Water Requirements for Southwestern Willow Flycatcher Habitat and Nesting at the Pueblo of Isleta

2006 Report

Jacqueline Smith and Kristine Johnson

Natural Heritage New Mexico

Museum of Southwestern Biology

Biology Department, MSC03 2020

University of New Mexico, Albuquerque, NM 87131

505-277-3822, X223, fax: 505-277-3844, kjohnson@unm.edu

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Introduction

SWFL Habitat: Vegetation and Surface Water

The southwestern willow flycatcher (SWFL, *Empidonax traillii extimus*) breeds in riparian habitats of the southwestern United States. In 1995, the southwestern subspecies of the willow flycatcher was listed by the U.S. Fish and Wildlife Service (USFWS) as federally endangered (USFWS 1995). A primary cause of the species' decline is habitat loss due to water diversion, impoundment, and channelization (USFWS 2002).

SWFLs typically nest in dense riparian vegetation near lentic water; e.g., slow-moving streams, river backwaters, oxbows, or marshy areas. These riparian habitats are created by hydrological events such as periodic flooding, sediment deposition, inundation, and groundwater recharge. SWFLs often place their nests in trees or shrubs that are rooted in or hanging over standing water (Whitfield and Enos 1996, Sferra et al. 1997). Surface water may be present early in the breeding season, but drying may leave soils damp or even dry later in the season. If traditional nesting areas become consistently dry due to drought or reservoirs receding, flycatchers may use the site for a breeding season or two, but over longer periods suitable riparian vegetation cannot be maintained, and dry sites are ultimately abandoned (USFWS 2002).

Plant species composition and structure vary widely across the SWFL breeding range. Regardless of plant species composition or height, occupied breeding sites usually consist of dense vegetation in the patch interior or several dense patches interspersed with open water or sparser vegetation. The densest vegetation typically occurs in the first three to four meters above ground. Thickets of trees and shrubs used for nesting range in height from 2-30 m (6 to 98 ft, USFWS 2002).

Water could impact SWFL nesting in several ways. The plants that provide SWFL nest sites are riparian obligates – water is essential for development of required vegetation. If suitable SWFL habitat goes without water for several years, substrate plants die and habitat quality declines (USFWS 2002). It is therefore clear that water affects SWFLs through its effects on vegetation. Second, food availability for SWFLs may be "largely influenced by the density and species of vegetation, proximity to and presence of water, saturated soil levels, and microclimate features such as temperature and humidity" (USFWS 2004). Absence of water may therefore mean a reduced food supply for adults and nestlings.

Finally, flycatchers apparently choose nesting territories based on the presence of water. In particularly dry years, SWFLs at traditional nesting sites on the Middle Rio Grande nested in reduced numbers relative to wetter years (Smith and Johnson 2004a,b) or failed to nest altogether (Johnson et al. 1999). In one New Mexico study, distance of nests from the main river channel was correlated with flow volumes (Brodhead and Finch 2005). In a study from Camp Pendleton, CA, 12 of 13 transient male territories were detected within 50 m of water, but only about half (9/17) of breeders were within 50 m. The rest were more than 150 m away (Kus 2000), which suggests that SWFLs preferred territories that were not directly adjacent to flowing water. In New Mexico, stream flows (which indicate current and longer-term climatic conditions) have been reported to correlate with nest success during two narrow time windows, late June-early July, and late July (Brodhead and Finch 2005). Thus, the presence of adequate water appears to affect not only vegetation, but nesting decisions and even nesting success. However, previous studies have not clarified the importance of flowing water, saturated soil, or inundation to vegetation parameters, territory and nest site selection, or reproductive success. To manage SWFL habitat for recovery of the species, it is important to understand more precisely the species' water needs.

SWFLs at the Pueblo of Isleta

SWFLs have been known to nest at the Pueblo of Isleta since 1994, when the first systematic studies of the area were performed (Mund et al. 1994). SWFLs were also present in 1995 (Mehlman et al. 1995) and 1996 (B. Howe and J. Richardson 1996 data sheets). With assistance from Natural Heritage New Mexico (NHNM) and funding from the U.S. Army Corps of Engineers, the ESA Collaborative Program, the Pueblo of Isleta, and NHNM, the Pueblo conducted surveys and nest monitoring in 2000, 2003, 2004, 2005, and 2006 and habitat research in 2003-2006 (Johnson and Smith 2000; Smith and Johnson 2004a,b; Smith and Johnson 2006).

In an effort to enhance SWFL breeding habitat, the Pueblo of Isleta began a project to introduce surface water to traditional SWFL nesting areas on the Pueblo. In 2004, the Pueblo installed a turnout gate to allow water movement from the Isleta Interior Drain into SWFL habitat at the Isleta Wasteway Channel site, where SWFLs nested in 2000, 2003, 2004, and 2005 (Johnson and Smith 2000, Smith and Johnson 2004a,b). In 2004, the newly-installed turnout delivered water to the northern part of the study area, but no water reached the center of the study site where SWFLs have traditionally nested. In 2005, river flows were extremely high due to winter-spring precipitation and runoff, and the entire study area was inundated (Figure 1).

We know from previous studies (Johnson and Smith 2000; Smith and Johnson 2004a,b; Smith and Johnson 2006) that in average years water tends to collect in some parts of the habitat and not others, such that some areas are consistently wet and some parts consistently drier. We observed an exceptionally wet year in 2005, when the entire habitat was inundated for much of the breeding season. Even in such an unusual year, higher areas dried before lower-lying spots. Thus, we can infer past water distribution in the habitat from present moisture distribution. Mapping wet versus dry areas of the study site and comparing vegetation between them provides information on the effects of varying saturation histories on current vegetation.

Finally, it is necessary to monitor the effects of water management on SWFL territory establishment and nesting success. Parasitism by brown-headed cowbirds and predation are important components of nesting success. Both could potentially be affected by water availability via its effects on vegetation. Water could also affect number of young fledged by influencing insect populations.

Figure 1. Isleta Return Channel 2004 (left) and 2005 (right), showing extreme fluctuations in water levels between average and excessively wet years. SWFL nesting area is left of road/investigators.

Relationship of Surface Water to Nesting Success at the Pueblo of Isleta

From 2003-2005, water levels in the traditional nesting area at the Pueblo varied widely (Table 1). In 2003, all territories were completely dry. In 2004, a moderately wet year, much of the site had saturated soil, and several territories were at least partially inundated at the beginning of the nesting season. After the extremely wet winter of 2005, the entire site was flooded at the beginning of the season, to a depth of over a meter in some places, and soil in all territories remained saturated throughout the nesting period.

Four years of vegetation data suggest that SWFLs at the Pueblo of Isleta place their nests near the edge of thickets, in substrate plants that provide relatively dense cover above the nest. The SWFLs in this study have not shown consistent preferences for any single substrate species and have placed nests in Russian olive, coyote willow, and saltcedar (Smith and Johnson 2004a,b; Smith and Johnson unpublished 2005 data). Vegetation structure and proximity to water appear to be more influential than substrate plant species.

Predation, nest parasitism by brown-headed cowbirds (BHCO, *Molothrus ater*), and nesting success at the Pueblo appeared to co-vary with water levels among years (Table 1). Predation and parasitism were highest in the driest year and lowest in the moderately wet year. Nesting success was highest in the moderate year and lowest in the dry year. SWFLs were most successful, experienced lowest parasitism, and suffered least predation in the moderately wet year. The latter result was surprising, as we expected the wettest year to be the best year for SWFL reproduction. In 2005, deep water flowed throughout traditional nesting territories. SWFLs do not typically nest near large flowing bodies of water (USFWS 2002), and distance from nest to active stream channel has been shown to be positively correlated with stream flow (Brodhead and Finch 2005). Since there was effectively no such distance between the river channel and traditional territories for much of the 2005 season, the birds might have been less attracted to the site than to other sites along the Middle Rio Grande. Several males nonetheless established territories, but nesting success was lower than in a moderately wet year, suggesting that the flooding also affected success of the nests that were established. In 2006, which was very dry early and heavily flooded later, nesting results were similar to those in 2005, the wettest year.

The data in Table 1 suggest that a relationship may exist between the amount of surface water at the Pueblo of Isleta and SWFL nesting success, mediated via parasitism and predation rates. In addition, this relationship is apparently not a simple matter of more water being better.

