

## DISTRIBUTION, ABUNDANCE, AND HABITAT CHARACTERISTICS OF SOUTHWESTERN WILLOW FLYCATCHERS (*EMPIDONAX TRAILLII EXTIMUS*) IN ARIZONA, 1993–2000

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**Abstract.** To determine the distribution and abundance of Southwestern Willow Flycatchers (*Empidonax traillii extimus*) in Arizona, personnel from many federal, state, tribal, and private entities conducted presence/absence surveys yearly, from 1993–2000. To aid recovery efforts for this endangered species, we synthesized the results of these surveys to provide a comprehensive estimate of Southwestern Willow Flycatcher distribution and abundance in Arizona. Surveys were conducted along 1279 km of riparian habitat in 17 drainages. Surveyors documented flycatchers within 16 geographical locations below 1500 m and one location above 2200 m in elevation. Below 1500 m, flycatchers occupied riparian forests dominated by mixtures of willow (*Salix* sp.) and tamarisk (*Tamarix* sp.) with median height 8.5 m (range 3–24 m). Above 2200 m, breeding sites consisted of Geyer willow (*Salix geyeriana*) patches with median height 4 m (range 3.5–4 m). Estimated number of territories increased from 32 in 1993 to 328 in 2000; this increase was largely the result of increased survey effort. Two locations (Roosevelt Lake and Gila/San Pedro River confluence) contained 71% of the known population. Historically, Southwestern Willow Flycatchers occurred along most major river drainages in Arizona. We compared current (1993–2000) distribution with historical records and found that flycatchers recently occurred in nine historic locations and were absent at four. Southwestern Willow Flycatchers in Arizona constitute one third of the range-wide population and this synthesis identifies extant populations where protection is needed, as well as future research needs.

**Key Words:** abundance, Arizona, distribution, *Empidonax traillii extimus*, endangered species, Southwestern Willow Flycatcher.

The central portion of the Southwestern Willow Flycatcher's (*Empidonax traillii extimus*) breeding range occurs in Arizona. Historical records indicate that flycatchers once bred along the Colorado, Gila, Little Colorado, San Francisco, Santa Cruz, San Pedro, and Verde rivers (Phillips et al. 1964, Unitt 1987). Phillips (1948) was one of the first to express concern over diminishing numbers of flycatchers in the state, and by the mid-1980s Unitt (1987) described its distribution as a few isolated groups. In 1995, the Southwestern Willow Flycatcher was listed as federally endangered (U.S. Fish and Wildlife Service 1995) and the U.S. Fish and Wildlife Service (USFWS) listed probable factors contributing to population declines as loss, alteration, and fragmentation of native riparian breeding habitat; loss of wintering habitat; nest predation; and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

In 1993, prompted by concern for the declining population, the Arizona Game and Fish Department (AGFD) and Arizona Partners in Flight initiated statewide flycatcher surveys. These surveys intensified when the flycatcher was listed as endangered and are conducted yearly. Survey results are synthesized and reported annually as an AGFD technical report (see Paradzick et al. 2001) that is distributed regionally to agencies, private organizations, and the public as a basis for management recommendations.

Synthesizing and reporting survey results on an annual basis provides a snapshot of flycatcher distribution that, when combined across several years, allows us to build a more comprehensive picture of Southwestern Willow Flycatcher distribution and abundance in Arizona. Thus, we synthesized survey work conducted by multiple agencies and hundreds of individuals between 1993–2000. Our goal was to provide an estimate of flycatcher distribution and abundance in Arizona, as well as describe habitat characteristics, to aid recovery efforts for this endangered species. This synthesis not only gives a current picture of flycatcher distribution but also allows for an assessment of changes in distribution.

### METHODS

#### SURVEY EFFORT AND TECHNIQUES

Numerous federal, state, and tribal agencies, as well as private organizations and volunteers, conducted surveys for Southwestern Willow Flycatchers in Arizona from 1993–2000. Surveys were performed within riparian habitat along major rivers and tributaries. Survey sites were selected in two ways: (1) personnel from natural resource agencies and private organizations voluntarily selected sites on public, tribal, or private lands (with landowner permission) that contained potentially suitable flycatcher breeding habitat; and, (2) public or private entities were required to survey specific sites through Section 7 consultation with USFWS. Definitions for what constituted a site were not standardized and consequently varied; however, in

most cases it referred to a discrete patch or multiple patches of habitat considered a manageable survey unit by the surveyor.

