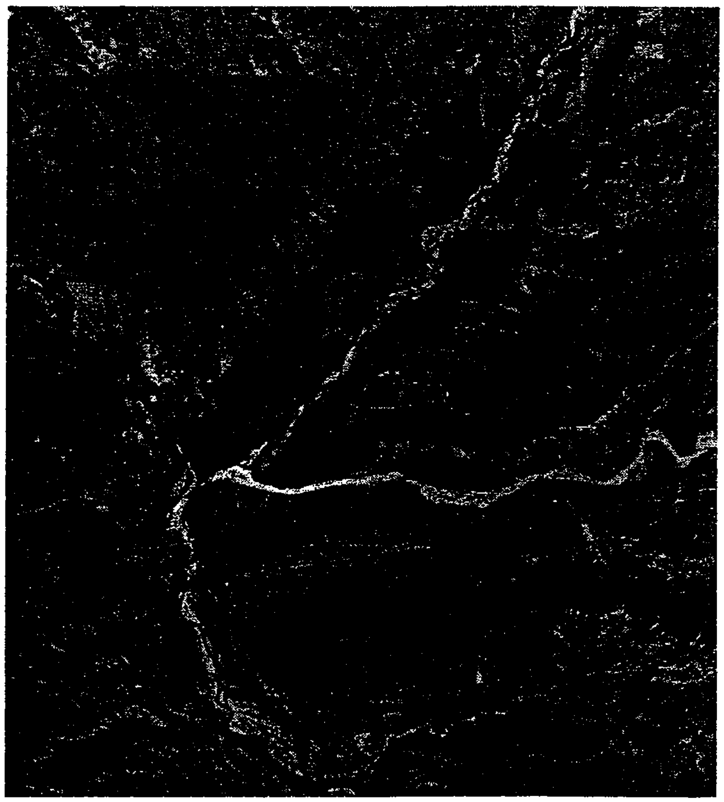
SOUTHWESTERN WILLOW FLYCATCHERS IN THE CLIFF-GILA VALLEY, NEW MEXICO:

LANDSCAPE-LEVEL EFFECTS ON DENSITY, REPRODUCTION, AND COWBIRD PARASITISM

Final Report for the 2000 Field Season



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EXECUTIVE SUMMARY

The year 2000 was an odd one for Willow Flycatchers in the Cliff-Gila Valley. The population dropped substantially in size, yet reproductive output was at an all-time high. Surveys indicated the population declined over 40%, to 131 territories in the Valley. Similar levels of declines were noted elsewhere in the Southwest, suggesting a range-wide decline. Such a decline may have been due, at least in part, to a continuation of the severe drought begun in 1999. The total amount of precipitation that fell at Cliff, NM, between September of 1999 and May of 2000 was 2.88 inches, or only 34% of the norm for that period. The drought impacted the river levels, ditch flows, soil moisture, and vegetation. The drought was not confined to the Southwestern United States, but extended south through most of the flycatchers' winter range as well.

Despite the decline in population, flycatchers in the Cliff-Gila Valley had a tremendous year for reproduction. They achieved their highest rates of nesting success in 2000 in the four years of monitoring – overall, 67% of nests fledged one or more young. Cowbird parasitism reached its lowest level as well (11.5%). In addition, clutch sizes, in those nests where it could be determined, were larger than normal, with most first clutches having four eggs. Many pairs had second broods. We suggest that because of the low population numbers, most flycatchers were able to occupy the highest quality territories, which contributed to the high overall breeding success. Perhaps related to this explanation is the fact that a higher than normal percentage of nests was placed in box elder, the preferred nesting substrate in this population.

In 2000, we began in-depth analyses of patch and landscape-level effects (including land use) on flycatcher occurrence, nesting success, and cowbird parasitism. Results emphasized the importance of box elder to this population. The proportion of trees within a patch that were box elder had significant positive effects on the occurrence and density of flycatchers within patches. Further, the higher the proportion of box elder in a patch, the lower the average parasitism rate with the patch. Patch size, which has been demonstrated to have very profound effects on eastern forest birds, was positively correlated with patch occupancy – the larger the patch, the more likely that flycatchers bred in the patch – but also positively correlated with brood parasitism. Average rates of nest success within a patch were related to the maturity and density of its riparian woodlands. Although grazing has been labeled as a major causal factor for the decline and endangerment of the southwestern Willow Flycatcher, we found no significant negative impact of grazing on flycatcher nest success or brood parasitism in this system. In fact, patches that were grazed had a higher likelihood of patch occupancy and higher densities of flycatchers than ungrazed patches.

INTRODUCTION

In the past decade, avian ecologists increasingly have focused on ecosystem processes and patterns at spatial scales larger than the nest site or territory, such as the patch or landscape scale (Freemark et al. 1995). In particular, declines in Neotropical bird species have been linked to changes in landscape characteristics (Robinson et al. 1995, Askins 1995). Almost all of this work has been conducted in the eastern half of North America, where a majority of the avifauna is adapted to forest interior conditions. There, forest fragmentation has caused these forest interior bird species to increasingly overlap with predators and brood parasites typical of open areas and edges, often with disastrous consequences (Paton 1994, Danielson et al. 1997). This is the so-called edge effect. Moreover, these effects decrease with distance from edge, such that larger patches provide better habitat than smaller ones.

In contrast, in the western parts of North America, contiguous closed-canopy forest is uncommon, being found primarily in high-elevation montane areas. Much of the region supports non-forested habitats such as grasslands, shrublands, and desert. Within these non-forested habitats, riparian systems occur as narrow, linear corridors of close-canopied woodland, which support a rich and distinct avian community (Knopf et al. 1988). In the Southwest, riparian ecosystems have been severely degraded and fragmented by as much as 90% (Knopf et al. 1988). However, these riparian systems are highly dynamic in nature, resulting in a natural pattern of fragmentation (Szaro 1989). It remains unknown if the negative impacts of forest fragmentation and edge effects so well documented in the East are equally prevalent in these lower-elevation western habitats. One study in Montana suggests not (Tewksbury et al. 1998).

The Southwestern race of the Willow Flycatcher (*Empidonax traillii extimus*) is a critically endangered Neotropical migrant bird that breeds exclusively in densely vegetated riparian areas in the region. Approximately 600 pairs were known to exist in 1999, with more than a third of those in the upper Gila River Valley in New Mexico (Marshall 2000). It is currently considered the top priority species for US Fish and Wildlife Service Region 2. Within its range, many apparently suitable habitat patches (based on vegetation composition and structure) remain unoccupied. Among occupied patches, rates of nesting success and cowbird parasitism vary greatly. While several studies have now examined nesting success, parasitism, and microhabitat preferences within a single site (e.g., Sogge et al. 1997a, Stoleson and Finch 1999a, Paradzick et al. 2000), none has addressed landscape-level effects on habitat occupation and nesting success. Such landscape-level effects on the flycatcher have been identified as a top research priority (Stoleson et al. 2000).

The Cliff-Gila Valley population. -- By far the largest known breeding concentration of Southwestern Willow Flycatchers is located in the Cliff-Gila Valley, Grant County, New Mexico. This population was estimated at 243 pairs in 1999 (P. Boucher, personal communication), and had increased every year since surveys began in 1994. These birds are located primarily on private property owned by the Pacific Western Land Company, a subsidiary of Phelps Dodge Corporation, and managed by the U Bar Ranch. Additional pairs occur on the adjacent Gila National Forest and other private holdings. Habitat preferences of flycatchers in this population differ, at least superficially, from those reported elsewhere (Hull and Parker 1995, Skaggs 1996, Stoleson and Finch 1999b), and from populations of other subspecies.