The goal of this project was to understand surface water requirements for territory establishment, nesting, and habitat development and maintenance at the Pueblo of Isleta. Specific objectives were to:

1. conduct breeding-season SWFL surveys at the study area,
2. conduct SWFL nest monitoring at the study area,
3. conduct vegetation measurements on nesting territories,
4. compare vegetation type and structure at nests and away from nests to determine desired vegetation parameters,
5. document and map saturated soils on 2006 SWFL territories,
6. investigate the relationship of soil saturation on the study site to territory selection and nesting success, and
7. investigate relationships of water availability to vegetation type and structure.

Methods

SWFL Surveys

In 2004, 2005, and 2006, we conducted protocol surveys at the Isleta Return Channel. All maps showing locations of territorial males and nests were created in ESRI ArcGIS, version 9.0.

We followed survey protocols and habitat evaluation as outlined in the USFWS SWFL survey protocol (Sogge et al. 1997). No imminent project was planned within the survey areas; therefore, we followed a three-visit schedule, per the 2000 addendum to the protocol (USFWS 2000). Starting 16 May 2006, we visited the Isleta Return Channel site, traditionally occupied by SWFLs, within the recommended dates: survey 1, 15-31 May; survey 2, 1-21 June; survey 3, 22 June – 10 July. We also surveyed the South of Isleta Marsh Expanded site twice, but we did not conduct a protocol survey there because birds have not nested there since 2000. We conducted surveys between sunrise and 9:00 a.m. Both sites were accessible to thorough walking surveys within suitable habitat.

Observations of SWFLs were used to determine status as migrant, territorial male, unpaired male, pair (breeding/non-breeding), or fledgling. Any bird detected at a site in May that was not present in later surveys was considered to be a migrant. SWFLs were differentiated from other flycatchers by vocalizations, and we considered any birds detected between 15 June and 25 July to be of the southwestern subspecies (*E. t. extimus*; Rourke et al. 1999).

We determined breeding status based on activity of territorial birds. The observer sat or stood quietly in the habitat and watched for the presence of a female, listened for *whitt* and interaction calls between the pair mates, and looked for territorial defense, copulation, carrying of nesting material, carrying of food, incubation, or feeding of young.

All survey results were reported on standard SWFL survey and detection forms (Appendix 1; Sogge et al. 1997). In addition, as required by our USFWS permit, during the course of the study, we informed biologists at the USFWS New Mexico Ecological Service Office and New Mexico Game and Fish Department of detections of SWFLs and their nests.

Nest Monitoring

We monitored SWFL nests to determine success, brood parasitism, and number of fledglings. Nest monitoring followed standard SWFL nest monitoring protocol (see details in Rourke et al. 1999). We kept nest calendars to estimate transition times and allow accurate assessment of nest fate with minimum disturbance. To avoid triggering premature fledging, we did not visit nests during the last few days of the nestling period. Nests were checked every two or three days near hatching, or if the approximate hatch date was unknown. Otherwise, nests were checked every four to seven days. During nest checks, we entered the territory and determined adult activity, approached the nest from a different path each time, quickly checked the contents with a mirror pole, and left by a different path to avoid leaving a dead end scent path for predators. To determine whether a nest fledged young, we checked for fledglings being fed in the territory. All nest site coordinates were recorded with GPS units, taken in North American Datum (NAD) 27, and plotted on digital USGS 7.5 minute quad maps. Territories in which nests failed were visited at least twice to check for re-nesting.

Vegetation Characteristics

We collected vegetation measurements at nests using methods recommended by Dr. Peter Stacey of the University of New Mexico (P. Stacey, pers. comm. 2004, Kus 1998). This method differs from the method used before 2004 on the Pueblo but is the same as that used in other SWFL habitats in New Mexico in 2004 and earlier.

We recorded two types of vegetation measurements. First, we recorded nest-centered data similar to Rourke et al. (1999, p. 24), including data on nest height, substrate tree species and height, and distance to water. When distances could not be estimated on site they were measured using GIS on an aerial photo.

Second, we estimated vegetation cover in four 5 m radius plots by noting the volume occupied between the ground and 3 m, 3-6 m above the ground, and 6 m to the top of highest canopy over the plot (Kus 1998). One plot was centered at the nest tree, and three more plots were located 15 m from the nest tree at due north and at 120º and 240º compass headings. We recorded estimates as percent volume occupied by all plants and percent of the total plant cover volume contributed by the three most common species. Volume estimates were recorded in categories of 0, 1-10, 11-25, 26-50, 51-75, 76-90, and 90-100%. In 2004, vegetation cover was also measured at randomly selected non-use sites. We selected a non-use site for each nest by selecting a compass heading and distance from a random numbers table. We accepted only headings and distances that determined a site inside the Isleta Return Channel Site.

We compared vegetation data for nests from 2004-2006 to a recent vegetation map of the area (Milford et al. 2005). We compared the top three cover species and their rankings found at nests with the three dominant species as defined by the vegetation map.

Soil Moisture

In late April 2006, Pueblo of Isleta Water Resources Department personnel, under the direction of John Sorrel and Cody Walker, dug a shallow (about 20 cm) trench from the area near the new turnout (installed in 2004) from the Isleta Interior Drain to deliver water to the northern part of the site.

To track soil moisture changes throughout the site, we installed 40 Tidbit temperature loggers (Onset Computer Corporation) at 50 m intervals on a predetermined grid covering the study area. We did not install data loggers where the habitat is clearly unsuitable for SWFLs, in a large section of gallery forest where we have never detected SWFLs. We installed the data loggers on 5 and 9 June (Figure 2) by digging a hole approximately 25 cm deep, filling it ¾ full with coarse silica sand, and burying the loggers in the sand. A pin flag through a hole in the logger marked the spot and held the logger in place. The data loggers were programmed to collect temperature data every half hour. After the breeding season was over, we collected the loggers from the field and downloaded the data.

We compared daily temperature fluctuations at each logger with direct observations of soil moisture during the season. When the soil was muddy or flooded, the temperature difference between the daily maximum and minimum was less than 7.5° C. Using 7.5° C as the transition point between wet and dry, we classified days at individual logger sites as dry if the daily temperature difference was 7.5° or more and wet if the difference was less than 7.5°. Based on the wet and dry logger data from five different dates during the breeding season, we created soil moisture maps of the habitat for those dates.

Finally, we noted where 2006 territories and nests were situated relative to vegetation types on the vegetation map and relative to wet soil at various times during the breeding season. To understand the relative importance of vegetation type and water availability (which are correlated) in nest and territory selection, we compared nest locations from wet, dry, and average years.