Survey objectives were to: (1) determine presence/absence of Southwestern Willow Flycatchers at a site; (2) estimate number of flycatcher territories; and, (3) provide a general habitat description. All surveyors were required to obtain federal endangered species permits, attend a training workshop conducted by AGFD, U.S. Geological Service, U.S. Bureau of Reclamation, and USFWS, and submit survey results to AGFD. This workshop included a natural history review of the Southwestern Willow Flycatcher, explanation of the survey protocol developed by Tibbitts et al. (1994) and later revised by Sogge et al. (1997a), instructions for completing forms and reporting data, and a field experience to familiarize participants with flycatcher identification, vocalizations, and breeding habitat.

The survey protocol (Tibbitts et al. 1994, Sogge et al. 1997a) requires a minimum of three surveys using tape-playback of the Southwestern Willow Flycatcher primary song to elicit vocalizations. At least one survey is required within each of three periods: 15 May–31 May, 1 June–21 June, and 22 June–10 July; consecutive surveys must be at least six days apart. Survey results were reported to AGFD on standardized forms that included location data, effort (survey hours), estimated number of adult flycatchers, territories, and pairs, breeding evidence, presence or recent sign of cattle, and presence/absence of cowbirds. Surveyors were also required to submit a 7.5-minute topographical map identifying the area surveyed.

#### DISTRIBUTION AND ABUNDANCE DATA SYNTHESIS

We considered Southwestern Willow Flycatchers to be breeding season residents when detected at a site between 22 June–25 July, or if breeding behavior was documented; birds detected solely outside those dates, and for which no breeding behavior was observed, were considered migrants. We report distribution as the number of sites occupied with breeding season residents. Luff et al. (2000) found that Southwestern Willow Flycatchers move more frequently between sites  $\leq 30$  km apart than those separated by greater distances; thus, we grouped occupied sites within 30 km into geographical locations.

Abundance estimates are given in terms of the number of territorial flycatchers detected; we defined a territorial flycatcher as a breeding season resident male defending an area within a site. However, the Southwestern Willow Flycatcher is a facultative polygynous species (Ford 1983) and at a few sites polygyny was as high as 50% (see Davidson and Allison *this volume*). Counting only male territories would under represent abundance; therefore, we considered a polygynous male with two females as two separate territories. Survey effort varied among surveyors and years; thus, abundance estimates should be considered the minimum number of territories present.

To compare recent (1993–2000) and historical breeding areas, we mapped pre-1990 distribution (per Phillips 1948, Phillips et al. 1964, Unitt 1987, Brown 1988) and overlaid recent survey results. We designated 16 historic locations, of which three were not

TABLE 1. NUMBER OF SITES, HOURS, AND KILOMETERS SURVEYED FOR SOUTHWESTERN WILLOW FLYCATCHERS IN ARIZONA, LISTED BY DRAINAGE, 1993–2000

Drainage	Sites	Hours	Kilometers
Agua Fria River	17	77	34
Black River	6	71	9
Big Sandy River	9	447	25
Blue River	4	43	11
Bill Williams River	9	1,673	38
Colorado River	141	6,238	254
Gila River	112	4,814	268
Hassayampa River	9	293	46
Little Colorado River	48	989	124
Salt River	28	1,231	83
Santa Cruz River	18	238	46
San Francisco River	7	167	21
Santa Maria River	9	333	29
San Pedro River	47	3,592	175
Tonto Creek	12	873	33
Verde River	62	816	78
Virgin River	9	278	5
Total	547	22,172	1,279

recently surveyed: Fort Mohave, Fort Apache, and the Santa Cruz River near Tucson. Historical and recently occupied sites within approximately 30 km were considered the same location. We could not compare abundance estimates because most historical accounts did not include number of territories.