Objectives

Our goals for this study in 2000 were:

1. survey for flycatchers following standardized protocols to estimate population sizes in the Cliff-Gila Valley.
2. locate and monitor nests of Willow Flycatchers to assess levels of nesting success, cowbird parasitism and predation.
3. characterize and quantify vegetation at nests sites, territories, and unused sites within occupied habitat patches.
4. band adult and nestling Willow Flycatchers to allow individual identification.

This report presents the results of the fourth year of the study.

Methods

Study area. — The Cliff-Gila Valley of Grant County, NM, comprises a broad floodplain of the Gila River, beginning near its confluence with Mogollon Creek and extending south-southwest toward the Burro Mountains. The study was primarily conducted from just below the US Route 180 bridge upstream to the north end of the U-Bar Ranch (approximately 5 km). In addition, flycatchers were studied in two disjunct sections of the valley: (1) the Fort West Ditch site of the Gila National Forest and adjacent holdings of The Nature Conservancy's Gila Riparian Preserve, located about 9 km upstream of the Route 180 bridge, and (2) the Gila Bird Area, a riparian restoration project comprising lands of the Gila National Forest and Pacific-Western Land Company, located some 8 km downstream of the Route 180 bridge. Most of the Cliff-Gila Valley consists of irrigated and non-irrigated pastures used for livestock production and hay farming. Elevations range from 1350 to 1420 m.

The Gila River and nearby earthen irrigation ditches are lined with riparian woodland patches of various ages and composition. Most patches support a mature woodland (>25 m canopy) of Fremont cottonwood (*Populus fremontii*), with a subcanopy of mixed deciduous trees including box elder (*Acer negundo*), Goodding's willow *(Salix gooddingii*), velvet ash (*Fraxinus velutinus*), Arizona walnut (*Juglans major*), Arizona sycamore (*Platanus wrightii*), Arizona alder (*Alnus oblongifolia*) and Russian olive (*Elaeagnus angustifolia*). The understory is composed of shrubs including three-leaf sumac (*Rhus trilobata*), false indigo (*Amorpha fruticosa*), New Mexico olive *(Forestieria neomexicana*), forbs, and grasses. Fewer patches support a shrubby, early successional growth of seepwillow (*Baccharis glutinosa*), coyote and bluestem willows (*Salix exigua* and *S. irrorata*), and saplings of the species mentioned above. Most habitat patches are less than 5 ha in area. The FS Fort West Ditch site and the Gila Bird Area are generally more open than patches on the U-Bar. In addition to the primary patches of riparian woodland along the Gila itself, numerous stringers of riparian vegetation extend along many of the earthen irrigation ditches. These stringers contain the same plant species as larger forest patches, but rarely exceed 10 m in width.

Surveys. – All riparian habitats within each site were surveyed systematically for Willow Flycatchers using standardized survey techniques developed by the USFWS (Sogge et al. 1997a). Three surveys were conducted at each site during the periods of 15-30 May, 1-21 June, 22 June-15 July. Survey procedures entailed two observers walking through or adjacent to riparian habitat on clear, calm days between dawn and noon. Recordings of Willow Flycatcher vocalizations were played periodically to elicit responses from territorial birds. We recorded data on numbers of flycatchers, evidence of breeding by flycatchers, and presence of brown-headed cowbirds. All personnel of the Rocky Mountain Research Station held valid state and federal permits required for surveying and monitoring Southwestern Willow Flycatchers, and attended a mandatory survey protocol training session before initiating fieldwork.

Nest monitoring. – We searched for nests of Willow Flycatchers and other species on a daily basis. Nests were monitored every 3-7 days, following a modified (less-intrusive) version of protocols proposed by the Arizona Game and Fish Department (Rourke et al. 1999). Nest contents were observed using pole-mounted mirrors or videocameras, or 15X spotting scopes. Nests that were abandoned or destroyed were examined for evidence (e.g., cowbird eggs, mammal hairs) to ascertain causes of nest failure. We considered a nest successful if: (1) parent birds were observed feeding one or more fledged young; (2) parent birds behaved as if dependent young were nearby when the nest was empty (defensive or agitated behavior near nest); or (3) nestlings were in the nest within one or two days of the estimated fledge date. We considered a nest failed if: (1) nest contents disappeared before fledging of young was possible, assuming 10-12 d required for fledging (depredation), (2) the nest contained no Willow Flycatcher young but contained cowbird eggs or chicks (parasitized), (3) the nest was deserted after eggs had been laid (desertion), or (4) the nest was abandoned prior to egg laying (abandonment).

Vegetation and landscape measurements. – We identified and included in our analyses 39 discrete woodland patches in the Cliff-Gila Valley. We limited our focus to those patches that might be considered potential flycatcher habitat according to published descriptions (Stoleson and Finch 1999a, b; Sogge and Marshall 2000). Patches included were (1) well within the floodplain and so mesic enough to qualify as habitat, (2) wide enough (>10 m average width), and (3) of sufficient age and stature to provide adequate structure. We did not include any of the numerous very small (< 0.3 ha) patches or young regeneration of coyote willow and seepwillow, as flycatchers in this area do not appear to use them regardless of landscape features (Stoleson and Finch, unpublished data).

Within each patch, vegetation was sampled systematically starting from a randomly chosen point, using a modified BBIRD methodology (Martin et al. 1997). Sampling points were established spaced 50 to 100 m apart and at least 10 m from habitat edges. The number of sample points per patch varied with patch size and shape. Vegetation characteristics measured at each point included stem counts for trees (within 8 m of point) and shrubs (within 4 m of point) by size class and species; basal area by species; average canopy height, and canopy cover. Canopy cover was measured using hemispherical densiometers; sample point values were the average measurements at the sample point and at 4 and 8 m in reach of the cardinal directions from the sample point. Canopy heights were measured using hand-held clinometers. For each vegetation variable, we calculated patch averages and standard deviations (as a measure of homogeneity within patches).

Locations and dimensions of riparian patches were calculated using a combination of GPS (Global Positioning System) measurements and photointerpretation of digitized aerial photos provided by the Gila National Forest. This area turned out to be one of the very few remaining in the country without registered digital orthoquads yet available; therefore, we were obliged to acquire basic spatial data in the field. For each riparian patch, we determined patch area (ha), average and minimum patch width (m), patch length (m; parallel to river course), proximity to water (m), proximity to river (m), proximity to nearest patch (m), proximity to nearest occupied patch (m), proximity to nearest roads (m), width of floodplain (m, perpendicular to river course), and proximity to nearest upland. From these values, we calculated ratios of length to width, and perimeter to area, as measures of proportion of edge (Freemark et al. 1995). Because of the controversy and lack of objective information on the impacts of grazing on Willow Flycatchers, we attempted to assess such impacts, if any, at the landscape and patch level in the Gila Valley. We determined the grazing status of each patch, which was entered into analyses as a categorical variable (grazed vs. ungrazed). Numerical variables used in subsequent analyses are listed in Table 1.

Analyses

We used nesting data from 1997-2000 to calculate patch-wise averages of flycatcher nesting success and rates of cowbird parasitism. Flycatcher population levels fluctuated among years, but proportions of the total found within each patch remained approximately constant each year. For analyses, we therefore used density estimates based on 1999 data only, as data from 2000 had not yet been collated. All means are reported $\pm$ standard deviations.

