Southwestern Willow Flycatcher Nesting Success, Cowbird Parasitism, and Habitat Characteristics at the Pueblo of Isleta, New Mexico

2004 Report

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Table of Contents

List of Tables

List of Figures

Introduction

The Southwestern Willow Flycatcher (SWFL, *Empidonax traillii extimus*) breeds in riparian areas of the southwestern United States. The subspecies was listed as federally endangered by the US Fish and Wildlife Service (USFWS) in February 1995 (USFWS 1995). Breeding populations in the middle Rio Grande of New Mexico are found in isolated fragments of suitable habitat situated between large tracts of unsuitable habitat.

The SWFL is one of several declining species that apparently have been impacted by Brown-headed Cowbird (BHCO, *Molothrus ater*) parasitism (USFWS 2002, Rothstein and Robinson 1994, Holmes 1993). Among SWFL populations, cowbird impact varies widely. In New Mexico, reported rates vary from 18% in the Cliff Gila Valley to 40% at other sites (USFWS 2002).

Habitat characteristics are related to the rate of cowbird parasitism. Cowbird parasitism rates are typically lower in large patches of unfragmented habitat (Smith et al. 2000, Robinson et al. 1995). In general, parasitism rates and cowbird densities typically decline with increasing densities of low vegetation, probably because nests in dense vegetation are harder for cowbirds to find (USFWS 2002, Uyehara and Whitfield 2000, Staab and Morrison 1999, Larison et al. 1998). Parasitism rates are higher when vegetation above nests provides perches for female cowbirds (Averill-Murray et al. 1999, Staab and Morrison 1999, Larison et al. 1998).

A second factor that could influence parasitism rates is the presence of alternative hosts. Although some studies expect a positive correlation between number of cowbirds present and host availability (Thompson et al. 2000, Robinson 1999), the presence of alternative hosts could also reduce cowbird pressure on SWFLs (Robinson et al. 2000, Spautz 1999). Alternative hosts could swamp cowbird laying efforts, give warning calls to potential hosts when cowbirds were present, or deter cowbirds, in the case of non-preferred hosts such as Red-winged Blackbirds (*Agelaius phoeniceus,* Spautz 1999). Finally, vegetation features and alternative host availability could interact to increase or decrease parasitism rates. In 2000, the Pueblo of Isleta site had apparently low parasitism rates in the presence of a large cowbird population. In 2003, however, the parasitism rate was 33% (Smith and Johnson 2004).

The purpose of this study is to continue work done in 2003, which included: 1. conducting protocol surveys for nesting or migratory willow flycatchers in suitable habitat at the Pueblo of Isleta, 2. monitoring nests for success and brood parasitism by BHCO, 3. determining the distribution of alternative hosts for BHCO brood parasitism, and 4. collecting data on vegetation at SWFL nests.

Methods

SWFL Surveys

In 2003, three sites on the Pueblo of Isleta were identified as suitable breeding habitat for SWFLs: South of Isleta Marsh Expanded, South of Highway 147 Bridge, and Isleta Return Channel (Smith and Johnson 2004). In 2004, we conducted surveys at two of these sites: South of Isleta Marsh Expanded and Isleta Return Channel. Although only the southern portion of the South of Isleta Marsh Expanded site is suitable for SWFLs, we surveyed the entire area. The northern portion of the site had an insufficient understory. Site names are exactly as reported in Johnson and Smith (2000) and Smith and Johnson (2004). 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). There were no imminent projects planned within this habitat; therefore, we followed a three-visit schedule, per the 2001 protocol addendum (USFWS 2000). Starting 18 May 2004, we visited both sites within the recommended dates: survey 1, 15-31 May; survey 2, 1-21 June; survey 3, 22 June – 10 July. We conducted tape playback surveys between sunrise and 9:00 am. Both sites were accessible to thorough walking surveys within suitable habitat.

The SWFL survey protocol is based on tape playback of the species' vocalizations. We walked through the habitat, covering the entire survey site, to ensure that the tape could be heard from any point in the habitat. Upon entering the habitat, we listened for vocalizations. After a listening period of several minutes, we played a tape for about 20 seconds, and listened again for several minutes. This procedure was repeated every 25-50 m as the surveyor walked through the site. Observations of SWFLs are used to determine status: 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. All SWFLs sighted during this survey were viewed long enough through binoculars to determine whether a bird had been previously banded. 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 new detections of SWFLs and their nests.

Nest Monitoring

We monitored SWFL nests to determine fate, productivity, and brood parasitism. 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 incubation 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 activity by the adults, 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 successfully fledged, 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.

Alternative Hosts

To determine the distribution of alternative hosts at the South of Isleta Marsh site, we mapped a 100 x 100m grid over the habitat, which created 15 intersection points on the site. We ran three point counts at these points in 2004; between 16 and 18 June, 21 and 22 June, and 28 June and 2 July. During each count, we waited for five minutes after arriving at a point to allow activity to resume after our disturbance, then we recorded all birds heard and seen from that point for five minutes. We recorded species, number, compass heading, and distance (0-25 m; 26-50 m). Birds estimated to be more than 50 m away were not recorded; these birds would either be within range of another point or out of the habitat. Alternative host individuals were mapped if they were recorded two or more times at similar compass headings, if one or more record was over 25 m from the point but both were within 90° of each other, or if the records were within 180° but were both less than 25 m away).

Vegetation Characteristics

Vegetation measurements were collected 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 in previous years on the Pueblo but is the same as that used in other SWFL habitats in New Mexico in 2004 and earlier.

We recorded three vegetation measurements. First, we recorded nest-centered data similar to Rourke et al. (1999, p. 24). This included 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, density of individual plants was measured using a modified point-centered quarter method. We divided 5 m radius plots into quarters along north-south and east-west lines, recording the distance to the nearest individual up to a distance of 5 m. This was done for individuals in the shrub, middle, and upper levels of canopy. Species, height, diameter at breast height (DBH), and average crown diameter were recorded for each individual plant in addition to distance from the center of the plot. One plot was centered at the nest tree, and three more subplots were located 15 m from the nest tree at due north and at 120° and 240° compass headings. These data were analyzed using standard point-center quarter calculations of plant density (Bonham 1989), with a correction for blank quarters (Warde and Petranka 1981).

Third, vegetation cover was estimated in the same 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). Estimates were recorded as percent volume occupied by all plants and percent of the total plant cover volume contributed by the top three species. Volume estimates were recorded in categories of 0, 1-10, 11-25, 26-50, 51-75, 76-90, and 90-100%.

All three types of vegetation measures were repeated at randomly located control plots between 50 and 100 m from the nest site. We measured nests vegetation at nests 1, 2, 3, 5, and 7 using this method.

Results

SWFL Surveys

No willow flycatchers were detected at the South of Isleta Marsh Expanded site. We surveyed twice for a total of two hours. We did not survey during the third survey period because no birds had been detected during the first two periods.

The Isleta Return Channel site had surface water in the habitat due to spring rains. In late May, much of the southern portion of the habitat near the tracks was inundated with about 0.6 m of water. Later in the breeding season, water was only present immediately east of the railroad tracks on the western edge of the habitat and at the north end of the site. In late June, we observed evidence of beaver activity in the area. The site is approximately 1.2 km in length, with an average canopy height of 15 m. The dominant plant species are cottonwood (*Populus* spp.), coyote willow (*Salix exigua*), and Russian olive (*Eleagnus angustifolia*). The cottonwood overstory dominates the northern and eastern portions of the site, and Russian olive and coyote willow dominate the central and western portions, where cottonwoods exist as single emergent trees.

We spent about 30 hours in the habitat mapping SWFL territories, including the tape playback surveillance. We found ten nests and seven SWFL pairs in 7 territories (Table 1, Figure 1).

Table 1. Summary of survey dates and results.

Site	Dates Visited	Adults	Pairs	Territories	Nests
Isleta Return Channel	5/18, 5/19, 6/18, 7/6, 7/19	14	7	7	10
South of Isleta Marsh (expanded)	5/25, 7/12	0	0	0	0

Nest Monitoring

Nests 1b and 1c were re-nesting attempts in the same tree after nest 1 failed. Nest 4b was a second nest built by pair 4 in a different tree after nest 4 failed. We found no evidence of cowbird parasitism in any nest. The nest success rate was 5 of 10 (50%), but 5 of 7 (71%) pairs were successful in fledging young. There was no apparent relationship between nest success and proximity to the Cooper's Hawk nest (Table 2, Figure 1)

Table 2. Summary of Nests Found. Nest number does not match territory number because territories were not all mapped when nests were found.

