Status and Migration of the Southwestern Willow Flycatcher in New Mexico

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Abstract—In the Southwestern United States, recent degradation of riparian habitats has been linked to decline of the Southwestern subspecies of the Willow Flycatcher. During a 2-year banding effort, migration patterns and bird fat content were analyzed. Recommendations for managers, and outlines for conservation plans, are included.

The Willow Flycatcher (*Empidonax traillii*) is a neotropical migratory landbird that breeds throughout the United States and southern Canada and is fairly abundant in the northern portion of its range. The species winters in the Choco Lowland, Gulf-Caribbean Slope, and the Pacific Arid Slope zoogeographic regions of Latin America and South America (Stotz and others 1996), although the limits of its winter distribution are poorly known. Regional variation among breeding individuals has long been considered prominent enough to warrant subspecies designations (Phillips 1948). Currently, most experts recognize 4 or 5 subspecies of the Willow Flycatcher (Unitt 1987, Browning 1993).

Recent degradation of riparian habitats in the southwestern United States is believed to be linked to the decline of the southwestern subspecies of the Willow Flycatcher (*Empidonax traillii extimus*). The Southwestern Willow Flycatcher breeds in Arizona, New Mexico, southern California, and southern parts of Utah, Nevada, and Colorado. Owing to its small population size, the southwestern subspecies was listed as federally endangered in 1995 and critical habitat was designated in 1997. Although used for migration and breeding, none of habitat associated with the Rio Grande was included in the critical habitat designation. While the majority of the flycatcher monitoring programs focus on breeding surveys, nesting success, and cowbird parasitism, it is widely acknowledged that declines in the abundance of this species may also be attributable to poor quality habitats visited in winter or during migration stopover.

In the Southwestern U.S. riparian corridors attract a concentration of migrating songbirds including Willow Flycatchers. The Rio Grande is the second largest riparian system in the Southwest and maintains the largest cottonwood forest in North America (Whitney 1994). This river system is also a primary source of agricultural and municipal water in both New Mexico and Texas. Cottonwood-willow habitats along the Rio Grande were historically associated with a braided river channel that meandered across a broad floodplain. The need to deliver water in a reliable manner and to limit damage due to flooding have resulted in management to reduce the meandering of the channel and the variability in river flow. Hence, riparian vegetation is restricted to the permanent watercourses that include the Rio Grande and associated water conveyance channels.

This paper gives a brief overview of Willow Flycatcher breeding status throughout the state of New Mexico and describes its migration pattern through the middle Rio Grande valley. We also summarize information on conservation plans underway.

Breeding Surveys 1994 to 1996

Breeding sites of the Southwestern Willow Flycatcher have been documented in New Mexico on the Upper Rio Grande and Rio Chama (Taos and Rio Arriba County), the Zuni River (McKinley County), the Middle and Lower Gila River (Grant County), the Middle Rio Grande (Valencia and Socorro Counties), and the Lower Rio Grande (Dona Ana County) (Williams 1997a). During flycatcher surveys from 1994 through 1996, at least 22 territories were found each year on the Upper Rio Grande (Tierra Azul, Taos Junction, Orilla Verde, Velarde, and San Juan Pueblo), 5 on the Chama, 17 on the Middle Rio Grande (Isleta, Peralta Dr., Bosque del Apache, San Marcial), 5 on the Zuni River, 5 on the Canadian River, 2 on the Lower Rio Grande (Radium Springs), and over 140 on the Gila River (Fort West Ditch, U-Bar Ranch, Redrock, Gila Lower Box). By 1998, the number of flycatcher territories jumped to over 220 (Dennis Parker and Scott Stoleson personal communications) owing to greater survey coverage in the Cliff-Gila Valley.

Number of known flycatcher sites, i.e., sites with at least one territory, varied by year, with 17 sites detected in 1994; 13 in 1995; and 19 in 1996 (Williams 1997a). Of these, 16 sites had breeding attempts in one or more years. In 1996, 18 sites had 1-4 territories, with breeding observed at 11 of them; 4 sites had 5-14 territories, with breeding at all of them; and only 1 site had greater than 15 territories. This latter site was on the U-Bar Ranch along the Gila River between Cliff and Gila.