Correlates of patch occupancy. – To assess landscape correlates of patch occupancy, we first compared occupied and unoccupied patches for each numerical variable using univariate t-tests. We included all numerical and categorical landscape variables that differed significantly (at $p < 0.10$) between occupied and unoccupied patches in a step-wise logistic regression using patch occupancy (occupied vs. unoccupied) as the dependent variable (Trexler and Travis 1993). We used a value of $p \leq 0.05$ to enter and 0.10 to remove individual variables from the model. We chose the most parsimonious among models with equal numbers of parameters using Akaike's Information Criterion (AIC), and we used Likelihood-ratio Chi-square to test for significant effects between nested logistic regression models (Anderson et al. 2000).

Correlates of flycatcher density, nest success, and brood parasitism. – We determined the correlation of each numerical landscape variable to the target variable using bivariate linear regressions. All numerical landscape variables that differed significantly (at $p < 0.10$) were included in a step-wise multiple regression, using $p \leq 0.05$ to enter and 0.10 to remove. We also compared the means of target variables between grazed and ungrazed patches using t-tests to assess any impacts of grazing as practiced at this site. We tested whether nest success and brood parasitism were density dependent by regressing the target variable against population density within a patch.

Table 1. Numerical landscape and habitat variables used in analyses

VARIABLE	DESCRIPTION
Patch size/shape	
AREA	Total area of patch, in hectares
LENGTH	Length of patch along axis parallel to river, in meters
AVEWIDTH	Average width of patch along axis perpendicular to river, in meters
LENGTH/WIDTH	Ratio of patch length to width
PERIMETER/AREA	Ratio of patch perimeter to area
Patch vegetation characteristics	
CANCVRave	Average % canopy cover in patch
CANCVRsd	Standard deviation of % canopy cover among sample points in patch
CANHTave	Average canopy height in patch, in meters
CANHTsd	Standard deviation of canopy heights among sample points in patch
SHRUBave	Average number of stems of shrubs and saplings per sample point
SHRUBsd	Standard deviation of shrub counts among sample points in patch
TREESave	Average number of stems of trees ($\geq$10 cm dia.) per sample point
TREESsd	Standard deviation of tree counts among sample points in patch
Stems10-30	Average count of trees in 10 – 30 cm dia. size class per sample point
Stems30-50	Average count of trees in 30 – 50 cm dia. size class per sample point
Stems50-70	Average count of trees in 50 – 70 cm dia. size class per sample point
Stems70+	Average count of trees in 70+ cm dia. size class per sample point
%BOX	Percentage of woody stems in patch that are boxelder (*Acer negundo*)
%SALIX	Percentage of woody stems in patch that are willow (*Salix* spp.)
BASALAREAave	Average estimated basal area per sample point, in square meters
BASALAREAsd	Standard deviation of est. basal area among sample points in patch
Patch position in landscape	
DistH20	Minimum distance to nearest water of any type, in meters
DistRIVER	Minimum distance to surface water of Gila River, in meters
DistNEAREST	Minimum distance to next nearest patch, in meters
DistOCCUP	Minimum distance to nearest patch occupied by flycatchers, in meters
FLOODPLAIN	Distance across floodplain perpendicular to flow of river, as measured at midpoint of patch, in meters
UPLAND	Minimum distance to closest upland/floodplain interface, in meters
DistROAD	Minimum distance to nearest road, in meters

RESULTS

Climate in 2000. – The drought that impacted the Cliff-Gila Valley in 1999 continued through the entire 2000 field season. The annual rainfall total for 1999 as measured in Cliff, NM, was 10.75 inches – only 74% of normal. However, the drought worsened after the 1999 field season. The total amount of precipitation that fell from the time the flycatchers left for their wintering grounds (1 Sept., 1999) until they returned to set up territories (1 June, 2000) was 2.88 inches, or only 34% of the norm for that period (ave. = 8.46 in). Thus, the Cliff-Gila Valley was extremely dry when the flycatchers returned to set up territories in late May. Water in the irrigation ditches was low, intermittent, or nonexistent. In the upper parts of the Valley (Fort West Ditch area), many of the cottonwoods and willows dropped their leaves, and some trees died. Rainfall only approached or exceeded normal levels after the birds had left in the fall (Table 2).

Table 2. Precipitation at Cliff, New Mexico, for 1999, 2000, and annual averages for 1936-1999. Data from the Western Regional Climate Center (2000).

	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	TOTAL
1999 precip.	0.11	0	0.35	0.39	0.08	0.93	5.09	1.88	1.85	0	0	0.07	10.75
2000 precip.	0.06	0.07	0.8	0.03	0	2.19	1.63	2.54	0.04	3.20	2.14	0.18	12.88
Average (1936-99).	1.00	0.94	0.86	0.33	0.35	0.53	2.77	2.84	1.65	1.28	0.71	1.16	14.52
2000: % of normal	6.0	7.4	93.0	9.1	0.0	413	58.8	89.4	2.4	250	371	15.6	88.7
2000: cumulative (in.) deviation from norm since Jan '99	-4.6	-5.5	-5.5	-5.8	-6.2	-4.5	-5.7	-6.0	-7.6	-5.7	-4.3	-5.3	

This extended drought was not confined to southwestern New Mexico, or even the southwestern United States. During the period 1999 – summer 2000, precipitation was well below normal throughout the Pacific slope of Mexico and Central America, at least as far south as Costa Rica. For example, precipitation at the northern end of the flycatchers' wintering grounds in Guerrero, Mexico, was 44% below normal for the period Jan. – Aug. of 2000 (SNM 2000; Fig. 1). For the same period, precipitation at Liberia, Costa Rica, in the center of the wintering grounds, was 35% below normal levels (INM 2000). Thus, it appears that the entire subspecies was subject to extensive drought on both the breeding and wintering grounds in 1999-2000.

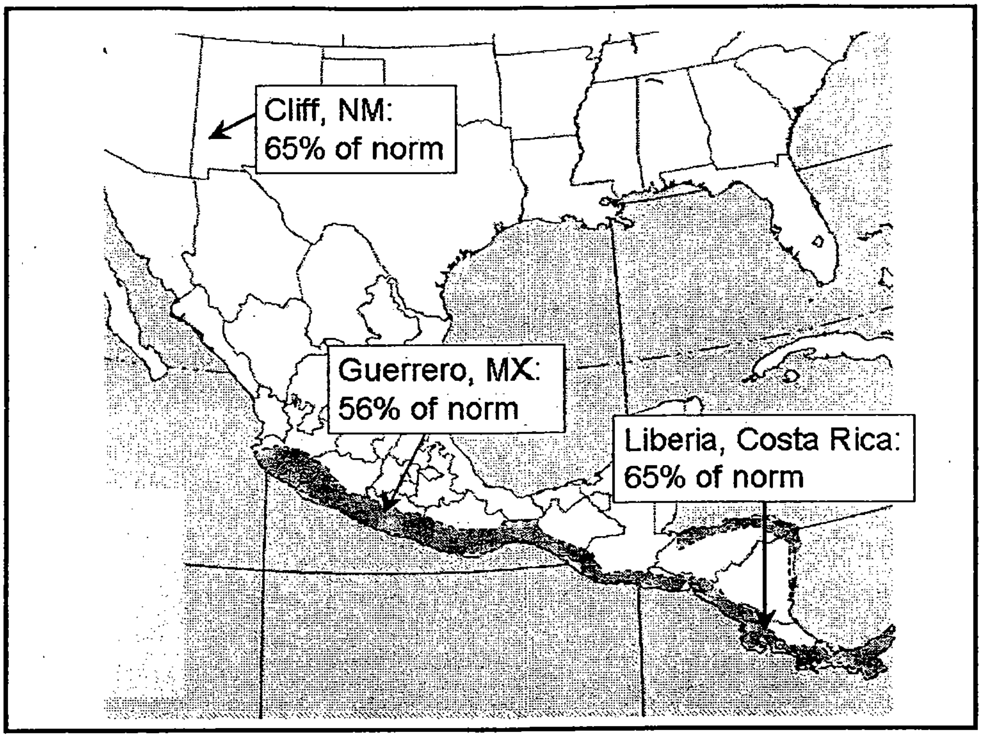

Figure 1. Proportion of normal precipitation from Jan. to Aug. 2000 at Willow Flycatcher breeding grounds (Cliff) and two sites on the wintering grounds, showing the wide area affected by drought. Shaded area indicates flycatcher wintering areas (from Howell & Webb 1997). Cliff climate data from WRCC 2000.