Territory	Nest	Date Discovered	Last Known Nest Contents	Nest Fate
1	1	6/3	Empty	Abandoned
1	1b	6/16	Empty	Abandoned
1	1c	6/25	1 SWFL nestling	Nestling died in nest
3	2	6/3	2 SWFL nestlings	2 SWFLs fledged
4	4	6/8	Empty	Unknown/disappeared
4	4b	6/23	3 SWFL nestlings	3 SWFLs fledged
5	5	6/11	3 SWFL nestlings	3 SWFLs fledged
6	3	6/7	4 SWFL nestlings	4 SWFLs fledged
7	7	6/22	1 SWFL nestling	1 SWFL fledged
8	8	6/22	1 SWFL egg	Blew down

Alternative Hosts

At the Isleta Return Channel site we mapped 52 territories of eight possible alternate host species (Table 3; Figures 2-9). The only species recorded during the point counts but deleted from the list of potential hosts were black-chinned hummingbird, because they are too small to host BHCO nestlings, and Cooper's hawk, because they are too large (as cited in Lowther 1993: Friedmann 1929, 1963, Friedmann et al. 1977, Friedmann and Kiff 1985). Although brown-headed cowbirds were seen frequently at the site (Figure 10), none of the SWFL nests was parasitized, nor did we see evidence of cowbird parasitism of other species. There were a total of 17 BHCOs seen during point counts.

Comparisons between years in abundances of alternative hosts are not straightforward because the spot mapping method was different in 2003. In 2003, surveys for alternative hosts were not conducted in the southern portion of the Isleta Return Channel site because there were no SWFLs nesting there.

In 2004, BHCO were concentrated in the southern portion of the habitat. We recorded 25 BHCO in 2003 and 17 in 2004. We mapped five territories in the northern portion of the Isleta Return Channel site and eight more territories were mapped in the southern portion (Figure 10). These sightings were usually of singing/calling male cowbirds, and their distribution within the habitat may be more affected by the presence of suitable perches than host nests. In 2003, BHCO were seen throughout the gallery forest in the western half of the site, and only a few times further south and east where SWFLs were nesting. Red-winged Blackbirds were not recorded in 2003 because only birds occurring in SWFL habitat were recorded.

Table 3. Alternate host species and territories mapped. Only the northern portion of the site was surveyed in 2003; northern portion for 2004 is first number, total is in parentheses.

Species	2003	2004
Bewick's Wren	6	0
Black-headed Grosbeak	12	6 (10)
Blue Grosbeak	0	1 (1)
Common Yellowthroat	0	3 (4)
Grey Catbird	8	3 (4)
Red-winged Blackbird		6 (15)
Spotted Towhee	16	5 (7)
Western Wood-pewee	0	2 (3)
Yellow-breasted Chat	0	6 (8)

Vegetation Characteristics

SWFL nests were placed in Russian olive, coyote willow, and salt cedar (Table 4). The average height of the nest tree, nest height, DBH of nest tree, and average distance from the nest to the edge of the nest tree canopy for nests 1, 2, 3, 5 and 7 are shown in Figure 11. Although there were no significant differences between nest and control plots, there are differences worth noting. The distance from the nest or center of the control plot to the edge of the clump of vegetation was less for actual nests than for control plots (14 vs. 32 m, Figure 11). The distance to the edge of the riparian habitat was greater for nest plots than for control plots (64 vs. 29 m, Figure 11). The average canopy height above nests was less than above control plots (21 vs. 28 m, Figure 11). Finally, the distance to surface water was less for nests than for control plots (32 vs. 41 m, Figure 11).

Table 4. Species of substrate tree by nest.

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

Individual plant density in the shrub component appeared higher at the nest than at the nearby subplots and control plots for three out of five nests measured (2, 3 and 5;

Figure 12). The other two nests measured (1 and 7) had very similar shrub densities at the nest plot as the nearby subplots, but higher shrub densities at the control plots.

Three nests with higher shrub density at the nest also fledged more young (2, 4 and 3 young, respectively) than the two other nests (0 and 1 young). Density of individual plants in the mid-canopy component was higher at the nest for three of five nests than in the nearby non-center subplots, but only two of this subset had higher mid-canopy density at the nest than at the control plots (Figure 13). Plants of the upper canopy component were much less dense than shrub and mid-canopy components. Upper canopy trees were only present at two of five nest center plots, one set of near-nest subplots, and 4 of 5 control plots (Figure 13).

At all nests, the volume measurement in the 0-3 m interval at the nest was higher than (N=4), or equal to (N=1), the same interval in the near-nest subplots. Three out of five nests had higher volume measurements at every height interval at the nest than at the nearby subplots. Nest 2 had higher volume measures in the 3-6m interval, but equal measures for the other two intervals, and nest 5 had higher volume in the 0-3m interval at the nest, but higher measures for the other intervals for the nearby subplots. The control plots had similar volume measurements as the paired near nest subplots.

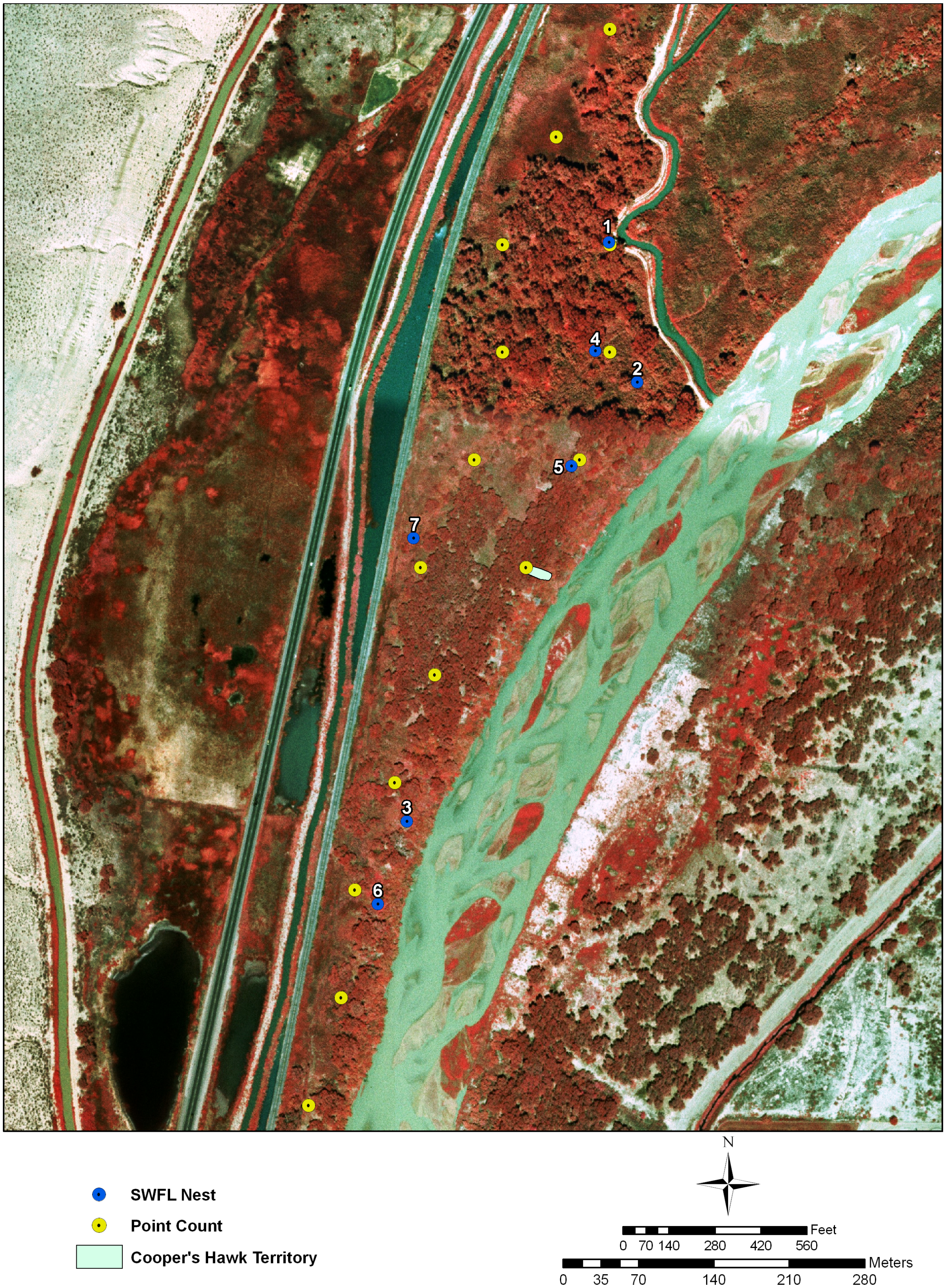

Figure 1. Map showing SWFL nests and Cooper's Hawk territory at Isleta Return Channel site 2004.