#### HABITAT

Surveyors classified site vegetation into five general types (per Sogge et al. 1997a): (1) monotypic high-elevation Geyer willow; (2) monotypic exotic tamarisk; (3) native broadleaf; (4) mixed native/exotic broadleaf (mostly native); and, (5) mixed native/exotic broadleaf (mostly exotic tamarisk). Surveyors also listed the three most common riparian plant species, visually estimated mean height of vegetation and distance to surface water or saturated soil, and recorded landownership information. We used data from the last year flycatchers were present at the site to summarize habitat and landownership information.

#### RESULTS

##### SURVEY EFFORT

Surveyors conducted 22,172 hrs of Southwestern Willow Flycatcher surveys at 547 sites from 1993–2000 (Table 1; Fig. 1), covering 1,279 km of riparian habitat in 17 drainages. Survey site elevation ranged from 30 m near Yuma along the Colorado River to 2800 m in the White Mountains. The majority of sites (446) surveyed were below 1200 m, 69 were between 1200–2200 m, and 32 were above 2200 m. Mean site length was 1.6 km (range = 0.1–24 km). Two hundred thirty-nine sites were surveyed in only one year, while 16 were surveyed all eight years. Survey effort increased



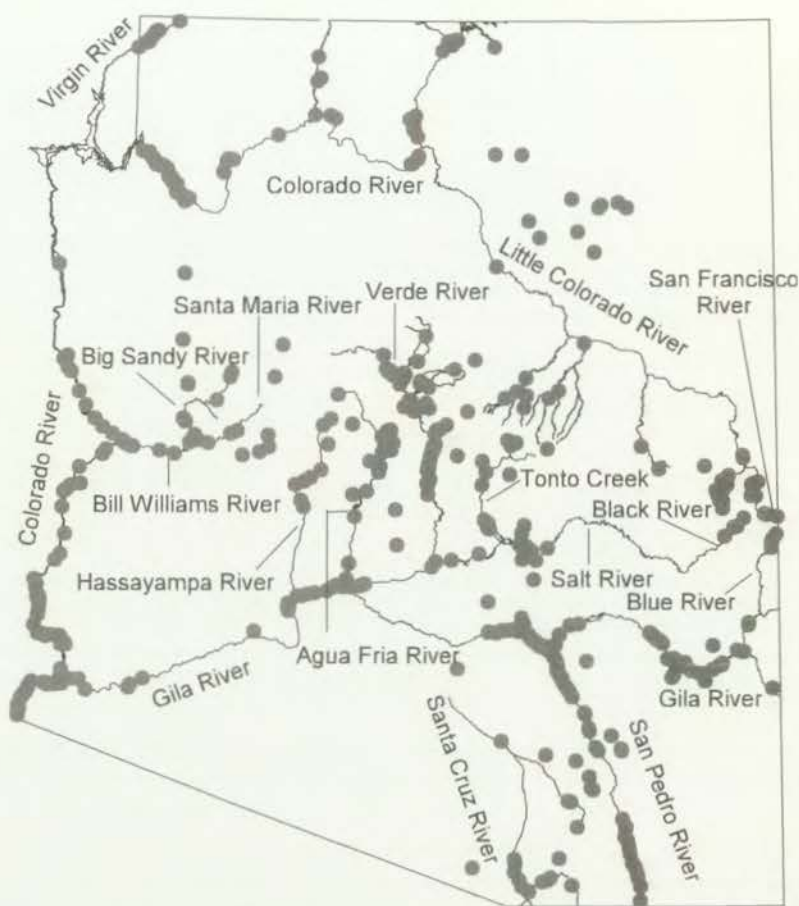


FIGURE 1. Southwestern Willow Flycatcher survey sites in Arizona, 1993–2000.

annually from 1993–1999, then decreased in 2000 (Fig. 2). Much of the increase in survey effort was focused along the lower Colorado River, Gila/San Pedro River confluence, and Roosevelt Lake, as a result of the Lake Mead (USFWS 1997) and Roosevelt Lake (USFWS 1996) Biological Opinions. These three areas accounted for over 65% of the statewide survey effort in 2000. Most sites surveyed were on federal (58%), private (20%), or tribal (8%) lands; the remainder (14%) were divided among county, municipal, and state lands.