Willow Flycatcher population surveys. – The population of Willow Flycatchers in the Cliff-Gila Valley declined substantially in 2000, from an estimated 243 pairs in 1999 to 139 pairs (Fig. 2). This represents a drop of 43%. On the U Bar Ranch itself, the numbers declined from 209 to 121 pairs, a decrease of 42% (Appendix). The birds appeared to have left the more peripheral and marginal areas of the valley, but remained relatively common in the core areas of prime habitat.

Oddly, in 2000, we noted the first instance of flycatchers occupying a patch we refer to here as SW Crescent – a small crescent-shaped patch of young regeneration just northwest of the Rt. 180 bridge. This patch has been surveyed every year since 1997, but has not been included in reports because no flycatchers had ever been detected. This colonization suggests that birds probably shifted around within the valley in 2000. Flycatcher numbers declined greatly in some patches dependent on irrigation ditches for water. For example, on the SW Stringer, we found 3 pairs plus two apparently single males in 2000, compared to 14 pairs in 1999. In contrast, other more low-lying patches (such as SE4) had their highest numbers ever in 2000 (6 pairs vs. 3-5 in previous years). Declines upstream on the Fort West Ditch and TNC properties were even more marked than on the U Bar Ranch.

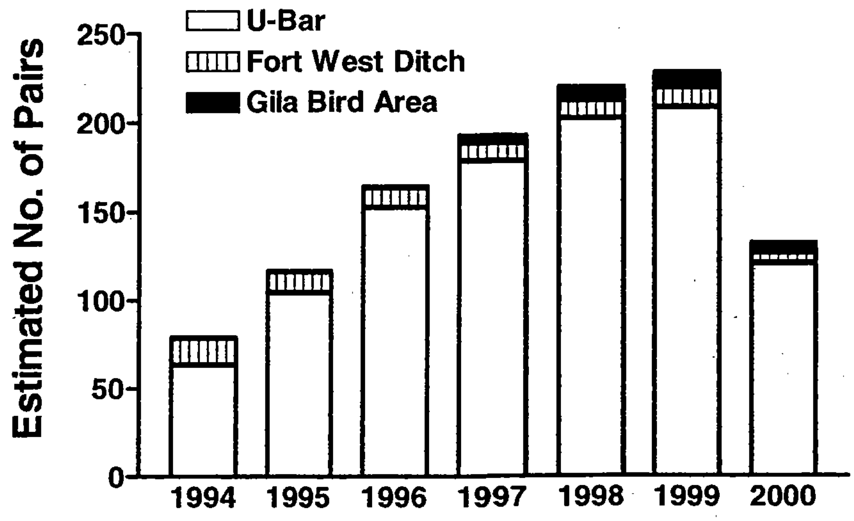

Figure 2. Population estimates of Willow Flycatchers in the Cliff-Gila Valley, 1994-2000.

Flycatcher nests. – We located 85 Willow Flycatcher nests in 2000. Of these, 71 (84%) were placed in box elder – a somewhat higher percentage than the 70% to 75% found in box elder in all previous years. A much lower percentage was found in willows (*n* = 3, or 3.5%) compared to previous years (average of 11.9%, *n* = 48). Relatively few were found in other tree species (Table 3). This concentration in box elder, the favorite nesting substrate, again suggests the flycatchers retreated to preferred areas in this very dry year.

As in previous years, Willow Flycatchers nested high in the Cliff-Gila Valley. Nest heights ranged from 1.8 to 24.1 m in height, with a mean height of 7.8 ± 3.5 m (Table 3). Trees and shrubs in which flycatchers built nests averaged 13.7 ± 4.9 m, and ranged from 2.7 to 30.1 m high. As with height, nest trees varied greatly in diameter, from 1.2 cm in alder to a huge 142.5 cm cottonwood (mean = 24.5 ± 19.8 cm). The nest located in that large cottonwood represents a new record for nest height for the species (24.1 m = 78.3 ft).

Table 3. Nest substrates, nest heights, and comparative nest success by substrate (based on nests of known outcome) for Willow Flycatcher nests in the Cliff-Gila Valley, 2000.

Nest Substrate	N	Mean nest ht. (m)	Range nest ht. (m)	% successful (N)
Box elder	71	8.2 ± 3.1	1.8 – 16.0	69% (52)
Fremont cottonwood	5	9.8 ± 7.7	4.0 – 24.1	100% (3)
Goodding's willow	3	4.0 ± 1.0	3.3 – 5.5	0% (3)
Russian olive	2	4.9	3.8 – 6.0	50% (2)
Arizona alder	2	2.7	2.3 – 3.0	0% (2)
Saltcedar	2	3.0	2.8 – 3.1	100% (2)

Willow Flycatcher nest success. – Despite the decline in population, flycatchers in the Cliff-Gila Valley enjoyed very high rates of nesting success in 2000. Overall, 67% of nests fledged one or more young – this is one of the highest rates of nest success recorded for this species; other sites with >60% nest success have had extensive cowbird trapping and other forms of intensive management (e.g., San Luis Rey, CA). Simple nest success gives only a partial picture of the breeding effort, though. Many pairs raised a second brood after successfully fledging their first. Clutch sizes appeared to be larger than in prior years, with most first nests containing four eggs (vs. a mean of 3.2 in prior years). One pair also had a second clutch of four eggs, and successfully raised a total of eight young from their two nests (in saltcedar). In addition to the 85 nests that were found, we found fledglings being fed in four territories where no nest was found. A minimum of 65 fledglings was produced from flycatcher nests on the U Bar, although the actual number was probably two or more times that amount.

As in previous years, the likelihood of a nest being successful appeared to vary among nest tree species, although small sample sizes for most species preclude statistical analysis. Nests in box elder were slightly more likely to be successful than average (Table 3). All nests in cottonwood and saltcedar fledged young, while no nest in willow or alder fledged any young in 2000.

Causes of nest failure. – Of the 21 nests known to have failed, eight failed due to unknown causes (although these were probably depredated). One failed due to weather (blown out of tree during a storm). The remainder failed due to predators ($n = 4$), abandonment ($n = 4$), or cowbird parasitism ($n = 4$). One nest in alder was parasitized by cowbirds, but was lost to a predator before the cowbird egg had hatched.

Cowbird parasitism. – Of 52 nests for which parasitism status was known, we found six flycatcher nests that had been parasitized by Brown-headed Cowbirds (11.5%). In at least one of those, the cowbird egg failed to hatch and flycatcher young were successfully produced. Unlike previous years, we found no cowbird fledgling being fed for which no nest was ever found. This is by far the lowest level of parasitism we have recorded in four years of study, and may be related to the suggestion that flycatchers nested primarily in optimal areas this year.