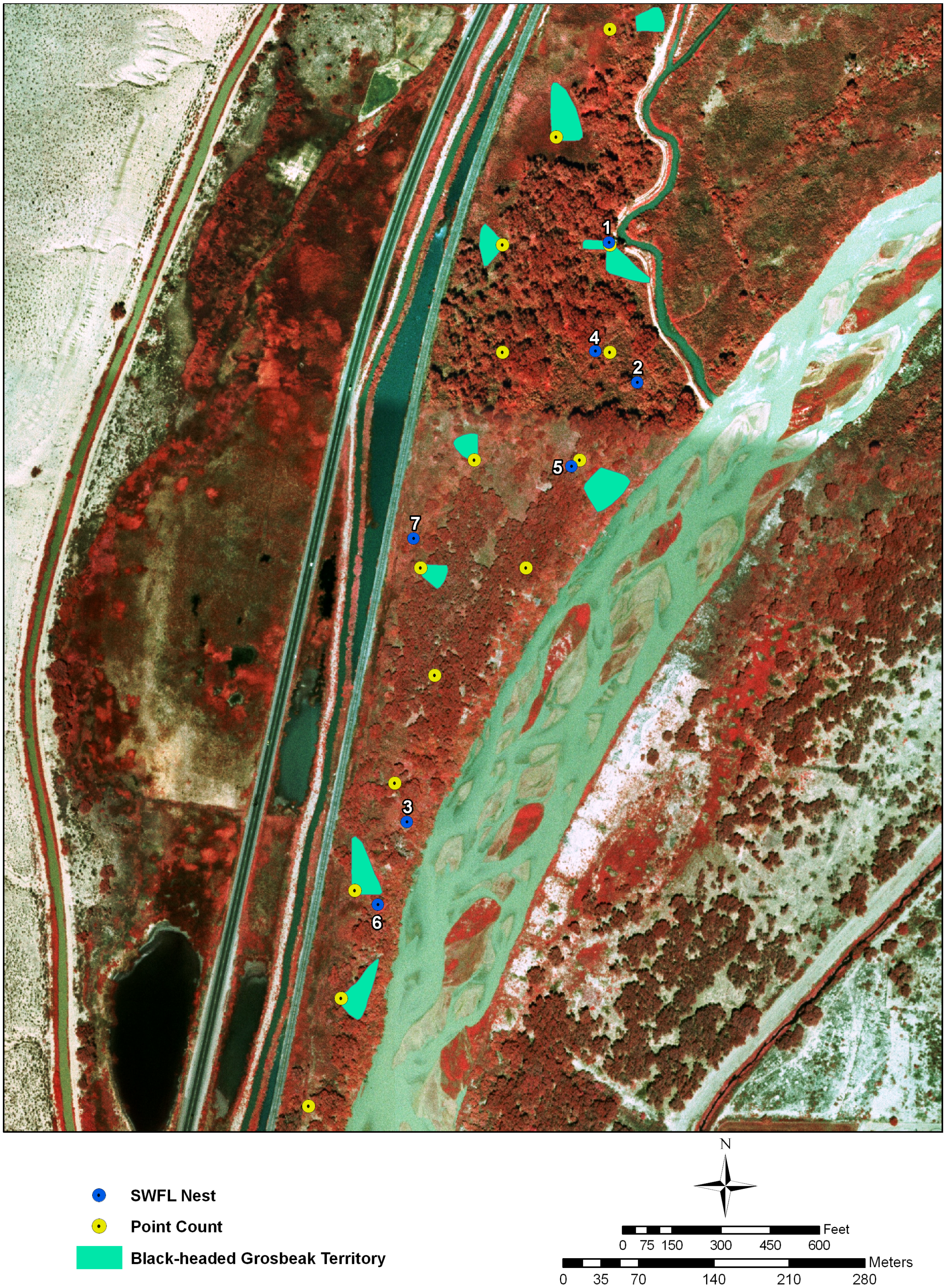

Figure 2. Map showing SWFL nests and Black-headed Grosbeak territories.

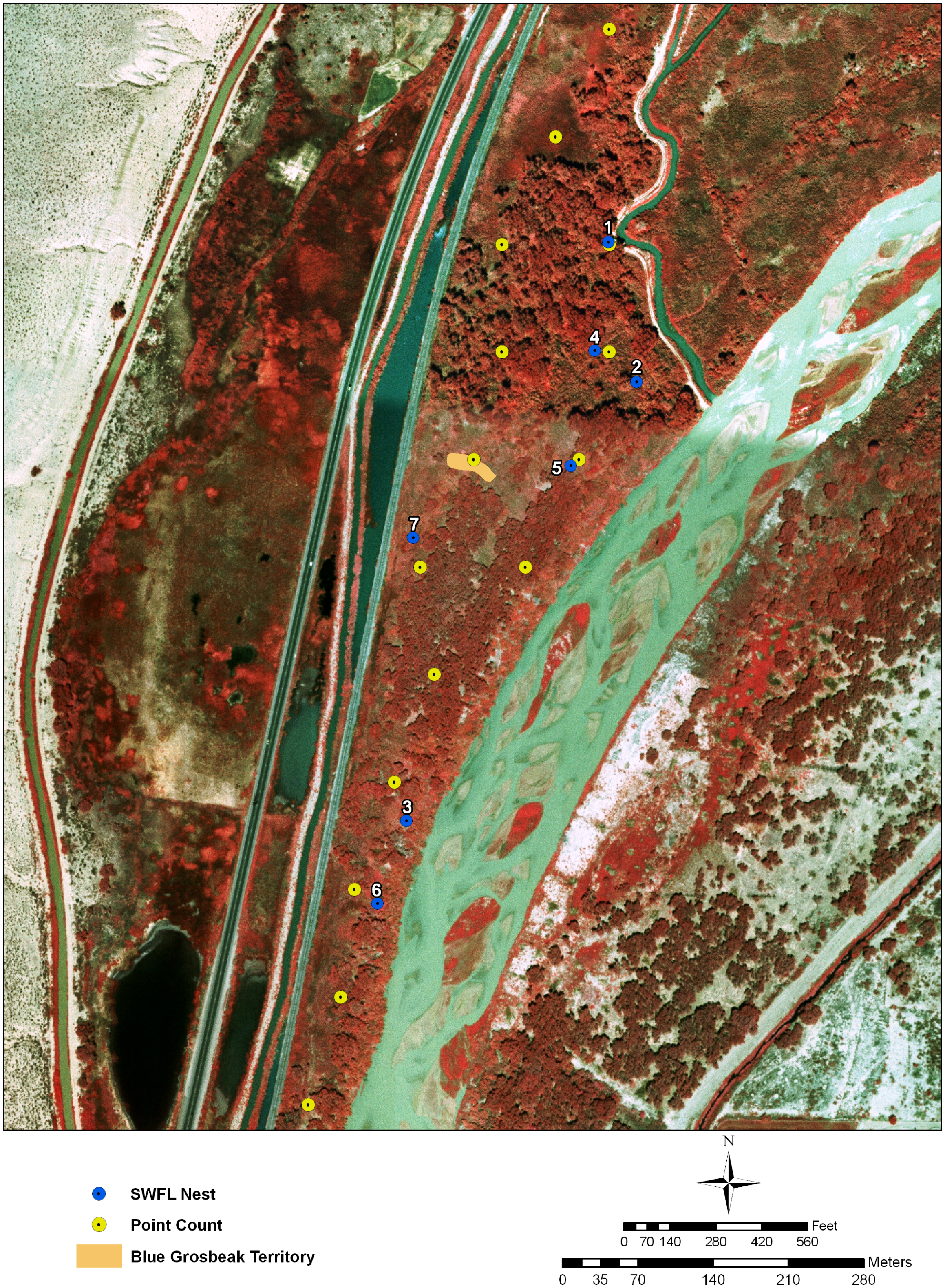

Figure 3. Map showing SWFL nests and Blue Grosbeak territories.