#### DISTRIBUTION AND ABUNDANCE

Surveyors detected resident Southwestern Willow Flycatchers at 92 sites (Fig. 3) along 12 drainages. We grouped the 92 occupied sites into 17 geographical locations within the state (Table 2). Despite numerous surveys, no resident flycatchers were detected on the Agua Fria, Black, Blue, Santa Cruz, and Virgin rivers. Eighty-nine occupied sites were located below 1200 m ele-

vation, zero between 1600–2200 m, and three above 2200 m.

The number of occupied sites increased from 1995–1997, corresponding to increased survey effort (Fig. 2); however, number of occupied sites remained relatively constant after 1997. The steepest increase occurred at the Gila/San Pedro River confluence, from two sites in 1993 to 21 in 1999. This increase was primarily due to expanded local survey effort.

Not all occupied sites had resident flycatchers throughout the study period. For example, only 47 of the 92 occupied sites were occupied in 2000 (five of the sites not surveyed in 2000 had resident birds when last surveyed). From 1993–2000, Southwestern Willow Flycatchers colonized 38 sites, abandoned 39, and were sporadically detected at eight. Colonization of sites was greatest at Lake Mead Delta, Gila/San Pedro River confluence, Roosevelt Lake, and Ehrenburg–Yuma locations, which had 10, six, six, and five colonizations, respectively. These lo-

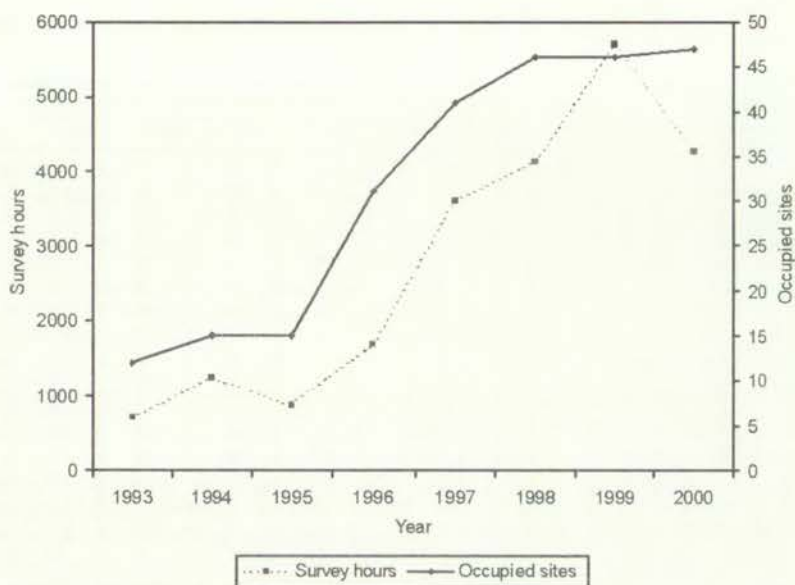


FIGURE 2. Number of Southwestern Willow Flycatcher survey hours and number of sites occupied by Southwestern Willow Flycatchers in Arizona, 1993–2000.

