2) [W = 4,486.5, *P* = 0.465]
Salix exigua	31.4 (34.6)	34.6 (35.8) [W = 5,027.0, *P* = 0.518]
Both *Salix* species	68.5 (37.0)	66.1 (36.5) [W = 4,727.0, *P* = 0.907]
Populus deltoides	1.3 (4.6)	1.4 (6.5) [W = 4,541.0, *P* = 0.305]
Tamarix sp.	23.4 (33.1)	27.8 (34.3) [W = 5,030.0, *P* = 0.499]
Eleagnus angustifolia	6.1 (19.2)	2.5 (9.5) [W = 4,559.5, P = 0.353]
Dead Shrubs %	37.0 (21.3)	35.4 (29.0) [W = 4,399.0, *P* = 0.154]
Tree Stem Density #/ha (sd)	**2,829 (1,330)**	**2,019 (1,101) [t = 4.60, *P* < 0.001]**
Tree Stem Species Composition % (sd)		
Salix gooddingii	71.5 (38.3)	68.8 (40.7) [W = 4,947.5, *P* = 0.962]
Salix exigua	5.1 (12.8)	3.7 (11.3) [W = 4,301.5, *P* = 0.060]
Both *Salix* species	76.6 (38.1)	72.4 (38.8) [W = 4,563.5, *P* = 0.357]
Populus deltoides	3.4 (9.7)	7.9 (19.8) [W = 5,043.5, *P* = 0.737]
Tamarix sp.	11.9 (26.8)	12.8 (24.2) [W = 5,379.5, *P* = 0.213]
Eleagnus angustifolia	8.1 (24.2)	5.6 (18.7) [W = 4,828.5, P = 0.691]
Dead Trees % (sd)	4.0 (6.5)	6.2 (9.5) [W = 5,202.0, *P* = 0.479]
Tree DBH Size Class Composition % (sd)		
Class 1	70.1 (16.3)	74.1 (18.0) [W = 5,703.0, *P* = 0.057]
Class 2	**29.0 (15.9)**	**24.3 (16.6) [W = 4,047.5, *P* = 0.030]**
Class 3	0.9 (2.1)	1.6 (3.9) [W = 5,175.5, *P* = 0.448]

Table 4. Summary of 2004-2006 nest and random plot shrub and tree stem count data and statistics (α = 0.5) for all nests in study **(boldface = significant difference between nest and random plots)**.

Vegetation parameter	Nest site (n = 112)	Random site (n = 98)
Shrub Canopy Layer		
Mean Plant Density (sd)	7,470/ha (7,533)	5,991/ha (6,185) [W = 5,013.5, *P* = 0.157]
Mean Plant Height (sd)	2.69 m (0.77)	2.61 m (0.69) [W = 5,329.5, *P* = 0.475]
Mean Plant Crown Width (sd)	1.00 m (0.35)	0.97 m (0.41) [W = 5,096.0, *P* = 0.215]
Mid-Canopy Layer		
Mean Plant Density (sd)	**3,079/ha (2,318)**	**2,079/ha (1,602) [W = 4,000.0, *P* < 0.001]**
Mean Plant Height (sd)	**8.05 m (1.56)**	**7.50 m (1.21) [W = 4,133.5, *P* = 0.002]**
Mean Plant Crown Width (sd)	2.89 m (1.03)	2.90 m (1.13) [W = 5,477.0, *P* = 0.893]
Upper Canopy Layer	n = 11	n = 8
Mean Plant Density (sd)	850/ha (698)	916/ha (812) [W = 49.0, *P* = 0.710]
Mean Plant Height (sd)	11.98 m (1.80)	11.80 m (2.42) [W = 43.5, *P* = 1.000]
Mean Plant Crown Width (sd)	6.08 m (3.01)	4.56 m (1.88) [t = 1.25, *P* = 0.227]
Mean Cover Value (sd)*		
0 – 3 m	28.6% (14.3%)	29.9% (17.1%) [W = 5,628.5, *P* = 0.950]
3 – 6 m	**33.4% (13.6%)**	**25.4% (12.5%) [W = 3,566.0, *P* < 0.001]**
>6 m	**20.1% (12.4%)**	**13.2% (12.8%) [W = 3,371.0, *P* < 0.001]**

* Values based on mid-point of Daubenmire ranking of 0 to 6: 0 = 0%; 1 = 5%(1-10%); 2 =18%(11-25%); 3 = 38%(26-50%); 4 = 63% (51-75%); 5 = 83%(76-90%); 6 =95%(>90%)

Table 5. Summary of 2004-2006 nest-centered data for nests in study area.