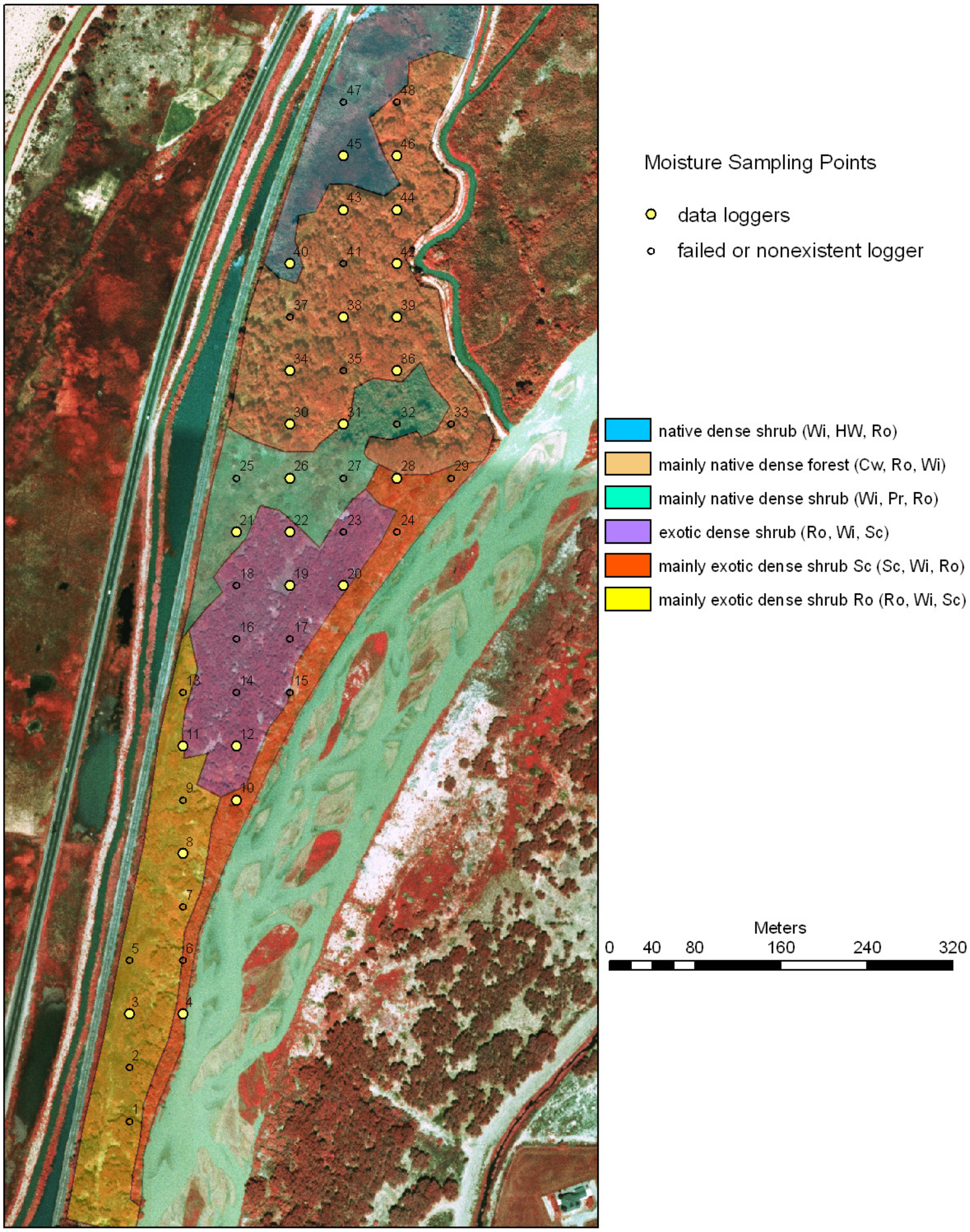

Figure 2. Data logger locations. Yellow dots mark locations with data; empty dots mark where either no loggers were placed or loggers failed.

Results

SWFL Surveys

We spent about 30 h in the habitat mapping SWFL territories, including the surveys. We found seven nests and five SWFL pairs in nine territories (Table 2, Figure 3). There were more territories than pairs because two of nine territories were probably transient males, and two territories (territories 1 and 3) moved/disappeared early in the season. By time the last nest had started (around 15 July), only 10 adults and five territories remained at the site (Table 3).

Table 1. SWFL nesting success, parasitism, and predation in dry, wet, and average years at Pueblo of Isleta.

Year	Soil Saturation	Number of Nests	% Nests Parasitized	% Nests Depredated	% Nest Success
2003	dry	6	33	50	33
2004	partial	10	0	11	50
2005	site flooded	7	14	20	43
2006	dry early, wet late	7	14	14-43*	43

*One 2006 nest was depredated and two disappeared; thus the exact depredation rate is unknown.

Table 2. Summary of survey dates and results.

Site	Year	Dates Visited	Adults	Pairs	Territories	Nests	Fledglings
Isleta Return Channel	2006	5/16, 6/7, 6/29, 7/7	12	5	9	7	10
Isleta Return Channel	2005	5/16, 6/7, 6/30, 7/5	12	6	9	7	8
Isleta Return Channel	2004	5/18, 5/19, 6/18, 7/6, 7/19	14	7	7	10	13
Isleta Return Channel	2003	5/23, 6/13, 6/18, 6/19, 6/30	12	5	5	6	7
South of Isleta Marsh (expanded)	2006	5/18, 6/1	0	0	0	0	0
South of Isleta Marsh (expanded)	2005	6/1, 6/14, 7/25	0	0	0	0	0
South of Isleta Marsh (expanded)	2004	5/25, 7/12	0	0	0	0	0
South of Isleta Marsh (expanded)	2003	5/23, 6/19, 6/27	0	0	0	0	0

Nest Monitoring

We found seven nests in the breeding season, constructed by five SWFL pairs (Table 3). Nest 10 was the only one found to be parasitized. The nest success rate was 3 of 7 (43%), but 3 of 5 (60%) pairs were successful in fledging young. Ten young successfully fledged this year.

Of the four years, 2003 had the fewest pairs breeding and the lowest nest and pair breeding success (Table 4). The year 2004 had the highest number of breeding pairs and the highest nest and pair breeding success. In 2006 birds had intermediate nest and pair success and fewer pairs bred than in other years.

Table 3. Summary of territories found in 2006.

Territory	Discovered	Nest Found	Nesting Attempts	Nest Fate	Last Seen on Territory
1	5/16				6/7 (gone 6/13)
2	5/16				6/27 (gone 6/29)
3	5/16				6/7 (gone 6/13)
4	5/16	5/31	1	fledged 6/27	
5	5/16	7/12	1	fledged ~8/8	
6	5/18				seen 5/18, 6/13, and 6/20 only
7	5/18	7/19	1	fledged ~8/10	
8	5/18	6/20, 6/29, 7/14	3	failed	7/25
9	6/9				seen only 6/9
10	6/13	6/20	1	failed and parasitized	7/14 (gone 7/19)
11	6/13				7/12 (gone 7/14)

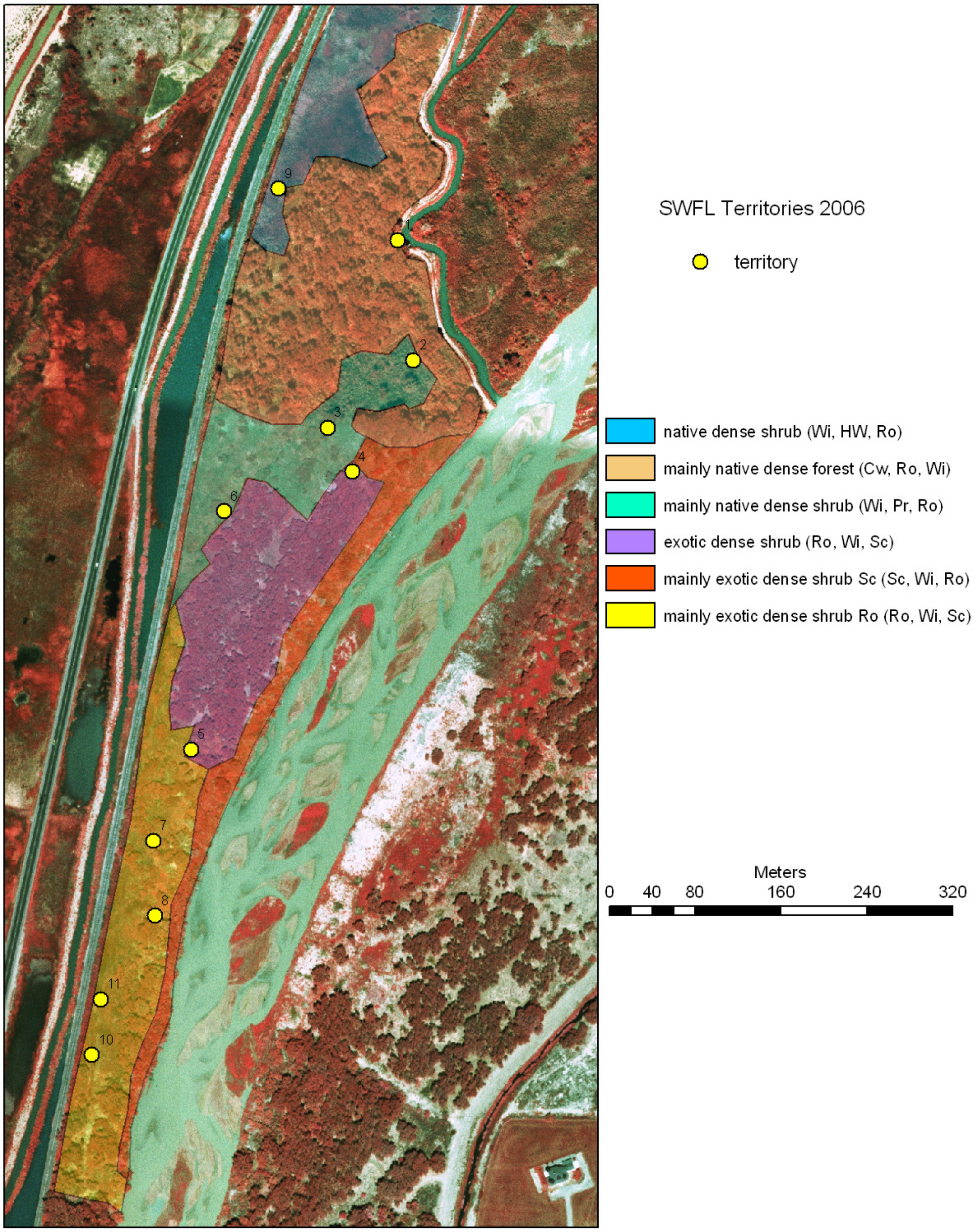

Figure 3. SWFL territories in 2006.