The Rocky Mountain Research Station initiated a research study in 1997 on the U-Bar Ranch to determine flycatcher nesting success and rates of cowbird parasitism in different-sized patches of habitat. Based on 1997 results,

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flycatchers selected box elder (*Acer negundo*) more frequently than other woody plants including willow to nest in and placed their nests higher on average than any other known *E. traillii* population in the United States (Scott Stoleson and Deborah Finch unpublished data). Box elder foliage is dense, and its twigs are structured in a way that was apparently highly suitable for nest placement by Gila River flycatchers. The Cliff-Gila breeding site had a high abundance of flying insects, moist soils, and numerous irrigation ditches criss-crossing the property. Larger habitat patches were closed to livestock during the breeding season. Brown-headed cowbirds (*Molothrus ater*) were present, but brood parasitism rates at flycatcher nests whose contents could be monitored were low (17 percent) relative to other hosts such as yellow-breasted chats (*Icteria virens*) and yellow warblers (*Vermivora celata*) (Stoleson and Finch unpublished data).

Lessons learned from studying the habitat conditions used by the Cliff-Gila population may be helpful for recovering the flycatcher and its habitats elsewhere in New Mexico, such as in the bosque of the middle Rio Grande. For example, the wet, "buggy" ditch habitats of densely-foliated, small-diametered shrubs or trees found on the U-Bar Ranch can potentially be simulated elsewhere. Similar conditions can be created through the manipulation of water in irrigation channels, alteration of channel mowing schedules, creation of backwater ponds, revegetation with native woody plants at suitable sites, and control of salt cedar (an alien plant that dries soils). To evaluate the potential of ditches to support flycatchers along the Rio Grande, let us turn to our migration study to determine if and how migrating Willow Flycatchers use channels during stopover.

Migration Study 1996 to 1997

Low Flow Conveyance Channel

To investigate the use of the Low Flow Conveyance Channel (LFCC) by Willow Flycatchers (*Empidonax trailii*) and other migrant songbirds, the Bureau of Reclamation (BOR) initiated a study in cooperation with the USDA-FS's Rocky Mountain Research Station in 1996. The objective of this study was to determine the effects of a rotational mowing system on the use of the Low Flow Conveyance Channel (LFCC) by migrant Willow Flycatchers and other songbirds. In the 1950's the LFCC was built to carry water from the Rio Grande at San Acacia to Elephant Butte Reservoir. This diversion was necessary because too little water was reaching Elephant Butte Reservoir and salt cedar had invaded the river channel and blocked flow in several sites. The LFCC was designed to carry 2,000 cubic feet per second (cfs) from the river to the reservoir with maximum hydraulic efficiency. Water has not been diverted into the LFCC since 1985 and currently the LFCC is used to capture irrigation return flows and as a shallow groundwater drain.

The vegetation along the LFCC's is comprised of primarily coyote willow (*Salix exigua*) and seep willow (*Baccharis* sp.). This vegetation was mowed annually from 1959 through 1994. As part of an agreement with the U.S. Fish an Wildlife Service the mowing of the LFCC was placed on a rotational schedule in 1996. Under this schedule 21 to 30 percent of the LFCC will be mowed annually. This schedule will result in multiple age classes of willow vegetation that are potential habitat for migrant birds. For instance, in our study area vegetation has grown rapidly and resulted in dense stands of 6-15 ft tall vegetation that was 8-25 ft wide. While these willow stands have not been historically available to migrating birds like Willow Flycatchers they may represent an important resource for this endangered subspecies.