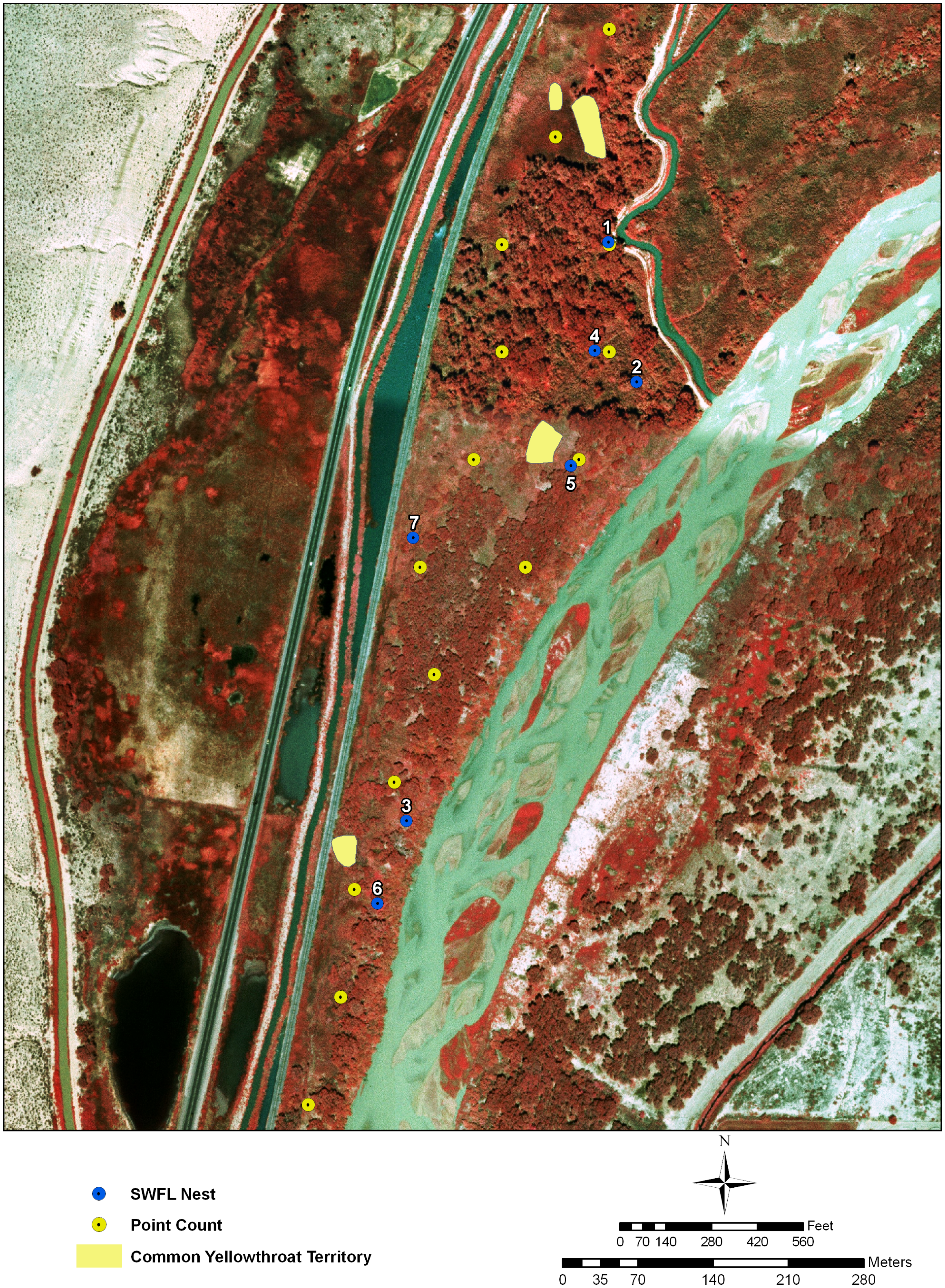

Figure 4. Map showing SWFL nests and Common Yellowthroat territories.

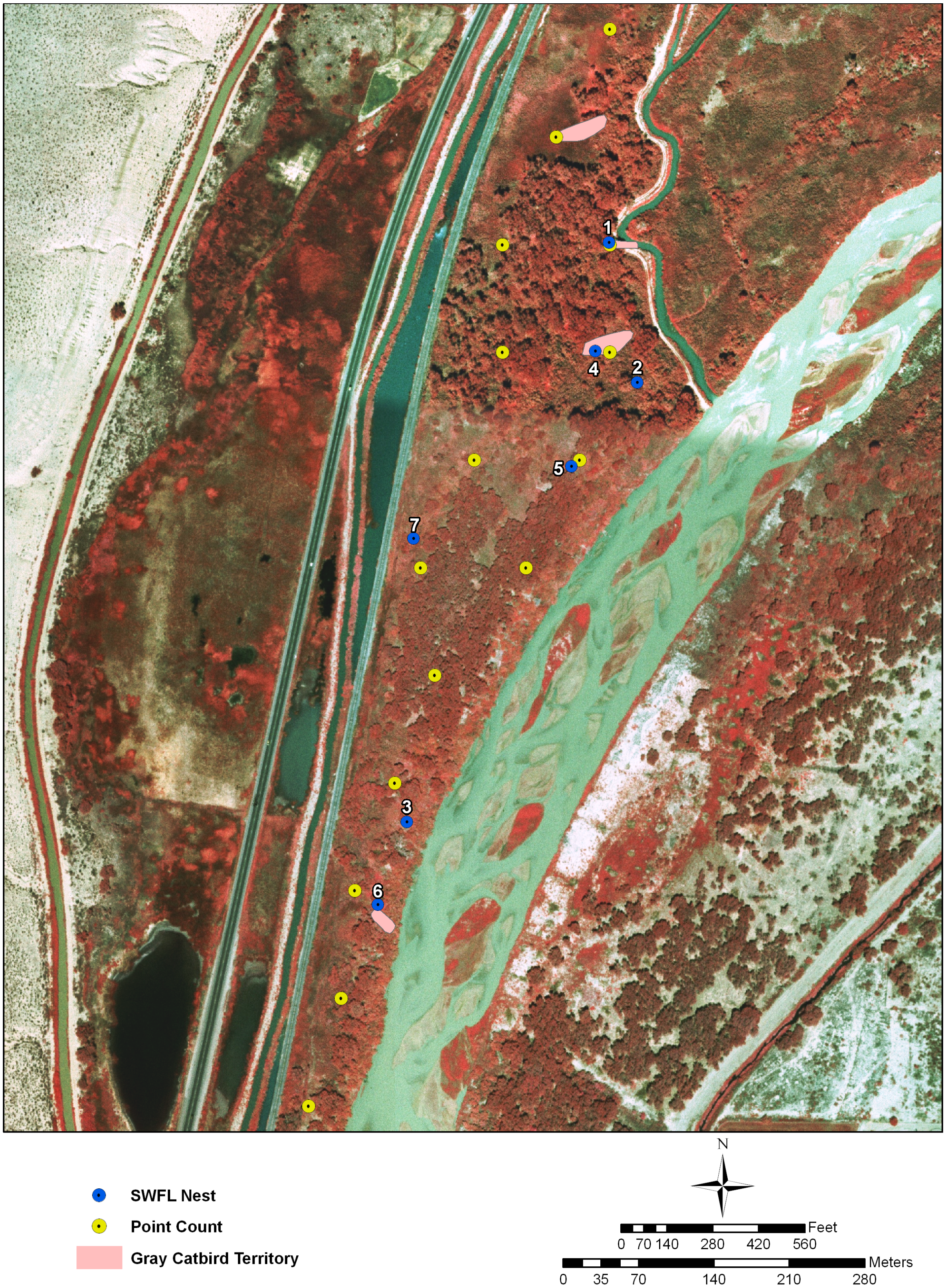

Figure 5. Map showing SWFL nests and Gray Catbird territories.

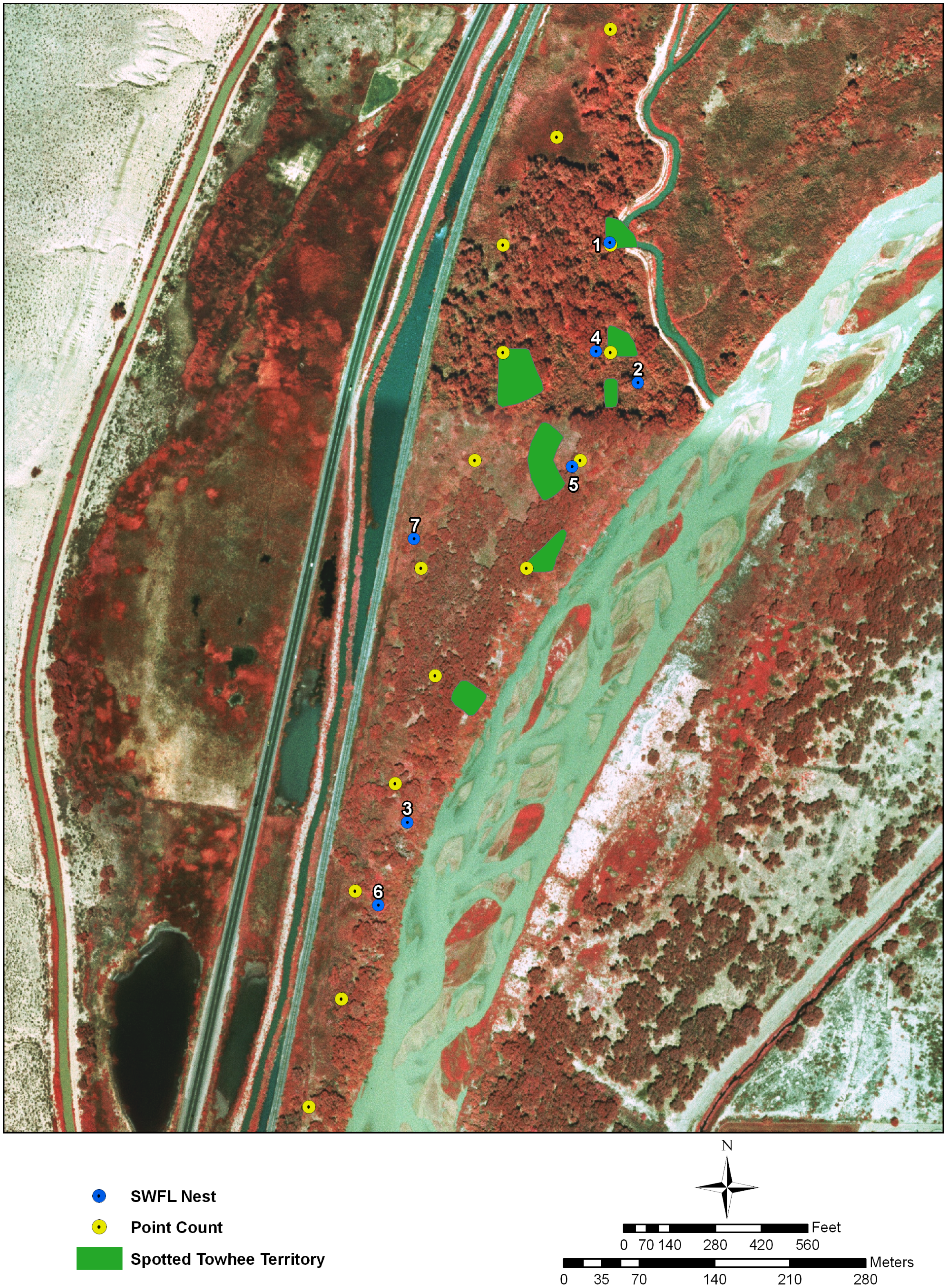

Figure 6. Map showing SWFL nests and Spotted Towhee territories.