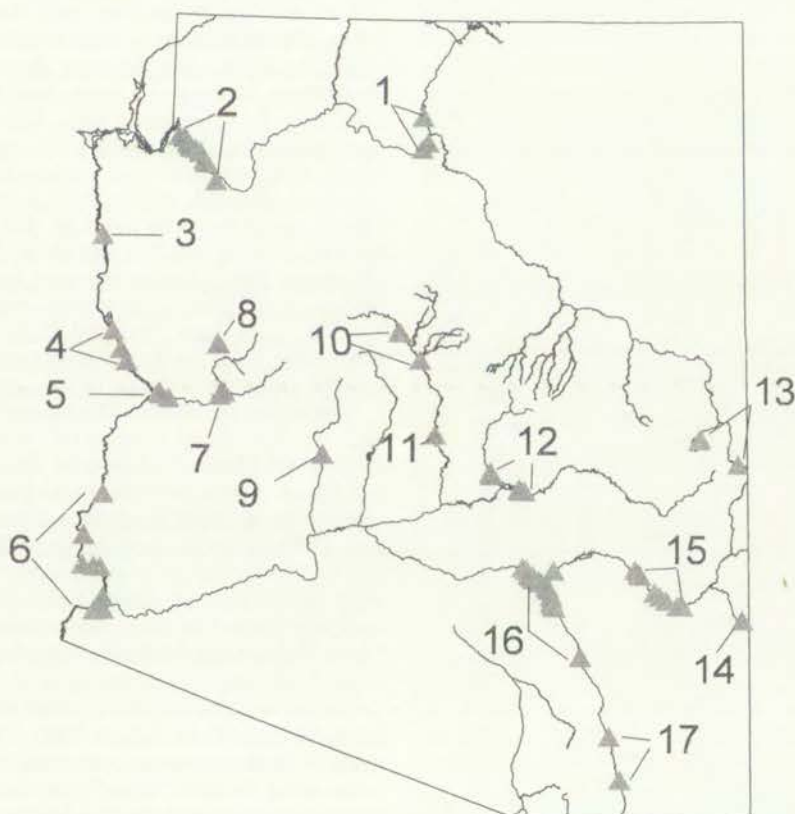


FIGURE 3. Survey sites/locations where resident Southwestern Willow Flycatchers were documented between 1993–2000 in Arizona. Location numbers correspond to locations listed in Table 2.

TABLE 2. SOUTHWESTERN WILLOW FLYCATCHER DISTRIBUTION AND TERRITORY ESTIMATES IN ARIZONA, 1993–2000

Map No.	Location	Occupied sites, estimated number of territories per year							
		1993	1994	1995	1996	1997	1998	1999	2000
1	Grand Canyon	2, 2	2, 5	2, 4	1, 3	1, 2	1, 1	1, 1	1, 1
2	Lake Mead Delta	1, 1		1, 1	1, 10	2, 8	8, 15	5, 11	5, 8
3	Lake Mohave				0, 0		0, 0	0, 0	1, 3
4	Topock Marsh	0, 0	0, 0	1, 2	2, 4	2, 13	1, 14	1, 15	1, 15
5	Bill Williams River Delta	0, 0	1, 1	1, 1	1, 1	0, 0	2, 2	1, 1	1, 1
6	Ehrenburg–Yuma	0, 0	0, 0	0, 0	7, 9	1, 1	0, 0	1, 2	0, 0
7	Alamo Lake	0, 0	2, 5	1, 4	2, 9	3, 10	3, 12	3, 23	3, 24
8	Rt. 93 Bridge		1, 1			1, 1			2, 16
9	Hassayampa River Preserve	0, 0	0, 0		0, 0	1, 1	1, 3	1, 2	0, 0
10	Camp Verde	1, 1	1, 7	1, 2	2, 8	1, 10	1, 7	1, 6	1, 5
11	Horseshoe Lake	1, 1	0, 0			1, 2	0, 0	0, 0	0, 0
12	Roosevelt Lake	2, 5	2, 33	2, 21	2, 38	2, 39	2, 48	5, 76	8, 115
13	White Mountains	2, 10	2, 10	2, 13	3, 14	3, 9	3, 10	3, 8	3, 5
14	Duncan						1, 2	1, 4	1, 1
15	Ft. Thomas–San Jose	1, 1	0, 0	1, 2	3, 8	4, 17	5, 12	2, 6	1, 15
16	Gila/San Pedro River	2, 11	4, 45	3, 32	6, 37	18, 76	18, 94	21, 134	19, 119
17	Upper San Pedro River				1, 2	1, 1	0, 0	0, 0	0, 0
Total		12, 32	15, 107	15, 82	31, 143	41, 190	46, 220	46, 289	47, 328

Notes: Map numbers correspond to Fig. 3. Blank fields indicate no surveys conducted.

cations, with the exception of Roosevelt Lake, also had the highest rate of abandonment; eight within both Ehrenburg–Yuma and Lake Mead Delta, and seven within Gila/San Pedro River confluence. No sites were abandoned at Roosevelt Lake. Resident Southwestern Willow Flycatchers were not detected in Ehrenburg–Yuma until 1996, when surveyors documented seven sites with resident birds; however, surveyors re-

ported only one occupied site in 1997 and 1999, and no resident flycatchers were documented in 2000. Flycatchers were also absent from three other locations: Hassayampa River Preserve, Horseshoe Lake, and Upper San Pedro River during the most recent surveys. The reasons why flycatchers abandoned sites were not always obvious, but human-caused extirpation occurred, or was suspected, within three locations: Lake Mead was allowed to inundate 445 ha of delta habitat, causing tree fall and flycatcher nest loss (Marshall 2000, McKernan and Braden 2001); bridge construction destroyed habitat at Ft. Thomas–San Jose (Marshall 2000); and a 1996 fire within Gila/San Pedro River confluence destroyed occupied habitat (Paxton et al. 1996).