Study Site and Mist Net Operation

In both 1996 and 1997 field data were collected in the first week of April through the first week of June and from the first week of August through the first week of November. In 1996 and 1997 nets were operated in willow, agricultural edge, cottonwood bosque and along the LFCC. Standard nylon mist nests (12 m x 2.6 m) were used. Mist nets were operated 5 days a week. Unless rain, high winds, or temperature dictated a change, mist nets were opened 15 minutes before sunrise and operated approximately six hours each banding mourning. Each captured individual was weighed to the nearest 0.1 g using a digital electronic balance. We estimated fat stores of each bird by observing the subcutaneous fat deposits in the interclavicular fossa and abdomen according to a six-point scale developed by Helms and Drury (1960). Unflattened wing chord, tarsus, tail length relative flight feather length (for wing formula calculation), presence of notch and emargination of primaries, bill width, bill length, lower mandible color, wingspan, and tail shape were measured according to Svensson (1984) and Pyle (1997). The amount of skull ossification was examined in fall to identify age. Plumage color and relative contrasts between body parts were recorded by referring to the color standard of Smithe (1975). Each bird was banded with a numbered aluminum leg band.

The same 14 net sites along the LFCC were used in 1996 and 1997. These net sites were located on the west bank of the LFCC, immediately south of the North Bosque del Apache National Wildlife Refuge Check Structure. We selected this location for the following reasons: 1) the willow growth in this section was typical of the LFCC, i.e., data collected from the area would be relatively representative of the entire LFCC; 2) the area was close to our original study site, therefore, this data set could be used as a spatial control for comparisons and it also made it possible to operate both net site concurrently. 3) the site was inside the Refuge boundary and, therefore, the probability of nets being vandalized was reduced. To maximize capture rate, nets were set up approximately perpendicular to the LFCC at 30-50 m intervals.

In addition, the 5 net sites established in salt cedar habitat adjacent to the LFCC in 1996 were also operated in 1997, and 2 additional nets were operated in this habitat bringing the total to 7. Of the 14 nets operated in the cottonwood habitat in 1996, 7 were operated in 1997. The number of nets in the willow habitat was increased from 3 in 1996 to 4 in 1997. Netting effort remained constant at 3 nets in the agricultural edge habitat. In total 39 nets were operated in during 1996 and 35 nets were operated in 1997. Because some of our net sites changed between 1996 and

1997 we needed to standardize our capture data to make comparisons. For this purpose we calculated our banding effort in each season in terms of net-hours. A single mist net operated for one hour is a net-hour.

Willow Flycatcher Identification

Willow Flycatchers are difficult to distinguish from Alder Flycatchers (*Empidonax alnorum*) in the field (Stein 1963, Pyle 1997). Most individuals (90 percent) of these species can however be separated based on Steins formula, which combines several wing measurements and bill length (Stein 1963). Alder flycatchers have not previously been recorded in New Mexico (Williams 1997b), but to demonstrate that the birds that we captured were Willow Flycatchers rather than Alder Flycatchers we undertook this analysis. We also identified Willow Flycatchers to subspecies in the field. These identifications were based on a number of morphological and coloration measurements. Because there is no proven method of validating these subspecies identifications, they should be applied with caution (Yong and Finch 1997). It is unlikely that every individual was classified correctly and the total accuracy cannot be estimated. Here we report some analyses designed to uncover potential distinctions among subspecies. We distinguished four subspecies (Browning 1993): *Empidonax traillii adastus*, *E.t. brewsteri*, *E. t. traillii*, and the Southwestern form *E. t. extimus*. For most of this report we distinguish only those birds categorized as endangered Southwestern Willow Flycatchers and lump those of other subspecies.

Banding Effort

In 1996 we netted for 7,997 net hours in the spring and 13,085 net hours in the fall for a total of 21,092 net hours. The majority of this effort was concentrated on the LFCC (2,491 net-hours in spring and 4,673 net hours in fall) and in cottonwood bosque (3,217 hrs in spring and 4,698 net hours in fall). Our overall netting effort in 1997 was very similar to that in 1996. We netted for 7,691 net hours in the spring and 12,938 net hours in the fall for a total of 20,629 net hours in 1997 which is 98 percent of our 1996 effort. A larger majority of our 1997 effort was focused on the LFCC (8,183 net hrs; 40 percent of total effort). Cottonwood and salt cedar habitats were the next most intensely banded sites with about 4,151 net hours each.