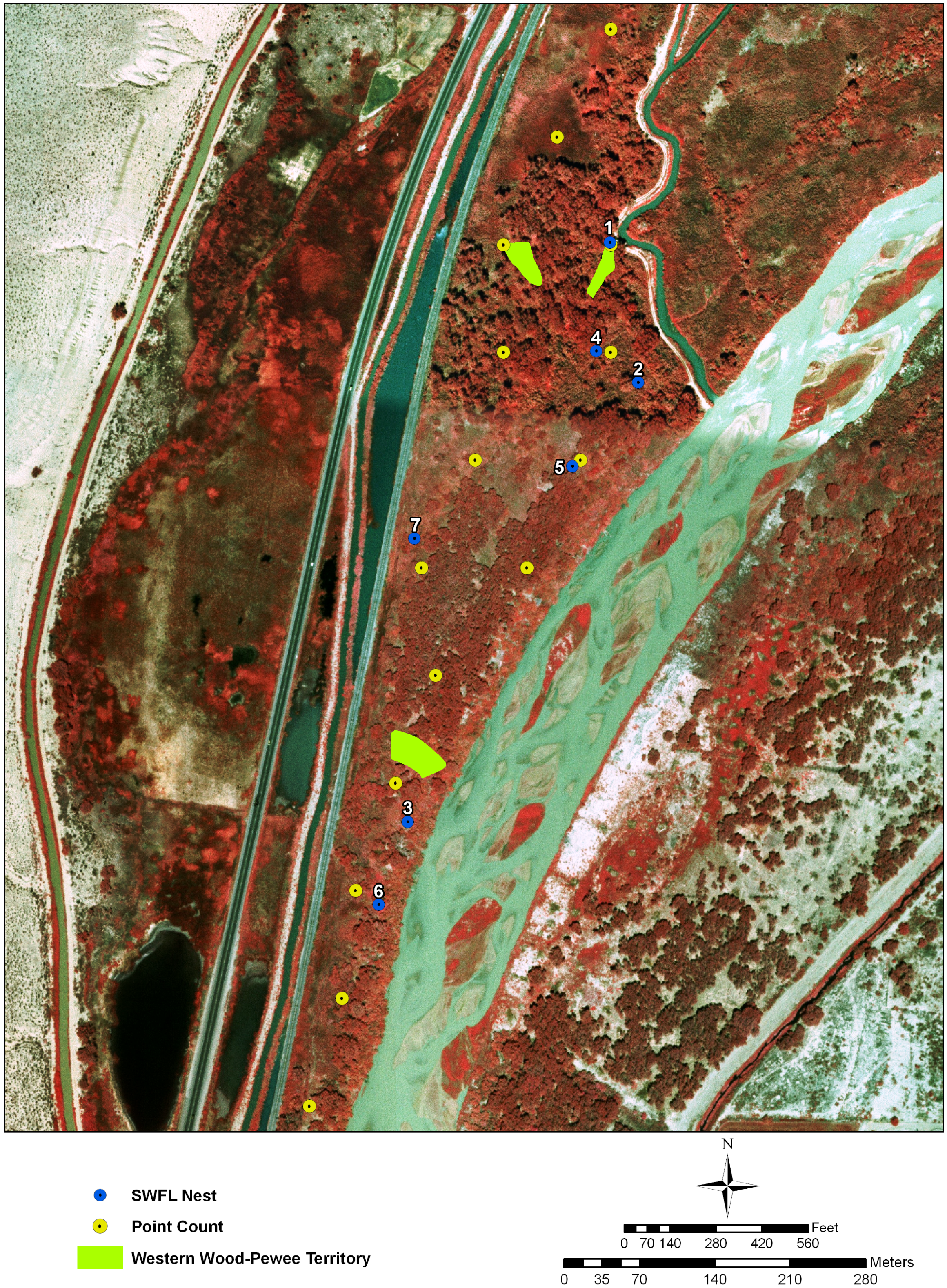

Figure 7. Map showing SWFL nests and Western Wood-Pewee territories.

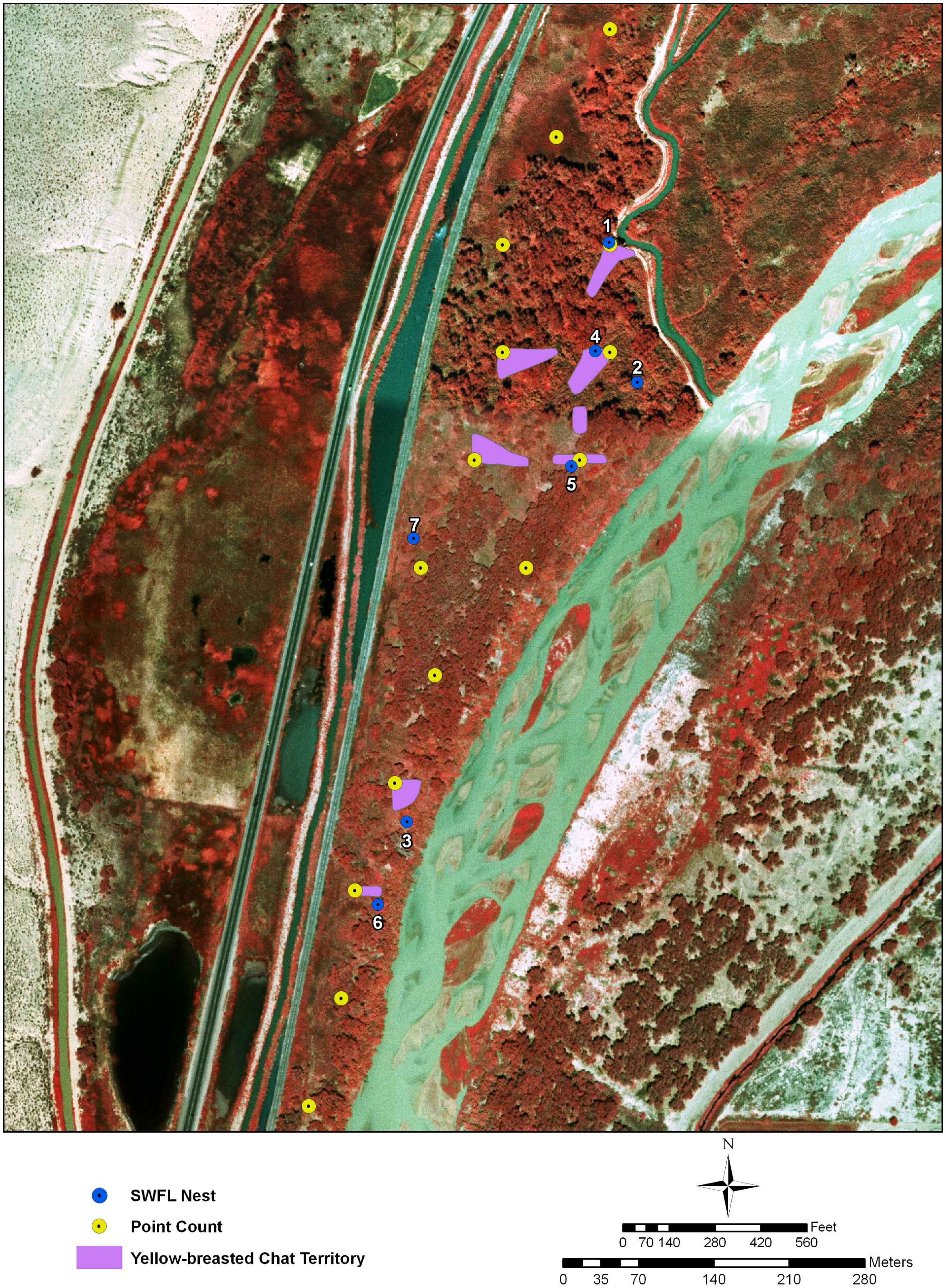

Figure 8. Map showing SWFL nests and Yellow-breasted Chat territories.