Southwestern Willow Flycatchers occurred at nine of 13 historic locations surveyed from 1993–2000 (Table 3); however, flycatchers were not found during the most recent survey at two of these locations (Ehrenburg–Yuma and Upper San Pedro River). Southwestern Willow Flycatchers occurred in eight locations where no prior record existed: Alamo Lake, Duncan, Hassayampa River Preserve, Horseshoe Lake, Lake Mead Delta, Lake Mohave, Roosevelt Lake, and Topock Marsh.

Territories documented statewide increased from 32 in 1993 to 328 in 2000 (Table 2). The most dramatic increase occurred at Roosevelt Lake and Gila/San Pedro River confluence; territory estimates at these two locations increased from 16 in 1993 to 234 in 2000, and accounted for 71% of the population in Arizona (35% and

TABLE 3. SOUTHWESTERN WILLOW FLYCATCHER SURVEY RESULTS (1993–2000) AT HISTORIC LOCATIONS IN ARIZONA

Historic Location	Resident flycatchers detected
Grand Canyon	Yes
Pasture Canyon	No
Fort Mohave Indian Reservation	NA <sup>a</sup>
Bill Williams River Delta	Yes
Ehrenburg–Yuma	Yes
Big Sandy River Rt. 93 Bridge	Yes
Camp Verde	Yes
Middle Verde River	No
Fort Apache Indian Reservation	NA <sup>a</sup>
Black River	No
White Mountains	Yes
Blue River	No
Fort Thomas–San Jose	Yes
San Pedro/Gila River Confluence	Yes
Upper San Pedro River	Yes
Santa Cruz River: Tucson	NA <sup>a</sup>

Notes: Historic sites from Phillips (1948), Phillips et al. (1964), Unit (1987), and Brown (1988).

<sup>a</sup> NA indicates that recent surveys were not conducted.



TABLE 4. AVERAGE CANOPY HEIGHT AND DISTANCE TO WATER FOR SOUTHWESTERN WILLOW FLYCATCHER OCCUPIED SITES IN ARIZONA, 1993–2000

Habitat type	Canopy height (m)			Distance to water (m)		
	N	Median	Range	N	Median	Range
High-elevation						
Monotypic Geyer willow	3	4	3.5–4	3	1	0–50
Low-elevation						
Native broadleaf	8	7.5	4–24	10	0	0
Mixed native/exotic broadleaf (mostly native)	28	10	3.7–17	30	0	0–200
Mixed native/exotic broadleaf (mostly exotic tamarisk)	33	8	3–16	41	0	0–500
Monotypic exotic tamarisk	8	6.5	4–9	8	1	0–15
Total low-elevation	77	8.5	3–24	89	0	0–500

Notes: Average height and distance measurements were visually estimated for each occupied site. Data reported are from the most recent year that the site was occupied. N values may differ from text because not all surveyors reported habitat data for occupied sites.

36%, respectively). Territory estimates from all other Arizona sites increased from 16 to 94 during the same period. In 2000, six locations had 10–25 territories, seven locations had <10, and four locations had no territories. Increased survey effort accounted for most of the territory increases, except at Roosevelt Lake. Survey effort and area were consistent at Roosevelt Lake from 1998–2000; thus, the increase of 67 territories reflects a population increase.

Because confirming breeding activity was not a primary objective during most surveys, surveyors devoted variable amounts of effort to locating nests; therefore, some sites received more thorough nest search coverage than others. Surveyors documented nesting evidence at 13 of the 17 locations; nesting was not documented at Ehrenburg—Yuma, Horseshoe Lake, Lake Mohave, and Rt. 93 Bridge. Low survey effort at Horseshoe Lake and Rt. 93 Bridge may account for the lack of nest documentation, but breeding activity was not suspected at Lake Mohave. Although intensive surveys were conducted in Ehrenburg—Yuma, no active nests were documented.