Results of Migration Study

Analysis by Stein's formula indicated that 88.5 percent of the birds that we have identified as Willow Flycatchers can be confirmed as Willow Flycatchers rather than Alder Flycatchers. Several factors indicate that birds whose species could not be confirmed on the basis of Stein's formula were also Willow Flycatchers. First, this formula only separates 90 percent of birds known to be Willow Flycatchers (Stein 1963). Thus a pure sample of Willow Flycatchers would not have more separation than our sample. Second, the presence of an Alder Flycatcher has never been confirmed in New Mexico (Williams 1997b). Third, young Willow Flycatchers have been shown to be less distinguishable from Alder Flycatchers on the basis of Steins formula (Hussell 1991). For these reasons we are confident that our identification of these birds as Willow Flycatchers is accurate.

A total of 92 Willow Flycatchers have been captured in the 2 years of the study and 13 of these were categorized as belonging to the endangered Southwestern subspecies. A total of 41 Willow Flycatchers were caught along the LFCC of which 5 were categorized as southwestern subspecies. It appears that the primary characteristic that we used to categorize flycatchers to subspecies was back color (table 1).

Principal Components analysis of tail length, wing length, bill length, wing formula, tarsus length (table 2) did not reveal a single or combination of morphological features that readily distinguishes among the subspecies of Willow Flycatchers. Thus, the accuracy with which subspecies assessment can be made in the field remains unclear.

Because of the low number of captures of Southwestern Willow Flycatchers it is impossible for us to make any generalizations about habitat use of this subspecies that are distinct from the rest of the species. As was true for most species, the capture rate of Willow Flycatchers declined from 1996 (2.4 birds/100 net hours) to 1997 (2.0 flycatchers/100 net hours). The greatest number of Willow Flycatchers were consistently captured in the LFCC habitat although capture rates were higher in the willow habitat (fig. 1).

Table 1—Back colors of 77 Willow Flycatchers caught while migrating along the Middle Rio Grande between 1994 and 1996. Color numbers and descriptions refer to those in the Naturalist's Color Guide (Smythe 1975). Individuals were assigned to color categories by matching the color of their back feathers to the most similar color sample. Individuals were assigned to subspecies in the field. Numbers in parentheses are the percent of individuals in each color category that were assigned to each subspecies.

		Subspecies			
Color Number	**Description**	***Adastus***	***Brewsteri***	***Extimus***	***Traillii***
29	Brownish Olive	2 (18)	1 (2)	0	0
43	Grayish Olive	1 (9)	2 (4)	19 (100)	2 (100)
46	Olive Green	1 (9)	0 (0)	0	0
47	Olive Green	0	1 (2)	0	0
48	Olive Green	1 (9)	40 (89)	0	0
49	Greenish Olive	6 (54)	1 (2)	0	0

Table 2—Mean (sd) mass and wing, tail, and tarsus, lengths of Willow Flycatchers caught in the Bosque del Apache in 1996 and 1997. N is number of birds measured.

			Mass (g)		Wing (cm)		Tail (cm)		Tarsus (cm)	
			$\bar{x}$ (sd)	n	$\bar{x}$ (sd)	n	$\bar{x}$ (sd)	n	$\bar{x}$ (sd)	n
1996.00	FA	AG	13.0 (—).	1	66.0 (—)	1	56.0 (—)	1	18.5 (—)	1
		CO	— (—)	0	66.5 (0.7)	2	55.5 (0.7)	2	16.5 (0.8)	2
		LF	11.4 (1.0)	8	66.7 (3.4)	8	54.4 (4.2)	8	15.4 (1.3)	8
		SS	12.6 (0.8)	7	65.9 (2.0)	7	55.7 (2.0)	6	16.2 (1.4)	7
		SW	12.1 (0.6)	4	67.2 (1.8)	5	53.8 (2.4)	5	16.6 (1.0)	5
	SP	AG	11.9 (0.4)	2	68.2 (2.5)	2	58.5 (2.1)	2	16.0 (0.3)	
		CO	— (—)	0	— (—)	0	— (——)	0	— (——)	0
		LF	12.1 (0.8)	12	67.3 (3.1)	13	56.7 (1.8)	13	16.4 (0.7)	13
		SS	12.9 (—)	1	68.0 (—)	1	59.0 (——)	1	16.8 (——)	1
		SW	12.1 (1.0)	11	68.1 (3.3)	11	58.1 (2.8)	11	16.5 (0.9)	11
1997.00	FA	AG	14.2 (——)	1	70.0 (——)	1	58.0 (——)	1	16.6 (——)	
		CO	— (——)	0	— (——)	0	— (——)	0	— (——)	0
		LF	11.3 (0.8)	7	66.1 (2.6)	7	55.6 (3.2)	7	15.5 (1.7)	7
		SS	12.3 (0.5)	2	65.0 (4.2)	2	55.0 (2.8)	2	15.5 (0.2)	2
		SW	11.5 (0.2)	3	65.3 (3.1)	3	53.3 (2.9)	3	16.0 (0.2)	3
	SP	AG	— (——)	0	— (——)	0	— (——)	0	— (——)	0
		CO	12.1 (1.5)	4	72.6 (3.0)	4	61.3 (3.9)	4	16.8 (0.6)	4
		LF	12.8 (0.9)	13	69.5 (3.3)	13	57.2 (3.5)	13	16.5 (0.8)	13
		SS	12.4 (0.6)	6	69.0 (2.5	7	59.4 (3.1)	7	16.4 (1.1)	7
		SW	13.5 (1.2)	5	69.4 (2.9)	5	57.8 (2.6)	5	16.6 (0.8)	5