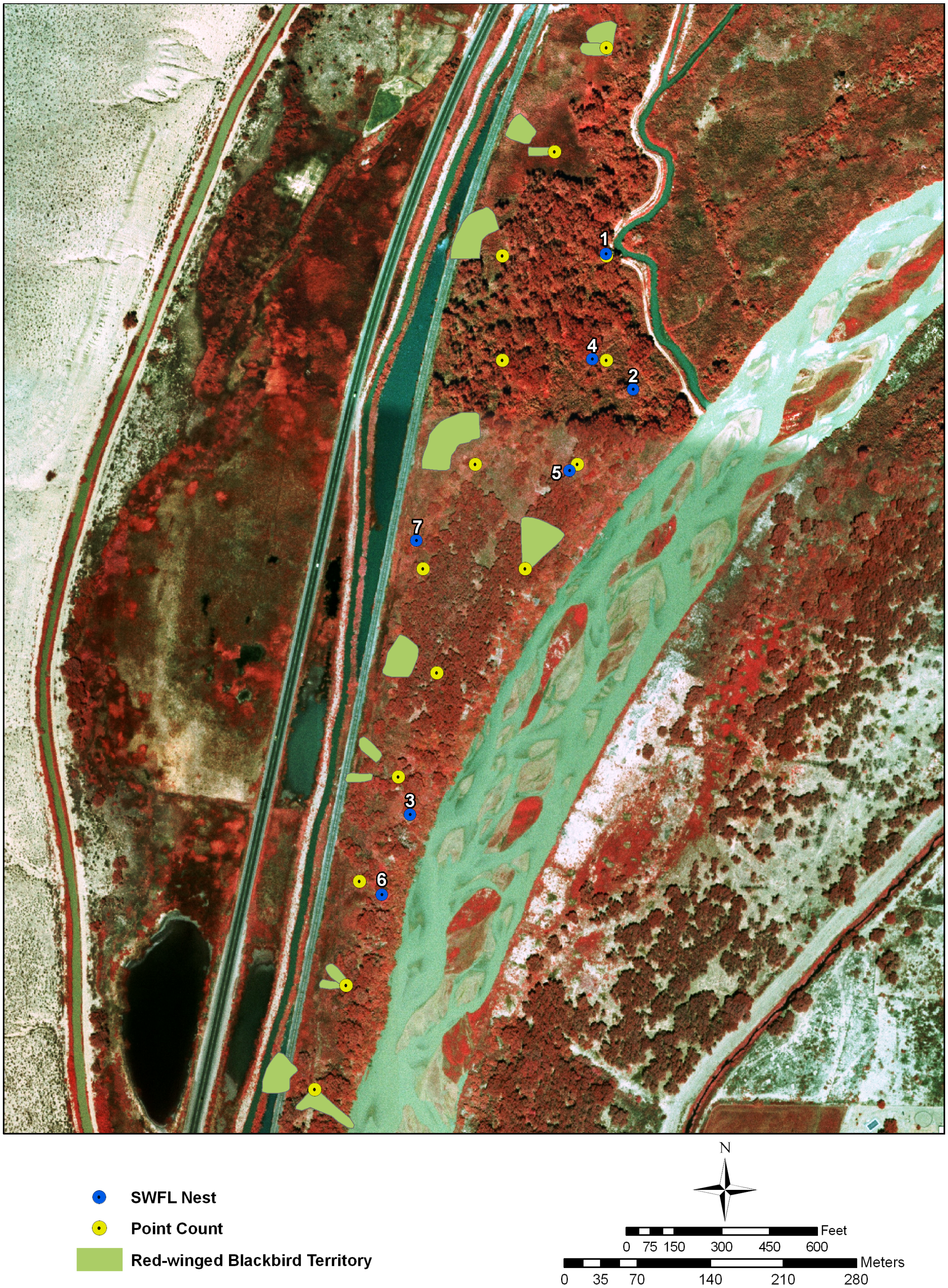

Figure 9. Map showing SWFL nests and Red-winged Blackbird territories.

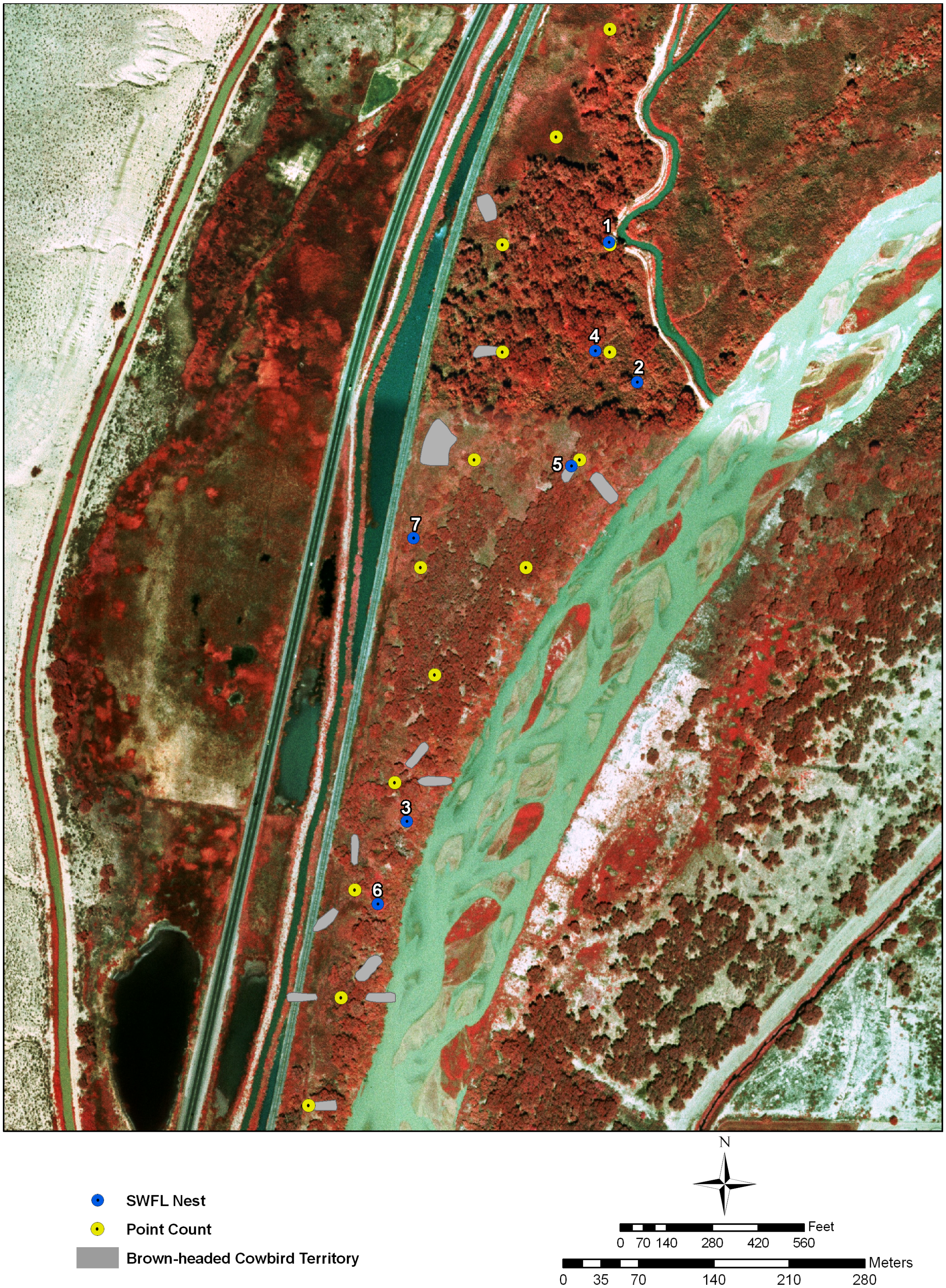

Figure 10. Map showing SWFL nests and Brown-headed Cowbird territories.