Table 4. Nest and pair success rates and number of pairs breeding for three years at the Isleta Return Channel Site.

Year	Nest Success	Pair Success	N Pairs Breeding
2006	43%	60%	5
2005	43%	50%	6
2004	50%	71%	7
2003	33%	40%	4

Vegetation Characteristics

SWFL nests were placed in Russian olive, coyote willow, and salt cedar in 2004 and 2005, but only Russian olive and coyote willow in 2003 and 2006 (Table 5). The average height of the nest tree, nest height, DBH of nest tree, average distance from the nest to the edge of the nest tree canopy, and average distance to water during nesting in 2004-2006 are shown in Table 6. The trees used for nests in 2006 were taller and had larger DBH than the two previous years, but the average distance to the edge of the clump of vegetation was lower in 2006. The average height of canopy over nests was also much lower in 2006. The distance from the nest to the edge of the clump of vegetation was smaller for 2004-2006 than the 2004 non-use plots. The distance from the nest to the edge of riparian habitat was larger for nests than for non-use plots. Sample sizes did not permit statistical comparisons.

Table 5. Species of substrate tree by nest.

Tree species	Nest 2003	Nest 2004	Nest 2005	Nest 2006
Russian olive	1, 1b, 2, 3, 5	1, 1b, 1c (all the same tree), 4, 4b (two trees)	6	5, 7, 8b, 8c*
coyote willow	4	2,5,8	1, 10, 4	4, 10
salt cedar		3, 7	4b, 7, 11	

*nest 8a disappeared before the species of the nest tree was recorded.

Table 6. Nest-centered data for four years. Non-use data was only collected in 2004.

nest year	2003	2004	2005	2006	non-use 2004
height nest tree (m)		4.8	4.9	6.1	
nest height (m)	3.42	3	2.7	2.8	
DBH nest tree (cm)		3.8	7.7	8.4	
distance to edge of substrate (m)		0.6	0.72	1.1	
distance to edge of clump (m)	26.5	14.4	14.6	7.9	31.75
distance to edge of riparian (m)		64	43	34.7	29.4
average canopy height (m)		21	28.6	9.3	27.5
distance to water (m)		32	50	24.7	41

For most nests, nest-centered vegetation was denser than at nearby subplots, especially in the 0-3 m height interval (Table 7). We ran a paired Student's t-test on vegetation cover at nest plots versus near-nest plots, testing height intervals separately, for all years (2004-2006). Height intervals 0-3 m and 3-6 m were significantly denser at the nest than at the nearby subplots ($p<0$ .001 and 0.01, respectively), but the vegetation was not significantly different at 6 m above the ground and higher ($p>0.1$).

Table 7. Vegetation cover categories at nests in 2006 at the nest and at near-nest subplots. Categories are as follows: 0 is 0%, 1 is 1-10%, 2 is 11-25%, 3 is 26-50%, 4 is 51-75%, 5 is 76-90%, and 6 is 90-100% vegetation cover density.

Nest	Height	Subplot 1	Subplot 1	Subplot 1	Nest subplot
10	0-3m	5	5	2	5
10	3-6m	1	0	0	2
10	6m	0	0	0	0
4	0-3m	2	2	1	3
4	3-6m	1	2	1	3
4	6m	0	0	1	1
5	0-3m	2	5	1	3
5	3-6m	1	2	2	3
5	6m	1	2	2	2
7b	0-3m	3	3	5	5
7b	3-6m	0	2	1	2
7b	6m	0	2	1	0
8a	0-3m	3	4	4	3
8a	3-6m	1	2	1	4
8a	6m	0	2	0	3
8c	0-3m	3	5	1	5
8c	3-6m	1	4	2	3
8c	6m	0	2	1	2

Although vegetation density at nest sites was generally higher than at their near-nest subplots, vegetation density at the nest plot was not different between unsuccessful and successful nests (Figure 4). Parasitized nests had the same dense understory as other nests (0-3m), but vegetation density above the nest (center 3-6 and >6m) was lower at parasitized than non-parasitized nests and on the associated near-nest subplots. Again, no statistical tests were performed because sample sizes were too small to provide adequate power.

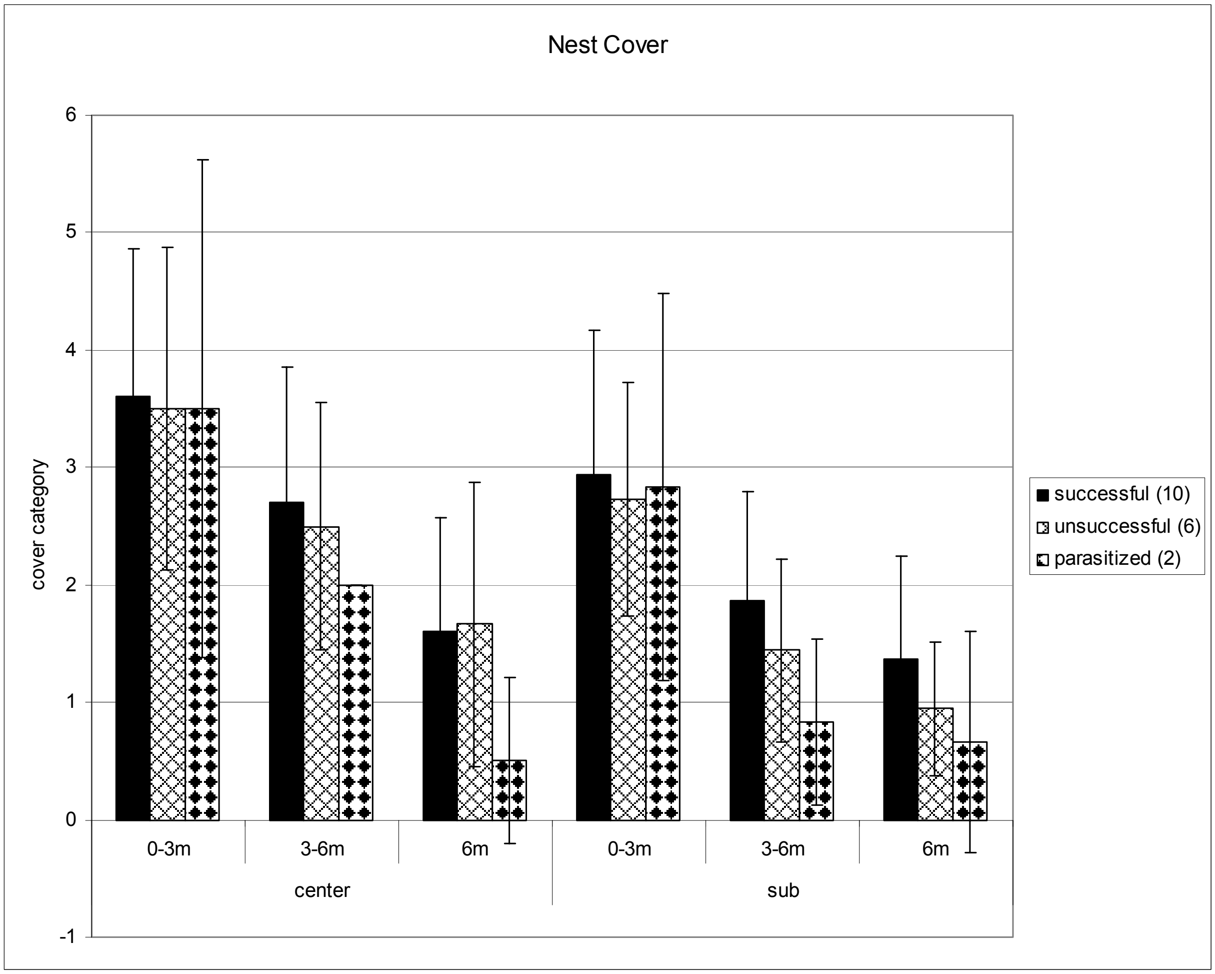

Figure 4. Vegetation cover averages for 2004-2006 at nest and near-nest subplots. Means with standard deviation bars; see legend for sample size.