To assess the relative habitat use of Willow Flycatchers we compared the percent of birds captured in each habitat to the percent of banding effort (net hours) devoted to each habitat. In each season except fall 1996 a larger percentage of Willow Flycatchers were captured along the LFCC than the percent effort devoted to that habitat. This indicates that Willow Flycatchers were relatively abundant in this habitat. This pattern was also evident in the willow habitats in all seasons and the salt cedar habitat in the fall of 1996 and the spring of 1997. Both the agricultural edge and the cottonwood habitats consistently captured fewer Willow Flycatchers than the amount of effort expended (fig. 1).

Willow Flycatcher migration peaked in the 1st week of June during the spring and in the 1st week of August in the fall (fig. 2). The peak of migration appears to be more narrow in the spring than in the fall. There does not appear to be a clear difference among habitats in the timing of migration. The majority of birds had little fat as indicated by fat scores of zero or one (fig. 3). Again there were no obvious differences in fat scores among birds captured in different habitats. This lack of pattern also was apparent in the mass of birds captured in different habitats (table 2).

Recommendations for the Future

It is clear from our data that Willow Flycatchers are using the LFCC as a stopover habitat during both the spring and the fall. By intensely studying an area of the LFCC we have been able to document both yearly variation in habitat use and the progression of change that follows rest from mowing. The fairly well developed willow stands that have developed in the absence of mowing since 1995 indicates that a rotational mowing system may be a viable means for providing habitat for migrant birds while not compromising the function of the LFCC. To understand the compatibility of these uses at a broad scale, however, it is necessary to have a broad view of the conditions that exist on the LFCC. That is, our study has been useful in documenting the potential to use rotational mowing to benefit migrant birds, but to understand how much of that potential can be realized we need to sample a broader portion of the LFCC.

To achieve this broader view of the LFCC we propose to continue our study of the same area that we have investigate over the past 2 years, but with reduced effort (3 days per week). On the remaining 2 sampling days per week we will measure vegetation and establish temporary netting sites at a spectrum of sites along the LFCC. This approach will give us a broader sample of vegetative structures, mowing histories and bird use data from which we can infer the relationship between mowing schedule and bird use along the LFCC. At the same time by maintaining some effort at the sites we have sampled previously we will be able to compare bird capture, vegetation, and arthropod abundance data collected in 1998 with that collected in previous years.