Landscape-Level Analyses

Patch descriptions. – We included 39 woodland patches in landscape analyses, which ranged from 0.38 to 11.8 ha in size. Most of the patches were located on the U Bar Ranch; many of these patches had cattle excluded by fences. Overall, 18 of 39 patches were grazed, primarily in fall and winter only. Of the 39 study patches, 27 supported breeding Willow Flycatchers in 1999. Flycatcher densities varied greatly among occupied patches, and ranged from 0.25 to 10.3 pairs/ha. Average nest success within patches (from nests monitored 1997- 2000) also varied greatly, from 0% to 100% successful (mean = 0.51 ± 0.24, $n = 392$ nests of known outcome). Brood parasitism within occupied patches varied from 0% to 100%, with a mean of $19.9 \pm 29.9\%$ ($n = 222$ nests of known parasitism status). Patches with very high or very low rates for either parameter had very small sample sizes (< 5) of flycatcher nests.

Landscape Correlates of Flycatcher Occupancy

Land use. – We found no evidence that grazing within a patch discouraged flycatchers from occupying that patch. In fact, flycatchers were found in a significantly greater portion of the grazed patches than the ungrazed patches (87.5 vs. 52.4%, respectively; $\chi^2 = 6.5$, df = 1, p = 0.011).

Univariate regressions. – We compared each landscape variable between patches that were occupied and those that were unoccupied by Willow Flycatchers. Six variables differed significantly ($p \leq 0.05$) between occupied and unoccupied patches (Table 4). Patches with flycatchers averaged larger in area, greater in length, had lower variation in the numbers of shrubs, a higher percentage of box elder, were closer to water, and closer to the next nearest

Table 4. Comparisons of landscape variables between patches occupied (n = 27) and not occupied (n = 12) by Willow Flycatchers. Significant p values (≤ 0.05) are indicated in bold.

	Mean ± SD				
Variable	occupied	unoccupied	t	df	p
AREA (ha)	4.30 ± 2.77	2.07 ± 1.36	-3.38	36.5	**0.002**
LENGTH (m)	507.71 ± 300.17	346.52 ± 134.49	-2.32	36.97	**0.026**
AVEWIDTH (m)	75.08 ± 43.34	70.39 ± 35.90	-0.33	37	0.75
LENGTH/WIDTH	8.16 ± 6.27	5.62 ± 2.43	-1.82	36.64	0.077
PERIMETER/AREA	355.41 ± 224.32	501.91 ± 220.91	1.77	35	0.085
CANCVRave (%)	83.59 ± 8.99	77.13 ± 19.20	-0.97	9.25	0.36
CANCVRsd	8.56 ± 3.89	14.32 ± 12.43	1.37	8.57	0.21
CANHTave (m)	14.98 ± 4.71	15.22 ± 7.58	0.12	36	0.91
CANHTsd	6.13 ± 3.06	5.05 ± 2.66	-0.94	32	0.35
SHRUBave (count)	28.30 ± 12.93	29.53 ± 17.60	0.24	36	0.81
SHRUBsd	14.57 ± 5.92	20.34 ± 5.47	2.56	32	**0.016**
TREESave (count)	10.02 ± 4.72	12.22 ± 7.85	1.01	33	0.32
TREESsd	5.22 ± 2.85	5.83 ± 3.78	0.50	32	0.62
Stems10-30 (count)	8.25 ± 4.80	10.19 ± 7.69	0.89	33	0.41
Stems30-50 (count)	0.97 ± 0.55	1.21 ± 1.14	0.60	9.31	0.56
Stems50-70 (count)	0.30 ± 0.30	0.39 ± 0.60	0.44	9.41	0.67
Stems70+ (count)	0.49 ± 0.58	0.43 ± 0.69	-0.27	33	0.79
%BOX	41.47 ± 28.67	8.87 ± 17.06	-4.41	33.57	**>0.001**
%SALIX	24.75 ± 21.83	40.31 ± 25.19	1.96	37	0.058
BASALAREAave (m^2)	418.37 ± 169.41	494.04 ± 275.98	0.77	10.17	0.46
BASALAREAsd	224.13 ± 119.13	237.76 ± 97.91	0.31	32	0.76
DistH20 (m)	3.74 ± 8.57	26.11 ± 33.58	2.28	11.64	**0.043**
DistRIVER (m)	64.24 ± 103.12	41.62 ± 42.82	-0.97	36.94	0.34
DistNEAREST (m)	174.57 ± 223.50	332.09 ± 221.62	2.04	37	**0.049**
DistOCCUP (m)	323.76 ± 660.96	792.73 ± 1121.34	1.64	37	0.110
FLOODPLAIN (m)	4256.43 ± 1764.87	3003.07 ± 1873.63	-2.01	37	0.052
UPLAND (m)	1160.12 ± 797.67	896.28 ± 805.90	-0.95	37	0.348
DistROAD (m)	1212.50 ± 740.26	1149.81 ± 876.80	-0.23	37	0.819

patch, than were patches without flycatchers. An additional four variables showed trends towards differences between the two patch types ($0.05 < p \leq 0.10$). Occupied patches tended to have a greater length-to-width ratio and a lower perimeter-to-area ratio, a *lower* percentage of woody stems that were willow, and a broader floodplain than unoccupied patches.

Logistic regression model. – We used six of the variables found to have significant or near-significant differences above in a logistic regression analysis. Since all of the variables describing patch size or shape were highly correlated with each other (all $r > 0.5$, $p < 0.05$), we used only AREA, with the greatest *p*-value, in our analysis to avoid problems associated with collinearity of variables.

The best logistic regression model, as determined by AIC, identified three variables as significant predictors of patch occupancy by Willow Flycatchers. These variables were percent of stems that were box elder (%BOX), the distance to the nearest patch (DistNEAREST), and the standard deviation of shrub counts (SHRUBsd). This model successfully classified 96.0% of occupied patches, 77.8% of unoccupied patches, and 91.2% of patches overall. The beta coefficients indicate that patches were increasingly more likely to be occupied with (1) increasing proportion of box elder, (2) decreasing distance to nearest patch, and (3) decreasing variation in the number of shrubs among points within the patch (Table 5).

Table 5. Landscape variables found to be significant ($p < 0.10$) predictors of patch occupancy by Southwestern Willow Flycatchers, based on a stepwise logistic regression.

Variable	β coefficient	S.E.	Wald χ^2	df	*p*
%BOX	0.211	0.123	2.951	1	0.086
DistNEAREST	-0.016	0.010	2.635	1	0.105
SHRUBSsd	-0.496	0.259	3.674	1	0.055
CONSTANT	9.190	4.558	4.066	1	0.044

Landscape Correlates of Flycatcher Density

Land use. – Grazing appeared to have a significant effect on flycatcher densities. Grazed patches supported significantly higher densities (2.51 ± 2.70 pairs/ ha) than did ungrazed patches (0.98 ± 1.94 pairs/ha; $t = 2.05$, df = 37, $p = 0.047$).

Bivariate correlations. – We found only one landscape variable, percent of box elder, was significantly correlated with flycatcher density. The density of flycatchers increased with increasing percentage of box elder within patches. A second variable, width of floodplain, showed a nearly significant positive correlation with density, suggesting that the broader the floodplain, the higher the density of flycatchers.