#### HABITAT

Southwestern Willow Flycatchers occupied habitat within two major biotic community divisions (*sensu* Minckley and Brown 1994): high-elevation occupied sites (>2200 m elevation) within arctic-boreal wetland communities, and lower elevation sites (<1600 m) within Sonoran riparian deciduous forest communities. The three occupied high-elevation sites were predominantly monotypic Geyer willow patches, with mountain alder (*Alnus tenuifolia*) reported as a sub-dominant species at one site. Within Sonoran deciduous forests, habitat was more heterogeneous. Surveyors classified vegetation at 41 occupied sites as mixed broadleaf/exotic (mostly tamarisk), 30 as mixed broadleaf/exotic

(mostly native), ten as native broadleaf, and eight as monotypic tamarisk. Willow was reported at 84 of the 89 low-elevation sites and tamarisk at 78. Fremont cottonwood (*Populus fremontii*) was reported less frequently at occupied sites (46); mesquite (*Prosopis* sp.), seepwillow (*Baccharis salicifolia*), buttonbush (*Cephalanthus occidentalis*), and boxelder (*Acer negundo*) were minor components of occupied habitat reported at 11, seven, two, and one site, respectively.

Canopy height was taller at low-elevation occupied sites, while the median distance to water was similar for all habitats types (Table 4). Surveyors reported seven occupied sites >50 m from water. However, six of these were located within reservoir deltas where fluctuating stream flows and lake levels may have lead to intermittent surface water closer than 50 m during the breeding season.

Surveyors reported Brown-headed Cowbirds at 88 occupied sites. Evidence of cattle was reported at 47 of 79 occupied sites where data were available. Southwestern Willow Flycatchers occurred predominantly on federal (50% of occupied sites and 57% of territories) and private lands (32% of occupied sites and 33% of territories). The remaining sites and territories were divided among county, municipal, state, and tribal lands.

#### DISCUSSION

Arizona has the most comprehensive statewide Southwestern Willow Flycatcher survey synthesis within the subspecies range. Cooperation among surveyors, data sharing, and adequate levels of funding made this synthesis possible. This level of effort allowed us to not only delineate occupied flycatcher habitat for conservation purposes, but also identify unoccupied areas and riparian habitat that require surveys. Arizona is located centrally in the subspecies

range, has the greatest number of occupied sites, and contains approximately one third of all territories (Sogge et al. *this volume*). Furthermore, the Gila/San Pedro River confluence and Roosevelt Lake comprise the second and third largest populations, respectively. However, with an entire population of about 1000 territories (Sogge et al. *this volume*), the Southwestern Willow Flycatcher remains endangered and in critical need of protection. This emphasizes the importance of conserving Arizona's population for recovery of the subspecies.

The status of Arizona's Southwestern Willow Flycatcher populations is linked to the extent to which we can protect and conserve relatively dense stands of riparian vegetation. Throughout the Southwest, such riparian habitat has been affected by over a century of poor land management practices, and up to 90% of riparian habitat in Arizona has been degraded (Governor's Riparian Habitat Task Force 1990). Prior to the 1880s, riparian habitats along low-elevation rivers and streams were wetter than at present (Minckley and Brown 1994). Subsequent river channelization, impoundment and diversion, groundwater withdrawal (Stromberg 1993), and excessive livestock grazing (Belsky et al. 1999a) have limited regeneration of native riparian plant species. The resulting riparian habitat loss has restricted flycatchers to isolated patches of habitat within a few locations in the state.

The extent to which Southwestern Willow Flycatcher populations in the state have declined is unknown. Historical distribution data are scarce (see Phillips 1948, Phillips et al. 1964, Unitt 1987, Brown 1988, Periman and Kelly 2000) and territory abundance records are non-existent. However, anecdotal reports indicate that the species was locally common along drainages and in locations where they have been extirpated. Southwestern Willow Flycatchers are absent or severely reduced within four areas of the state. The most precipitous decline in distribution occurred along the lower Colorado River (near Yuma) and on the Santa Cruz River, where breeding has not been recorded since the early 1900s (Hunter et al. 1987; T. Huels, unpubl. data). Similarly, distribution of flycatchers at high-elevation locations (White Mountains, and Black and Blue rivers) has been reduced and is cause for concern, especially since recent surveys indicate declining populations at occupied sites.