Conservation Plans and Research Needs

In January 1998, the U.S. Fish and Wildlife Service assembled a Recovery Team for the Southwestern Willow Flycatcher that is comprised of a technical subgroup and seven stakeholder implementation subgroups. The technical subgroup is made up of technical experts from universities, research institutions, agencies, and other organizations. Implementations teams are composed of stakeholders from special interest groups, conservation organizations, state and federal agencies, and other entities having a stake

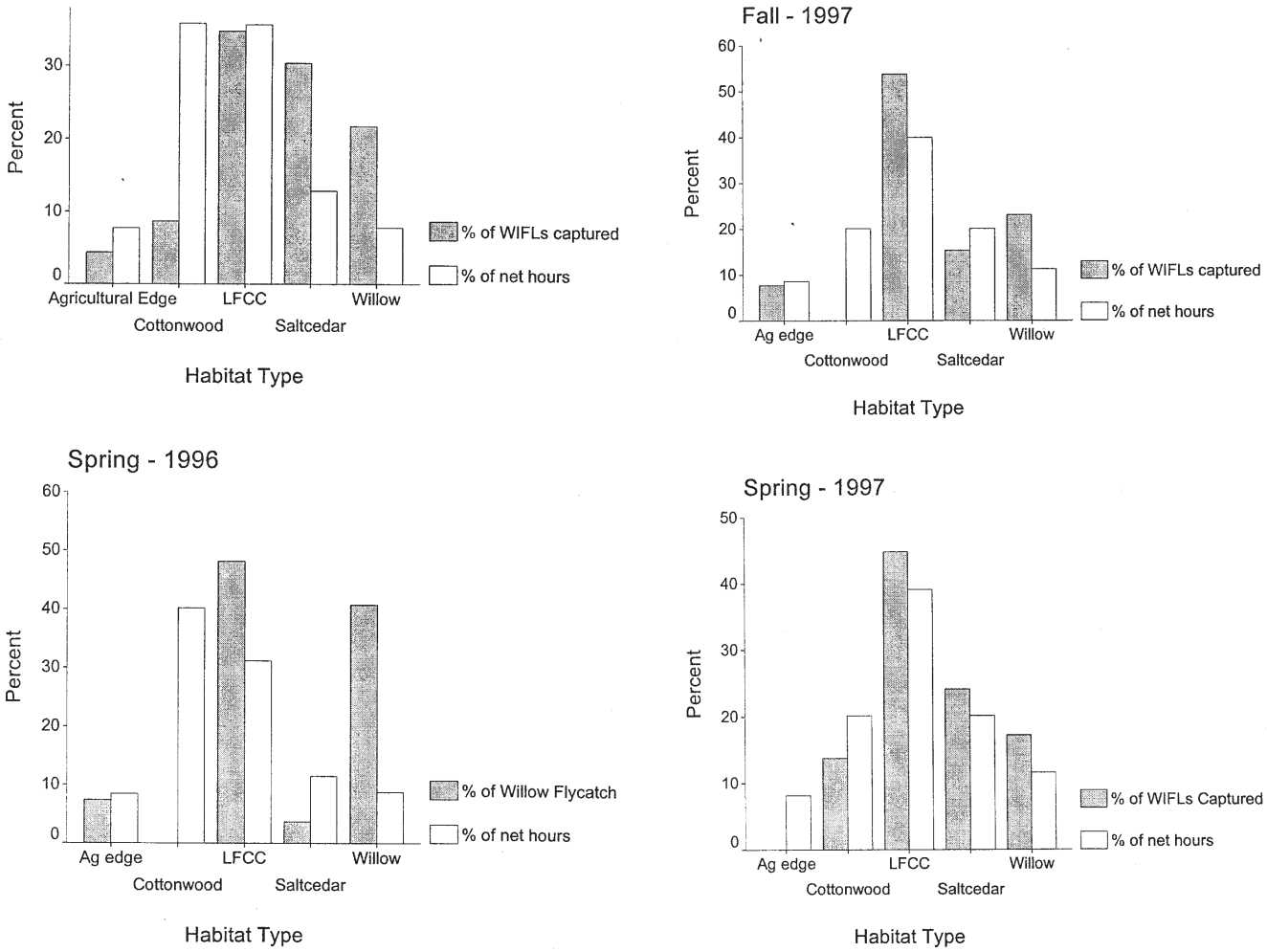


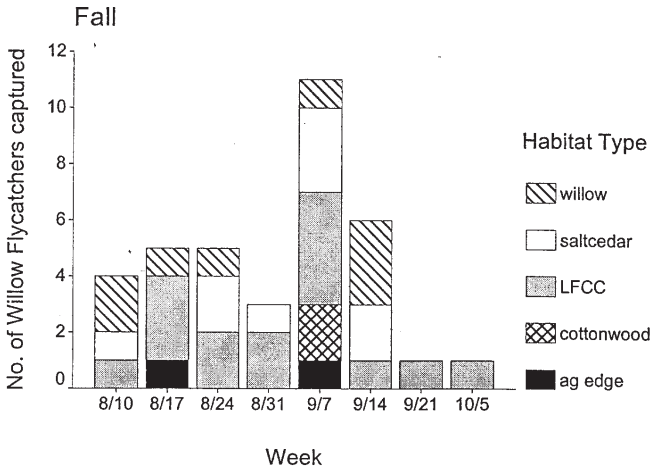
Figure 1—Percent of Willow Flycatchers and banding effort in each of 5 habitat of the Bosque del Apache. Relative abundance of flycatchers among habitats can be assessed by comparing the percent effort with the percent of captures within and among habitats. Habitats in which the percent captures bars are larger than the percent effort bars likely have higher abundances of flycatchers.

in, or affected by management of, the Willow Flycatcher and its habitats. A first draft of the recovery plan will be submitted to the Fish and Wildlife Service by October 1999.

A Conservation Assessment prepared by technical experts (many of whom are now on the Recovery Team) was financed by the U.S. Forest Service in 1997-98 and will be published or in press in a technical monograph series