Mutiple regression analysis. – The stepwise multiple regression analysis also revealed only box elder to be a significant predictor of flycatcher density; density increased with increasing percentage of box elder ($r^2 = 0.14$, $F_{1,29} = 4.85$, $p = 0.036$). As indicated by the r^2 value, this variable explained less than 15% of the variation in density among patches. There seemed to be no significant interaction effects in this data set.

Landscape Correlates of Flycatcher Nest Success

Population density. – Average rates of nest success within patches were not correlated with the density of flycatchers within those patches ($r^2 = 0.002$, $p = 0.84$). Thus, nest success does not appear to be density-dependent in this population.

Land use. – We found no detectable impact of grazing on flycatcher nest success. Occupied patches that were grazed ($n = 15$) had a similar overall rate of nest success (0.56) as patches that were excluded from grazing (0.45; $n = 12$; $t = -1.1$, df = 25, $p = 0.28$).

Bivariate correlations. – Six variables were significantly correlated with average patch-wise nest success. Average rates of nest success increased with decreasing variation in canopy cover, and with increasing average canopy cover, average canopy height, numbers of woody stems in the 30-50 cm DBH and 70+ cm DBH size classes, and with increasing distance from nearest occupied patch (Table 7). Two additional variables showed not-quite-significant trends: nest success increased with decreasing variation in tree counts, and with increasing percent of stems that were box elder.

Table 6. Bivariate correlations of landscape variables on average patch-wise density of Willow Flycatchers.

VARIABLE	Pearson *r*	*P*
AREA (ha)	0.023	0.89
LENGTH (m)	0.057	0.73
AVEWIDTH (m)	0.074	0.66
LENGTH/WIDTH	0.023	0.89
PERIMETER/AREA	0.010	0.95
CANCVRave (%)	0.069	0.69
CANCVRsd	0.093	0.60
CANHTave (m)	0.054	0.75
CANHTsd	0.098	0.58
SHRUBave (count)	0.11	0.52
SHRUBsd	0.089	0.62
TREESave (count)	0.16	0.37
TREESsd	0.092	0.61
Stems10-30 (count)	0.14	0.41
Stems30-50 (count)	0.042	0.81
Stems50-70 (count)	0.086	0.62
Stems70+ (count)	0.025	0.89
%BOX	0.44	**0.006**
%SALIX	0.19	0.24
BASALAREAave (m^2)	0.16	0.35
BASALAREAsd	0.13	0.48
DistH20 (m)	0.15	0.37
DistRIVER (m)	0.068	0.68
DistNEAREST (m)	0.25	0.12
DistOCCUP (m)	0.23	0.17
FLOODPLAIN (m)	0.28	0.080
UPLAND (m)	0.30	0.067
DistROAD (m)	0.071	0.67

Multiple regression analysis. – Five variables were found to be significant predictors of flycatcher nest success (Table 8). Oddly, only one variable identified as a significant predictor by the multiple regression analysis (CANCVRsd) showed a significant correlation with nest success in the univariate regression analyses. Nest success increased with increasing average basal area, and with decreasing width of floodplain, patch area, total number of stems in the 10-30 cm DBH size class, and variation in canopy cover. According to the multiple regression equation, these six variables explained 84% of the variation in nest success among patches ($r^2 = 0.84$, $F_{5,19} = 19.98$, $p < 0.001$).

Landscape Correlates of Brood Parasitism on Willow Flycatchers

Population density. – Average rates of brood parasitism within occupied patches were not correlated with the density of flycatchers within those patches ($r^2 = 0.002, p = 0.82$). Thus, brood parasitism does not appear to be density-dependent in this population.

Land use. – Brood parasitism within a patch was not significantly affected by grazing status of the patch. Average patch-wise parasitism rates did not differ between grazed (20.7 $\pm$ 29.3%) and ungrazed patches (18.8 + 31.9%; $t = 0.16$, df = 25, $p = 0.88$).

Bivariate correlations. – Two landscape variables related to patch dimensions were significantly and positively correlated with brood parasitism rates: patch area and average width (Table 9). The positive correlation coefficients indicate that with increasing patch size and width, brood parasitism rates increased. This result is opposite what would be expected if these riparian woodland patches showed an edge effect. An additional three variables showed not-quite-significant trends as well. Parasitism rates increased with the number of small stems (10-30cm DBH), but decreased with increasing stems in the 30-50 cm DBH size class and with the percentage of box elder.

Multiple regression analysis. – The average patch-wise rate of cowbird parasitism was best predicted by a single variable in a stepwise multiple regression analysis. The average parasitism rate decreased with increasing percentage of box elder ($r^2 = 0.21, F_{1,23} = 6.04, p = 0.022$). This model explained only about 20% of the variation in parasitism rates among patches.

Table 7. Bivariate correlations of landscape variables with average patch-wise nest success in Willow Flycatchers

VARIABLE	Pearson *r*	P
AREA (ha)	0.26	0.19
LENGTH (m)	0.18	0.36
AVEWIDTH (m)	0.17	0.41
LENGTH/WIDTH	0.10	0.61
PERIMETER/AREA	0.043	0.83
CANCVRave (%)	0.50	**0.010**
CANCVRsd	-0.56	**0.004**
CANHTave (m)	0.56	**0.003**
CANHTsd	0.33	0.10
SHRUBave (count)	0.27	0.19
SHRUBsd	0.28	0.18
TREESave (count)	0.059	0.78
TREESsd	-0.35	0.085
Stems10-30 (count)	-0.070	0.73
Stems30-50 (count)	0.46	**0.019**
Stems50-70 (count)	0.31	0.12
Stems70+ (count)	0.45	**0.023**
%BOX	0.37	0.057
%SALIX	-0.001	0.99
BASALAREAave (m^2)	0.28	0.17
BASALAREAsd	-0.031	0.89
DistH20 (m)	0.12	0.55
DistRIVER (m)	-0.22	0.27
DistNEAREST (m)	0.027	0.89
DistOCCUP (m)	0.39	**0.042**
FLOODPLAIN (m)	-0.062	0.76
UPLAND (m)	-0.062	0.76
DistROAD (m)	0.084	0.68

Table 8. Variables included in a linear stepwise multiple regression of landscape variables on Willow Flycatcher nest success.

Variable	Coefficient (β)	*t*	*p*
CANCOVRsd	-0.56	-5.46	<0.001
FLOODPLAIN	-0.50	-4.92	<0.001
AREA	-0.27	-2.83	0.011
TOT10-30	-0.15	-7.02	<0.001
ESTBAave	1.08	6.44	<0.001
CONSTANT	0.93	8.68	<0.001

Table 9. Bivariate correlations of landscape variables with average patch-wise rates of brood parasitism in Willow Flycatchers

VARIABLE	Pearson *r*	P
AREA (ha)	0.43	**0.027**
LENGTH (m)	0.14	0.49
AVEWIDTH (m)	0.41	**0.032**
LENGTH/WIDTH	-0.010	0.62
PERIMETER/AREA	0.021	0.92
CANCVRave (%)	-0.26	0.21
CANCVRsd	-0.11	0.61
CANHTave (m)	-0.30	0.14
CANHTsd	-0.24	0.24
SHRUBave (count)	0.14	0.50
SHRUBsd	-0.16	0.46
TREESave (count)	0.30	0.14
TREESsd	0.046	0.83
Stems10-30 (count)	0.38	0.053
Stems30-50 (count)	-0.36	0.069
Stems50-70 (count)	-0.31	0.12
Stems70+ (count)	-0.16	0.44
%BOX	-0.38	0.054
%SALIX	-0.13	0.54
BASALAREAave (m^2)	0.13	0.52
BASALAREAsd	-0.015	0.94
DistH20 (m)	0.12	0.54
DistRIVER (m)	0.11	0.60
DistNEAREST (m)	0.014	0.94
DistOCCUP (m)	-0.15	0.45
FLOODPLAIN (m)	0.11	0.59
UPLAND (m)	0.13	0.53
DistROAD (m)	0.037	0.85