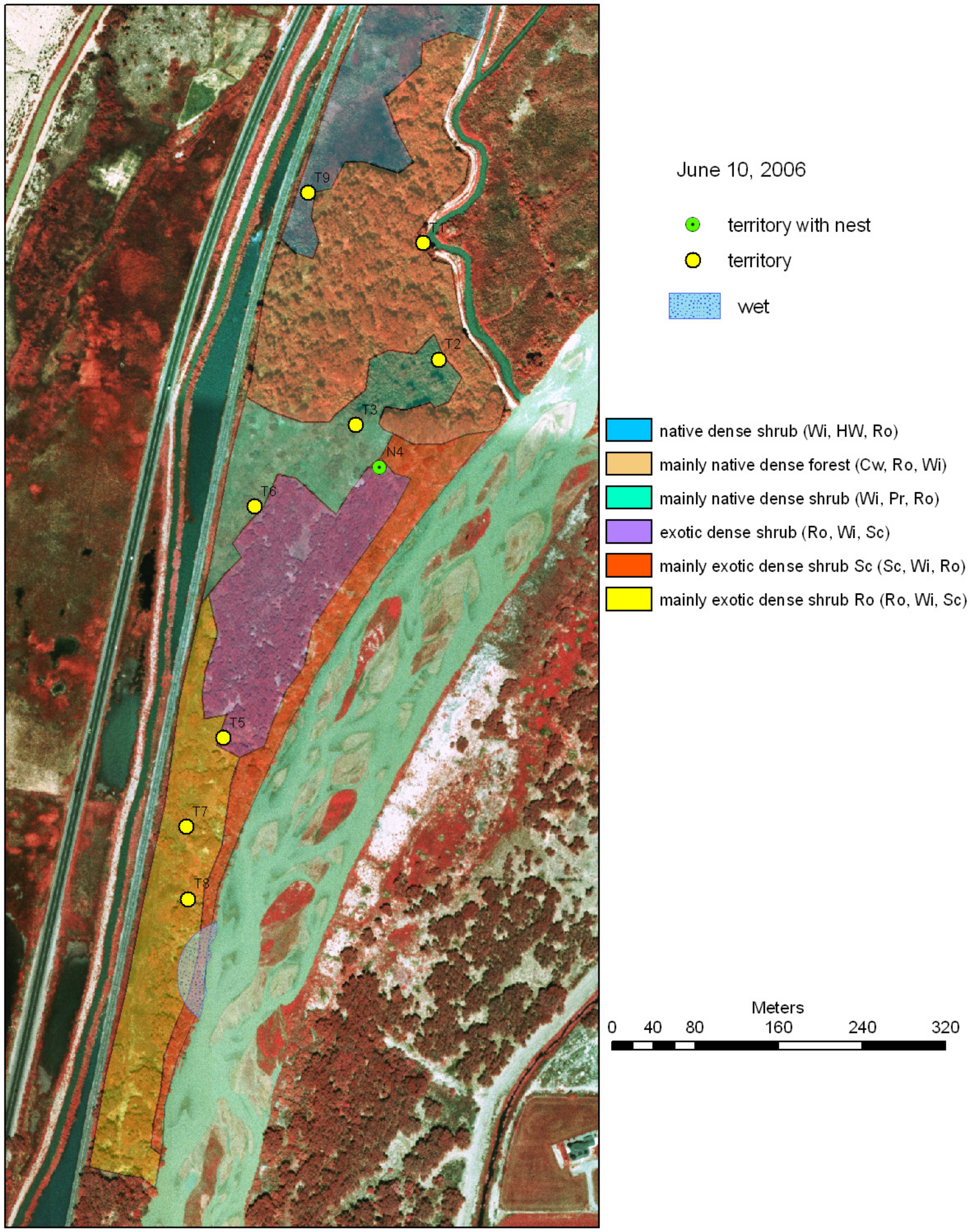

Figure 5. Nests, territories and soil moisture on June 10, 2006.

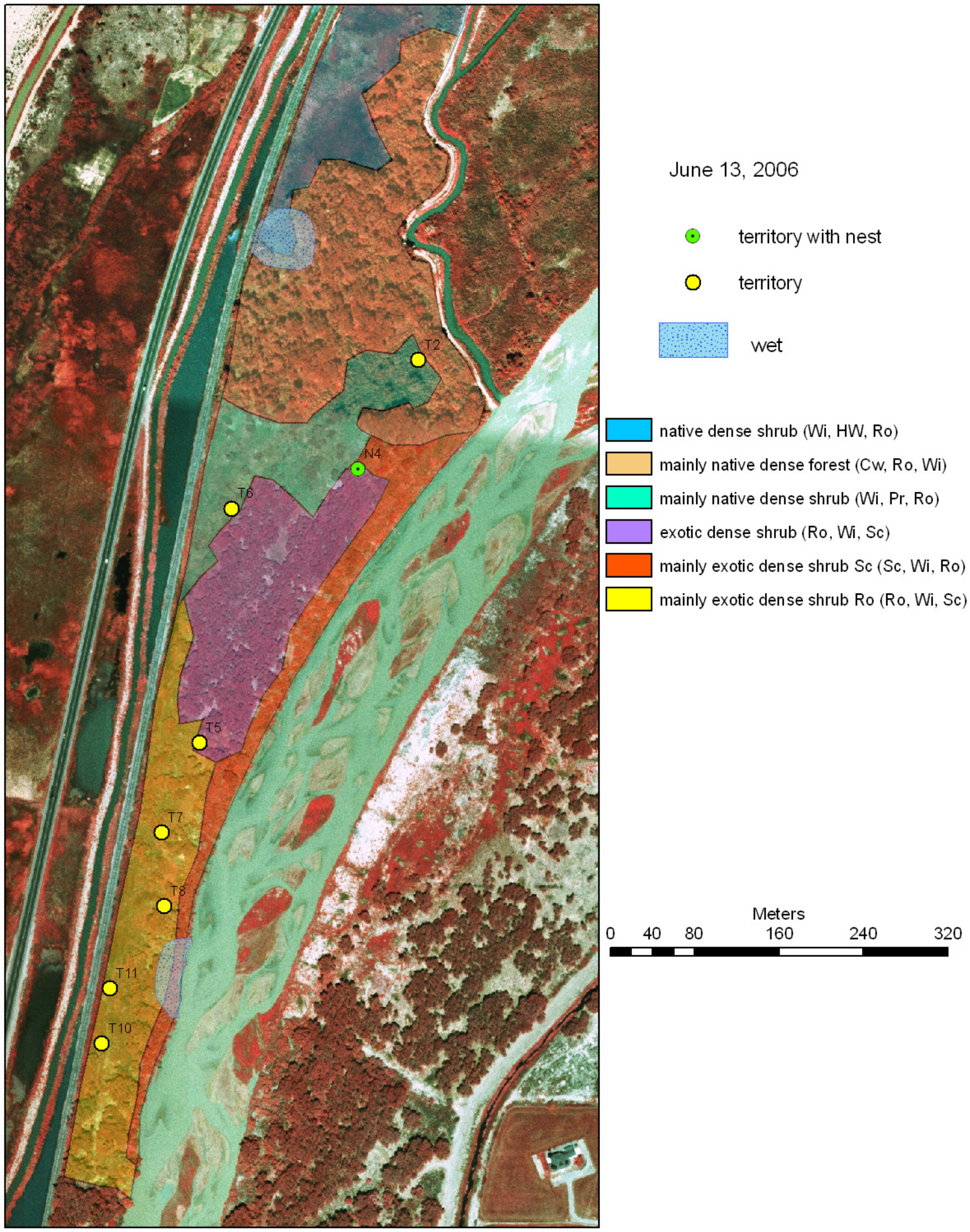

Figure 6. Nests, territories, and soil moisture on June 13, 2006.