by 1999. The goal of this assessment is to review and synthesize the state of knowledge about the flycatcher and formulate recommendations for managing its populations and habitats throughout the Southwest. Designed to support the recovery plan, the review is composed of chapters on southwestern riparian history, flycatcher status, threats, winter and migration biology, breeding ecology, demography, effects of cowbird parasitism, flycatcher habitat use, management recommendations, and research needs. Some of the relevant management recommendations in the conservation assessment include:

- Close occupied sites to recreational use during the breeding season.
- Remove cows from occupied sites during the breeding season.
- Trap cowbirds at sites having parasitism rates that exceed 10 percent.
- Discourage spread of exotic woody plants such as salt cedar.
- Prevent wildfires in riparian areas and develop fire plans in advance of wildfires.
- Develop and conserve water for stimulating riparian vegetation growth.
- Reduce "phreatophyte" control on irrigation ditches and channels.
- Restore riparian areas near source populations of Willow Flycatchers.

The conservation assessment has also identified critical gaps in knowledge that prevent experts and managers from being fully effective in designing approaches for



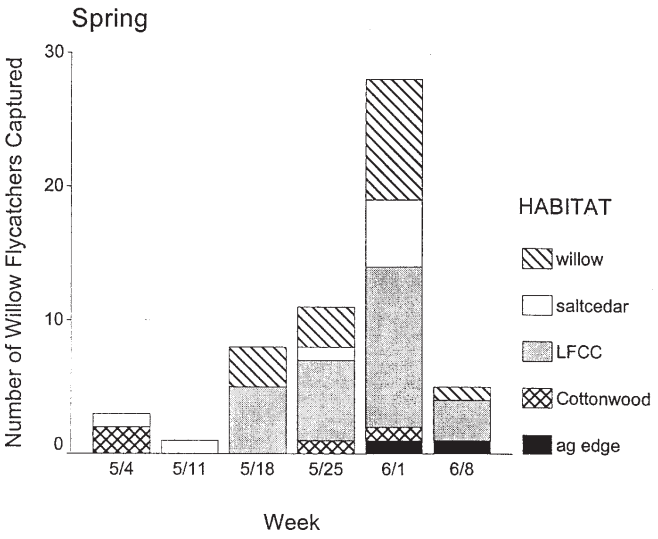
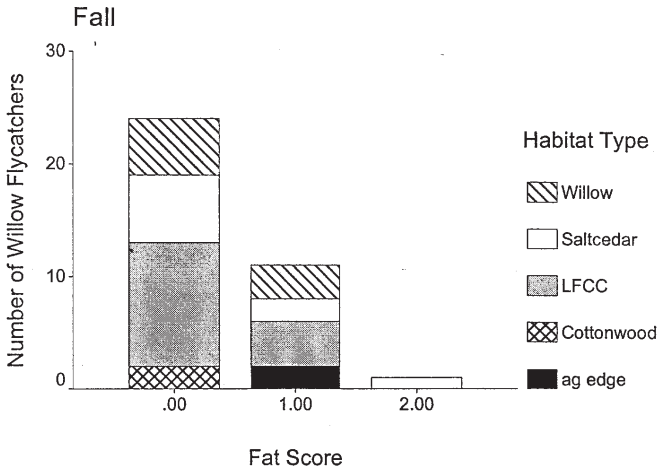