Parameter	**Delta nests mean (n = 90)**	**Non-delta nests mean (n = 22)**	**All nests mean (n = 112)**
Nest height (m)	2.8	3.8	3.0
Nest substrate height (m)	5.4	5.9	5.5
Nest substrate dbh (cm)	4.0	6.2	4.4
Distance to substrate edge (m)	0.8	1.7	0.9
Distance to riparian edge (m)	95.3	33.3	83.0
Distance to water (early breeding season) (m)	21.6	20.3	21.4
Distance to channel (m)	103.1	26.5	88.6
Distance to road (m)	330.8	257.2	321.2
Nest Substrate Species	**Percent**	**Percent**	**Percent**
Salix gooddingii	48.3	4.5	39.6
Salix exigua	25.8	9.1	22.5
Both *Salix* species	74.1	13.6	62.1
Tamarix ramosissima	24.7	59.1	31.5
Eleagnus angustifolia	1.1	22.7	5.4
Baccharis sp.	0	4.5	0.9

In the literature, dense vegetation 3 to 6 m above ground, regardless of species composition, is a common theme of lower elevation SWFL habitat (USFWS 2002). Our data support this fact. Tree stem counts from the 11.35 m radius center plots show that nest sites are denser than random sites (Table 1). The majority of trees (70.1%) are in DBH Class I (5 to 10 cm), which corresponds to the 3 to 6 m height class. Data from 5 m subplots show that in the nest plots the mid-canopy layer is denser and the canopy cover higher in the 3 to 6 m zone than in random plots (Table 2). The mean mid-canopy plant height of 8.37 m confirms that these mid-canopy plants occupy the 3 to 6 m zone. Basically, data from center plots and subplots is indicating the same thing; whether one looks at plant density based on DBH class, canopy class, or canopy cover by height zone, densities are higher in nest sites at the mid-canopy or 3 to 6 m height zone (which is usually at or just above nest height) than in random sites.

When the remaining nests from other reaches are added in, results are similar. *Salix* species still dominate both shrub and tree stem counts, although the increased abundance of saltcedar and Russian olive in the northern reaches increases the percentage of these species in both nest and random plots (Table 3). Tree stem density is significantly greater in nest plots than in random plots. In subplot data, mean mid-canopy plant density and canopy cover at the 3 to 6 m and greater than 6 m zones are significantly greater in the nest plots than in random plots. These data also confirm the importance of dense vegetation in the tree/mid-canopy/3 to 6 m height zone to breeding SWFLs.

Lastly, when nest-centered data are considered, the differences between delta nests and non-delta nests are related to habitat. Habitat in occupied reaches north of the delta are typically composed of older age trees and contain a larger percentage of exotic vegetation (primarily Russian olive and saltcedar). These species retain suitability for nesting SWFLs longer and often provide the critical vegetation density and structure at greater heights, thus resulting in the differences in nest height and substrate DBH shown in Table 5. Additionally, habitat in the northern reaches is much narrower and more linear than in the delta and explains the significant differences in distance to riparian edge, water, and channel documented in this study.

Conclusions and Recommendations

Data collected at SWFL nest sites along the Rio Grande includes shrub and tree density, riparian plant species composition, vegetation height, and vertical foliage density. Our data indicate that breeding SWFLs prefer nesting sites with tree densities of approximately 2,800 per hectare and dense vegetation in the mid-canopy layer between 3 and 6 m in height. While *Salix*-dominated habitat is preferred in the Elephant Butte Reservoir delta, willows are less frequently selected at upstream sites. This is probably a function of the paucity of willow habitat of suitable height and structure in the upstream reaches. In some upstream sites, such as at Sevilleta NWR and La Joya SWA, mature saltcedar and/or Russian olive stands were preferred nesting sites.

We recommend that in the near future additional vegetation quantification should be conducted in sites along the Rio Grande that were previously occupied, but have been apparently abandoned by breeding SWFLs. Comparisons could be made with occupied sites to determine what specific change in habitat conditions may have contributed to site abandonment. These sites include 1) the “condo-site” just upstream of the San Marcial railroad bridge, 2) the reach between the railroad bridge and the delta of Elephant Butte Reservoir, 3) the northeastern section of the delta downstream of the “1830-berm”, and 4) the northern Rio Grande in the Velarde area.

Vegetation quantification should also be conducted at SWFL habitat restoration sites along the Middle Rio Grande to determine the effectiveness of these efforts at creating SWFL breeding habitat. Data from restoration sites can be statistically compared to data from existing breeding sites and an appropriate confidence level used to determine the success of the particular restoration effort.

Lastly, to supplement this micro-scale habitat quantification, a GIS-based macro-scale habitat patch analysis should be conducted to understand the relationship between patch size, width, and other dimensions to habitat suitability. Eventually, after further habitat analysis, we can apply our results to develop habitat restoration guidelines and prescriptions for selecting and designing restoration sites as well as measuring success of restoration projects.

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