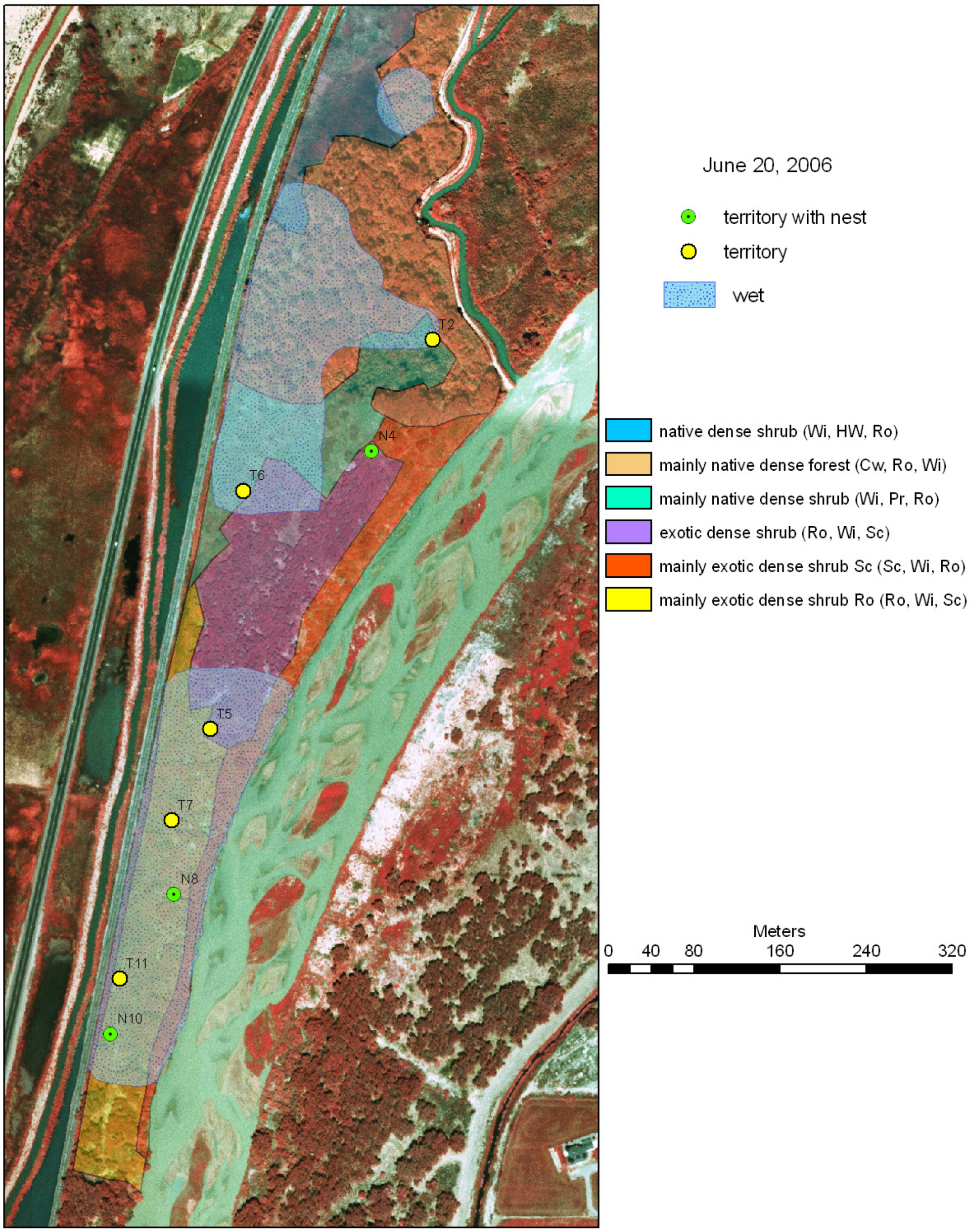

Figure 7. Nests, territories, and soil moisture on June 20, 2006.

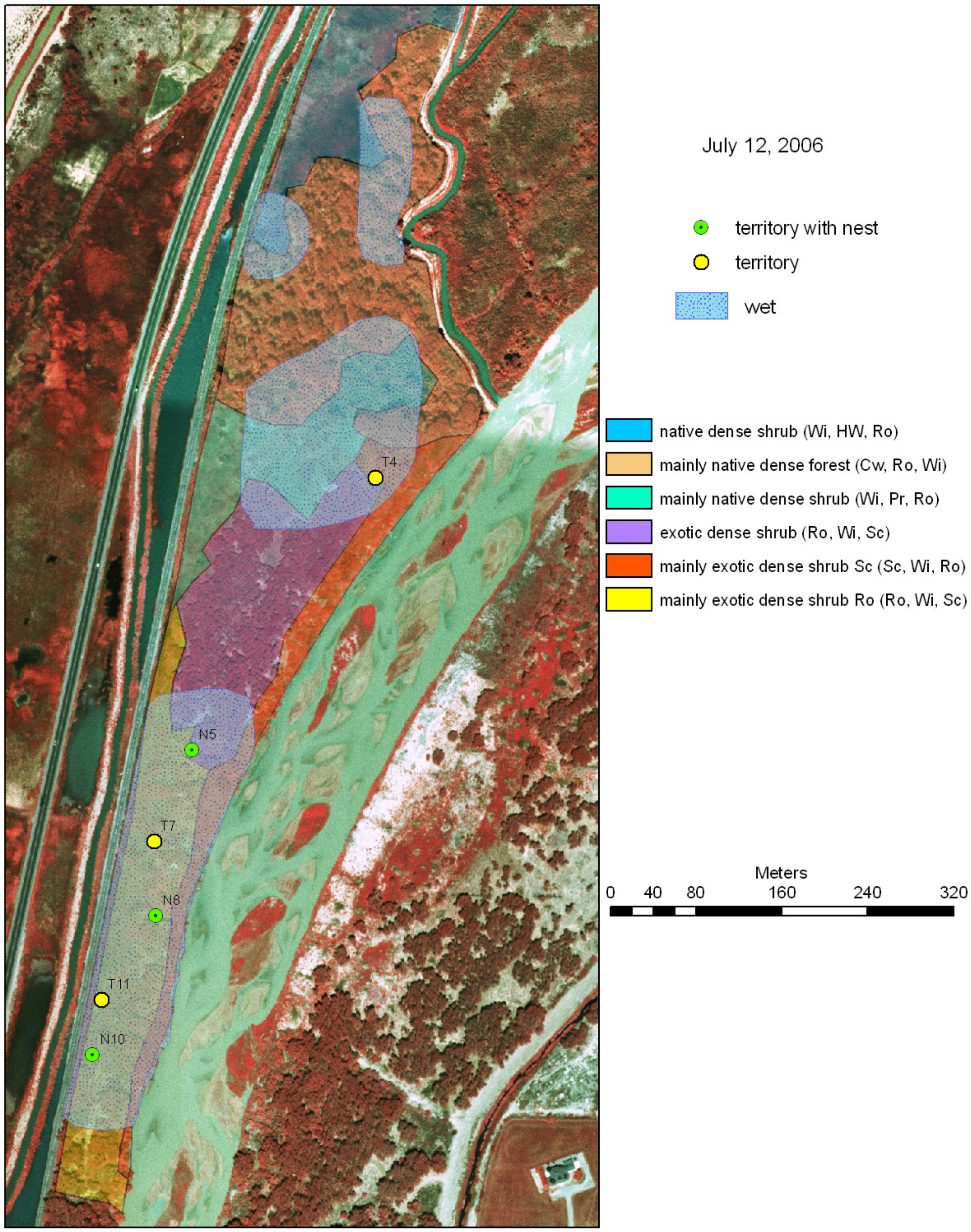

Figure 8. Nests, territories, and soil moisture on July 12, 2006.