Figure 2—Number of Willow Flycatchers caught in the Bosque del Apache during the spring and fall by week and habitat.



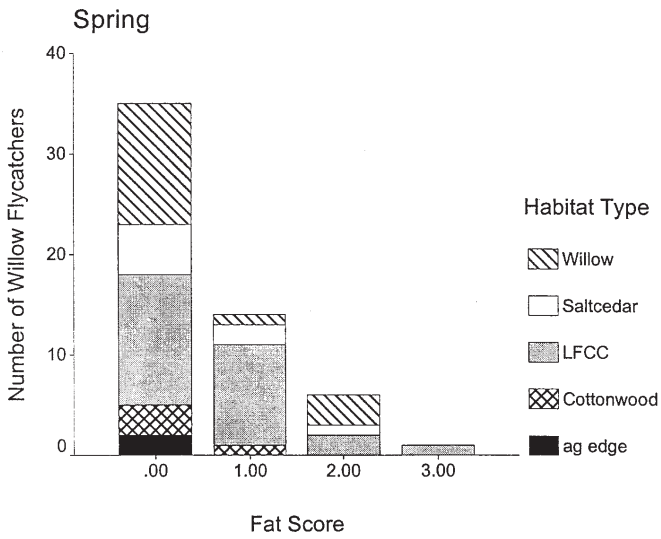


Figure 3—Fat scores of Willow Flycatchers caught in the Bosque del Apache in the spring and fall by habitat.

recovering flycatcher populations and habitats. Research needs include:

- Understanding the relationships between landscape attributes, habitat occupancy patterns and nesting success of the Southwestern Willow Flycatcher.
- Understanding how cowbird travel distances and parasitism rates pertain to livestock presence and absence, and Willow Flycatcher nesting sites.
- Developing knowledge of the direct effects of land use (grazing, ditching, recreation, exotic plant control, channel mowing, water management) on Willow Flycatchers.
- Evaluating flycatcher nesting success and migration stopover use in exotic and native vegetation.
- Designing and modifying methods to restore and sustain riparian habitats and recover flycatcher populations.

Conclusions

In summary, survey data indicated that the majority of Southwestern Willow Flycatchers breeding in New Mexico are found in the southwestern portion of the state, mostly on private property along the Gila River. In 1998, more than 200 territories were detected on the U-Bar Ranch alone in the valley between the towns of Cliff and Gila. Several breeding sites were also located on the Rio Grande but only two (San Juan Pueblo and San Marcial) had more than 5 flycatcher territories in 1995 and 1996. To recover flycatchers, more attention to habitat restoration along the middle and upper Rio Grande and associated tributaries is needed. Linking research knowledge of flycatcher habitat use in the Cliff-Gila valley to ongoing and new restoration efforts along the Rio Grande may be of benefit to recovering the flycatcher in the middle and northern regions of New Mexico. In addition, our study of flycatcher migration along

the Low Flow Conveyance Channel suggests that ditches and channels are important stopover habitat, particularly if water is present and bankside willows are allowed to grow. Based on our evaluation of stopover habitat use and Gila River breeding habitat use, we suggest that habitats for breeding Willow Flycatchers can be created along the Rio Grande if specific habitat conditions are supplied. These conditions include at minimum slow or still water, vegetation that supplies a suitable twig structure for nest placement (for example shrub willow, box elder), moist soils (unlikely where large salt cedar thickets have established), and a high abundance of flying insects.

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