Within the last seven years occupied habitat within three locations has been destroyed (Marshall 2000). Additionally, inundation of all currently occupied habitat at Roosevelt Lake is expected to occur (USFWS 1996). Few data are available to discern how this loss will affect the

Arizona and range-wide population. Under natural conditions, riparian habitat in the Southwest is both spatially and temporally dynamic. Movement data (Luff et al. 2000) and surveys (i.e., site colonization and abandonment rates) suggest that flycatchers are adapted to dynamic conditions and move frequently between local sites, especially in response to development of new habitat. In 1993, floodwaters on the San Pedro River scoured much of the main channel vegetation suitable for flycatcher breeding (T. McCarthy, pers. comm.). However, habitat persisted in small areas on the edges of the floodplain near seeps and irrigation outflow zones. In recent years, flycatchers moved from these edge areas to riparian vegetation that reestablished in the main channel. A similar pattern occurred at Roosevelt Lake, where flycatchers dispersed from one large, older patch to younger vegetation that established following receding water levels. Areas outside frequent flood scouring and inundation zones may act as refuge habitat. These areas, which may or may not be currently occupied, could be critical for localized persistence and dispersal following a disturbance event, like the inundation of Roosevelt Lake. Demographic research is needed to elucidate population growth rates (sink/source relationships) and the linkages between local sites and locations.

Human-caused modification of riparian ecosystems has also contributed to the dynamic nature of flycatcher habitat. In Arizona, exotic tamarisk has become widespread in many drainages including the Colorado (Hunter et al. 1988), Gila, Salt (Graf 1982), and San Pedro rivers (Stromberg 1998). Although flycatchers historically nested in willow and other native vegetation (Phillips et al. 1964, Unitt 1987, Rosenburg et al. 1991), tamarisk now occurs at almost all occupied sites within Arizona and is frequently used as a nesting substrate (90% of 1220 flycatcher nests found 1993–2000 were placed in tamarisk; AGFD, unpubl. data). This is in contrast to other states where native-dominated sites and nesting substrates predominate (Sogge and Marshall 2000).

Whether native- or tamarisk-dominated, flycatchers occupy patches close to water with relatively dense canopy cover and understory. This precludes the flycatcher from shrub-dominated patches with low canopy cover, as well as gallery forests with little understory. Furthermore, recent landscape-level analysis of Southwestern Willow Flycatcher habitat at Alamo Lake, Roosevelt Lake, and Gila/San Pedro River confluence found that floodplain width and the amount and variation of dense vegetation were correlated with flycatcher presence (AGFD, unpubl.



data). The lack of occupied sites between 1600 and 2200 m elevation reflects topographical limitations for development of suitable riparian vegetation, because the cooler climate, steep canyons, and frequency of scouring floods in Arizona's mid-elevations often restrict habitat into narrow linear bands of vegetation often dominated by sycamore (*Platanus wrightii*) with little understory. The creation and persistence of suitable riparian vegetation is linked to local and landscape-scale environmental conditions (e.g., topography, hydrology, flow regimes, and soil conditions) and more research is needed to understand these connections.

Populations of Southwestern Willow Flycatchers in Arizona are in critical need of protection. Distribution surveys indicate two large flycatcher concentrations (one under threat of being lost) and 11 smaller populations scattered throughout the state. With over half of territories occurring on public lands, much could be done to protect and enhance breeding habitat. However, significant areas of riparian habitat have not been surveyed in Arizona and may contain unidentified populations of Southwestern Willow Flycatchers; this is especially true for private and tribal lands, both of which are in need of more survey effort. This emphasizes the need to develop partnerships to enhance riparian areas and allow access and data sharing. Finally, long-term persistence of Southwestern Willow Fly-

catchers in Arizona is tenuous without addressing the ultimate causes for riparian ecosystem degradation (e.g., modified flow regimes, groundwater withdrawal, and urbanization). Recovery will require cooperative planning that includes federal, state, local, and tribal governments, as well as private landowners and organizations to protect and restore flycatcher breeding habitat.

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