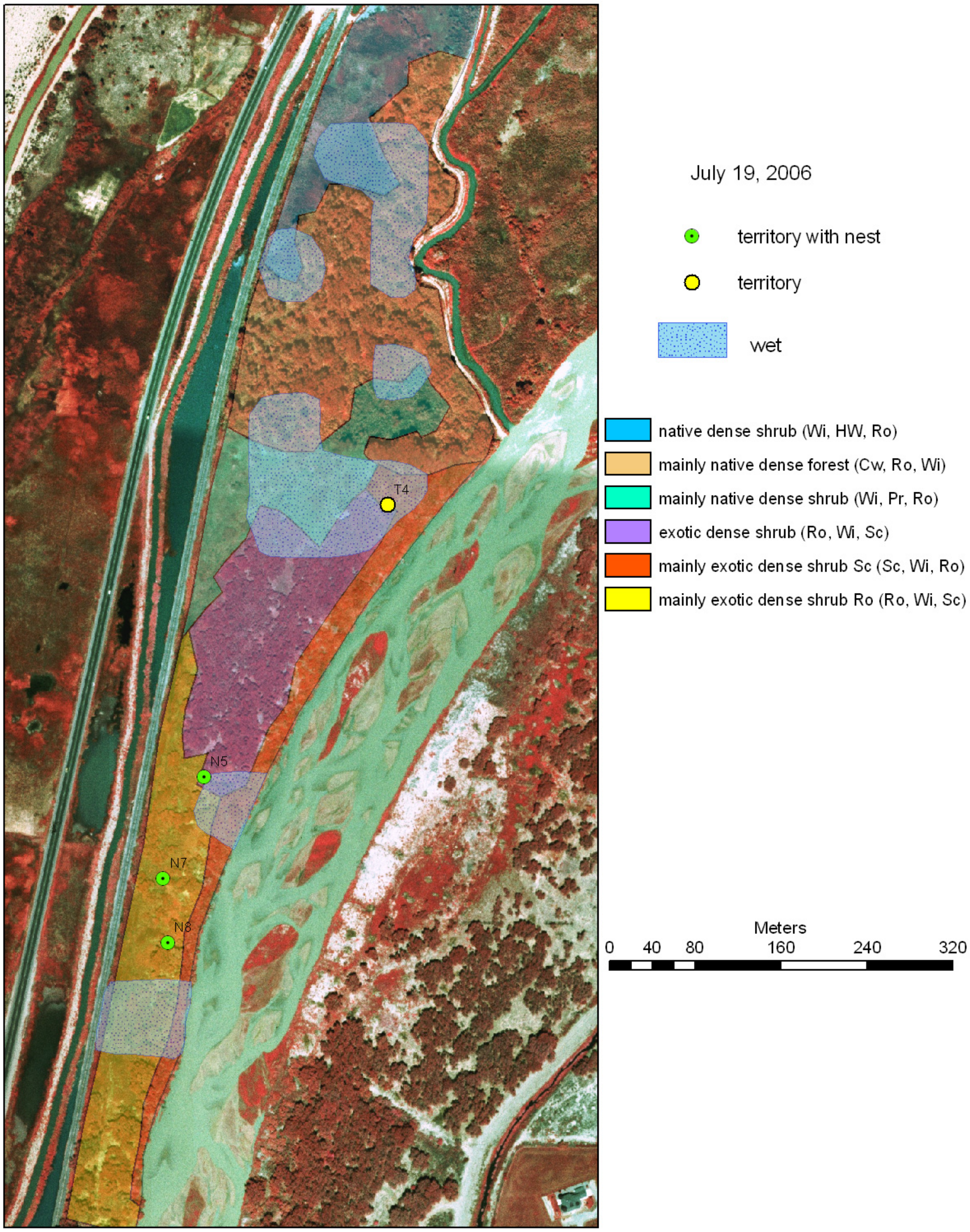

Figure 9. Nests, territories, and soil moisture on July 19, 2006.

Vegetation Types Preferred for Nesting

We found general agreement between the vegetation map of the area (Milford et al. 2005) and the vegetation data at nests from 2004-2006.

2006

In early June 2006, we detected SWFLs singing on nine territories in four habitat types (Figure 5). By 13 June, however, three of the four northernmost territories were unoccupied (Figure 6). At the time the three males disappeared, two males established territories in the southern part of the study site and stayed. We assume that these two males moved south, and the third was a migrant. After this shift, all remaining territories were situated either partly or entirely in only two of the six vegetation types on the study area: mainly native dense shrub (dominated by coyote willow, *Phragmites* spp., and Russian olive, in that order) or mainly exotic dense shrub Ro (Russian olive; dominated by Russian olive, coyote willow, and saltcedar, in that order) (Figures 6-9). The three territories partially situated in these vegetation types (4, 5, and 6 on Figure 6) contained dense, relatively tall trees or shrubs from the exotic dense shrub vegetation type (Russian olive-dominated), adjacent to open, meadow habitats. SWFLs generally avoided the other four types: native dense shrub, mainly native dense forest, mainly exotic dense shrub Sc (salt cedar), and exotic dense shrub (Figure 6).

In 2006, two of five nests (40%, nests 5 and 7B) in mainly exotic dense shrub were successful. One of three nests (33%, nest 4) in mainly native dense shrub was successful. Given the small sample size of 2006 nests, we cannot conclude that nest success differed between the two preferred vegetation types.

2004-2006

Looking at all nest data from 2004, 2005, and 2006, 14 of 17 nests were located entirely or partially in the same two vegetation types (Figure 10). As in 2006, traditional territories crossing two vegetation types included tall, dense trees or shrubs adjacent to open areas. Two nests (one territory) not in the two preferred vegetation types were active in 2004 and 2005 and were adjacent to open, wet, drain habitat on the edge of mainly native dense forest (territory 1, 2004 and 2005)(Figure 10). The only other nest outside the preferred two vegetation types (nest 4b, 2005) was in mainly exotic dense shrub (Figure 10).

Success of nests from territories entirely or partially in mainly exotic dense shrub was 57.1% (four of seven nests) over the three years. Success in mainly native dense shrub was 71.4% (five of seven nests) over the three years. Success in mainly native dense forest was 50% (one of two nests) and in mainly exotic dense shrub was 100% (one nest).

Soil Moisture and Territory Choice

We mapped areas of moist and wet soil in the habitat, except for points where the loggers failed or were lost. Out of 40 loggers, 13 failed to collect data after the first day of deployment. Four loggers were not recovered this year because they were still underwater when we collected loggers from the field. We may be able to recover them when the area dries out in winter or spring of 2007.

In early June 2006 when SWFLs were establishing territories, the entire site was dry, except for one small area near the river which was wet from groundwater (Figure 5). Six males established dry territories in the northern part of the study site, and three were settled in the southern part. The southern part is narrower, and territories are bounded by the river on the east and the drain on the west. By 13 June, the area was still dry. Two of the northern birds had apparently moved south, and one had left the area (Figure 6). The eighth territory was already at the nest stage between 10-13 June when other pairs moved south; thus, moving was not an option for that nesting pair.

In mid-June, water releases from upstream reservoirs raised water levels in the Isleta Riverside Drain and the Rio Grande, saturating large parts of the study site (Figure 7). Soil at seven of eight active territories became saturated. By 12 July, rains had begun, and the southern part of the study area remained wet. The northern part was still partly saturated, but water had moved east somewhat (Figure 8). Two unpaired males had left their territories in the north by 12 July, leaving only nest 4, which had fledged young on 27 June.

In early July, little rain fell, and by 19 July parts of the southern area had dried out (Figure 9). Nest 10 had failed and territory 11 had been abandoned, leaving only territories 5, 7, and 8 with active nests. Nest 8 was abandoned on 21 July. Rain began again the last few days of July, re-saturating the areas around the two remaining nests, which went on to fledge young in early August.

Water or Vegetation – Which has Priority?

Both vegetation types preferred by most SWFL pairs (mainly native dense shrub and mainly exotic dense shrub Ro) occurred in relatively low-lying areas of the study site that became saturated by groundwater or rains during the 2006 season (Figure 8). It is therefore difficult to separate preference for water from preference for vegetation types that tend to occur in wet areas. Two types of data shed light on this question.

First, in early 2006, when almost the entire study site was dry, two pairs moved from the northern area to territories in the south that had nearby water and saturated soil. The abandoned territories were in one of two preferred vegetation types, and several birds had nested in that part of the study site in previous years. Thus, it appears that the birds were attempting to nest closer to water, perhaps because insect availability should be greater there in a dry year.

To further tease apart vegetation and soil moisture, we compared vegetation types at nests over several years with different soil moistures. In 2004, a moderately wet year, six of seven nests were located entirely or partially in one of the two preferred vegetation types. In 2005, an extremely wet year, only two nests were situated in the two preferred habitats. Two of five nests were in other vegetation types, and one was outside but near a preferred type. In 2006, birds moved out of dry territories in a preferred habitat type to areas of the study site near water.