DISCUSSION

The year 2000 was an odd one for Willow Flycatchers in the Cliff-Gila Valley. The population appeared to have dropped substantially in size, yet reproductive output was at an all-time high. The decline in population was likely due to the continued severe drought, not just in southwestern New Mexico, but extending south to the birds' wintering grounds in western Central America. It is noteworthy that population declines of approximately 40% were also reported from both the Kern River Preserve and Camp Pendleton in California (M. Whitfield, personal communication). This suggests a possible range-wide decline in numbers. It appears that populations of the entire subspecies may have been reduced because of extensive and prolonged drought on both the breeding and wintering grounds. Alternatively, populations may not have changed in size, but rather some birds might have never returned to their breeding grounds in 2000 because of drought-induced food shortages. No data exist to support this idea directly, although a study in Costa Rica during the winter and spring of 1999/2000 found most birds still present on territory in early May of 2000 (Koronkiewicz and Sogge 2000), at the same time that some birds had already arrived on the breeding grounds on the U-Bar (pers. observ).

In general, populations tend to expand into new areas when they are increasing, and often contract spatially when declining (Caughley 1977). In the Cliff-Gila Valley in 2000, we witnessed local contraction away from the peripheries of the population. Relatively fewer birds than in previous years nested in edge areas with willow, younger habitats, or along narrow stringers of vegetation. Most birds were concentrated in dense box elder stands, as reflected by the proportion of nests placed in that species.

The higher nest success we observed in 2000 may be an artifact of this apparent contraction. The birds nesting in these highest-quality areas may experience high nest success every year. In prior years, additional birds inhabiting marginal areas may have experienced poor nest success, thus diminishing the overall average success rate. Nest success has shown a strong and significant negative correlation with population size in the Cliff-Gila Valley from 1997 to 2000 (Fig. 3), which would lend credence to this hypothesis. Alternatively, some other density dependent factor may have influenced nest success, though what that factor may have been is unclear.

Factors affecting patch occupancy and flycatcher density. – Within the Cliff-Gila valley, habitat patches exhibited a range in density of Willow Flycatchers, including numerous patches with no birds at all. At a basic level, the birds occupied only the more mature, taller, and more structurally complex patches. We ignored the younger, simpler patches in our analyses. Among those older, more complex patches, flycatchers showed distinct preferences for larger, longer patches with a higher proportion of box elder, relatively lower variation in the density of shrubs, and those closer to water and to the next nearest patch. Most of these variables are partially correlated with each other. For example, box elder tends to be more frequent in patches closer to water. In part because of these correlations, a logistic regression model identified only three variables as significant predictors of patch occupancy: box elder, distance to the next nearest patch, and variation in shrubs. The model successfully categorized a higher percentage of occupied (96%) than unoccupied patches (78%). This may reflect the fact that occupied patches varied less in the various measurements than did unoccupied patches. It may also mean that some unoccupied patches (those incorrectly categorized as occupied) are in fact suitable for flycatchers, but have not yet been colonized. Thus, the area may not be fully saturated with flycatchers yet.

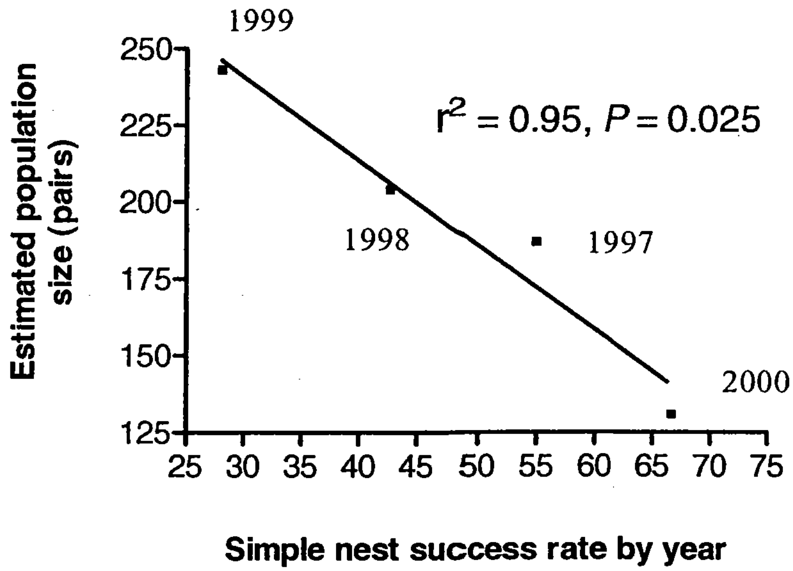

Figure 3. Flycatcher nest success has been strongly and negatively correlated with population size.

Previous studies of this population of flycatchers have shown that box elder is strongly preferred for nesting (Stoleson and Finch 1999a, b). Therefore, it seems logical that patches with an abundance of the preferred nesting tree would be more likely to have flycatchers than those without. The second variable, distance to nearest patch, suggests that flycatchers are more likely to colonize and occupy habitat patches that are near other habitat patches rather than isolated. Perhaps the likelihood of flycatchers dispersing among patches decreases with distance between patches, as has been shown with other birds (Greenwood and Harvey 1982). Finally, although occupied and unoccupied patches did not differ significantly in the average number of shrubs per sample point (Table 4), occupied patches had considerably less variation within the patch. This suggests that Willow Flycatchers tended to avoid the extremes of very dense undergrowth and very open understory. Although often thought of as a shrub-inhabiting bird, the flycatcher's weak feet and short legs make it unsuitable for hopping through dense thickets. At the other extreme, very open understories may provide inadequate cover from predators or substrates for insect prey.

Not only was the proportion of box elder a significant predictor of patch occupancy, but also it was the sole variable found to be significantly correlated with flycatcher density. This too can be attributed to the strong preference birds in this population show for nesting in box elder.

Factors affecting Willow Flycatcher nest success and brood parasitism. – Assessing correlates of nest success based on a per-patch average is necessarily a coarse-level analysis for a variety of reasons. Habitat within patches may vary, as may the ability for observers to locate and monitor flycatcher nests. Most nest failures in this population result from predation (Stoleson and Finch 1999a). Therefore, any factors we identify as significant correlates of nest success may in fact be irrelevant to the flycatcher itself, but instead may represent correlates of density of the particular suite of predators found at the site. However, even if that were the case, our findings remain relevant for at least this site.

We identified a variety of variables that were significantly associated with nest success in both bivariate and multiple regression analyses, although the two analyses found different sets of correlates (Tables 7 & 8). Generally, nest success tended to be higher in more mature patches: those with taller and more closed canopies, more trees in the larger size classes (and so higher basal area), and fewer trees in the smallest size class. Bivariate regressions suggested that nest success tended to increase with distance from the nearest occupied patch, though any biological explanation for such a relationship is unclear. As nearest occupied patch was not found to be a significant predictor of patch-wise nest success in the logistic regression analysis, its inclusion in the bivariate may be an artifact of this particular data set or completely spurious. Equally inexplicable was the inclusion in the logistic regression of both patch area and floodplain width, both negatively correlated with nest success. Perhaps larger patches, or patches in wider floodplains, were more likely to be used as hunting grounds for the major avian predators at the site (Cooper's Hawk *Accipiter cooperii*, and Common Raven *Corvus corax*). Further work is needed to verify and understand these relationships.