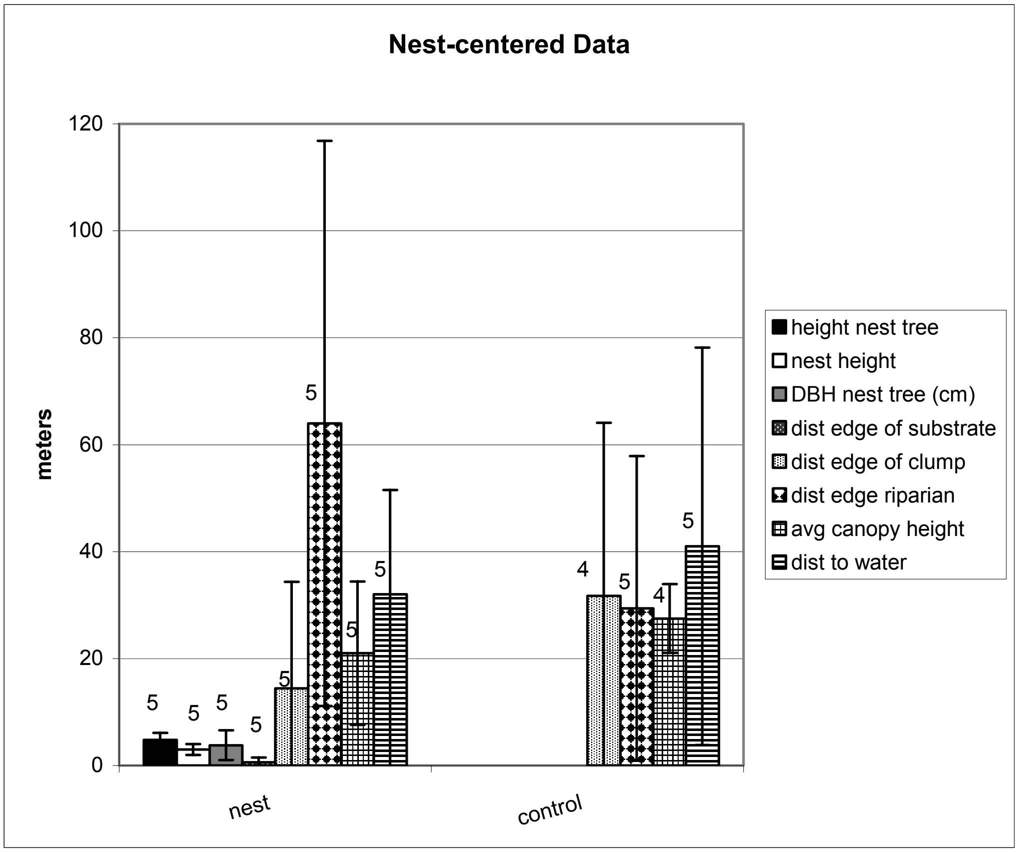

Figure 11. Nest-centered data averaged over nests for nest plots and control plots. Error bars represent +/- one standard deviation, and Ns are shown above bars.

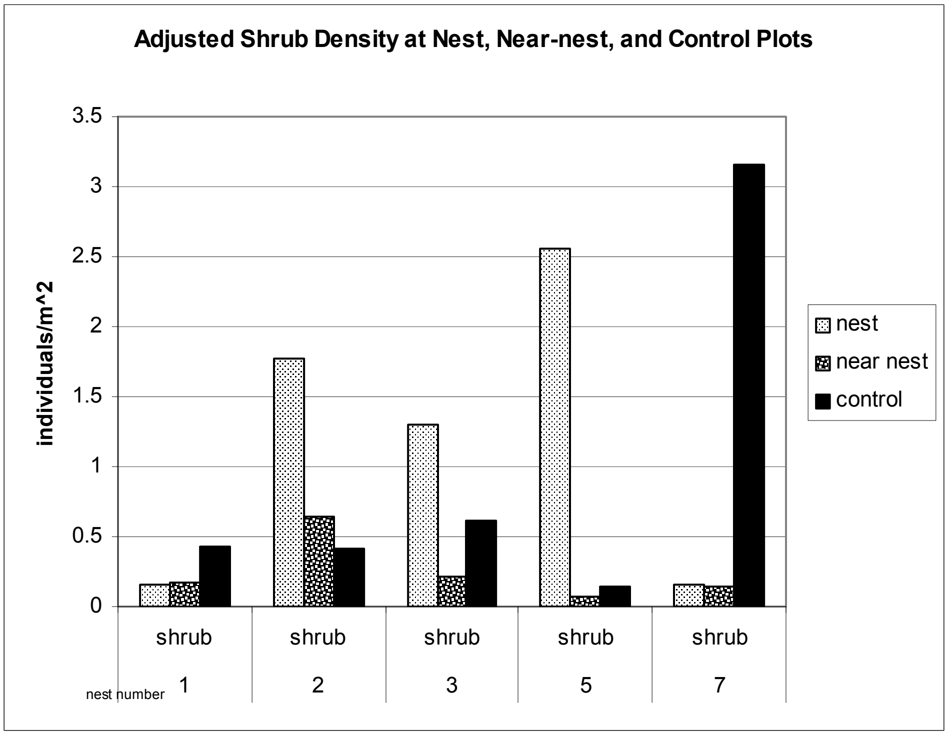

Figure 12. Density of individual plants in the shrub component at nests, near nest subplots and control plots. Densities are adjusted for empty quarters.

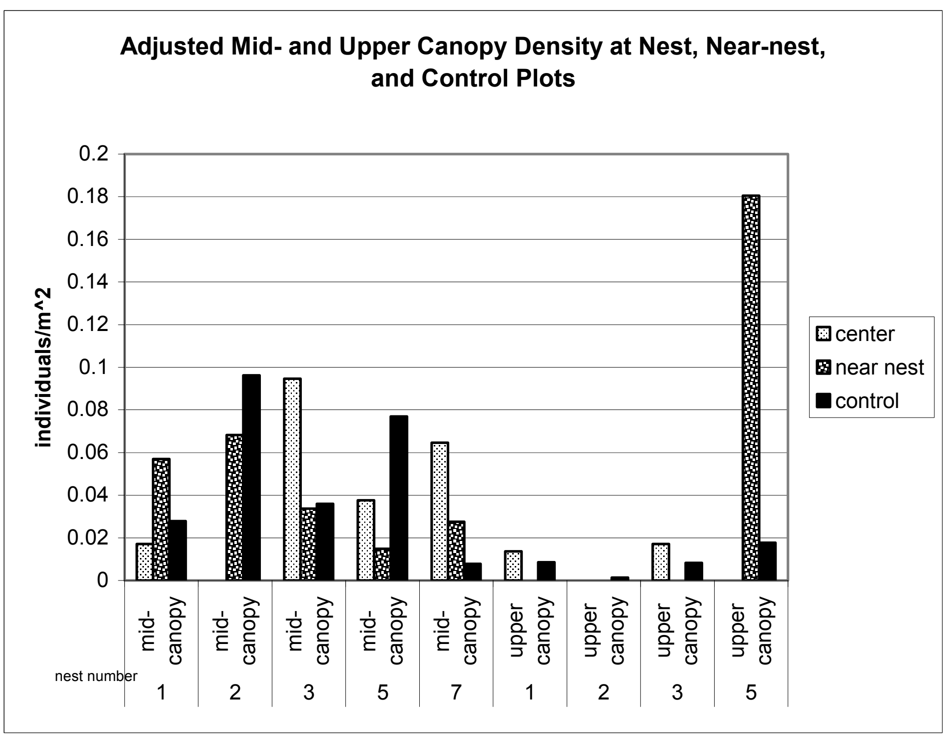

Figure 13. Density of individual plants in the mid- and upper canopy component at nests, near nest subplots, and control plots. Nest 7 had no upper canopy plants.

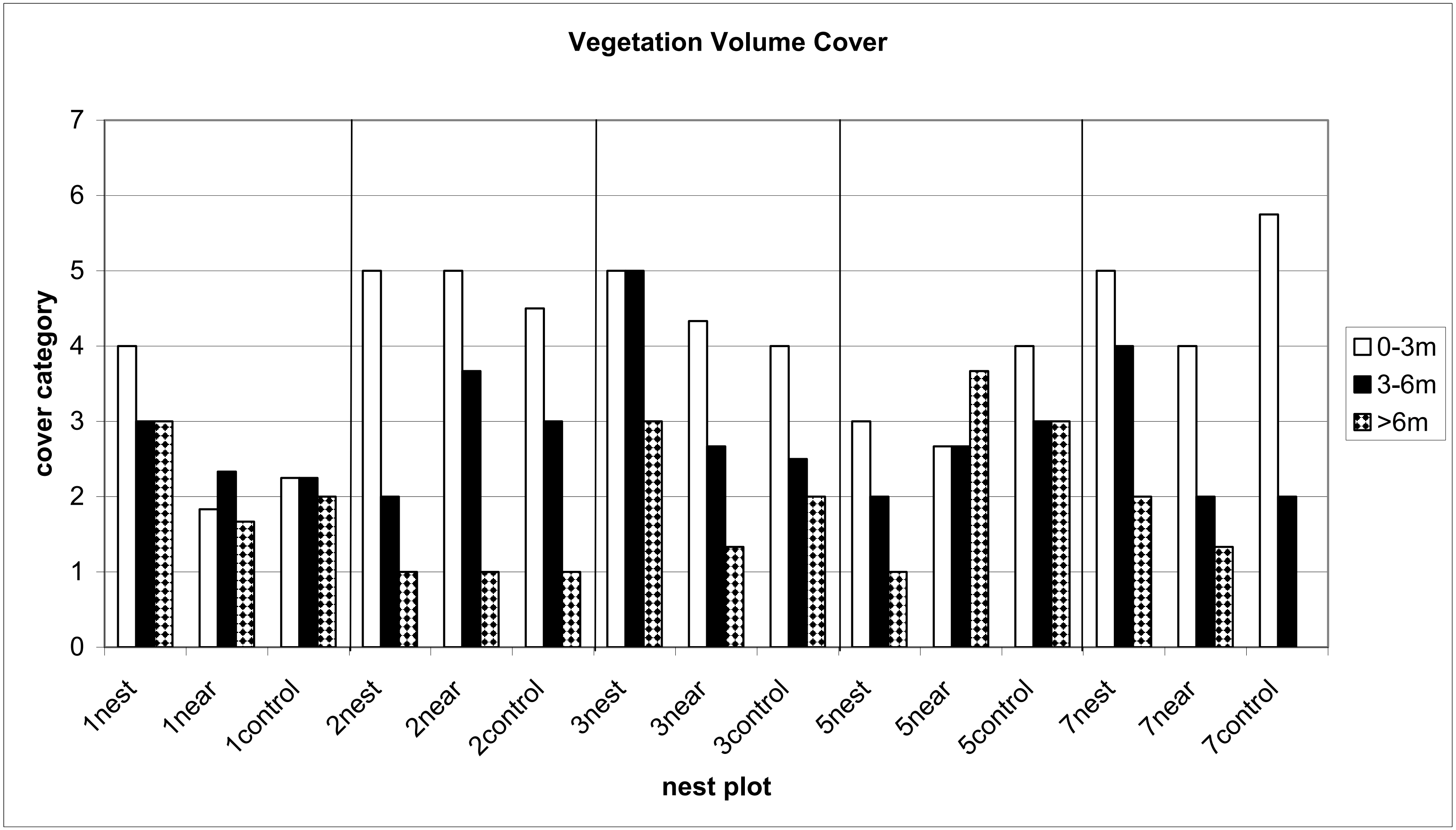

Figure 14. Vegetation volume cover measured at three height intervals at nests, near nest subplots, and control plots. Error bars have been removed for clarity.