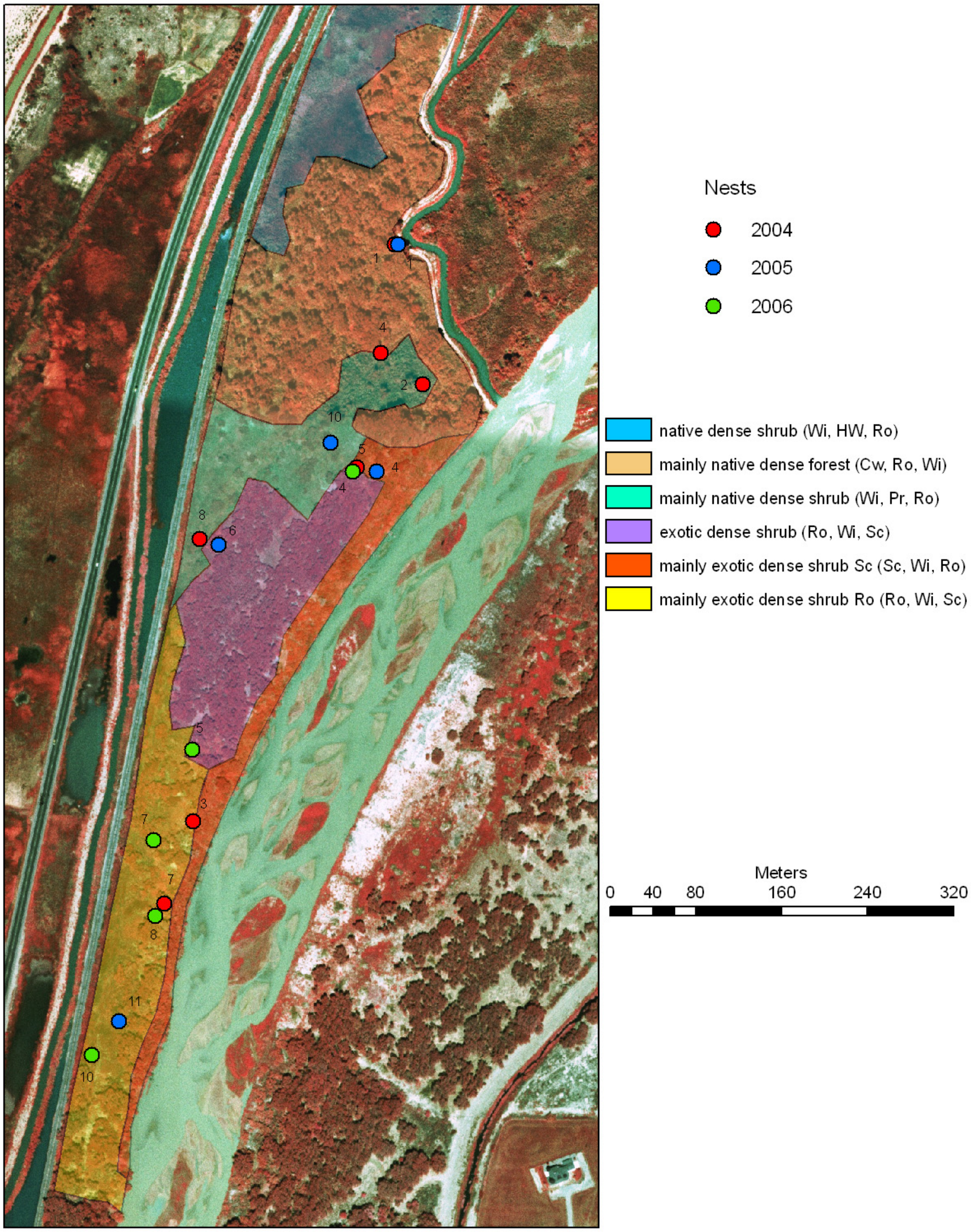

Figure 10. SWFL nests in 2004 - 2006. Nests in 2003 cannot be mapped because the location data are questionable.

Discussion

Vegetation Density at Nests

Our vegetation density measurements at nests and nearby subplots suggest that vegetation at nest sites differs from the surrounding vegetation in a territory. Vegetation immediately (5 m) around and above the nest differed from vegetation 15 m away. Once birds chose to nest in an area, they placed their nests in vegetation that was denser from 0-3 m and 3-6 m above the ground, but not necessarily above 6m. It may be important for a nest site to have an overstory, but the overstory may not need to be directly above the nest. It may not show up in our measurements because the plot is only 10 m in diameter.

Does near-nest vegetation influence nest success? Vegetation density directly at and above unsuccessful nests was not different from that of successful nests. The only discernable difference between successful and unsuccessful is that near-nest subplots around unsuccessful nests were less dense at 3-6 and above 6 m. Parasitized nests were less dense above 3 m, at both center plots and near-nest plots than other nests, but understory density was similar for parasitized and unparasitized nests. The sparse vegetation directly above parasitized nests may have allowed nest parasites to see the nest or the visiting adult more easily.

Preferred Vegetation Types

In 2006 and over the last three years, nests were non-randomly distributed in two of the six vegetation types on the study area. Both preferred types included large coyote willow components. Mainly native dense shrub is dominated by coyote willow, with lesser amounts of *Phragmites* spp. and Russian olive. SWFLs tended to place nests in either coyote willow or Russian olive. If birds like mainly native dense shrub, why would they not prefer native dense shrub, which occurs at the north end of the study site? We suggest that preference for the mainly native over native type is based on structure. The native type has shorter coyote willows and lacks Russian olive, which provides taller, denser structure in which to hide nests.

The other preferred type was mainly exotic dense shrub Ro, which is dominated by Russian olive but also contains coyote willow and saltcedar. Birds probably prefer this type over exotic dense shrub because the latter has a higher exotic component. SWFLs use Russian olive, apparently because it provides an acceptable nest substrate in the absence of large coyote willows, but they avoid Russian olive thickets such as occur in the exotic dense shrub vegetation type. These thickets lack a live understory. As exotics go, SWFLs appear to prefer Russian olive over saltcedar; thus their almost complete avoidance of mainly exotic dense shrub Sc.

Success rate appeared to be higher in mainly native dense shrub. This area is typically settled before the mainly exotic dense shrub in the south. Higher nesting success in the mainly native type could occur because older, dominant, or more experienced birds are able to acquire territories there. Alternatively, the habitat there could enhance nesting success. However, sample sizes do not allow firm conclusions on the relative merits of these two habitat types.

Water and Territory Choice

This was the first year that we observed pairs moving established territories. We believe that two pairs left suitable but dry habitat in the north to nest in suitable vegetation in the south, where soil moisture is traditionally higher and the narrow strip of habitat is bounded by water on both sides. That northern sites have traditionally been settled first suggests that the mainly native dense shrub habitat in the north is preferred as long as sufficient soil moisture is available, but that birds will move south in the absence of water in the north.

If the lack of water in the north caused the birds to move south, then it may also have increased their risk of BHCO parasitism. In 2005 and 2006, the southernmost nest was parasitized. In addition to the lack of dense vegetation above the nest discussed above, spatial aspects of southern territories might place them at increased risk of parasitism. The southern part of the habitat is much narrower than the north and is bounded by open habitat, unlike the north. BHCO parasitism rates have been shown to increase with the amount of edge habitat (Sedgwick and Knopf 1988), open area nearby (Brittingham and Temple 1983), and proximity of foraging areas for BHCO (Tewksbury et al. 2006). In addition, several prominent snags provide perches for BHCO near southern SWFL territories.

Nests in 2003 were all in the north area of the habitat. The habitat in the south was probably not mature enough for nesting, and the northeast edge of the habitat had the only available surface water that year. In this year, two nests were parasitized. Both were along the northeast edge of the habitat, making it easier for BHCO females to spot the nests. In subsequent years, SWFLs usually did not place nests along the edge of the habitat.

Water differences between years also seem to be correlated with predation levels, but the possible mechanism is much less clear. Predation may be correlated indirectly to water levels if adults forage further away from the nest in dry years. Nest predator species probably change between wet and dry years, causing different rates and patterns in nest predation. For example, access of small mammalian predators to nests is probably limited by deep standing water under nests.

Water or Vegetation?

Statistical analysis is not possible with such small sample sizes, but our comparative data suggest that the presence of water somewhat relaxes preferences for vegetation type. In the wettest year, pairs ventured somewhat outside typically favored habitats. Although birds apparently prefer two main habitat types (mainly native dense shrub and mainly exotic dense shrub Ro), given a choice of preferred habitats with and without water, they gravitate toward wetter territories. Thus, it appears that Isleta SWFLs strongly prefer two vegetation types and also prefer to place territories in wet areas of those two habitats.

The driest year of our study was 2003. Our 2003 location data are not precise enough to allow analysis of nest placement relative to water and vegetation type, but we can identify general areas of the study site where they occurred. General 2003 nest locations agree with 2004-2006 data, except that only one territory was found in the south. This appears to contradict our conclusions on the importance of water. Why, in that driest of years, did birds not settle in the south, which is bounded by water on both sides and tends to have moist soil most of the time? We suggest that the coyote willows were too short in 2003. Structure of the vegetation has been improving over the past four years such that the southern area now includes more suitable habitat.

Future Work

This was intended to be a two-year project. We need another year of data to substantiate our interesting but still-tentative conclusions. In addition, 13 data loggers failed, and four have yet to be recovered. We will ask that Onset Computer Corp. replace the failed loggers and, in year two, we will buy enough loggers that two can be placed at every other point for insurance. More complete data will allow us to refine our soil moisture maps. In year two we will also ground truth the Milford et al. (2005) vegetation map of the study site.

Conclusions

After five years of monitoring SWFL nesting and three years of studying habitat preferences, we can tentatively conclude that SWFLs prefer to establish territories in two vegetation types. Strong preference for these two types is mitigated somewhat by the presence of abundant surface water in other habitat types. Conversely, in dry years, the birds seem to gravitate toward the wettest areas of these two habitat types. Within preferred habitats, they tend to nest on the edge of clumps, near open meadow habitat. Nests are typically placed in vegetation that is denser from 0 to 6 m above the ground than at other spots in the territory. Nests with low-density vegetation above the nest appear to be at increased risk of nest parasitism.

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