As with nest success, the patch-wise rates of brood parasitism were associated with different variables in the bivariate and multiple regression analyses. The bivariate analyses suggested that as patch width, and so area, increased, so did average parasitism rates. Why this might be so is unclear, as it seems contrary to patterns reported from fragmented forests in the Midwest and Eastern states (Robinson et al. 1995). One possible explanation is that like other flycatchers, Willow Flycatchers demonstrate conspecific attraction – that is, birds tend to be clumped in distribution across a landscape. Anecdotal information suggests that dispersing birds, especially young birds, are most likely to settle close to other flycatchers whenever possible, rather than cuing in to any particular aspect of the habitat itself (Muller et al. 1997). By doing so, larger clusters of flycatchers in larger patches are more likely to include many young, inexperienced birds occupying less suitable or marginal microhabitats within the patch. These inexperienced birds are most likely to be the ones parasitized or depredated. Such a pattern was documented in Hooded Warblers (*Wilsonia citrina*; Stutchbury 1997).

Based on the logistic regression analysis, box elder was the only significant predictor of patch-wise parasitism rates. With an increasing proportion of box elder, patch parasitism rates tend to decline. This result may help to explain why these flycatchers prefer box elder as a nesting tree. In previous analyses at the scale of nest site, we found that nests in box elder were much less likely to be parasitized than were nests in either willows or Russian olive, the next most frequent nesting substrates in this population (Stoleson and Finch in review).

Landscape-level processes in a linear riparian ecosystem. – Edge effects are best recognized at the scale of individual nests, rather than whole patch. However, as narrower patches have a greater portion of their area close to edges than do wider patches, any correlate of patch width could be considered an indication of an edge effect. Patch width was significantly correlated only with brood parasitism, and that was a positive correlation: the wider the patch, the higher the average parasitism rate. This contrasts with the predicted pattern if edge effects pertained to this system. In previous analyses at the nest site scale, we found no significant differences in distance to edge between successful and failed nests, or between parasitized and nonparasitized nests, supporting our finding reported here of no evidence for edge effects (Stoleson and Finch 1999a).

Evidence for patch size effects. – Although larger patches were more likely to be occupied by flycatchers, we found no data to indicate that patch size affected Willow Flycatchers in the same way it affects forest interior species in the East. Our analyses suggest that average rates of nest success actually decreased with increasing patch size, and brood parasitism rates increased with increasing patch size – both opposite to the usual conception of patch size effect. Willow Flycatchers in the Southwest occur in habitat that is naturally patchy, so it was expected that we found no negative impact of small patch size. However, the opposite effect, of apparent benefit from smaller patches, is unexpected. As mentioned above, this apparent inverse effect may result from conspecific attraction. It should be noted that in eastern forests, benefits from breeding in larger patches accrue only with patches >1000 m wide – much larger than any habitat patches found on the Gila River (Robinson et al. 1995).

Management implications. – Although grazing has been identified as a major causal factor for the decline and endangerment of the southwestern Willow Flycatcher (USFWS 1995), we found no significant negative impact of grazing on flycatcher nest success or brood parasitism in this system. In fact, grazing was associated with a higher likelihood of patch occupancy and higher densities of flycatchers. This association does not necessarily reflect a causal relationship, however.

We feel the reason for this apparent paradox is the type of grazing management practiced at our study site, compared to that practiced in other areas of the Southwest. Almost all of our grazed patches are part of the U Bar Ranch, which practices a very progressive management style based on rapid rotations and adaptive management. They employ no fixed rotation schedules, and most patches that are grazed support cattle only in fall and/or winter, and then for brief periods. How our assessment of grazing impacts might apply to other grazing management practices is unknown. The type of management practiced by the U Bar is becoming increasingly common throughout the West, however (Ehrhart and Hansen 1997, Leonard et al. 1997).

Importance of box elder. – It should be apparent that the one factor most significantly and strongly associated with Willow Flycatcher occurrence and success in the Cliff-Gila Valley is the prevalence of box elder. This tree species seems to define prime flycatcher habitat both at the nest site and patch levels. Our study site is unusual among Southwestern Willow Flycatcher sites in the use of box elder, primarily because most of this tree's range lies well above the elevations where the flycatcher is most frequently found. Furthermore, box elder is most common along steep-sided, high-gradient montane streams (Carter 1997), which are unsuitable for Willow Flycatchers. Thus, our findings concerning box elder may be mostly irrelevant to most other active Willow Flycatcher sites in the Southwest. However, these results may be very important within this valley, and in other floodplain riparian areas at similar or higher elevations. In these mid-elevation areas, flycatchers may benefit from management that actively promotes box elder. Box elder is a secondary successional, shade-tolerant species that may become established only slowly, if ever, in disturbance-prone sites.

Future Project Goals

In 2001, we hope to expand our characterization of Willow Flycatcher habitat at larger spatial scales to allow a more robust analysis. Specifically, we hope to measure more habitat patches in the Cliff-Gila Valley, including more patches of younger growth. Most of the analyses presented here pertain to patches rather than landscapes. Therefore, we will work to obtain more and better measures of landscape-level features, such as stream gradients, canyon depths, and channel widths. We will also continue to band birds and begin to analyze patterns of within-site movement, site fidelity, and survival. And, as in previous years, we will conduct official flycatcher surveys in collaboration with Paul Boucher of the Gila National Forest, and find and monitor flycatcher nests.

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APPENDIX. Population estimates of Willow Flycatchers by patch in the Cliff-Gila Valley, New Mexico, based on protocol surveys. Numbers are: pairs (+ probable single territorial males).

PATCH	**Survey 1 (5/25 - 5/26)**	**Survey 2 (6/14 - 6/19)**	**Survey 3 (7/5 – 7/7)**
NW1	1 (+5)	4 (+1)	4
NW2	0	0	0
NW3	0	1	3
NW4	12 (+5)	15 (+4)	16 (+1)
Bennett project	0	0	0
NW5	0 (+1)	0 (+1)	1
NW Stringer	0 (+4)	3 (+3)	3 (+2)
NE1	0	0 (+1)	0
NE2	0	0	1
NE3	1 (+ 2)	4 (+2)	1
NE4	3 (+5)	8 (+2)	5 (+1)
NE5	3 (+4)	3	3 (+1)
SW1	1 (+1)	2 (+1)	3
SW2	2 (+1)	5	5 (+1)
SW3	1 (+2)	3	5
SW4	0 (+1)	1 (+2)	2
SW5	0	0	0
SW Crescent	0	1 (+1)	0
SW Stringer	2 (+1)	1 (+2)	3 (+2)
SE1	7 (+11)	19 (+2)	35
SE2	3 (+1)	14	8 (+1)
SE3	5 (+1)	7 (+1)	6
SE4	6 (+1)	6 (+1)	5
SUBTOTAL U Bar	47 (+46) = 93 terr.	97 (+24) = 121 terr.	109 (+9) = 118 terr.
Fort West Ditch	0 (+5)	4 (+1)	4
Gila Bird Area	0	4 (+1)	2
TOTAL	47 (+51) = 98 terr.	105 (+26) = 131 terr.	115 (+9) = 124 terr.