Discussion

This study continued the surveys, nest monitoring, and alternate host mapping begun in 2003 (Smith and Johnson 2004). These two studies address two specific tasks laid out in the executive summary of the Southwestern Willow Flycatcher Recovery Plan (USFWS 2002): to "initiate or continue monitoring of SWFL populations and nests at core occupied and suitable breeding sites," and to "evaluate the relationship between cowbird parasitism, habitat quality, alternative hosts, and SWFL population levels on the Middle Rio Grande."

2004 was wetter than 2003 at the Isleta Return Channel Site, and there were more SWFLs and nests in 2004. The year 2000 was also wet, and more adults were detected on the site that year than in either 2003 or 2004. The number of nesting SWFL pairs was equal in 2000 and 2004, but in 2000 five unpaired territorial males were present.

The nest success rate in 2004 was 50%, but 71% of all pairs nesting at the site fledged at least one young. In 2003, the nest success rate was only 33% (40% pair success; Smith and Johnson 2004). There was no formal nest monitoring in 2000, but observations indicate the maximum possible nest success rate was 62% (71% pair success; Johnson and Smith 2000). The improved hydrologic conditions in 2000 and 2004 may have increased prey quantities and/or habitat quality, causing an increase in reproductive success

Cowbird parasitism was not detected in 2000 or 2004. In 2003, cowbird parasitism was 33% (Smith and Johnson 2004). Low moisture in the habitat may indirectly cause increased parasitism levels. During dry years, SWFLs may need to be away from the nest more because of lower food resource levels around the nest, resulting in less vigilance and defense against female cowbirds. In wet years, the birds may be able to forage more efficiently and closer to the nest, allowing parents to be more vigilant for BHCO. Banks and Martin (2001) found that time spent near the nest was positively correlated with parasitism frequency over four host species. Within species, however, parasitism decreased with increasing frequency of female visits to the nest. In another study, female WIFL were found to chase female BHCO from the nest (Uyehara and Narins 1995). Alternatively, the increased moisture levels could cause the vegetation to grow more densely, in turn causing increased protection from parasitism. BHCO parasitism in song sparrows (*Melospiza melodia*) was shown to decrease with increasing low vegetation (Larison et al. 1998).

The abundance of alternative host nests in the habitat may also have influenced changes in cowbird parasitism on SWFLs between 2003 and 2004. Abundance of BHCO on the site was similar between years; 25 BHCO were recorded in 2003 and 17 in 2004. More time was spent surveying for alternative hosts in 2003, so the numbers of BHCO on the site may have been comparable during the two years.

However, relative abundance of alternative host species differed between years. In 2003, Spotted Towhee was the most commonly mapped species, followed by Black-headed Grosbeak and Gray Catbird. In 2004, Yellow-breasted Chat was the most commonly mapped species, followed by Black-headed Grosbeak and Spotted Towhee. The change in species composition of alternative hosts at the site could have made nests of preferred alternative hosts more abundant. Common Yellowthroat and Yellow-breasted Chat nests were available as hosts in 2004 (4 and 8 nests, respectively), but not in 2003. Both are among the17 species most commonly parasitized by BHCO (Lowther 1993). The total number of alternative host species was also higher in 2004 (seven) than in 2003 (four). The increase in number of alternative host species and suitable host species may have allowed BHCO to choose other host species over SWFLs.

The SWFL pairs at the Isleta Return Channel site chose to nest almost equally in Russian olive, coyote willow, and salt cedar. Pair 1 (nests 1, 1b, 1c) re-nested in the same individual Russian olive, but pair 4 (nests 4 and 4b) nested in two different Russian olive trees about 15 m apart. In 2000, eight nests were found in coyote willow, and one was found in saltcedar. In 2003, five nests were placed in Russian olive, and one nest was placed in coyote willow. SWFL may be nesting in exotic trees in dry years because they are denser or otherwise more suitable than native trees in dry years (Smith and Johnson 2004). More data are needed to test this hypothesis.

Our sample size of five measured nests does not reveal any significant differences in vegetation characteristics between control plots and nest plots, but there are interesting trends. In the nest-centered data, the distance to the edge of the clump of vegetation was shorter for nests than control plots, suggesting that SWFLs nest in areas of more heterogeneous vegetation. The distance from the plot to the edge of the riparian habitat was larger for nests than control plots, indicating that more interior areas are chosen. The average canopy height over plots was less for nests than for control plots, but this may be because SWFL do not nest in the gallery forest, where some control plots occurred. The distance to water was less for nest plots than for control plots, indicating that SWFL put their nests near water.

Individual plant density also suggests a possible pattern. Plant density in the shrub component was higher at three of five nests than at nearby subplots, and higher also than the control plots. Nest 1 may have failed to fit this pattern because it was next to a dirt road, which lowered the density measures. Nest 7 also did not fit this pattern; it was in a group of medium-sized tamarisk trees with no individual shrubs. This nest was the last territory to establish and fledged only one young, so it may have been in suboptimal habitat. The control plots for nest 1 were more typical of the habitat because they were not in the road. Nest 7 control plot was in a thicket of coyote willow; therefore the shrub component was unusually dense.

The vegetation measurement method used this year is not well suited to this small and heterogeneous site. The random placement of so few control plots does not provide an accurate representation of the habitat at this site. The area around the nest would be better represented by continuous measurements away from the nest, instead of sampling the area using subplots placed at regular distances and compass headings from the nest. In addition, continuous transect measurements away from the nest would better capture the transition between habitat at the nest and habitat near the nest. Casual observation suggests that successful nests have dense vegetation at the nest but are placed near openings. Transects rather than subplots might better capture this feature.

Plants in the mid-canopy component were more dense at the nest than in the nearby subplots for three of five nests. Nest 1 had low density mid-canopy at the nest because of the dirt road. Nest 2 had low density mid-canopy component because it was in a coyote willow thicket, so was very dense with shrubs but not mid-canopy trees. Individuals of the upper canopy were only present at two of five nests. This occurred partly because our plots were small enough to avoid the relatively infrequent large trees, but also because nests were usually not directly under upper canopy trees.

Four of five nests had denser vegetation at the nest in the 0-3 m interval than at the nearby subplots. The fifth nest (2) had equal volume measurements in this interval at the nest as at the nearby subplots. Three of five nests were denser in every height interval at the nest than at nearby subplots.

In general, SWFL chose nest sites with very dense undergrowth and denser vegetation at all heights than the immediate surroundings. The volume density measures may show stronger patterns than the individual plant density because the birds are actually choosing sites depending on density of vegetation, not stems of individual plants.

These results corroborate some of the findings from the 2003 breeding season. Smith and Johnson (2004) found that foliage density decreased with increasing distance from the nest. Although those measurements were not broken down by height, they do support our findings that nests are usually located in an area of relatively dense vegetation. They also found that the vegetation immediately above the nest was denser at the nest than near the nest. At three of five 2004 nests the equivalent was true; vegetation in the 3-6 and >6 m intervals was denser above the nest than at the nearby subplots.

Vegetation may affect where SWFL choose to place their nests, and it may also affect the success of their nests once that choice is made. The nests with higher shrub density and higher density at the nest than at nearby subplots fledged more young than the nests with lower shrub density. Nests with higher shrub density at the nest than at nearby subplots may have openings in the vegetation next to the nests as described above. These openings may be important for foraging. Low, dense cover may better conceal nests from predators.

Our three years of SWFL data on the Pueblo of Isleta suggest a negative relationship between water levels in the habitat and brood parasitism by BHCO on SWFLs. A few possible mechanisms could be mediating such a relationship. Increased water could be affecting nest tree species choice, which may affect parasitism rates. Low water levels may also affect prey levels in the habitat, such that SWFLs need to spend more time away from their nests in dry years, giving them less chance to repel female cowbirds. Finally, moisture levels may affect the habitat or the breeding of alternative host species in a way that affects parasitism levels on SWFLs. Additional years of nest survey data and habitat measurements will help define the relationship between water levels in the habitat and brood parasitism levels in SWFL.

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